

The Dictionary of Substances and their Effects

Second Edition

Editor
Sharat Gangolli

DOSE



Volume 3

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**The Dictionary
of Substances
and their Effects**
Second Edition

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Guide to Content

The data for each chemical in DOSE are organised as follows:

DOSE No.	Invertebrate toxicity
Chemical name	Toxicity to other species
Structure/line formula	Bioaccumulation
Molecular formula	
Molecular weight	Environmental fate
CAS Registry No.	Nitrification inhibition
Synonyms	Carbonaceous inhibition
EINECS No.	Anaerobic effects
RTECS No.	Degradation studies
Uses	Abiotic removal
Occurrence	Adsorption and retention
Physical properties	Mammalian and avian toxicity
Melting point	Acute data
Boiling point	Sub-acute and sub-chronic data
Flash point	Carcinogenicity and chronic effects
Specific gravity	Teratogenicity and reproductive effects
Partition coefficient	Metabolism and toxicokinetics
Volatility	Irritancy
Solubility	Sensitisation
Occupational exposure	Genotoxicity
Limit values	
UN number	Other effects
HAZCHEM code	Other adverse effects (human)
Conveyance classification	Any other adverse effects
Supply classification	
Risk phrases	Legislation
Safety phrases	
Ecotoxicity	Other comments
Fish toxicity	References

These headings only appear in an item when data have been identified for that heading. The user can, therefore, assume that the absence of a heading means that no relevant data were retrieved from the sources examined.

Dose No.

Each of the 4123 compounds in DOSE is identified by a unique, sequential alphanumeric DOSE No. For example, the first compound in DOSE, *A- α -C*, has DOSE No. A1; the last entry, *zoxazolamine*, has DOSE No. Z25.

Chemical name

In general, the chemical name is the common name of the substance, for example *nitrobenzene*. If it is not possible to allocate a precise chemical name (i.e. if the substance is of unknown or variable composition, or consists of biological materials), a short phrase appears instead, for example *chlorinated paraffins (C12, 60%)*.

Molecular formula

This is the elemental composition of the compound. The elements appear alphabetically for inorganic compounds, i.e. Ag_2CO_3 , Cl_2Cr , etc, but for organic compounds, carbon and hydrogen content are shown first followed by the other elements in alphabetical order, i.e. $\text{C}_6\text{H}_5\text{Br}$.

Molecular weight

This is directly calculated from the molecular formula. No molecular weights are given for polymers.

CAS Registry No.

The CAS Registry No. is a number sequence adopted by the Chemical Abstracts Service (American Chemical Society, Columbus, Ohio, USA) to uniquely identify specific chemical substances. The number contains no information relating to the chemical structure of a substance and is, in effect, a catalogue number relating to one of the millions of unique chemical substances recorded in the CAS Registry. New numbers are assigned sequentially to each new compound identified by Chemical Abstracts Service. This information is also provided in the full index of CAS Registry Numbers available at the end of Volume 7.

Synonyms

For common chemicals, several chemical names and numerous trade names may be applied to describe the chemical in question. Many of these names are identified to aid users on the range of names which have been used to describe each substance.

EINECS No.

This number is assigned by the European Commission to each record in the EINECS (European Inventory of Existing Commercial Chemical Substances) inventory. The numbers are in the format XXX-XXX-X, for example, 202-716-0 for *nitrobenzene*.

RTECS No.

The RTECS (Registry of Toxic Effects of Chemical Substances) number is a unique identifier assigned by NIOSH (National Institute of Occupational Safety and Health in the US) to every substance in the RTECS database. The number is in the format of two alphabetic characters followed by seven numeric characters, for example, DA 6475000 for *nitrobenzene*.

Uses

Principal uses of the substances are given, with information on other significant uses in industrial processes.

Occurrence

Natural occurrences, whether in plants, animals or fungi are reported.

Physical properties

Melting/Boiling point

These data are derived from various sources.

Flash point

The flash point is the lowest temperature at which the vapours of a volatile combustible substance will sustain combustion in air when exposed to a flame. The flash point information is derived from various sources. Where possible the method of determination of the flash point is given.

Specific gravity (density)

The specific gravity of each substance has been derived from a variety of sources. Where possible the data have been standardised.

Partition coefficient

Partition coefficients, important for structure-activity relationship considerations, particularly in the aquatic environment, are indicated. Ideally the *n*-octanol/water partition coefficient is quoted. The major data source for this measurement is:

Sangster, J J. *Phys. Chem. Ref. Data* 1989, **18**(3), 1111-1229

Where no reference is quoted, it can be assumed that the information was derived from this source.

Volatility

The vapour pressure and vapour density are quoted where available. Where possible, the data have been standardised.

Solubility

Solubility data derived from several sources are quoted for both water and organic solvents where available.

Occupational exposure

Limit values

This field contains the occupational exposure limit values (or threshold limit values) from France, Germany, Japan, Sweden, UK and USA.

The airborne limits of permitted concentrations of hazardous chemicals represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. These limits are subject to periodic revision and vary between different countries. The term *threshold limit* relates primarily to the USA, but equivalent terms are available in most industrialised countries. The data relates to concentrations of substances expressed in *parts per million (ppm)* and *milligrams per cubic meter (mg m⁻³)*.

French exposure limits are published by the French Ministry in Charge of Labour and presented in the report *Valeurs limites d'exposition professionnelle aux agents chimiques en France* (ND 1945-153-93). The values in DOSE have been taken from the 1998 edition. The FR-VLE values are short-term limits (15 minutes), and FR-VME values are long-term limits (8 hours).

German data currently include the national MAK values where available. The MAK value (Maximale Arbeitsplatz-Konzentration) is defined as the maximum permissible concentration of a chemical compound present in the air within a working area which, according to current knowledge, does not impair the health of the employee or cause undue annoyance. Under those conditions, exposure can be repeated and of long duration over a daily period of eight hours, constituting an average working week of 40 hours. MAK values are published by the Geschäftsstelle der Deutschen Forschungsgemeinschaft, Bonn, in "Maximum Concentrations at the Workplace and Biological Tolerance Values for Working Materials." The values in DOSE have been taken from the 1998 edition.

Japanese exposure limits are those recommended by the Japanese Society of Occupational Health. Unless otherwise indicated, these values are long-term exposure limits (the mean exposure concentration at or below which adverse health effects caused by the substance do not appear in most workers, working 8 hours a day, 40 hours a week under a moderate workload). The values in DOSE were published in 1997.

Swedish data can include short-term exposure limit, a level limit, or a ceiling limit. The values in DOSE were adopted in 1996.

In the UK occupational limits relating to airborne substances hazardous to health are published by the Health and Safety Executive annually in Guidance Note EH40. The values in the DOSE items have been taken from the 1999 edition.

There are Maximum Exposure Limits (MEL) in the UK which are subject to regulation and which should not normally be exceeded. They derive from Regulations, Approved Codes of Practice, European Community Directives, or from the Health and Safety Commission. In addition, there are Occupational Exposure Standards (OES) which are considered to represent good practice and realistic criteria for the control of exposure. In an analogous fashion to the USA Threshold Limits, there are long-term limits, expressed as time-weighted average concentrations over an 8-hour working day, designed to protect workers against the effects of long-term exposure. The short-term exposure limit is for a time-weighted average of 15 minutes. For those substances for which no short-term limit is listed, it is recommended that a figure of three times the long-term exposure limit averaged over a 15-minute period be used as a guideline for controlling exposure to short-term excursions.

The threshold limit values for the USA have been taken from the *Threshold Limit Values and Biological Exposure Indices*, 1999 produced by the American Conference of Governmental Industrial Hygienists, Cincinnati, USA. The limits relate to *Threshold Limit – Time Weighted Average*, *Threshold Limit – Short Term Exposure Limit* and *Threshold Limit – Ceiling Limit*. The Threshold Limit Value – Time Weighted Average (TLV-TWA) allows a time-weighted average concentration for a normal 8-hour working day and a 40-hour working week, to which nearly all workers may be repeatedly exposed day after day, without adverse effect. The Threshold Limit Value – Short Term Exposure Limit (TLV-STEL) is defined as a 15-minute, time-weighted average which should not be exceeded at any time during a work day, even if the 8-hour time-weighted average is within the TLV. It is designed to protect workers from chemicals which may cause irritancy, chronic or irreversible tissue damage, or narcosis of sufficient degree to cause the likelihood of accidental injury. Many STELs have been deleted pending further toxicological assessment. With Threshold Limit – Ceiling Values (TLV-C) the concentration should not be exceeded during any part of the working day.

UN number

The United Nations Number is a four-figure code used to identify hazardous chemicals and is used for identification of chemicals transported internationally by road, rail, sea and air. In the UK this number is also called the “Substance Identification Number” or “SI Number”.

HAZCHEM code

The Hazchem Code is used to instruct United Kingdom emergency services on equipment, evacuation and other methods of dealing with transportation incidents. It is administered by the Chemical Industries Association.

Conveyance classification

The information presented for the transportation of substances dangerous for conveyance by road is derived from the UK’s Approved Carriage List, Health and Safety Commission, UK.

Supply classification

The information presented for the supply of substances is derived from the UK’s Approved Supply List: information approved for the classification and labelling of substances and preparations dangerous for supply [Chemicals (Hazard Information and Packaging) Regulations 1999 (CHIP 99)*] Health and Safety Commission, UK.

Risk and safety phrases

Risk and safety phrases used in connection with DOSE items are approved phrases for describing the risks involved in the use of hazardous chemicals and have validity in the United Kingdom and throughout the countries of the European Community. The approved texts have designated R (Risk) and S (Safety) numbers from which it is possible to provide translations for all approved languages adopted by the European Community. The risk and safety phrases quoted in DOSE relate to the UK’s Approved Supply List: information

*At the time of going to press the Health and Safety Commission, UK announced that an amendment (Amendment No. 2) to the CHIP 99 regulations is intended to come into force on 1 January 2000. The supply classifications and the risk and safety phrases reported in this edition of DOSE do not include any changes which are proposed in Amendment No. 2 to CHIP 99. These changes are incorporated in the updates to the electronic versions of DOSE released after 1 January 2000.

approved for the classification and labelling of substances and preparations dangerous for supply [Chemicals (Hazard Information and Packaging) Regulations, 1999 (CHIP 99)] Health and Safety Commission, UK. The risk and safety phrases should be used to describe the hazards of chemicals on data sheets for use and supply; for labelling of containers, storage drums, tanks etc., and for labelling of articles specified as dangerous for conveyance by road. (See also footnote on page xi.)

Ecotoxicity

Information is presented on the effects of chemicals on various ecosystems. Results of studies carried out on aquatic species, primarily fish and invertebrates, but also fresh water and marine microorganisms and plants are reported. Persistence and potential for accumulation in the environment and any available information on the harmful effects to non-target species, i.e. the unintentional exposure of terrestrial and/or aquatic species to a toxic substance is given. Ecotoxicology can be defined as that science involved in the study of the production of harmful effects by substances entering the natural environment, especially effects on populations, communities and ecosystems; or as the study of the effects of chemicals on ecosystems and their non-human components. An essential part of the ecotoxicology is the assessment of movement of potentially toxic imbalance through environmental compartments and through food webs.

Ecotoxicology, unlike human toxicology, is more concerned with the effects to populations than to individuals. Human toxicology is based on the extrapolation of data from many species to one species man, whereas ecotoxicology necessitates the extrapolation from a few species to many, or from limited field data to entire ecosystems.

Ecotoxicology must not be confused with environmental toxicology which is the direct effects of environmental chemicals to humans. The term environmental toxicology should only be applied to the study of direct effects of environmental chemicals on human beings. Although the main thrust of preventative toxicology is in the area of human health, it is becoming increasingly evident that human health is intimately connected with conditions in the natural environment. Chemicals released into the environment far from human habitation may become a health hazard for humans through food chain accumulation. Other chemicals may adversely affect crop growth or kill economically important fish stocks or bird life.

Fish toxicity

LC₅₀ values, with duration of exposure, are quoted for two species of freshwater and one marine species if available. Any additional information on bioassay type (static or flow through) and water condition (pH, temperature, hardness or oxygen content) is reported.

Invertebrate toxicity

LC₅₀ values with duration of exposure, are quoted for molluscs and crustaceans. EC₅₀ values, i.e. concentrations which will immobilise 50% of an exposed population, are given for microbes, algae and bacteria. Values which will inhibit microbial or algal growth are reported. Duration of exposure is given when available.

Toxicity to other species

Toxicity to species other than mammals, birds, invertebrates and fish (e.g. reptiles, amphibians, plants, seaweeds), is reported here. LD₅₀, LC₅₀ and EC₅₀ values are given with duration of exposure, concentration and as much supplementary information as possible.

Bioaccumulation

Bioaccumulation, biomagnification and bioconcentration data are quoted primarily for fish, invertebrates, bacteria and algae. Bioaccumulation is the progressive increase in the amount of a chemical in an organism or part of an organism which occurs because the rate of intake exceeds the organism's ability to remove the substance from its body. Bioconcentration is a process leading to a higher concentration of a chemical in an organism than in its environment. Lastly, biomagnification is a sequence of processes in an ecosystem by which higher concentrations are attained in organisms at higher trophic levels, i.e. at higher levels in the food chain.

Environmental Fate

Degradation data are used to assess the persistence of a chemical substance in the environment, in water, soil and air. If the substance does not persist, information on the degradation products is also desirable. Intermediates may be either harmless or toxic substances which will themselves persist. Degradation occurs via two major routes, microbial degradation utilising microorganisms from a variety of habitats and decomposition by chemical methods. Microbial degradation is associated with the production of elemental carbon, nitrogen and sulfur from complex molecules. Standard biodegradation tests estimate the importance of microbial biodegradation as a persistence factor. Most tests use relatively dense microbial populations adapted to the compound being studied. Rapid degradation results in these tests implies that the compound will degrade under most environmental conditions, although specialised environments where degradation would not occur can exist. Compounds which are not readily degradable are likely to persist over a wide range of environmental situations.

Chemical degradation processes include photolysis, hydrolysis, oxidation and removal by reversible/irreversible binding to sediment. Factors which influence degradation rates, such as duration of exposure, temperature, pH, salinity, concentrations of test substance, microbial populations, and other nutrients, must also be taken into account.

Due care must also be given when metabolism results in the production of substances that are more toxic than their parents.

Nitrification inhibition

The nitrogen cycle is the major biogeochemical process in the production of nitrogen, an essential element contained in amino acids and proteins. Nitrogen is an essential element in microorganisms, higher plants and animals. Interference in the production of nitrogen from more complex molecules can be determined by standard tests using nitrogen-fixing bacteria. The degree of inhibition can be used to estimate the environmental impact of the test chemical.

Carbonaceous inhibition

Another major biogeochemical process is the recycling of carbon via the decomposition of complex organic matter by bacteria and fungi. In nature the process is important in the cycling of elements and nutrients in ecosystems. The degradation sequence occurs in stages, cellulose → cellobiose → glucose → organic acids and carbon dioxide. Chemical inhibition of microbial processes at all or any of these stages is reported here.

Anaerobic effects

Anaerobic microbial degradation of organic compounds occurs in the absence of oxygen and is an important degradation process in both the natural environment and in waste treatment plants. Data on the effects of chemicals on anaerobic systems are reported here. An important method uses anaerobic digestion tests which compare the production of methane and carbon dioxide by anaerobic microbes in a sludge sample with and without added test material. Methane production is at the end of the food chain process used by a wide range of anaerobic microorganisms.

Degradation studies

This section focuses on microbial degradation in both soil and water under anaerobic and aerobic conditions. The half-life of the chemical substance in the environment is reported with its degradation products where possible, giving an indication of the degree of its persistence. Water pollution factors: BOD (biochemical/biological oxygen demand), COD (chemical oxygen demand) and ThOD (theoretical oxygen demand) are stated, where available. BOD estimates the extent of natural purification which would occur if a substance were discharged into rivers, lakes or the sea. COD is a quicker chemical method for this determination which uses potassium dichromate or permanganate to establish the extent of oxidation likely to occur. ThOD measures the amount of oxygen needed to oxidise hydrocarbons to carbon dioxide and water. When organic molecules contain other elements nitrogen, sulfur or phosphorus, the ThOD depends on the final oxidation stage of these elements.

Abiotic removal

Information on chemical decomposition processes is contained in this section. The energy from the sun is able to break carbon-carbon, and carbon-hydrogen bonds, cause photodissociation of nitrogen dioxide to nitric oxide and atomic oxygen and photolytically produce significant amounts of hydroxyl radicals. Hydrolysis occurs when a substance present in water is able to react with the hydrogen or hydroxyl ions of the water. Therefore the extent of photolytic and oxidative reactions occurring in the atmosphere and hydrolysis in water can be used as a measure of environmental pollution likely to arise from exposure to a substance. Removal by activated carbon is also reported.

Adsorption and retention

The environmental impact of a chemical substance is determined by its ability to move through the environment. This movement depends on the affinity of the chemical toward particulate matter: soil and sediment. Chemicals which have a high affinity for adsorption are less readily transported in the gaseous phase or in solution, and therefore can accumulate in a particular medium. Chemical substances which are not readily adsorbed are transported through soil, air and aquatic systems.

Mammalian and avian toxicity

Studies on mammalian species are carried out to determine the potential toxicity of substances to humans. Avian species are studied primarily to assess the environmental impact on the ecosystem, however data from avian studies are also used for assessing human toxicity. This is specifically applied to pesticides, with neurotoxicology studies.

Procedures involve undertaking a series of established exposure studies on a particular substance using specific routes, oral, inhalation, dermal or injection for variable durations. Exposure durations include acute or single exposure to a given concentration of substance. Sub-acute or sub-chronic exposure, i.e. repeat doses over an intermediate time period, up to 4 weeks for sub-acute and 90 day/13 week (in rodents) or 1 year (in dogs) for sub-chronic studies. Chronic/long-term studies involve exposure to specific concentrations of chemical for a duration of 18 month-2 years. A variety of species are used in toxicity testing, most commonly rodents (rats, mice, hamsters) and rabbits, but tests can also be carried out on monkeys, domestic animals and birds.

Acute data

Single exposure studies quoting LD₅₀, LC_{LO}, LD_{LO}, TC_{LO} and TD_{LO} data.

Sub-acute and sub-chronic data

Results of repeat doses, intermediate duration studies are quoted. Priority is given to reporting the adverse effects on the gastro-intestinal, hepatic, circulatory, cardiopulmonary, immune, renal and central nervous systems.

Carcinogenicity and chronic effects

Information on the carcinogenicity of substances unequivocally proven to cause cancer in humans and laboratory animals, together with equivocal data from carcinogenicity assays in laboratory animals are reported. Additionally, treatment-related chronic adverse effects are reported. Criteria for inclusion required the study to report the species, duration of exposure, concentration and target organ(s); sex is also given where available.

Teratogenicity and reproductive effects

The results of studies carried out in intact animal and *in vitro* systems to determine the potential for teratogenic, foetotoxic and reproductive damage are reported here. Criteria for inclusion required the species, duration of exposure, concentration and details of the effect in relation to fertility to be stated. Adverse effects reported in this section include sexual organ dysfunction, developmental changes (to embryos and foetuses), malformations, increases in spontaneous abortions or stillbirths, impotence, menstrual disorders and neurotoxic effects on offspring.

Metabolism and toxicokinetics

Data are quoted on the metabolic fate of the substance in mammals, and includes adsorption, distribution, storage and excretion. Mechanisms of anabolic or catabolic metabolism, enzyme activation and half-lives within the body are reported when available. Additionally findings from *in vitro* studies are reported.

Irritancy

Chemical substances which cause irritation (itching, inflammation) to skin, eye and mucous membranes on immediate contact in either humans or experimental animals are reported here. Exposure can be intentional in human or animal experiments, or unintentional via exposure at work or accident to humans.

Sensitisation

Sensitisation occurs where an initial accidental or intentional exposure to a large or small concentration of substance causes no reaction or irritant effects. However, repeat or prolonged exposure to even minute amounts of a sensitising chemical causes increasingly acute allergic reactions.

Genotoxicity

Genotoxicity testing is carried out to determine the mutagenic and/or carcinogenic potential of a chemical substance. A standard series of tests are carried out under controlled laboratory conditions on an established set of test organisms. A hierarchical system using bacteria, yeasts, cultured human and mammalian cells, *in vivo* cytogenetic tests in mammals and plant genetics is used to assess the genotoxic potential of the substance under study. Bacteria, unlike mammals, lack the necessary oxidative enzyme systems for metabolising foreign compounds to the electrophilic metabolites capable of reacting with DNA. Therefore, bacteria are treated with the substance under study in the presence of a post-mitochondrial supernatant (S9) prepared from the livers of mammals (usually rats). This fraction is supplemented with essential co-factors to form the S9 mix necessary for activation. DOSE reports published studies: giving the test organisms, whether metabolic activation (S9) was required, and the result, positive or negative.

Other effects

Other adverse effects (human)

Adverse effects to humans from single or repeat exposures to a substance are given. The section includes results of epidemiological studies, smaller less comprehensive studies of people exposed through their work environment and accidental exposure of a single, few or many individuals.

Any other adverse effects

Adverse effects to organisms or animals other than man are reported here.

Legislation

Any form of legislation, medical (food and drugs) or environmental from European, American and worldwide sources is reported.

Other comments

All other relevant information, including chemical instability and incompatibility, reviews, phytotoxicity and toxic effects associated with impurities, is contained in this section.

References

Contains references to data from above sections.

Indexes

The most convenient means of accessing a chemical in DOSE is via one of the indexes at the back of Volume 7. DOSE contains three indexes: chemical name and synonyms, CAS Registry Numbers and molecular formulae.

Index of chemical names and synonyms

Contains the name of the chemical used in DOSE together with a number of synonyms for that chemical. All names are arranged alphabetically.

Index of CAS Registry Numbers

Contains a list of the CAS Registry Numbers of the chemicals in DOSE in ascending order. This number is linked to the preferred DOSE name for that chemical and its DOSE number.

Index of molecular formulae

Contains a list of the molecular formulae of the chemicals in DOSE in alphabetical order for inorganic compounds, i.e. Ag_2CO_3 , Cl_2Cr , etc., but for organic compounds, carbon and hydrogen content are shown first followed by the other elements in alphabetical order, i.e. $\text{C}_6\text{H}_5\text{Br}$. This number is linked to the preferred DOSE name for that chemical and its DOSE number.

Note

The Royal Society of Chemistry (RSC) has only assessed published information in compiling The Dictionary of Substances and their Effects. However, the RSC would welcome any relevant information on the chemicals that is not readily accessible, but in the public domain, for inclusion when the items in DOSE are updated.

If you have any relevant information, please contact:

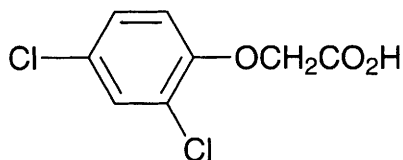
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D1 2,4-D



$C_8H_6Cl_2O_3$

Mol. Wt. 221.04

CAS Registry No. 94-75-7

Synonyms (2,4-dichlorophenoxy)acetic acid; 2,4-dichlorophenoxyacetic acid

EINECS No. 202-361-1

RTECS No. AG 6825000

Uses Systemic herbicide.

Physical properties

M. Pt. 140.5°C **B. Pt.** 160°C at 0.4 mmHg **Flash point** >79.4°C **Specific gravity** 1.565 at 30°C

Partition coefficient $\log P_{ow}$ 2.58-2.83 (pH 1) (1) **Volatility** v.p. 0.34 mmHg at 160°C

Solubility Water: 311 mg l⁻¹ at pH 1, 25°C. Organic solvents: acetone, diethyl ether, dioxane, ethanol, heptane, toluene, xylene, dimethyl sulfoxide

Occupational exposure

DE-MAK 1 mg m⁻³ (inhalable fraction of aerosol)

FR-VME 10 mg m⁻³

UK-LTEL 10 mg m⁻³

UK-STEL 20 mg m⁻³

US-TWA 10 mg m⁻³

Supply classification harmful

Risk phrases Harmful if swallowed – Irritating to eyes, respiratory system and skin (R22, R36/37/38)

Safety phrases Keep out of reach of children (if sold to general public) – Wear suitable protective clothing and gloves (S2, S36/37)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) cut-throat trout 0.5-1.2 mg l⁻¹ (2).

LC₅₀ (48 hr) rainbow trout, bluegill sunfish 0.9-1.1 mg kg⁻¹ (3).

LC₅₀ (96 hr) channel catfish, bluegill sunfish 181.2, 266.3 mg l⁻¹, respectively (4).

Invertebrate toxicity

Caused 50% decrease in oxygen evolution and 50% decrease in growth rate in several species of algae at concentrations of between 5-9 mg l⁻¹ (5).

In blue-green alga *Anabaenopsis raciborskii* growth and nitrogen fixation stimulated at 10 mg l⁻¹, no growth inhibition occurred at 100 mg l⁻¹ and complete growth inhibition occurred at 1000 g l⁻¹ (6).

Not toxic to bees (7).

LC₅₀ (96 hr) crawfish 750.1 mg l⁻¹ (4).

Environmental fate

Nitrification inhibition

Very slight inhibition of nitrification occurred in soil incubated with 3 ppm (8).

Degradation studies

In soil t_{1/2} <7 days (7).

Twenty six days for ring cleavage in soil suspension (9).

Biodegradable (10).

Mineralisation of [14C]2,4-D in soil amended with NH_4O_3 fertilizer was markedly reduced and progressively decreased with N application rate. The addition of $\text{Ca}(\text{H}_2\text{PO}_4)_2$ did not generally affect mineralisation. Addition of both N and P fertilizers to the soil either further reduced or did not affect mineralisation. NH_4NO_3 may increase overall soil microbial activity, especially nitrification activity, but as a result of catabolite repression it may inhibit 2,4-D degradation (11).

Abiotic removal

Rate of adsorption to activated carbon from 22 mg l⁻¹ solution 60.1% at pH 3.0; 18.8% at pH 7.0; 14.3% at pH 11.0 (12).

Mammalian & avian toxicity

Acute data

LD₅₀ oral Japanese quail 668 mg kg⁻¹ (7).

LD₅₀ oral wild duck >1000 mg kg⁻¹ (7).

LD₅₀ oral pigeon 668 mg kg⁻¹ (7).

LD₅₀ oral pheasant 472 mg kg⁻¹ (7).

LD₅₀ oral mouse, rat 347, 375 mg kg⁻¹, respectively (13,14).

Gavage ♂ and ♀ Fischer 344 rats no-observed-adverse-effect level for acute neurotoxicity 15 mg kg⁻¹ (15).

LD₅₀ dermal rabbit >1600 mg kg⁻¹ (7).

LD₅₀ intraperitoneal mouse, rat 375, 666 mg kg⁻¹, respectively (16).

Sub-acute and sub-chronic data

Mice fed 1000 mg kg⁻¹ diet for 1 month had increased mortality, depressed growth rate, slightly increased liver weight and slightly cloudy swelling of the liver. Animals fed up to 10,000 mg kg⁻¹ diet refused food with rapid weight loss. Increased liver and kidney weights and unstated pathological changes were noted in these organs (13).

♂ and ♀ Fischer 344 rats administered 2,4-D in feed for 52 wk. No-observed-adverse-effect level 75 mg kg⁻¹ day⁻¹ in diet (15).

No adverse effects were reported in a man who took 500 mg orally daily for 3 weeks (~ 8 mg kg⁻¹ day⁻¹) (17).

Fatality has been reported following ingestion of 6 g, yet in another patient 7 g was not fatal. Estimated no effect level (NOEL) 36 mg kg⁻¹ (18).

Carcinogenicity and chronic effects

Long term oral administration and subcutaneous administration did not cause a significant increase in tumours in mice. In long term oral administration to rats an increased incidence of randomly distributed malignant tumours was observed. Results from a single cohort study among exposed workers in Sweden was not sufficient to evaluate carcinogenicity to man. No evaluation of carcinogenicity could be made from available animal data (19). In 2 yr dietary trials, rats receiving 1250 mg kg⁻¹ diet and dogs receiving 500 mg kg⁻¹ diet showed no ill-effects (7).

Teratogenicity and reproductive effects

Caused embryo-lethal and growth retarding effects, but no teratogenic effect following maximum tolerated dose to pregnant rats (20).

Foetal anomalies were observed in some strains of mice. Results of various other studies were variable (19).

Metabolism and toxicokinetics

In rats, following oral administration, eliminated rapidly mainly as the unchanged substance. Single doses up to 10 mg kg⁻¹ eliminated almost completely after 24 hr. With higher doses, complete elimination takes longer (7). Pregnant New Zealand rabbits were administered a single intravenous dose of carbon-14-labelled 2,4-D with unlabelled sodium 2,4-D (1, 10 or 40 mg kg⁻¹) in saline on days 28-30 of gestation. Blood and tissue was collected up to 2 h after dosing. There was rapid transfer of 2,4-D to the foetal plasma and brain, which peaked after 30 min for plasma. The maternal kidney and uterus showed the highest extraplasmal tissue levels of 2,4-D, and the foetal brain had the lowest. The foetal tissue content was ≤20% of that in the dam, but the level in the brain was 7% of that in foetal plasma compared with 2% of that in maternal plasma (21).

Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation and 750 µg instilled into rabbit eye caused severe irritation (22).

Genotoxicity

Salmonella typhimurium TA1535, TA1537 with and without metabolic activation negative (19).

Bacillus subtilis with and without metabolic activation rec assay did not indicate DNA damage (23).

Saccharomyces cerevisiae D4, gene conversion increased by concentrations >400 µg ml⁻¹ (24).

Saccharomyces cerevisiae D5, mitotic recombination increased at 300 µg ml⁻¹ (25).

Did not increase dominant lethal mutations following oral and intraperitoneal administration to mice (26).

No detectable increase in micronuclei in erythrocytes of mouse bone marrow (27).

No increase in the number of recessive lethals observed in ♂ *Drosophila melanogaster* (28).

Induced chromosome aberrations, including chromosome bridges, fragments, lagging chromosomes, C-mitosis and chromatin bodies, in a number of plants (29,30).

Other effects

Other adverse effects (human)

Chronic effects among workers include fibrillary movements, skeletal muscle damage, peripheral neuropathy and paralysis (19).

Caused moderate to severe chloracne in 18% of 73 employees engaged in manufacture of 2,4-D and 2,4,5-T. No systemic toxicity was observed (31).

Any other adverse effects

29% inhibition of testicular DNA synthesis at 200 mg kg⁻¹ in mice (32).

I₅₀ values (inhibition of 50% of enzyme activity) for serum enzymes (species unspecified) alanine aminotransferase, alkaline phosphatase, γ-glutamyl transferase and lactate dehydrogenase (*in vitro*) are 6.97×10^{-2} M, 5.05×10^{-2} M, 2.35×10^{-2} M and 1.07×10^{-2} M, respectively (33).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (34).

UK DoE advisory value for drinking water 1000 µg l⁻¹ (35).

WHO Class II human tolerable daily intake (TDI) 0.3 mg kg⁻¹ EEC maximum residual level citrus fruits 2 ppm (8).

Use of 2,4-D, its salts and esters prohibited in India and Colombia. Use restricted in USA and Guatemala (36).

Other comments

Persistence: degraded leaches into water; some degradation occurs in water (35).

Residues found on crops, soil and water (19).

In plants and micro-organisms, metabolism involves hydroxylation, decarboxylation, cleavage of the acid side chain and ring opening (7).

Two submersed aquatic macrophytes, *Potamogeton pectinatus* L. and *Myriophyllum sibiricum* Komarov, were grown in the presence of 0.01 and 0.1 mg 2,4-D l⁻¹. The lower concentrations of 2,4-D stimulated flowering by *M. sibiricum* and tuber production by *P. pectinatus*. Both species were injured by the higher concentration (37).

Review integrating data from worker exposure studies, whole animals, metabolic and laboratory studies with epidemiological findings to assess the increased risk of developing human cancer to exposure (38).

Salts are readily absorbed by roots while esters are readily absorbed by foliage. Acts as growth inhibitor (7).

The toxicity of 2,4-D to *Rhizobium* sp. may be mediated by its ability to combine with cellular macromolecules, interfering with the normal functions of the cell (39).

Odour threshold detection 3.13 mg kg⁻¹ (40).

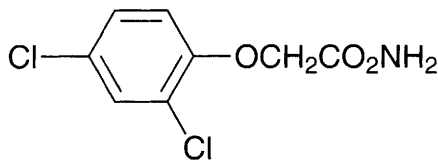
Toxicity and hazards reviewed (41).

Metabolic pathways reviewed (42).

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D2 2,4-D, amine salt



$C_8H_7Cl_2NO_3$

Mol. Wt. 236.05

CAS Registry No. 1982-42-9; 2307-55-3

Synonyms 2,4-dichlorophenoxyacetic acid, amine salt; (2,4-dichlorophenoxy)acetic acid, amino salt; 2-(2,4-dichlorophenoxy)acetamide; 2,4-D-ammonium salt

EINECS No. 217-842-1

RTECS No. AB 6945000; AG 7075000

Uses Systemic herbicide.

Physical properties

M. Pt. 179-180°C

Occupational exposure

DE-MAK 1 mg m⁻³ (total dust)

Supply classification harmful

Risk phrases Harmful by inhalation, in contact with skin and if swallowed (R20/21/22)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs (S2, S13)

Environmental fate

Adsorption and retention

Persists in soil for ~1 month (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1200 mg kg⁻¹ (2).

LD₅₀ oral mouse 300 mg kg⁻¹ (2).

Metabolism and toxicokinetics

Following oral administration to rats, rapidly absorbed giving peak plasma concentrations after 4-7 hr (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (3).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

Other comments

Residual of 1 µg l⁻¹ detected in treated water supplies (5).

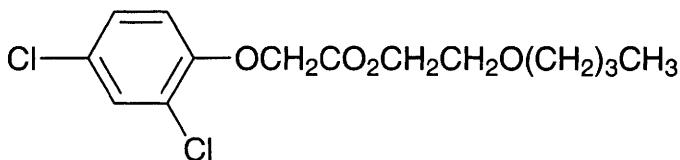
Approved for use on river banks (5).

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D3 2,4-D, butoxyethanol ester



C₁₄H₁₈Cl₂O₄

Mol. Wt. 321.20

CAS Registry No. 1929-73-3

Synonyms 2,4-dichlorophenoxyacetic acid, butoxyethanol ester; (2,4-dichlorophenoxy)acetic acid, butoxyethanol ester; 2,4-D(BEE); (2,4-dichlorophenoxy)acetic acid, 2-butoxyethyl ester; 2,4-D-butotyl

EINECS No. 217-680-1

RTECS No. AG 7700000

Uses Systemic herbicide.

Physical properties

B. Pt. 156-162°C at 1 mmHg **Specific gravity** 1.225 at 20°C with respect to water at 20°C

Volatility v.p. 1.70×10^{-3} mmHg at 25°C

Solubility Water: 12 mg l⁻¹. Organic solvents: oils

Occupational exposure

DE-MAK 1 mg m⁻³ (total dust)

Supply classification harmful

Risk phrases Harmful by inhalation, in contact with skin and if swallowed (R20/21/22)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs (S2, S13)

Ecotoxicity

Fish toxicity

LC₅₀ fathead minnow (96 hr) 56 mg l⁻¹; 1500 µg lethal to eggs in 48 hr exposure; 10 months no effect level 300 µg l⁻¹ (1).

Invertebrate toxicity

LC₅₀ (96 hr) *Gammarus lacustris* 440 µg l⁻¹ (2).

LC₅₀ (96 hr) *Gammarus fasciatus* 6 mg l⁻¹ (3).

LC₅₀ (48 hr) *Daphnia magna* 6 mg l⁻¹ (3).

LC₅₀ (48 hr) *Cypridopsis vidua* 2 mg l⁻¹ (3).

LC₅₀ (48 hr) *Asellus brevicaudus* 3 mg l⁻¹ (3).

LC₅₀ (48 hr) *Palaemonetes kadiakensis* 1 mg l⁻¹ (3).

LC₅₀ (96 hr) *Pteronarcys californica* 1 mg l⁻¹ (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral ♂ rat 940 mg kg⁻¹ (5).

LD₅₀ dermal rabbit ≈4000 mg kg⁻¹ (5).

Sub-acute and sub-chronic data

LC₅₀ 8 day dietary trial, bobwhite quail and Japanese quail >5000 mg kg⁻¹ (6).

LC₅₀ 8 day dietary trial, ring-necked pheasant and mallard >5000 mg kg⁻¹ (6).

Teratogenicity and reproductive effects

TD_{Lo} oral rat (6-15 day pregnant) 1500 mg kg⁻¹ (7).

Caused embryo-lethal and growth retarding effects, but no teratogenic effect following maximum tolerated dose to pregnant rats (8).

Irritancy

Acute eye and skin irritation reported in agricultural workers (9).

Legislation

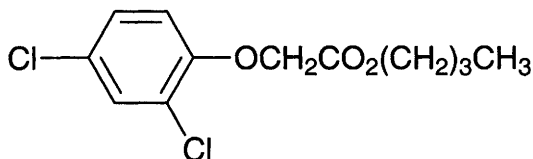
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (10).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (11).

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D4 2,4-D, butyl ester



C₁₂H₁₄Cl₂O₃

Mol. Wt. 277.15

CAS Registry No. 94-80-4

Synonyms 2,4-dichlorophenoxyacetic acid, butyl ester; (2,4-dichlorophenoxy)acetic acid, butyl ester; butyl dichlorophenoxyacetate

EINECS No. 202-364-8

RTECS No. AG 8050000

Uses Systemic herbicide.

Physical properties

M. Pt. 9°C B. Pt. 146-147°C Flash point >79.4°C Volatility v.p. 3.9×10^{-4} mm Hg at 25°C
Solubility Water: 1 mg l⁻¹ at 25°C. Organic solvents: ethanol

Occupational exposure

DE-MAK 1 mg m⁻³ (total dust)

Supply classification harmful

Risk phrases Harmful by inhalation, in contact with skin and if swallowed (R20/21/22)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs (S2, S13)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 380-920 mg kg⁻¹ (1).

Sub-acute and sub-chronic data

No adverse effects noted when 5 ml of 3.13% solution administered 5 × wk⁻¹ for 3 wk to intact and abraded rabbit skin (2).

Carcinogenicity and chronic effects

No increase in incidence of tumours observed in mice treated with single injection of 21.5 mg kg⁻¹ (3).

No evaluation of carcinogenicity could be made from subcutaneous and oral administration tests in mice (4).

Teratogenicity and reproductive effects

Oral administration produced increased frequency of foetal anomalies among BL6, AKR and/or C3H strains of mice, but not among B6AK and A/Ha strains (4).

Genotoxicity

Not mutagenic in bacterial test systems (5).

Legislation

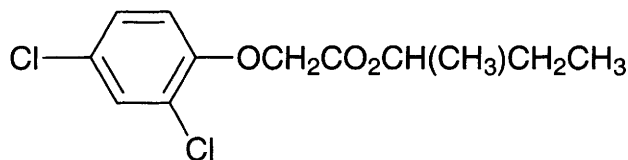
Limited under the EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (6).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (7).

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D5 2,4-D, *sec*-butyl ester



$C_{12}H_{14}Cl_2O_3$

Mol. Wt. 277.15

CAS Registry No. 94-79-1

Synonyms 2,4-dichlorophenoxyacetic acid, *sec*-butyl ester; (2,4-dichlorophenoxy)acetic acid, *sec*-butyl ester

Uses Systemic herbicide.

Occupational exposure

DE-MAK 1 mg m⁻³ (total dust)

Supply classification harmful

Risk phrases Harmful by inhalation, in contact with skin and if swallowed (R20/21/22)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs (S2, S13)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 620-713 mg kg⁻¹ (1).

LD₅₀ oral chicken 2000 mg kg⁻¹ (1).

Legislation

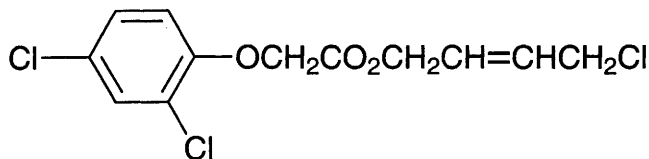
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (2).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (3).

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3. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D6 2,4-D, 4-chloro-2-butenyl ester



$C_{12}H_{11}Cl_3O_3$

Mol. Wt. 309.58

CAS Registry No. 2971-38-2

Synonyms 2,4-dichlorophenoxyacetic acid, 4-chloro-2-butenyl ester; (2,4-dichlorophenoxy)acetic acid, 4-chloro-2-butenyl ester

RTECS No. AG 8200000

Uses Systemic herbicide.

Physical properties

Solubility Organic solvents: oils

Occupational exposure

DE-MAK 1 mg m⁻³ (total dust)

Supply classification harmful

Risk phrases Harmful by inhalation, in contact with skin and if swallowed (R20/21/22)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs (S2, S13)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 490-550 mg kg⁻¹ (1).

LD₅₀ (2 hr) inhalation mouse 2190 mg m⁻³ (1).

Legislation

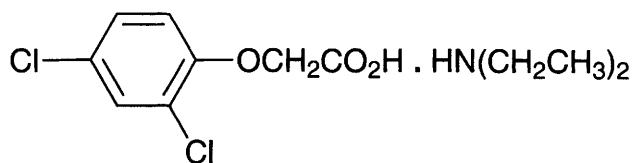
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (2).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (3).

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1. Izmerov, N. F. et al *Toxicometric Parameters of Industrial Toxic Chemicals Under Single Exposure* 1982, 35, CIP, Moscow, USSR.
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3. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D7 2,4-D, diethylamine salt



$C_{12}H_{17}Cl_2NO_3$

Mol. Wt. 294.18

CAS Registry No. 20940-37-8

Synonyms 2,4-dichlorophenoxyacetic acid, diethylamine salt; (2,4-dichlorophenoxy)acetic acid, diethylamine salt; 2,4-DE; (2,4-dichlorophenoxy)acetic acid, N-ethylethanolamine ester; 2,4-D, diethylammonium salt

EINECS No. 244-120-3

RTECS No. AG 8390000

Uses Systemic herbicide.

Occupational exposure

DE-MAK 1 mg m⁻³ (total dust)

Supply classification harmful

Risk phrases Harmful by inhalation, in contact with skin and if swallowed (R20/21/22)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs (S2, S13)

Ecotoxicity

Invertebrate toxicity

LC₅₀ (48 hr) *Daphnia magna* 4 mg l⁻¹ (1).

LC₅₀ (48 hr) *Cypridopsis vidua* 8 mg l⁻¹. No effect level (48 hr) *Gammarus fasciatus*, *Asellus cerevicaudus*, *Orconectes nais* and *Palaemonetes kadiakensis* 100 mg l⁻¹ (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 405 mg kg⁻¹ (2).

Legislation

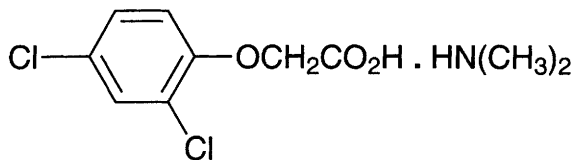
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Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

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3. EC Directive Relating to the Quality of Water Intended for Human Consumption 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
4. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D8 2,4-D, dimethylamine salt



$C_{10}H_{13}Cl_2NO_3$

Mol. Wt. 266.12

CAS Registry No. 2008-39-1

Synonyms 2,4-dichlorophenoxyacetic acid, dimethylamine salt; (2,4-dichlorophenoxy)acetic acid, dimethylamine salt; 2,4-D-DMA; 2,4-D, dimethylammonium salt

EINECS No. 217-915-8

RTECS No. AG 8400000

Uses Systemic herbicide.

Physical properties

M. Pt. 85-87°C **Flash point** >88°C **Volatility** v.p. 8×10^{-8} mmHg at 25°C

Solubility Water: 3 kg l⁻¹ at 20°C. Organic solvents: acetone, ethanol, methanol, isopropanol

Occupational exposure

DE-MAK 1 mg m⁻³ (total dust)

Supply classification harmful

Risk phrases Harmful by inhalation, in contact with skin and if swallowed (R20/21/22)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs (S2, S13)

Ecotoxicity

Fish toxicity

Lowest observed avoidance concentration, rainbow trout 1.0 mg l⁻¹ (1).

LC₅₀ (48 hr) rainbow trout 258 mg l⁻¹ (2).

LC₅₀ (96 hr) rainbow trout 100 mg l⁻¹ (3).

LC₅₀ (48 hr) bluegill sunfish 382 mg l⁻¹ (2).

LC₅₀ (48 hr) fathead minnow 184 mg l⁻¹ (2).

Invertebrate toxicity

Lowest observed avoidance concentration, mayfly nymphs >10 mg l⁻¹ (1).

Environmental fate

Degradation studies

The effect of pH, organics, metal reductants, fixed aerobic conditions versus cycling through aerobic and anaerobic conditions on the degradation of 2,4-D dimethylamine salt was studied in model soil beds (containing loamy sand soil). Applied liming was effective in reducing 2,4-D concentrations in soils. Added organic matter decreased 2,4-D concentration and zinc had little effect on aerobic degradation of 2,4-D. 2,4-D degradation was slower under anaerobic conditions; however, cycling through aerobic and anaerobic conditions promoted degradation of 2,4-D. Upward movement of 2,4-D was observed (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rabbit, rat 338-960 mg kg⁻¹ (5).

LD₅₀ oral rat, mouse 300-515 mg kg⁻¹ (6).

LD₅₀ dermal rabbit 2115 mg kg⁻¹ (6).

Sub-acute and sub-chronic data

No adverse effects noted when 15 ml of 3.13% solution administered 5 × wkly for 3 wk to intact and abraded rabbit skin (7).

LC₅₀ 8 day dietary trial, bobwhite quail, Japanese quail >5,000 mg kg⁻¹ (8).

LC₅₀ 8 day dietary trial, ring-necked pheasant and mallard duck >5,000 mg kg⁻¹ (8).

Oral administration of 10-100 mg kg⁻¹ for 60 days to cats decreased the number of B- and T-lymphocytes and neutrophils in blood. In sheep, 100-200 µg kg⁻¹ for 20 days decreased cellular and humoral immunity (5).

Teratogenicity and reproductive effects

LD_{Lo} oral rat (6-15 days gestation) 3 g kg⁻¹ (9).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (10).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (11).

WHO Class II; EPA Toxicity Class I (eyes), Class III (oral) (12).

Other comments

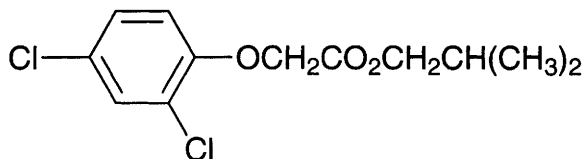
Experimental concentrations of 0.5 mg l⁻¹ can significantly taint the flesh of rainbow trouts to make them unpalatable (13).

Regional dermal deposition on farmers when handling, mixing and spraying the herbicide was determined following 30 separate exposures. Three distinct levels of dermal deposits could be clearly ascertained. These densities were quite uniform and indicated a greatly reduced but nevertheless general permeation of the herbicide through 2 layers of protective clothing. Somewhat higher median deposit densities were found on exposed body regions less likely to be contaminated during the mixing process, such as the head, neck and outside elbow regions. The highest median deposit densities occurred on regions of the body most likely to be contaminated during the mixing process, i.e. the wrist and chest regions. The overall body deposits, minus the hand regions, were 10-20% of the total body deposits and thus, when protective garments equivalent to those used in this study are worn, hand protection must remain a major concern when spraying herbicides with ground-rigs (14).

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12. *The Pesticide Manual* 9th ed., 1991, British Crop Protection Council, Farnham, UK.
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D9 2,4-D, isobutyl ester



$C_{12}H_{14}Cl_2O_3$

Mol. Wt. 277.15

CAS Registry No. 1713-15-1

Synonyms 2,4-dichlorophenoxyacetic acid, isobutyl ester; (2,4-dichlorophenoxy)acetic acid, isobutyl ester; (2,4-dichlorophenoxy)acetic acid, 2-methylpropyl ester; 2,4-D-2-methylpropyl ester

EINECS No. 216-992-5

RTECS No. AG 8550000

Uses Systemic herbicide.

Physical properties

B. Pt. 133-134°C

Occupational exposure

DE-MAK 1 mg m⁻³ (total dust)

Supply classification harmful

Risk phrases Harmful by inhalation, in contact with skin and if swallowed (R20/21/22)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs (S2, S13)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, rabbit 300-500 mg kg⁻¹ (1,2).

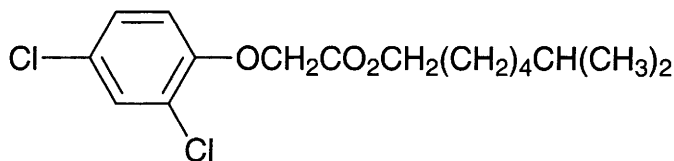
Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides maximum permissible concentration 0.1 µg l⁻¹ (3).

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D10 2,4-D, isooctyl ester



$\text{C}_{16}\text{H}_{22}\text{Cl}_2\text{O}_3$

Mol. Wt. 333.25

CAS Registry No. 25168-26-7

Synonyms 2,4-dichlorophenoxyacetic acid, isooctyl ester; (2,4-dichlorophenoxy)acetic acid, isooctyl ester; 2,4-D(IOE); 2,4-dichlorophenoxyacetic acid, 6-methylheptane ester; isooctyl 2,4-dichlorophenoxyacetate

EINECS No. 246-704-3

RTECS No. AG 8575000

Uses Systemic herbicide.

Physical properties

M. Pt. 12°C B. Pt. 317°C Flash point 51.7°C Specific gravity 1.152 at 20°C with respect to water at 4°C

Volatility v.p. 2×10^{-6} mmHg at 25°C

Solubility Water: 10 mg l⁻¹. Organic solvents: acetone, dimethyl sulfoxide, ethanol, oils

Occupational exposure

DE-MAK 1 mg m⁻³ (total dust)

Supply classification harmful

Risk phrases Harmful by inhalation, in contact with skin and if swallowed (R20/21/22)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs (S2, S13)

Ecotoxicity

Fish toxicity

LC₅₀ (48 hr) bluegill sunfish 8.8-60 mg l⁻¹ (1).

Not toxic to cutthroat trout and lake trout below 60 mg l⁻¹ (2).

Invertebrate toxicity

LC₅₀ (96 hr) *Gammarus lacustris* 2.4 mg l⁻¹ (3).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, rabbit 300 mg kg⁻¹ (4).

LD₅₀ percutaneous rabbit >4000 mg kg⁻¹ (5).

Sub-acute and sub-chronic data

No adverse effects noted when 15 ml of 3.13% solution administered 5 × wkly for 3 wk to intact and abraded rabbit skin (6).

Carcinogenicity and chronic effects

5/17 ♀ mice treated with 21.5 mg kg⁻¹ developed reticulum-cell sarcomas (7).

No evaluation of carcinogenicity could be made from oral administration tests in mice (8).

Teratogenicity and reproductive effects

Oral administration produced increased frequency of foetal anomalies among BL6, AKR and/or C3H strains of mice, but not among B6AK and A/Ha strains (8).

Irritancy

Skin and eye irritant (9).

Genotoxicity

Salmonella typhimurium TA100, TA1357, TA98 with and without metabolic activation negative (10).

Legislation

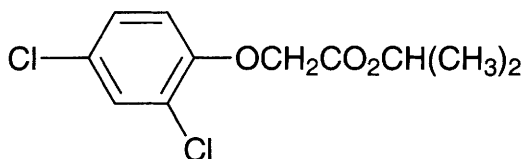
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration $0.1 \mu\text{g l}^{-1}$ (11).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (12).

References

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D11 2,4-D, isopropyl ester



$\text{C}_{11}\text{H}_{12}\text{Cl}_2\text{O}_3$

Mol. Wt. 263.12

CAS Registry No. 94-11-1

Synonyms 2,4-dichlorophenoxyacetic acid, isopropyl ester; (2,4-dichlorophenoxy)acetic acid, isopropyl ester; (2,4-dichlorophenoxy)acetic acid, 1-methylethyl ester

EINECS No. 202-305-6

RTECS No. AG 8750000

Uses Systemic herbicide.

Physical properties

M. Pt. Crystallises in 2 forms: $5-10^\circ\text{C}$ and $20-25^\circ\text{C}$ **B. Pt.** 130°C at 1 mmHg **Specific gravity** 1.255-1.270 at 25°C with respect to water at 25°C **Volatility** v.p. 1.05×10^{-2} mmHg at 25°C
Solubility Water: 46 mg l^{-1} . Organic solvents: alcohols, most oils

Occupational exposure

DE-MAK 1 mg m⁻³ (total dust)

Supply classification harmful

Risk phrases Harmful by inhalation, in contact with skin and if swallowed (R20/21/22)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs (S2, S13)

Ecotoxicity

Fish toxicity

LC₅₀ (48 hr) bluegill sunfish 0.8 mg l⁻¹ (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 375-540 mg kg⁻¹ (2,3).

LD₅₀ oral chicks 1420 mg kg⁻¹ (2).

Carcinogenicity and chronic effects

No increase in incidence of tumours observed in mice treated with single injection of 21.5 mg kg⁻¹ (4).

No evaluation of carcinogenicity could be made from subcutaneous and oral administration tests in mice (5).

Teratogenicity and reproductive effects

Oral administration produced increased frequency of foetal anomalies among BL6, AKR and/or C3H strains of mice, but not among B6AK and A/Ha strains (5).

Irritancy

Irritating to skin and eyes (6).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (7).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (8).

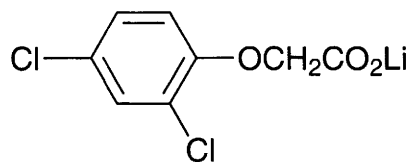
Other comments

Hazardous properties reviewed (9).

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D12 2,4-D, lithium salt



$C_8H_5Cl_2LiO_3$

Mol. Wt. 226.97

CAS Registry No. 3766-27-6

Synonyms 2,4-dichlorophenoxyacetic acid, lithium salt; (2,4-dichlorophenoxy)acetic acid, lithium salt

RTECS No. AG 8800000

Uses Systemic herbicide.

Occupational exposure

DE-MAK 1 mg m⁻³ (total dust)

Supply classification harmful

Risk phrases Harmful by inhalation, in contact with skin and if swallowed (R20/21/22)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs (S2, S13)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 850 mg kg⁻¹ (1).

Legislation

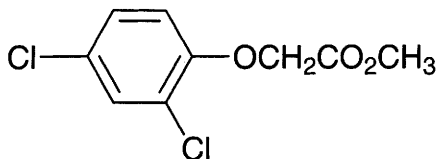
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (2).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (3).

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3. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D13 2,4-D, methyl ester



$C_9H_8Cl_2O_3$

Mol. Wt. 235.07

CAS Registry No. 1928-38-7

Synonyms 2,4-dichlorophenoxyacetic acid, methyl ester; (2,4-dichlorophenoxy)acetic acid, methyl ester

EINECS No. 217-670-7

RTECS No. AG 8810000

Uses Systemic herbicide.

Physical properties

B. Pt. 119°C at 11 mmHg

Occupational exposure

DE-MAK 1 mg m⁻³ (total dust)

Supply classification harmful

Risk phrases Harmful by inhalation, in contact with skin and if swallowed (R20/21/22)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs (S2, S13)

Legislation

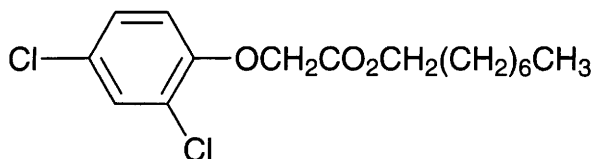
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (1).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (2).

References

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2. S. I. 1991 No. 472 The Environmental Protection (Prescribed Processes and Substances) Regulations 1991, HMSO, London, UK

D14 2,4-D, octyl ester



$C_{16}H_{22}Cl_2O_3$

Mol. Wt. 333.25

CAS Registry No. 1928-44-5

Synonyms 2,4-dichlorophenoxyacetic acid, octyl ester; (2,4-dichlorophenoxy)acetic acid, octyl ester

EINECS No. 217-674-9

RTECS No. AG 8850000

Uses Systemic herbicide.

Physical properties

B. Pt. 173-174°C at 1 mmHg

Occupational exposure

DE-MAK 1 mg m⁻³ (total dust)

Supply classification harmful

Risk phrases Harmful by inhalation, in contact with skin and if swallowed (R20/21/22)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs (S2, S13)

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 1200 mg kg⁻¹ (1).

LD_{Lo} dermal rabbit 2 g kg⁻¹ (1).

Legislation

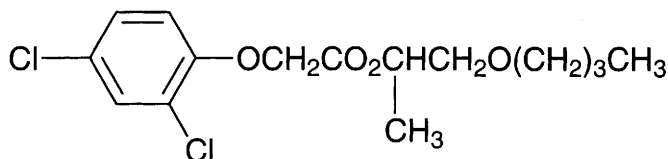
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (2).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (3).

References

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D15 2,4-D, propylene glycol butyl ether ester



C₁₅H₂₀Cl₂O₄

Mol. Wt. 335.23

CAS Registry No. 1320-18-9

Synonyms (2,4-dichlorophenoxy)acetic acid, monoester with 1,2-propanediol, butyl ether ester; 2,4-dichlorophenoxyacetic acid, propylene glycol butyl ether ester; (2,4-dichlorophenoxy)acetic acid, propylene glycol butyl ether ester; 2,4-D PGBE

RTECS No. AG 8886000

Physical properties

Volatility v.p. 2.4 mmHg at 25°C

Solubility Organic solvents: oils

Occupational exposure

DE-MAK 1 mg m⁻³ (total dust)

Supply classification harmful

Risk phrases Harmful by inhalation, in contact with skin and if swallowed (R20/21/22)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs (S2, S13)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 500 mg kg⁻¹ (1).

Teratogenicity and reproductive effects

Caused embryo-lethal and growth retarding effects, but no teratogenic effect following maximum tolerated dose to pregnant rat (2).

Legislation

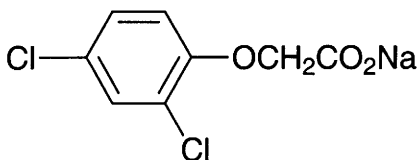
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (3).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

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4. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D16 2,4-D, sodium salt



C₈H₅Cl₂O₃Na

Mol. Wt. 243.02

CAS Registry No. 2702-72-9

Synonyms 2,4-dichlorophenoxyacetic acid, sodium salt; (2,4-dichlorophenoxy)acetic acid, sodium salt; 2,4-DNa

EINECS No. 220-290-4

RTECS No. AG 8925000

Uses Systemic herbicide.

Physical properties

Solubility Water: 18 g l⁻¹ at 20°C

Occupational exposure

DE-MAK 1 mg m⁻³ (total dust)

Supply classification harmful

Risk phrases Harmful by inhalation, in contact with skin and if swallowed (R20/21/22)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs (S2, S13)

Mammalian & avian toxicity

Acute data

LD₅₀ oral wild duck >2025 mg kg⁻¹ (1).

LD₅₀ oral mouse, rat, rabbit, guinea pig 375, 550, 800, 1000 mg kg⁻¹, respectively (2).

LD₅₀ intraperitoneal mouse, rat 375, 424 mg kg⁻¹, respectively (1,3).

LD₅₀ intravenous rabbit 400 mg kg⁻¹ (4).

Genotoxicity

Induced chromosomal aberrations in the meristems of *Allium cepa* and barley (5).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (6).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (7).

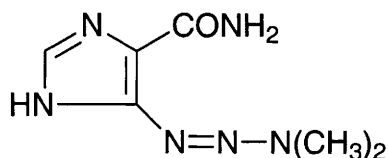
Other comments

Adsorption on bentonite, illite, kaolinite and translocation measured in brown forest soil was studied and environmental fate reviewed (8).

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D17 dacarbazine



C₆H₁₀N₆O

Mol. Wt. 182.19

CAS Registry No. 4342-03-4

Synonyms 5-(3,3-dimethyl-1-triazenyl)-1H-imidazole-4-carboxamide; 5-(3,3-dimethyl-1-triazeno)-imidazole-4-carboxamide; 5(or 4)-(3,3-dimethyl-1-triazeno)-imidazole-4(or 5)-carboxamide; biocarbazine R; detricine; DTIC

EINECS No. 224-396-1

RTECS No. NI 3950000

Uses Antineoplastic agent.

Physical properties

M. Pt. 250-255°C (decomp.)

Solubility Water: 1 mg ml⁻¹ at 20°C

Mammalian & avian toxicity

Acute data

LD₅₀ intraperitoneal mouse, was reported in one experiment to be 350 mg kg⁻¹, but in another experiment, tumour-bearing mice tolerated an intraperitoneal dose of 1200 mg kg⁻¹ (1).

LD₅₀ oral mouse >1060 mg kg⁻¹ (1).

LD₅₀ intraperitoneal rat 350 mg kg⁻¹ (2).

LD₅₀ intraperitoneal mouse 567 mg kg⁻¹ (3).

LD₅₀ intravenous rat 411 mg kg⁻¹ (4).

Sub-acute and sub-chronic data

Rats given a single intraperitoneal dose of 500 mg kg⁻¹ showed weight loss, pallor and bloody nares, and those given 1000 mg kg⁻¹ orally also had stilted gait, pulmonary congestion, pleural fluid, anaemia and leucopenia. In dogs the maximum tolerated dose over 28 days was 2.5 mg kg⁻¹ day⁻¹ when given intraperitoneally, and 5 mg kg⁻¹ day⁻¹ orally. In monkeys the respective doses were 15-30 and 10 mg kg⁻¹. In all animals studied major toxicity involved damage to the gut, bone marrow and lymphoid tissue. Recovery from toxic effects was reported to be within 6 wk of cessation of treatment (1).

In humans leucopenia and thrombocytopenia occurred from 5 to 21 days after a dose of 4.5 mg kg⁻¹ day⁻¹ for 10 days; blood counts recovered only after 2-3 wk. Nausea and vomiting have limited the therapeutic dose given either intravenously or orally (5).

Three cases of hepatic vein thrombosis leading to fatal hepatic necrosis have been reported. In each, the patient was treated for melanoma with 200-260 mg m⁻² daily intravenously for one cycle of 5 days. All patients experienced moderately severe gastrointestinal and bone marrow toxicity and also developed symptoms of liver failure half-way through the second course of therapy, which followed about 1 month after the first course (6).

Carcinogenicity and chronic effects

Sufficient evidence for carcinogenicity in animals, inadequate data for evaluation of carcinogenicity in humans, IARC classification group 2B (7).

Rats were fed dacarbazine in the diet for up to 14 wk. Cumulative doses of various groups were 974 mg in ♂ rats, and 740, 608, 570 or 346 mg in ♀ rats. Of the ♂ rats 8/16 developed mammary adenocarcinomas, 15/16 thymic lymphosarcomas and 5/16 splenic lymphosarcomas by 18 wk; one haemangioma also occurred. No neoplasm was found in ♂ controls at that time. Of the high dose ♀, 24/24 had mammary adenocarcinomas and thymic lymphosarcomas, 21/24 had splenic lymphosarcomas, 10/24 had cerebral ependymomas and 4/24 had pulmonary alveolar carcinomas by 18 wk. In the group given 608 mg, 6/12 had mammary carcinomas, 5/12 thymic lymphosarcomas and 3/12 splenic lymphosarcomas by 24 wk. With 570 mg 1/16 had a mammary adenocarcinoma, 12/16 had mammary adenofibromas, 3/16 thymic lymphosarcomas, 2/16 splenic lymphosarcomas, uterine leiomyosarcomas and leiomyosarcomas elsewhere. Among the 120 ♀ controls a total of 4 mammary adenocarcinomas and 10 mammary adenofibromas occurred (8).

Mice were given intraperitoneal injections of 25 or 50 mg kg⁻¹ 3 × a wk for 6 months. The combined tumour incidences with the 2 doses were 21/41 lung tumours, 15/41 lymphomas and 10/41 splenic haemangiomas in ♂ mice, and 16/19 lung tumours and 5/19 uterine tumours in ♀ mice. The tumour incidence in all controls was 31%, with 10 lung tumours, 3 lymphomas and no haemangiomas in 101 ♂, and 21 lung tumours and 3 uterine tumours in 153 ♀ (9).

Groups of 16 ♀ rats were given single intraperitoneal injections of 100, 250 or 400 mg per rat. Another group was injected with 2.5 mg 3 × a wk for 12 wk (total 76.5 mg). After 66 wk the treated rats displayed a dose-dependent increase in mammary adenocarcinoma incidence with 0/20 in the group that received multiple injections, 1/16 in those given 100 mg, 5/16 in those given 250 mg and 11/16 in those given 400 mg. Other tumours that occurred with increased frequency included mammary adenofibromas, cerebral ependymomas, ependymblastoma, embryonal adenosarcomas, adrenal cortical adenoma, bronchogenic adenocarcinomas and renal cortical adenocarcinoma. No tumour was observed in the control groups (8).

In a large systematic follow-up of patients with Hodgkin's disease treated with an intensive chemotherapeutic combination including dacarbazine, plus adriamycin, vinblastine and bleomycin but no alkylating agent, preliminary evidence suggested no excess of acute nonlymphocytic leukaemia in the first decade after therapy (10).

Teratogenicity and reproductive effects

Adult ♂ mice were administered single intraperitoneal doses of 50 or 200 mg kg⁻¹. Ultrastructural changes in spermatogonia and spermatocytes indicative of cytotoxicity were observed after the higher dose. Abnormalities were also observed in early spermatids in the Golgi and cap phases, with defects in acrosome formation and disruptions of the acrosomal sac. Spermatids in stages of maturation exhibited normal ultrastructures (11).

When rats were injected on the 12th day of pregnancy with a single intraperitoneal dose of 100-1000 mg kg⁻¹, urogenital anomalies, such as hydronephrosis, hydroureter and hypoplastic, ectopic testes were observed in the foetuses. Embryotoxicity did not exceed that in controls with doses of 100-900 mg kg⁻¹, but 1000 mg kg⁻¹ induced 15% embryoletality. Dose-dependent foetal growth retardation was observed with all doses (12).

Foetuses of rabbits given intraperitoneal injections of 10 mg kg⁻¹ on days 6-18 of gestation showed skeletal abnormalities. Doses of 2.5 and 5.0 mg kg⁻¹ were ineffective. Rats were given intraperitoneal injections of 30, 50 or 70 mg kg⁻¹ on days 6-15 of pregnancy. Teratogenic effects, including abnormalities of the skeletal system, eyes, cardiovascular system and abdominal wall, were seen with the 2 higher doses. The mean foetal weight was reduced with all 3 doses, and the rate of resorptions increased. Offspring of rats treated from day 15 of pregnancy through day 21 *post partum* with 7.5, 15 or 30 mg kg⁻¹ showed a dose-dependent increase in postnatal mortality (13).

Metabolism and toxicokinetics

Following a single intraperitoneal injection of [¹⁴C]methyl-labelled dacarbazine to rats, exhalation of ¹⁴CO₂ occurred with a *t*_{max} of ~2 hr (0.95 mg kg⁻¹) and 2.5 hr (95 mg kg⁻¹). Of the total radioactivity administered, 8.5% was exhaled as ¹⁴CO₂, 54% was excreted via the urine, predominantly as the unchanged substance. In the liver, kidney and lung formations of 7-[¹⁴C]methylguanine in DNA and RNA was directly proportional with dose. DNA methylation with a single dose of 9.8 mg kg⁻¹ was highest in the liver (35 μmoles 7-methylguanine per mole of guanine), followed by the kidney (25 μmoles) and lung (20 μmoles). The remainder tissues showed 7-methylguanine concentrations ≈50% of those in liver DNA, with the exception of the brain which had ≈1 μmole per mole of guanine. At the specific radioactivity used (48 mCi mmole⁻¹) the promutagenic base O⁶-methylguanine was only detectable in the liver, kidney, lung and stomach DNA (0.6-0.8 μmoles mole⁻¹ guanine). Autoradiography studies revealed a diffuse distribution of reaction products in rat liver. In contrast, *N*-nitrosodimethylamine known to be bioactivated by the hepatic cytochrome P₄₅₀ system showed a predominantly centrilobular distribution. This difference may be due to the greater stability of proximate carcinogens generated by α-C hydroxylation at one of the methyl groups of dacarbazine (14).

Dacarbazine is poorly absorbed from the gastrointestinal tract (15).

Sensitisation

Dacarbazine treatment has frequently been reported to cause photosensitivity reactions (16).

Genotoxicity

Mutagenic in the tk⁺/tk⁻ assay with mouse lymphoma cells after metabolic activation (17).

Mutagenic to *Drosophila melanogaster* (18).

Induced mitotic crossing-over in *Saccharomyces cerevisiae* (19).

Induced chromosome anomalies and reduced the mitotic index in mouse bone marrow cells *in vivo* (20).

No sister chromatid exchange was observed in the peripheral lymphocytes of 6 melanoma patients given intravenous injections of 250 mg m⁻² daily for 5 days (21).

Other effects

Other adverse effects (human)

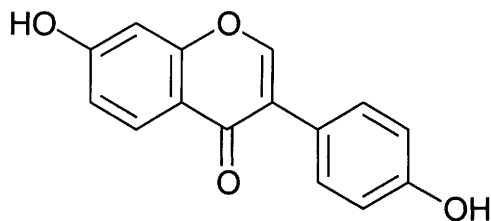
Leucopenia and thrombocytopenia may be severe in patients and the maximum effect may not be seen for 3-4 wk. Anorexia, nausea and vomiting are common. Other side effects include hepatotoxicity, skin reactions, alopecia, an

influenza-like syndrome, and facial flushing and paraesthesia. Extravasation produces pain and tissue damage. Anaphylaxis has occurred occasionally (15).

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D18 daidzein



$C_{15}H_{10}O_4$

Mol. Wt. 254.24

CAS Registry No. 486-66-8

Synonyms 7-hydroxy-3-(4-hydroxyphenyl)-4H-1-benzopyran-4-one; isoflavone, 4',7-dihydroxy-; 4',7-dihydroxyisoflavone; 7,4'-dihydroxyisoflavone; daidzeol

EINECS No. 207-635-4

Uses Daidzein is the major active principle in extracts of *Radix puerariae*, a traditional Chinese medication.

Occurrence Isoflavone phytoestrogen found in numerous plants eaten by humans and food-producing animals.

Physical properties

M. Pt. 297-298°C (dendritic needles from ether; slight decomp.); 315-323°C decomp.

Solubility Water: practically insoluble in water. Organic solvents: ethanol, diethyl ether

Environmental fate

Degradation studies

Three metabolites were isolated from the anaerobic fermentation of daidzein by human faecal bacteria under anaerobic conditions: dihydrodaidzein, benzo-4,7-diol, 3-(4-hydroxyphenyl), and equol (1).

Mammalian & avian toxicity

Metabolism and toxicokinetics

Significant glucuronidation of plant oestrogens occurs in the gastrointestinal tract of sheep and cattle, which reduces the role of hepatic glucuronidation of ingested substances (2).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1538 with and without metabolic activation negative (3).

Daidzein did not exhibit clastogenicity nor did it induce hypoxanthine guanine phosphoribosyltransferase mutations in cultured Chinese hamster V79 cells (4).

The effect of daidzein in the single cell gel electrophoresis assay (Comet assay) in human sperm was compared with its effect on human peripheral lymphocytes from the same donor. Daidzein caused a greater positive response in sperm than in peripheral lymphocytes, which may have been due to the fact that damage induced in the elongated spermatids and consequent spermatozoa cannot be repaired (5).

Other effects

Any other adverse effects

Sixteen samples of soybean meal examined in the mouse uterine weight bioassay had oestrogenic activity. EtOAc extracts of the meals also had oestrogenic activity. Genistein and daidzein were present in the extracts; the former may have been responsible for most of the oestrogenic activity (6).

Daidzein and genistein in the diet of captive cheetahs have been suggested as a probable cause of infertility and liver disease in these animals (7).

Daidzein binds to rat α -fetoprotein with K_d c. 5×10^{-6} M. The authors suggest that this is sufficiently high that daidzein may modulate estradiol and estrone binding to rat α -fetoprotein *in vivo* when present at dietary levels (8).

Other comments

Culture broths of an unidentified species of *Streptomyces*, designated 85-88, showed toxicity to mosquito larvae that was traced to three crystalline compounds, identified as tangeritin, genistein, and daidzein. The acetates of these isoflavones showed greater activity than the parent compounds (9).

Daidzein is a potent and selective inhibitor of human mitochondrial aldehyde dehydrogenase and suppresses the ethanol intake of Syrian golden hamsters. The as yet undefined mechanism by which daidzein suppresses ethanol intake differs from that proposed for the classic ADH inhibitor disulfiram (10).

Two potent, reversible inhibitors of human alcohol dehydrogenase isoenzymes isolated from the Kudzu root (*Radix puerariae*) were identified as daidzein and genistein. Rat and rabbit class I ADHs are also inhibited by these isoflavones. The 7-O-glucosyl derivatives of daidzein and genistein do not inhibit ADH but are potent aldehyde dehydrogenase inhibitors (11).

Phytochemical mimicry of reproductive hormones and modulation of herbivore fertility by phytoestrogens reviewed (12).

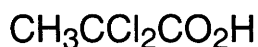
Endocrine disrupting effects discussed (13,14).

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D19 dalapon



$\text{C}_3\text{H}_4\text{Cl}_2\text{O}_2$

Mol. Wt. 142.97

CAS Registry No. 75-99-0

Synonyms 2,2-dichloropropionic acid; α,α -dichloropropionic acid

EINECS No. 200-923-0

RTECS No. UF 0690000

Uses Herbicide. Intermediate in organic synthesis.

Physical properties

M. Pt. 20°C B. Pt. 190°C Flash point >110°C Specific gravity 1.389 at 20°C

Partition coefficient $\log P_{\text{ow}}$ 0.76 (1) Volatility v.p. 0.12 mmHg at 25°C

Solubility Organic solvents: diethyl ether, ethanol

Occupational exposure

DE-MAK 1 ppm (5.9 mg m⁻³)

FR-VME 1 ppm (6 mg m⁻³)

US-TWA 1 ppm (5.8 mg m⁻³)

Supply classification harmful

Risk phrases Harmful if swallowed – Irritating to the skin – Risk of serious damage to eyes (R22, R38, R41)

Safety phrases Keep out of reach of children (if sold to general public) – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – Wear eye/face protection (S2, S26, S39)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout, goldfish, channel catfish >100 mg l⁻¹ (2).

Invertebrate toxicity

EC₅₀ (48 hr) *Daphnia pulex* 11 mg l⁻¹ (3).

LC₅₀ (48 hr) *Simocephalus serrulatus* 16 mg l⁻¹ (3).

Non-toxic to bees (2).

Bioaccumulation

Calculated bioconcentration factor 2 indicated that environmental accumulation is unlikely (4).

Environmental fate

Nitrification inhibition

Reported to be slightly inhibitory to nitrification microbes in soil (5).

Degradation studies

Degraded by soil bacteria *Alcaligenes* spp. (6).

Can be degraded by methanogenic bacteria (7).

Microbial degradation involved dechlorination and liberation of carbon dioxide (8).

Following soil application at a rate of 22 kg ha⁻¹ duration of herbicide activity is ≈3-4 hr (2).

Abiotic removal

Hydrolytic t_{1/2} ≈3-4 month, degradation product pyruvic acid (1).

t_{1/2} for reaction with photochemically produced hydroxy radicals 72 days (9).

Adsorption and retention

Reported to be leached readily from soil (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral Japanese quail, chicken >5000-5660 mg kg⁻¹ (2).

LD₅₀ oral rat 907 mg kg⁻¹ (1).

LD₅₀ oral rat 7570-9330 mg kg⁻¹ (10).

LD₅₀ oral ♀ mouse >4600 mg kg⁻¹ (2).

Carcinogenicity and chronic effects

Rats were fed 50 mg kg⁻¹ day⁻¹ for 2 yr in diet. Evidence of slight average increase in kidney weight but no adrenal effects observed at 15 mg kg⁻¹ day⁻¹ (1).

Metabolism and toxicokinetics

Oral dog rapidly eliminated, following a single dose of 500 mg 65-70% was excreted within 2 hr (2).

Irritancy

Non-permanent irritant to skin and eyes of rabbit (concentration and duration unspecified) (2).

Genotoxicity

Salmonella typhimurium TA1535, TA1536, TA1537, TA1538 with and without metabolic activation negative (11).

Streptomyces caelicolor spot; plate tests base substitution, frameshift mutation negative (11).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (12).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (13).

Other comments

Residues have been isolated from drinking water supplies (14).

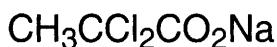
Environmental fate reviewed (14).

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D20 dalapon-sodium



$\text{C}_3\text{H}_3\text{Cl}_2\text{NaO}_2$

Mol. Wt. 164.95

CAS Registry No. 127-20-8

Synonyms 2,2-dichloropropanoic acid, sodium salt; 2,2-dichloropropionic acid, sodium salt; sodium 2,2-dichloropropionate; dikopan

EINECS No. 204-828-5

RTECS No. UF 1225000

Uses Systemic herbicide.

Physical properties

M. Pt. $>191^\circ\text{C}$ (decomp.) Volatility v.p. 7.52×10^{-8} mmHg at 20°C

Solubility Water: 900 g kg^{-1} at 25°C . Organic solvents: ethanol, methanol

Occupational exposure

DE-MAK 1 ppm (5.9 mg m^{-3})

Ecotoxicity

Fish toxicity

LC_{50} (96 hr) rainbow trout, goldfish, channel catfish >100 mg l^{-1} (1).

LC_{50} (96 hr) carp >500 mg l^{-1} (1).

LC_{50} (96 hr-static) guppy 223 mg l^{-1} (2).

LC_{50} (48 hr) bluegill sunfish 115 mg l^{-1} (3).

Invertebrate toxicity

LD_{50} (48 hr) *Daphnia pulex* 11 mg l^{-1} (4).

Environmental fate

Degradation studies

In soil, readily undergoes microbial degradation involving dechlorination and liberation of carbon dioxide (5). Following an application rate of 22 kg ha^{-1} duration of residual activity in soil is ≈ 3 -4 months (1).

Abiotic removal

Slowly hydrolysed in aqueous solutions at 25°C (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral Japanese quail, ♀ mouse >4600 mg kg⁻¹ (1).

LD₅₀ oral chicken 5660 mg kg⁻¹.

LD₅₀ oral ♀ rat 7570 mg kg⁻¹ (1).

LD₅₀ oral ♂ rat 9330 mg kg⁻¹ (1).

LD₅₀ oral ♀ guinea pig, rabbit 3860 mg kg⁻¹ (1).

LD₅₀ dermal rabbit >2000 mg kg⁻¹ (1).

Sub-acute and sub-chronic data

LC₅₀ mallard duck, Japanese quail, pheasant >5000 mg kg⁻¹ 8 day diet (6).

Carcinogenicity and chronic effects

In 2 yr feeding trials, rats receiving 15 mg kg⁻¹ day⁻¹ showed no ill-effects, but at 50 mg kg day⁻¹ there was a slight increase in kidney weight (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (7).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (8).

WHO Class Table 5; EPA Toxicity Class II (1).

Other comments

Mode of action – by the precipitation of protein, which interferes with the production of pantothenic acid (1).

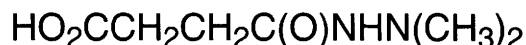
Does not undergo significant degradation in plants (1).

Toxicity and hazards reviewed (9).

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D21 daminozide



C₆H₁₂N₂O₃

Mol. Wt. 160.17

CAS Registry No. 1596-84-5

Synonyms N-(dimethylamino)succinamic acid; butanedioic acid, mono(2,2-dimethylhydrazide); succinic acid, mono(2,2-dimethylhydrazide); SADH

EINECS No. 216-485-9

RTECS No. WM 9625000

Uses Plant growth regulator.

Physical properties

M. Pt. 154-155°C **Partition coefficient** $\log P_{ow}$ -2.4914 at 2°C **Volatility** v.p. 1.71×10^{-4} mmHg at 23°C
Solubility Water: 100 g l⁻¹ at 25°C. Organic solvents: acetone, methanol

Occupational exposure

Supply classification harmful

Risk phrases Possible risk of irreversible effects (R40)

Safety phrases Keep out of reach of children (if sold to general public) – Wear suitable protective clothing and gloves (S2, S36/37)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) bluegill sunfish 423 mg l⁻¹ (1).

LC₅₀ (96 hr) rainbow trout 149 mg l⁻¹ (1).

Invertebrate toxicity

EC₅₀ (96 hr) *Daphnia* sp. 76 mg l⁻¹ (1).

Not toxic to bees (2).

Environmental fate

Degradation studies

t_{1/2} 17.3 hr, aerobic condition in sandy loam at pH 5.6, containing 7.34% organic matter (3).

Abiotic removal

Slowly decomposed by light, t_{1/2} 105 days (3).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 8400 mg kg⁻¹ (2).

LD₅₀ oral redwing blackbird >100 mg kg⁻¹ (4).

LC₅₀ (1 hr) inhalation rat >147 mg l⁻¹ air (2).

LD₅₀ dermal rabbit >5000 mg kg⁻¹ (2).

LD₅₀ intraperitoneal mouse 1325 mg kg⁻¹ (5).

Sub-acute and sub-chronic data

LC₅₀ (8 day) mallard duck, bobwhite quail >10,000 mg kg⁻¹ diet (3).

In 1 yr feeding trials no ill-effect observed in dogs up to 70,000 mg kg⁻¹ diet total dose (3).

Carcinogenicity and chronic effects

Non-carcinogenic in 2 yr feeding trial in rats at 5000 mg kg⁻¹ diet and in mice at 3000 mg kg⁻¹ diet (2).

Teratogenicity and reproductive effects

In a 3-generation study in rats no effect level (NOEL) 1000 mg kg⁻¹ diet on reproduction. In rabbits NOEL 3000 mg kg⁻¹ diet on teratogenicity and embryotoxicity (3).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537, TA97 with and without metabolic activation negative (6).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (7).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (8).

Tolerable Daily Intake (TDI) for humans 0.5 mg kg⁻¹ for daminozide containing <30 mg 1,1-dimethylhydrazine kg⁻¹ (3).
WHO Class Table 5 (9).
EPA Toxicity Class IV (3).

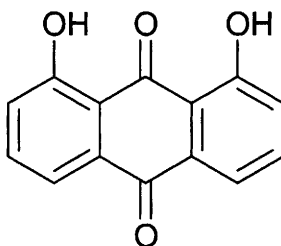
Other comments

Metabolic pathways reviewed (10).

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D22 danthron



C₁₄H₈O₄

Mol. Wt. 240.22

CAS Registry No. 117-10-2

Synonyms 1,8-dihydroxy-9,10-anthracenedione; 1,8-dihydroxyanthraquinone; dioxyanthrachinonum; antrapurol; chrysazin; diarthon; dantron

EINECS No. 204-173-5

RTECS No. CB 6650000

Uses Laxative. Intermediate in manufacture of alizarin and indanthrene dyestuffs.

Physical properties

M. Pt. 191-193°C

Solubility Water: 1.56 mg l⁻¹ at 25°C. Soluble in alkali hydroxide solutions. Organic solvents: chloroform, diethyl ether, ethanol, hot glacial acetic acid

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird 316 mg kg⁻¹ (1).

LD₅₀ oral mouse >7 g kg⁻¹ (2).

LD₅₀ intraperitoneal mouse 500 mg kg⁻¹ (3).

Carcinogenicity and chronic effects

Some studies have suggested that chronic administration at very high doses to rats and mice may be associated with the development of intestinal and liver tumours (4).

National Toxicology Program classification: reasonably anticipated to be a human carcinogen (5).

Metabolism and toxicokinetics

Phase II conjugation to form glucuronide (6).

Oral rat 115, 530 and 1400 µg and gavage rat 2880 µg metabolites at both routes included monosulfate, glucuronide, phase 2 metabolites which behaved as the corresponding diconjugates, and several phase 1 metabolites in conjugated form. Following infusion, about 80% of the danthron conjugates in bile were excreted after 1 hr; the dose fractions found after 5 hr represented about 20%, 30% and 40% at the low, intermediate and high dose groups, respectively. The corresponding fractions in urine were 16%, 12% and 10%, respectively. Phase 1 metabolites were more abundantly present in bile than in urine (7).

Irritancy

500 mg instilled into rabbit eye for 24 hr produced mild effects (8).

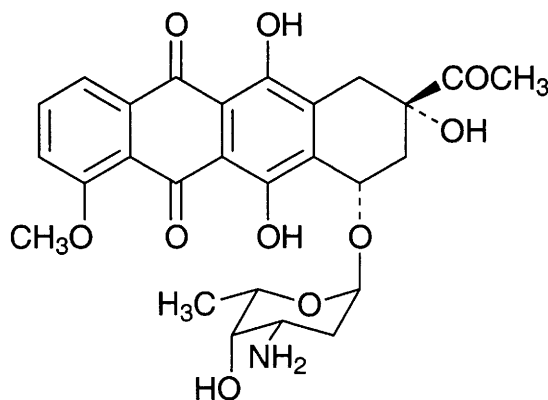
Genotoxicity

Hepatocyte primary culture/DNA repair test positive (9).

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D23 daunomycin



$C_{27}H_{29}NO_{10}$

Mol. Wt. 527.53 CAS Registry No. 20830-81-3; 23541-50-6 (hydrochloride)

Synonyms daunorubicin; acetyladiamycin; cerubidin; (+)-dunomycin; leukaemomycin C; RP 13057; rubidomycin; rubimycin C; (8*S*-*cis*)-8-acetyl-10-[(3-amino-2,3,6-trideoxy- α -L-lyxo-hexopyranosyl)oxy]-7,8,9,10-tetrahydro-6,8,11-trihydroxy-1-methoxy-5,12-naphthacenedione

EINECS No. 244-069-7

RTECS No. HB 7875000; HB 7878000

Uses Antibiotic. Antineoplastic agent.

Occurrence Isolated from *Streptomyces peucetius* and *Streptomyces coeruleorubidus*.

Physical properties

M. Pt. 208-209°C

Solubility Water: miscible (hydrochloride). Organic solvents: methanol, aqueous alcohols (hydrochloride)

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 205 mg kg⁻¹ (1).

LD₅₀ intravenous rat and mouse 13, 20 mg kg⁻¹, respectively (2).

LD₅₀ intraperitoneal mouse and rat 5, 8 mg kg⁻¹, respectively (2).

LD₅₀ intraperitoneal mouse 2.5 mg kg⁻¹ (3).

LD₅₀ subcutaneous mouse 47 mg kg⁻¹ (4).

Sub-acute and sub-chronic data

Perfusion of 7.5 mg l⁻¹ for 10 min was well tolerated by the human eye. Higher doses have been shown to cause damage to all ocular structures in animals (5).

♀ Rats administered single doses of 6 or 12 mg kg⁻¹ suffered chronic renal failure (6).

Daunomycin was shown to inhibit the contractile response to Ca²⁺ *in vitro* in the guinea pig heart. Pre-treatment of cardiac sarcolemmal membranes for 1 hr with 52.7 mg l⁻¹ reduced the number of PN 200-110 binding sites (Ca²⁺ channels) to 55% of controls, whereas 0.527 mg l⁻¹ had no effect. Treatment of guinea pigs with 4 mg kg⁻¹ over 2 wk did not change the number of PN 200-100 binding sites mg heart protein⁻¹, but ventricular weight was decreased (7).

Mice were given intraperitoneal injections of 26 mg kg⁻¹ day⁻¹ for 3 days. Disorganization of cytoplasmic organelles in the liver was observed by electron microscope study. Pronounced dilatation and fragmentation of cisternae of rough endoplasmic reticulum, proliferation of smooth endoplasmic reticulum tubules, swollen mitochondria, hypertrophy of cisternae of Golgi complex, and an increase in the number of autophagic vacuoles containing cytoplasmic organelles was observed in parenchymal cells (8).

After 15 treatments consisting of daily intravenous doses of 2 mg kg⁻¹ for 3 days with treatment and 3 days without treatment, all of 4 treated monkeys died after 9, 9, 7 and 6 doses. All monkeys given 0.5 or 1.0 mg kg⁻¹ in the same way survived the 15 treatments (9).

In dogs 1 mg kg⁻¹ caused severe bone marrow aplasia followed by death (10).

Doses of 12-50 mg kg⁻¹ caused bradycardia, hypotension, ventricular arrhythmias and respiratory depression in hamsters and rhesus monkeys (11).

Carcinogenicity and chronic effects

No adequate data for evaluation in humans, sufficient evidence for carcinogenicity in animals, IARC classification group 2B (12).

A group of 40 mice received wkly subcutaneous injections of 1.25 mg kg⁻¹ for 12 wk. At 22 months after the start of treatment, local sarcomas were found in 5 ♂ and 5 ♀ but not in controls. The incidences of other tumours were not increased (13).

A group of 25 ♀ rats was given single intravenous doses of 12.5 mg kg⁻¹. During the following yr 14 rats died, 2 with malignant tumours. All rats killed at 12 months had tumours, including 11 mammary adenocarcinomas and 2 fibroadenomas (1 rhabdomyosarcoma of the thigh and 1 uterine polyp). The mean induction time was 121 days. None of the 25 controls developed tumours in the 12 month period (14).

Groups of 20 ♀ rats were given single intravenous injections of 0, 5, 10 or 20 mg kg⁻¹ and observed for up to 12 months. All rats given the highest dose died or were killed before 52 days due to chronic glomerulonephritis. Of the treated rats 16/33 developed a total of 27 tumours, compared with 5/20 controls. Five tubular adenomas and 2 clear-cell carcinomas of the kidney were found in treated rats between 189-365 days. No such tumours were found in controls (15).

Metabolism and toxicokinetics

The main metabolite in human and rat hepatocytes *in vitro* was the 13-dihydro-derivative (16).

Metabolites identified in human urine were daunorubicinol, daunorubicinol aglycone, deoxydaunorubicinol aglycone, deoxydaunomycin aglycone, desmethyldeoxydaunorubicinol aglycone, desmethoxydeoxyrubicinol aglycone-4-*O*-sulfate, desmethyldeoxydaunorubicinol aglycone-4-*O*-glucuronide and deoxydaunorubicinol aglycone glucuronide (17). Daunomycin has been shown to be converted into daunorubicinol by lymphocyte cytoplasm in a NADPH-dependent reaction (18).

Genotoxicity

Salmonella typhimurium TA1535, without metabolic activation, positive (19).

Induced sex-linked reversions in the white-ivory test in *Drosophila melanogaster* (20).

Did not induce unscheduled DNA synthesis in human fibroblasts *in vitro* (21).

Induced chromosome and chromatid breaks and translocations in human peripheral leucocytes *in vitro* (22).

Other effects

Other adverse effects (human)

In man, nausea and vomiting together with leucopenia has occurred after administration of 70 mg m⁻² (23).

Daunomycin therapy has been associated with cardiac toxicity and fatal disturbances of cardiac function have been reported (24).

Cardiotoxicity has been reported to be more likely when the total dose exceeds 550 mg m⁻² in adults, or 300 mg m⁻² in children. Transient red discoloration of the urine has occurred (25).

Any other adverse effects

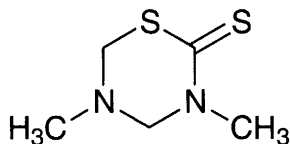
The drug has been found to show immunosuppressive activity in mice (26).

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D24 **dazomet**



C₅H₁₀N₂S₂

Mol. Wt. 162.28

CAS Registry No. 533-74-4

Synonyms dimethylformocarbithialdine; tetrahydro-3,5-dimethyl-2H-1,3,5-thiadiazine-2-thione; 3,5-dimethyl-1,3,5-thiadiazine-2-thione; 3,5-dimethyl-1,3,5-thiadiazine-2-thione; DMTT

EINECS No. 208-576-7

RTECS No. XI 2800000

Uses Soil fungicide, nematicide and weed killer by virtue of release of methyl isothiocyanate.

Physical properties

M. Pt. 104-105°C (decomp.) **Partition coefficient** log P_{ow} 0.1461 at pH 7 **Volatility** v.p. 2.7 × 10⁻⁶ mmHg at 20°C

Solubility Water: 3 g l⁻¹ at 20°C. Organic solvents: acetone, benzene, chloroform, cyclohexane

Occupational exposure

Supply classification harmful

Risk phrases Harmful if swallowed – Irritating to the eyes (R22, R36)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from heat – Do not breathe dust – Avoid contact with the skin (S2, S15, S22, S24)

Ecotoxicity

Fish toxicity

LC₅₀ (48 hr) harlequin fish 0.045 mg l⁻¹ (1).

Invertebrate toxicity

Not toxic to bees (2).

Environmental fate

Nitrification inhibition

Inhibits nitrification in soil for 30 days at 150 ppm (3).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, ♂, ♀ mouse 520, 450, 710 mg kg⁻¹, respectively (4).

LC₅₀ (4 hr) inhalation rat 8.4 mg l⁻¹ air (4).

LD₅₀ percutaneous rat >2000 mg kg⁻¹ (5).

LD₅₀ intraperitoneal rat, rabbit 87, 127 mg kg⁻¹, respectively (5).

Sub-acute and sub-chronic data

In feeding trial in rats no effect level 20 mg kg⁻¹ (4).

Irritancy

Dermal rabbit (24 hr) 500 mg produced mild irritation and 500 mg instilled into rabbit eye for 24 hr produced severe irritation (6).

Legislation

Maximum permissible concentration in domestic water in former USSR 0.01 mg l⁻¹ (7).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (8).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (9).

WHO Class III (10).

EPA Toxicity Class III (4).

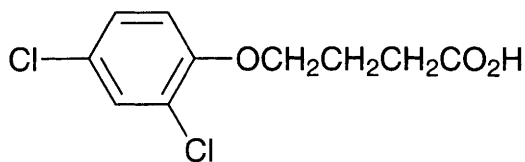
Other comments

In soil, breaks down to methyl(methylaminoethyl)dithiocarbamic acid which in turn yields methyl isothiocyanate (4).

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D25 2,4-DB



$C_{10}H_{10}Cl_2O_3$

Mol. Wt. 249.09

CAS Registry No. 94-82-6

Synonyms 2,4-dichlorophenoxybutyric acid; 4-(2,4-dichlorophenoxy)butanoic acid;
4-(2,4-dichlorophenoxy)butyric acid

EINECS No. 202-366-9

RTECS No. ES 9100000

Uses Herbicide.

Physical properties

M. Pt. 119-119.5°C

Solubility Water: 46 mg l⁻¹ at 25°C. Organic solvents: acetone, benzene, diethyl ether, ethanol

Occupational exposure

Supply classification harmful

Risk phrases Harmful in contact with skin and if swallowed (R21/22)

Safety phrases Keep out of reach of children (if sold to general public) – Wear suitable protective clothing and gloves (S2, S36/37)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout ≈4 mg l⁻¹ (amine salt and esters) (1).

Invertebrate toxicity

Non-toxic to bees (1).

Environmental fate

Nitrification inhibition

Inhibition of nitrification in soil – inhibiting for 8 wk at normal rate (2).

Degradation studies

t_{1/2} in soil <7 days. Microbial degradation leads to the formation of 2,4-D which undergoes further degradation (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 370-700 mg kg⁻¹ (1).

LD₅₀ dermal rat 800 mg kg⁻¹ (3).

Sub-acute and sub-chronic data

LC₅₀ 8 day feeding trial, ring-necked pheasant, mallard duck >5000 mg kg⁻¹ diet (4).

LC₅₀ 8 day feeding trial, Japanese quail, bobwhite quail >5000 mg kg⁻¹ diet (2).

Genotoxicity

Escherichia coli PQ37 SOS chromotest with and without metabolic activation negative (5).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (6).
Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (7).
EPA Toxicity Class III (1).
WHO Toxicity Class III (8).

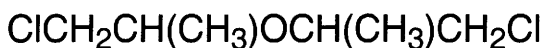
Other comments

Metabolic pathways reviewed (9).

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D26 DCIP



C₆H₁₂Cl₂O

Mol. Wt. 171.07

CAS Registry No. 108-60-1

Synonyms bis(2-chloro-1-methylethyl) ether; 2-chloro-1-methylethyl ether; 2,2'-dichlorodiisopropyl ether; Nemamort; propane, 2,2'-oxybis(1-chloro-); 2,2'-oxybis(1-chloropropane)

EINECS No. 203-598-3

RTECS No. KN 1750000

Uses Nematocide. Extractant. Ingredient in paint and varnish removers. Solvent for fats, waxes and greases. Ingredient in potting and cleaning solutions. A component in textile processing.

Physical properties

M. Pt. -97 -- -102°C **B. Pt.** 187.8°C **Flash point** 85°C (open cup) **Specific gravity** 1.103 at 20°C with respect to water at 4°C **Partition coefficient** log P_{ow} 1.76 (1) **Volatility** v.p. 0.10 mmHg at 20°C ; v.den. 6.0 **Solubility** Water: 1.7 g l⁻¹. Organic solvents: dimethyl sulfoxide, ethanol

Ecotoxicity

Bioaccumulation

Weighted average bioconcentration factor in edible part of freshwater and estuarine aquatic organisms eaten by Americans calculated as 2.47 (2).

Environmental fate

Degradation studies

Static culture flask biodegradation at 5 mg l⁻¹ yeast extract the original culture achieved 85% biodegradation in 7 days and subcultures 100% in 7 days (3).

No biodegradation after 5 days at 20°C incubated with Ohio river water at initial concentration 33 mg l⁻¹ (4).

Abiotic removal

Estimated degradation t_{1/2} 59 day and 3 day in Rhine basin and Rhine river, respectively (5).

Direct photolysis would not be expected in surface waters as DCIP has no chromophores to absorb visible or near-ultraviolet radiation (6).

Calculated atmospheric t_{1/2} 30 hr at atmospheric concentration of 5 × 10⁵ hydroxyl radicals cm⁻³ (7).

Volatilisation t_{1/2} estimated at 6 days from model environmental pond (8).

Adsorption and retention

Estimated K_{oc} 73 based on measured water solubility of 1700 ppm at 20°C, suggesting high mobility in soil and hence potential leaching (9,10).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 240 mg kg⁻¹ (11).

LC_{Lo} (5 hr) inhalation rat 700 ppm (11).

LD₅₀ dermal rabbit 3000 mg kg⁻¹ (12).

Carcinogenicity and chronic effects

No adequate data for carcinogenicity to humans, limited evidence for carcinogenicity in animals, IARC classification group 3 (13).

Inhalation ♀ rats, no evidence of carcinogenicity. Gavage ♂ and ♀ mice positive. Tumours in liver or lung (14).

National Toxicology Program evaluation of DCIP by gavage, rat negative, mouse positive (15).

Metabolism and toxicokinetics

Oral rat 90 mg kg⁻¹ [¹⁴C]DCIP. Urinary radioactivity excretion 48% within 48 hr; intraperitoneal rat 30 mg kg⁻¹ 50% urinary ¹⁴C elimination 19 hr (16).

Urinary metabolites included 1-chloropropan-2-ol, propylene oxide; 2-(2-chloro-1-methylethoxy)propanoic acid and N-acetyl-S-(2-hydroxypropyl)cysteine (16,17).

Irritancy

Dermal rabbit (24 hr) 50 mg caused mild irritation and 500 mg instilled into rabbit eye caused mild irritation (18).

Genotoxicity

Salmonella typhimurium TA98 with metabolic activation positive (19).

Mouse lymphoma L5178Y without metabolic activation negative (20,21).

Chinese hamster ovary cell lines with metabolic activation induced sister chromatid exchange and chromosomal aberrations (22).

Escherichia coli Microscreen prophage lambda induction assay with and without metabolic activation negative (23).

Other effects

Any other adverse effects

Inhalation rat (duration unspecified) 350 ppm 4 hr day⁻¹ caused respiratory distress and affected liver, kidney and spleen (24).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorine compounds: guide level 1 µg l⁻¹ (25).

Included in Schedule 6 (Release into Land: Prescribed Substances) of Statutory Instrument No. 472, 1991 (26).

Other comments

Occurs as a contaminant in surface drinking water and groundwater in Europe and USA, concentration range 0.11-19 µg l⁻¹ (2,3,27).

Occurs in industrial effluent from propylene glycol production (4, 28-30). Can be used as an agent for preventing the growth of sulfate reducing bacteria (31).

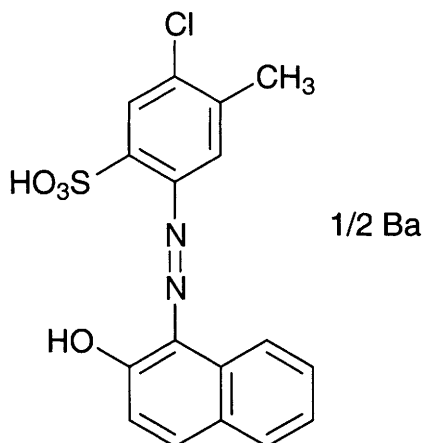
Toxicity of DCIP has been reviewed (32).

Human health effects and experimental toxicology reviewed (33).

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D27 D & C Red 9



$C_{34}H_{26}BaCl_2N_4O_8S_2$

Mol. Wt. 890.97

CAS Registry No. 5160-02-1

Synonyms 5-chloro-2-[(2-hydroxy-1-naphthalenyl)azo]-4-methyl benzenesulfonic acid, barium salt (2:1); C.I. Pigment Red 53, barium salt (2:1); bronze scarlet CA; Japan red 204; lake red CBA; pigment lake red BFC; pigment red barium salt (53:1)

EINECS No. 225-935-3

RTECS No. DB 5500000

Uses In the manufacture of its alkaline earth metal salts, which are used in the manufacture of pigments for inks, plastics and rubber. In cosmetic and drugs preparations.

Physical properties

Solubility Water: miscible. Organic solvents: ethanol

Occupational exposure

UK-LTEL 0.5 mg m⁻³ (as Ba)

Mammalian & avian toxicity

Sub-acute and sub-chronic data

Group of 5 ♂ and 5 ♀ rats were fed 2500, 5000, 10,000 or 20,000 mg kg⁻¹ diet for 20 wk. Splenomegaly occurred in all treated groups (1).

Carcinogenicity and chronic effects

Insufficient evidence for evaluation of carcinogenicity in animals, no adequate data for evaluation of carcinogenicity in humans, IARC classification group 3 (2).

Rats were fed 0, 100, 500, 2500 or 10,000 mg kg⁻¹ diet. About 80% survived in all groups 18 months or longer. In surviving rats at 103-108 wk, total number of rats developing tumours in the respective groups were 22/50 (controls), 19/50, 23/50, 27/50 and 21/50. Tumours not occurring in controls but only in the treated groups included fibrosarcomas in 5 treated rats of the various treatment groups; 3 epidermoid carcinomas and 1 interstitial-cell adenoma of the testis in rats fed the lowest dose; 1 thyroid adenocarcinoma, 1 adrenal adenoma, 1 malignant, mixed mesodermal tumour, 2 interstitial-cell adenomas of the testis, 1 kidney pelvic carcinoma, 1 pulmonary adenocarcinoma and 1 uterine polyp in rats fed the highest dose; 1 thyroid adenoma in rats fed the 500 mg kg⁻¹ level; 1 thyroid adenocarcinoma in rats fed the 2500 mg kg⁻¹ level (1).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 without metabolic activation positive. Did not induce chromosome aberrations or sister chromatid exchanges in Chinese hamster ovary cells. Negative in the mouse lymphoma L5178Y cell mutagenicity assay (3).

Legislation

Provisionally approved for use in cosmetics (generally lipstick) and drugs in the US provided ingestion corresponds to no more than ≈ 0.1 ppm in the daily diet. No more than 6% by weight permitted in lipstick. No restrictions on externally applied drugs and cosmetics (US Code of Fed. Regs. 1974).

Other comments

Reviews on experimental toxicology and human health effects listed (4).

Toxicity studies for certain dyestuffs and the effect on the use of the corresponding pigments reviewed (5).

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D28 D-D

CAS Registry No. 8003-19-8

Synonyms 1,3-dichloro-1-propene mixture with 1,2-dichloropropane

RTECS No. TX 9800000

Uses Nematicide. Soil fumigant.

Believed to be no longer manufactured or marketed (1).

Physical properties

Solubility Water: ≈ 2 g l⁻¹. Organic solvents: halogenated organic solvents, hydrocarbons, corn oil

Ecotoxicity

Fish toxicity

No loss of equilibrium or death to stickleback or rainbow trout within 24 hr at 5 ppm. Test conditions: pH 7; dissolved oxygen content 7.5 ppm; total hardness (soap method) 300 ppm; methyl orange alkalinity 310 ppm; free carbon dioxide 5 ppm and temperature 12.8°C (2).

LC₅₀ (96 hr) rainbow trout, bluegill sunfish, bass 3.4-3.5 mg l⁻¹ (3).

LC₅₀ (96 hr) channel catfish 414 mg l⁻¹ (3).

Invertebrate toxicity

LD₅₀ contact bee >60 µg bee⁻¹ (4).

Environmental fate

Nitrification inhibition

Inhibitory to nitrification in soil for 4-8 wk at a concentration of 133 ppm (5).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 140 mg kg⁻¹ (6).

LD₅₀ oral mouse 3 mg kg⁻¹ (6).

LD₅₀ (4 hr) inhalation rat 1000 ppm (7).

LC₅₀ dermal rat, rabbit 2100 mg kg⁻¹ (8,9).

Sub-acute and sub-chronic data

Inhalation rat and mouse (12 wk) 0, 5, 15 or 50 ppm for 6 hr day⁻¹ 5 day wk⁻¹. The only exposure related effect observed was an increase in liver weight in ♂ animals and in kidney weight in ♀ rats at 50 ppm. A slight diffuse hepatocytic enlargement in 12/21 of the 50 ppm ♂ mice was the only compound-related histopathologic change present (10).

Inhalation rat (4 hr) 2000-80,000 mg m⁻³ caused respiratory distress, dyspnoea, hypernoea, mucous nasal discharge and lachrymation. In animals that died, severe oedema of the lungs and distortion of the stomach and upper small intestine were observed (11).

Irritancy

Dermal rabbit (24 hr) 500 mg caused severe irritation, and 5 mg instilled into rabbit eye caused severe irritation (period of exposure unspecified) (7).

Genotoxicity

Salmonella typhimurium TA100, TA1535, with and without metabolic activation positive (12).

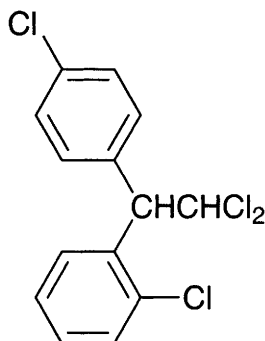
Other comments

Following repeated use of D-D, 3 farmers noted erythematous, itching eruption following direct contact with the solution. Patch tests with 1% D-D in acetone gave positive results in only 1 patient (13).

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D29 *o,p'*-DDD



$C_{14}H_{10}Cl_4$

Mol. Wt. 320.04

CAS Registry No. 53-19-0

Synonyms 1,1-dichloro-2-(*o*-chlorophenyl)-2-(*p*-chlorophenyl)ethane; 1-chloro-2-[2,2-dichloro-1-(4-chlorophenyl)ethyl]benzene; 1-(2-chlorophenyl)-1-(4-chlorophenyl)-2,2-dichloroethane; 2-(*o*-chlorophenyl)-2-(*p*-chlorophenyl)-1,1-dichloroethane

INECS No. 200-166-6

RTECS No. KH 7880000

Uses Insecticide. Antineoplastic agent.

Physical properties

M. Pt. 77-78°C

Solubility Water: <1 mg l⁻¹ at 24°C. Organic solvents: acetone, dimethyl sulfoxide, ethanol, isooctane, carbon tetrachloride

Ecotoxicity

Bioaccumulation

Bioaccumulation factor in fish 417 to 9214 (1).

Mammalian & avian toxicity

Carcinogenicity and chronic effects

Hepatomas increased in mice fed 250 mg kg⁻¹ (2).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (3).

Other effects

Any other adverse effects

Inhibits adrenal steroid biosynthesis (4).

Legislation

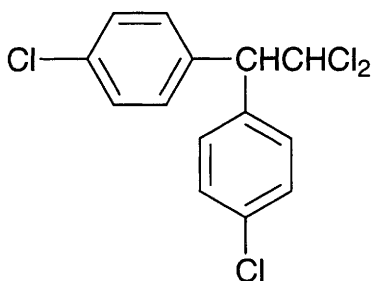
Limited under EC Directive on Drinking Water Quality. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (5).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (6).

References

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D30 *p,p'*-DDD



$C_{14}H_{10}Cl_4$

Mol. Wt. 320.04

CAS Registry No. 72-54-8

Synonyms 2,2-bis(4-chlorophenyl)-1,1-dichloroethane; *p,p'*-dichlorodiphenyl-2,2-dichloroethane; 1,1-dichloro-2,2-bis(*p*-chlorophenyl)ethane; tetrachlorodiphenylethane; DDD; TDE; *p,p'*-TDE

EINECS No. 200-783-0

RTECS No. KI 0700000

Uses Insecticide.

Physical properties

M. Pt. 109-111°C **B. Pt.** 193°C at 1 mmHg **Specific gravity** 1.385 at 20°C with respect to water at 4°C

Partition coefficient $\log P_{ow}$ 6.02 (1) **Volatility** v.p. 1.02×10^{-6} mmHg at 30°C

Solubility Water: 0.160 mg l⁻¹ at 24°C. Organic solvents: fats and oils

Ecotoxicity

Fish toxicity

When applied at rate of 0.0143 mg l⁻¹ to control gnat larvae, did not cause injury to fish (2).

LC₅₀ (96 hr static) rainbow trout 70 µg l⁻¹ (3).

LC₅₀ (96 hr static) fathead minnow 4.4 mg l⁻¹ (3).

LC₅₀ (96 hr static) largemouth bass 42 µg l⁻¹ (3).

Invertebrate toxicity

LC₅₀ (96 hr static) *Asellus brevicaudus* 16 µg l⁻¹ (3).

LC₅₀ (96 hr) *Palaemonetes kadiakensis* 2.4 µg l⁻¹ (3).

LC₅₀ (96 hr) *Pteronarcys californica* 380 µg l⁻¹ (3).

Environmental fate

Degradation studies

Non-biodegradable (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mallard duck >2000 mg kg⁻¹ (5).
LD₅₀ oral ring-necked pheasant 386 mg kg⁻¹ (5).
LD₅₀ oral ♂ rat >4000 mg kg⁻¹ (6).
LD₅₀ dermal rabbit 1200 mg kg⁻¹ (7).

Sub-acute and sub-chronic data

LC₅₀ 5 day dietary trial, bobwhite quail 1835-2584 ppm (8).

Carcinogenicity and chronic effects

Feeding trials in CF-1 mice of 125 ppm caused increased incidence of liver tumours, particularly in ♀ (2).

Teratogenicity and reproductive effects

LD_{Lo} (teratogenicity) oral rat 54 g kg⁻¹ total dose (9).

Metabolism and toxicokinetics

Stored in body fat, but is mobilised and excreted faster than *p,p'*- DDT (10).
Principal urinary metabolite in ♀ mice bis(*p*-chlorophenyl)acetic acid (11).
Oral rat (2 wks) 8.51-2000 ppm in diet. Liver and serum burdens of DDE increased with dietary DDD reaching a maximum of 0.53 µM in liver and 4.7 µM in serum. The possibility that the DDE may have been generated artifactually in the diet was ruled out by examination of food by gas chromatography. This suggests that DDD is metabolised to DDE in rats (12).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (13).
Escherichia coli WP2, HCR negative (14).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (15).
Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (16).

Other comments

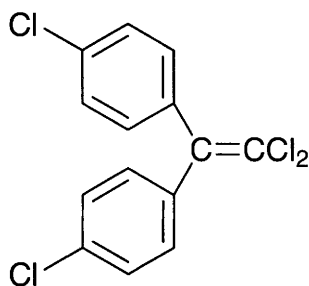
Metabolite and contaminant of *p,p'*-DDT.
Endocrine disruptor causing sex reversal in alligator embryos (17).
Toxicology and human health effects reviewed (18).

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D31 *p,p'*-DDE



$C_{14}H_8Cl_4$

Mol. Wt. 318.03

CAS Registry No. 72-55-9

Synonyms 2,2-bis(4-chlorophenyl)-1,1-dichloroethylene; 4,4'-DDE; 1,1-dichloro-2,2-bis(*p*-chlorophenyl)ethylene; 1,1'-dichloroethylidenebis(4-chlorobenzene); DDE

EINECS No. 200-784-6

RTECS No. KV 9450000

Physical properties

M. Pt. 88-90°C **B. Pt.** 316.5°C **Partition coefficient** $\log P_{ow}$ 4.28 **Volatility** v.p. 6.5×10^{-6} mmHg at 20°C
Solubility Water: 0.04 mg l⁻¹ at 20°C. Organic solvents: acetone, dimethyl sulfoxide, ethanol

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr static) minnow, trout 32 µg l⁻¹ (1).
 LC₅₀ (96 hr static) bluegill sunfish 240 µg l⁻¹ (1).
 LC₅₀ (96 hr static) Atlantic salmon 96 µg l⁻¹ (1).

Toxicity to other species

DDE ranging from 3.3 to 66.5 µg was dissolved in 5, 10 and 25 µl of ethanol and applied to the shells of marine turtle (*Chelonia mydas*) eggs. The eggs were incubated at 27.6 and 30.4°C (the upper and lower temperature boundaries for sex determination). Only 8% of applied DDE was found in the embryos. No changes in hatching success, deformities, size or incubation time were observed. The sex ratio did not differ from what would be expected on consideration of temperature alone (2).

Bioaccumulation

Bioconcentration factor in model aquatic ecosystem: alga 2720; snail 13,700; carp 8450 (3).

The levels of *p,p'*-DDE and metabolites in the polar bear food chain from the Canadian Arctic were: arctic cod <0.1 ng *p,p'*-DDE g⁻¹ lipid weight, ringed seal blubber 0.38±0.16 ng g⁻¹ 3-MeSO₂-4,4'-DDE. The latter compound was identified in polar bear fat at 2.0±0.7 ng g⁻¹. Although important, methyl sulfone formation is not the major route for 4,4'-DDE biotransformation in polar bear and ringed seal (4).

Environmental fate

Degradation studies

Non-biodegradable (5).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 200, 880 mg kg⁻¹, respectively (6,7).

Sub-acute and sub-chronic data

LC₅₀ 5 day feeding trial Japanese quail 1355 mg kg⁻¹ diet (8).

LC₅₀ 5 day feeding trial bobwhite quail 825 mg kg⁻¹ diet (8).

LC₅₀ 5 day feeding trial ring-necked pheasant 829 mg kg⁻¹ diet (8).

LC₅₀ 5 day feeding trial mallard duck 3572 mg kg⁻¹ diet (8).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity in animals, IARC classification group 2B (9).

Hepatomas increased in mice fed 250 mg kg⁻¹ (10).

Induced a small number of neoplastic nodules in lifetime tests on hamsters fed a diet containing 500-1000 ppm *p,p'*-DDE (11).

Teratogenicity and reproductive effects

Prepubertal and postpubertal Wistar rats injected intraperitoneally once with 220 mg kg⁻¹ and observed until 20 wk of age. Reproductive organ and body weights were similar to controls as were spermatid numbers within the testis, sperm numbers within the epididymis, sperm motility and morphology (12).

Metabolism and toxicokinetics

Converted by dehydrochlorination into 2,2-bis[bis(*p*-chlorophenyl)] ethylene. Further metabolism occurs in the rat kidney to yield 2,2-bis(*p*-chlorophenyl) acetic acid (13).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (14).

Other effects

Any other adverse effects

In herring gulls, shell thickness found to be inversely proportional to DDE concentration in the egg (15).

Endocrine disruptor which binds strongly with the androgen receptor in rats and inhibits androgen receptor action via the inhibition of androgen-induced transcription (16).

p,p'-DDE (100 µM) caused 100% inhibition of specific binding of [3H]5α-DHT to rat androgen-binding protein (17).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (18).

Included in Schedule 5/6 (Release into Water/Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (19).

Other comments

Metabolite of the pesticide *p,p'*-DDT.

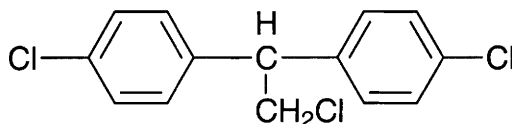
DDT and its derivatives reviewed (20,21).

Effects and mechanism of action on eggshell formation in birds reviewed (22).

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D32 *p,p'*-DDMS



$C_{14}H_{11}Cl_3$

Mol. Wt. 285.60

CAS Registry No. 2642-80-0

Synonyms 1-chloro-2,2-bis(*p*-chlorophenyl)ethane; 1,1-(2-chloroethylidene)bis(4-chlorobenzene); 1,1-bis(*p*-chlorophenyl)-2-chloroethane

RETECS No. KH 5480000

Ecotoxicity

Fish toxicity

After injection into rainbow trout, 0.5% was metabolised to 1,1'-bis (*p*-chlorophenyl ethylene), which was not metabolised further (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorine compounds: guide level 1 $\mu\text{g l}^{-1}$ (2).

Included in Schedule 6 (Release into Land: Prescribed Substances) of Statutory Instrument No. 472, 1991 (3).

Other comments

Metabolite of DDT.

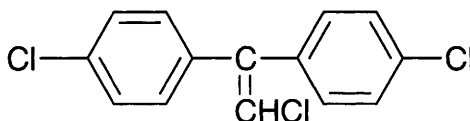
Reviews on experimental toxicology and human health effects listed (4).

Toxicity of DDT insecticide discussed (5).

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D33 *p,p'*-DDMU



$C_{14}H_9Cl_3$

Mol. Wt. 283.58

CAS Registry No. 1022-22-6

Synonyms 1-chloro-2,2-bis(*p*-chlorophenyl)ethylene; 1,1-(chloroethenylidene)bis(4-chlorobenzene); 1,1-bis(*p*-chlorophenyl)-2-chloroethylene; *p,p'*-DDD olefin; *p,p'*-DME

EINECS No. 213-823-7

RTECS No. KU 7040000

Physical properties

Partition coefficient $\log P_{ow}$ 6.00 (calc.) (1)

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 2700 mg kg⁻¹ (2).

Sub-acute and sub-chronic data

Oral Japanese quail 100 mg kg⁻¹ via diet for 12 hr to day-32, liver weight increased rapidly up to day-7 and a maximum was reached in 16 days. Progressive cytoplasmic and nuclear changes were observed, including initial increases in binucleate cells and mitotic figures. Cytoplasmic degeneration frequency increased with hydropic swellings causing enlarged hydropic hepatocytes as balloon cells which appeared by day-16. Degeneration progressed with lipid accumulation in the hepatocytes around central veins followed by formation of signet ring cells and fatty cysts in the mid-lobular areas. Hypertrophy of hepatocytes and lipid accumulation followed a similar pattern. Increased fibrocytic activity accompanied lipid accumulation resulting in increased thickening of the liver trabeculae. Occurrence coincided with increased lipid deposition and first appearance of hepatocyte necrosis by day-10. Kupffer cell activity observed as cell hypertrophy of the sinusoidal channels occurred on days 10, 16 and 24. Lipid accumulation stabilised by day-24 and liver regeneration occurred (3).

Metabolism and toxicokinetics

Following oral administration to pigeons, highest concentrations were found in fat tissues. No metabolism was identified (4).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorine compounds: guide level $1 \mu\text{g l}^{-1}$ (5).

Included in Schedule 6 (Release into Land: Prescribed Substances) of Statutory Instrument No. 472, 1991 (6).

Other comments

Metabolite of DDT.

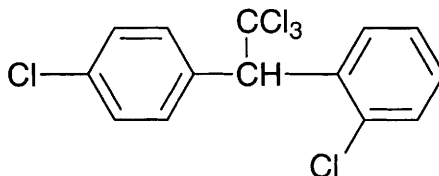
Reviews on experimental toxicology and human health effects listed (7).

Toxicity of DDT insecticide discussed (8).

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D34 *o,p'*-DDT



$\text{C}_{14}\text{H}_9\text{Cl}_5$

Mol. Wt. 354.49

CAS Registry No. 789-02-6

Synonyms 2,2-bis(*o,p'*-chlorophenyl)-1,1,1-trichloroethane; 1,1,1-trichloro-2-(*o*-chlorophenyl)-2-(*p*-chlorophenyl)ethane; 1-chloro-2-[2,2,2-trichloro-1-(4-chlorophenyl)ethyl]benzene

EINECS No. 212-332-5

RTECS No. KH 7910000

Occurrence Contaminant of *p,p'*-DDT.

Ecotoxicity

Fish toxicity

LC_{50} harlequin fish 0.03 mg l^{-1} (1).

Mammalian & avian toxicity

Acute data

LD_{50} intraperitoneal mouse 1577 mg kg^{-1} (2).

Teratogenicity and reproductive effects

Reduces fertility in rat, competing with oestradiol for binding oestrogen receptors in uterine cytosol (3).

Genotoxicity

Stimulated DNA synthesis and cell division in uterine epithelium, stroma and myometrium (4).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration $0.1 \mu\text{g l}^{-1}$ (5).

Included in Schedule 5 (Release into Water: Prescribed Substances) Statutory Instrument No. 472, 1991 (6).

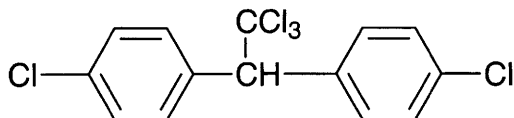
Other comments

Endocrine disrupting effects discussed (7).

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D35 *p,p'*-DDT



$\text{C}_{14}\text{H}_9\text{Cl}_5$

Mol. Wt. 354.49

CAS Registry No. 50-29-3

Synonyms dichlorodiphenyltrichloroethane; 1,1'-(2,2,2-trichloroethylidene)bis(4-chlorobenzene); 1,1,1-trichlorobis(chlorophenyl)ethane; 1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane; 1,1'-bis(4-chlorophenyl)-2,2,2-trichloroethane; Dicophane; 4,4'-DDT; DDT; chlorophenothane (isomer mixture)

EINECS No. 200-024-3

RTECS No. KJ 3325000

Uses Formerly used as an insecticide, in the control of the vectors of malaria in tropical countries. Its use for agriculture is now banned in most countries.

Physical properties

M. Pt. 108.5-109°C **B. Pt.** 185-187°C at 0.05 mmHg **Flash point** 162-171°C **Partition coefficient** $\log P_{ow}$ 6.19 at 20°C **Volatility** v.p. 1.9×10^{-7} mmHg at 20°C

Solubility Water: 3.1-3.4 $\mu\text{g l}^{-1}$ at 25°C. Organic solvents: acetone, benzene, chloroform, cyclohexane, dichloromethane, diethyl ether, 1,4-dioxane, ethanol, trichloroethane

Occupational exposure

DE-MAK 1 mg m⁻³ (inhalable fraction of aerosol)

FR-VME 1 mg m⁻³

UK-LTEL 1 mg m⁻³

UK-STEL 3 mg m⁻³

US-TWA 1 mg m⁻³

Supply classification toxic, dangerous for the environment

Risk phrases Toxic if swallowed – Possible risk of irreversible effects – Toxic: danger of serious damage to health by prolonged exposure if swallowed – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R25, R40, R48/25, R50/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Do not breathe dust – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S22, S36/37, S45, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 19 µg l⁻¹ (1).

LC₅₀ (96 hr) bluegill sunfish 8 µg l⁻¹ (1).

LC₅₀ (96 hr) rainbow trout 7 µg l⁻¹ (1).

LC₅₀ (96 hr) brown trout 2 µg l⁻¹ (1).

LC₅₀ (96 hr) perch 9 µg l⁻¹ (1).

LC₅₀ harlequin fish 0.013 mg l⁻¹ (2).

No-observed-effect concentration (NOEC) fathead minnow 0.5 µg l⁻¹ (3).

Lowest-observed-effect concentration (LOEC) fathead minnow 2.0 µg l⁻¹ (3).

Fry survival, adult survival and reproduction most sensitive responses at LOEC (3).

Invertebrate toxicity

IC₅₀ (concentration causing immobilisation of 50% test organisms) (48 hr) *Daphnia* sp. 4 µg l⁻¹ (4).

LC₅₀ (96 hr) *Daphnia* sp. 1 µg l⁻¹ (4).

In algae 30% decrease in photosynthesis caused by 10 µg l⁻¹ (4 hr) (1).

Bioaccumulation

Bioconcentration factors of 12,000-40,000 reported in fish. In lake trout DDT and its metabolites DDE and DDA reported to increase progressively with age from about 1 mg kg⁻¹ at 1 yr to concentrations of 14 mg kg⁻¹ or higher at 12-yr-old (1).

Bioaccumulation factors higher in aquatic than terrestrial ecosystems (5).

Environmental fate

Degradation studies

Acclimatised *Bacillus*, *Flavobacterium*, *Micrococcus* and *Pseudomonas* soil and activated sludge degraded concentrations up to 0.03 mg l⁻¹ within 23 hr, unacclimatised bacteria cannot degrade DDT. It is normally very persistent in soils with an estimated t_{1/2} of 4-30 yr (4).

Abiotic removal

Photooxidation by UV light in aqueous medium at 90-95°C; time for formation of carbon dioxide (% of theoretical): 25%-25.9 hr; 50%-66.5 hr; 75%-120 hr (6).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 110, 300 mg kg⁻¹, respectively (7).

LD₅₀ percutaneous ♀ rat 2510 mg kg⁻¹ (8).

LD₅₀ intraperitoneal rat, mouse 9, 32 mg kg⁻¹, respectively (9).

LD₅₀ intravenous rat, mouse 68 mg kg⁻¹ (10).

Estimated oral human fatal dose 500 mg kg⁻¹ (11).

Sub-acute and sub-chronic data

LC₅₀ 5 day feeding trial ring-necked pheasant 311 mg kg⁻¹ diet (12).

LC₅₀ 5 day feeding trial mallard duck 1900 mg kg⁻¹ diet (12). LC₅₀ 5 day feeding trial, bobwhite quail 611 mg kg⁻¹ diet (12).

LC₅₀ 5 day feeding trial, Japanese quail 568 mg kg⁻¹ diet (12).

No effect level (NOEL), 160 day feeding trial in rats 1 mg kg⁻¹ diet. Though stored in body fat and excreted in milk, 17 humans who consumed 35 mg daily (~0.5 mg kg⁻¹ daily) for 1.75 yr, suffered no ill-effect (8).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity in humans, sufficient evidence for carcinogenicity in animals, IARC classification group 2B (13).

Three feeding studies with hamsters gave negative results and feeding studies with dogs and monkeys were inconclusive (13).

2 yr dietary level of 5 ppm produced tissue changes in rats. 1 ppm produced no effects (14).

This was confirmed for ♂ but not ♀ rats (15).

Caused significant increase in hepatomas in mice (16,17).

Oral administration to mice caused benign and malignant liver neoplasms, lymphomas and lung neoplasms.

Subcutaneous injection of mice produced liver tumours, lymphomas and lung tumours (18).

Oral administration to rats caused liver neoplasms (19).

National Toxicology Program investigated DDT in rats and mice via oral administration. Negative results were obtained in rats and mice (20).

Teratogenicity and reproductive effects

Reported to alter fertility in ♀ rat, ♂ mouse and ♂ dog (21).

No teratogenic effects in rats or mice at levels up to 200 mg kg⁻¹ in diet (22).

Metabolism and toxicokinetics

Accumulates in the body, particularly in fatty tissues, and is very slowly eliminated. In one worker, a level of 648 mg kg⁻¹ was found in fat tissue, without ill-effect (23).

Crosses the placenta and appears in breast milk. Metabolised in the body to *p,p'*-DDE, 1,1'-(2,2-dichloroethylidene)-bis(4-chlorobenzene) (DDD), 1,1'-(2-chloroethenylidene)-bis(4-chlorobenzene), 1,1-(2-chloroethylidene)-bis(4-chlorobenzene), 1,1'-bis(4-chlorophenyl) ethylene, 2,2-bis(4-chlorophenyl)ethanol, and 2,2-bis(4-chlorophenyl) acetic acid (DDA) (8).

Irritancy

Heavy exposure may result in eye and skin irritation (24).

Genotoxicity

Negative in *Salmonella typhimurium* mutagenicity assay and inconclusive results in mammalian test systems (22).

Workers exposed to DDT and other pesticides showed increased chromatid-type aberrations, but not chromosomal aberrations, in peripheral lymphocytes. Conflicting results obtained in rats and mice: chromosomal aberrations induced in bone-marrow cells of mice but not rats, and chromosomal aberrations in spermatocytes of mice treated *in vivo*; it did not induce micronuclei in bone-marrow treated cells of treated mice. In human cells *in vitro*, it did not induce chromosomal aberrations, irritation or unscheduled DNA synthesis. It did not induce mutation, DNA strand breaks or unscheduled DNA synthesis in cultured rodent cells; conflicting results were obtained for chromosomal aberrations in Chinese hamster cells. Inhibited intercellular communication in human and rodent cell systems. Did not induce sex-linked recessive lethal mutations in *Drosophila*, but conflicting results were obtained with regard to aneuploidy; it caused dominant lethal mutations. Did not induce mutation in fungi, either after direct exposure or in a host-mediated assay. Not mutagenic to bacteria and did not induce breakage of plasmid DNA (25).

Other effects

Other adverse effects (human)

It is estimated that a dose of 10 mg kg⁻¹ would cause signs of poisoning in humans (5).

Causes hepatic damage, central nervous system degeneration, agranulocytosis, dermatitis, weakness and convulsions (11).

Human volunteers exposed to 423 mg m⁻³ for 1 hr day⁻¹ for 6 days suffered only eye irritation (26).

Potential risk factors for non-Hodgkin's lymphoma evaluated in a case-referent study of 106 cases of the disease, and 275 referents, all alive. Occupational exposure to solvents, phenoxy acids and creosote were associated with significantly increased risk (27).

Any other adverse effects

Lower dermal absorption than other pesticides. Mechanism of neuro-toxic action – inhibits transport processes (5).

p,p'-DDT (100 µM) caused an inhibition of specific binding of [3H]5α-DHT to rat androgen-binding protein of around 40% (28).

Even at high concentrations (282 µmol kg⁻¹) DDT administered intramuscularly to white leghorn roosters had neither oestrogen agonist nor antiestrogenic activity as measured by its effect on oestrogen-related mRNA stabilising factor (29).

Legislation

UK DoE have set an advisory value of 7 µg l⁻¹ for total DDT in drinking water (30).

WHO guideline value 2 µg l⁻¹ (31).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.5 µg l⁻¹ (32).

Included in Schedule 5 and 6 (Release into Water and Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (33).

Use prohibited in EC and USA. EC maximum permissible level: fruit and vegetables 0.1 ppm; meat, meat preparations and animal fats 1 ppm; raw and whole cream cows milk 0.04 ppm; foodstuffs except fats 0.05 ppm (fats 0.5 ppm); cereals 0.05 ppm (9).

Maximum permissible concentration in domestic water in former USSR 0.1 mg l⁻¹ (34).

Human tolerable daily intake (TDI) 0.02 mg kg⁻¹. WHO Class II (35).

EPA Toxicity Class II (8).

Other comments

Residues from use as insecticide. Accumulates in animal tissues. Extensive use in industrial countries has not been associated with an increase in hepatic cancer in humans (5).

Odour threshold 0.35 mg l⁻¹.

Toxicology and human health effects reviewed (36).

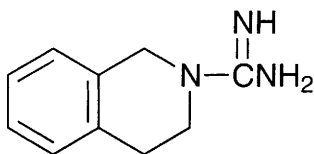
Environmental health aspects reviewed (37,38).

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D36 debrisoquine



$C_{10}H_{13}N_3$

Mol. Wt. 175.23 CAS Registry No. 1131-64-2; 581-88-4 (sulfate)

Synonyms 3,4-dihydro-2(1H)-isoquinolinecarboximidamide; 3,4-dihydro-2(1H)-isoquinolinecarboxamidine; isocaramidine

EINECS No. 214-470-1

Uses Antihypersensitive agent (as the sulfate).

Physical properties

M. Pt. 278-280°C (sulfate)

Solubility Water: 2.5% (sulfate). Organic solvents: ethanol (sulfate)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 610 mg kg⁻¹ (1).

LD₅₀ oral mouse 235 mg kg⁻¹ (2).

LD₅₀ intraperitoneal mouse 132 mg kg⁻¹ (2).

LD₅₀ subcutaneous mouse 136 mg kg⁻¹ (2).

LD₅₀ intravenous mouse 31.7 mg kg⁻¹ (2).

Metabolism and toxicokinetics

Debrisoquine is rapidly absorbed from the gastrointestinal tract. The major metabolite is 4-hydroxydebrisoquine.

Metabolism is subject to genetic polymorphism (3).

Other effects

Other adverse effects (human)

Suppresses peripheral but not central formation of homovanillic acid from dopamine in plasma of schizophrenic patients (4).

Abrupt cessation of treatment has been reported to lead to rebound hypertension (3).

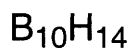
Other comments

Genetic polymorphism reviewed (5-7).

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D37 decaborane



B₁₀H₁₄

Mol. Wt. 122.22

CAS Registry No. 17702-41-9

Synonyms decaborane(14); decaboron tetrahydride; boron hydride; *nido*-decaborane(14); tetradecahydrodecaborane

EINECS No. 241-711-8

RTECS No. HD 1400000

Uses In rocket propellants. Catalyst in olefin polymerisation.

Physical properties

M. Pt. 99.6-99.7°C **B. Pt.** 213°C **Flash point** 80°C **Specific gravity** 0.940 at 25°C with respect to water at 4°C **Volatility** v.p. 19 mmHg at 100°C

Solubility Water: miscible. Organic solvents: acetic acid, acetic anhydride, benzene, 1-bromopropane, carbon disulfide, carbon tetrachloride, ethanol, ethyl acetate, ethyl borate, ethyl silicate

Occupational exposure

DE-MAK 0.05 ppm (0.25 mg m⁻³)

FR-VME 0.05 ppm (0.3 mg m⁻³)

US-TWA 0.05 ppm (0.25 mg m⁻³)

US-STEL 0.15 ppm (0.75 mg m⁻³)

UN No. 1868 HAZCHEM Code 2WE Conveyance classification flammable solid, toxic

Environmental fate

Abiotic removal

Hydrolyses in hot water (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 64 mg kg⁻¹ (2).

LD₅₀ oral mouse 41 mg kg⁻¹ (3).

LC₅₀ (4 hr) inhalation rat 46 ppm (4).

LD₅₀ dermal rabbit 71 mg kg⁻¹ (3).

LC₅₀ intraperitoneal mouse 33 mg kg⁻¹ (3).

LD₅₀ intraperitoneal rat, rabbit 23, 28 mg kg⁻¹, respectively (5).

Other effects

Any other adverse effects

Acute effects observed in rats after exposure by inhalation to 32-84 ppm were restlessness, depressed breathing, incoordination, general weakness, spasmodic movements, convulsions and corneal opacities. Intraperitoneal administration of 30 mg kg⁻¹ to rabbits. Within 3-6 hr rabbits showed irritability, then lethargy and finally unresponsiveness to stimuli. All died in less than 24 hr (6).

In anaesthetised dogs, intravenous injections of 4-10 mg kg⁻¹ produced bradycardia, transient hypertensive effects and an immediate decrease in cardiac output (7).

Decaborane exhibited modified Type II spectral change and inhibited ethylmorphine *N*-demethylase and aniline hydroxylase *in vitro* on rat liver microsomal enzymes. Pyridoxal phosphate had no effect on altering inhibition (8). Intraperitoneal administration of 30 mg kg⁻¹ to rats markedly reduced the noradrenaline content of the iris adrenergic nerves within 24 hr (9).

Other comments

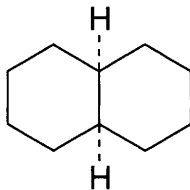
Physical properties, toxicity and safety precautions in handling decaborane reviewed (1).

Chemistry and hazards reviewed (10,11).

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D38 *cis*-decahydronaphthalene



$C_{10}H_{18}$

Mol. Wt. 138.25

CAS Registry No. 493-01-6;
91-17-8 (decahydronaphthalene)

Synonyms *cis*-bicyclo[4.4.0]decane; *cis*-decalin; *cis*-perhydronaphthalene

EINECS No. 207-770-9

Uses Solvent.

Occurrence Component of crude oil. Emitted into the atmosphere from refineries.

Physical properties

M. Pt. -43°C **B. Pt.** 195.7°C **Flash point** 58°C **Specific gravity** 0.897 at 20°C with respect to water at 4°C

Volatility v.p. 1 mmHg at 23°C

Solubility Organic solvents: chloroform

Occupational exposure

UN No. 1147 HAZCHEM Code 3  Conveyance classification flammable liquid

Environmental fate

Degradation studies

BOD₅: 0% of ThOD; COD: 5% of ThOD (1).

ThOD 3.362 mg l⁻¹ O₂ (2).

Degradation by seawater microorganisms: 13.6% breakdown occurred after 21 days at 22°C in stoppered bottles containing a 1000 mg l⁻¹ mixture of alkanes, cycloalkanes and aromatics (3).

Abiotic removal

Evaporation rate relative to *n*-butyl acetate, which has been assigned a value of 1 at 25°C , is 0.080 (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 4170 mg kg⁻¹ (5).

LC_{Lo} (4 hr) inhalation rat 500 ppm (5).

LC_{Lo} (4 hr) inhalation mouse 993 ppm (isomer not specified) (6).

LD₅₀ dermal rabbit 5900 mg kg⁻¹ (5).

Sub-acute and sub-chronic data

Inhalation (90 day) ♂, ♀ rats, ♂, ♀ dogs, ♀ mice 5 or 50 ppm. No distinct exposure-related lesions were noted in dogs. Reversible hepatocellular cytoplasmic vacuolisation was noted in ♀ mice at both concentrations. Nephropathy characterised by hyaline droplets, necrosis and intratubular casts was noted in ♂ rats (7).

Teratogenicity and reproductive effects

Mice were given 2700 mg kg⁻¹ by gavage on days 6-13 of gestation. A 14% maternal mortality was associated with a significant increase in maternal weight. No teratogenic effect was observed in offspring (isomer not specified) (8).

Metabolism and toxicokinetics

Following intragastric administration to rats, *cis,cis*-1-decalol and *cis,trans*-1-decalol were excreted in the urine. Kidney extracts of ♂ rats showed the presence of 2-decalones (9).

Irritancy

Dermal rabbit (24 hr) 10 mg produced mild irritation (5).

500 mg instilled into rabbit eye for 24 hr produced mild irritation (10).

LC_{Lo} human nose, eye and pulmonary effects 100 ppm (11).

Other effects

Any other adverse effects

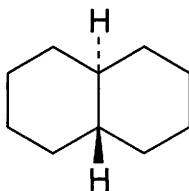
Following intragastric administration to rats (dose and duration not specified), reduced weight gain and hyaline droplet formation in the proximal tubules were observed in ♂ rats only (9).

No effect level, inhalation rat (6 hr) 200 ppm (isomer not specified) (12).

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D39 *trans*-decahydronaphthalene



C₁₀H₁₈

Mol. Wt. 138.25

CAS Registry No. 493-02-7;
91-17-8 (decahydronaphthalene)

Synonyms *trans*-bicyclo[4.4.0]decane; *trans*-decalin; *trans*-perhydronaphthalene

EINECS No. 207-771-4

Uses Solvent.

Physical properties

M. Pt. -32°C (99% pure) **B. Pt.** 187.25°C at 756 mmHg **Flash point** 52°C **Specific gravity** 0.870 at 20°C
with respect to water at 40°C **Volatility** v.p. 10 mmHg at 47°C

Solubility Organic solvents: chloroform, methanol

Occupational exposure

UN No. 1147 HAZCHEM Code 3 $\frac{2}{+}$ Conveyance classification flammable liquid

Environmental fate

Degradation studies

BOD₅: 0% of ThOD. COD: 5% of ThOD (1).

ThOD 3.362 mg l⁻¹ O₂ (2).

Degradation in sea water by oil oxidising microorganisms: 13.6% breakdown after 21 days at 22°C in stoppered bottles containing a 1000 mg l⁻¹ mixture of alkanes, cycloalkanes and aromatics (isomer not specified) (3).

Abiotic removal

Evaporation rate relative to *n*-butyl acetate, which has been assigned a value of 1 at 25°C, is 0.129 (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 4170 mg kg⁻¹ (5).

LD₅₀ dermal rabbit 5900 mg kg⁻¹ (5).

LC_{Lo} (4 hr) inhalation rat 500 ppm (5).

LC_{Lo} (4 hr) inhalation mouse 993 ppm (isomer not specified) (6).

Carcinogenicity and chronic effects

TC_{Lo} inhalation rat, 90 days continuously, neoplastic effects 5 ppm (7).

TC_{Lo} inhalation mouse, 90 days continuously, carcinogenic effects 50 ppm (isomer not specified) (7).

Teratogenicity and reproductive effects

Mice were given 2700 mg kg⁻¹ by gavage on days 6-13 of gestation. A 14% maternal mortality was associated with a significant increase in maternal weight. No teratogenic effect was observed in offspring (isomer not specified) (8).

Metabolism and toxicokinetics

Following intragastric administration to rats, *trans,trans*-1-decalol and *trans,cis*-2-decalol were excreted in the urine. Kidney extracts from ♂ rats showed the presence of 2-decalones (9).

Irritancy

Dermal rabbit (24 hr) 10 mg produced mild irritation (5).

500 mg instilled into rabbit eye for 24 hr produced mild irritation (10).

LC_{Lo} human nose, eye and pulmonary effects 100 ppm (isomer not specified) (11).

Other effects

Any other adverse effects

Following intragastric administration to rats, (dose and duration not specified), reduced weight gain and hyalin droplet formation in the proximal tubules were observed in ♂ rats only (9).

Other comments

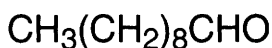
Component of crude oil; emitted into the atmosphere from refineries.

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D40 decanal



$\text{C}_{10}\text{H}_{20}\text{O}$

Mol. Wt. 156.27

CAS Registry No. 112-31-2

Synonyms 1-decanal; decyl aldehyde; capraldehyde

EINECS No. 203-957-4

RTECS No. HD 6000000

Uses Food flavouring.

Occurrence Constituent of orange oil.

Physical properties

M. Pt. -5°C B. Pt. $208-209^{\circ}\text{C}$ Flash point 85°C Specific gravity 0.830 at 20°C with respect to water at 4°C

Volatility v.p. ~ 0.15 mmHg at 20°C

Solubility Organic solvents: acetone, carbon tetrachloride, diethyl ether, ethanol

Mammalian & avian toxicity

Acute data

LD_{50} oral redwing blackbird >111 mg kg^{-1} (1).

LD_{50} oral rat 3730 mg kg^{-1} (2).

LD_{50} dermal rabbit 5040 mg kg^{-1} (2).

Irritancy

Dermal rabbit (24 hr) 14 mg produced severe irritation (2).

Dermal rabbit (24 hr) 500 mg produced mild irritation (3).

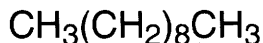
Genotoxicity

Salmonella typhimurium TA98, TA100 with and without metabolic activation negative (4).

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D41 decane



$\text{C}_{10}\text{H}_{22}$

Mol. Wt. 142.28

CAS Registry No. 124-18-5

Synonyms *n*-decane

EINECS No. 204-686-4

RTECS No. HD 6500000

Uses Internal standard in gas chromatographic analysis of organic acids. Blowing agent. Catalyst. Solvent.

Physical properties

M. Pt. -30°C **B. Pt.** 174°C **Flash point** 64°C **Specific gravity** 0.730 at 20°C with respect to water at 4°C

Partition coefficient $\log P_{\text{ow}}$ 6.25 **Volatility** v.p. 2.7 mmHg at 20°C

Solubility Water: 0.009 mg l^{-1} at 20°C . Organic solvents: diethyl ether, ethanol

Occupational exposure

SE-LEVL 350 mg m^{-3}

SE-STEL 500 mg m^{-3}

UN No. 2247 HAZCHEM Code 3  Conveyance classification flammable liquid

Ecotoxicity

Invertebrate toxicity

Concentration that inhibited the activity of a bacterial culture (aerobic heterotrophs, *Nitrosomonas* and methanogens) (IC_{50}) $179 \mu\text{g l}^{-1}$ (1).

EC_{50} (48 hr) *Daphnia magna* 72 g l^{-1} (2).

Did not significantly alter the growth rate of mussel larvae *Mytilus edulis* at 10 mg l^{-1} (3).

Environmental fate

Degradation studies

Utilised as a growth substrate by yeasts and *Aspergillus japonicus* (4,5).

Degradation by activated sludge 1.3% of ThOD after 6 hr, 2.6% of ThOD after 12 hr, 4.7% of ThOD after 24 hr (6).

Degradation in seawater by oil oxidising microorganisms: 100% breakdown after 21 days at 22°C in stoppered bottles containing a 1000 mg l^{-1} mixture of alkanes, cycloalkanes and aromatics (7).

In rotating disk contact aerator a concentration of 203.7 mg l^{-1} was removed by >99% in 24 hr (8).

Biodegradable (9).

Abiotic removal

May be isolated from solid or liquid wastes, with other organic contaminants, by contact with a perfluorinated solvent, which is then subjected to UV irradiation, optionally with added photooxidant such as ozone, for photodegradation (10).

Evaporation rate relative to *n*-butyl acetate, which has been assigned a value of 1 at 25°C , is 0.126 (11).

Mammalian & avian toxicity

Acute data

LC_{50} (2 hr) inhalation mouse $72,300 \text{ mg m}^{-3}$ (12).

LD_{50} intravenous mouse 912 mg kg^{-1} (13).

Sub-acute and sub-chronic data

Rats showed a significant weight gain and an increase in the total leukocyte count after exposure to 540 ppm for 18 hr a day for 123 days. However, microscopic examination revealed no signs of organ toxicity. Dermal application to mice of $0.1\text{--}0.15 \text{ g animal}^{-1} 3 \times \text{wkly}$ for 50 wk caused dermal fibrosis, pigmentation, and some ulceration. Kidney effects and some haemorrhaging were also observed in some animals (14).

Carcinogenicity and chronic effects

TD_{Lo} equivocal tumorigenic agent, 52 wk intermittently 25 g kg⁻¹ (15).

Metabolism and toxicokinetics

In an *in vitro* study, decane was oxidised by microsomes from the livers of mouse, rat, rabbit, cattle, pigeon and chick embryo. Decanol, decanoic acid and decamethylene glycol were the major metabolites (16).

Other comments

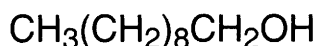
Air pollutant from building materials and consumer products. Water pollutant. Obtained during petroleum refining.

Solubility parameter SP_o = 7.7. SP_o is calculated by taking the square root of the sum of the squares of the Hansen solubility parameters SP_d, SP_p and SP_h (cal^{1/2} cm^{-3/2}) (11).

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D42 1-decanol



C₁₀H₂₂O

Mol. Wt. 158.28

CAS Registry No. 112-30-1

Synonyms hydroxydecane; *n*-decyl alcohol; nonylcarbinol; decyl alcohol

EINECS No. 203-956-9

RTECS No. HE 4375000

Uses Synthetic flavouring, antifoaming agent, solvent, plant growth regulator and sucker control agent; intermediate in perfume manufacture and for plasticisers, petroleum additives, lubricants and surfactants.

Occurrence In essential oils of ambrette seeds and almond flowers, in citrus oils and fermented beverages.

Physical properties

M. Pt. 7°C **B. Pt.** 231°C **Flash point** 82°C **Specific gravity** 0.829 at 20°C with respect to water at 4°C

Partition coefficient log P_{ow} 4.57 **Volatility** v.p. 1 mmHg at 70°C ; v.den. 5.3

Solubility Organic solvents: diethyl ether, ethanol

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow, bleak 24, 7.2 mg l⁻¹, respectively (1,2).

Invertebrate toxicity

LC₅₀ (96 hr) *Nitocra spinipes* 4 mg l⁻¹ (1).

EC₅₀ (5 min) *Photobacterium phosphoreum* 1.48 ppm Microtox test (3).

Bioaccumulation

Bioconcentration factor in fathead minnow 490 (4).

Environmental fate

Degradation studies

Activated sludge 0.9%, 9.2% and 29.3% of ThOD after 6, 12 and 24 hr, respectively (5).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 4720, 6000 mg kg⁻¹, respectively (6).

LC₅₀ (2 hr) inhalation mouse 4 g m⁻³ (7).

LD₅₀ dermal rabbit 3560 mg kg⁻¹ (6).

LD₅₀ intraperitoneal rat, mouse 800 mg kg⁻¹ (8).

Carcinogenicity and chronic effects

Applied to skin of mice 3 × wk⁻¹ for 60 wk after an initiating dose of dimethylbenzanthracene, it had tumour-promoting activity (9).

Teratogenicity and reproductive effects

No embryotoxicity or teratogenicity reported in rats following intragastric administration of 1 ml day⁻¹ during days 1-15 of pregnancy (10).

Irritancy

75 mg applied to human skin caused severe irritation (11).

2600 mg kg⁻¹ applied to rabbits' skin caused moderate irritation; 83 mg applied to rabbits' eyes caused severe irritation (duration unspecified) (12).

Other effects

Other adverse effects (human)

Acute exposure causes central nervous system depression, hypotension, nausea, vomiting and diarrhoea (13).

Any other adverse effects

Rat aspiration test fatal due to pulmonary oedema (13).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (14).

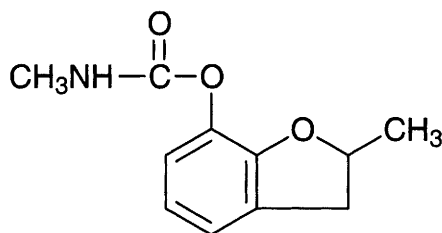
The log P_{ow} exceeds the European Community recommended value 3.0 (6th and 7th amendments) (15).

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D43 decarbofuran



$C_{11}H_{13}NO_3$

Mol. Wt. 207.23

CAS Registry No. 1563-67-3

Synonyms 2,3-dihydro-2-methylbenzofuran-7-yl methylcarbamate; methylcarbamic acid, 2,3-dihydro-2-methyl-7-benzofuranyl ester; 2,3-dihydro-2-methyl-7-benzofuranyl methylcarbamate

RTECS No. FB 9625000

Uses Superseded insecticide.

Occupational exposure

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed (R23/24/25)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S13, S36/37, S45)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 43 mg kg⁻¹ (1).

LD_{Lo} subcutaneous guinea pig 25 mg kg⁻¹ (2).

Legislation

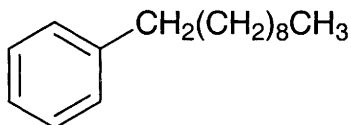
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration for individual pesticides 0.1 µg l⁻¹ (3).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

References

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D44 decylbenzene



$\text{C}_{16}\text{H}_{26}$

Mol. Wt. 218.38

CAS Registry No. 104-72-3

Synonyms 1-phenyldecane; *n*-decylbenzene

EINECS No. 203-230-1

Uses In stripper solutions for resists.

Physical properties

B. Pt. 255-280°C **Flash point** 107°C **Specific gravity** 0.9 at 20°C **Partition coefficient** $\log P_{\text{ow}}$ 7.35

Environmental fate

Degradation studies

In a model system containing 10% soil and a 1.35% mixture of 6 hydrocarbons including decylbenzene, suspended in a mineral salt medium, the rate of degradation was 25.7 g kg⁻¹ soil day⁻¹ (1).

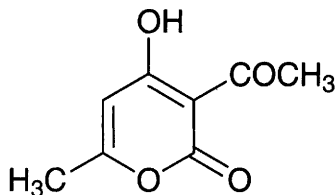
Other comments

Residues have been found in waste water, sea water and sediments.

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D45 dehydroacetic acid



$C_8H_8O_4$

Mol. Wt. 168.15

CAS Registry No. 771-03-9

Synonyms methylacetopyranone; 3-acetyl-6-methyl-2H-pyran-2,4(3H)-dione (keto form); 3-acetyl-4-hydroxy-6-methyl-2H-pyran-2-one (enol form); DHA

EINECS No. 212-227-4

RTECS No. UP 8050000

Uses Has been used as a fungicide. Plasticiser. In anti-enzyme toothpastes. To reduce pickle bloating. In organic synthesis.

Occurrence Isolated from *Solandra nitida*.

Physical properties

M. Pt. 111-113°C **B. Pt.** 270°C **Flash point** 157°C **Volatility** v.p. 1 mmHg at 91.7°C

Solubility Water: <0.1%. Organic solvents: acetone, benzene, diethyl ether, ethanol, methanol, carbon tetrachloride

Ecotoxicity

Fish toxicity

Time to produce death at 5 ppm in brown trout 22 hr, perch 6 hr. No effect observed within 24 hr for bluegill sunfish and goldfish (1).

Environmental fate

Degradation studies

Confirmed biodegradable (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 500 mg kg⁻¹ (3).

LD₅₀ oral mouse 1330 mg kg⁻¹ (4).

LD₅₀ intraperitoneal mouse 2000 mg kg⁻¹ (5).

LD_{Lo} dermal rabbit 5 g kg⁻¹ (6).

Sub-acute and sub-chronic data

Humans injected 0.01 g kg⁻¹ daily for 150 days without observable ill-effects. At high dosages monkeys showed anorexia, vomiting, weakness, stupor, ataxia and convulsions (7).

Carcinogenicity and chronic effects

Assessment after subcutaneous administration to rat questionable (8).

Teratogenicity and reproductive effects

Oral administration to Wistar rats 0, 25, 50, 100 mg kg⁻¹ during days 6-17 of gestation. In the 50 and 100 mg kg⁻¹ groups, maternal body weight gain and food consumption were depressed. In foetuses from both groups, considerable body weight loss, high incidence of skeletal variations, and delayed ossification were observed.

Increase in foetal death was also observed in the highest dose group, considered to be due to marked retardation in intra-uterine development. No evidence of foetal malformations or teratogenicity (9).

Metabolism and toxicokinetics

In rabbits metabolites are triacetic acid lactone, hydroxydehydroacetic acid and possibly the salt of triacetic and lactone-3-carboxylic acid (10).

Irritancy

Irritating to skin, mucous membranes and upper respiratory tract. Causes severe eye irritation (11).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537, TA1538 with and without metabolic activation negative (12).

Other effects

Other adverse effects (human)

Causes impaired kidney function (13).

Legislation

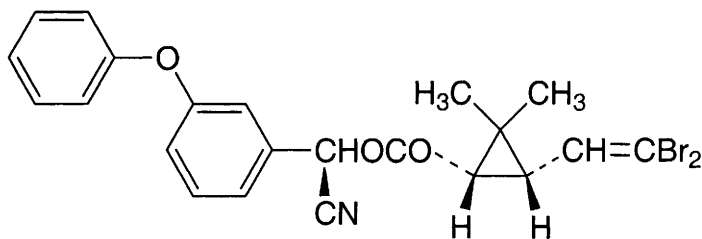
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (14).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (15).

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15. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D46 deltamethrin



$C_{22}H_{19}Br_2NO_3$

Mol. Wt. 505.21

CAS Registry No. 52918-63-5

Synonyms [1R-[1 α (S*)3 α]]-cyano(3-phenoxyphenyl)methyl 3-(2,2-dibromoethenyl)-2,2-dimethylcyclopropanecarboxylate; (S)- α -cyano-3-phenoxybenzyl (1R)-cis-3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylate; decamethrin; deltamethrine; cis-deltamethin; RU22974; cislin; butox

EINECS No. 258-256-6

RTECS No. GZ 1233000

Uses Insecticide.

Physical properties

M. Pt. 100-102°C **B. Pt.** decomp. >300°C **Specific gravity** 0.55 g cm⁻³ bulk density at 25°C

Partition coefficient log P_{ow} 4.6 at 25°C **Volatility** v.p. 0.015 mmHg at 25°C

Solubility Water: <0.2 μ g l⁻¹ at 25°C. Organic solvents: acetone, cyclohexanone, dioxane, ethanol

Occupational exposure

Conveyance classification toxic substance, flammable liquid

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) mirror carp, rainbow trout, cichlid, pumpkinseed sunfish 0.5-1.8 μ g l⁻¹ (1,2).

Short-term (96 hr) and long-term (28 days) sublethal exposure of freshwater catfish *Heteropneustes fossilis* to deltamethrin disturbs the homeostasis of calcium and phosphate, which are the important ions for synthesis of vitellogenin, thus affecting the reproductive state of the fish (3).

Invertebrate toxicity

LC₅₀ (96 hr) crab *Uca pugnator* 1.5 μ g l⁻¹ (1).

EC₅₀ (48 hr) *Daphnia magna* 0.05-0.07 μ g l⁻¹ (4,5).

Little effect on freshwater mussels but Northern lobster (*Homarus americanus*) were much more sensitive. Lethal threshold 1.4 ng l⁻¹ (6,7).

Single application to honeybee highly toxic with contact LD₅₀ 0.051 μ g bee⁻¹ (8).

Direct application to bees in field gave high mortality at 11.2 g ha⁻¹ but no significant mortality effect on bees over 7 days (9).

Innocuous to bees at 12.5 g ha⁻¹, although there was a repellent effect due to the formulating materials which lasted 2-3 hr (10).

No field effects observed in birds after use to control insects, tsetse fly and blackfly (11,12).

The filtering behaviour of freshwater mussels was studied during short-term (30 min) and long-term (1 wk) exposure to deltamethrin. During short-term exposure 1 and 5 μ g l⁻¹ caused an increase in filter feeding, whereas 10 to 50 μ g l⁻¹ resulted in a decrease. During long-term exposure 1 μ g l⁻¹ caused no effect whereas 10 to 50 μ g l⁻¹ caused inhibition of filtration activity by reducing active periods of the adductor muscles (13).

Bioaccumulation

The accumulation of deltamethrin in *Chlorella*, *Daphnia magna*, *Cyprinus carpio* and *Poecilia reticulata* was examined. Deltamethrin accumulated in *Chlorella* but not in *Daphnia magna* or fish (14).

Environmental fate

Degradation studies

In soil, undergoes microbial degradation within 1-2 wk. Biodegradation takes place especially after the hydrolysis of the ester bond, forming 3-phenoxybenzoic acid and 3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylic acid and subsequently 3-(2-hydroxyphenoxy)benzoic acid, benzoic acid and 3-(4-hydroxyphenoxy)benzoic acid (1,15).

Adsorption and retention

Strongly absorbed by soil colloids (15).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 3450 mg kg⁻¹ (16).

LD₅₀ oral ♀, ♂ rat 30-50 mg kg⁻¹ (in vegetable oil) (17,18).

LD₅₀ oral rat >5000 mg kg⁻¹ (in aqueous solution) (15).

LC₅₀ (6 hr) inhalation rat 0.6 mg l⁻¹ air (2).

LC₅₀ (1 hr) inhalation rat >4.6 mg l⁻¹ air (2).

LD₅₀ intravenous ♀ rat 4 mg kg⁻¹ (18).

LD₅₀ dermal rat, rabbit >2000 mg kg⁻¹ (2).

Sub-acute and sub-chronic data

In rats given up to 10 mg kg⁻¹ by gavage day⁻¹ for 13 wk, slight hyperexcitability was noted in some animals at the highest dose. Lower body weight gain was noted in ♂ at 2.5 and 10 mg kg⁻¹. No other treatment-related effect was reported. In dogs similarly treated over 13 wk, dilated pupils were seen at doses of 2.5 and 10 mg kg⁻¹ day⁻¹. The incidence of vomiting increased dose-dependently at doses from 1 mg kg⁻¹. The central nervous system was the main target of toxicity with various neurological symptoms at the higher doses. No histopathological lesion was found, neither was any other toxic effect recorded (19).

LD₅₀ (8 day) oral mallard duck >4640 mg kg⁻¹ (15).

LD₅₀ (8 day) oral quail >10,000 mg kg⁻¹ (15).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans, IARC classification group 3 (20).

In 24 month studies, no treatment-related non-neoplastic effect was found in mice fed up to 100 mg kg⁻¹ diet daily or up to 8 mg kg⁻¹ by gavage on 5 day wk⁻¹. In rats fed up to 50 mg kg⁻¹ diet for 24 months no significant treatment-related non-neoplastic effect was noted, except for slightly reduced weight gain at the 50 mg kg⁻¹ dose level. In dogs given up to 40 mg kg⁻¹ in the diet for 24 months, no treatment-related non-neoplastic effect was noted (19).

Mice were given 1 or 4 mg kg⁻¹ by gavage day⁻¹ on 5 day wk⁻¹ for 104 wk. Further groups received 8 mg kg⁻¹ day⁻¹ for 104 wk. A survival rate of 40-64% was similar in treated and control groups except in high dose ♀ of which only 32% were alive at 120 wk. There was no increase in the incidence of tumours at any site in the treated groups. In a parallel study, rats were administered 0, 3 or 6 mg kg⁻¹ by gavage. In all groups 60% or more were alive at 120 wk. The incidence of thyroid adenomas in ♂ was 19/50 in the group that received 3 mg kg⁻¹ and 14/49 in ♀ in the group that received 6 mg kg⁻¹, compared with 6/48 ♂ and 4/47 ♀ in controls, respectively (21).

Teratogenicity and reproductive effects

Mice were given 0, 3, 6 or 12 mg kg⁻¹ by gavage on days 7-16 of gestation and to rats at 0, 1.25, 2.5 or 5.0 mg kg⁻¹ by gavage on days 7-20 of gestation. In mice there was a dose-dependent decrease in maternal weight and an increase in supernumerary ribs; however, there was no effect on number of implantation sites, perinatal mortality, foetal weight, ossification centres, or visceral abnormalities. In rats there was a dose-dependent decrease in maternal body weight with no effect on foetal parameters (17).

In a screening test in ♀ mice, animals were treated with a minimally maternally toxic dose of 14 mg kg⁻¹ day⁻¹ by oral intubation on days 8-12 of gestation. Although maternal weight gain was decreased, there was no effect on neonatal survival or weight gain (22).

A repeat study using similar procedures at 10 mg kg⁻¹ day⁻¹ suggested an effect on neonatal survival (20,23). Treatment of quail eggs by immersion in aqueous emulsions (equivalent to 0-1.5 g active ingredient in 110 litres applied ha⁻¹) on days 0, 4 or 14 of incubation had no effect on hatchability or developmental malformation. An effect on incubation time was seen at the highest concentration when given at the preincubation stage (24).

Metabolism and toxicokinetics

Cutaneous and gastrointestinal absorption of deltamethrin in humans has been demonstrated after acute poisoning from occupational exposure or ingestion. Presence of the metabolite 3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylate has been reported in the urine of people with acute deltamethrin intoxication (25).

The metabolism of this compound has been studied in rats *in vivo* and *in vitro* and shown to occur via ester hydrolysis, oxidation, hydroxylation and conjugation (19,20).

Deltamethrin was labelled with ¹⁴C in the dibromovinyl substituent or in the benzylic carbon and administered orally to rats. 8 days later, the highest concentrations were retained in fat tissue, regardless of the labelling position, suggesting that unmetabolised deltamethrin is retained in the fat. When the ¹⁴C label was in the cyano group, the greatest ¹⁴C activity was found in the skin and stomach and, in the rat, also in the intestine and blood due to remaining thiocyanate. In rats, 80-90% of the radiolabel was eliminated within 24 hr. When the ¹⁴C label was in the cyano group, elimination was slower. In general unmetabolised deltamethrin and hydroxylated metabolites were excreted in the faeces, while more polar hydrolysis products and conjugates were eliminated in the urine. Mice had a somewhat slower rate of elimination than rats (48-60% within 24 hr) (26,27).

Sensitisation

Weak allergenic effect in Magnusson and mast cell degranulation tests (28).

Genotoxicity

Salmonella typhimurium TA98, TA100 with and without metabolic activation negative (29).

Escherichia coli WP2 with and without metabolic activation negative; *Saccharomyces cerevisiae* D3, DNA damage with and without metabolic activation negative (17).

Induced chromosomal aberrations in root meristem cells of *Allium cepa* (30).

Did not induce gene mutation in Chinese hamster V79 cells, with and without metabolic activation (29).

Induced chromosomal aberrations and micronucleus formation in bone marrow cells of mice *in vitro* (31).

No chromosomal aberration was observed in mouse bone marrow cells *in vivo* (32), but morphological sperm abnormalities were induced in mice (31).

Statistically significant modest induction of sister chromatid exchanges in mouse bone marrow following oral exposure to 20 mg kg⁻¹ (33).

Other effects

Other adverse effects (human)

Among 325 cases of deltamethrin intoxication reviewed from Chinese literature, common findings included paraesthesia (particularly involving the face), dizziness, headache, nausea, anorexia and fatigue. Less common findings included chest tightness, palpitations, blurred vision, increased sweating and low-grade fever. Muscular fasciculations, convulsions and coma were reported in some of those more severely poisoned. Two deaths from convulsions were reported (25).

A cross-sectional survey of the prevalence of acute pyrethroid poisoning in cotton farmers was conducted in 1987 and 1988. A total of 3113 pyrethroid sprayers (2230 men (71.6%) and 883 women (28.4%)) were interviewed after spraying and followed up for 72 h. Adverse effects of pyrethroid exposure were found in 823 (26.8%), manifested as abnormal facial sensations, dizziness, headache, fatigue, nausea or loss of appetite. Dermal contamination is the main route of exposure to pyrethroids in cotton growers (34).

Any other adverse effects

Deltamethrin has been demonstrated to bind covalently to mammalian hepatic proteins *in vitro*, although the binding was less pronounced than that of cismethrin (35).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (36).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (37).

EC maximum residue limits: salad 0.5 ppm; fruit and other vegetables 0.2 ppm; cereals 1 ppm (2).

WHO Class II (38).

Tolerable daily intake (TDI) (human) 0.01 mg kg⁻¹ (2).

Other comments

Residues have been found in soil, crops and some animal tissues (1).

No residues were detectable in plants ~10 days after application (15).

Metabolites identified in plants include the 4'-hydroxylated ester, the *trans*-methyl hydroxylated ester, the dibromo acids with and without *trans*-methyl hydroxylation and *m*-phenoxybenzoic acid (15).

Of the 8 possible stereoisomers only 1*R*, 3*R*, *S* (benzyl) and 1*R*, 3*S*, *S* (benzyl) have insecticidal activity. The commercial product, deltamethrin, contains only the former, *cis*, isomer (20).

Physical properties, mode of action, toxicity, application, occurrence and environmental effects reviewed (1).

No field effects observed in birds after use to control insects, tsetse fly and blackfly (11,12).

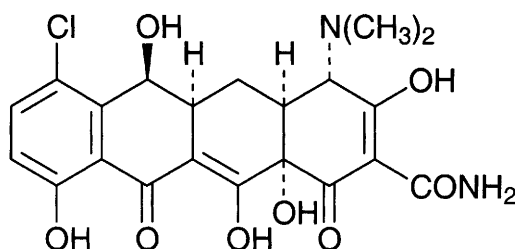
Chemical structure and biological activity reviewed (39).

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D47 demeclocycline



$C_{21}H_{21}ClN_2O_8$

Mol. Wt. 464.86

CAS Registry No. 127-33-3

Synonyms 7-chloro-6-demethyltetracycline; demethylchlortetracycline; 7-chloro-4-dimethylamino-1,4,4a,5,5a,6,11,12a-octahydro-3,6,10,12,12a-pentahydroxy-1,11-dioxo-2-naphthacenecarboxamide; methylchlorotetracycline; declomycin

EINECS No. 204-834-8

RTECS No. QI 7650000

Uses Antibiotic (as the hydrochloride).

Occurrence Obtainable from certain strains *Streptomyces aureofaciens*.

Physical properties

M. Pt. 174-178°C (decomp.)

Solubility Organic solvents: ethanol, methanol

Mammalian & avian toxicity

Acute data

LD₅₀ intraperitoneal rat 358 mg kg⁻¹ (1).

LD₅₀ intraperitoneal mouse 454 mg kg⁻¹ (1).

LD₅₀ intravenous mouse 79 mg kg⁻¹ (2).

Sub-acute and sub-chronic data

Oral administration at 20 mg kg⁻¹ day⁻¹ for 7 days to rhesus monkeys greatly inhibited bone growth but not dentine apposition (3).

Other effects

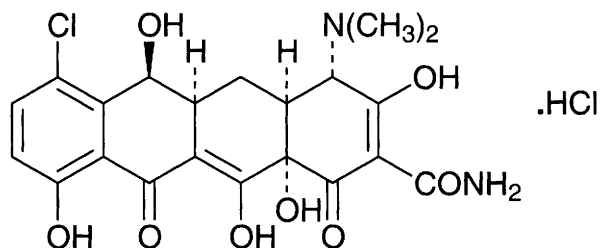
Any other adverse effects

Inhibited DNA synthesis in mitogen-induced lymphocyte proliferation test (4).

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D48 demeclocycline hydrochloride



C₂₁H₂₂Cl₂N₂O₈

Mol. Wt. 501.32

CAS Registry No. 64-73-3

Synonyms declomycin hydrochloride

EINECS No. 200-592-2

RTECS No. QI 7700000

Uses Antibiotic.

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 2370 mg kg⁻¹ (1).

LD₅₀ intravenous mouse 275 mg kg (2).

Metabolism and toxicokinetics

Widely distributed throughout the body in humans 36-91% bound to protein. 40-50% of oral dose excreted in urine unchanged. Large amounts excreted in faeces after oral administration but very little after intramuscular administration (3).

Human plasma t_{1/2} 10-15 hr (4).

Sensitisation

Photosensitivity of the skin and nails reported in human patients (5).

Other effects

Other adverse effects (human)

Reversible nephrogenic diabetes insipidus with polyuria, polydipsia and weakness may occur in human patients (5).

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D49 demeton

$C_8H_{19}O_3PS_2$

Mol. Wt. 258.34

CAS Registry No. 8065-48-3

Synonyms *O,O*-diethyl *O*-[2-(ethylthio)ethyl]phosphorothioate and *O,O*-diethyl *S*-[2-(ethylthio)ethyl]-phosphorothioate

RTECS No. TF 3150000

Uses Superseded insecticide and acaricide.

Physical properties

B. Pt. 134°C at 2 mmHg **Flash point** 45°C **Specific gravity** 1.1183 at 20°C with respect to water at 4°C

Volatility v.p. 2.6×10^{-4} mmHg at 20°C

Solubility Water: 2 g l⁻¹ at 25°C. Organic solvents: ethanol, propylene glycol, toluene

Occupational exposure

DE-MAK 0.01 ppm (0.11 mg m⁻³)

FR-VME 0.01 ppm (0.1 mg m⁻³)

US-TWA 0.01 ppm (0.11 mg m⁻³)

Supply classification very toxic, dangerous for the environment

Risk phrases Very toxic in contact with skin and if swallowed – Very toxic to aquatic organisms (R27/28, R50)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S28, S36/37, S45, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 3.2 mg l⁻¹ (1).

LC₅₀ (96 hr) bluegill sunfish 100 µg l⁻¹ (1).

Invertebrate toxicity

LC₅₀ (96 hr) *Gammarus fasciatus* 27 µg l⁻¹ (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral starling 13.3-39 mg kg⁻¹ (3).

LD₅₀ oral coturnix 13.3 mg kg⁻¹ (3).

LD₅₀ oral redwing blackbird 2.37-22 mg kg⁻¹ (3).

LD₅₀ oral ♀ rat 2.5 mg kg⁻¹ (4).

LD₅₀ oral ♂ rat 6.2 mg kg⁻¹ (4).

LD₅₀ dermal ♀ rat 8.2 mg kg⁻¹ (5).

LD₅₀ dermal ♂ rat 14 mg kg⁻¹ (4).

LD₅₀ subcutaneous mouse 15 mg kg⁻¹ (5).

A single exposure of rats to 18 mg m⁻³ was fatal, with survival periods of between 50-90 min (6).

Sub-acute and sub-chronic data

LC₅₀ 8 day dietary, ring-necked pheasant 665 mg kg⁻¹ (7).

LC₅₀ 8 day dietary, mallard duck 600 mg kg⁻¹ (7).

LC₅₀ 8 day dietary, bobwhite quail 596 mg kg⁻¹ (7).

LC₅₀ 8 day dietary, Japanese quail 275 mg kg⁻¹ (7).

Rats exposed to concentration of 3 mg m⁻³ for 2 hr each day showed no signs of ill-effects during the first exposure; tremors became apparent during the second; dehydration was noted during the third; more severe tremors were noted during the fourth exposure (6).

Teratogenicity and reproductive effects

Reported to be teratogenic in mice (8).

Metabolism and toxicokinetics

Following oral administration in mice, rapidly absorbed, metabolised and eliminated almost entirely within 4 hr. Mostly eliminated in urine. Principal metabolites in animals and plants are the oxidation products, sulfoxides and sulfones (9).

Readily absorbed through the skin (10).

Irritancy

Lachrymator (7).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1539, TA1538 positive (11).

Escherichia coli WP₂ *uvrA* reverse mutation assay positive (12).

Escherichia coli W3110/p3478 pol A assay without metabolic activation negative (13).

Bacillus subtilis H17/M45 rec assay without metabolic activation positive (13).

Induced sister chromatid exchanges in hamster cell line V79 (14).

Induced unscheduled DNA synthesis in human fibroblasts (WI-38 cells) (11).

Other effects

Other adverse effects (human)

Cholinesterase inhibition through phosphorylation of active site of enzyme. Ocular effects include miosis, blurring of distant vision, rhinorrhea and frontal headache (15).

Legislation

Maximum permissible concentration in domestic water in former USSR 0.1 mg l⁻¹ (16).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (17).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (18).

Other comments

Reaction product comprising demeton-O and demeton-S in the ratio of ~2:1.

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D50 demeton-methyl



$\text{C}_6\text{H}_{15}\text{O}_3\text{PS}_2$

Mol. Wt. 230.29

CAS Registry No. 8022-00-2

Synonyms methyl demeton; phosphoric acid, *O,O*-dimethyl *O*-[2-(ethylthio)ethyl] ester; [2-(ethylthio)ethyl] *O,O*-dimethyl phosphorothioate

RTECS No. TG 1760000

Uses Insecticide. Acaricide.

Physical properties

B. Pt. 89°C at 0.15 mmHg **Specific gravity** 1.207 at 20°C with respect to water at 4°C

Volatility v.p. 3×10^{-4} mmHg at 20°C

Solubility Water: 3300 mg l⁻¹ at 20°C. Organic solvents: acetone, dichloromethane, diethyl ether, ethanol, propan-2-ol

Occupational exposure

DE-MAK 0.5 ppm (4.8 mg m⁻³)

FR-VME 0.5 mg m⁻³

US-TWA 0.5 mg m⁻³

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) mirror carp 6.3-9.1 mg l⁻¹ (1).

LC₅₀ (24 hr) harlequin fish 9 mg l⁻¹ (2).

Invertebrate toxicity

LC₅₀ (96 hr) marine wedge clam 6.4 µg l⁻¹ (3).

LC₅₀ (24 hr) *Macrobrachium lamerrei* 1.6 mg l⁻¹ (4).

Environmental fate

Abiotic removal

Undergoes hydrolysis to give dimethyl phosphate (5).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 46, 65 mg kg⁻¹, respectively (5,6).

LC₅₀ (4 hr) inhalation cat 20 mg m⁻³ (6).

LD₅₀ dermal rat 300 mg kg⁻¹ (7).

LD₅₀ intravenous mouse 0.5-1.0 mg kg⁻¹ (8).

LD₅₀ intraperitoneal guinea pig 65 mg kg⁻¹ (9).

Carcinogenicity and chronic effects

In a 2-yr feeding trial the no-effect level for rats was 1 mg kg⁻¹ (demeton-S-methyl) (5).

Genotoxicity

Salmonella typhimurium TA98, TA102, TA1535 with and without metabolic activation negative (10).

Onion and barley chromosomal aberrations positive (11).

Other effects

Other adverse effects (human)

Inhibits cholinesterase activity (5).

Reported to cause alterations in intra-ocular pressure in various eye layers. Symptoms of acute poisoning include nausea, headache, dizziness, vomiting and hyperaemia of the nasal mucosa and membranes of the respiratory organs. It also causes inner ear irritations (12).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (13).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (14).

WHO Class 1b; EPA Toxicity Class 1. Tolerable daily intake (TDI) human 0.3 µg kg⁻¹. EEC MRL Carrots 0 ppm; other fruits and vegetables 0.4 mg kg⁻¹ (demeton-S-methyl) (5).

Other comments

In plants the thioethyl group is oxidised to give the sulfoxide and sulfone (5).

Physical properties, toxicity and safety precautions reviewed (15).

Consists of an isomeric mixture of demeton-O-methyl and demeton-S-methyl.

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D51 demeton-O



$\text{C}_8\text{H}_{19}\text{O}_3\text{PS}_2$

Mol. Wt. 258.34

CAS Registry No. 298-03-3

Synonyms phosphorothioic acid, *O,O*-diethyl *O*-[2-(ethylthio)ethyl] ester; demetonthione;
O,O-diethyl *O*-2-ethylthioethyl phosphorothioate

EINECS No. 206-053-8

RTECS No. TF 3125000

Uses Component of demeton. Insecticide. Acaricide.

Physical properties

B. Pt. 92-93°C at 0.15 mmHg **Specific gravity** 1.119 at 21°C with respect to water at 4°C

Volatility v.p. 2.86×10^{-4} mmHg at 20°C

Solubility Water: 60 mg l⁻¹ at 25°C. Organic solvents: ethanol, propylene, glycol, toluene

Occupational exposure

Supply classification very toxic, dangerous for the environment

Risk phrases Very toxic in contact with skin and if swallowed – Very toxic to aquatic organisms (R27/28, R50)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S28, S36/37, S45, S61)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 7.5 mg kg⁻¹ (1).

LD₅₀ subcutaneous mouse 15 mg kg⁻¹ (2).

LD₅₀ intraperitoneal hamster 10 mg kg⁻¹ (3).

Genotoxicity

In vivo Syrian hamster bone marrow cells chromosomal aberrations positive (4).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (5).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (6).

References

1. *Guide to Chemicals used in Crop Protection* 1973, 6, 161.
2. *Naunyn-Schmiedeburgs Arch. Exp. Pathol. Pharmacol.* 1953, 217, 144.
3. *Arch. Toxicol.* 1986, 58, 152.
4. Dzwonkowska, A. et al *Arch. Toxicol.* 1986, 58(3), 152-156.
5. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
6. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D52 demeton-O-methyl



$\text{C}_6\text{H}_{15}\text{O}_3\text{PS}_2$

Mol. Wt. 230.29

CAS Registry No. 867-27-6

Synonyms O-[2-(ethylthio)ethyl] O,O-dimethyl phosphorothioate; O-2-ethylthioethyl O,O-dimethyl phosphorothioate; methylmercaptofostion; methyl-mercaptofos

EINECS No. 212-758-1

RTECS No. TG 1650000

Uses Insecticide.

Physical properties

B. Pt. 89°C **Specific gravity** 1.207 at 20°C with respect to water at 4°C **Volatility** v.p. 3.61×10^{-4} mmHg at 20°C

Solubility Water: 3.3 g l⁻¹ at 20°C

Occupational exposure

Supply classification toxic

Risk phrases Toxic if swallowed (R25)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Avoid contact with the skin – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S24, S36/37, S45)

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 46, 75 mg kg⁻¹, respectively (1).

LD₅₀ intravenous rat 216 mg kg⁻¹ (2).

Other effects

Other adverse effects (human)

Produces alterations in intra-ocular pressure in various eye layers (3).

Inhibits cholinesterase activity (4).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (5).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (6).

Other comments

Reported to be less toxic than demeton-S-methyl (4).

References

1. *Farmakol. Toksikol.* (Moscow) 1959, 22, 559.
2. *Biochem. J.* 1957, 67, 187.
3. *Documentation of Threshold Limit Values* 5th ed., 1986, 388, ACGIH, Cincinnati, OH, USA.
4. Hayes, W. J. *Pesticide Studies in Man* 1982, 341, Williams & Wilkins, Baltimore, MD, USA.
5. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
6. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Substances and Processes) Regulations* 1991, HMSO, London, UK

D53 demeton-S



$\text{C}_8\text{H}_{19}\text{O}_3\text{PS}_2$

Mol. Wt. 258.34

CAS Registry No. 126-75-0

Synonyms *O,O*-diethyl *S*-[2-(ethylthio)ethyl] phosphorothioate; *O,O*-diethyl *S*-2-ethylthioethyl phosphorothioate

EINECS No. 204-801-8

RTECS No. TF 3130000

Uses Insecticide and acaricide.

Physical properties

B. Pt. 132-134°C at 2 mmHg **Specific gravity** 1.132 at 21°C with respect to water at 4°C

Volatility v.p. 2.6×10^{-4} mmHg at 20°C

Solubility Water: 2 g l⁻¹ at 25°C

Occupational exposure

Supply classification very toxic

Risk phrases Very toxic in contact with skin and if swallowed (R27/28)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S36/37, S45)

Ecotoxicity

Bioaccumulation

Freshwater Zebra mussels *Dreissena polymorpha* exposed to 10 mg l⁻¹ for 10 days reached body burden saturation levels of 60 mg kg⁻¹ within 7 days. Elimination of accumulated organophosphate was so low that an efficient metabolism of the pesticide was unlikely (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 10 mg kg⁻¹ (2).

LD₅₀ intraperitoneal rat, mouse 1.5, 1.9 mg kg⁻¹, respectively (2,3).

LD₅₀ subcutaneous mouse 6 mg kg⁻¹ (4).

LD₅₀ intravenous rat 1700 µg kg⁻¹ (5).

Teratogenicity and reproductive effects

Reported to be teratogenic in mammals and birds, with 10 mg kg⁻¹ the lowest teratogenic dose (6).

Metabolism and toxicokinetics

Oxidised to give the sulfoxide and sulfone (7).

Following oral administration in mice, principal elimination route was urine, 50-70% being eliminated within 24 hr, 90% of which was in the hydrolysed form (8).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (9).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (10).

Other comments

Component of the pesticide Demeton.

Detected in sewage sludge effluent and river and drinking waters.

References

1. Dauberschmidt, C. et al *Arch. Environ. Contam. Toxicol.* 1997, **33**(1), 42-46.
2. *AMA Arch. Ind. Health* 1956, **13**, 606.
3. *Bratisl. Lek. Listy* 1958, **38**, 151.
4. *Naunyn-Schmiedeburgs Arch. Exp. Pathol. Pharmacol.* 1953, **217**, 144.
5. *Biochem. Pharmacol.* 1961, **6**, 244.
6. Braun, A. G. et al *J. Toxicol. Environ. Health* 1983, **11**, 275.
7. *The Pesticide Manual* 6th ed., 1979, 154, British Crop Protection Council, Farnham, UK.
8. White-Stevens, R. *Pesticides in the Environment* 1971, **1** (Part 2), 157, Marcel Dekker, New York.
9. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
10. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D54 demeton-S-methyl



$\text{C}_6\text{H}_{15}\text{O}_3\text{PS}_2$

Mol. Wt. 230.29

CAS Registry No. 919-86-8

Synonyms S-[2-(ethylthio)ethyl] O,O-dimethyl phosphorothioate; S-2-ethylthioethyl O,O-dimethyl phosphorothioate; O,O-dimethyl S-(ethylmercapto)ethyl thiophosphate; O,O-dimethyl S-[2-(ethylthio)ethyl] phosphorothioate; isomethylsystox

EINECS No. 213-052-6

RTECS No. TG 1750000

Uses Insecticide and acaricide.

Physical properties

B. Pt. 74°C at 0.052 mmHg **Specific gravity** 1.207 at 20°C **Partition coefficient** log P_{ow} 1.32 at 20°C

Volatility v.p. 40 mPa at 20°C

Solubility Water: 22 g l⁻¹ at 20°C. Organic solvents: chloromethane, isopropanol, toluene

Occupational exposure

Supply classification toxic, dangerous for the environment

Risk phrases Toxic in contact with skin and if swallowed – Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R24/25, R51/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S28, S36/37, S45, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (48 hr) Japanese killifish, rainbow trout and carp, >10 mg l⁻¹ (1).

Invertebrate toxicity

Toxic to bees (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 40 mg kg⁻¹ (2).

LC₅₀ (4 hr) inhalation rat 0.13 mg l⁻¹ (3).

LD₅₀ intraperitoneal rat ~21 mg kg⁻¹ (1).

LD₅₀ percutaneous ♂ rat ~30 mg kg⁻¹ (3).

Carcinogenicity and chronic effects

No effect level, 2-yr feeding trial in rats and mice 1 mg kg⁻¹ diet (1).

No effect level, 1-yr feeding trial in dogs 1 mg kg⁻¹ diet (3).

Metabolism and toxicokinetics

In mammals, following oral administration, metabolism involves oxidation of the thioethyl group to give the sulfoxide (oxydemeton-methyl) and sulfone (demeton-S-methylsulfone), and hydrolysis to dimethyl phosphate. Rapidly eliminated in the urine. In plants the thioethyl group is also oxidised to give the sulfoxide and sulfone. Hydrolysis gives dimethyl phosphate (1).

Irritancy

Mild eye irritant (1).

Other effects

Other adverse effects (human)

Inhibits cholinesterase (4).

Produces alterations in intra-ocular pressure in various eye layers (5).

Among 673 cases of occupational intoxication, including 3 fatalities, symptoms included tremor, ataxia, Parkinsonism and/or hiccup (4).

Legislation

Maximum permissible concentration in domestic water in former USSR 0.01 mg l⁻¹ (1).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (6).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (7).

Tolerable Daily Intake (TDI) in humans 0.3 µg kg⁻¹ (sum of demeton-S-methyl, demeton-S-methylsulphon and oxydemeton-methyl).

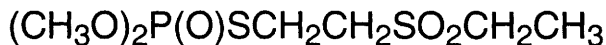
Other comments

Environmental health criteria reviewed (8).

References

1. *The Agrochemicals Handbook* 3rd ed., 1991, The Royal Society of Chemistry, London, UK.
2. *Farm Chemicals Handbook* 1989, C189, Meister Pub. Co., Willoughby, OH, USA.
3. *The Pesticide Manual* 11th ed., 1997, British Crop Protection Council, Farnham, UK.
4. Hayes, W. J. *Pesticide Studies in Man* 1982, 341, Williams & Wilkins, Baltimore, MD, USA.
5. *Documentation of Threshold Limiting Values* 5th ed., 1986, 388, ACGIH, Cincinnati, OH, USA.
6. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
7. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Substances) Regulations* 1991, HMSO, London, UK.
8. *Environmental Health Criteria No. 197: Demeton-S-methyl* 1997, WHO/IPCS, Geneva, Switzerland

D55 demeton-S-methyl sulfone



$\text{C}_6\text{H}_{15}\text{O}_5\text{PS}_2$

Mol. Wt. 262.29

CAS Registry No. 17040-19-6

Synonyms S-[2-(ethylsulfonyl)ethyl] O,O-dimethyl phosphorothioate; demeton-S-methylsulfon; dioxymeton-S-methyl; isometasystox sulfone

EINECS No. 241-109-5

RTECS No. TF 9050000

Uses Systemic insecticide and acaricide.

Occurrence Metabolite of demeton-S-methyl.

Physical properties

M. Pt. 51.6°C **B. Pt.** 120°C at 0.03 mmHg **Specific gravity** 1.416 at 20°C with respect to water at 4°C

Volatility v.p. 4.2×10^{-7} mmHg at 20°C

Solubility Water: >200 g l⁻¹ at 20°C. Organic solvents: alcohols, ketones and most chlorinated hydrocarbons

Occupational exposure

Supply classification toxic

Risk phrases Harmful in contact with skin – Toxic if swallowed (R21, R25)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Do not breathe dust – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S22, S28, S36/37, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (duration unspecified) orfe 102 mg l⁻¹ (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 30, 38 mg kg⁻¹, respectively (1).

LC₅₀ (4 hr) inhalation rat 0.2 mg l⁻¹ (1).

LD₅₀ dermal rat ~500 mg kg⁻¹ (1).

LD₅₀ intraperitoneal rat ~20.8 mg kg⁻¹ (1).

Carcinogenicity and chronic effects

In 2-yr feeding study in rats, the no-effect level was 1 mg kg⁻¹ (1).

Metabolism and toxicokinetics

In mammals, following oral administration, rapidly eliminated predominantly in urine (1).

Irritancy

Mild eye irritant (1).

Other effects

Other adverse effects (human)

Fasciculations and general weakness that required mechanical ventilation for 7-11 days suffered by patients who had attempted suicide by ingestion (2).

Cholinesterase inhibitor (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration $0.1 \mu\text{g l}^{-1}$ (3).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

Human Tolerable Daily Intake (TDI) $0.3 \mu\text{g}$ (sum of demeton-S-methylsulfon, demeton-S-methyl and oxydemeton-methyl) (1).

Other comments

In plants, oxidation and hydrolysis yields dimethyl phosphate and phosphonic acid (1).

References

1. *The Agrochemicals Handbook* 3rd ed., 1991, The Royal Society of Chemistry, London, UK.
2. Besser, R. et al *Arch. Toxicol.* 1989, **63**(5), 412-415.
3. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
4. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D56 demeton-S sulfone



$\text{C}_8\text{H}_{19}\text{O}_5\text{PS}_2$

Mol. Wt. 290.34

CAS Registry No. 2496-91-5

Synonyms *O,O*-diethyl S-[2-(ethylsulfonyl)ethyl] phosphorothioate; phosphorothioic acid, *O,O*-diethyl S-[2-(ethylsulfonyl)ethyl] ester; demeton sulfone; demeton thiol sulfone; isosystox sulfone

RTECS No. TF 2976000

Uses Insecticide.

Mammalian & avian toxicity

Acute data

LD_{50} oral rat 1.9 mg kg^{-1} (1).

LD_{50} intraperitoneal rat 1.8 mg kg^{-1} (1).

Legislation

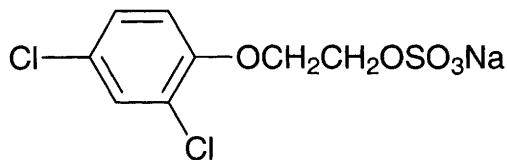
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration $0.1 \mu\text{g l}^{-1}$ (2).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (3).

References

1. *AMA Arch. Ind. Health* 1956, **13**, 606.
2. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
3. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D57 2,4-DES-sodium



$C_8H_7Cl_2NaO_5S$

Mol. Wt. 309.10

CAS Registry No. 136-78-7

Synonyms 2-(2,4-dichlorophenoxy)ethyl hydrogen sulfate, sodium salt; disul-sodium

EINECS No. 205-259-5

RTECS No. KK 4900000

Uses In herbicidal formulations.

Physical properties

M. Pt. 170°C Specific gravity 1.70 at 20°C Volatility v.p. 0.1 mmHg at 20°C

Solubility Water: 250 g kg⁻¹. Organic solvents: acetone, benzene, methanol

Occupational exposure

FR-VME 10 mg m⁻³

UK-LTEL 10 mg m⁻³

US-TWA 10 mg m⁻³

UK-STEL 20 mg m⁻³

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 730 mg kg⁻¹ (1).

Carcinogenicity and chronic effects

In 2 yr feeding trials rats receiving 2000 mg kg⁻¹ diet suffered no ill-effects (1).

Irritancy

Irritating to skin and respiratory system (2).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (3).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

Other comments

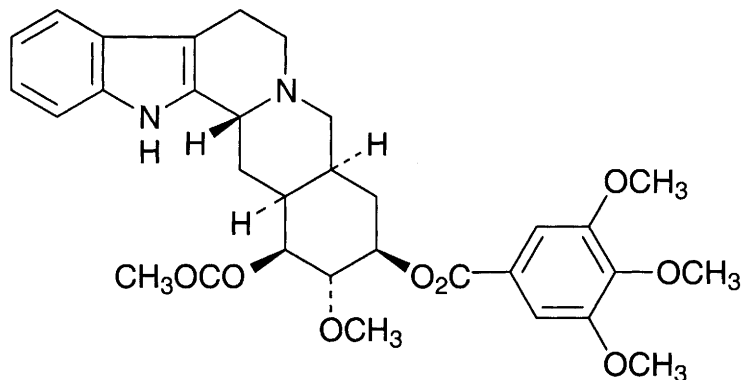
Health hazards and safety reviewed (5).

2,4-DES-sodium is not itself phytotoxic but is converted in moist soil into 2-(2,4-dichlorophenoxy)ethanol which is oxidised to 2,4-D. It is used as a mixture with simazine (1).

References

1. *The Pesticide Manual* 7th ed., 1983, 165, British Crop Protection Council, Farnham, UK.
2. *The Agrochemicals Handbook* 1st ed., 1983, The Royal Society of Chemistry, London, UK.
3. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
4. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
5. *Dangerous Prop. Ind. Mater. Rep.* 1987, 7(5), 92-94

D58 deserpidine



$C_{32}H_{38}N_2O_8$

Mol. Wt. 578.66

CAS Registry No. 131-01-1

Synonyms 11-desmethoxyreserpine; methyl 11-demethoxy-18-O-(3,4,5-trimethoxybenzoyl)reserpate; (3 β ,16 β ,17 α ,18 β ,20 α)-17-methoxy-18-[(3,4,5-trimethoxybenzoyl)oxy]-yohimban-16-carboxylic acid, methyl ester; canescine; raunormine; recanescine; reserpidine; deserpine

EINECS No. 205-004-8

RTECS No. ZG 0875000

Uses Antihypertensive agent.

Occurrence An ester alkaloid isolated from the root of *Rauwolfia canescens* and from *Penicillium* and other fungi.

Physical properties

M. Pt. α -form 228-232°C; β -form 230-232°C; γ -form 138°C

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 500 mg kg⁻¹ (1).

LD₅₀ intraperitoneal mouse 60 mg kg⁻¹ (1).

LD₅₀ intravenous rat 15 mg kg⁻¹ (2).

Carcinogenicity and chronic effects

TD_{Lo} oral woman, 9 yr continuously, neoplastic effects 16 mg kg⁻¹ (3).

TD_{Lo} oral rat, 77 wk continuously, carcinogenic effects 54 mg kg⁻¹ (4).

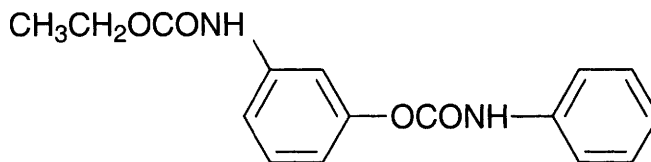
Teratogenicity and reproductive effects

TD_{Lo} rat (6-16 days of pregnancy) reproductive effects 5 mg kg⁻¹ (route of administration unspecified) (5).

References

1. J. Am. Pharm. Assoc. 1955, **44**, 688.
2. Usdin, E. et al *Physiotropic Drugs and Related Compounds* 2nd ed., 1972, 104, Washington, DC, USA.
3. *Lancet* 1974, ii, 672.
4. C. R. Hebd. *Seances Acad. Sci.* 1962, **254**, 1535.
5. C. R. *Seances Soc. Biol. Ses Fil.* 1961, **155**, 2291

D59 desmedipham



C₁₆H₁₆N₂O₄

Mol. Wt. 300.31

CAS Registry No. 13684-56-5

Synonyms 3-[[[(phenylamino)carbonyl]oxy]phenyl]carbamic acid, ethyl ester;
ethyl 3-phenylcarbamoyloxyphenylcarbamate; ethyl 3'-phenylcarbamoyloxycarbanilate;
3-ethoxycarbonylamino-phenyl-N-phenylcarbamate; betanex; EP 475

EINECS No. 237-198-5

RTECS No. FD 0425000

Uses Selective postemergence herbicide used to control various annual weeds.

Physical properties

M. Pt. 120°C **Partition coefficient** log P_{ow} 3.39 at pH 5.9 (1) **Volatility** v.p. 3×10^{-6} mmHg at 25°C

Solubility Water: 7 mg l⁻¹ at pH 7, 20°C. Organic solvents: acetone, benzene, chloroform, ethyl acetate, hexane, isophorone, methanol, toluene

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout 1.7 mg l⁻¹ (1).

LC₅₀ (96 hr) 6.0 mg l⁻¹ (1).

Invertebrate toxicity

EC₅₀ (48 hr) *Daphnia* 1.88 mg l⁻¹ (2).

Environmental fate

Degradation studies

t_{1/2} in soil is >20 days with the formation of ethyl 3-hydroxycarbanilate, which undergoes further microbial degradation to carbon dioxide (1,3).

Abiotic removal

Desmedipham is hydrolysed in neutral and alkaline media; 50% hydrolysis occurs in 31 days at pH 5, in 14 hr at pH 7 and in 21 min at pH 9 (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat >10.25 g kg⁻¹ (1).

LD₅₀ oral mouse >5000 mg kg⁻¹ (2).

LD₅₀ oral quail 2480 mg kg⁻¹ (4).

LC₅₀ (4 hr) rat >7.4 mg l⁻¹ (1).

LD₅₀ dermal rabbit 2025-10,250 mg kg⁻¹ (16% EC formulation) (1).

Sub-acute and sub-chronic data

LC₅₀ (5 day) oral mallard duck, bobwhite quail >10,000 mg kg⁻¹ diet (1).

Carcinogenicity and chronic effects

In 2-yr feeding trials no-effect level for rats was 60 mg kg⁻¹ diet, and for mice 1250 mg kg⁻¹ diet (1).

Metabolism and toxicokinetics

In mammals, following oral administration, 80% of the parent compound and its metabolites are eliminated in the urine within 24 hr (1).

Irritancy

Moderately toxic for eye irritation (EPA Toxicity Category III) (3).

Sensitisation

Practically non-toxic for dermal irritation (EPA Toxicity Category IV) (3).

Genotoxicity

Did not increase the rate of chromosomal aberrations in rat bone marrow *in vivo* (5).

Other effects

Any other adverse effects

Chronic inhalation and internal administration to albino rats induced changes in ECG and integral rheology of the cardiovascular system (6).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (7).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (8).

WHO Class Table 5 (9).

EPA Toxicity Class III (2).

Other comments

Residues have been found in water and on crops.

Inhibits photosynthesis (1).

In sugar beet, ethyl *N*-(3-hydroxyphenyl)carbamate is the major metabolite, with *m*-aminophenol as a further metabolite (1).

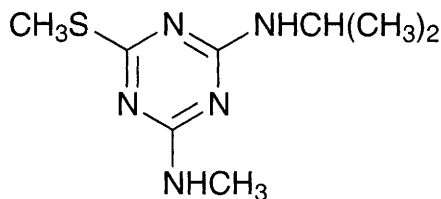
EPA considers the risk of desmedipham to aquatic plants and animals is minimal and that the acute risk to insects, birds, and mammals is also minimal. A low to moderate chronic risk to birds exists, but the chronic risk to mammals is minimal (3).

Metabolic pathways reviewed (10).

References

1. *The Agrochemicals Handbook* 3rd ed., 1991, The Royal Society of Chemistry, London, UK.
2. *The Pesticide Manual* 10th ed., 1994, British Crop Protection Council, Farnham/The Royal Society of Chemistry, Cambridge, UK.
3. *Prevention, Pesticides and Toxic Substances (7508W)*, March 1996, United States Environmental Protection Agency, EPA-738-F-96-006.
4. *Wirksubstanzen der Pflanzenschutz und Schadlingsbekämpfungsmittel* 1976, 71, Verlag Paul Parey, Berlin, Germany.
5. Babayan, E. A. et al *Biol. Zh. Arm.* 1987, **40**(1), 62-67 (Russ.) (*Chem. Abstr.* **107**, 2398n).
6. Egiazaryan, A. R. *Zh. Eksp. Klin. Med.* 1990, **30**(2), 193-199 (Russ.) (*Chem. Abstr.* 1991, **114**, 116621e).
7. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
8. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
9. *The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification* 1998-1999 WHO/PCS/98.21.
10. Roberts, T.R. et al (Eds.) *Metabolic Pathways of Agrochemicals. Part 1: Herbicides and Plant Growth Regulators* 1998, The Royal Society of Chemistry, Cambridge, UK

D60 desmetryn



$C_8H_{15}N_5S$

Mol. Wt. 213.31

CAS Registry No. 1014-69-3

Synonyms 2-isopropylamino-4-methylamino-6-methylthio-1,3,5-triazine; *N*²-isopropyl-*N*⁴-methyl-6-methylthio-1,3,5-triazine-2,4-diamine; *N*-methyl-*N*¹-(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine; Desmetryne; Semeron

EINECS No. 213-800-1

RTECS No. XZ 0175000

Uses Systemic herbicide.

Physical properties

M. Pt. 84-86°C **Specific gravity** 1.172 (20°C) **Partition coefficient** log P_{ow} 2.38 (1) **Volatility** v.p. 1×10^{-6} mmHg at 20°C

Solubility Water: 580 mg l⁻¹ at 20°C. Organic solvents: acetone, dichloromethane, hexane, methanol, toluene, octanol

Occupational exposure

Supply classification harmful

Risk phrases Harmful in contact with skin and if swallowed (R21/22)

Safety phrases Keep out of reach of children (if sold to general public) – Wear suitable protective clothing and gloves (S2, S36/37)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout, common carp 2.2, 3.7 mg l⁻¹, respectively (1).

Invertebrate toxicity

LC₅₀ (48 hr) *Daphnia* 45 mg l⁻¹ (1).

LC₅₀ (72 hr) *Scenedesmus subspicatus* 0.004 mg l⁻¹ (1).

Not toxic to bees (1).

Environmental fate

Degradation studies

In soil, involves oxidation of methylthio group to sulfoxide and sulfone hydrolysis with the introduction of a 2-hydroxy group, dealkylation at the substituted amino groups, cleavage of the amine moiety and ring opening. Duration of residual activity ~3 months (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1390 mg kg⁻¹ (1).

LD₅₀ oral mouse 1750 mg kg⁻¹ (1).

LC₅₀ (1 hr) inhalation rat 1563 mg l⁻¹ air (1).

LD₅₀ dermal rat 2000 mg kg⁻¹ (1).

Sub-acute and sub-chronic data

In 90-day feeding studies in rats and dogs, no-effect level was 200 mg kg⁻¹ diet (1).

Metabolism and toxicokinetics

Rapidly absorbed and metabolised following oral ingestion. Dealkylation at the amino group and side chain oxidation are predominant detoxification reactions. May also undergo sulfoxidation followed by reaction with hepatic glutathione to yield mercapturic acid derivatives (2).

Irritancy

When applied to rabbit skin produced mild effects (3).

Genotoxicity

Salmonella typhimurium TA1535, TA1537, TA1538, TA98, TA100 with and without metabolic activation negative (4).

Bacillus subtilis MA5 DNA damage assay negative (5).

Saccharomyces cerevisiae mutagenicity assay negative. *Saccharomyces cerevisiae* intragenic mitotic recombination assay positive (6).

Other effects

Any other adverse effects

Inhibits lactate dehydrogenase activity in soya bean seed and bovine heart *in vitro* (7).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (8).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (9).

WHO Class III (10).

EPA Toxicity Class III (1).

Other comments

Inhibits photosynthesis (1).

Herbicidal action is due to inhibition of Hill reaction necessary for plant respiration (2).

Metabolic pathways reviewed (11).

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D61 deuterium



D_2

Mol. Wt. 4.03

CAS Registry No. 7782-39-0

Synonyms heavy hydrogen; $^2\text{H}_2$

EINECS No. 231-952-7

Uses Fusion reaction fuel. Laser gas. UV light source.

Physical properties

M. Pt. -249°C B. Pt. -249°C Specific gravity 0.169 at -253°C Volatility v.p. 129 mmHg

Occupational exposure

UN No. 1957 Conveyance classification flammable gas

Other effects

Any other adverse effects

Replacement of more than 33% of hydrogen in body water of mammals is reported to have catastrophic consequences. In rats and mice lower levels have resulted in sterility, neuromuscular disturbances, fine muscle tremors, and a tendency to convulsions. Impairment of kidney function, anaemia, disturbed carbohydrate metabolism, central nervous system disturbances and altered adrenal function were found in mice. Haemoglobin, red blood cell count, serum glucose and cholesterol all decreased in deuterated dogs (1).

Has been reported to stunt growth of mammals when consumed regularly as heavy water (2).

Other comments

Replacement of more than 66% of hydrogen in higher green plants is reported to have catastrophic consequences. However, green and blue/green algae have been grown in which >99.5% of the hydrogen has been replaced by deuterium.

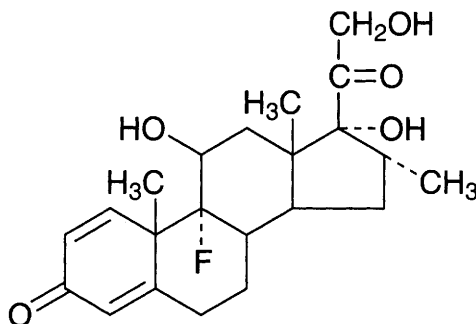
Numerous varieties of bacteria, moulds, fungi, and some protozoans have been successfully grown in fully deuteriated form (1).

Occurrence ~0.0145% of total hydrogen.

References

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D62 dexamethasone



$C_{22}H_{29}FO_5$

Mol. Wt. 392.47

CAS Registry No. 50-02-2

Synonyms (11 β ,16 α)-9-fluoro-11,17,21-trihydroxy-16-methylpregna-1,4-diene-3,20-dione; 9-fluoro-11 β ,17,21-trihydroxy-16 α -methylpregna-1,4-diene-3,20-dione; prednisolone F; Superprednol; Decaderm; Dexacont; Dexason; hexadrol; Visumetazone

EINECS No. 200-003-9

RTECS No. TU 3980000

Uses Adrenocortical steroid. Glucocorticoid. Anti-inflammatory. Anti-allergy agent. Growth hormone.

Physical properties

M. Pt. 262-264°C **Partition coefficient** log P_{ow} 1.99 (1)

Solubility Water: 100 mg l⁻¹ at 25°C. Organic solvents: acetone, chloroform, diethyl ether, dioxane, methanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat >3 g kg⁻¹ (2).

LD₅₀ intraperitoneal rat 54 mg kg⁻¹ (2).

LD₅₀ intraperitoneal mouse 410 mg kg⁻¹ (3).

LD₅₀ subcutaneous rabbit 7.2 mg kg⁻¹ (2).

LD₅₀ subcutaneous rat 14 mg kg⁻¹ (4).

Sub-acute and sub-chronic data

The effects of dexamethasone on the healing of wound holes made in parietal bone of 4 wk old rats and on the growth of femurs were studied. The drug was administered subcutaneously at 0.5, 1.0 and 2.0 mg kg⁻¹ day⁻¹ for 1, 2 and 4 wk. The regeneration of the uncalcified area of the wound holes was delayed. Administration for 1 wk resulted in a weak inhibition of new growth of blood vessels into the wound hole. Inhibition was stronger by wk 2. Dexamethasone may inhibit wound healing by the retardation of mineralisation, which is closely linked to the inhibition of reconstruction of blood vessels in the wound hole. The growth of the femur was strongly inhibited; the normal age-dependent mineralisation of the femur was clearly inhibited (5).

Sheep were infused with 100 mg day⁻¹ for 5 days. Mean arterial blood pressure was increased. The activity of the pressor and mineralocorticoid activity was demonstrated by urinary excretion of sodium (6).

The effects of dexamethasone, administered at 0.1 or 1.0 mg kg⁻¹ 2 × day⁻¹ for 4 or 5 days, on the immune response of weaned pigs to a viral antigen (hog cholera) or a *Salmonella* antigen were studied. Antibody formation was inhibited in response to both antigens. The lower the antigen dose, the greater was the corticosteroid effect (7).

Oral rat 10 mg kg⁻¹ day⁻¹ for 21 days resulted in inhibition of (pro)insulin biosynthesis and immunoreactive insulin release by isolated islets (8).

Intraperitoneal rat 1 mg kg⁻¹ day⁻¹ for 10 days caused destructive changes in muscle fibres. In white muscle

fibres, damage involved mainly the myofibril apparatus, whereas in red muscle both fibrils and mitochondria were damaged. Cell elements of blood vessel walls were also damaged, e.g. swelling of some capillary endotheliocytes and widening of endoplasmic reticulum tubules of arteriole endotheliocytes and smooth muscle cells (9).

Administration of 10 mg kg⁻¹ day⁻¹ for 8 days (route not specified) to rats led to a decrease in body weight due to a 50% decrease in feed intake. Treated rats showed a marked increase in total lipids and triglycerides in their livers. Glycogen infiltration and fatty changes in the liver, degenerative changes and necrosis in the myocardium, nephrosis in kidneys, marked depletion of lymphoid tissue in the spleen and lymph nodes, and atrophy of exocrine and endocrine pancreas were the histopathological changes observed (10).

Teratogenicity and reproductive effects

Negative for inhibition of intercellular communication in the V79 cell metabolic assay used as a screen *in vitro* for developmental toxicants (11).

Pregnant rhesus monkeys were given 1.0 or 10.0 mg kg⁻¹ dexamethasone sodium phosphate on days 20-50 of gestation. Minor cranial skeletal abnormalities consistent with glucocorticoid-mediated teratogenesis were observed (12).

Metabolism and toxicokinetics

Adult ♂ volunteers were administered 10 mg orally. The major urinary excretion products were isomeric 6-hydroxy metabolites. Dexamethasone and its 20-hydroxy metabolite were found in minor quantities (13). Dexamethasone has been found to cross the human placenta. An enzyme in the placenta forms an 11-keto metabolite; a greater ratio of metabolite:dexamethasone was found during early pregnancy in the foetal circulation than in the maternal circulation (14).

Other effects

Other adverse effects (human)

Dexamethasone (1 to 10 nM) caused significant inhibition of monokine and lymphokine secretion in human whole blood cell cultures (15).

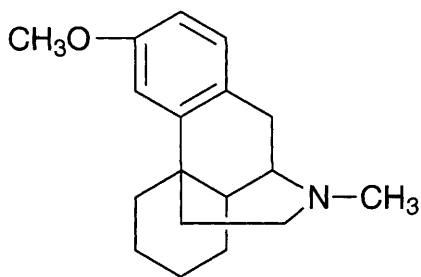
Any other adverse effects

Administration to rats (route and dose not specified) produced structural alterations and vasodilation in the liver. There was an increase in glycogen, lipids, nuclear size and lactate dehydrogenase activity and a decline in the enzymic activity of glucose-6-phosphatase, phosphorylase and succinate dehydrogenase (16).

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D63 dextromethorphan



C₁₈H₂₅NO

Mol. Wt. 271.40

CAS Registry No. 125-71-3

Synonyms 3-methoxy-*N*-methylnorphinan (+)-form

EINECS No. 204-752-2

RTECS No. QD 0194000

Uses Antitussive.

Physical properties

Solubility Organic solvents: chloroform

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 210 mg kg⁻¹ (1).

LD₅₀ subcutaneous mouse 112 mg kg⁻¹ (2).

Metabolism and toxicokinetics

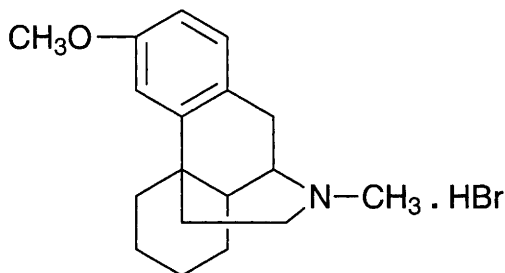
Phase I metabolism results in *N*-demethylation and *O*-demethylation; phase II metabolism leads to conjugation with sulfate and degradation to morphinan structure (3).

Urinary metabolites studied in human volunteers given 50 mg dextromethorphan orally. The main biotransformation pathways are *O,N*-demethylation, *O,N*-acetylation and hydroxylation of the phenol ring and the saturated ring system with subsequent oxidation (4).

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D64 dextromethorphan hydrobromide



C₁₈H₂₆NOBr

Mol. Wt. 352.31

CAS Registry No. 125-69-9

EINECS No. 204-750-1

RTECS No. QD 0222000

Uses Antitussive.

Physical properties

M. Pt. 122-124°C

Solubility Water: 16.7 g l⁻¹. Organic solvents: ethanol, chloroform

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 350 mg kg⁻¹ (1).

LD₅₀ oral mouse 165 mg kg⁻¹ (2).

LD₅₀ subcutaneous rat 423 mg kg⁻¹ (3).

LD₅₀ intravenous mouse 34 mg kg⁻¹ (3).

LD₅₀ intravenous rabbit 15 mg kg⁻¹ (2).

Metabolism and toxicokinetics

In humans, readily absorbed from gastrointestinal tract, metabolised in liver and excreted in urine as unchanged dextromethorphan and demethylated metabolites, including dextrophan (4).

Irritancy

May cause skin irritation (1).

Other effects

Other adverse effects (human)

Exposure can cause gastrointestinal disturbance and central nervous system depression (1).

In humans acute overdose, as for any narcotic drug, may result in respiratory arrest and coma, with an initial clinical presentation of pinpoint pupils, hypertension, bradycardia and respiratory depression, urinary retention, muscle spasm and itching (5).

Human volunteers were exposed to 40 ppm for 2 hr. Peripheral blood lymphocytes were examined for chromosomal aberrations before and after exposure. No significant differences were observed (6).

Produces very slight psychic dependence but not physical dependence of the morphine type (7).

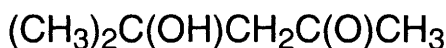
Interaction with anti-depressant phenylzinc sulfate reported to be probable cause of death of a woman (8).

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7. 17th Report WHO Expert Committee on Drug Dependence WHO Tech. Rep. Ser. No. 437, 1970.
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D65 diacetone alcohol



$\text{C}_6\text{H}_{12}\text{O}_2$

Mol. Wt. 116.16

CAS Registry No. 123-42-2

Synonyms diacetone; 2-methylpentanol-2-ol-4-one; diketone alcohol; 4-hydroxy-4-methyl-2-pentanone; 4-hydroxy-2-keto-4-methylpentane; 4-hydroxy-4-methylpentan-2-one; dimethylacetonylcarbinal; DAA

EINECS No. 204-626-7

RTECS No. SA 9100000

Uses Used as a solvent for cellulose compounds, vinyl epoxy resins, waxes, fats and oils. It is a constituent of hydraulic brake fluids (1).

Occurrence

Isolated as a metabolite of methyl isobutylketone from guinea pig serum after intraperitoneal injection (2).

Physical properties

M. Pt. -44°C **B. Pt.** 167.9°C **Flash point** 64°C **Specific gravity** 0.931 at 20°C with respect to water at 4°C

Volatility v.p. 1 mmHg at 20°C ; v.den. 4.0

Solubility Water: 1000 g l⁻¹. Organic solvents: miscible with diethyl ether, ethanol

Occupational exposure

DE-MAK 50 ppm (240 mg m⁻³)

FR-VME 50 ppm (240 mg m⁻³)

SE-LEVL 25 ppm (120 mg m⁻³)

SE-STEL 50 ppm (240 mg m⁻³)

UK-LTEL 50 ppm (241 mg m⁻³)

UK-STEL 75 ppm (362 mg m⁻³)

US-TWA 50 ppm (238 mg m⁻³)

UN No. 1148 **HAZCHEM Code** 2ME (flash point $<23^\circ\text{C}$, initial boiling point $>35^\circ\text{C}$), 2M (flash point $\geq 23^\circ\text{C}$, $\leq 61^\circ\text{C}$, initial boiling point $>35^\circ\text{C}$) **Conveyance classification** flammable liquid

Supply classification irritant

Risk phrases Irritating to the eyes (R36)

Safety phrases Keep out of reach of children (if sold to general public) – Avoid contact with skin and eyes (S2, S24/25)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) bluegill sunfish (freshwater), inland silverside (saltwater) 420 mg l⁻¹ static bioassay at 23°C (3).

LC₅₀ (24 hr) goldfish >5000 mg l⁻¹ (4).

Invertebrate toxicity

EC₅₀ (48 hr) *Daphnia magna* 8750 mg l⁻¹ (5).

Toxicity threshold *Microcystis aeruginosa* 530 mg l⁻¹; *Scenedesmus quadricauda* 3000 mg l⁻¹; *Entosiphon sulcatum* 1400 mg l⁻¹; *Pseudomonas putida* 825 mg l⁻¹ (6,7).

Environmental fate

Degradation studies

ThOD 2.21 mg O₂ l⁻¹ (8).

BOD 0.07 mg O₂ l⁻¹ (8).

COD 2.11 mg O₂ l⁻¹ (8).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 3.95, 4.0 g kg⁻¹, respectively (9,10).

LD₅₀ dermal rabbit 13.5 g kg⁻¹ (11).

LD₅₀ intraperitoneal mouse 933 mg kg⁻¹ (12).

Irritancy

In humans exposure to 100 ppm (vapour) caused nose and throat irritation. Vapours also irritated eyes. Contact with the skin produced dermatitis and defatting (1).

Eye contact with the liquid causes transient corneal damage (13).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537, TA1538 with and without metabolic activation negative (14).

Saccharomyces cerevisiae JD1 mitotic gene conversion negative (14).

In vitro rat liver RL₄ cells chromosome assay positive (14).

Other effects

Any other adverse effects

Has a slightly greater narcotic effect than acetone (15).

In inhalation experiments, animals suffered narcosis causing decreased respiration, decreased blood pressure and muscle relaxation (9).

Ingestion (species unspecified) causes haemolysis and liver damage. Respiratory failure appears to be cause of death (16).

Oral rats (duration and dose unspecified) caused destruction of erythrocytes with reduction in haemoglobin (17).

Legislation

Organic solvents are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (18).

Other comments

Threshold odour concentration 0.28 ppm (19).

Rats are able to survive saturated air exposures of 1500 ppm (20).

Physicochemical properties, toxicity and hazards reviewed (21).

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D66 diacetyl peroxide



$\text{C}_4\text{H}_6\text{O}_4$

Mol. Wt. 118.09

CAS Registry No. 110-22-5

Synonyms acetyl peroxide

EINECS No. 203-748-8

RTECS No. AP 8500000

Uses Initiator and catalyst for resins.

Physical properties

M. Pt. 30°C B. Pt. 63°C at 21 mmHg Volatility v.p. 1.18 mmHg at 20°C

Solubility Water: miscible. Organic solvents: carbon tetrachloride, diethyl ether, ethanol

Mammalian & avian toxicity

Irritancy

Irritating to skin, eyes and mucous membranes (species unspecified) (1).

60 mg instilled into rabbit eye for 1 min caused severe irritation (2).

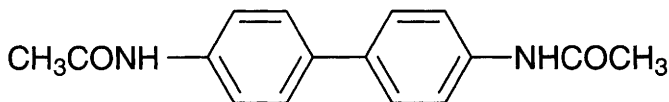
Legislation

Oxidising agents are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (3).

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D67 diacetylbenzidine



$C_{16}H_{16}N_2O_2$

Mol. Wt. 268.32

CAS Registry No. 613-35-4

Synonyms *N,N'*-(1,1'-biphenyl)-4,4'-diylbisacetamide; 4,4'-diacetylbenzidine; 4,4'-diacetamidobiphenyl; *N,N'*-4,4'-biphenylenebisacetamide; 4',4''-biacetanilide

EINECS No. 210-338-2

RTECS No. DT 2800000

Uses Manufacture of dyestuffs.

Physical properties

M. Pt. 327-330°C

Solubility Organic solvents: ethanol, ethyl acetate

Occupational exposure

Supply classification harmful

Risk phrases Harmful by inhalation, in contact with skin and if swallowed (R20/21/22)

Safety phrases Keep out of reach of children (if sold to general public) – Do not breathe dust – Wear suitable protective clothing (S2, S22, S36)

Mammalian & avian toxicity

Acute data

LD_{Lo} oral rat 6300 mg kg⁻¹ (1).

LD_{Lo} intraperitoneal rat 64 mg kg⁻¹ (2).

Sub-acute and sub-chronic data

In 6 rats administered a single intraperitoneal dose of 200 mg the average survival time was 5 months; 1 rat had liver necrosis and 3 had glomerulonephrosis (3).

In an 8-month study with a group of 10 ♂ and 10 ♀ rats given 429 mg kg⁻¹ via diet, 80% of animals of both sexes died from severe glomerulonephritis (4).

Oral mice (duration unspecified) 4 g kg⁻¹ diet caused kidney lesions but no liver damage (5).

Oral rats 2.5 g kg⁻¹ diet caused lipaemia and glomerular lesions with many fat filled spaces developing within 8-18 wk (6).

Chronic glomerulonephritis was seen in 110 ♀ and 50 ♂ rats fed 430 mg kg⁻¹ diet (duration unspecified). Lesions developed more rapidly in the ♀ rats (7).

Carcinogenicity and chronic effects

No adequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (8).

Oral ♂, ♀ rats (8 month) 1.6 mm kg⁻¹ in diet, experiment was terminated after 10 months. 8/10 animals died of glomerulonephritis, no gross evidence of this lesion was seen in rats fed substituted diacetylbenzidines. 2 ♂ rats developed squamous cell carcinomas of the ear duct at 5 and 7 months (4).

Subcutaneous rats (9 month) 15 mg to 40 rats, 2 ♂ rats developed hepatomas and 3 ♂ and 1 ♀ developed carcinomas of both the liver and zymbal gland (9).

Of 6 ♀ mice administered a single subcutaneous dose of 100 mg, 3 developed tumours of the mammary gland and one a skin tumour. Of 18 ♀ rats administered a single intraperitoneal injection of 100 mg, 12 tumours of the external auditory canal, 6 mammary tumours (including adenocarcinomas) and 2 skin carcinomas occurred in 11 animals (3).

Metabolism and toxicokinetics

Following intraperitoneal injection into rats, a comparatively low level of binding to liver DNA was observed. After enzymatic hydrolysis, the major DNA adduct was *N*-(deoxyguanosin-8-yl)-*N'*-acetybenzidine accompanied by a small amount of *N*-(deoxyguanosin-8-yl)-*N*, *N'*-diacetybenzidine (10).

Genotoxicity

Salmonella typhimurium TA1538 with metabolic activation positive (11).

In vitro rabbit bladder did not induce DNA repair (12).

Legislation

Production of benzidine and its derivatives prohibited in Japan.

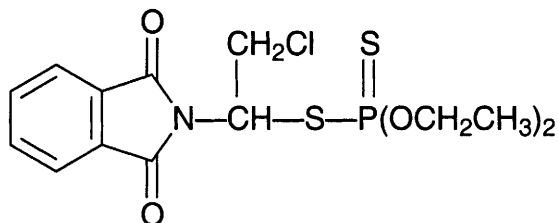
Other comments

Metabolite present in urine of ♂ rats and guinea pigs following intraperitoneal injection of 4,4'-dinitrophenyl (13). Also a metabolite of benzidine (14).

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D68 dialifos



C₁₄H₁₇ClNO₄PS₂

Mol. Wt. 393.85

CAS Registry No. 10311-84-9

Synonyms S-(2-chloro-1-phthalimidoethyl) O,O-diethyl phosphorodithioate; N-[2-chloro-1-(diethyloxyposphinothioylthio)ethyl]phthalimide; S-[2-chloro-1-(1,3-dihydro-1,3-dioxo-2H-isindol-2-yl)ethyl] O,O-diethyl phosphorodithioate; Dialifor; Torak

EINECS No. 233-689-3

RTECS No. TD 5165000

Uses Superseded insecticide and acaride.

Physical properties

M. Pt. 67-69°C **Volatility** v.p. 1×10^{-3} mmHg at 35°C

Solubility Organic solvents: acetone, cyclohexanone, isophorone, xylene

Occupational exposure

Supply classification very toxic, dangerous for the environment

Risk phrases Toxic in contact with skin – Very toxic if swallowed – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R24, R28, R50/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S28, S36/37, S45, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (24 hr) rainbow trout 0.55-1.08 mg l⁻¹ (1).

Invertebrate toxicity

LD₅₀ contact bee 34-38 µg bee⁻¹ (1).

Environmental fate

Degradation studies

Residue t_{1/2} on citrus fruits 40-80 days (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mallard duck 940 mg kg⁻¹ (1).

LD₅₀ oral rat, mouse, rabbit 39-71 mg kg⁻¹ (1,3).

LD₅₀ dermal rabbit 145 mg kg⁻¹ (1).

Sub-acute and sub-chronic data

Oral rat (90 day) 10 mg kg⁻¹ diet caused inhibition of plasma and erythrocyte cholinesterase activity (3).

Metabolism and toxicokinetics

After dietary intake in a cow, no residues were detected in the milk, no unchanged dialifos was detected in urine but 3% of total dose was found unchanged in faeces. Urinary metabolites included diethyl thiophosphate and diethyl phosphate. No phosphorus-containing hydrolytic residues were found (4).

Other effects

Other adverse effects (human)

Exposed farm workers suffered skin diseases and respiratory disorders (5).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (6).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (7).

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D69 di-allate



$\text{C}_{10}\text{H}_{17}\text{Cl}_2\text{NOS}$

Mol. Wt. 270.22

CAS Registry No. 2303-16-4

Synonyms S-(2,3-dichloro-2-propenyl) bis(1-methylethyl) carbamothioate; S-2,3-dichloroallyl diisopropyl thiocarbamate; bis(1-methylethyl)carbamothioic acid, S-(2,3-dichloro-2-propenyl) ester; diallate; Avade

EINECS No. 218-961-1

RTECS No. EZ 8225000

Uses Superseded herbicide.

Physical properties

M. Pt. 25-30°C B. Pt. 97°C at 0.15 mmHg **Specific gravity** 1.188 at 20°C with respect to water at 15.6°C

Partition coefficient $\log P_{\text{ow}}$ 5.23 (est.) (1) **Volatility** v.p. 1.5×10^{-4} mmHg at 25°C

Solubility Water: 14 mg l⁻¹ at 25°C. Organic solvents: acetone, benzene, ethanol, ethyl acetate, kerosene, xylene

Occupational exposure

Supply classification harmful

Risk phrases Harmful if swallowed – Possible risk of irreversible effects (R22, R40)

Safety phrases Keep out of reach of children (if sold to general public) – Avoid contact with the eyes – Wear suitable protective clothing and gloves (S2, S25, S36/37)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) bluegill sunfish, rainbow trout 5.9-7.9 mg l⁻¹ (2).

Bioaccumulation

Bioconcentration factor of 126 indicates moderate environmental accumulation (3).

Environmental fate

Nitrification inhibition

Caused inhibition of nitrification in soil, inhibitory for 8 wk at normal rate of application (4).

Degradation studies

t_{1/2} in various soils range from 2-6 wk. t_{1/2} in sterilised soil 20 wk (5).

Abiotic removal

70-76% removal from soil by volatilisation (6).

Adsorption and retention

K_{oc} for various soils 280-1900 (3,7).

Mammalian & avian toxicity

Acute data

LC₅₀ oral mallard duck, bobwhite quail >5000 mg kg⁻¹ diet (2).

LD₅₀ oral rat 395-1000 mg kg⁻¹ (7).

kg⁻¹ diet (2).

LD₅₀ oral dog 510 mg kg⁻¹ (2).

LD₅₀ dermal rabbit 2000-2500 mg kg⁻¹ (2).

Sub-acute and sub-chronic data

In a 90-day feeding study rats receiving 400 mg kg⁻¹ diet suffered weight loss, irritability, hyperactivity and mild cardiac changes, but no fatalities occurred at the high dose of 1200 mg kg⁻¹. In beagle dogs adverse effects were observed at 600 mg day⁻¹, but not at 125 mg day⁻¹ (2).

Following repeated application to eyes and skin of guinea pigs and rabbits (dose and duration unspecified), in addition to local irritation, weight loss, leukocytosis and anaemia were observed. Oral and subcutaneous administration produced similar effects (8,9).

Carcinogenicity and chronic effects

No adequate evidence for carcinogenicity to humans, limited evidence for carcinogenicity to animals, IARC classification group 3 (10).

In tests on 2 strains of mice of both sexes, following oral administration of 215 mg kg⁻¹ in diet, there was a significant increase in hepatomas in ♂ of both strains and of lung adenomas in ♂ of one strain (11,12).

A chronic feeding study in rats of 300 mg kg⁻¹ diet gave inconclusive evidence of carcinogenicity (13).

In tests on 2 strains of mice, following a single subcutaneous dose of 1000 mg kg⁻¹ systemic reticulum cell sarcomas developed in ♂ mice of strain (12).

Metabolism and toxicokinetics

In rats the *S*-diisopropylcarbamyl conjugates of mercapturic acid (62%), cysteine (7%), mercaptoacetic acid (1.5%) and carbon dioxide (20%) were excreted. The principal metabolic pathway in rodents appears to involve sulfoxidation, non-enzymic reaction of the sulfoxide with glutathione and formation of mercapturic acids (14). Sulfoxidised metabolites undergo two distinct types of reaction important to their biological activity: (i) rearrangement-elimination to form 2-chloroacrolein; and (ii) carbamylation of tissue thiols with liberation of 2,3-dichloroallylsulfonic acid (15).

Irritancy

Repeated application to eyes and skin of guinea pigs and rabbits caused local irritation (8,9).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535 with metabolic activation positive. *Escherichia coli* WP2, WP2uvrA with and without metabolic activation negative. *Saccharomyces cerevisiae* D3 with metabolic activation positive; without metabolic activation negative. *Saccharomyces cerevisiae* D7 with and without metabolic activation, negative. Induced sex-linked recessive lethal mutations in *Drosophila melanogaster* (16).

Streptomyces coelicolor without metabolic activation positive (17).

Induced dose-related unscheduled DNA synthesis in human embryo EUE cells, as measured by autoradiography, but not when measured by scintillation counting (18).

Induced sister chromatid exchanges and chromosomal aberrations in cultured Chinese hamster ovary cells in the presence of metabolic activation (19).

Did not induce dominant lethal mutations when mice were given intraperitoneal injection of 100 or 200 mg kg⁻¹ (20).

There is sufficient evidence for its mutagenicity in cellular systems, but insufficient evidence for its mutagenicity in mammals (7).

Legislation

Maximum permissible concentration in domestic water in the former USSR 30 µg l⁻¹ (21).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (22).
Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (23).

Other comments

Physical properties, use, carcinogenicity, mutagenicity and mammalian toxicity reviewed (7).
Environmental fate reviewed (5).
Exists as a mixture of the *E* and *Z* isomers in approximately equimolar proportions.
Metabolic pathways reviewed (24).

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D70 diallylamine



C₆H₁₁N

Mol. Wt. 97.16

CAS Registry No. 124-02-7

Synonyms di-2-propenylamine; N-2-propenyl-2-propen-1-amine

EINECS No. 204-671-2

RTECS No. UC 6650000

Uses Organic synthesis.

Physical properties

M. Pt. -88°C B. Pt. 111-112°C Flash point 15°C Specific gravity 0.787 at 20°C with respect to water at 4°C
Solubility Water: 86 g l⁻¹. Organic solvents: diethyl ether, ethanol

Occupational exposure

UN No. 2359 HAZCHEM Code 2WE Conveyance classification flammable liquid, toxic, corrosive

Environmental fate

Degradation studies

Concentrations of 200 mg l⁻¹ incubated with *Aerobacter* spp. at 30°C; 62% degraded by parent in 105 hr; 100% degradation in 17 hr with mutant strains (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 516, 578 mg kg⁻¹, respectively (2,3).

LC₅₀ (4 hr) inhalation rat 2760 ppm (4).

LC₅₀ (8 hr) inhalation rat 795 ppm (4).

LD₅₀ dermal rabbit 356 mg kg⁻¹ (3).

LD₅₀ intraperitoneal mouse 187 mg kg⁻¹ (2).

Irritancy

Dermal rabbit (24 hr) 100 µg caused irritation (3).

50 mg instilled into rabbit eye for 20 sec caused severe irritation (2).

Extremely destructive to tissues of the mucous membranes and upper respiratory tract, eyes and skin (species unspecified) (5).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (6).

Other effects

Any other adverse effects

Inhalation may be fatal as a result of spasm, inflammation and oedema of the larynx and bronchi, chemical pneumonitis and pulmonary oedema (species unspecified) (5).

In rats 1 ml applied to 1 cm² area of shaved abdominal skin produced severe necrosis and fatality (4).

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D71 diallyl ether



C₆H₁₀O

Mol. Wt. 98.14

CAS Registry No. 557-40-4

Synonyms allyl ether; 3,3'-oxybis-1-propene

EINECS No. 209-174-4

RTECS No. KN 7525000

Uses Manufacture of polymers used in production of contact lenses.

Physical properties

B. Pt. 94-95°C **Flash point** -6°C **Specific gravity** 0.805 at 18°C with respect to water at 4°C

Solubility Water: practically insoluble. Organic solvents: acetone, chloroform, ethanol

Occupational exposure

UN No. 2360 HAZCHEM Code 3WE Conveyance classification flammable liquid, toxic

Environmental fate

Nitrification inhibition

Concentrations of 100 mg l⁻¹ treated with activated sludge; 75% inhibition of NH₃ oxidation (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 320 mg kg⁻¹ (2).

LD₅₀ dermal rabbit 600 mg kg⁻¹ (3).

Irritancy

Dermal rabbit (24 hr) 500 mg (open) caused mild irritation and 100 mg instilled into rabbit eye for 24 hr caused moderate irritation (4).

Other effects

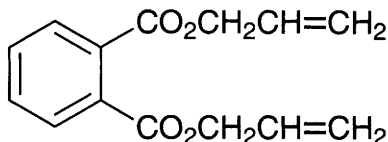
Other adverse effects (human)

An irritant; can be absorbed through the skin.

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D72 diallyl phthalate



$C_{14}H_{14}O_4$

Mol. Wt. 246.26

CAS Registry No. 131-17-9

Synonyms 1,2-benzenedicarboxylic acid, di-2-propenyl ester; DAP; diallyl o-phthalate; Dapon 35

EINECS No. 205-016-3

RTECS No. CZ 4200000

Uses Plasticiser. Polymer intermediate. Dyestuff carrier.

Physical properties

M. Pt. -70°C **B. Pt.** $161\text{--}162^{\circ}\text{C}$ at 4 mmHg **Flash point** 166°C **Specific gravity** 1.121 at 20°C with respect to water at 4°C

Solubility Water: 182 mg l^{-1} (1). Organic solvents: dimethyl sulfoxide, ethanol, mineral oil

Occupational exposure

SE-LEVL 3 mg m^{-3}

SE-STEL 5 mg m^{-3}

UK-LTEL 5 mg m^{-3}

Supply classification harmful, dangerous for the environment

Risk phrases Harmful if swallowed – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R22, R50/53)

Safety phrases Keep out of reach of children (if sold to general public) – Avoid contact with skin and eyes This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions safety data sheet (S2, S24/25, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (48 hr) golden orfe 0.4 mg l^{-1} (2).

Invertebrate toxicity

Toxicity threshold, *Microcystis aeruginosa* 0.65 mg l^{-1} , *Pseudomonas putida* >100 mg l^{-1} , *Scenedesmus quadricauda* 2.9 mg l^{-1} , *Entosiphon sulcatum* 13 mg l^{-1} , *Uronema parduczi* 22 mg kg^{-1} (3-5).

LC₅₀ (24 hr) *Daphnia magna* 26 mg l^{-1} ; NOEC (survival/reproduction) 3.2 mg l^{-1} (6).

Environmental fate

Degradation studies

Microorganisms were unable to utilise diallyl phthalate as sole carbon source, although it was degraded in the presence of other carbon sources (7).

Phthalate esters undergo $\geq 50\%$ ultimate degradation within 28 days in standardized aerobic biodegradation tests with sewage sludge inocula. Biodegradation is expected to be the dominant loss mechanism in surface water, soils and sediments (8).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 770 mg kg^{-1} (9).

LD₅₀ oral rabbit 1700 mg kg^{-1} (10).

LD₅₀ dermal rabbit 3400 mg kg⁻¹ (10).
LD₅₀ intraperitoneal mouse 670 mg kg⁻¹ (11).

Carcinogenicity and chronic effects

Tumours in haematopoietic system in ♀ rats. In ♂ mice haematopoietic system and stomach. Tumours induced in ♀ mice (12).

The National Toxicology Program tested rats and mice via gavage. No evidence of carcinogenicity in ♂ and ♀ rats, equivocal evidence of carcinogenicity in ♂ and ♀ mice (13).

Metabolism and toxicokinetics

Following oral administration to rats and mice, plasma serum glutamic-pyruvic transaminase activity levels were elevated. Urinary excretion and carbon dioxide exhalation were major routes of metabolic elimination of diallyl phthalate. 6-7% and 1-3% of dose was found in tissues of rats and mice, respectively. Monoallylphthalate, allyl alcohol, 3-hydroxypropylmercapturic acid and an unidentified polar metabolite were found in the urine. No glucuronide or sulfate conjugates were detected. Toxicokinetic studies showed rapid clearance from the blood. The substance was not detected in blood, liver, kidney, muscle, skin or small intestine 30 min after intravenous injection (14,15).

Irritancy

500 mg instilled into rabbit eye caused irritation. Also irritating to mucous membranes and upper respiratory tract (9).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA97, TA1537 with and without metabolic activation negative (16).

Mouse lymphoma L5178Y cell mutagenicity assay positive. Sister chromatid exchange induction assay in Chinese hamster ovary cells positive. (17).

Other effects

Any other adverse effects

Symptoms of poisoning in rats are depression, arching of the back, general weakness and anorexia. Fatty degeneration occurs in liver and kidneys (18).

Hepatotoxic to rats and mice (15).

Following dermal application in acute toxicity tests to rabbits, mild skin inflammation, hepatitis and lung congestion were observed (19).

Other comments

Aquatic toxicity of eighteen phthalate esters reviewed (1).

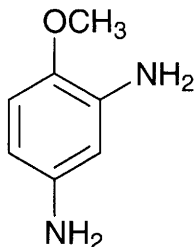
The environmental fate of eighteen phthalate esters reviewed (8).

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D73 2,4-diaminoanisole



$C_7H_{10}N_2O$

Mol. Wt. 138.17

CAS Registry No. 615-05-4

Synonyms methoxyphenylenediamine; 4-methoxy-1,3-phenylenediamine; 4-methoxy-*m*-phenylenediamine; 4-methoxy-1,3-benzenamine; 2,4-DAA

EINECS No. 210-406-1

RTECS No. BZ 8580500

Uses Preparation of dyestuffs. Hair dyes. Corrosion inhibitor for steel.

Physical properties

M. Pt. 66-68°C

Solubility Organic solvents: diethyl ether, dimethyl sulfoxide, ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 460 mg kg⁻¹ (1).

LD₅₀ intraperitoneal rat 116 mg kg⁻¹ (2).

Carcinogenicity and chronic effects

No adequate evidence for carcinogenicity in humans, sufficient evidence for carcinogenicity in animals, IARC classification group 2B (3).

Evidence relating bladder cancer or any other cancer to occupational exposure to hair dyestuffs incorporating this substance is inconclusive (4).

There is sufficient evidence for carcinogenicity of the sulfate in experimental animals. In the absence of epidemiological studies relating specifically to this substance, the authors conclude that it should be regarded as if it presented a carcinogenic risk to humans (5).

Metabolism and toxicokinetics

Following intraperitoneal administration of [¹⁴C]-labelled substance 85% of radioactivity was excreted in urine, and 9% in faeces after 48 hr. Major metabolites were 4-acetylamino-2-aminoanisole; 2, 4-diacetylaminoanisole; 2,4-diacetylaminophenol; 5-hydroxy-2,4-diacetylaminoanisole and 2-methoxy-5-(glycolamido)-acetanilide or its isomer. These metabolites were excreted in the urine both free and as glucuronides and sulfates (species unspecified) (6).

Metabolism and covalent binding were shown to be cytochrome P₄₅₀ mediated (7).

Irritancy

Dermal rabbit (24 hr) 12.5 mg caused mild irritation (1).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1538 with and without metabolic activation positive (8).

In vivo oral CFY rats 1 g kg⁻¹ body weight per 24 hr; no increase in incidence of micronucleated erythrocytes (9).

Negative in a dominant lethal assay in which rats were given 40 mg kg⁻¹ day⁻¹ body weight, 3 × wk for 10 wk (10).

No increases were reported in the frequency of morphologically abnormal sperm in treated mice (11).

Other effects

Other adverse effects (human)

One of a number of pollutants in drinking water suggested as a possible cause of Kashin-Beck disease in a Chinese village (12).

Legislation

Permitted for use in cosmetics in EEC as oxidising colouring agent in hair dyes only if concentration in finished product is <6%.

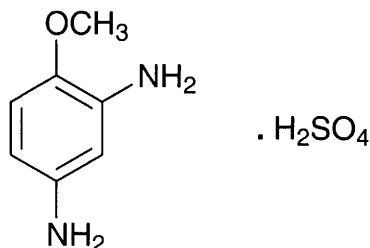
Other comments

Histology and pathogenesis mechanism of black thyroid induced in rats by oral administration of 2,4-diaminoanisole sulfate (DAAS) was studied. Thyroid peroxidase plays an essential role in discoloration and is related to iodine metabolism, suggesting that pigmentation of the thyroid gland induced by oral administration of DAAS is due to deposition of oxidised derivatives, resulting in suppressed thyroid function (13).

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13. Matsui, I. et al *Biomed. Res.* 1991, **12**(2), 77-83

D74 2,4-diaminoanisole sulfate



$C_7H_{12}N_2O_5S$

Mol. Wt. 236.25

CAS Registry No. 39156-41-7

Synonyms 4-methoxy-*m*-phenylenediamine sulfate; 4-methoxy-1,3-benzenediamine sulfate

EINECS No. 254-323-9

RTECS No. ST 2705000

Uses Preparation of dyestuffs, including hair dyes. Corrosion inhibitor for steel.

Physical properties

M. Pt. 189-192°C (decomp.)

Solubility Water: miscible. Organic solvents: ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat >4000 mg kg⁻¹ (1).

LD₅₀ intraperitoneal mouse, rat 160, 372 mg kg⁻¹, respectively (1,2).

Sub-acute and sub-chronic data

Sub-chronic dietary studies in rats and mice at concentrations up to 0.58% caused a number of fatalities. No gross abnormalities were noted, except that thyroid goitre was found in rats (3).

Carcinogenicity and chronic effects

No adequate evidence for carcinogenicity in humans, sufficient evidence for carcinogenicity in animals, IARC classification group 2B (4).

In a chronic dietary study with up to 0.5% in rats and 0.24% in mice, the only compound-related organ lesions observed were diffuse hyperplasia in the liver and C-cell hyperplasia in the thyroid of ♀ rats (5).

In one dietary experiment in mice and two dietary experiments in rats at concentrations up to 5000 mg kg⁻¹ diet, benign and malignant tumours of the thyroid gland were induced with the highest doses tested. Tumours of the skin and of the preputial and clitoral tissues and Zymbal gland were also induced in rats. Tests of a hair dyestuff formulation by skin application to rats and mice were considered to be inadequate for evaluation (6).

Evidence relating to occupational exposure to hair dyestuff formulations containing this substance and bladder cancer, or any other cancers, is inconclusive (7).

Teratogenicity and reproductive effects

Following dermal application of hair dyestuff formulations, which also included several aromatic amine derivatives, to rats on every 3rd day up to 19 days of gestation, there was no significant increase in soft tissue anomalies in the living foetuses, but there was a statistically significant increase in the occurrence of skeletal changes (8).

Irritancy

Irritation to the eyes, skin, mucous membranes and upper respiratory tract (species unspecified) (9).

Genotoxicity

Saccharomyces cerevisiae mitotic recombination assay without metabolic activation positive (10).

L5178Y mouse lymphoma cell assay without metabolic activation positive (11).

Induced mutation in *Drosophila melanogaster* (12).

Negative in a dominant lethal assay in which rats were given 40 mg kg⁻¹ day⁻¹ body weight, 3 × wk⁻¹ for 10 wk (13).

Other effects

Any other adverse effects

Absorption leads to formation of methaemoglobin which in sufficient concentration causes cyanosis (9).

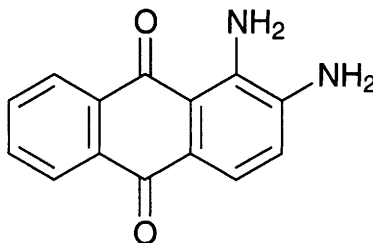
Legislation

Permitted for use in cosmetics in EC as oxidising colouring agents for hair dyestuffs only if concentration in finished product is <6%, calculated as the free base.

References

1. Burnett, C. et al *J. Toxicol. Environ. Health* 1977, **2**, 657.
2. *Genetica Polonica* 1985, **26**, 109.
3. Ward, J. M. et al *J. Natl. Cancer Inst.* 1979, **62**, 1067-1073.
4. *IARC Monograph* 1987, **Suppl. 7**, 61.
5. Natl. Cancer Inst. *Tech. Report Ser. No. 84*; DHEW Publ. No. NIH 78-1334 US Govt. Print. Off., Washington, DC, USA.
6. *IARC Monograph* 1982, **27**, 103-117.
7. *IARC Monograph* 1982, **27**, 307-318.
8. Burnett, C. et al *J. Toxicol. Environ. Health* 1976, **1**, 1027-1040.
9. Lenga, R. E. *The Sigma-Aldrich Library of Chemical Safety Data* 2nd ed., 1988, **2**, 2266, Sigma-Aldrich, Milwaukee, WI, USA.
10. Mayer, V. W. et al *Mutat. Res.* 1980, **78**, 243-252.
11. Palmer, K. A. et al *J. Environ. Pathol. Toxicol.* 1977, **1**, 87-91.
12. Blijleran, W. G. H. *Mutat. Res.* 1977, **48**, 181-186.
13. Sheu, C.-J. W. et al *Mutat. Res.* 1979, **68**, 85-98

D75 1,2-diaminoanthraquinone



C₁₄H₁₀N₂O₂

Mol. Wt. 238.25

CAS Registry No. 1758-68-5

Synonyms 1,2-diamino-9,10-anthracenedione; 1,2-anthraquinonediamine

EINECS No. 217-156-2

RTECS No. CB 6200000

Uses Preparation of dyestuffs.

Physical properties

M. Pt. 289-291°C

Solubility Organic solvents: chloroform, diethyl ether, ethanol, pyridine, xylene

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird >113 mg kg⁻¹ (1).

LD₅₀ intraperitoneal rat 2700 mg kg⁻¹ (2).

LD₅₀ intravenous mouse 320 mg kg⁻¹ (3).

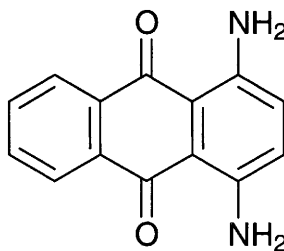
Irritancy

Irritating to skin, eyes, mucous membranes and upper respiratory tract (species unspecified) (4).

References

1. Schafer, W. et al *Arch. Environ. Contam. Toxicol.* 1983, **12**, 355.
2. *Gig. Tr. Prof. Zabol.* 1977, **21**(12), 27.
3. U.S. Army Armament Res. Dev. Command, Chem. Syst. Lab., NIOSH Exchange Chem., NX No. 01102, Aberdeen Proving Ground, MD 21010, USA.
4. Lenga, R. E. *The Sigma-Aldrich Library of Chemical Safety Data* 2nd ed., 1988, **1**, 1045, Sigma-Aldrich, Milwaukee, WI, USA

D76 1,4-diaminoanthraquinone



C₁₄H₁₀N₂O₂

Mol. Wt. 238.25

CAS Registry No. 128-95-0

Synonyms 1,4-diamino-9,10-anthracenedione; 1,4-anthraquinonediamine; Celliton Red Violet RN; Disperse Violet 1; C.I. 61100

EINECS No. 204-922-6

RTECS No. CB 6300000

Uses Dyestuff for synthetic fabrics and as a stain dyestuff.

Physical properties

M. Pt. 265-268°C

Solubility Organic solvents: acetic acid, benzene, ethanol, nitrobenzene, pyridine

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird >87.0 mg kg⁻¹ (1).

LD₅₀ oral rat 5790 mg kg⁻¹ (2).

LD₅₀ intraperitoneal rat 250 mg kg⁻¹ (3).

Irritancy

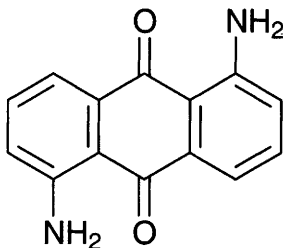
500 mg instilled into rabbit eye for 24 hr caused mild irritation. Also irritating to skin, mucous membranes and upper respiratory tract (2).

Genotoxicity

Salmonella typhimurium TA98, TA1537, TA1538 with and without metabolic activation negative (4).
Bacteriophage T4D induction of rapid lysis mutants positive (5).

References

1. Schafer, E. W. et al *Arch. Environ. Contam. Toxicol.* 1983, **12**, 355.
2. Lenga, R. E. *The Sigma-Aldrich Library of Chemical Safety Data* 2nd ed., 1988, **1**, 1045, Sigma-Aldrich, Milwaukee, WI, USA.
3. *Gig. Tr. Prof. Zabol.* 1977, **21**(12), 27.
4. Henry, M. C. *Gov. Rep. Announce. Index (U. S.)* 1984, **84**(19), 63 (*Chem. Abstr.* **102**, 57512x).
5. Kvelland, I. *Hereditas (Lund, Swed.)* 1983, **99**(2), 209-213 (*Chem. Abstr.* **100**, 144867u).

D77 1,5-diaminoanthraquinone

$C_{14}H_{10}N_2O_2$

Mol. Wt. 238.25

CAS Registry No. 129-44-2

Synonyms 1,5-diamino-9,10-anthracenedione; 1,5-anthraquinonediamine

EINECS No. 204-947-2

RTECS No. CB 6400000

Uses Preparation of dyestuffs.

Physical properties

M. Pt. 308°C (decomp.) **B. Pt.** (sublimes)

Solubility Organic solvents: acetone, benzene, chloroform, ethanol, nitrobenzene

Mammalian & avian toxicity**Acute data**

LD₅₀ oral redwing blackbird 113 mg kg⁻¹ (1).

LD₅₀ intraperitoneal rat 1300 mg kg⁻¹ (2).

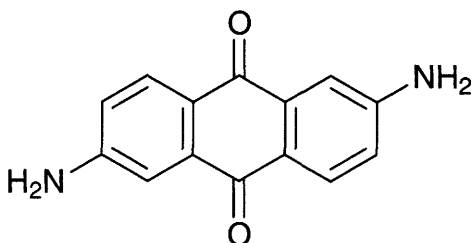
Irritancy

500 mg instilled into rabbit eye for 24 hr caused mild irritation. Also caused irritation to skin, mucous membranes and upper respiratory tract (species unspecified) (3).

References

1. Schafer, E. W. et al *Arch. Environ. Contam. Toxicol.* 1983, **12**, 355-382.
2. Gig. Tr. Prof. Zabol. 1977, **21**(12), 27.
3. Lenga, R. E. *The Sigma-Aldrich Library of Chemical Safety Data* 2nd ed., 1988, **1**, 1046, Sigma-Aldrich, Milwaukee, WI, USA

D78 2,6-diaminoanthraquinone



$C_{14}H_{10}N_2O_2$

Mol. Wt. 238.25

CAS Registry No. 131-14-6

Synonyms 2,6-diamino-9,10-anthracenedione; 2,6-anthraquinonediamine

EINECS No. 205-013-7

RTECS No. CB 6450000

Uses Preparation of dyestuffs.

Physical properties

M. Pt. $>325^{\circ}\text{C}$

Solubility Water: pyridine

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird 113 mg kg⁻¹ (calc.) (1).

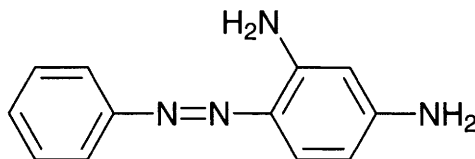
Irritancy

500 mg instilled into rabbit eye for 24 hr caused mild irritation. Also irritating to skin, mucous membranes and upper respiratory tract (species unspecified) (2).

References

1. Schafer, E. W. et al *Arch. Environ. Contam. Toxicol.* 1983, **12**, 355-382.
2. Lenga, R. E. *The Sigma-Aldrich Library of Chemical Safety Data* 2nd ed., 1988, **1**, 1046, Sigma-Aldrich, Milwaukee, WI, USA

D79 2,4-diaminoazobenzene



$C_{12}H_{12}N_4$

Mol. Wt. 212.25

CAS Registry No. 495-54-5

Synonyms 4-(phenylazo)-1,3-benzenediamine; 4-phenylazo-*m*-phenylenediamine; azobenzene-2,4-diamine

EINECS No. 207-803-7

RTECS No. ST 3325000

Uses Dyestuff for paper and leather.

Physical properties

M. Pt. 63°C **B. Pt.** 286°C **Volatility** v.p. 1 mmHg at 99.8°C

Solubility Organic solvents: benzene, diethyl ether, ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1650 mg kg⁻¹ (1).

Irritancy

20 mg instilled into rabbit eye for 24 hr produced moderate irritation (1).

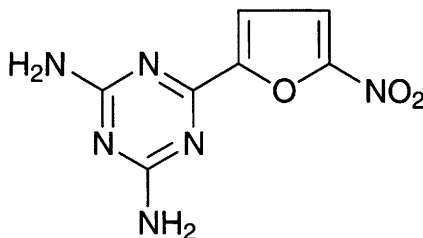
Genotoxicity

Salmonella typhimurium TA100 with and without metabolic activation negative. Did not directly induce unscheduled DNA synthesis in rat hepatocytes, but was mutagenic in the presence of metabolic activation (2).

References

1. Marhold, J. V. *Sbornik Vysledku Toxikologickeho Vysetreni Latek A Pripravku* 1972, 237, Prague, Czechoslovakia.
2. Sandhu, P. et al *Mutat. Res.* 1990, **240**(3), 227-236

D80 2,4-diamino-6-(5-nitro-2-furanyl)-s-triazine



$C_7H_6N_6O_3$

Mol. Wt. 222.16

CAS Registry No. 720-69-4

Synonyms 1,3,5-triazine-2,4-diamine, 6-(5-nitro-2-furanyl)-

RTECS No. XY 6895000

Physical properties

Solubility Organic solvents: dimethyl sulfoxide

Mammalian & avian toxicity

Carcinogenicity and chronic effects

In chronic carcinogenicity tests in rats (dose and duration unspecified) 4,6-diamino-2-(5-nitro-2-furyl)-s-triazine proved to be strongly carcinogenic (1).

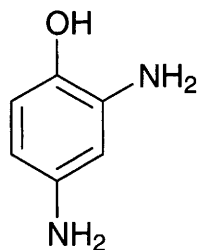
Genotoxicity

Salmonella typhimurium TA1535, TA1536, TA1537, TA1538 with and without metabolic activation negative (2).

References

1. Cohen, S. M. et al *J. Natl. Cancer Inst.* 1973, 51(2), 403-417.
2. Yahagi, T. et al *Cancer Res.* 1974, 34(9), 2266-2273

D81 2,4-diaminophenol



$C_6H_8N_2O$

Mol. Wt. 124.14

CAS Registry No. 95-86-3

Synonyms phenol, 2,4-diamino-; 1-hydroxy-2,4-diaminobenzene; 3-amino-4-hydroxyaniline

EINECS No. 202-459-4

RTECS No. SK 7530000

Uses Photographic developer. Dihydrochloride used in fur and hair dye formulations.

Physical properties

M. Pt. 78-80° (decomp.)

Solubility Water: 275 g l⁻¹ at 15°C (dihydrochloride). Organic solvents: acetone, chloroform, diethyl ether, light petroleum

Environmental fate

Degradation studies

12 mg COD g⁻¹ dry inoculum hr⁻¹, sole carbon source, treated with adapted activated sludge at 20°C, 83% COD removal (1).

Biodegradable (2).

Mammalian & avian toxicity

Acute data

LD_{Lo} intraperitoneal mouse 50 mg kg⁻¹ (3).

Genotoxicity

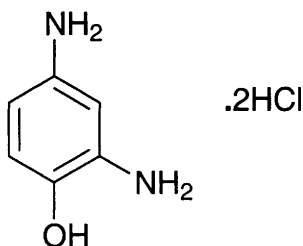
Salmonella typhimurium TA1538 with metabolic activation positive (4).

In vitro Chinese hamster V79 cells, inhibition of DNA synthesis positive (5).

References

1. Pitter, P. *Water Res.* 1976, **10**, 231-235.
2. *Ministry of International Trade and Industry (MITI)* 1984, Japan.
3. *Rev. Belge Pathol. Med. Exp.* 1952, **22**, 1.
4. Dybing, E. et al *Biochem. Pharmacol.* 1977, **26**, 729-734.
5. Richard, A. M. et al *Chem. Res. Toxicol.* 1991, **4**(2), 151-156

D82 2,4-diaminophenol dihydrochloride



C₆H₁₀Cl₂N₂O

Mol. Wt. 197.06

CAS Registry No. 137-09-7

Synonyms diaminophenol hydrochloride

EINECS No. 205-279-4

RTECS No. SK 7600000

Uses Bactericide. Hair dye component. Chemical synthesis. Photographic developer.

Physical properties

M. Pt. 222°C (decomp.)

Solubility Water: 270 g l⁻¹ at 15°C. Organic solvents: diethyl ether, ethanol

Ecotoxicity

Fish toxicity

Goldfish (48 hr) approximate fatal concentration 80 mg l⁻¹ (1).

Rainbow trout and stickleback (24 hr) no loss of equilibrium or death occurred when exposed to 10 mg l⁻¹ (2).

Mammalian & avian toxicity

Acute data

LD_{Lo} intraperitoneal mouse 50 mg kg⁻¹ (3).

Carcinogenicity and chronic effects

National Toxicity Program investigated 2,4-diaminophenol dihydrochloride by gavage in rat and mouse. No evidence of carcinogenic activity was demonstrated in rats, while some evidence of carcinogenic activity was demonstrated in mice (4).

Irritancy

Rabbit eye (10 min) 4 mg produced dark brown staining of the corneal stroma, permanent opacification and vascularisation (5).

Genotoxicity

In vitro mouse lymphoma L5178Y tk+/tk- positive (6).

References

1. McKee, J. E. et al *Water Quality Criteria* 1963, Resources Agency of California, State Water Quality Control Board.
2. McPhee, C. et al *The Toxicity of 2014 Chemicals to Fish* 1989, EPA 560/6-89-001, PB 89-156715, Washington, DC, USA.
3. *Rev. Belge Pathol. Med. Exp.* 1952, **22**, 1.
4. *National Toxicology Program Research and Testing Division* 1992, Report No. 401, NIEHS, Research Triangle Park, NC, USA.
5. Grant, W. M. *Toxicology of the Eye* 2nd ed., Charles C. Thomas, Springfield, IL, USA.
6. Moore, M. M. et al *Environ. Mutagen.* 1987, **9**(2), 161-170

D83 1,2-diaminopropane



C₃H₁₀N₂

Mol. Wt. 74.13

CAS Registry No. 78-90-0

Synonyms 1,2-propanediamine; propylenediamine

EINECS No. 201-155-9

RTECS No. TX 6650000

Uses Fuel and oil additive. Reagent for mercury.

Physical properties

M. Pt. -37.2°C B. Pt. 119-120°C Flash point 33°C Specific gravity 0.870 at 20°C with respect to water at 4°C Volatility v.p. 7.6 mmHg at 20°C ; v.den. 2.6

Solubility Water: miscible. Organic solvents: acetone, benzene, chloroform, ethanol

Occupational exposure

UN No. 2258 Conveyance classification corrosive substance, danger of fire (flammable liquid)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 13 mg l⁻¹ (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 2230 mg kg⁻¹ (2).

LD₅₀ dermal rabbit 500 mg kg⁻¹ (3).

Irritancy

Dermal rabbit 435 mg caused severe irritation, and 87 mg instilled into rabbit eye caused severe irritation (period of exposure unspecified) (2).

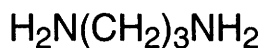
Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (4).

References

1. Protic, M. et al *Aquat. Toxicol.* 1989, 14(1), 47-64.
2. *Union Carbide Data Sheet* 12 March 1969, New York, USA.
3. *AMA Arch. Ind. Hyg. Occup. Med.* 1954, 10, 61.
4. Zeiger, E. et al *Environ. Mutagen.* 1987, 9(Suppl. 9), 1-110

D84 1,3-diaminopropane



$\text{C}_3\text{H}_{10}\text{N}_2$

Mol. Wt. 74.13

CAS Registry No. 109-76-2

Synonyms 1,3-propanediamine; trimethylenediamine

EINECS No. 203-702-7

RTECS No. TX 6825000

Uses Cross-linking agent for epoxy resins. Preparation of wood preservatives.

Physical properties

M. Pt. -12°C B. Pt. 140°C Flash point 48°C Specific gravity 0.8881 at 20°C with respect to water at 20°C

Volatility v.p. 5.3 mmHg at 20°C ; v.den. 2.5

Solubility Water: miscible. Organic solvents: benzene, diethyl ether, ethanol, methanol

Ecotoxicity

Fish toxicity

LC_{50} (96 hr) fathead minnow 16 mg l^{-1} (1).

Environmental fate

Degradation studies

Maximum growth rate of *Trichosporon cutaneum* with 1,3-diaminopropane as the sole carbon source 0.32 hr^{-1} (2).

Mammalian & avian toxicity

Acute data

LD_{50} oral rat 350 mg kg^{-1} (3).

LD_{50} dermal rabbit 200 mg kg^{-1} (3).

Teratogenicity and reproductive effects

LD_{Lo} intraperitoneal mouse 264 mg kg^{-1} caused teratogenic effects (unspecified). Animals were exposed for 12 days during pregnancy (4).

Irritancy

Dermal rabbit 50 mg caused severe irritation and 1 mg instilled into rabbit eye caused severe irritation (period of exposure unspecified) (5).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (6).

Other effects

Any other adverse effects

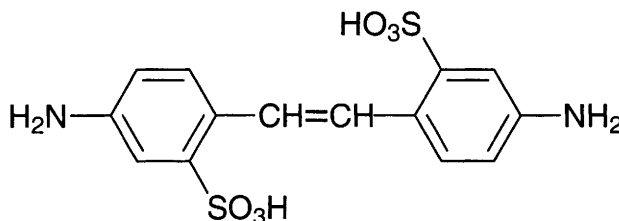
No immunosuppressive effects observed (7).

The acute neurotoxicity of a homologous series of diamines (ethylenediamine to 1,6-diaminohexane), tested by injection into the lateral ventricle of conscious rats, was documented as changes in behaviour and EEG. Three distinct patterns were seen ranging from prostration and EEG depression, to EEG seizures and convulsions, to a mixture of the patterns. All compounds were acutely lethal after micromole doses (8).

References

1. Protic, M. et al *Aquat. Toxicol.* 1989, **14**(1), 47-64.
2. Middelhoven, W. J. et al *Antonie van Leeuwenhoek* 1986, **56**(2), 525-526 (*Chem. Abstr.* **106**, 152733m).
3. *Am. Ind. Hyg. Assoc. J.* 1962, **23**, 95.
4. *Teratology* 1983, **28**, 237.
5. *Union Carbide Data Sheet* 21 Jan 1963, New York, USA.
6. Zeiger, E. et al *Environ. Mutagen.* 1989, **9**(Suppl.9), 1-110.
7. Komori, T. et al *Int. J. Immunopharmacol.* 1991, **13**(1), 67-73.
8. Strain, G. M. et al *Res. Commun. Chem. Pathol. Pharmacol.* 1989, **64**(3), 489-492

D85 4,4'-diamino-2,2'-stilbenedisulfonic acid



$C_{14}H_{14}N_2O_6S_2$

Mol. Wt. 370.41

CAS Registry No. 81-11-8

Synonyms 2,2'-disulfo-4,4'-stilbenediamine; 2,2'-(1,2-ethenediyl)bis[5-aminobenzenesulfonic acid]; amsonic acid; diaminostilbenedisulfonic acid

EINECS No. 201-325-2

RTECS No. WJ 6603000

Uses Manufacture of dyestuffs. Bleach manufacture.

Physical properties

Solubility Water: miscible. Organic solvents: diethyl ether, ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral guinea pig 47 g kg⁻¹ (1).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1547 with and without metabolic activation negative (2).

Other effects

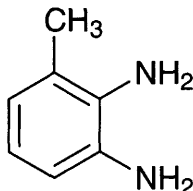
Other adverse effects (human)

Has been associated with impotence among 11 workers exposed to the compound (3).

References

1. *Gig. Sanit.* 1980, **45**(3), 73.
2. Quinn, M. M. et al *Am. J. Ind. Med.* 1990, **18**(1), 55-68.
3. Zeiger, E. et al *Environ. Mutagen.* 1987, **9**, 1-110

D86 2,3-diaminotoluene



$C_7H_{10}N_2$

Mol. Wt. 122.17

CAS Registry No. 2687-25-4

Synonyms toluene-2,3-diamine; 2,3-toluenediamine; 3-methyl-*o*-phenylenediamine; 3-methyl-1,2-benzenediamine; 1,2-diamino-3-methylbenzene; *o*-toluenediamine

EINECS No. 220-248-5

RTECS No. XS 9550000

Uses Chemical intermediate for antioxidants and the corrosion inhibitor tolyltriazole.

Physical properties

M. Pt. 61-63°C B. Pt. 255°C

Solubility Water: miscible. Organic solvents: diethyl ether, ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ intraperitoneal mouse 286 mg kg⁻¹ (1).

Teratogenicity and reproductive effects

Not found to be teratogenic on oral administration to rats and rabbits (dose and duration unspecified) (2).

Genotoxicity

In vivo mouse bone marrow and Ehrlich ascites tumour cells, no increase in the incidence of metaphases with aberrations (1).

Other comments

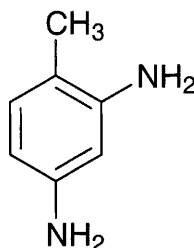
Present in small amounts in preparation of 2,4-diaminotoluene.

Mutagenicity of monocyclic aromatic amines reviewed (3).

References

1. Mikstacki, A. *Genet. Pol.* 1985, **26**(1), 109-116 (*Chem. Abstr.* 103, 220593f).
2. Becci, P. J. et al *Toxicol. Appl. Pharmacol.* 1983, **71**(3), 323-329.
3. Chung, K.-T. et al *Mutat. Res.* 1997, **378**(1), 1-16

D87 2,4-diaminotoluene



C₇H₁₀N₂

Mol. Wt. 122.17

CAS Registry No. 95-80-7

Synonyms toluene-2,4-diamine; 4-methyl-*m*-phenylenediamine; 2,4-toluenediamine; 4-methyl-1,3-benzenediamine; 5-amino-*o*-toluidine; 1,3-diamino-4-methylbenzene; *m*-tolenylenediamine; 3-amino-*p*-toluidine; 2,4-diamino-1-methylbenzene; 2,4-DAT

EINECS No. 202-453-1

RTECS No. XS 9625000

Uses Manufacture of dyestuffs for textiles, leather and furs. Used in hair-dye formulations. Developer for direct dyes. Intermediate in the manufacture of toluene diisocyanate which is used in the production of polyurethane.

Physical properties

M. Pt. 97-99°C **B. Pt.** 283-285°C **Partition coefficient** log *P*_{ow} 0.337 (est.) (1)

Volatility v.p. 1 mmHg at 106.5°C

Solubility Water: miscible. Organic solvents: hot benzene, diethyl ether, ethanol

Occupational exposure

Supply classification toxic

Supply classification dangerous for the environment

Risk phrases May cause cancer – Harmful in contact with skin – Toxic if swallowed – Irritating to the eyes – May cause sensitisation by skin contact – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R45, R21, R25, R36, R43, R50/53)

Safety phrases Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S53, S45, S60, S61)

Environmental fate

Degradation studies

Undergoes biodegradation in activated sludge (2).

Abiotic removal

Estimated atmospheric *t*_{1/2} 8 hr for reaction with hydroxyl radicals (1).

Adsorption and retention

K_{oc} sorption constant under aerobic and anaerobic conditions on loam soil after 8 hr contact 500-1300. Sorption was slightly stronger under aerobic than anaerobic conditions (3).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 260 mg kg⁻¹ (4).

LD₅₀ intraperitoneal rat, mouse 325, 480 mg kg⁻¹, respectively (5).

Carcinogenicity and chronic effects

No adequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (6).

Oral rats (2 groups of 12 animals) (30-36 wk) 0.06% or 0.1% via diet induced multiple hepatocellular carcinomas. Multiple metastases were present in the lymph nodes, omentum, lungs or epididymis in 6/9 survivors of high dose animals (7).

Dermal mice (18 month) 0.05 ml at 1:1 mixture of hair dye formulation containing 0.2% 2,4-diaminotoluene, 3% 2,5-diaminotoluene sulfate, 1.5% *p*-phenylenediamine and 6% hydrogen peroxide. Incidence of tumours not significantly different from controls (8).

Teratogenicity and reproductive effects

Gavage ♀ CD-1 mice (gestation days 6-13) 2350 mg kg⁻¹ day⁻¹ caused 2% maternal mortality. No foetotoxicity or teratogenicity observed (9).

Metabolism and toxicokinetics

Following intraperitoneal administration of ¹⁴C labelled compound to rats, circulating radioactivity reached a maximum at 1 hr and decreased rapidly for 7 hr. 98.7% had been excreted after 5 days (76.5% in urine, 22.2% in faeces). The major unconjugated metabolites in urine were 4-acetylamino-2-amino-toluene, 2,4-diacetylamino toluene and 2,4-diacetylamino benzoic acid (10).

2,4-Diamino-5-hydroxytoluene has been identified as a major urinary product in rats, *n*-acetyl- and glucuronide conjugates were also found (11).

An *N*-acetyl transferase indicating the formation of the *n*-acetyl conjugate has been found in the cytosolic fraction of liver in several species, and to a lesser extent in that of the kidney, intestinal mucosa and lung (12).

Irritancy

Dermal rabbit (24 hr) 500 mg produced mild irritation. 100 mg instilled into rabbit eye for 24 hr produced moderate irritation (13).

Genotoxicity

Salmonella typhimurium TA98, TA1538 with metabolic activation positive (14).

Induced sex-linked recessive lethal mutations in *Drosophila melanogaster* (15).

Induced unscheduled DNA synthesis in cultured primary rat hepatocytes (16).

Chinese hamster V79 cells with metabolic activation induced microsomal aberrations (17).

Induced morphological transformation in secondary Syrian hamster embryo cells (18).

Inhibited the incorporation of ¹²⁵Iodine into murine testicular DNA (19).

Increased the frequency of sister chromatid exchanges in bone marrow of mice following intraperitoneal administration (20).

Induced unscheduled DNA synthesis in rat hepatocytes *in vivo* (21).

Other effects

Any other adverse effects

In rats covalent binding to liver nuclear DNA, RNA and microsomal and soluble proteins has been reported (13).

Produced methaemoglobinemia in rats, rabbits and guinea pigs. The level correlated with the total amount of free aminophenol excreted in the urine (10).

Legislation

Use in hair dye formulations prohibited in the US in 1971 (22).

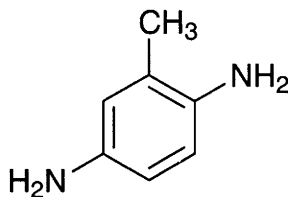
Other comments

Hydrolysis product of toluene and toluene diisocyanate. Commercial grade usually produced as part of a mixture 80% 2,4-diaminotoluene and 20% 2,6-diaminotoluene or 65% 2,4-diaminotoluene and 35% 2,6-diaminotoluene. Mutagenicity of monocyclic aromatic amines reviewed (23).

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D88 2,5-diaminotoluene



$C_7H_{10}N_2$

Mol. Wt. 122.17

CAS Registry No. 95-70-5

Synonyms 2-methyl-1,4-benzenediamine; 2,5-toluenediamine; 4-amino-2-methylaniline; 2-methyl-*p*-phenylenediamine; *p*-toluenediamine

EINECS No. 202-442-1

RTECS No. XS 9700000

Uses Manufacture of dyestuffs.

Physical properties

M. Pt. 64°C B. Pt. 273-274°C

Solubility Water: miscible. Organic solvents: benzene, diethyl ether, ethanol

Occupational exposure

Supply classification toxic

Supply classification dangerous for the environment

Risk phrases Harmful by inhalation and in contact with skin – Toxic if swallowed – May cause sensitisation by skin contact – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R20/21, R25, R43, R50/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Avoid contact with the skin – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S24, S37, S45, S60, S61)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 102 mg kg⁻¹ (1).

Teratogenicity and reproductive effects

Teratogenic in mice, causing vertebral and rib abnormalities. Exencephaly and prosopoanthesis also observed. Studies in rats gave negative results (2).

Irritancy

Dermal rabbit (24 hr) 12.5 mg caused mild irritation (1).

Caused occupational allergic contact dermatitis in beauticians (3).

Genotoxicity

Salmonella typhimurium TA1538 with metabolic activation positive (4).

Negative in mice using the dominant lethal assay, the sperm morphology test and/or the recessive spot test (5).

Other effects

Other adverse effects (human)

When used as a dyestuff on eyelashes caused heteroconjunctivitis and blepharitis with opacities of cornea which gradually cleared over several wk (6).

Legislation

Use in hair-dyestuff formulations prohibited in Italy (4).

Other comments

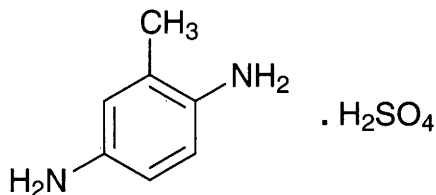
A number of hair dyes giving positive results in various short-term mutagenicity tests have shown no clear evidence of carcinogenicity in animal bioassays. Discrepancies between the results of mutagenicity and carcinogenicity tests in hair dyes and other chemicals are discussed, and the value of short-term mutagenicity tests for assessing chemical safety is questioned (7).

References

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D89 2,5-diaminotoluene sulfate



$\text{C}_7\text{H}_{12}\text{N}_2\text{O}_4\text{S}$

Mol. Wt. 220.25

CAS Registry No. 615-50-9

Synonyms 2-methyl-1,4-benzenediamine sulfate; 2-methyl-*p*-phenylenediamine sulfate; 2,5-toluenediamine sulfate; *p*-toluenediamine sulfate

EINECS No. 210-431-8

RTECS No. XT 0525000

Uses Dyestuff for hair and furs. Intermediate in production of other dyestuffs.

Physical properties

M. Pt. $>300^\circ\text{C}$

Solubility Water: miscible. Organic solvents: ethanol

Occupational exposure

Supply classification toxic

Supply classification dangerous for the environment

Risk phrases Harmful by inhalation, in contact with skin and if swallowed – Toxic if swallowed – May cause sensitisation by skin contact – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R20/21/22, R25, R43, R50/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Avoid contact with the skin – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S24, S37, S45, S60, S61)

Mammalian & avian toxicity

Acute data

LD_{50} oral rat 98 mg kg^{-1} (1).

LD_{50} intraperitoneal rat 49 mg kg^{-1} (1).

Sub-acute and sub-chronic data

No toxicologically significant increase in methaemoglobin formation was reported in rats following subcutaneous injection of 0.75-24 mg kg^{-1} as a single dose or repeated daily for 3-5 days, or as single intraperitoneal injection of 4-32 mg kg^{-1} , although a few Heinz bodies were found 2-3 days after several subcutaneous injections (2).

Carcinogenicity and chronic effects

No adequate evidence for carcinogenicity to humans, inadequate evidence for carcinogenicity to animals, IARC classification group 3 (3).

Aplastic anaemia was reported in patients using hair dyes containing 2,5-diaminotoluene sulfate (4,5).

Tests of hair dye formulations by skin application to rats and mice; and experimental mixtures similar to those used as hair dyestuffs were inadequate for evaluation (6).

Dermal rats (2 yr) hair dye formulations in conjunction with hydrogen peroxide administered twice wkly caused no clinical or pathological changes (2).

Teratogenicity and reproductive effects

Dermal rat (7 days during gestation) 2 ml kg⁻¹ of hair dye formulation containing 3% mixture: including 4% 2,4-diaminoanisole sulfate; 2% *p*-phenylenediamine; and 6% hydrogen peroxide. Compared to 3 control groups, skeletal changes were observed in 6169 live foetuses. In a group of 20 ♀ rats treated with a formulation containing a 6% mixture no increase in foetal abnormalities was found compared with controls (1).

Metabolism and toxicokinetics

Of 10 mg applied during hair dyeing in humans it was estimated that 4.6 mg had been absorbed through the skin (7).

Absorbed through skin in dogs and excreted in urine. 40 mg was absorbed in 3 hr from a gel containing 1.4 g. When hydrogen peroxide was added to the gel immediately before use <3 mg was absorbed (8).

Irritancy

Irritating to skin, eyes, mucous membranes and upper respiratory tract (species unspecified) (9).

Genotoxicity

Salmonella typhimurium TA1538 with metabolic activation positive (10).

No dominant lethality was induced in rats administered 20 mg kg⁻¹ intraperitoneally 3 × wkly for 8 wk before mating (11).

Did not induce micronucleated cells in rats administered 2 oral doses of 120 mg kg⁻¹ at intervals of 24 hr (12).

Inhibited the incorporation of ¹²⁵I into murine testicular DNA (13).

Legislation

Use in hair dyestuff formulations prohibited in Italy (6).

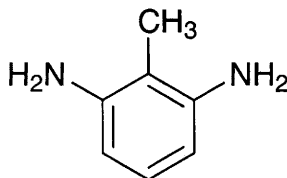
Other comments

Physicochemical properties, assay and identification procedures, pharmacokinetics, bioavailability and toxicity reviewed (14).

References

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D90 2,6-diaminotoluene



C₇H₁₀N₂

Mol. Wt. 122.17

CAS Registry No. 823-40-5

Synonyms 2,6-toluenediamine; 2-methyl-1,3-benzenediamine; 1,3-diamino-2-methylbenzene; 2-methyl-*m*-phenylenediamine; 2,6-DAT

EINECS No. 212-513-9

RTECS No. XS 9750000

Uses Chemical intermediate. Vulcanising agent.

Physical properties

M. Pt. 104-106°C

Solubility Water: soluble. Organic solvents: benzene, ethanol

Occupational exposure

Supply classification harmful

Supply classification dangerous for the environment

Risk phrases Harmful in contact with skin and if swallowed – Possible risk of irreversible effects – May cause sensitisation by skin contact – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R21/22, R40, R43, R50/53)

Safety phrases Keep out of reach of children (if sold to general public) – Avoid contact with the skin – Wear suitable protective clothing and gloves – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S2, S24, S36/37, S60, S61)

Environmental fate

Adsorption and retention

K_{oc} sorption constant under aerobic and anaerobic conditions on loam soil after 8 hr contact 500-1300. Sorption was slightly stronger under aerobic than anaerobic conditions (1).

Mammalian & avian toxicity

Carcinogenicity and chronic effects

Induced an elevated incidence of kidney tumours in a 2-yr study in rats, but not in mice (2).

Not found to be carcinogenic to ♂ or ♀ rats or mice in 2-yr bioassays (3).

Metabolism and toxicokinetics

Following oral administration to rats >80% was excreted, mostly in the urine. Almost 100% was excreted after 3 days. The metabolites identified included 4-hydroxy-2-acetylamino-6-aminotoluene and 2,6-di(acetylamino)-toluene which are known to be mutagenic to *Salmonella typhimurium* TA98, and 3-hydroxy-2,6-diaminotoluene and 2-acetylamino-6-aminotoluene (4).

Genotoxicity

Salmonella typhimurium TA98, TA100 with metabolic activation positive (5).

In vitro rat hepatocytes unscheduled DNA synthesis negative (6).

Inhibited the incorporation of ¹²⁵Iodine into murine testicular DNA (7).

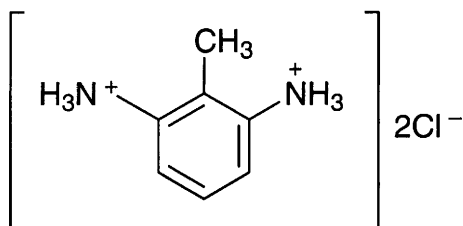
Other comments

Occurs in preparation of 2,4-diaminotoluene. Hydrolysis product of 2,6-toluene diisocyanate. Mutagenicity of monocyclic aromatic amines reviewed (8).

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D91 2,6-diaminotoluene dihydrochloride



$\text{C}_7\text{H}_{12}\text{Cl}_2\text{N}_2$

Mol. Wt. 195.09

CAS Registry No. 15481-70-6

Synonyms 2,6-diaminotoluene dihydrochloride

EINECS No. 239-505-8

RTECS No. XT 0370000

Mammalian & avian toxicity

Carcinogenicity and chronic effects

National Toxicology Program investigated 2, 6-toluenediamine hydrochloride in mice, rats. Designated non-carcinogen in mice and rats (1).

Rats and mice given 250, 500 or 50, 100 ppm in diet respectively showed equivocal evidence of carcinogenicity including: a significant dose-related increase in liver tumours in rats; an increased incidence of liver tumours in ♀ mice and kidney tumours in ♂ rats compared with controls (2).

Genotoxicity

Salmonella typhimurium positive (strain and metabolic activation unspecified) (3).

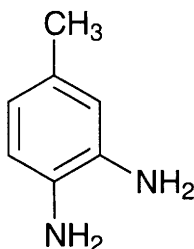
Other comments

Human health effects and experimental toxicology reviewed (4).

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D92 3,4-diaminotoluene



C₇H₁₀N₂

Mol. Wt. 122.17

CAS Registry No. 496-72-0

Synonyms 3,4-toluenediamine; 4-methyl-*o*-phenylenediamine; 4-methyl-1,2-benzenediamine; 1,2-diamino-4-methylbenzene

EINECS No. 207-826-2

RTECS No. XS 9820000

Uses Chemical intermediate.

Physical properties

M. Pt. 91-93°C **B. Pt.** 155-156°C at 18 mmHg **Volatility** v.p. 18 mmHg at 155°C

Solubility Water: very soluble. Organic solvents: ligroin

Mammalian & avian toxicity

Irritancy

2.4 mg ml⁻¹ solution instilled into rabbit eye for 10 min caused irritation (1).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1538 with and without metabolic activation positive (2).

Induced micronucleated cells in bone marrow of mice (3).

Inhibited the incorporation of ¹²⁵iodine into murine testicular DNA (4).

Other effects

Any other adverse effects

Highly active in production of duodenal ulcers in rats (5).

Other comments

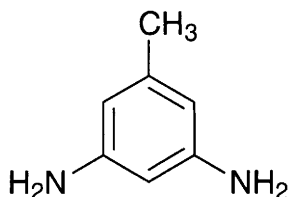
Present in small amounts in preparation of 2,4-diaminotoluene.

Mutagenicity of monocyclic aromatic amines reviewed (6).

References

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D93 3,5-diaminotoluene



$C_7H_{10}N_2$

Mol. Wt. 122.17

CAS Registry No. 108-71-4

Synonyms 5-methyl-1,3-benzenediamine; 3,5-tolylenediamine

EINECS No. 203-609-1

Uses Intermediate in the preparation of agrochemicals, pharmaceuticals and heat-resistant polymers.

Occurrence Formed as a minor product during the manufacture of other diaminotoluene isomers.

Physical properties

M. Pt. 98.1°C **B. Pt.** 283-285°C **Partition coefficient** $\log P_{ow}$ 0.337 (calc.) (1)

Volatility v.p. 1.59×10^{-3} mmHg at 25°C

Solubility Water: miscible. Organic solvents: diethyl ether, ethanol

Ecotoxicity

Bioaccumulation

A calculated bioconcentration factor of 1.06 indicates that environmental accumulation is not likely (2).

Environmental fate

Degradation studies

A biological screening study indicated that 3,5-diaminotoluene was resistant to biodegradation (3).

Abiotic removal

In the atmosphere degraded by reaction with photochemically produced hydroxyl radicals $t_{1/2}$ 96 min (4).

Mammalian & avian toxicity

Teratogenicity and reproductive effects

Data from the literature was assembled to determine developmental toxicity potential. Species positive only in rat (5).

Irritancy

2.5 g instilled into rabbit eye for 10 min did not cause irritation (6).

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D94 diammonium oxalate



$\text{C}_2\text{H}_8\text{N}_2\text{O}_4$

Mol. Wt. 124.10

CAS Registry No. 1113-38-8

Synonyms ethanedioic acid, diammonium salt; ammonium oxalate

EINECS No. 214-202-3

RTECS No. RO 2750000

Uses Manufacture of explosives. Electrolytic de-tinning of iron. Metal polishes. Dyestuffs. Chemical analysis.

Occurrence Component of poisonous plants (1).

Physical properties

Specific gravity 1.50

Solubility Water: 1 g in 20 ml

Environmental fate

Degradation studies

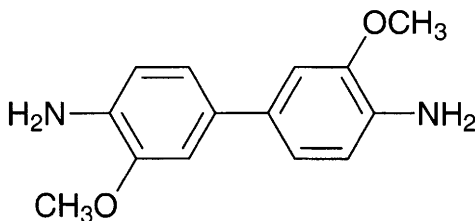
Activated sludge study – adapted activated sludge product as sole carbon source. 92.5% removal at 9.3 mg CODg⁻¹ dry inoculum hr⁻¹ (2).

Nutrient in hydrocarbon oil degradation in sea water by *Pseudomonas* (3).

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D95 o-dianisidine



$\text{C}_{14}\text{H}_{16}\text{N}_2\text{O}_2$

Mol. Wt. 244.29

CAS Registry No. 119-90-4

Synonyms 3,3'-dimethoxy-[1,1'-biphenyl]-4,4'-diamine; [1,1'-biphenyl]-4,4'-diamine, 3,3'-dimethoxy-; benzidine, 3,3'-dimethoxy-; Amacel Developed Navy SD; Azogene Fast Blue B; Blue Base Irga B; Blue Base NB; Blue BN Base; Cellitazol B; Cibacete Diazo Navy Blue 2B; C.I. Disperse Black 6; Diacel Navy DC; Fast Blue Base B; Fast Blue DSC Base; Hiltonil Fast Blue B Base; Kayaku Blue B Base; Lake Blue B Base; Mitsui Blue B Base; Naphthanil Blue B Base; Setacyl Diazo Navy R

EINECS No. 204-355-4

RTECS No. DD 0875000

Uses Intermediate for manufacture of azo dyestuffs.

Physical properties

M. Pt. 137-138°C **Flash point** 206°C (closed cup) **Volatility** v.den. 8.5
Solubility Organic solvents: ethanol, benzene, diethyl ether, acetone

Occupational exposure

Supply classification toxic

Risk phrases May cause cancer – Harmful if swallowed (R45, R22)

Safety phrases Restricted to professional users – Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S53, S45)

Ecotoxicity

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 128 ppm Microtox test (1).

Environmental fate

Degradation studies

Aerobacter sp. 500 mg l⁻¹ degraded at 30°C, 78% in 120 hr by the parent and 100% in 36 hr by a mutant (2).

Abiotic removal

Removal from waste water was reported by oxidation by peroxide and the oxidation products are fixed by the proteins in a bovine blood haemoglobin, which are then easily separated (3).

99.2% removal was reported in solution containing 0.1 g l⁻¹ *o*-dianisidine by treatment with peroxidase and hydrogen peroxide for 3 hr, followed by centrifugation (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1920 mg kg⁻¹ (5).

Sub-acute and sub-chronic data

Oral rat (13 wk) 0.017-0.25% in drinking water. Rats showed dose-related decreases in water consumption and weight gain. Liver and kidney weights increased. Target organs were the kidneys and thyroid. These lesions were characterised by chronic nephropathy and increased pigment in the follicular cells of the thyroid. All treated and control animals survived the 13 wk treatment (6).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (7).

Oral rat (duration and concentration unspecified) induced tumours of the bladder, intestine, skin and Zymbal gland (8-10).

Oral mouse (112 wk) 0-630 mg l⁻¹ of the hydrochloride in drinking water. No treatment-related mortality or pathological effects were observed (11).

Genotoxicity

Salmonella typhimurium TA98, TA100 without metabolic activation negative, with metabolic activation positive; TA1535, TA1537 with and without metabolic activation negative (12).

Drosophila melanogaster sex-linked recessive lethal mutation assay negative (13).

In vitro rat primary hepatocytes DNA damage positive (14).

In vitro Chinese hamster ovary cells, sister chromatid exchange positive (15).

In vitro HeLa cells, unscheduled DNA synthesis with metabolic activation positive (16).

Other effects

Any other adverse effects

Following oral administration to rats *o*-dianisidine was bound covalently to haemoglobin (17).

Other comments

o-Dianisidine is often manufactured in the same factories as benzidine and contamination with the latter may contribute to the bladder cancer risk (18).

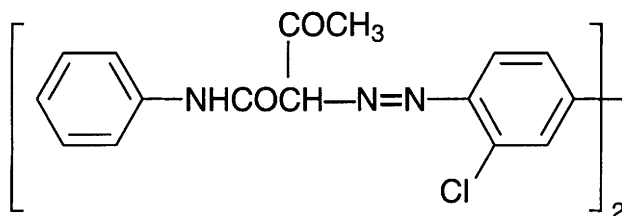
No case is on record in the former USSR of occupational urinary bladder neoplasms produced solely by *o*-dianisidine (19).

Physical properties, uses, biological hazards, carcinogenicity and mutagenicity reviewed (8,9,20,21).

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D96 Diarylanilide Yellow



$C_{32}H_{26}Cl_2NO_4$

Mol. Wt. 559.47

CAS Registry No. 6358-85-6

Synonyms 2,2-[(3,3'-dichloro-[1,1'-biphenyl]-4,4'-diyl)bis(azo)]bis[3-oxo-N-phenylbutanamide]; C.I. Pigment Yellow 12; benzidine yellow; C.I. 21090; Daimichi yellow G; brilliant yellow; Monolite GT; Symuler fast yellow GF

EINECS No. 228-787-8

RTECS No. AK 4580000

Uses Dyestuff for lacquers, printing inks, plastics, textiles and paper.

Physical properties

M. Pt. 317°C

Solubility Organic solvents: benzene, ethanol, linseed oil

Mammalian & avian toxicity

Sub-acute and sub-chronic data

Oral rat, mouse tolerated dietary levels of ≤ 630 mg kg^{-1} day $^{-1}$ with no signs of intoxication. No adverse effects were exerted on growth, food intake, health conditions, survival or histology. No metabolism to 3,3'-dichlorobenzidine or 3,3'-dimethylbenzidine was observed. (Duration of study unspecified.) (1).

Carcinogenicity and chronic effects

National Toxicology Program investigated diarylanilide yellow orally in rat and mouse. Classified as non-carcinogenic in rat and mouse (2).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (3).

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D97 diatomaceous earth

CAS Registry No. 61790-53-2

Synonyms flux-calcined diatomaceous earth; soda ash flux-calcined Kieselguhr; Filter agent, Celatom FW-14; Kieselguhr; diatomite; amorphous silica; purified siliceous earth

EINECS No. 272-489-0

RTECS No. HL 8600000

Uses Filter medium. Filler in paint, paper and scouring powders. Insulator. Suspending agent for medicines.

Occurrence Occurs as the mineral diatomite.

Occupational exposure

DE-MAK 4 mg m⁻³ (uncalcined) (inhalable fraction of aerosol)

UK-LTEL 1.2 mg m⁻³ (natural, respirable dust)

US-TWA 10 mg m⁻³ (inhalable particulate); 3 mg m⁻³ (respirable particulate)

Mammalian & avian toxicity

Acute data

LD₅₀ intravenous rat 15 mg kg⁻¹ (1).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans and to animals, IARC classification group 3 (2).

Oral rat (2 yr) 5 g kg⁻¹ in diet. In 30 animals, 5 malignant tumours (1 salivary gland carcinoma, 1 skin carcinoma, 2 sarcomas of the uterus, 1 peritoneal mesothelioma) and 13 benign tumours (9 mammary fibroadenomas, 1 adrenal pheochromocytoma, 3 pancreatic adenomas) were observed. In 27 controls 3 carcinomas (1 each in the lung, forestomach and ovary) and 5 mammary fibroadenomas were observed (3).

Intratracheal hamster (20 wk) 3 mg wkly. No respiratory tumour was observed up to 80 wk (4).

Subcutaneous mouse (19 month) single injection of 20 mg. No malignant tumours were observed and the survival rate was not significantly different from controls. The treated group showed an extensive granulomatous and fibrotic reaction. Intraperitoneal mouse (19 month) single injection of 20 mg induced a significant increase in lymphosarcomas in the abdominal cavity (5).

Teratogenicity and reproductive effects

Oral rabbit single administration to test the carrier material of a sugar coated pill containing 5.5% amorphous silica, 70 hr after coitus. Some increase in developmental abnormalities but the numbers were not significantly different from those in controls (6).

Other effects

Other adverse effects (human)

In a reported study of 428 diatomite workers exposed for ≥5 yr and followed for 21 yr, disabling pneumoconiosis was shown to be associated almost entirely with exposure to cristobalite, formed after high temperature calcining of diatomite (7).

Other comments

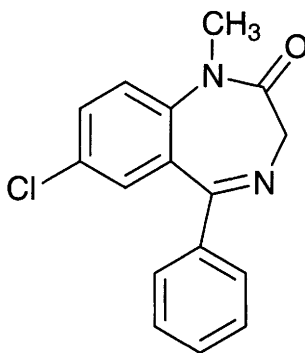
Composed of skeletons of small aquatic plants and containing 88% amorphous silica (8).

Production, uses, occurrence, analysis, carcinogenicity, teratogenicity, mammalian acute toxicity and metabolism of silica, including diatomaceous earth, reviewed (9).

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D98 diazepam



$C_{16}H_{13}ClN_2O$

Mol. Wt. 284.74

CAS Registry No. 439-14-5

Synonyms 7-chloro-1-methyl-5-phenyl-3H-1,4-benzodiazepin-2(1H)-one; 7-chloro-1,3-dihydro-1-methyl-5-phenyl-2H-1,4-benzodiazepin-2-one; Valium

EINECS No. 207-122-5

RTECS No. DF 1575000

Uses Sedative. Tranquilliser.

Physical properties

M. Pt. 125-126°C

Solubility Organic solvents: acetone, benzene, chloroform, dimethylformamide, ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird 316 mg kg⁻¹ (1).

LD₅₀ oral starling 100 mg kg⁻¹ (1).

LD₅₀ oral rat 710 mg kg⁻¹ (2).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans and animals, IARC classification group 3 (3).

Metabolism and toxicokinetics

Both the drug and its major metabolite, N-desmethyldiazepam, are secreted into milk and both cross the placenta. The latter can also accumulate in cerebrospinal fluid (4).

The main phase I reactions are *N*-demethylation and 3-hydroxylation. The product of these reactions is oxazepam, itself a sedative (5).

Human plasma $t_{1/2}$ <8 days (6).

Genotoxicity

In vitro human leucocytes positive (7).

Neither chromosomal aberrations nor sister chromatid exchanges were observed in the lymphocytes of patients receiving treatment with diazepam (8).

In vivo Chinese hamster did not induce chromosomal aberrations in bone marrow cells (8).

It did not inhibit intercellular communication in cultured rat hepatocytes, it was not mutagenic to bacteria (strains unspecified), but urine from mice treated with diazepam showed increased mutagenicity as compared with controls (8).

Other comments

Many species of *Streptomyces* will hydroxylate diazepam at the 3-position (9).

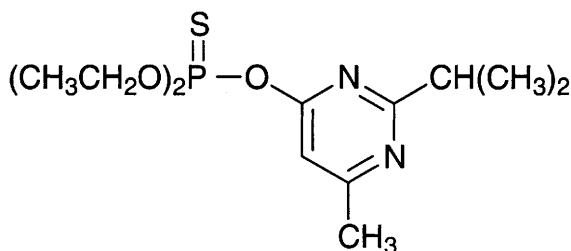
Aspergillus niger will degrade diazepam to produce 2-acetamido-2'-benzoyl-4'-chloroacetanilide. *Penicillium velutinum* metabolised diazepam to 2-acetamido-2'-benzoyl-4'-chloro-*N*-methylacetanilide (10).

Presence detected in water rivers at concentrations of 0.5 µg l⁻¹, and potable waters at 10 ng l⁻¹ (6).

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D99 diazinon



C₁₂H₂₁N₂O₃PS

Mol. Wt. 304.35

CAS Registry No. 333-41-5

Synonyms *O,O*-diethyl *O*-(2-isopropyl-6-methylpyrimidin-4-yl) phosphorothioate; phosphorothioic acid, *O,O*-diethyl *O*-[6-methyl-2-(1-methylethyl)-4-pyrimidinyl] ester; basudin; neocidol; spectracide

EINECS No. 206-373-8

RTECS No. TF 3325000

Uses Insecticide. Acaricide.

Physical properties

M. Pt. 120°C (decomp.) **B. Pt.** 83-84°C at 0.0002 mmHg **Specific gravity** 1.117 at 20°C with respect to water at 4°C **Partition coefficient** $\log P_{ow}$ 3.30 (calc.) (1) **Volatility** v.p. 1.4×10^{-4} mmHg at 20°C
Solubility Water: 60 mg l⁻¹ at 20°C. Organic solvents: acetone, benzene, cyclohexane, dichloromethane, diethyl ether, ethanol, light petroleum, toluene, vegetable oils

Occupational exposure

DE-MAK 0.1 mg m⁻³ (inhalable aerosol fraction)

FR-VME 0.1 mg m⁻³

JP-OEL 0.1 mg m⁻³

UK-LTEL 0.1 mg m⁻³

UK-STEL 0.3 mg m⁻³

US-TWA 0.1 mg m⁻³

Supply classification harmful, dangerous for the environment

Risk phrases Harmful if swallowed – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R22, R50/53)

Safety phrases Keep out of reach of children (if sold to general public) – Avoid contact with skin and eyes – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S2, S24/25, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) bluegill sunfish 16 mg l⁻¹ (2).

LC₅₀ (96 hr) rainbow trout 2.6-3.2 mg l⁻¹ (2).

LC₅₀ (96 hr) carp, fathead minnow 0.1-23 mg l⁻¹ (3).

European eel (96 hr) 0.042 mg l⁻¹. Liver and muscle glycogen content decreased from 6-96 hr exposure. Blood glucose values were elevated after exposure; liver, blood and muscle levels increased during exposure reaching a maximum at 96 hr. Signs of intoxication were observed e.g. muscular twitching, gyrating and diminished sensory activity (4).

LC₅₀ (48 hr) killifish 4.4 mg l⁻¹ (5).

Invertebrate toxicity

EC₅₀ (5 min) *Photobacterium phosphoreum* 1.7-10.3 ppm Microtox test (6).

EC₅₀ (48 hr) *Daphnia magna* 1.2 µg l⁻¹ (7).

LC₅₀ (96 hr) *Gammarus lacustris* 200 µg l⁻¹ (8).

EC₅₀ (24 hr) *Artemia* sp. (Artoxkit M) 19 mg l⁻¹, *Brachionus plicatilis* (Rotokit M) 28 mg l⁻¹ (9).

LC₅₀ (48, 96 hr) *Ceriodaphnia dubia* static test 0.26-0.58 and 0.4-0.89 µg l⁻¹, respectively (10).

Bioaccumulation

Bioconcentration factors for carp were 21 in muscle, 60 in liver, 111 in kidney and 32 in gall-bladder (11).

Bioconcentration factor for killifish (whole body) 49 (5).

Excretion rate constant for killifish (whole body) 0.12 hr⁻¹ (5).

Environmental fate

Degradation studies

t_{1/2} for microbial degradation in submerged paddy field 2 days. Metabolites identified were 2-isopropyl-6-methyl-4-hydroxypyrimidine, diazoxon, hydroxydiazinon and sulfotap (12).

Degradation involves oxidation to phosphate and hydrolysis (13).

Detoxification can be effected by immobilised phosphotriesterase from *Pseudomonas diminuta*, in a fixed bed reactor use tritylagarose (14).

Abiotic removal

t_{1/2} for photodegradation under UV irradiation 4 days compared with 9 days for control samples (15).

100% removal from water reported by treatment using reverse osmosis (16).
 $t_{1/2}$ for hydrolysis in water at 20°C, 31 days at pH 5.0, 185 days at pH 7.4, and 136 days at pH 9.0. Major hydrolysis products are 2-isopropyl-4-methyl-6-hydroxypyrimidine and diethyl thiophosphoric acid on diethyl phosphoric acid (17).
 $t_{1/2}$ for evaporation from pond water 4.25 days (18).
Calculated $t_{1/2}$ for reaction with photochemically generated hydroxyl radicals in the atmosphere 4.1 hr (19).
76-95% removal from waste water reported by 6-hr treatment with granular activated carbon (20).

Adsorption and retention

Complexes with montmorillonite saturated with alkaline earth and transition metal cations (21).
Diazinon at 7 or 51 ppm in sandy loam soil degraded with $t_{1/2}$ of 37.4 hr after exposure to natural light. After 35.5 hr of sunlight exposure, 21% was bound to the soil, some as metabolite, while 40% existed as free diazinon and 25% as free oxypyrimidine, 7% loss was attributable to volatilisation (22).

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird, starling, common grackle, quail 2-7.5 mg kg⁻¹ (23).
LD₅₀ oral rat 250-320 mg kg⁻¹ (24,25).
LD₅₀ (4 hr) inhalation mouse, rat 1600, 3500 mg m⁻³, respectively (26,27).
LD₅₀ dermal mouse 2750 mg kg⁻¹ (28).
LD₅₀ intraperitoneal mouse, rat 33, 65 mg kg⁻¹, respectively (29,30).

Sub-acute and sub-chronic data

LD₅₀ (8 day) oral Japanese, bobwhite quail, ring-necked pheasant, mallard duck 275-665 mg kg⁻¹ (31).
Oral ♂ rat (60 day) 10.8 mg kg⁻¹ day⁻¹ caused significant rise in renal and hepatic glutamic oxalacetic transaminase and glutamic pyruvic transaminase activities (32).
Oral ♀ rat (14 day) 157 mg l⁻¹ in drinking water had a direct effect on blood clotting activity (33).
Oral rat (30 day) 0.1 or 1.2 mg kg⁻¹ day⁻¹, the high dose reduced acetyl cholinesterase activity by 22-30% in plasma and 5-9% in the brain of ♀ rats. Inhibition was lower in ♂ rats (34).
Oral rat (90 day) diet, no-effect level 0.1 mg kg⁻¹; oral dog (90 day) diet, no-effect level 0.02 mg kg⁻¹ (35).

Carcinogenicity and chronic effects

National Toxicology Program investigated diazinon in rat and mouse via oral administration. Negative results were reported (36).
Oral mouse (18-19 month) 0, 0.6, 3.0 or 15 mg kg⁻¹ day⁻¹. All treated ♀ and ♂ mice given the high dose suffered a significant reduction in weight gain. Skin irritation, loss of hair, skin lesions and piloerection were reported in treated animals. No inflammatory, degenerative, proliferative or neoplastic lesions were observed and there were no significant trends in mortality (37).

Teratogenicity and reproductive effects

Oral rat, 3 generation study, 0.2 or 0.4 mg kg⁻¹ day⁻¹ caused no foetotoxic effects (38).
Gavage rabbit (day 6-18 gestation) 7, 25 or 100 mg kg⁻¹ day⁻¹. The study reported 9/22 fatalities for the high-dose level but no foetotoxic or teratogenic effects were observed (39).

Metabolism and toxicokinetics

In rats 69-80% of orally administered ¹⁴C-diazinon was excreted in the urine within 12 hr. Unchanged diazinon and 3 major metabolites, all with the pyrimidine ring intact, were identified in the urine. These metabolites were the result of a split of the O-P bond with subsequent hydroxylation of the isopropyl side chain. There was no significant exhalation of labelled carbon dioxide (40).
In mammals, primary metabolites are diethylthiophosphate and diethylphosphate (2).

Irritancy

Dermal rabbit 500 mg caused moderate irritation and 100 mg instilled into rabbit eye caused severe irritation (duration of exposure unspecified) (41).

Genotoxicity

Salmonella typhimurium TA98 with metabolic activation positive (42).

In vitro human lymphocytes chromosomal aberrations positive (43).

In vitro mouse lymphoma L-5178Y tk+ /tk- with and without metabolic activation positive (44).

Allium cepa and barley meristems chromosomal aberrations positive (45).

In vivo mouse dominant lethal study negative (46).

Other effects

Other adverse effects (human)

In one apparent suicide attempt, symptoms typical of organophosphate poisoning were observed, including muscarinic, nicotinic and central nervous system manifestations (47).

Any other adverse effects

Intraperitoneal rat, single dose of 40 mg kg⁻¹ caused hyperglycaemia and reduced hepatic glycogen within 2 hr. Hepatic phosphorylase and phosphoglucomutase activities were enhanced while that of glucose-6-phosphatase was unaltered. The activities of fructose-1,6-diphosphatase and phosphoenolpyruvate carboxy kinase were increased. Ascorbic acid and cholesterol levels of the adrenals were reduced (48).

Compound is an inhibitor of acetylcholinesterase (true) and cholinesterase (pseudo) and affects the central and peripheral nervous system of many species (24).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (49).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (50).

EC maximum residue levels for cereals and shell fruits 0.05 ppm; other fruits and vegetables 0.5 ppm (2).

WHO Class II (51).

EPA Toxicity Class II or III (2).

Tolerable Daily Intake (TDI) human 0.002 mg kg⁻¹ (2).

Other comments

Residues have been isolated from fish, surface water and groundwater samples (52,19).

Occurrence, environmental fate, physical properties, metabolism, toxicity, teratogenicity, mutagenicity, carcinogenicity and health effects of diazinon reviewed (52-55).

Environmental health criteria reviewed (56).

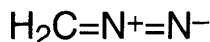
Environmental fate of diazinon reviewed (19).

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D100 diazomethane



CH₂N₂

Mol. Wt. 42.04

CAS Registry No. 334-88-3

Synonyms azimethylene; diazirine

EINECS No. 206-382-7

RTECS No. PA 7000000

Uses Methylating agent.

Physical properties

M. Pt. -145°C B. Pt. -23°C Volatility v.den. 1.45

Solubility Organic solvents: benzene, diethyl ether, 1,4-dioxane

Occupational exposure

US-TWA 0.2 ppm (0.34 mg m⁻³)

Supply classification toxic

Risk phrases May cause cancer (R45)

Safety phrases Restricted to professional users – Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S53, S45)

Mammalian & avian toxicity

Sub-acute and sub-chronic data

Inhalation rabbit, 1 to 4 exposures for 5-20 min (dose unspecified) resulted in bronchopneumonia, followed by death before 7 days (1).

Inhalation cat (10 min) 175 ppm resulted in pulmonary oedema and haemorrhage, death occurred within 3 days (2).

Carcinogenicity and chronic effects

No adequate data for carcinogenicity to humans, limited evidence for carcinogenicity to animals, IARC classification group 3 (3).

Inhalation mouse, rat (6 month) exposure 2-3 min daily to 0.1 or 0.33 mg ml⁻¹ in diethyl ether. 2/10 surviving mice developed multiple pulmonary adenomas compared with 2/8 in controls. 3/7 surviving rats developed pulmonary adenomas, 1 also had a squamous cell carcinoma of the lung with a metastasis attached to the diaphragm and invading the skeletal muscle. No tumours were reported in 4 control rats (4).

Dermal mouse (5 month) 2-3 drops of 0.1-3.3 mg ml⁻¹ solution, 5 × wkly. 8/12 animals died between 5-12 months all had lung adenomas (4).

Subcutaneous mouse (12 month) single injection of 0.33-1.01 mg. 1/9 surviving mice had a spindle cell sarcoma invading the adjacent muscle and 1 developed multiple pulmonary adenomas (4).

Sensitisation

Sensitisation was reported in man following exposure to an accidental spillage (5).

Genotoxicity

Demonstrated to cause DNA methylation by the formation of N-7-methylguanine (6).

Other effects

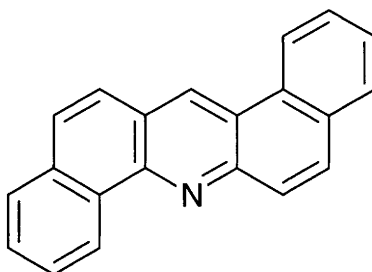
Other adverse effects (human)

Inhalation by humans, depending on the degree of exposure, caused chest pains, asthmatic symptoms, cough and fever, fulminating pneumonia, moderate cyanosis, shock and death (7).

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D101 dibenz[*a,h*]acridine



$C_{21}H_{13}N$

Mol. Wt. 279.34

CAS Registry No. 226-36-8

Synonyms 7-azadibenzo[*a,h*]anthracene; dibenzo[*a,d*]acridine; 1,2,5,6-dibenzacridine; 1,2,5,6-dibenzoacridine

RTECS No. HN 0875000

Uses Experimental carcinogen.

Physical properties

M. Pt. 266-267°C **B. Pt.** 524°C

Ecotoxicity

Fish toxicity

Hepatic neoplasms and lesions have been detected in marine English sole when present with other hydrocarbons in sediment (1).

Mammalian & avian toxicity

Acute data

TD_{Lo} dermal mouse 790 mg kg⁻¹ (2).

TD_{Lo} subcutaneous mouse 430 mg kg⁻¹ (2).

TD_{Lo} intravenous mouse 10 mg kg⁻¹ (2).

Sub-acute and sub-chronic data

LD_{Lo} oral mice (63 wk) 13 g kg⁻¹ (intermittently administered total dose) (2).

Carcinogenicity and chronic effects

No adequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (3).

Rat, implantation into lungs produced tumours in a dose-dependent manner (4).

Carcinogenic and mutagenic potential have been evaluated in a CASE structure-activity study (5).

Metabolism and toxicokinetics

During a 6 min incubation 21 nmol dibenz[*a,h*]acridine were metabolised by microsomes from pretreated rats. The predominant metabolites were the potentially mutagenic benzo-ring dihydrols with bay-region double bonds including dibenz[*a,h*]-3,4-dihydrodiol and dibenz[*a,h*]acridine-1,2-dihydrodiol (21 and 23% of total metabolism) (6).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Polycyclic aromatic hydrocarbons: maximum admissible concentration 0.2 µg l⁻¹ (7).

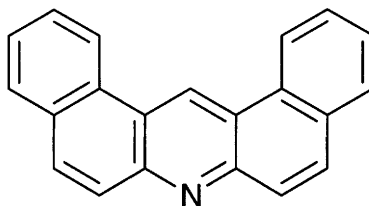
Other comments

Pollutant in air and in some foods, particularly those foods high in protein.

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D102 dibenz[*a,j*]acridine



C₂₁H₁₃N

Mol. Wt. 279.34

CAS Registry No. 224-42-0

Synonyms 7-azadibenzo[*a,j*]anthracene; dibenzo[*a,j*]acridine; 1,2,7,8-dibenzacridine; DB[*a,j*]AC; 3,4,5,6-dibenzacridine; 3,4,6,7-dinaphthacridine

RTECS No. HN 1050000

Uses No commercial production or known use for this compound.

Physical properties

M. Pt. 216°C

Solubility Organic solvents: acetone, ethanol

Mammalian & avian toxicity

Acute data

TD_{Lo} oral mouse 590 mg kg⁻¹ (1).

TD_{Lo} dermal mouse 700 mg kg⁻¹ (1).

TD_{Lo} subcutaneous mouse 40 mg kg⁻¹ (1).

Carcinogenicity and chronic effects

No adequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (2).

Oral mouse 5 mg wkly. No tumours developed over 572 days (3).

Dermal mouse 0.3% twice wkly some skin tumours developed (3).

Dermal mouse ≥0.1% twice wkly for 12-14 months, skin tumours developed (3).

Subcutaneous mouse 1 mg single dose caused some local sarcomas and increased the incidence of lung tumours (3).

Metabolism and toxicokinetics

Isolated rat lung tissue metabolised the compound to sulfate and thioether conjugates, as well as a 3,4-dihydrodiol of the parent compound (4).

Placental transfer of dibenz[*a,j*]acridine or its metabolite occurs (5).

Genotoxicity

Salmonella typhimurium TA1535, TA1537, TA1538, TA100, TA98 with metabolic activation positive (6).

Escherichia coli K12 *envA uvrB* with metabolic activation phase induction test positive (7).

Escherichia coli DNA damage positive (8).

Primary rat hepatocytes unscheduled DNA synthesis negative (9).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Polycyclic aromatic hydrocarbons: maximum admissible concentration 0.2 µg l⁻¹ (10).

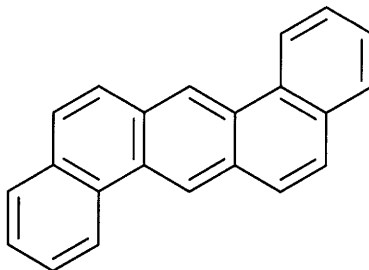
Other comments

Pollutant in air. Identified in cigarette smoke, from coal emissions, coal-tar pitch and gasoline engine exhaust. In industrial effluent.

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D103 dibenz[*a,h*]anthracene



C₂₂H₁₄

Mol. Wt. 278.35

CAS Registry No. 53-70-3

Synonyms DB[*a,h*]A; 1,2,5,6-dibenzanthracene; 1,2,7,8-dibenzanthracene; dibenzo[*a,h*]anthracene; 1,2,5,6-dibenzoanthracene; DBA; 1,2,5,6-dibenzo[*a*]anthracene

EINECS No. 200-181-8

RTECS No. HN 2625000

Physical properties

M. Pt. 266-267°C **B. Pt.** 524°C **Specific gravity** 1.282 **Partition coefficient** log *P*_{ow} 6.75

Solubility Water: 0.5 µg l⁻¹ at 27°C. Organic solvents: benzene, petroleum oils, toluene

Occupational exposure

Supply classification toxic, dangerous for the environment

Risk phrases May cause cancer – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R45, R50/53)

Safety phrases Restricted to professional users – Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S53, S45, S60, S61)

Ecotoxicity

Invertebrate toxicity

LC₅₀ (96 hr) ragworm >1 ppm (initial concentration), static bioassay seawater at 22°C (1).

Environmental fate

Degradation studies

Degradation by microorganisms has shown limited success (2).

Abiotic removal

After 1 min contact with ozone, only 3.6% of the original quantity remained (1).

Mammalian & avian toxicity

Acute data

LD_{Lo} intravenous mouse 10 mg kg⁻¹ (3).

Sub-acute and sub-chronic data

Intraperitoneal rat 3-90 mg kg⁻¹ single injection reduced growth rate over several wk (4).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2A (5).

Oral mouse 9-19 mg (total dose) over 5-7 months produced stomach tumours in 7/22 survivors after 1 yr (6).
 Oral mouse 0.4 mg day⁻¹ in mineral oil emulsion which replaced drinking water induced papillomas of the forestomach and squamous-cell carcinomas of the forestomach within 406 days (7).
 Oral mouse 0.2 mg ml⁻¹ in olive oil emulsion, replacing drinking water; equivalent to 0.75-0.85 mg day⁻¹ induced tumours: 27/27 survivors at 200 days had pulmonary adenomatosis; 24/27 had alveologenic carcinoma; 16/27 had haemangio-endotheliomas; and 12/13 ♀ animals had mammary carcinomas (8).
 Dermal mouse life application of 0.2%-0.25% twice wkly induced both skin and mammary tumours (9,10).
 Intratracheal rat (30 month) 5 doses of 0, 0.5, 2, 10 or 20 mg induced lung squamous cell carcinomas in animals receiving >2 mg (11).
 The compound has been included in a CASE-SAR analysis (12).

Teratogenicity and reproductive effects

The compound and its metabolites are thought capable of crossing the placenta (6).
 Subcutaneous rat 5 mg kg⁻¹ day⁻¹ from day 1 of pregnancy caused some foetal deaths, and may have decreased fertility in subsequent matings (6).

Metabolism and toxicokinetics

Intraperitoneal ♂ Wistar rats (3 day) 2 ml kg⁻¹ day⁻¹ or 20 mg ml⁻¹ arachis oil incubated with rat liver microsomes. Pretreatment with dibenz[*a,h*]anthracene resulted in the formation of secondary metabolites (detected as triols) one of which was characterised as 2,3,4-trihydroxy-3,4-dihydrobenz[*a*]anthracene (13).
 Rat liver and mouse skin metabolised the compound to 1,2-, 3,4- and 5,6-dihydrodiols (6).
 When incubated with rat liver cytosol, dibenz[*a,h*]anthracene biotransformed to form bioalkylated substituents which in some cases were more potent than parent compound (14).

Genotoxicity

Salmonella typhimurium TA1535, TA1537, TA1538, TA100, TA98 with metabolic activation positive (14).
Escherichia coli Q13 with metabolic activation DNA damage positive (15).
 Many genotoxic tests of different types have produced positive results, establishing the compound as a mutagen (5).
 Human hepatoma (HepG2) cell-mediated assay and Chinese hamster lung cell V79-16 subline positive (16).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Polycyclic aromatic hydrocarbons: maximum admissible concentration 0.2 µg l⁻¹ (17).

Other comments

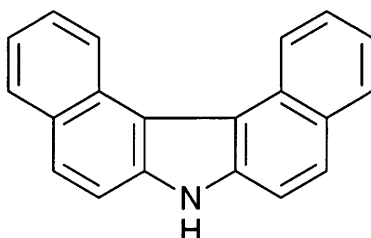
Contaminant in wood preservative sludge. Coal tar. Emissions from automobile exhaust gas and cigarettes.
 Pollutant in water. Formed as pyrolysis product of the tobacco constituent stigmasterol. Contaminant detected in a range of foodstuffs, including meat, vegetables, vegetable oils and cereals.
 Genotoxicity reviewed (5).
 Carcinogenic risk to humans evaluated (4,5,18).
 Metabolism reviewed (19). Analysis of lava and humus from Icelandic soil samples ranged from 0-2.3 µg kg⁻¹ (20).

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D104 7H-dibenzo[c,g]carbazole



C₂₀H₁₃N

Mol. Wt. 267.33

CAS Registry No. 194-59-2

Synonyms 3,4,5,6-dibenzocarbazole; 7-aza-7H-dibenzo[c,g]fluorene

EINECS No. 205-895-3

RTECS No. HO 5600000

Physical properties

M. Pt. 158°C

Solubility Water: miscible. Organic solvents: acetone, benzene, diethyl ether, ethanol

Ecotoxicity

Bioaccumulation

Daphnia pulex bioaccumulation coefficient 7126 (1).

Environmental fate

Degradation studies

Oxidised by an isolate identified as *Pseudomonas* HL7b without any apparent lag time (2).

Mammalian & avian toxicity

Acute data

LD_{Lo} intraperitoneal mouse 13 mg kg⁻¹ (3).

Sub-acute and sub-chronic data

Intratracheal hamster 3 mg 5 wkly instillations induced hyperplastic epithelium and squamous metaplasia at application site (4).

Carcinogenicity and chronic effects

No adequate data for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (5).

Oral mouse (59 wk) 0.25-4.0 mg twice wkly induced papillomas, squamous-cell carcinomas of the forestomach and malignant and benign hepatomas. Pulmonary adenomas were seen in all strain A mice, but in none of the CBA strain mice. Tumour incidence in controls was not reported (6).

Dermal mouse 0.2% 3 × wkly induced papillomas, squamous-cell carcinomas and hepatoma after an average latent period of 110 days (7).

Intratracheal hamster 15 wkly instillations of 0.5 or 3 mg induced squamous-cell carcinomas and adenomas of the bronchial and tracheal epithelium (8).

Subcutaneous mouse (13 month) 3 × 1 mg over 1 month induced sarcomas (9).

Subcutaneous mouse (42 wk) single dose of 0.2 mg. Sarcomas in 3 strains of mice and lung tumours in strain A only reported. Hepatic changes, characterised by cyst formation and bile-duct proliferation were also observed (10).

Intraperitoneal mouse (20 wk) single dose of 0.25 mg. Significant incidence of lung tumours compared with controls (11).

Mouse bladder implantation (40 wk), 1-2 mg induced papillomas or adenomas and metaplasia. No control mice developed tumours (12).

Metabolism and toxicokinetics

3 mg of tritiated substance, administered intratracheally to hamsters, was cleared from the respiratory tract with a $t_{1/2}$ of 1-3 hr. It was distributed to the liver, kidney, brain and fat, with highest concentrations observed in the intestine. 6 hr after administration; 5 times as much radioactivity was observed in the faeces (16%) as in the urine (3%) (4).

Primary mouse embryo cells were able to metabolise dibenzocarbazole *in vitro*. Pretreatment of cells with 2,3,7,8-tetrachlorodibenzo-*p*-dioxin stimulated DNA-adduct formation in exposed cells and activated cytochrome P 4501A1-linked ethoxyresorufin deethylase activity. This suggests that cytochrome P 4501A1 may play a role in metabolising dibenzocarbazole (13).

Genotoxicity

Salmonella typhimurium TA100 with metabolic activation positive (14).

Other effects

Any other adverse effects

Following topical and intraperitoneal administration (species unspecified) of 10 mg of 7H-dibenzo[*c,g*]carbazole and its phenolic metabolites, DNA adducts were identified in the liver and skin. Following topical application DNA adduction in the liver was 13.5 × higher than in the skin (15).

Other comments

Contaminant in cigarette smoke (16).

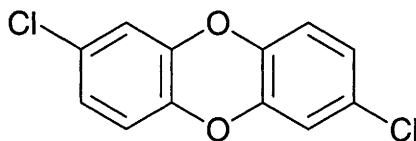
The occurrence, analysis, metabolism, carcinogenicity and genotoxicity of polycyclic aromatic hydrocarbons reviewed (16).

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D105 dibenzo-*p*-dioxin, 2,7-dichloro-



$C_{12}H_6Cl_2O_2$

Mol. Wt. 253.08

CAS Registry No. 33857-26-0

Synonyms 2,7-dichlorodibenzo-*p*-dioxin; 2,7-dichlorobenzo[*b,e*][1,4]dioxin; 2,7-dichlorodibenzodioxin; DCDD

RTECS No. HP 3100000

Physical properties

M. Pt. 209°C **Partition coefficient** log P_{ow} 5.75 (1) **Volatility** v.p. 9.0×10^{-7} mmHg at 25°C

Solubility Organic solvents: methanol

Ecotoxicity

Bioaccumulation

Bioconcentration factor in guppy 4800 (1).

Environmental fate

Degradation studies

A bacterium, tentatively identified as an *Erwinia* sp. isolated from sewage, showed resistance to copper ions and the ability to degrade 2,7-dichloro-*p*-dioxin (2).

Mammalian & avian toxicity

Sub-acute and sub-chronic data

Oral rat 40 or 400 $\mu\text{g kg}^{-1}$ for 3 days. Six days after treatment lipid peroxidation and glucose peroxidase activity were determined in the liver and kidney. Two days after treatment hepatic aryl hydrocarbon hydroxylase activity was determined. No toxic or biochemical changes were observed as determined by these parameters (3).

Oral rat and mouse (17 wk) 0.5 or 1.0% in diet. The higher dose caused 2-4% fatality, and the lower dose 2% fatality in mice. There were no deaths in rats or in controls (4).

Carcinogenicity and chronic effects

No adequate data for evaluation of carcinogenicity to humans, inadequate evidence for carcinogenicity to animals, IARC classification group 3 (5).

Tumours found in circulatory system, haematopoietic system or liver (carcinomas and adenomas) in σ mice when given via food (6).

Oral rat and mouse (42 wk) 0.5 or 1.0% of diet. No tumours were observed in treated animals (4).

Dermal mouse (59 wk) 3 mg kg^{-1} $3 \times \text{wk}^{-1}$, no skin tumours were reported (4).

National Toxicology Program investigated 2,7-dichlorodibenzo-*p*-dioxin orally in rat and mouse. Equivocal results were obtained in ♂ mice, negative results were obtained in rats and ♀ mice (7).

Teratogenicity and reproductive effects

Oral rat, 100 mg kg⁻¹ day⁻¹ from days 6-15 of gestation did not induce any teratogenic or embryotoxic effects (8).

Irritancy

2 mg instilled into rabbit eye caused mild irritation (period of exposure unspecified) (8).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA97 with and without metabolic activation negative (6).

Concentrations of 25-5000 µg l⁻¹ failed to transform C3U/10T1/2 cells or to initiate transformation in cultures subsequently heated with the tumour promoter 12-*O*-tetradecanoylphorbol 13-acetate (9).

Other effects

Any other adverse effects

Suppressed antibody responses in mouse spleen cells *in vitro* (10).

Legislation

Polychlorinated dibenzo-*p*-dioxins are included in Schedule 6 (Release into Land: Prescribed Substances)

Statutory Instrument No. 472, 1991 (11).

Other comments

In flue gas emissions from waste incinerators.

2,7-Dichloro-*p*-dioxin has been reported to have flameproofing properties, and bacteriocidal, fungicidal and insecticidal properties, although there is no evidence that it has been exploited commercially (12).

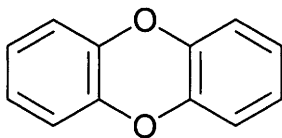
Physical properties, use, occurrence, carcinogenicity, teratogenicity, genotoxicity and metabolism of chlorinated dibenzodioxins reviewed (12).

QSAR generated octanol-water partition coefficients for chlorinated, brominated and mixed halogenated dibenzodioxins indicate that their ecological behaviour will be similar to the pure chlorinated compounds (13).

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D106 dibenzo-*p*-dioxin



$C_{12}H_8O_2$

Mol. Wt. 184.19

CAS Registry No. 262-12-4

Synonyms dibenzo[*b,e*][1,4]dioxin; dibenzo[1,4]dioxin; diphenylene dioxide; oxanthrene; phenodioxin

EINECS No. 205-974-2

RTECS No. HP 3090000

Physical properties

M. Pt. 122-123°C Volatility v.p. 1.125×10^{-4} mmHg at 25°C

Solubility Water: 1 mg l⁻¹ at 25°C

Environmental fate

Degradation studies

A strain of *Pseudomonas* was able to utilise dibenzo-*p*-dioxin as a sole source of carbon (1).

Abiotic removal

Degraded in the atmosphere by reaction with photochemically produced hydroxyl radicals with an estimated $t_{1/2}$ of 10 hr (2).

The heterocyclic ring was ultimately ruptured when irradiated by sunlight or light of 300 nm (3).

Mammalian & avian toxicity

Acute data

LD₅₀ oral ♀, ♂ rats 1220, 1730 mg kg⁻¹, respectively (calc.) (4).

Carcinogenicity and chronic effects

National Toxicology Program investigated dibenzo-*p*-dioxin orally in rat and mouse. Classified non-carcinogenic in rat and mouse (5).

Metabolism and toxicokinetics

Intraperitoneal mouse rapidly metabolised into unknown polar products. Rat, mouse and rabbit liver microsomes also metabolised dibenzo-*p*-dioxin efficiently (6).

In rats primary hydroxylation takes place exclusively at the 2, 3, 7 or 8 position (7).

Urinary and faecal metabolites identified in rats were the 2-hydroxy-, 1-methylthio- and 1-hydroxy- analogues (8).

Other comments

Analysis of extracts from filters of respirators worn by fire fighters and clean-up squads, during and after the 1986 agrochemicals warehouse fire in Basle, found no above-background level of exposure to polycyclic aromatic hydrocarbons, polychlorinated dibenzo-*p*-dioxins or polychlorinated dibenzofurans. There was no indication that the fire produced clastogenic material in quantities that could increase clastogenic activity and/or cytotoxicity of the air (9).

Emissions from waste incinerators and automobile exhausts.

Chemistry and health effects of dioxins reviewed (10).

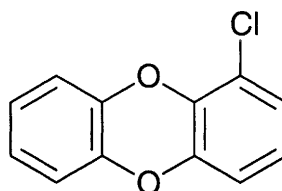
Dioxins, their chemistry and toxic effects reviewed (11).

Environmental fate and potential human health risks and dibenzofurans have been extensively reviewed (12-22).

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D107 dibenzo-*p*-dioxin, 1-chloro-



$C_{12}H_7ClO_2$

Mol. Wt. 218.64

CAS Registry No. 39227-53-7

Synonyms 1-chlorodibenzodioxin; 1-monochlorodibenzo-*p*-dioxin; 1-chlorodibenzo[*b,e*][1,4]dioxin

RTECS No. HP 3095300

Physical properties

M. Pt. 104.5-105.5°C Partition coefficient low P_{ow} 5.04 (1) Volatility v.p. 9×10^{-3} mmHg at 25°C

Solubility Organic solvents: methanol

Mammalian & avian toxicity

Carcinogenicity and chronic effects

No adequate data for evaluation of carcinogenicity to humans, inadequate evidence of carcinogenicity to animals, IARC classification group 3 (2).

Other comments

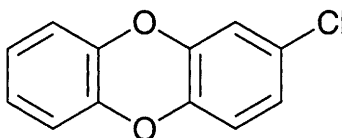
Formed in waste incineration plants (3).

Environmental fate of chlorinated dibenzodioxins reviewed (4).

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D108 dibenzo-*p*-dioxin, 2-chloro-



$C_{12}H_7ClO_2$

Mol. Wt. 218.64

CAS Registry No. 39227-54-8

Synonyms 2-chlorodibenzodioxin; 2-chlorodibenzo[*b,e*][1,4]dioxin

RTECS No. HP 3095500

Physical properties

M. Pt. 88-89°C **Partition coefficient** low P_{ow} 5.28 (1) **Volatility** v.p. 1.28×10^{-2} mmHg at 25°C

Solubility Organic solvents: methanol

Ecotoxicity

Bioaccumulation

Bioconcentration and dietary accumulation of some chlorinated dibenzo-*p*-dioxin (PCDD) congeners and octachlorodibenzofuran (OCDF) was investigated in the guppy. Dietary bioaccumulation of the PCDD congeners and OCDF was insignificant. Bioconcentration factors of PCDDs and OCDF were approx. two orders of magnitude lower than those of polychlorinated biphenyls of similar log P_{ow} . Low bioaccumulation and dietary bioaccumulation factors of the PCDDs are due to rapid depuration of the chemicals from the fish. Metabolic transformation of the PCDDs in the fish is an important factor causing this rapid depuration. Metabolic transformation of the PCDDs appears to involve hydroxylation, probably mediated by mixed function oxidases (2).

Environmental fate

Degradation studies

Co-metabolised by the biphenyl-utilising *Alcaligenes* strain JBI, but it cannot be utilised as a sole carbon source (3).

Mammalian & avian toxicity

Carcinogenicity and chronic effects

No adequate evidence of carcinogenicity to humans, insufficient evidence of carcinogenicity to animals. IARC classification Group 3 (4).

Other comments

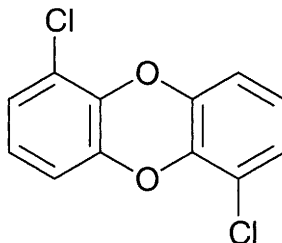
Formed during the manufacture of chlorophenols, in chlorinated water supplies and in waste incineration plants (5,6).

Environmental fate of chlorinated dibenzodioxins reviewed (7).

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D109 dibenzo-*p*-dioxin, 1,6-dichloro-



C₁₂H₆Cl₂O₂

Mol. Wt. 253.08

CAS Registry No. 38178-38-0

Synonyms 1,6-dichlorodibenzo-*p*-dioxin; 1,6-dichlorodibenzodioxin; 1,6-dichlorodibenzo[*b,e*][1,4]dioxin

RTECS No. HP 3095800

Occurrence Photodegradation product of tetrachlorodibenzo-*p*-dioxins (1).

Physical properties

M. Pt. 197-199°C **Volatility** v.p. 1.1×10^{-8} mmHg at 25°C

Mammalian & avian toxicity

Carcinogenicity and chronic effects

No adequate data for evidence of carcinogenicity to humans, insufficient evidence of carcinogenicity to animals, IARC classification group 3 (2).

Legislation

Polychlorinated dibenzo-*p*-dioxins are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (3).

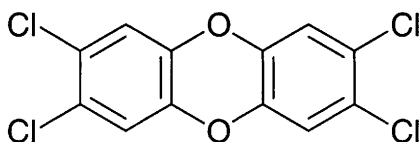
Other comments

Environmental fate of chlorinated dibenzodioxins reviewed (4).

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D110 dibenzo-*p*-dioxin, 2,3,7,8-tetrachloro-



C₁₂H₄Cl₄O₂

Mol. Wt. 321.97

CAS Registry No. 1746-01-6

Synonyms 2,3,7,8-tetrachlorodibenzo[*b,e*][1,4]dioxin; 2,3,7,8-tetrachlorodibenzo-1,4-dioxin; dioxin; TCDD

EINECS No. 217-122-7

RTECS No. HP 3500000

Physical properties

M. Pt. 305-306°C **Partition coefficient** log *P*_{ow} 6.0151 (1) **Volatility** v.p. 4.7 × 10⁻⁸ mmHg at 25°C

Solubility Water: 0.2 µg l⁻¹. Organic solvents: acetone, anisole, benzene, chloroform, dichlorobenzene, methanol, sunflower oil

Ecotoxicity

Fish toxicity

Intraperitoneal rainbow trout single dose of 25 and 125 mg kg⁻¹ caused 85% mortality in 2-4 wk. 5 µg kg⁻¹ day⁻¹ caused a decrease in body weight and 20% mortality after 11 wk (2).

LC₅₀ in eggs of fathead minnow and zebra fish, 539 and 2610 pg g⁻¹, respectively (3).

Invertebrate toxicity

No effects on survival or growth relative to controls were observed for the marine amphipod *Ampelisca abdita* in 10 day whole-sediment bioassays using spiked sediment samples (0-25 µg kg⁻¹ dry weight) (4).

Bioaccumulation

Bioconcentration factor for fathead minnow 4.2, rainbow trout 27,000 and for mosquito larvae 5000-9222 (5-7).

Biota-sediment accumulation factor for the oligochaetes *Lumbriculus variegatus* was 1.6 (±0.27) when simultaneously exposed to octachloro-dibenzo-*p*-dioxin (8).

Soft-shell clams *Mya arenaria* were exposed to 10 or 2000 ppb of tritiated TCDD in water for 24 hr. Gill, digestive gland, foot, and gonad were sampled for 2 wk after exposure. In the gill levels peaked at the beginning of depuration (406 and 8658 pg g⁻¹ wet weight for low and high doses, respectively), peak levels in the digestive gland and foot occurred at 12-24 hr post-exposure (digestive gland: 539 and 9369 pg g⁻¹ wet weight, foot: 146 and 21718 pg g⁻¹ wet weight). Tissue concentrations in the gonad increased throughout the post-exposure period reaching a maximum at 2 wk (243 and 3012 pg g⁻¹ wet weight) (9).

Environmental fate

Degradation studies

The white rot fungus *Phanerochaete chrysosporium* was shown effectively to degrade polychlorinated dibenzo-*p*-dioxins (10).

t_{1/2} in model aquatic environment ~ 600 day (11).

Abiotic removal

Absorbed by hydroxy aluminium treated kaolinite (12).

Removal from waste gases effected by scrubbing with a calcium hydroxide solution prepared from calcium oxide and sorbent materials, such as activated carbon, metallurgical coke, activated alumina, silica gel or kieselguhr (13).

Contaminated soil can be treated by an electrically heated pyrolyser at ~2200°C (14).

Ozonation caused >99% decomposition in alkaline water samples. The reactions were of 2nd order and the rates decreased with increasing number of chlorine atoms. No decomposition occurred in acid media (15).

>99% removal from incinerator flue gases containing 300-400 ng m⁻³ was effected by contacting with a catalyst comprising a honeycomb support with porosity ≥ 2 mm containing 8.5:1.5 molar ratio of titanium oxide/silica and 1.5 g l⁻¹ platinum at 450°C (16).

Adsorption and retention

Sorption isotherm for surface soils from Times Beach, Missouri, was 30,400 ml g⁻¹ which corresponds to a value of log K_{oc} of 6.66, where K_{oc} is the partition coefficient normalised on the basis of soil organic content (17).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, guinea pig 1, 45 µg kg⁻¹ respectively (18,19).

LD₅₀ oral rabbit 115 µg kg⁻¹ (18).

LD₅₀ dermal rabbit 275 µg kg⁻¹ (20).

LD₅₀ intraperitoneal rat 60 µg kg⁻¹ (21).

Sub-acute and sub-chronic data

Intraperitoneal mouse a single injection of 50 µg kg⁻¹ 4 days before immunisation with the T-dependent antigen ovalbumin suppressed the normal immune response in popliteal and inguinal lymph nodes (22).

Intraperitoneal guinea pig single dose of 10 µg kg⁻¹ reduced the contractability of the right ventricular papillary muscle when assessed *in vitro* 5 day after administration (23).

Intraperitoneal rhesus monkey single injection of 400 µg kg⁻¹ resulted in high concentration within the skin and produced alopecia and acne (24).

Oral rat 0.001 or 0.01 µg kg⁻¹ 5 day wk⁻¹ for 13 wk. The high dose caused a slight increase in liver weight (25).

Oral mouse 25 µg kg⁻¹ 4 × wk⁻¹ induced a 2000-fold increase in 7- and 8-carboxyporphyrins in the liver (26).

Carcinogenicity and chronic effects

Limited evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 1 (27).

National Toxicology Program tested rats and mice via gavage. Positive results were reported. In dermal tests on mice, positive results were reported for ♀ mice and equivocal results were reported for ♂ mice (28,29).

Subcutaneous or intraperitoneal hamster (13 months) fatal dose of 600 µg kg⁻¹ induced squamous-cell carcinomas of the skin. Neoplasms were not observed in other organs (30).

Intraperitoneal mouse (18 months) 0, 1, 30 or 60 µg kg⁻¹ day⁻¹ 5 × wk⁻¹ induced thymic lymphomas and hepatocellular carcinomas (31).

Oral mouse (12 months) 7 µg wk⁻¹. No tumours were observed in mice autopsied at 12 months but 3/19 had liver cirrhosis and 8 had dermatitis and amyloidosis (32).

Gavage ♀ rat (6 months) 1 µg kg⁻¹ wk⁻¹. No exposure-related ³²P-labelled spots indicative of covalent DNA binding adducts in the kidney or liver reported. There was a 37-77% reduction in the levels of I-compounds (DNA-adduct like compounds) in the liver which was suggested to be related to hepatocarcinogenicity of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (33).

Teratogenicity and reproductive effects

Gavage mouse 0-24 µg kg⁻¹ and 6, 8, 10, 12 or 14 day gestation. Foetal mortality was significantly increased at the high dose rate administered on day 6 of gestation. There was a dose-related incidence of foetal cleft palate for dams treated on day 6-12. Hydronephrosis was observed for all treated groups. There was a dose-related increase in the severity of renal lesion for treatment groups on each day (34).

Pregnant C57BL/6N mice dosed on gestation day 10 with 14 µg kg⁻¹ causes hydronephrosis in 100% of offspring. TCDD induces hyperplasia of the ureteric epithelium, which occludes the ureteric lumen, blocking the flow of urine (35).

Treatment of pregnant rats on gestational day 15 with a single oral dose of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) (0.5, 1.0 or 2.0 µg kg⁻¹) resulted in reproductive abnormalities in the ♂ offspring. In 62-day-old offspring, TCDD decreased the weight of seminal vesicles (24-26%), prostate (32-44%), testicular parenchyma (14%) and epididymis (19%). Total number of sperm in the epididymis was decreased by 30-33% in rats prenatally exposed to TCDD. The timing of the effects was variable and the responses were not necessarily dose-dependent (36).

Three groups of ♀ rhesus monkeys (8 per group) were exposed to 0, 5 and 25 ng kg⁻¹ TCDD in the diet for 5 years. Ten years after treatment the incidence and severity of endometriosis (a condition in which tissue more or less perfectly resembling the uterine mucous membrane occurs aberrantly in various locations in the pelvic cavity) was found to be correlated with TCDD exposure (37).

Cavage rat and hamster (day 8 or 15 and 11 of gestation respectively) 1 and 2 µg kg⁻¹ respectively. Rats dose on day 15 and hamsters on day 11 had a 3 day delay in puperty, a 58% reduction in ejaculated sperm counts and a 38% reduction in epididymal sperm storage (38).

Metabolism and toxicokinetics

Following dermal application of 36 ng cm⁻² to rats, 26 ng was absorbed within 120 hr. Absorption kinetics appeared to be first-order with a rate constant of 0.005 hr⁻¹ (39).

Pregnant rats were given a single subcutaneous injection of 3, 30 or 300 ng kg⁻¹ on day-19 of gestation. Maternal liver concentrations declined rapidly during lactation (t_{1/2} ~7 days). Peak liver concentrations were higher in the offspring exposed via the milk than in the maternal liver. Only lower concentrations were found in the animals exposed (40).

Following oral administration to rats of ¹⁴C-2,3,7,8-tetrachlorodibenzo-*p*-dioxin levels were found to be 10 × higher in the liver and fat than in other tissues (20).

Following oral administration to rats the major route of excretion was via the faeces. Urine contained 3-18% of the cumulative dose after 7 wk, t_{1/2} for elimination was 23.7 day (41).

Following intraperitoneal administration to mice, a large proportion of the dose persisted unmetabolised in the liver, particularly concentrated in the microsomal fraction, 11-20 day after treatment. Elimination was principally via the faeces, possibly via the bile (42).

Irritancy

2 mg instilled into rabbit eye caused moderate irritation (period of exposure unspecified) (20).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (43).

In vitro Chinese hamster ovary cells, chromosome aberration and sister chromatid exchanges negative (44).

In vitro mouse lymphoma L5178Y cells, gene mutation negative (44).

In vivo rat lymphocytes, sister chromatid exchanges, positive (45).

In vivo rat dominant lethal mutations negative (46).

Other effects

Other adverse effects (human)

Aggregation of 6 small cohort studies shows 37 deaths from cancer compared with 33 expected among 956 men exposed during the manufacture of 2,4,5-trichlorophenol and 2,4,5-trichlorophenoxyacetic acid (47).

A ten-year mortality study of the population involved in the Seveso incident in 1976 in which an estimated 300 g of material was discharged over an area of 2.2 km² shows that the only confirmed effect in humans is chloracne, which in the majority of cases has regressed (48).

In Seveso, Italy, the rate of soft-tissue sarcoma was 5.7 per 100,000 cases in polluted areas compared to 3.2 per 100,000 cases in non-polluted areas (49).

Researchers found that in Italy, after the Seveso accident which released kilogram amounts of TCDD to the environment, the area where the population was most heavily exposed to TCDD, 26 ♂ babies and 48 ♀ babies

were born in the period nine months after the accident until Dec 1984. Normally the ratio of babies born is 106 ♂s to 100 ♀s. The male:female ratio returned to normal in the period 1985 to 1994. The half-life of TCDD in adults is about eight years, so about half of the dioxin was cleared from exposed adults by 1985. No ♂s at all were born to parents who both had measured TCDD blood levels of 100 ppt or higher. In animals, TCDD is antioestrogenic. The authors do not know how the TCDD may have altered the sex ratio in humans (50).

Three cases of soft tissue sarcoma have been reported in Vietnam veterans exposed to 2,3,7, 8-tetrachlorodibenzo-*p*-dioxin containing defoliants (51).

A mortality study of workers occupationally exposed to TCDD does not confirm the high relative risks reported for many cancers in previous studies. Conclusions about increased risk of soft-tissue sarcoma are limited by small numbers and misclassification on death certificates. Excess mortality from all cancers combined, respiratory tract cancers and soft-tissue sarcoma may result from TCDD exposure, but other factors including smoking and exposure to other chemicals may be contributory (52).

In vitro human cells (type unspecified) were treated with TCDD. The transformed cells showed a decrease in ATP or histamine stimulated intracellular free calcium. The inositol triphosphate (IP3) steady state level was higher in transformed cells, but the level of IP3 generation by ATP or histamine stimulation was reduced. These results suggest that the neoplastic nature of TCDD may be caused by alteration of signal transduction pathways (53).

Any other adverse effects

Exposure to dioxin and dioxin-like compounds *in ovo* has been shown to be associated with grossly asymmetric avian brains (54).

Subcutaneous rat single injection of 3, 30 or 300 ng kg⁻¹ induced ethoxyresorufin *o*-diethylase in the liver (55,40). Intraperitoneal rat single dose of 5, 15, 25 or 125 µg kg⁻¹ caused a dose-dependent reduction in the activities of the liver glucogenic enzymes, phosphoenol pyruvate carboxylase, pyruvate carboxylase and glucose-6-phosphatase, and the glycolytic enzyme pyruvate kinase (56).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorine compounds: guide level 1 µg l⁻¹. Haloform concentrations must be as low as possible (57).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (58).

Other comments

Environmental toxicology of polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) reviewed (59).

Formation of chlorinated dibenzo-*p*-dioxins in pulp and the fate of dioxins during paper manufacturing reviewed (60).

Teratogenicity, foetotoxicity (61), carcinogenicity and mutagenicity of PCDD and PCDF reviewed and a risk assessment attempted (62).

Presence of PCBs and chlorinated dibenzo-*p*-dioxins in breast milk in industrialised countries reviewed (63).

Human exposure to PCDD and PCDF from municipal waste incinerators, including industrial sources, urban air and soil, milk and daily intake reviewed (64).

Suspected environmental endocrine disruptor (65).

Residues have been detected in the serum and adipose tissue of soldiers exposed to agent orange defoliant (66), and residents following environmental contamination of Seveso, Italy (67).

Residues found in water and sediments (68) and in paper products (69).

A contaminant of the herbicides 2,3,5-T and agent orange (70,71).

Carcinogenicity of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin reviewed (72).

Physical properties, occurrence, analysis, carcinogenicity, mammalian toxicity, metabolism and genotoxicity of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin reviewed (70).

2,3,7,8-tetrachlorodibenzo-*p*-dioxin is reported to be the most toxic of the chlorinated dibenzo-*p*-dioxins (70).

Immunotoxicity reviewed (73).

Environmental fate of chlorinated dibenzodioxins reviewed (74).

Environmental problems of dioxins as endocrine disruptors reviewed (75).

Endocrine disruptors in drinking water reviewed (76).

Endocrine disruptor studies at the National Center for Environmental Health Laboratory reviewed (77).

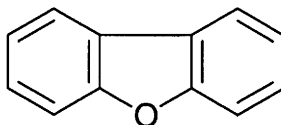
Endocrine – modulating substances in the environment – the wildlife connection reviewed (78).

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D111 dibenzofuran



$C_{12}H_8O$

Mol. Wt. 168.19

CAS Registry No. 132-64-9

Synonyms 2,2'-biphenylene oxide; 2,2'-biphenylene oxide; dibenzo[*b,d*]furan; diphenylene oxide; (1,1'-biphenyl)-2,2'-diyl oxide

EINECS No. 205-071-3

RTECS No. HP 4430000

Physical properties

M. Pt. 81-83°C B. Pt. 285°C

Ecotoxicity

Fish toxicity

Time to produce sickness at 5 ppm: brown trout 4 hr; bluegill sunfish 6 hr; goldfish 6 hr. All species died within 8

hr. Time to produce sickness at 1 ppm: brown trout 22 hr. Water characteristics for tests were pH 7, dissolved oxygen concentration 7.5 ppm, total hardness 300 ppm (soap method), methyl orange alkalinity 310 ppm, free carbon dioxide 5 ppm, temperature 35°C (1).

Bioaccumulation

Confirmed to be accumulated at a medium level (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird 102 mg kg⁻¹ (3).

Teratogenicity and reproductive effects

Embryotoxic at 20 µl when applied to mallard duck eggs (4).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (5,6).

Other comments

Contaminant in water resources. Tobacco smoke. Coal liquefactions.

Laboratory chlorination at pH 3 and pH 8 produced a number of mono- and dichlorinated derivatives (7).

Ozonolysis found to be faster in water than organic solvents (8).

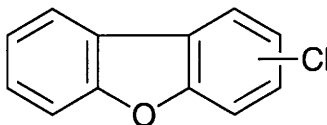
Chloro-derivatives are reported to be toxic (9).

Environmental toxicology of polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans reviewed (10).

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D112 dibenzofuran, chlorinated



C₁₂H₇ClO

Mol. Wt. 202.64

CAS Registry No. 42934-53-2

Synonyms chlorodibenzofuran; monochlorodibenzofuran

Environmental fate

Abiotic removal

Removal from flue gases has been achieved by passage through wet scrubbers followed by adsorption on activated carbon filters (1).

Contaminated waters have been treated with ferrous salts to give 20-1000 mg Fe²⁺ l⁻¹, then with an oxidising agent such as hydrogen peroxide, converting ferrous into ferric ions, which facilitated adsorption on ferric-hydroxo complexes followed by separation as flocculants at pH 5-10. The method was reported to be useful for treating landfill leachate and groundwater (2).

Removal from contaminated materials has been achieved by continuous treatment at 600-700°C for ~2 hr, preventing reformation of dioxins and furans during cooling (3).

Genotoxicity

Salmonella typhimurium TA98, TA100 with and without metabolic activation strongly mutagenic (3-chlorodibenzofuran) (4).

Salmonella typhimurium TA98, TA100 with and without metabolic activation weakly mutagenic (2-chlorodibenzofuran) (4).

Salmonella typhimurium TA98, TA100 with and without metabolic activation negative (1-chlorodibenzofuran and 4-chlorodibenzofuran) (4).

Other comments

Thermal degradation product of polychlorinated biphenyls. Residues have been found in soil, sediments, water, fish and animal tissues (1-3).

Environmental fate of chlorinated dibenzofurans reviewed (5).

Environmental toxicology of polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans reviewed (6).

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D113 dibenzofuran, polychlorinated

CAS Registry No. 136677-10-6

Ecotoxicity

Fish toxicity

Rainbow trout were administered 0 or 3 µg kg⁻¹ [¹⁴C]2,3,4,7,8-pentachlorodibenzofuran intraperitoneally in corn oil and induced to spawn 10 months later. All combinations of treated/untreated ♂ × treated/untreated ♀ crosses were investigated. No differences were found between treated and control fish, in fecundity, or in fertilisation rates between any crosses. Average prehatch mortalities, posthatch survival, or survival through swim-up, and the first 21 days of feeding were not different between the cross groups. However, in the treated ♀ × treated ♂ cross group, fertilisation mortality, prehatch mortality, and total mortality were significantly correlated with egg concentrations of pentachlorodibenzofuran, which ranged from 68-443 pg g⁻¹ (1).

Environmental fate

Abiotic removal

Ozonation caused >99% decomposition in alkaline water samples. The reactions are of 2nd order and their rates decreased with increasing number of chlorine atoms. No decomposition occurred in acid media (2).

A reduction in flue gases from the incineration of wastes was achieved by injecting calcium-based sorbents into the waste gas at 700°C (3).

Mammalian & avian toxicity

Sub-acute and sub-chronic data

Oral monkeys 20 µg 3 × wkly for 3 wk developed Yusho symptoms. Blood levels were decreased by treatment with squalane (4).

Several intraperitoneal doses (unspecified) 1 wk, 1, 3 and 6 months before immunisation of mice with sheep red blood cells caused a time- and dose-dependent suppression of delayed foot-pad reaction when a challenge injection of sheep red blood cells was given into the foot pad. This suppressive effect was correlated with atrophic changes of the thymic cortex. Toxic histological effects found in Clara cells were degeneration in the earlier stages and hyperplasia in later stages (5).

Teratogenicity and reproductive effects

Pregnant mice were exposed on days 10-13 of gestation. The dams were killed on day 18 of gestation.

Teratogenicity was demonstrated by cleft palate and hydronephrosis. An ED₅₀ of 36 µg kg⁻¹ for cleft palate and 7 µg kg⁻¹ for hydronephrosis were established for 2,3,4,7,8-pentachlorodibenzofuran. The teratogenic responses occurred at a dose below that where any obvious maternal or foetal toxicity was detected (6).

Metabolism and toxicokinetics

Rats were given a single intravenous mixture of congeners (dose unspecified). After 5 hr the 2,3,7,8-substituted congener was the major polychlorinated dibenzofuran retained in the liver (7).

Following dietary administration to lactating cows, ~20% was excreted in the milk. Both the faeces and the milk were important routes of excretion (8).

Other effects

Other adverse effects (human)

Examination of contaminated rice oil from the Yusho (Japan) poisoning incident indicated the mean body burden of 2,3,4,7,8-pentachlorodibenzofuran equivalents associated with nausea and anorexia to be 4.4 µg kg⁻¹, and that associated with chloracne to be 5.9 µg kg⁻¹. For the Yucheng (Taiwan) poisoning incident, blood measurements for chloracne show a similar body burden of 4.0 µg kg⁻¹ (9).

Polychlorinated dibenzofurans were detected in the milk of humans on various fish diets in California. Only the 2,3,7,8-substituted isomer was detected at levels comparable to those reported in other regions of the world (10).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) of Statutory Instrument No. 472, 1991 (11).

Other comments

The biological and toxic effects, and mode of action of polychlorinated dibenzofurans has been reviewed (12).

Environmental fate of polychlorinated dibenzofurans reviewed (13).

Carcinogenicity and mutagenicity of polychlorinated dibenzofurans reviewed (14).

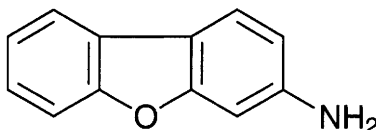
Environmental toxicology of polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans reviewed (15).

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D114 3-dibenzofuranamine



$C_{12}H_9NO$

Mol. Wt. 183.21

CAS Registry No. 4106-66-5

Synonyms 3-aminodibenzofuran

RTECS No. HP 4650000

Physical properties

M. Pt. 94°C

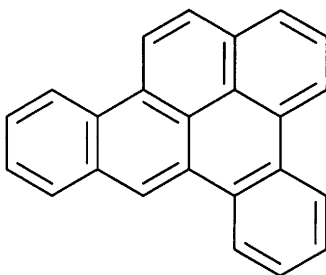
Genotoxicity

Salmonella typhimurium TA98, TA100 with and without metabolic activation positive (1).

References

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D115 dibenzo[a,e]pyrene



C₂₄H₁₄

Mol. Wt. 302.38

CAS Registry No. 192-65-4

Synonyms naphtho[1,2,3,4-def]chrysene; 1,2:4,5-dibenzopyrene; DB[a,e]P

EINECS No. 205-891-1

RTECS No. QL 0175000

Physical properties

M. Pt. 233°C

Solubility Organic solvents: acetic acid, acetone, benzene, ethanol, hot toluene

Environmental fate

Abiotic removal

Contaminated soil was treated by supercritical fluid extraction with carbon dioxide/methanol. A 7 hr extraction period resulted in removal of 92% of the total PAH content (>0.1%) (1).

Mammalian & avian toxicity

Carcinogenicity and chronic effects

No adequate data for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (2).

Dermal mouse (12 month) 0.1% or 0.05% 3 × wkly induced papillomas, carcinomas and epitheliomas. No tumours appeared in controls (3).

Subcutaneous mouse, 3 monthly injections or a single injection of 0.6 mg induced sarcomas within 142 and 220 days, respectively (4).

Metabolism and toxicokinetics

In vitro metabolites with aroclor 1254-induced rat liver S9 were the 3,4-dihydrodiol-, 3-hydroxy-, 7-hydroxy- and 9-hydroxy-derivatives (5).

Following topical application to mice (dose unspecified) DNA adducts were identified in the skin and lungs. The majority of the adducts were removed within 21 days of treatment, but low levels persisted for 3 months in both tissues (6).

Genotoxicity

Salmonella typhimurium TA98, TA100 with metabolic activation positive (5).

Other effects

Other adverse effects (human)

Mouse skin tumorigenicity of coal and wood combustion emission was compared with human lung cancer.

Indoor air particles (<10 µm) were collected from Chinese communes, one where lung cancer mortality is high

and smoky coal is the major fuel used, and the other where wood or smokeless coal is used and lung cancer mortality is low. The organic extract of the smoky coal combustion particles was a potent complete carcinogen, but the wood extract was relatively inactive. 88% of mice treated with smoky coal extract developed carcinomas at the end of the 77 wk study, agreeing with the human epidemiological data (7).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Polycyclic aromatic hydrocarbons: maximum admissible concentration 0.2 µg l⁻¹ (8).

Other comments

Contaminant in flue gases from coal combustion, gasoline engine exhaust, coal tar and tobacco smoke. Residues have been detected in water, sediments and soil (9).

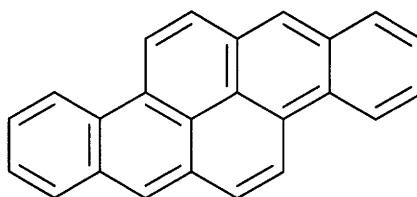
PAHs were detected at different depths at the sediment-water interface, in sediments and in benthic algae at stations in the Gotland Deep and the Gulf of Finland. Pyrene is the main PAH in water and algae, whereas 5 and 6-ring PAHs are accumulated in the sediments (10).

The occurrence, analysis, metabolism, carcinogenicity and genotoxicity of PAHs reviewed (9).

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D116 dibenzo[a,h]pyrene



C₂₄H₁₄

Mol. Wt. 302.38

CAS Registry No. 189-64-0

Synonyms dibenzo[b,def]chrysene; 3,4:8,9-dibenzopyrene; 1,2,6,7-dibenzopyrene; DB[a,h]P

EINECS No. 205-878-0

RTECS No. HO 5775000

Occurrence Contaminant in flue gases from coal combustion, automobile engine exhaust, coal tar and tobacco smoke.

Physical properties

M. Pt. 317°C Partition coefficient $\log P_{ow}$ 6.47 (est.) (1)

Solubility Organic solvents: 1,4-dioxane

Mammalian & avian toxicity

Carcinogenicity and chronic effects

No adequate data for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (2).

Dermal mouse (12 month) 0.1% or 0.05% 3 × wkly induced papillomas and epitheliomas. No tumours appeared in controls (3).

Subcutaneous mouse, single dose of 6 mg, induced malignant tumours at the site of injection in 17/20 animals after 3 months. All animals died within 42 wk (4).

34/35 ♂ mice given injections of 0.6 mg 3 × monthly developed sarcomas; 10 ♀ mice developed sarcomas. The mean latent periods were 111 and 128 days, respectively (5).

Metabolism and toxicokinetics

Following topical application to mice (dose unspecified) DNA adducts were identified in the skin and lungs. The majority of the adducts were removed within 21 days of treatment, but low levels persisted for 3 months in both tissues (6).

The 1,2- and 3,4-dihydrodiols have been identified as metabolites following incubation with rat liver preparations (7).

Genotoxicity

Salmonella typhimurium TA98, TA100 with metabolic activation positive (8).

The 1,2-dihydrodiol has been shown to be mutagenic in bacteria with metabolic activation (8), a tumour initiator on mouse skin and tumorigenic in newborn mice (9).

Legislation

The $\log P_{ow}$ value exceeds the European Community recommended level of 3.0 (10).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Polycyclic aromatic hydrocarbons: maximum admissible concentration 0.2 µg l⁻¹ (11).

Other comments

The occurrence, analysis, metabolism, carcinogenicity and genotoxicity of PAHs reviewed (12).

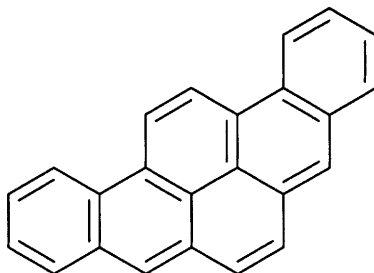
PAHs were detected at different depths at the sediment-water interface, in sediments and in benthic algae at stations in the Gotland Deep and the Gulf of Finland. Pyrene is the main PAH in water and algae, whereas 5 and 6-ring PAHs are accumulated in the sediments (13).

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12. IARC Monograph 1983, 32, 33-191.
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D117 dibenzo[a,i]pyrene



C₂₄H₁₄

Mol. Wt. 302.38

CAS Registry No. 189-55-9

Synonyms benzo[*rst*]pentaphene; dibenzo[*b,h*]pyrene; 3,4:9,10-dibenzopyrene; 1,2:7,8-dibenzopyrene; DB[*a,i*]P

EINECS No. 205-877-5

RTECS No. DI 5775000

Uses Rocket fuel additive.

Physical properties

M. Pt. 281.5-282.5°C **B. Pt.** 275°C at 0.05 mmHg **Partition coefficient** log P_{ow} 6.47 (est.) (1)

Solubility Organic solvents: boiling glacial acetic acid, boiling benzene, 1,4-dioxane

Environmental fate

Abiotic removal

t_{1/2} in soil for dibenzo[*a,i*]pyrene and other non-volatile PAHs >300 days (2).

Mammalian & avian toxicity

Carcinogenicity and chronic effects

No adequate data for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (3).

Intratracheal rat 1 mg wkly for 12 wk and 0.5 mg wkly for 17 wk induced respiratory tumour incidences of 75% and 65%, respectively (4).

Dermal mouse (12 month) 0.1% or 0.05% 3 × wkly induced papillomas and epitheliomas. No tumours appeared in controls (5).

Subcutaneous mouse, 3 monthly injections or a single injection of 0.6 mg induced sarcomas in all animals (6).

Subcutaneous mouse, single injection of 0.5 mg, induced sarcomas at the site of injection in 50% animals in 14 wk and 98% animals in 24 wk (7).

Subcutaneous mouse, single injection of 100 mg induced 125 fibrosarcomas and 2 local carcinomas in 138 surviving animals after 10 wk (8).

Metabolism and toxicokinetics

The 1,2- and 3,4-dihydrodiols have been reported as metabolites following incubation with rat liver preparations (9).

The 3,4-dihydrodiol metabolite has been reported to be mutagenic to bacteria in the presence of metabolic activation and is also a tumour initiator on mouse skin and tumorigenic in newborn mice (10,11). Following single subcutaneous injection of 500 µg, 85% was distributed from the injection site, complete removal within 10 wk (12).

Genotoxicity

Following topical application to mice (dose unspecified) DNA adducts were identified in the skin and lungs. The majority of the adducts were removed within 21 days of treatment, but low levels persisted for 3 months in both tissues (13).

Salmonella typhimurium TA98, TA100, with metabolic activation, positive (10,14).

Induced DNA damage in *Escherichia coli* and *Bacillus subtilis* (15,16).

In vitro primary rat hepatocytes, no induction of unscheduled DNA synthesis (17).

Legislation

The log P_{ow} value exceeds the European Community recommended level 3.0 (18).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Polycyclic aromatic hydrocarbons: maximum admissible concentration 0.2 µg l⁻¹ (19).

Other comments

Contaminant in flue gases from coal combustion, coal tar, cigarette smoke. Occurs in sea water and sediments (20).

The occurrence, analysis, metabolism, carcinogenicity and genotoxicity of PAHs reviewed (20).

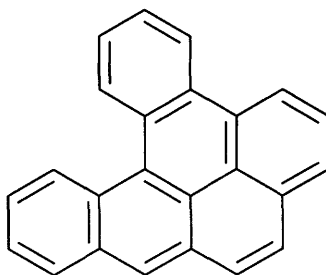
Health hazards associated with dibenzo[*a,i*]pyrene reviewed (21).

PAHs were detected at different depths at the sediment-water interface, in sediments and in benthic algae at stations in the Gotland Deep and the Gulf of Finland. Pyrene is the main PAH in water and algae, whereas 5 and 6-ring PAHs are accumulated in the sediments (22).

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D118 dibenzo[a,l]pyrene



$C_{24}H_{14}$

Mol. Wt. 302.38

CAS Registry No. 191-30-0

Synonyms 1,2,3,4-dibenzopyrene; 1,2,9,10-dibenzopyrene; 2,3,4,5-dibenzopyrene; 4,5,6,7-dibenzopyrene

EINECS No. 205-886-4

RTECS No. HO 6125000

Uses No commercial production or known use of this compound.

Occurrence Occurs in fossil fuels.

Physical properties

M. Pt. 162.4°C

Solubility Organic solvents: olive oil

Mammalian & avian toxicity

Carcinogenicity and chronic effects

No adequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (1).

Dermal ICR Swiss albino mice (6 month) 0.1%, 0.05%, 0.01% or 0.001% induced skin tumours in all groups within 2 months of start of treatment (2).

Subcutaneous injection XV11 nc/ZE mice 0.6 mg dibenzo[a,l]pyrene in 0.2 ml olive oil (2 injections with one month interval between them and a third injection 2 months later to mice which had not already developed a strong fibrous reaction at the injection site). All mice developed sarcomas at the injection site, latent period 130 days in ♂ and 113 days in ♀ mice (3).

Induces tumours in rat mammary glands (4).

Metabolism and toxicokinetics

NADPH-supported metabolism was conducted with uninduced and 3-methylcholanthrene-induced rat liver microsomes. Major metabolites with 3-methylcholanthrene-induced microsomes included: dibenzo[a,l]pyrene 8,9-dihydrodiol (16%); dibenzo[a,l]pyrene 11,12-dihydrodiol (8%); 7-hydroxydibenzo[a,l]pyrene (10%); and a trace amount of dibenzo[a,l]pyrenedione (5).

The critical metabolic activation of PAH involved in the tumour initiation process can be understood in terms of two main pathways, one-electron oxidation to produce radical cations and monooxygenation to produce bay-region diol epoxides (6-9).

Genotoxicity

Salmonella typhimurium TA98, TA100 with metabolic activation positive (5).

After dermal application to ♂ Parkes mice, binding to DNA in skin and lung tissue was reported (10).

Intramammary injection of 0.25 μ mol gland⁻¹ in rats produced two major and five minor DNA adducts in mammary epithelial cells. DNA adducts in non-target tissues showed a similar pattern except the liver which had four additional adducts (4).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Polycyclic aromatic hydrocarbons: maximum admissible concentration $0.2 \mu\text{g l}^{-1}$ (11).

Other comments

Dibenzo[*a,l*]pyrene occurs in some products of incomplete combustion. Identified in mainstream cigarette smoke (12).

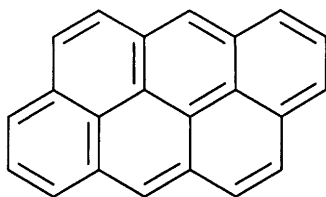
Detected in products of coal gasification (13,14).

Metabolism and mutagenicity reviewed (14).

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D119 dibenzo[*cd,jk*]pyrene



C₂₂H₁₂

Mol. Wt. 276.34

CAS Registry No. 191-26-4

Synonyms anthanthren; anthanthrene; dibenzo[*cd,jh*]pyrene; dibenzo[*def,mno*]chrysene

EINECS No. 205-884-3

RTECS No. HO 5900000

Uses No commercial use or production.

Physical properties

M. Pt. 264°C

Solubility Organic solvents: benzene, dioxane, olive oil, toluene

Environmental fate

Adsorption and retention

Concentration in soil in England has been reported to have increased throughout the 20th century (1).

Mammalian & avian toxicity

Carcinogenicity and chronic effects

No adequate evidence for carcinogenicity to humans, limited evidence for carcinogenicity to animals, IARC classification group 3 (2).

2 of 3 dermal mouse studies produced negative results in tumour promotion studies, the other was inconclusive (3).

A CASE structure-activity study has related *Salmonella* mutagenicity studies to carcinogenicity potential (4).

Dermal Swiss mice (70 wk) 109 µg dibenzo[*cd,jk*]pyrene (purity 98.6%, impurities included 1,2,3,7,8,9-hexahydroanthanthrene, 4,5,6,10,11,12-hexahydroanthanthrene, tetrahydroanthanthrene and 4,5-dihydroanthanthrene) in acetone (exposure period 30 wk) induced papillomas, keratoacanthomas, carcinomas and a sebaceous gland adenoma (5).

Intrapulmonary rat (102/88 wk) high/low dose animals treated with 0.83 mg or 0.16 mg dibenzo[*cd,jk*]pyrene in 0.05 ml mixture of beeswax and tricaprylin. 1/35 animals in low dose group and 19/35 high dose animals had squamous-cell carcinomas (6).

Genotoxicity

Salmonella typhimurium TA98, TA100 with metabolic activation positive (7,8).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Polycyclic aromatic hydrocarbons: maximum admissible concentration 0.2 µg l⁻¹ (9).

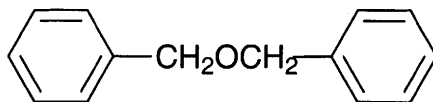
Other comments

Pollutant in air, water and sewage sludge. Occurs as product of incomplete combustion. Fossil fuels, high concentrations in coal tar. Identified in cigarette smoke and marijuana cigarette smoke. Contaminant in the exhaust of gasoline engines, lubricating oils and motor oils.

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D120 dibenzyl ether



C₁₄H₁₄O

Mol. Wt. 198.26

CAS Registry No. 103-50-4

Synonyms benzyl ether; BA; BA (plasticiser); benzyl oxide; plastikator BA

EINECS No. 203-118-2

RTECS No. DQ 6125000

Uses Plasticiser for nitrocellulose. Solvent in perfumery. Acaricide.

Physical properties

M. Pt. 1.5-3.5°C B. Pt. 295-298°C (decomp.) Flash point 135°C Specific gravity 1.0014 at 20°C with respect to water at 4°C Volatility v.den. 6.84

Solubility Organic solvents: acetone, chloroform, diethyl ether, miscible with ethanol

Ecotoxicity

Bioaccumulation

Non-accumulative or low accumulative (1).

Environmental fate

Degradation studies

40% of an initial volume of 100 µl was degraded by 1 ml of cell-free filtrate of *Coriolus versicolor* after 1 day (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 2500 mg kg⁻¹ (3).

Irritancy

500 mg applied to skin or eye of rabbits for 24 hr caused mild irritation (4).

Other comments

Decomposes with heat and at room temperature.

Relative energy differences (RED) for fat (lard) at 37°C, fat (lard) at 23°C, blood serum, sucrose, urea, keratin and lignin are 0.35, 0.40, 1.58, 1.61, 1.30, 0.92 and 1.23 respectively. RED allows estimates of where a solvent may tend to reside or penetrate. RED values approaching zero indicate high affinity; values < 1.0 indicate a significant, strong affinity, while higher values indicate lower affinities (5).

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D121 diborane



B_2H_6

Mol. Wt. 27.67

CAS Registry No. 19287-45-7

Synonyms diborane(6); borane (B_2H_6); boron hydride (B_2H_6); diboron hexahydride; boroethane

EINECS No. 242-940-6

RTECS No. HQ 9275000

Uses Catalyst for olefin polymerisation. Reducing agent and intermediate. Used in rocket propellants.

Physical properties

M. Pt. -165°C B. Pt. -92.5°C Flash point -90°C (closed cup) Specific gravity 0.447 (liquid) at -112°C , 0.577 (solid) at -183°C with respect to water at 4°C Volatility v.p. 244 mmHg at -112°C ; v.den. 0.96

Solubility Organic solvents: carbon disulfide

Occupational exposure

FR-VME 0.1 ppm (0.1 mg m^{-3})

JP-OEL 0.01 ppm (0.012 mg m^{-3}) (provisional value)

UK-LTEL 0.1 ppm (0.12 mg m^{-3})

US-TWA 0.1 ppm (0.11 mg m^{-3})

UN No. 1911 Conveyance classification toxic gas, danger of fire (flammable gas)

Environmental fate

Abiotic removal

Hydrolyses in water to $\text{H}_2 + \text{H}_3\text{BO}_2$, can be removed from exhausts by adsorption techniques (1).

Mammalian & avian toxicity

Acute data

LC_{50} (4 hr) inhalation mouse, rat 29, 40 ppm, respectively (2,3).

LC_{Lo} (2 hr) inhalation dog 125 ppm (4).

LC_{Lo} (8 hr) inhalation hamster 50 ppm (5).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Boron guide level: 8 $\mu\text{g l}^{-1}$ (6).

Other comments

Toxicology reviewed (2).

Spontaneously flammable in moist air.

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D122 dibromoacetone



$\text{C}_2\text{HBr}_2\text{N}$

Mol. Wt. 198.84

CAS Registry No. 3252-43-5

Synonyms acetonitrile, dibromo-

EINECS No. 221-843-2

RTECS No. AL 8450000

Physical properties

B. Pt. 169-170°C Specific gravity 2.296 at 20°C Partition coefficient $\log P_{\text{ow}}$ 0.42 (calc.) (1)

Solubility Water: miscible. Organic solvents: dimethyl sulfoxide, ethanol

Environmental fate

Abiotic removal

Reduction (dehalogenation) was achieved in water by treatment with sodium sulfite (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 245, 361 mg kg⁻¹, respectively (3).

LD₅₀ intravenous mouse 56 mg kg⁻¹ (4).

Sub-acute and sub-chronic data

Gavage rat (14 day) 23-180 mg kg⁻¹ day⁻¹ resulted in 100% mortality in the high dose group and 20-40% mortality in 90 mg kg⁻¹ group. The only signs of toxicity were decreases in relative spleen and thymus weights (♂) and an increase in relative liver weight (♀) in the 90 mg kg⁻¹ group, and a dose-dependent depression in weight gain in both sexes (3).

Gavage rat (90 day) 6, 23 or 45 mg kg⁻¹ resulted in 5-10% mortality in the 23 and 45 mg kg⁻¹ groups. Significant signs of toxicity were reduced body weights in ♂ in the 45 mg kg⁻¹ group. Relative organ weights, clinical chemistry and haematology were generally unchanged (3).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans and animals, IARC classification group 3 (5).

Oral mouse (9 month) 10 mg kg⁻¹ 3 × wk⁻¹ for 8 wk induced lung tumours in 10/32 treated animals compared with 3/31 in controls. Dermal mouse, 400 mg kg⁻¹ 3 × wk⁻¹ for 24 wk (period of observation unspecified). No skin tumour occurred. Dermal mouse (1 yr) initiation/promotion experiment, 200, 400 or 800 mg kg⁻¹ 3 × wk⁻¹ for 2 wk, followed 2 wk later by application of 1 µg 12-*O*-tetradecanoylphorbol 13-acetate 3 × wk⁻¹ for 20 wk. An increased incidence of animals with skin tumours, including squamous-cell papillomas and carcinomas reported, (5).

Teratogenicity and reproductive effects

Oral rat, at doses up to those toxic to the dam did not affect litter size, but birth weight was reduced. Post natal growth was affected up to 4 days of age whereas growth up to day 42 was not affected (6).

Metabolism and toxicokinetics

Gavage rat 149 mg kg⁻¹ excreted 7.7% of the dose as thiocyanate in the urine within 24 hr (7).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537, TA1538 with and without metabolic activation negative (8).

In vitro human lymphoblasts DNA strand breaks without metabolic activation positive (8).

In vitro Chinese hamster ovary cells sister chromatid exchange with and without metabolic activation positive (8).

In vivo mouse micronucleus test negative (8).

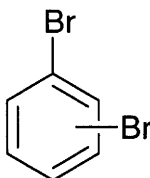
Drosophila melanogaster aneuploidy in oocytes negative (9).

In vivo mouse sperm morphology test negative (10).

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D123 dibromobenzene



$C_6H_4Br_2$

Mol. Wt. 235.91

CAS Registry No. 26249-12-7

Synonyms benzene, dibromo-

EINECS No. 247-544-7

RTECS No. CZ 1780000

Occupational exposure

UN No. 2711 HAZCHEM Code 2 $\frac{+}{-}$ Conveyance classification flammable liquid

Mammalian & avian toxicity

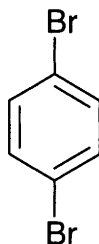
Acute data

LD₅₀ intraperitoneal mouse 780 mg kg⁻¹ (1).

References

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D124 1,4-dibromobenzene



$C_6H_4Br_2$

Mol. Wt. 235.91

CAS Registry No. 106-37-6

Synonyms *p*-dibromobenzene; *p*-bromophenyl bromide

EINECS No. 203-390-2

RTECS No. CZ 1791000

Uses Coupling agent. Synthesis of dyestuffs.

Physical properties

M. Pt. 87.3°C B. Pt. 220.4°C Specific gravity 2.261 g cm⁻³ at 17°C Partition coefficient log P_{ow} 3.89 (1)

Volatility v.p. 1 mmHg at 61°C

Solubility Organic solvents: benzene, chloroform, diethyl ether, ethanol

Occupational exposure

UN No. 2711 HAZCHEM Code 2.7 Conveyance classification flammable liquid

Ecotoxicity

Fish toxicity

Mosquito fish (*Gambusia affinis*) exposed for 42 days to sublethal concentrations of 1,4-dibromobenzene as low as 0.3 $\mu\text{mol l}^{-1}$ suffered growth rate reduction. EC_{50} and EC_{10} values for four halobenzenes (1,4-dibromobenzene, 1,2,3-trichlorobenzene, 1,2,4-tribromobenzene, and pentachlorobenzene) were 0.067-3.4 and 0.0042-0.32 $\mu\text{mol l}^{-1}$, respectively (within the ranges 5 to 8% and 0.1 to 3.9% of the LC_{50} values) (2).

Invertebrate toxicity

EC_{50} (30 min) *Photobacterium phosphoreum* 2.84 ppm Microtox test (3).

Toxicity to other species

Results from studies using the frog embryo teratogenesis assay-Xenopus suggest that a highly toxic arene oxide intermediate of 4-bromobenzene formed as the result of mixed-function oxidase-mediated metabolism may play an important role in the developmental toxicity of 4-bromobenzene *in vitro* (4).

Bioaccumulation

Bioconcentration factor guppy 1400 (1).

Non-accumulative or low accumulative (5).

Mammalian & avian toxicity

Acute data

LD_{50} oral mouse 3120 mg kg⁻¹ (6).

LD_{50} intraperitoneal mouse 1900 mg kg⁻¹ (6).

Sub-acute and sub-chronic data

Oral ♂ rat (90 days) 10 or 20 mg kg⁻¹ increased relative liver weight, cytochrome P_{450} content and azoreductase activity (7).

Genotoxicity

In vitro rat liver foci bioassay negative (8).

Following intraperitoneal administration to mice, 1,4-dibromobenzene was found to be covalently bound to DNA from liver, kidney, lung and stomach. No interaction with DNA was observed in rat organs (9).

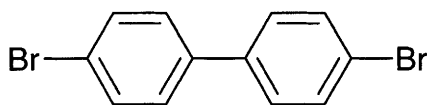
Other comments

Contaminant in flue gases of waste incinerators.

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D125 4,4'-dibromobiphenyl



$C_{12}H_8Br_2$

Mol. Wt. 312.00

CAS Registry No. 92-86-4

Synonyms 4,4'-dibromo-1,1'-biphenyl; *p,p'*-dibromobiphenyl

EINECS No. 202-198-6

Physical properties

M. Pt. 167-170°C B. Pt. 355-360°C

Ecotoxicity

Bioaccumulation

High bioaccumulation (1).

References

1. *JETOC Newsletter No 6* 1988, Japan Chemical Industry Ecology and Toxicology and Information Center, Tokyo, Japan

D126 dibromochloromethane



CHBr₂Cl

Mol. Wt. 208.28

CAS Registry No. 124-48-1

Synonyms chlorodibromomethane; CDBM; DBCM

EINECS No. 204-704-0

RTECS No. PA 6360000

Uses Component of fire extinguishers. Aerosol propellants. Refrigerants. Pesticides. Solvent. Intermediate in organic synthesis.

Physical properties

M. Pt. -22°C **B. Pt.** 119-120°C **Specific gravity** 2.451 at 20°C with respect to water at 4°C

Partition coefficient log P_{ow} 2.24 (1) **Volatility** v.p. 76 mmHg at 20°C

Solubility Water: 4.4 g l⁻¹ at 22°C. Organic solvents: acetone, benzene, diethyl ether, dimethyl sulfoxide, ethanol

Ecotoxicity

Fish toxicity

LC₅₀ (30 hr) *Brachydanio rerio* 250 mg l⁻¹; and induced hepatocellular carcinoma in 3/11 fish at 26.5 wk (2).

LC₅₀ (8 hr) carp embryos 53 mg l⁻¹ (3).

Bioaccumulation

Calculated bioconcentration factor of 0.74-1.47 indicates that environmental accumulation is unlikely (4).

Environmental fate

Degradation studies

Methanogenic bacterial cultures from sewage effluent totally degraded dibromochloromethane within 2 wk (5).

In an aerobic culture 25-39% degradation occurred within 28 days (6).

Abiotic removal

Irradiation at 253.7 nm for ≤30 min at pH 7.5 induced photolysis by breaking the C-Br bond (7).

Removal from chlorinated water was achieved by adsorption onto activated carbon treated with *p*-tert-butylcalix(6)arene (1% w/w) (8).

$t_{1/2}$ for volatilisation from river water was 46 hr (9).

$t_{1/2}$ for reactions with photochemically produced hydroxyl radicals in the atmosphere was 36 wk (10).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 800-848 mg kg⁻¹ (11).

Oral ♂ Wistar rats 0.4-3.2 mmol kg⁻¹ suffered arrhythmogenic and negative chronotropic and dromotropic effects. Atrioventricular conduction time and the intraventricular extension time were increased, a slight shortening of the repolarization velocity was observed, myocardial contractility was depressed and the heart was sensitised to the arrhythmogenic effects of epinephrine (12).

Sub-acute and sub-chronic data

No changes in mortality, clinical signs, ophthalmoscopic examinations or haematology were found in rats receiving DBCM in corn oil daily by gavage (0-200 mg kg⁻¹ day⁻¹) for 90 consecutive days. Mean final body weight and body weight gain were decreased in high-dose animals. Indications of hepatotoxicity were found. The lowest observed adverse effect dose level was 50 mg kg⁻¹ day⁻¹ (13).

In a 13-wk study, rats and mice were treated with DBCM by gavage in corn oil at 0-250 mg kg⁻¹. At 250 mg kg⁻¹ hepatic and renal toxicity was produced in ♂ and ♀ rats and ♂ mice and mortality was increased in ♂ and ♀ rats (14).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity in humans, limited evidence for carcinogenicity in animals, IARC classification group 3 (15).

National Toxicology Program investigated dibromochloromethane in rats and mice via gavage. No evidence of carcinogenicity in rats. Some evidence of carcinogenicity (increased incidence of treatment related neoplasms, malignant, benign or combined) in ♀ mice, equivocal evidence of carcinogenicity was reported for ♂ mice (16). In mice receiving 0.04–400 mg l⁻¹ in drinking water for 2 yr, the incidence of neoplasms of the liver, kidney, lung, skin, mammary gland, spleen and other organs was the same as in controls (17).

In a 2-yr study, rats were given 0–80 mg kg⁻¹, mice 0–100 mg kg⁻¹, by gavage in corn oil. High-dose ♂ mice had reduced survival relative to controls. Non-neoplastic hepatic lesions were seen in treated ♂ and ♀ mice; nephrosis was seen in treated ♂ mice. The combined incidence of hepatocellular adenoma and carcinoma was increased in treated ♀ mice but only marginally so in treated ♂ mice (14).

Teratogenicity and reproductive effects

When ICR Swiss mice were given dibromochloromethane at levels of 0, 0.1, 1.0 and 4 ml l⁻¹ in drinking water, there appeared to be dose-dependent effects on survival and weight gain of the young, and on viability and lactation indices (18).

Metabolism and toxicokinetics

After intragastric administration of radiolabelled DBCM to rats and mice, most was eliminated by the lungs in the expired air either as carbon dioxide or the unmetabolised compound (19).

The mean basic level of bromide in plasma of control rats (*n* = 27) was 0.075 ± 0.086 mmol l⁻¹. Following administration by gavage of 0.4, 0.8, 1.6 or 3.1 mmol kg⁻¹ chlorodibromomethane the mean bromide levels rose to maximum values that were higher by factors of 27, 48, 69 and 135, respectively, than controls. Further results from the authors' work together with literature data suggest that there may be a risk of bromide accumulation following repeated uptake of the trihalomethane (20).

Oral rat (90 day) 0.2, 12.5 and 125 mg kg⁻¹ produced little or no change in microsomal enzyme activity (21).

Genotoxicity

Reported mutagenic in some studies: experiments performed in closed containers generally gave positive results (15). *Salmonella typhimurium* TA100 without metabolic activation positive (22,23).

Bacillus subtilis DNA damage assay positive (24).

In vitro Chinese hamster ovary cells, chromosome aberrations with and without metabolic activation negative; sister chromatid exchanges without metabolic activation negative, with metabolic activation positive (25).

In vitro mouse lymphoma L5178Y tk⁺/tk⁻ forward mutation assay positive (26).

Induced chromosome aberration *in vivo* in rat bone marrow cells when administered intraperitoneally (27).

Rat liver unscheduled DNA synthesis negative (28).

Other effects

Any other adverse effects

In ♂ mice necropsy showed fatty liver infiltration and evidence of haemorrhaging in the adrenal glands and brain (29).

Legislation

Limited under UK Statutory Instrument No. 1147, 1989, maximum admissible concentration in drinking water for total trihalomethanes, being the aggregate of trichloromethane, dibromochloromethane and dichlorobromomethane, 100 µg l⁻¹ (30).

WHO guideline value for drinking water 60 µg l⁻¹ (31).

Other comments

Disinfection by-product in untreated and partially treated water. Health hazards have been reviewed (32).

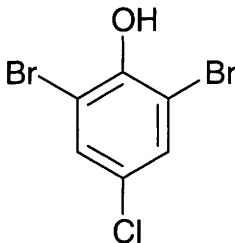
Environmental fate of dibromochloromethane reviewed (10).

Biosynthesised by some marine macroalgae (10).

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D127 2,6-dibromo-4-chlorophenol



$C_6H_3Br_2ClO$

Mol. Wt. 286.35

CAS Registry No. 5324-13-0

Synonyms 4-chloro-2,6-dibromophenol

Ecotoxicity

Fish toxicity

Brown trout, bluegill sunfish, yellow perch exposed to 5 ppm died within 2-4 hr. Exposure period 24 hr. Test conditions: static bioassay; pH 7; dissolved oxygen content 7.5 ppm; total hardness (soap method) 300 ppm; methyl orange alkalinity 310 ppm; free carbon dioxide 5 ppm; temperatures 12.8°C (1).

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D128 1,2-dibromo-3-chloropropane



$\text{C}_3\text{H}_5\text{Br}_2\text{Cl}$

Mol. Wt. 236.33

CAS Registry No. 96-12-8

Synonyms 3-chloro-1,2-dibromopropane; dibromochloropropane; DBCP

EINECS No. 202-479-3

RTECS No. TX 8750000

Uses Superseded nematicide and soil fumigant. Intermediate in organic synthesis.

Physical properties

M. Pt. 6°C **B. Pt.** 196°C **Flash point** 77°C (open cup) **Specific gravity** 2.08 at 20°C with respect to water at 20°C **Partition coefficient** $\log P_{\text{ow}}$ 2.26 (est.) (1) **Volatility** v.p. 0.8 mmHg at 21°C

Solubility Water: 0.1%. Organic solvents: ethanol, halogenated hydrocarbons, isopropanol, methanol

Occupational exposure

UN No. 2872 **HAZCHEM Code** 2X **HAZCHEM Code** 2X **Conveyance classification** toxic substance

Supply classification toxic

Risk phrases May cause cancer – May cause heritable genetic damage – Toxic if swallowed – Harmful: danger of serious damage to health by prolonged exposure through inhalation and if swallowed – Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment – May impair fertility (R45, R46, R25, R48/20/22, R52/53, R60)

Safety phrases Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet – Restricted to professional users (S53, S45, S61)

Ecotoxicity

Fish toxicity

Exposure to 5 ppm did not cause sickness or death to brown trout, bluegill sunfish, yellow perch or goldfish within 24 hr (2).

Bioaccumulation

The calculated bioconcentration factor of 11 indicates that environmental accumulation is unlikely (3).

Environmental fate

Degradation studies

Reported to be degraded by the nitrifying soil bacteria *Nitrosomonas europaea*, *Nitrosococcus oceanus* and

Nitrosolobus multififormis (4).

Undergoes dehalogenation to *n*-propanol by soil bacteria (5).

Degraded to trihalomethanes by *Pseudomonas putida* cultures (6).

Abiotic removal

Products of photolysis in water are 1-bromo-3-chloropropanone, 2-bromo-3-chloropropanol, 1-bromo-3-chloro-2-propanol, 1-chloro-2-propanone, 3-bromo-1-chloropropane, acetone and methanol. The rate of photolysis was increased in the presence of hydrogen peroxide, but the nature of the products were not appreciably influenced (7). Removal from groundwater is reported by packed column aeration and granular activated carbon adsorption.

Air: water ratios in excess of 200:1 were required (8).

$t_{1/2}$ for volatilisation range from 4.6 day in dry soil of low organic content to 26.6 days in wet soil of high organic content (9).

$t_{1/2}$ for volatilisation from streams 9.5 hr, rivers 13.5 hr, ponds 8 days and lakes 224 days (10).

$t_{1/2}$ for reaction with photochemically produced hydroxyl radicals in the atmosphere 36 days (11).

Adsorption and retention

Log k_{oc} in soils 1.3-2.1 (9,12).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse, rabbit 170, 275, 180 mg kg⁻¹, respectively (4,13).

LC₅₀ (8 hr) inhalation rat 103 ppm (14).

LD₅₀ dermal rabbit 1420 mg kg⁻¹ (4,15).

LD₅₀ oral chicken 60 mg kg⁻¹ (16).

Sub-acute and sub-chronic data

Oral ♂ rat (64 day) 0, 5, 50, 100 or 200 ppm in drinking water caused a dose-related decrease in water consumption such that the average daily intake was 0, 0.4, 3.3, 5.4 and 9.7 mg kg⁻¹ day⁻¹ for each group respectively. No evidence of liver damage was identified, and no significant gonadotoxic effect was observed (17). Single dose of 200 mg kg⁻¹ to rats (route unspecified). 24 hr after treatment acute renal insufficiency was evident, and reversed by day 14. Morphological findings consisted of severe acute tubular necrosis which was localised to the juxtamedullary cortex (18).

Subcutaneous ♂ rat 5-20 mg kg⁻¹ on alternate days from days 2-20 of life resulted in a marked dose-related reduction in testis, epididymis and seminal vesicle weights. Histological evaluation revealed degenerative cellular changes in the testes tubules of the 5 mg kg⁻¹ group and obliteration of the seminiferous tubules in the 10 mg kg⁻¹ group (19).

Intraperitoneal rat, single dose of 9 mg kg⁻¹ caused DNA damage in the kidneys within 10 minutes of administration. Acute renal damage was caused by 70 mg kg⁻¹ after 48 hr (20).

LD₅₀ (3 wk) oral rat 70 mg kg⁻¹ (21).

24 workers exposed applying pesticides ≥2 months during the year in which they were studied had a mean sperm count of 22×10^6 ml⁻¹, while 31 <2 month had a mean sperm count of 39×10^6 ml⁻¹ and the mean count for 19 workers exposed for <2 wk was 46×10^6 ml⁻¹. Normal counts are $>40 \times 10^6$ ml⁻¹. Serum levels of follicle stimulating hormone were also reported to increase relative to the period of exposure (22,23).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (24).

National Toxicology Program investigated 1,2-dibromo-3-chloropropane in rats and mice via inhalation and gavage. Positive results were reported in both studies (25).

Gavage rat and mouse (90 wk) 15-210 mg kg⁻¹ 5 day wk⁻¹. A significant incidence of squamous-cell carcinomas in the forestomach in both species and adenocarcinomas in the mammary glands of ♀ rats (26).

Metabolism and toxicokinetics

Metabolised by rat liver microsomes to 2-bromoacrolein, which is strongly mutagenic to *Salmonella typhimurium* TA100 (27).

Irritancy

Inhalation rat 600 mg m⁻³ caused irritation of skin, eyes, mucous membranes and respiratory tract (period of exposure unspecified) (14).

Dermal rabbit, 10 g caused severe irritation and 1% solution instilled into rabbit eye caused mild irritation (period of exposure unspecified) (4).

Genotoxicity

Salmonella typhimurium TA100, TA1530, TA1535 with and without metabolic activation positive (28).

In vitro rat liver parenchymal cells, DNA damage positive (29).

In vitro mouse lymphoma L5178Y tk⁺/tk⁻ cells, mutagenicity assay positive (30).

In vitro Chinese hamster ovary cells, sister chromatid exchanges and chromosomal aberrations positive (30).

Drosophila melanogaster sex-linked recessive lethal assay, heritable translocations and aneuploidy positive (31).

In vivo exposed human workers, caused abnormal incidence of Y-chromosome nondisjunction (32).

Other effects

Other adverse effects (human)

Among a cohort of 550 chemical workers exposed to many compounds, including 1,2-dibromo-3-chloropropane, a statistically non-significant increase in mortality from cancers at all sites was found, due mainly to deaths from respiratory cancer (33).

Among 1034 workers exposed occasionally to several brominated chemicals, including 1,2-dibromo-3-chloropropane, a slightly increased, statistically non-significant mortality rate from respiratory cancer was observed. Among 238 routinely exposed workers, no cancer deaths were observed (34).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (35).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (36).

WHO guideline value for drinking water 1 µg l⁻¹ (37).

Other comments

Residues have been isolated from water, soils and root crops (38,3).

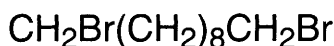
Physical properties, analysis, use, metabolism, mutagenicity and toxicity of 1,2-dibromo-3-chloropropane reviewed (38,39).

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D129 1,10-dibromodecane



$\text{C}_{10}\text{H}_{20}\text{Br}_2$

Mol. Wt. 300.08

CAS Registry No. 4101-68-2

Synonyms decamethylene dibromide

EINECS No. 223-871-0

Uses Alkylating agent.

Physical properties

M. Pt. 27°C **B. Pt.** 160°C at 15 mmHg **Flash point** 110°C **Specific gravity** 1.335 at 30°C
Solubility Organic solvents: diethyl ether, ethanol

Ecotoxicity

Fish toxicity

Not toxic to brown trout, bluegill sunfish, yellow perch, goldfish (24 hr) at 5 mg l⁻¹. Test conditions: static bioassay; pH 7; dissolved oxygen content 7.5 ppm; total hardness (soap method) 300 ppm; methyl orange alkalinity 310 ppm; free carbon dioxide 5 ppm; temperature 12.8°C (1).

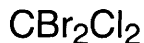
Bioaccumulation

No or low bioaccumulation (2).

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D130 dibromodichloromethane



CBr_2Cl_2

Mol. Wt. 242.72

CAS Registry No. 594-18-3

Synonyms carbon dibromide dichloride; dichlorodibromomethane

EINECS No. 209-829-4

Physical properties

M. Pt. 38°C **B. Pt.** 150.2°C **Specific gravity** 2.42 at 25°C with respect to water at 0°C

Solubility Organic solvents: acetone, benzene, diethyl ether, ethanol

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Guide level for total haloforms 1 µg l⁻¹ (1).

Other comments

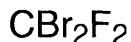
Found in tap water (2).

Disinfection by-product in drinking water.

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D131 dibromodifluoromethane



CBr_2F_2

Mol. Wt. 209.82

CAS Registry No. 75-61-6

Synonyms difluorodibromomethane; Freon 12B2; Halon 1202

EINECS No. 200-885-5

RTECS No. PA 7525000

Uses Blowing agent. Tracer for plumes of power plants.

Physical properties

M. Pt. -141°C **B. Pt.** 23.2°C **Specific gravity** 2.288 at 15°C with respect to water at 4°C

Volatility v.p. 623 mmHg at 21°C ; v.den. 7.24

Solubility Water: miscible. Organic solvents: acetone, benzene, diethyl ether, methanol

Occupational exposure

DE-MAK 100 ppm (870 mg m⁻³)

FR-VME 100 ppm (860 mg m⁻³)

UK-LTEL 100 ppm (872 mg m⁻³)

US-TWA 100 ppm (858 mg m⁻³)

UK-STEL 150 ppm (1310 mg m⁻³)

UN No. 1941 HAZCHEM Code 2Z Conveyance classification other dangerous substance

Environmental fate

Abiotic removal

Gaseous dibromodifluoromethane and other halo-compounds were almost completely converted into carbon dioxide and hydrogen halides by water vapour and/or oxygen at elevated temperatures with a catalyst consisting of sulfated titanium dioxide having a sulfate content of 0.05-10% by weight (1).

Mammalian & avian toxicity

Acute data

LC_{Lo} (15 min) inhalation rat 54,630 ppm (2).

LC_{Lo} (15 min) inhalation mouse 67 g m⁻³ (3).

Sub-acute and sub-chronic data

Inhalation rat, dog (7 month) at concentrations of ~2300 ppm. >50% the rats died in 6 wk. The dogs showed rapid and progressive signs of intoxication with weakness and loss of balance after a few days exposure. Autopsy revealed diffuse passive pulmonary congestion, some liver damage and evidence of damage to the central nervous system. Rats and dogs tolerated 350 ppm without signs of intoxication (4).

Inhalation rat (15 min) 4000 ppm produced significant pulmonary damage, oedema and irritation (5).

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D132 1,2-dibromoethane



C₂H₄Br₂

Mol. Wt. 187.86

CAS Registry No. 106-93-4

Synonyms *sym*-dibromoethane; α,β -dibromoethane; ethylene dibromide; 1,2-ethylene dibromide; glycol dibromide; EDB

EINECS No. 203-444-5

RTECS No. KH 9275000

Uses Alkylating agent. Pesticide fumigant. Solvent. Anti-knock agent in petrol.

Physical properties

M. Pt. 9-10°C **B. Pt.** 131-132°C **Flash point** >104°C **Specific gravity** 2.1707 at 20°C with respect to water at 4°C **Volatility** v.p. 11 mmHg at 25°C ; v.den. 6.48
Solubility Water: 4.3 mg l⁻¹ at 30°C. Organic solvents: diethyl ether, ethanol

Occupational exposure

UK-LTEL MEL 0.5 ppm (3.9 mg m⁻³)

UN No. 1605 **HAZCHEM Code** 2XE **Conveyance classification** toxic substance

Supply classification toxic

Supply classification dangerous for the environment

Risk phrases May cause cancer – Toxic by inhalation, in contact with skin and if swallowed – Irritating to eyes, respiratory system and skin – Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R45, R23/24/25, R36/37/38, R51/53)

Safety phrases Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet (S53, S45, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (48 hr) bluegill sunfish 18 mg l⁻¹ (1).

Japanese medaka (97 days, 73 days or 24 hr day⁻¹ for 97 days) 0.13, 6.20 and 18.58 mg l⁻¹, respectively. Samples were taken at 24, 36 and 58 wk. At intermediate and high concentrations there was clear evidence of carcinogenicity, observed as hepatocellular adenomas and carcinomas, cholangiomas, and gall bladder papillary adenomas and adenocarcinomas (2).

Bioaccumulation

Non-accumulative or low accumulative (3).

Environmental fate

Nitrification inhibition

Inhibition of nitrification activated sludge 43% inhibition at 50 mg l⁻¹, 74% inhibition at 330 mg l⁻¹, inhibition of nitrification in soil for 4-8 wk inhibitory at 32 ppm (4).

Degradation studies

Reported to be oxidised by *Nitrosomonas europaea* by a mechanism probably catalysed by ammonia oxygenase (5). Several methanogen bacteria were shown to produce ethylene. However, bacterial biodegradation was completely inhibited at a concentration of 1.3 mg l⁻¹ (6).

Under aerobic conditions, the microbial community biodegraded ethylene dibromide. The biodegradative activity of the subsurface community appears to differ in both rate and product distribution from the activities of aquatic or surface soil communities (7).

Abiotic removal

Removal from well water containing 0.17 ppb was effected by granular activated carbon filtration (8).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rabbit, rat, mouse 55-250 mg kg⁻¹ (9-11).

LC₅₀ (30 min) inhalation rat 14,300 mg m⁻³ (12).

LD₅₀ dermal rat, rabbit 300 mg kg⁻¹ (10,13).

LD₅₀ intraperitoneal mouse 220 mg kg⁻¹ (14).

Two human fatalities have been associated with occupational exposure to ethylene dibromide (15).

Sub-acute and sub-chronic data

Oral chicken 50-320 mg kg⁻¹ diet, smaller eggs are laid; after 6 wk egg laying irreversibly ceased in hens receiving the highest dose (16).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2A (17).

National Toxicology Program investigated ethylene dibromide in rat, mouse via gavage and by inhalation.

Designated carcinogenic in rat and mouse by both routes (18,19).

Oral mouse (62 wk) 60 or 120 mg kg⁻¹ day⁻¹ 5 × wkly for 12 wk, then 100 or 200 mg kg⁻¹ for wk 13-15, then the initial dose levels were given, and at 42 wk all mice received 60 mg kg⁻¹. Squamous-cell carcinomas of the forestomach occurred in >70% of treated animals, while no tumours were found in controls. Oral rat (62 wk) 40 or 80 mg kg⁻¹ day⁻¹ 5 × wkly for 16 wk. The higher dose was discontinued due to toxic effects. From wk 30-54 all rats received 40 mg kg⁻¹ day⁻¹. Squamous-cell carcinomas of the forestomach occurred in >90% of treated rats. Among 40 controls 1 adenoma was observed in a ♀ (20,21).

Teratogenicity and reproductive effects

Intraperitoneal ♂ rat (5 day) 10 mg kg⁻¹ day⁻¹ reversibly damaged spermatogenic cells (22).

Oral bull, 4 mg kg⁻¹ on alternate days, abnormal spermatozoa were observed after 2-3 wk, indicating an interference with spermatogenesis and with the maturation of spermatozoa in the epididymis (23).

Doses of 2 mg kg⁻¹ day⁻¹ had no effect on the reproductive capacity of cows and ewes (24).

Inhalation ♀ pregnant mouse (23 hr, 6-15 day gestation) lowest toxic concentrations for teratogenic effects 38 ppm (25).

Metabolism and toxicokinetics

Intraperitoneal monkey, metabolised to products which become bound to the tissues, preferentially the liver and kidney tubules, and in the adrenal zona reticularis. These binding sites correspond to sites of tissue lesion observed in humans poisoned with ethylene dibromide (26).

Intravenous mouse, ¹⁴C-labelled compound. A selective localisation of bound radioactivity was observed in the conjunctival epithelium of the eyes. An *in vitro* study demonstrated the presence of irreversibly protein-bound radioactivity (27).

Intraperitoneal rat, mouse 37 mg kg⁻¹. Hepatic S-[2-(N⁷-guanylethyl)]glutathione DNA adducts were detected (28).

After intraperitoneal administration of 30 mg kg⁻¹ ¹⁴C-labelled ethylene dibromide to guinea pigs, the greatest concentration of ¹⁴C was found in those tissues in which pathological changes have been reported (kidneys, liver and adrenals). 65% of the dose was excreted as metabolites in the urine and 12% unchanged in expired air (29).

Oral mouse, rat urinary metabolites identified were S-(2-hydroxyethyl)cysteine and N-acetyl-S-(2-hydroxyethyl)cysteine (30).

Enzymic reactions with glutathione occurred *in vivo* and *in vitro*. Glutathione levels were depleted in the liver after administration of toxic levels. Further metabolism of the glutathione conjugate to S-(2-hydroxyethyl)cysteine and its sulfoxide occurred in the kidney (31).

Irritancy

Dermal rabbit (14 day) 1% solution caused severe irritation (9).

Dermal human (2 hr) 1538 mg caused severe irritation (32).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA97 with and without metabolic activation positive (33).

Escherichia coli mutagenicity assay positive (34).

Drosophila melanogaster sex-linked recessive lethal assay positive (35).

In vitro mouse lymphoma L5178Y cells gene mutation positive. *In vitro* Chinese hamster ovary cells chromosome aberration and sister chromatid exchange positive (36).

Did not induce chromosomal aberrations and sister chromatid exchange in exposed pine-tree sprayers and fruit packers (cell-type unspecified) (37).

Other effects

Other adverse effects (human)

The mortality of 161 men exposed in 2 factories since the mid-1920s and 1942, respectively, was studied. By 1976, 36 workers had died, 7 from cancers (5.8 expected) (38).

In another study, the mortality of 2510 workers at a chemical plant where ethylene dibromide was one of several chemicals. No statistically significant excess of cancer at any site was found (39).

An excess of lymphoma was detected in a mortality study of grain workers in the USA who may have had exposure to ethylene dibromide, among other chemicals (40).

Two occupational field studies were conducted to detect the effects of ethylene dibromide exposure on σ reproductive potential. The first study was a longitudinal study of ten ethylene dibromide-exposed men conducted in Colorado in the summer of 1983. The exposure time was ~6 wk. The second was a cross-sectional study of 45 ethylene dibromide-exposed papaya workers and 43 unexposed men conducted in Hawaii in December 1983 in which the average term of employment was about 5 yr. In the longitudinal study, sperm velocity decreased in all exposed men and in only two unexposed men. The longer term exposure resulted in decreased sperm motility and viability. The results from both studies suggest that the accessory sex glands may be affected by ethylene dibromide exposure (41).

Any other adverse effects

In vitro rat primary hepatocytes (2 hr) 0, 14, 140, 1400 or 14,000 ppm in an atmosphere of 1, 2 or 20% oxygen. Toxicity was measured by leakage of aspartate aminotransferase and trypan blue exclusion. LC_{50} immediately after exposure was ~14,000 ppm, but only 140 ppm when assayed 24 hr after exposure. Toxicity was shown to be oxygen-dependent (42).

In vitro rat liver mitochondria were demonstrated to undergo a dose-dependent depletion of glutathione, associated with calcium release, suggesting that 1,2-dibromoethane induces calcium efflux by activating a selective pathway which is sensitive to critical sulfhydryl groups (43).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Guide level for total haloforms $1 \mu\text{g l}^{-1}$ (44).

Other comments

Disinfection by-product in drinking water. Contaminant in flue gases from waste incinerators. Residues have been detected in natural waters, sediments and on crops. In petrol engine exhausts.

Levels of $0.001\text{--}0.17 \mu\text{g m}^{-3}$ were detected in urban air in London, England. Such levels do not constitute a risk to health (45).

Uses, carcinogenicity, genotoxicity and toxicology of ethylene dibromide reviewed (17,46).

Threshold odour concentration 26 ppm (47).

Study of the nature and general magnitude of cancer risks from air pollution in US urban area reported (48).

Toxicity and health effects reviewed (49,50).

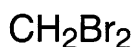
Environmental health criteria reviewed (51).

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D133 dibromomethane



CH_2Br_2

Mol. Wt. 173.83

CAS Registry No. 74-95-3

Synonyms methylene dibromide; methylene bromide

EINECS No. 200-824-2

RTECS No. PA 7350000

Uses Alkylating agent. Used in fire extinguishers. Solvent.

Physical properties

M. Pt. -52°C **B. Pt.** 96-98°C **Flash point** >100°C **Specific gravity** 2.4956 at 20°C with respect to water at 4°C **Partition coefficient** $\log P_{ow}$ 1.54 (1) **Volatility** v.p. 340 mmHg at 20°C ; v.den. 6.05
Solubility Water: 11.7 g l⁻¹ at 15°C. Organic solvents: miscible with acetone, diethyl ether, ethanol

Occupational exposure

UN No. 2664 **HAZCHEM Code** 2Z **Conveyance classification** toxic substance

Supply classification harmful

Risk phrases Harmful by inhalation – Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R20, R52/53)

Safety phrases Keep out of reach of children (if sold to general public) – Avoid contact with the skin – Avoid release to the environment. Refer to special instructions/safety data sheet (S2, S24, S61)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 108 mg kg⁻¹ (2).

LC₅₀ (2 hr) inhalation rat 40 g m⁻³ (3).

LD₅₀ subcutaneous mouse 3740 mg kg⁻¹ (4).

LD_{Lo} rectal rabbit 5000 mg kg⁻¹ (5).

Sub-acute and sub-chronic data

Oral rat (short-term study; exact period unspecified) up to 1000 mg l⁻¹ in drinking water produced no overt toxic effects. The only biochemical parameter affected was reduced lactate dehydrogenase activity in ♀ rats.

Morphological changes were observed in the highest dose group but these were considered to be mild and adaptive in nature, and could not be related to any functional changes (6).

Metabolism and toxicokinetics

Metabolised to carbon monoxide *in vivo* and *in vitro*, reaction catalysed by hepatic microsomal P₄₅₀ mixed function oxidase (species unspecified) (7).

Dermal ♂ Fischer 344 rats 3.1 cm² dorsal skin exposed to neat, one-third saturated, two-thirds saturated and saturated aqueous solutions of dibromomethane for 24 hr. Blood samples were obtained via indwelling jugular catheters during exposure (0, 0.5, 1, 2, 4, 8, 12 and 24 hr). Peak blood level attained during exposure for 24 hr to neat chemicals was 18.2 µg ml⁻¹. Blood level was directly related to the exposure concentrations and the rapid appearance in the blood from aqueous solutions demonstrates that detectable amounts were absorbed during exposure of only ≈1% of the skin surface area of the rat (8).

Genotoxicity

Salmonella typhimurium TA100 with and without metabolic activation positive (9-11).

Drosophila melanogaster sex-linked recessive lethal assay negative (12).

In vitro Chinese hamster cells, induced an increase in chromosomal aberrations but did not increase the sister chromatid exchange frequency (13).

Legislation

Limited under EC Directive in Drinking Water Quality 80/778/EEC. Guide level for total haloform concentrations 1 µg l⁻¹ (14).

Other comments

Found as a disinfection by-product in drinking water (15-19).

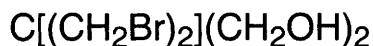
Present in some industrial wastewaters.

Toxicity and hazards reviewed (20).

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D134 dibromoneopentyl glycol



$\text{C}_5\text{H}_{10}\text{Br}_2\text{O}_2$

Mol. Wt. 261.94

CAS Registry No. 3296-90-0

Synonyms dibromopentaerythritol; pentaerythritol dibromide; DBNPG; 2,2-bis(bromomethyl)-1,3-propanediol

EINECS No. 221-967-7

RTECS No. TY 3195500

Uses In organic synthesis, principal use is in unsaturated polyester resins where it is used to replace part of the regular glycol to yield a resin with a desirable bromine content.

Physical properties

Solubility Water: $\leq 1 \text{ g l}^{-1}$ at 19°C. Organic solvents: dimethyl sulfoxide, ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 3460 mg kg⁻¹ (1).

Carcinogenicity and chronic effects

Gavage rat, mouse (13 wk, 5 day week⁻¹) 0-800 and 0-400 mg kg⁻¹ day⁻¹, respectively, in corn oil. Kidney and urinary bladder tumours seen in high dose animals (2).

National Toxicology Program 2 yr feed study on mice and rats. Clear evidence of carcinogenicity (3).

Teratogenicity and reproductive effects

Gavage mouse (13 wk) 25-400 mg kg⁻¹ reduced absolute weights of testis, epididymis and cauda epididymis.

Gavage rat 50-800 mg kg⁻¹ reduced absolute weight of epididymis, increased relative weight of testis and increased sperm density (2).

♀ Swiss CD-1 mice (98 day) 0.1, 0.2 and 0.4% in feed for 7 days. Impaired fertility reported, absence of an effect on reproductive organ weights and oestral cyclicity (4).

Gavage CD-1 mice (13 wk) 0.4% in feed decreased number of litters and pups per litter in breeding pairs (♀ more affected than ♂ in cross-over breeding studies). Effects on ♀ reproduction in subsequent continuous breeding studies in mice reported (5).

Metabolism and toxicokinetics

Rats fed 100 mg kg⁻¹ day⁻¹ had increased tissue bromide content (1).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (6).

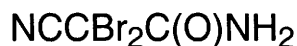
Salmonella typhimurium TA100 without metabolic activation negative, with Aroclor 1254-induced rat liver metabolic activation negative, with Aroclor 1254-induced hamster liver metabolic activation positive (7).

In vitro Chinese hamster ovary cells with metabolic activation chromosomal aberration positive (8,9).

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D135 2,2-dibromo-3-nitrilopropionamide



C₃H₂Br₂N₂O

Mol. Wt. 241.87

CAS Registry No. 10222-01-2

Synonyms 2,2-dibromo-2-cyanoacetamide; dibromocyanoacetamide; DBNPA;

α,α-dibromo-α-cyanoacetamide

EINECS No. 233-539-7

RTECS No. AB 5956000

Uses Bactericide.

Mammalian & avian toxicity

Acute data

LD₅₀ oral rabbit 118 mg kg⁻¹ (1).

LD₅₀ intravenous mouse 10 mg kg⁻¹ (2).

Irritancy

Dermal rabbit 500 mg caused severe irritation and 100 mg instilled into rabbit eye caused severe irritation (periods of exposure unspecified) (1).

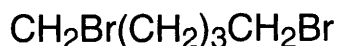
Other comments

Contaminant in effluents from paper mills.

References

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D136 1,5-dibromopentane



$\text{C}_5\text{H}_{10}\text{Br}_2$

Mol. Wt. 229.94

CAS Registry No. 111-24-0

Synonyms pentamethylene bromide; pentamethylene dibromide

EINECS No. 203-849-7

RTECS No. SA 0320000

Uses Alkylating agent.

Physical properties

M. Pt. -34°C B. Pt. 110°C at 15 mmHg Flash point 110°C Specific gravity 1.7018 at 20°C with respect to water at 4°C

Solubility Organic solvents: benzene, carbon tetrachloride, chloroform

Genotoxicity

Salmonella typhimurium TA100, TA1530, TA1535 without metabolic activation positive (1).

References

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D137 2,3-dibromopropanol



$\text{C}_3\text{H}_6\text{Br}_2\text{O}$

Mol. Wt. 217.89

CAS Registry No. 96-13-9

Synonyms 2,3-dibromopropan-1-ol; 2,3-dibromopropyl alcohol; DBP

EINECS No. 202-480-9

RTECS No. UB 0175000

Uses Flame retardant.

Physical properties

B. Pt. $95-97^\circ\text{C}$ at 10 mmHg Flash point $>110^\circ\text{C}$ Specific gravity 2.120 at 20°C with respect to water at 4°C

Partition coefficient $\log P_{\text{ow}}$ 0.90 (1)

Solubility Organic solvents: acetone, benzene, diethyl ether, ethanol

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 420 mg l⁻¹ (2).

Invertebrate toxicity

LC₅₀ (5 min) *Photobacterium phosphoreum* 322 ppm Microtox test (3).

Environmental fate

Nitrification inhibition

Inhibition of nitrification in sewage sludge concentrations of 31 mg l⁻¹ 15% inhibition; 100 mg l⁻¹ 25% inhibition (4).

Mammalian & avian toxicity

Acute data

LD_{Lo} intraperitoneal mouse 125 mg kg⁻¹ (5).

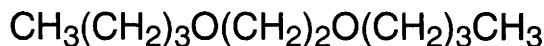
Genotoxicity

Drosophila melanogaster sex-linked recessive lethals and translocations positive (6).

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D138 1,2-dibutoxyethane



C₁₀H₂₂O₂

Mol. Wt. 174.28

CAS Registry No. 112-48-1

Synonyms 1,1'-[1,2-ethenediylbis(oxy)]bisbutane; dibutyl cellosolve; dibutyl oxitol; ethylene glycol dibutyl ether; glycol dibutyl ether

EINECS No. 203-976-8

RTECS No. KH 9450000

Uses In lithographic developers. Solvent.

Physical properties

B. Pt. 203.6°C **Flash point** 85°C (open cup) **Specific gravity** 0.837 at 25°C with respect to water at 25°C

Volatility v.p. 0.12 mmHg at 25°C

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 3250 mg kg⁻¹ (1).

LD₅₀ dermal rabbit 3560 mg kg⁻¹ (2).

Irritancy

Dermal rabbit 500 mg caused mild irritation and 500 mg instilled into the eye caused irritation (periods of exposure unspecified) (2).

References

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D139 dibutoxyethoxyethyl adipate

$\text{C}_{22}\text{H}_{42}\text{O}_8$

Mol. Wt. 434.57

CAS Registry No. 141-17-3

Synonyms hexanedioic acid, bis[2-(2-butoxyethoxy)ethyl] ester; adipic acid, bis[2-(2-butoxyethoxy)ethyl] ester

EINECS No. 205-465-5

RTECS No. AU 8420000

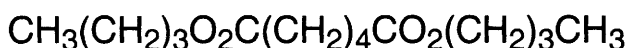
Uses Antistatic agent. Plasticiser.

Mammalian & avian toxicity**Acute data**

LD₅₀ oral rat 6 g kg⁻¹ (1).

References

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D140 dibutyl adipate

$\text{C}_{14}\text{H}_{26}\text{O}_4$

Mol. Wt. 258.36

CAS Registry No. 105-99-7

Synonyms hexanedioic acid, dibutyl ester; adipic acid, dibutyl ester; butyl adipate; di-*n*-butyl adipate; dibutyl hexanoate

EINECS No. 203-350-4

RTECS No. AV 0900000

Uses Plasticiser. Pesticide. Skin conditioning agent in cosmetic formulations (only one reported product) (1).

Physical properties

M. Pt. -32.4°C B. Pt. 305°C Flash point 110°C Specific gravity 0.962 at 20°C with respect to water at 4°C
Solubility Organic solvents: diethyl ether, ethanol

Mammalian & avian toxicity**Acute data**

LD₅₀ oral rat 12,900 mg kg⁻¹ (2).

LD₅₀ dermal rabbit 20,000 mg kg⁻¹ (3).
LD₅₀ intraperitoneal rat 5240 mg kg⁻¹ (4).

Teratogenicity and reproductive effects

Intraperitoneal rat (5-15 day gestation) lowest toxic dose for teratogenic effect 1050 mg kg⁻¹ (4).

Irritancy

Dermal rabbit (24 hr) 10 mg caused mild irritation (4).
500 mg instilled into rabbit eye (24 hr) caused mild irritation (5).

Other comments

Existing data are insufficient to support the safety of dibutyladipate in cosmetics (1).
Contaminant in groundwater supply (6).

References

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2. Frear, E. H. (Ed.) *Pesticide Index* 5th ed., 1976, 72, College Science Publications, State College, PA, USA.
3. *AMA Arch. Ind. Occup. Med.* 1951, 4, 119.
4. *J. Pharm. Sci.* 1973, 62, 1396.
5. Marhold, J. V. *Prehled Prumyslove Toxikologie: Organické Latky* 1986, 377, Aricenum, Prague, Czechoslovakia.
6. Guardiola, J. et al *Water Supply* 1989, 7(4), 11-16

D141 dibutylamine



C₈H₁₉N

Mol. Wt. 129.25

CAS Registry No. 111-92-2

Synonyms N-butyl-1-butanamine; N-dibutylamine

EINECS No. 203-921-8

RTECS No. HR 7780000

Uses Corrosion inhibitor. Chemical intermediate in the manufacture of emulsifiers. Rubber accelerators, dyestuffs and insecticides. Flotation agents.

Physical properties

M. Pt. -62°C B. Pt. 159°C Flash point 41°C Specific gravity 0.7670 at 20°C with respect to water at 4°C

Partition coefficient log P_{ow} 2.83 Volatility v.p. 2 mmHg at 20°C ; v.den. 4.46

Solubility Water: 3.1 g l⁻¹. Organic solvents: acetone, benzene, diethyl ether, ethanol

Occupational exposure

UN No. 2248 HAZCHEM Code 3W Conveyance classification corrosive substance, danger of fire (flammable liquid)

Supply classification harmful

Risk phrases Flammable – Harmful by inhalation, in contact with skin and if swallowed (R10, R20/21/22)

Safety phrases Keep out of reach of children (if sold to general public) (S2)

Ecotoxicity

Fish toxicity

Critical range (24 hr) creek chub, 20-60 ng l⁻¹ (1).

Environmental fate

Abiotic removal

By activated carbon 0.174 g g⁻¹ carbon – 87% reduction (2).

Mammalian & avian toxicity

Acute data

LC_{Lo} (4 hr) inhalation rat 500 ppm (3).

LD₅₀ oral rat 220 mg kg⁻¹ (4).

LD₅₀ oral mouse 290 mg kg⁻¹ (5).

LD₅₀ intraperitoneal mouse 200 mg kg⁻¹ (6).

LD₅₀ dermal rabbit 1010 mg kg⁻¹ (4).

Irritancy

Inhalation causes irritation of nose, throat and lungs (species unspecified) (7).

10 mg applied to rabbit skin for 24 hr produced severe effect (8).

250 µg instilled into rabbit eye produced severe effect (8).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (9).

Other effects

Any other adverse effects

Extremely destructive to tissue of mucous membranes and upper respiratory tract, eyes and skin. Inhalation may be fatal as a result of spasm, inflammation and oedema of the larynx and bronchi, chemical pneumonitis and pulmonary oedema (10).

Other comments

Threshold odour concentration, absolute recognition 0.08 ppm; 50% recognition 0.27 ppm; 100% recognition 0.48 ppm (2).

References

1. McKee, J. E. et al *Water Quality Criteria*, 1963, The Resources Agency of California, State Water Quality Control Board.
2. Hellman, T. M. et al *Chem. Eng. Prog.* 1973, **69**, 9.
3. *Arch. Environ. Health* 1960, **1**, 343.
4. *Zeit. Gesamte Hyg. Ihre Grenzgebiete* 1974, **20**, 393.
5. *Gig. Sanit.* 1975, **40**(11), 21.
6. United States Patent Document 3816470 (RTECS).
7. Keith L. H. et al (Ed.) *Compendium of Safety Data Sheets for Research and Industrial Chemicals* 1985 **2**, 514, VCH, New York, USA.
8. *AMA Arch. Ind. Hyg. Occup. Med.* 1954, **10**, 61.
9. Clayton G. D. et al (Ed.) *Patty's Industrial Hygiene and Toxicology*, 3rd ed., 1982, **2**, 3141, Interscience Publishers, New York, USA.
10. Lenga, R. E. *The Sigma-Aldrich Library of Chemical Safety Data* 2nd ed., 1988, **1**, 1096, Sigma-Aldrich, Milwaukee, WI, USA

D142 di-sec-butylamine



$\text{C}_8\text{H}_{19}\text{N}$

Mol. Wt. 129.25

CAS Registry No. 626-23-3

Synonyms *N*-(2-methylpropyl)-2-butanamine; bis(2-methylpropyl)amine; di-2-butylamine

EINECS No. 210-937-9

Physical properties

B. Pt. 134-135°C Flash point 24°C Specific gravity 0.75 at 20°C

Occupational exposure

Supply classification harmful

Risk phrases Flammable – Harmful by inhalation, in contact with skin and if swallowed (R10, R20/21/22)

Safety phrases Keep out of reach of children (if sold to general public) (S2)

Ecotoxicity

Fish toxicity

Critical range for creek chub (24 hr) 15-40 mg l⁻¹ (1).

Mammalian & avian toxicity

Sub-acute and sub-chronic data

In the rat, exposure by inhalation at 150 mg l⁻¹ for 6.5 hr per day for 19 days caused restlessness, initial tremors, uncoordination and no weight gain. Autopsy showed that the organs were normal (2).

References

1. McKee, J. E. et al *Water Quality Criteria* 1963, Resources Agency of California, State Water Control Board.
2. Cage, J. C. *Br. J. Ind. Med.* 1970, 27

D143 2-dibutylaminoethanol



$\text{C}_{10}\text{H}_{23}\text{NO}$

Mol. Wt. 173.30

CAS Registry No. 102-81-8

Synonyms 2-(*N,N*-dibutylamino)ethanol; *N,N*-dibutylaminoethanol; 2-(dibutylamino)ethanol; dibutylaminoethanol; 2-di-*n*-butylaminoethanol; *N,N*-dibutylethanolamine

EINECS No. 203-057-1

RTECS No. KK 3850000

Uses In preparation of catalysts and corrosion inhibitors.

Physical properties

B. Pt. 229-230°C Flash point 93°C (open cup) Specific gravity 0.860 at 20°C with respect to water at 4°C

Volatility v.den. 6.0

Solubility Water: <1 mg ml⁻¹ at 18°C. Organic solvents: acetone, dimethyl sulfoxide, ethanol

Occupational exposure

FR-VME 2 ppm (14 mg m⁻³)

US-TWA 0.5 ppm (3.5 mg m⁻³)

UN No. 2873 HAZCHEM Code 3☒ Conveyance classification toxic substance

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1070 mg kg⁻¹ (1).

LD₅₀ dermal rabbit 1680 mg kg⁻¹ (1).

LD₅₀ intraperitoneal rat 144 mg kg⁻¹ (2).

LD₅₀ intraperitoneal mouse 52 mg kg⁻¹ (3).

Irritancy

Dermal rabbit (24 hr) 10 mg caused severe irritation and 20 mg instilled into rabbit eye (24 hr) caused severe irritation (1).

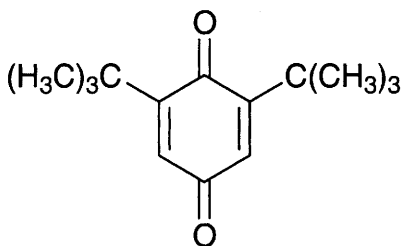
Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (4).

References

1. Smyth, H. F. et al *Arch. Ind. Hyg. Occup. Med.* 1954, **10**, 61.
2. *Toxicol. Appl. Pharmacol.* 1968, **12**, 486.
3. *Russ. Chem. Rev. (Engl. Transl.)* 1969, **38**, 975.
4. Zeiger, E. et al *Environ. Mutagen.* 1987, **9**(Suppl. 9), 1-110

D144 2,6-di-*tert*-butyl-*p*-benzoquinone



C₁₄H₂₀O₂

Mol. Wt. 220.31

CAS Registry No. 719-22-2

Synonyms 2,6-di-*tert*-butyl-1,4-benzoquinone; 2,6-di-*tert*-butyl-2,5-cyclohexadiene-1,4-dione

EINECS No. 211-946-0

RTECS No. DK 3970000

Uses Oxidant, polymerisation catalyst.

Physical properties

M. Pt. 68°C B. Pt. 60°C at 0.01 mmHg sublimes

Mammalian & avian toxicity

Acute data

LD₅₀ intraperitoneal mouse 2270 mg kg⁻¹ (1).

Metabolism and toxicokinetics

When 2,6 di-*tert*-butyl-*p*-benzoquinone (DBQ) was administered orally to rats 36% was excreted in urine and 63% in faeces in 7 days. 35% of oral dose recovered in rat bile within 48 hr. Major urinary metabolites were identified as glucuronic and/or sulfuric acid ether conjugates of 2,6 di-*tert*-butylhydroquinone (DBHQ) (11.3% of dose), 3,3-dimethyl-5-hydroxy-7-*tert*-butyl coumaran 7.2% and 2-*tert*-butyl-6-(2-hydroxy-1,1-dimethyl ethyl)-*p*-benzoquinone 6.1%.

The principal biliary metabolite was a glucuronic acid conjugate of DBHQ (26.7% of dose) (2).

Other effects

Any other adverse effects

Administration to mouse caused ulcerated nasal septum and haemorrhage (1).

Other comments

In river water from 0.001 to 0.011 ppm, in river sediment from 0.1 to 40 ppm (3).

References

1. *Toxicol. Lett.* 1980, **6**, 173.
2. Daniel, J. W. et al *Food Cosmet. Toxicol.* 1973, **11**(5), 793-796
3. Verschueren K. *Handbook of Environmental Data on Organic Chemicals* 2nd Ed., 1983, Van Nostrand Reinhold, New York, USA

D145 dibutyl ether



C₈H₁₈O

Mol. Wt. 130.23

CAS Registry No. 142-96-1

Synonyms 1-butoxybutane; *n*-butyl ether; butyl oxide; dibutyl oxide; 1,1'-oxybis(butane); 5-oxanonane

EINECS No. 205-575-3

RTECS No. EK 5425000

Uses Alkylating agent. Catalyst and catalyst activator. Solvent.

Physical properties

M. Pt. -98°C **B. Pt.** 142-143°C **Flash point** 25°C **Specific gravity** 0.769 at 20°C with respect to water at

4°C **Partition coefficient** log P_{ow} 3.21 **Volatility** v.p. 4.8 mmHg at 20°C ; v.den. 4.5

Solubility Water: 300 mg l⁻¹ at 20°C. Organic solvents: diethyl ether, ethanol

Occupational exposure

UN No. 1149 **HAZCHEM Code** 3  **Conveyance classification** flammable liquid

Supply classification irritant

Risk phrases Flammable – Irritating to eyes, respiratory system and skin (R10, R36/37/38)

Safety phrases Keep out of reach of children (if sold to general public) (S2)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 52 mg l⁻¹ (1).

Invertebrate toxicity

EC₅₀ (48 hr) *Daphnia magna* >150 mg l⁻¹ (2).

EC₅₀ (5 min) *Photobacterium phosphoreum* 62 ppm Microtox test (3).

Environmental fate

Abiotic removal

Adsorption capacity for activated carbon 39 mg g⁻¹. Complete removal reported in waste water containing 1000 mg l⁻¹ (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 7.4 g kg⁻¹ (5).

LC₅₀ (4 hr) inhalation rat 4000 ppm (5).

LD₅₀ dermal rabbit 10 g kg⁻¹ (5).

Irritancy

Human (15 min) atmospheric concentration of 200 ppm caused irritation of the eyes and nose (6).

Dermal rabbit 380 mg caused mild irritation (period of exposure unspecified) (7).

Legislation

The log P_{ow} value exceeds the European Community recommended level 3.0 (8).

Other comments

Contaminant in air and water. Volatilises into air from waste-water effluents (9).

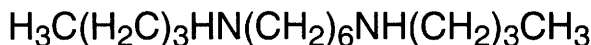
Threshold odour concentration 8 mg m⁻³ (10).

Autoignition temperature 185/194°C.

References

1. Geiger, D. L. et al *Acute Toxicities of Organic Chemicals to Fathead Minnows* 1984/85, 414, Center for Lake Superior Environmental Studies, University of Wisconsin-Superior, WI, USA.
2. Bringmann, G. et al *Z. Wasser Abwasser Forsch.* 1982, **15**(1), 1.
3. Kaiser, K. L. E. et al *Water Pollut. Res. J. Can.* 1991, **26**(3), 361-431.
4. Guisti, D. M. et al *J. Water Pollut. Control Fed.* 1974, **46**(5), 947-965.
5. Smyth, H. F. et al *Arch. Ind. Hyg. Occup. Med.* 1954, **10**, 61.
6. *J. Ind. Hyg. Toxicol.* 1946, **28**, 262.
7. *Union Carbide Data Sheet* 1971, Union Carbide Corp., New York, USA.
8. *1967 Directive on Classification, Packaging, and Labelling of Dangerous Substances* 67/548/EEC; *6th Amendment EEC Directive* 79/831/EEC; *7th Amendment EEC Directive* 91/32/EEC 1991, HMSO, London, UK.
9. Canela, A. M. et al *Proc., Annu. Meet. Air Waste Manage. Assoc.* 1990, **83**(9), 90/188.3.
10. Hollingsworth, R. L. et al *AMA Arch. Ind. Health* 1956, **14**, 138-147.

D146 *N,N'*-dibutylhexamethylenediamine



$\text{C}_{14}\text{H}_{32}\text{N}_2$

Mol. Wt. 228.42

CAS Registry No. 4835-11-4

Synonyms DBHMD; dibutylhexamethylenediamine; *N,N'*-dibutyl-1,6-hexanediamine

EINECS No. 225-417-7

RTECS No. MO 1250000

Physical properties

B. Pt. 141°C at 6 mmHg Specific gravity 0.825 at 25°C

Mammalian & avian toxicity

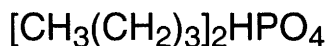
Acute data

LD₅₀ (4 hr) inhalation rat 220 mg m⁻³ (1).

References

1. *Food Chem. Toxicol.* 1984, 22, 425

D147 dibutyl hydrogen phosphate



$\text{C}_8\text{H}_{19}\text{O}_4\text{P}$

Mol. Wt. 210.21

CAS Registry No. 107-66-4

Synonyms phosphoric acid, dibutyl ester; dibutyl acid phosphate; dibutyl phosphate; di-*n*-butyl phosphate

EINECS No. 203-509-8

RTECS No. TB 9605000

Uses Catalyst. Lubricating oil additive.

Occurrence Waste product in nuclear fuel reactors.

Physical properties

M. Pt. 100°C (decomp.) Specific gravity 1.06 at 20°C Volatility v.p. 1 mmHg at 20°C

Occupational exposure

FR-VME 1 ppm (5 mg m⁻³)

UK-LTEL 1 ppm (8.7 mg m⁻³)

US-TWA 1 ppm (8.6 mg m⁻³)

UK-STEL 2 ppm (17 mg m⁻³)

US-STEL 2 ppm (17 mg m⁻³)

Mammalian & avian toxicity

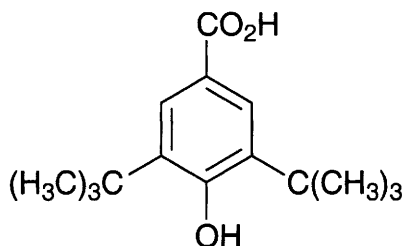
Acute data

LD₅₀ oral rat 3200 mg kg⁻¹ (1).

References

1. Patty, F. A. (Ed.) *Industrial Hygiene and Toxicology* 2nd ed., 1963, 1918, Interscience Publishers, New York, USA

D148 3,5-di-*tert*-butyl-4-hydroxybenzoic acid



$C_{15}H_{22}O_3$

Mol. Wt. 250.34

CAS Registry No. 1421-49-4

Synonyms 3,5-bis(1,1-dimethylethyl)-4-hydroxybenzoic acid

EINECS No. 215-823-2

RTECS No. DG 6320000

Genotoxicity

No effect to excision repair replication of DNA in irradiated human lymphocytes (1).

Other comments

Residues have been found in water samples (2-4).

Found in soil as a metabolite of BHT (5).

Urinary metabolite of BHT in rats (6,7).

References

1. Daugherty, J. P. et al *Biochem. Biophys. Res. Comm.* 1978, **80**, 963.
2. Van de Meent, W. *Proc. Inform. Colloq.-Anal. Org. Micropollut. Water* Feb 1976, Voorburg, Netherlands.
3. Jolley, R. L. et al *Trace Subst. Environ. Health* 1975, **9**, 247.
4. Nikami, N. et al *Chemosphere* 1979, **8**, 311.
5. Nikami, N. et al *Chemosphere* 1979, **8**, 305.
6. Takahashi, O. et al *Toxicol. Lett.* 1980, **6**, 287.
7. Kamiya, N. et al *Kenkyu Nenpo- Tokyo-toritsu Eisei Kenkyusho* 1976, **27**, 63

D149 1,3-dibutyl-1-nitrosourea



$C_9H_{19}N_3O_2$

Mol. Wt. 201.27

CAS Registry No. 56654-52-5

Synonyms *N,N'*-dibutyl-*N*-nitrosourea

RTECS No. YS 8235000

Genotoxicity

In vitro Chinese hamster fibroblast cells, chromosomal aberrations positive (1).

References

1. Ishidate, M. et al *Mutat. Res.* 1977, **48**(3/4), 337-354

D150 di-*tert*-butyl peroxide



$\text{C}_8\text{H}_{18}\text{O}_2$

Mol. Wt. 146.23

CAS Registry No. 110-05-4

Synonyms bis(1,1-dimethylethyl) peroxide; DTBP; *tert*-butyl peroxide

EINECS No. 203-733-6

RTECS No. ER 2450000

Uses Polymerisation catalyst. Ignition accelerator for diesel fuel. Chemical intermediate.

Physical properties

M. Pt. -40°C **B. Pt.** 110°C **Flash point** 1°C **Specific gravity** 0.796 **Volatility** v.p. 19.5 mmHg at 20°C
Solubility Water: $<1\text{ mg ml}^{-1}$ at 21°C . Organic solvents: acetone, dimethyl sulfoxide, ethanol, ligroin, styrene

Occupational exposure

UN No. 2102

Supply classification oxidising, highly flammable

Risk phrases May cause fire – Highly flammable (R7, R11)

Safety phrases Keep out of reach of children (if sold to general public) – Keep container tightly closed in a cool place – Keep away from acids – Keep away from sources of ignition – No smoking – Wear suitable protective clothing, gloves and eye/face protection (S2, S3/7, S14, S16, S36/37/39)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 10 g kg^{-1} (1).

LD₅₀ oral mouse 20 g kg^{-1} (2).

LC₅₀ (4 hr) inhalation rat $>4100\text{ ppm}$ (3).

LD₅₀ intraperitoneal rat 3210 mg kg^{-1} (4).

Carcinogenicity and chronic effects

A single dose of 14.6 mg to mice induced malignant lymphomas and pulmonary adenomas (5).

Irritancy

Irritant to skin, eyes and mucous membranes (species unspecified) (1).

500 mg instilled into rabbit eye for 24 hr produced mild irritation (2).

Genotoxicity

Salmonella typhimurium TA98, TA100 with metabolic activation negative (6).

Legislation

Oxidising agents are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (7).

Other comments

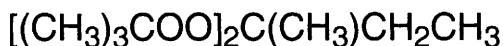
Experimental toxicology and human health effects reviewed (8).

References

1. Keith, L. H. et al (Ed.) *Compendium of Safety Data Sheets for Research and Industrial Chemicals* 1987, 5, 2294, VCH, New York, USA.
2. Marhold, J. V. *Sbornik Vysledku Toxikologickeho Vysetreni Latek A Pripravku* 1972, 40, Prague, Czechoslovakia.

3. ARCO Chemical Company Report, June 1980.
4. *Fed. Proc.* 1948, 7, 252., London.
5. Kutin, P. et al *Radiat. Res.* 1963, *Suppl* 3, 193.
6. Yamaguchi, T. et al *Agric. Biol. Chem.* 1980, **44**, 1675-1678.
7. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
8. *BIBRA Toxicity Profiles* 1990, British Industrial Biological Research Association, Carshalton, UK

D151 2,2-di(*tert*-butylperoxy)butane



$\text{C}_{12}\text{H}_{26}\text{O}_4$

Mol. Wt. 234.34

CAS Registry No. 2167-23-9

Synonyms 1-methylpropylidenebis[(1,1-dimethylethyl) peroxide]; *sec*-butylidenebis[*tert*-butyl peroxide]

EINECS No. 218-507-2

Uses Catalyst. Cross-linking agent. Vulcanising agent.

Physical properties

Flash point 80°C (50% solution in mineral oil)

Solubility Organic solvents: mineral oil

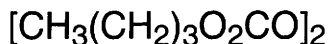
Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (1).

References

1. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D152 dibutyl peroxydicarbonate



$\text{C}_{10}\text{H}_{18}\text{O}_6$

Mol. Wt. 234.25

CAS Registry No. 16215-49-9

Synonyms peroxydicarbonic acid, dibutyl ester; butyl peroxydicarbonate

EINECS No. 240-344-0

RTECS No. SD 9660000

Uses Catalyst.

Occupational exposure

UN No. 2170

Legislation

Oxidising agents are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (1).

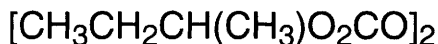
Other comments

Self accelerating decomposition temperature (50% solution) 5°C.

References

1. S. I. No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D153 di-sec-butyl peroxydicarbonate



$\text{C}_{10}\text{H}_{18}\text{O}_6$

Mol. Wt. 234.25

CAS Registry No. 19910-65-7

Synonyms peroxydicarbonic acid, bis(2-methylpropyl) ester; peroxydicarbonic acid, di-sec-butyl ester; sec-butyl peroxydicarbamate

EINECS No. 243-424-3

RTECS No. SD 9675000

Uses Vulcanising agent and catalyst for polymerisation.

Physical properties

Flash point -1°C

Mammalian & avian toxicity

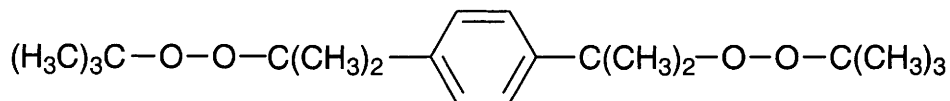
Acute data

LD₅₀ dermal rabbit 1200 mg kg⁻¹ (1).

References

1. Society of Plastics Industry *SPI Bulletin* 1/75-19B

D154 1,4-di(tert-butylperoxyisopropyl)benzene



$\text{C}_{20}\text{H}_{34}\text{O}_4$

Mol. Wt. 338.49

CAS Registry No. 2781-00-2

Synonyms 1,4-phenylenebis(1-methylethylidene) bis(1,1-dimethylethyl peroxide); p-phenylenediisopropylidene bis(tert-butyl peroxide); Perkadox 14/40C; Peroximon F40; Peroximon F100

EINECS No. 220-479-1

Uses Vulcanising agent and polymerisation catalyst.

Physical properties

Flash point 113°C

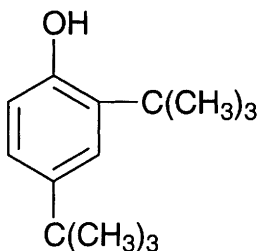
Other comments

Properties of organic peroxides in relation to rubber industry processing techniques from a safety engineering perspective reviewed (1).

References

1. De Groot, J. J. *Rubber World* 1989, **199**(5), 19-21, 24-26, 29

D155 2,4-di-*tert*-butylphenol



$C_{14}H_{22}O$

Mol. Wt. 206.33

CAS Registry No. 96-76-4

Synonyms 2,4-bis(1,1-dimethylethyl)phenol; 2,4-bis(*tert*-butyl)phenol; 2,4-di-*tert*-butylhydroxybenzene; antioxidant no. 33

EINECS No. 202-532-0

RTECS No. SK 8260000

Uses Chemical intermediate. Antioxidant. Stabiliser. Disinfectant.

Physical properties

M. Pt. 51°C **B. Pt.** 261°C **Flash point** 129°C **Specific gravity** 0.907 at 60°C with respect to water at 4°C

Volatility v.p. 1 mmHg at 45°C

Solubility Organic solvents: carbon tetrachloride

Ecotoxicity

Bioaccumulation

No or low bioaccumulation (1).

Mammalian & avian toxicity

Acute data

LD₅₀ intraperitoneal mouse 25 mg kg⁻¹ (2).

LD₅₀ intravenous mouse 100 mg kg⁻¹ (3).

Sub-acute and sub-chronic data

Demonstrated not to cause haemorrhage (and did not reduce prothrombin index) following oral administration to rats (dose and duration unspecified) (4).

Irritancy

Irritating to eyes, skin, mucous membranes and upper respiratory tract. Prolonged contact and intense exposure may damage the eyes and cause severe irritation or burns (species unspecified) (4).

Other effects

Other adverse effects (human)

May have been the responsible agent for an outbreak of vitiligo (skin depigmentation) among rubber injection moulding workers (5).

Other comments

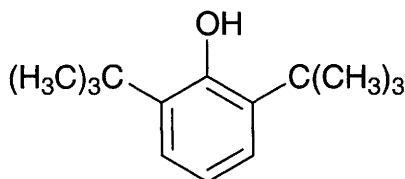
Residues detected in river water and sediments (6,7).

Threshold odour concentration in water 0.5 mg l⁻¹ (8).

References

1. JETOC Newsletter No. 6 1988, Japan Chemical Industry Ecology Toxicology and Information Center, Tokyo, Japan.
2. NTIS Report AD691-490 Natl. Tech. Inf. Ser., Springfield, VA, USA.
3. James, R. et al *J. Med. Chem.* 1980, **23**, 1350.
4. Dietz, F. et al GWF, *Gas-Wasserfach: Wasser-Abwasser* 1978, **119**(6).
5. O'Malley, M. A. et al *J. Occup. Med.* 1988, **30**(6), 512-516.
6. Jungclaus, G. A. et al *Organic Compounds in an Industrial Wastewater: A Case Study of their Environmental Impact*.
7. Richardson, M. L. *Compendium of Toxicological Ecological Data on Chemicals found by GC-MS in Water Samples 1985*, Thames Water Authority, UK.
8. Lenga, R. E. *The Sigma-Aldrich Library of Chemical Safety Data* 2nd ed., 1988, **1**, 1103, Sigma Aldrich, Milwaukee, WI, USA

D156 2,6-di-*tert*-butylphenol



C₁₄H₂₂O

Mol. Wt. 206.33

CAS Registry No. 128-39-2

Synonyms 2,6-bis(1,1-dimethylethyl)phenol

EINECS No. 204-884-0

RTECS No. SK 8265000

Uses Chemical intermediate. Antioxidant.

Physical properties

M. Pt. 35-38°C B. Pt. 253°C Flash point 118°C Specific gravity 0.914 at 20°C

Solubility Organic solvents: carbon tetrachloride, ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1320 mg kg⁻¹ (1).

LD₅₀ oral mouse 3000 mg kg⁻¹ (2).

LD₅₀ intravenous mouse 60 mg kg⁻¹ (3).

Irritancy

Dermal rabbit (24 hr) 500 mg caused severe irritation and 50 µg instilled into rabbit eye for 24 hr caused severe irritation (1).

Irritating to eyes, skin, mucous membranes and upper respiratory tract. Prolonged contact or intense exposure may damage the eyes and cause severe irritation or burns (species unspecified) (4).

Other effects

Any other adverse effects

Markedly increased cholinesterase activity in blood of rats and mice. Mice treated with 33% of the LD₅₀ value showed a 24.4% increase in blood cholinesterase activity after 1 hr. 20% of the LD₅₀ increased the metabolism of toluene by liver microsomes in mice and also increased liver cytochrome P₄₅₀ levels, indicating an enzyme inducing effect (2).

Inhibited the formation of prostaglandin E by rabbit kidney slices, indicating a requirement for lipid peroxidase in the activity of prostaglandin cyclooxygenase (5).

Caused haemorrhage, death and reduced the prothrombin index following oral administration to rats (dose and duration unspecified) (6).

Other comments

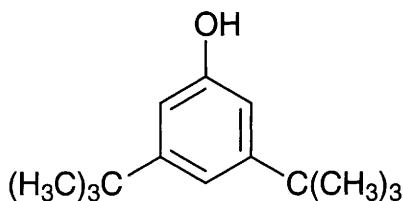
Residues detected in river water and sediments (7,8).

Threshold odour concentration in water 0.2 mg l⁻¹ (9).

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D157 3,5-di-*tert*-butylphenol



C₁₄H₂₂O

Mol. Wt. 206.33

CAS Registry No. 1138-52-9

Synonyms 3,5-bis(1,1-dimethylethyl)phenol

EINECS No. 214-513-4

Physical properties

M. Pt. 87-89°C

Mammalian & avian toxicity

Irritancy

Irritating to eyes, skin, mucous membranes and upper respiratory tract. Prolonged contact or severe exposure may damage the eyes and cause severe irritation or burns (species unspecified) (1).

Other effects

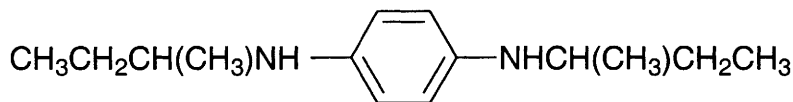
Any other adverse effects

Demonstrated not to cause haemorrhage and did not reduce the prothrombin index following oral administration to rats (dose and duration unspecified) (2).

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D158 *N,N'*-di-*sec*-butyl-*p*-phenylenediamine



$C_{14}H_{24}N_2$

Mol. Wt. 220.36

CAS Registry No. 101-96-2

Synonyms *N,N'*-bis(1-methylpropyl)-1,4-benzenediamine

EINECS No. 202-992-2

RTECS No. SS 9040000

Uses Antioxidant in fuels.

Physical properties

M. Pt. 17.8°C Flash point 140.6°C Specific gravity 0.94-0.95 at 24°C with respect to water at 24°C

Solubility Water: <1 mg ml⁻¹ at 20°C. Organic solvents: acetone, dimethyl sulfoxide, ethanol

Mammalian & avian toxicity

Acute data

LD_{Lo} oral rat 200 mg kg⁻¹ (1).

LC_{Lo} (6 hr) inhalation rat 600 mg m⁻³ (1).

LD₅₀ dermal guinea pig 5 g kg⁻¹ (2).

Irritancy

Corrosive to skin (species unspecified) (3).

Sensitisation

Mild allergen (species unspecified) (3).

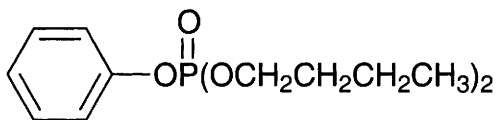
Genotoxicity

In vitro Chinese hamster lung or ovary cells with and without metabolic activation negative (4).

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D159 dibutyl phenyl phosphate



$C_{14}H_{23}O_4P$

Mol. Wt. 286.31

CAS Registry No. 2528-36-1

Synonyms phosphoric acid, dibutyl phenyl ester; DBPP

EINECS No. 219-772-7

RTECS No. TB 9626600

Uses Lubricating oil additive.

Physical properties

Solubility Water: 96 mg l⁻¹ at 20°C. Organic solvents: dimethyl sulfoxide

Occupational exposure

US-TWA 0.3 ppm (3.5 mg m⁻³)

Ecotoxicity

Fish toxicity

Not toxic to brown trout, bluegill sunfish, yellow perch (24 hr) at 5 mg l⁻¹. Test conditions: static bioassay; pH 7; dissolved oxygen content 7.5 ppm; total hardness (soap method) 300 ppm; methyl orange alkalinity 310 ppm; free carbon dioxide 5 ppm; temperature 12.8°C (1).

Bioaccumulation

The calculated bioconcentration factor of 270 indicates that environmental accumulation is likely (2).

Environmental fate

Degradation studies

Rapid biodegradation at 3 mg l⁻¹ was reported in semicontinuous activated sludge processes (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral chicken 2030 mg kg⁻¹ (3).

LD₅₀ oral mouse, rat 1790, 2140 mg kg⁻¹, respectively (4).

Sub-acute and sub-chronic data

Oral rat (91 day) 5, 50 or 250 mg kg⁻¹ day⁻¹. Body weight, erythrocyte counts, haematocrit and haemoglobin levels were reduced compared to controls for the high-dose group. They also had increased liver weights with concomitant decreased hepatocyte vacuolation and increased fatty accumulation. Urinary bladder

histopathological changes, consisting of mononuclear cell infiltration and transitional and epithelial cell hyperplasia, were noted in the mid- and high-dose groups (5).

Teratogenicity and reproductive effects

Oral rat (2-generation study) 5, 50 or 250 mg kg⁻¹ day⁻¹. Mating and fertility indices were comparable among the parental animals in both generations, but survival among high-exposure pups reared by control dams appeared to be decreased. The no adverse effect level was 5 mg kg⁻¹ day⁻¹ (5).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535 with and without metabolic activation negative (6).

Other effects

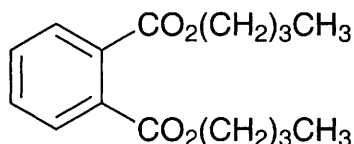
Any other adverse effects

Dibutyl phenyl phosphate is unlikely to cause organophosphorus compound-induced delayed neurotoxicity. The inhibition of brain acetylcholinesterase is not a good indicator of the acute toxicity of this compound (7).

References

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D160 dibutyl phthalate



C₁₆H₂₂O₄

Mol. Wt. 278.35

CAS Registry No. 84-74-2

Synonyms 1,2-benzenedicarboxylic acid, dibutyl ester; phthalic acid, dibutyl ester; di-*n*-butyl phthalate; *n*-butyl phthalate; dibutyl *o*-phthalate; DBP

EINECS No. 201-557-4

RTECS No. TI 1940000

Uses In binding agents. Catalyst. In epoxy resins, rubbers, plastics, surface coatings and colour photography films. High-boiling solvent. Insect repellent in clothing. Plasticiser.

Physical properties

M. Pt. -35°C **B. Pt.** 340°C **Flash point** 171°C (open cup) **Specific gravity** 1.043 at 20°C with respect to water at 4°C **Partition coefficient** log P_{ow} 4.72 (1) **Volatility** v.p. 1.4 × 10⁻⁵ mmHg at 25°C

Solubility Water: 11.2 mg l⁻¹ (2). Organic solvents: acetone, benzene, diethyl ether, ethanol

Occupational exposure

FR-VME 5 mg m⁻³

JP-OEL 5 mg m⁻³ (provisional value)

SE-LEVL 3 mg m⁻³

UK-LTEL 5 mg m⁻³

US-TWA 5 mg m⁻³

SE-STEL 5 mg m⁻³

UK-STEL 10 mg m⁻³

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) flow-through, channel catfish 0.46 (0.40-0.53) mg l⁻¹, bluegill 1.55 (1.38-1.74) mg l⁻¹ (3).

Invertebrate toxicity

LC₅₀ (24 hr) grass shrimp 10-50 ppm (4).

EC₅₀ (30 min) *Photobacterium phosphoreum* 11-23 ppm Microtox test (5).

EC₅₀ (48 hr) *Tetrahymena pyriformis* growth inhibition 7.0 mg l⁻¹ (6).

EC₅₀ (96 hr) *Chlorella pyrenoidosa* growth inhibition >13 mg l⁻¹ (7).

LC₅₀ (48 hr) *Daphnia magna* static 3.0 mg l⁻¹; NOEC 1.7 mg l⁻¹ (8,9).

Bioaccumulation

Seedlings placed in air containing dibutyl phthalate (concentration unspecified) accumulated phthalate to a concentration 10⁶ times that in the surrounding air within 3 days (10).

Log bioconcentration factor for American oyster, brown shrimp and sheepshead minnow were 1.50, 1.22 and 1.07, respectively (11).

Environmental fate

Carbonaceous inhibition

Methanogenesis was not inhibited in a sludge digester at concentrations up to 200 mg l⁻¹ (12).

Degradation studies

The anaerobic bioconversion of levels was reduced by 80 and 50%, respectively, after 4 wk incubation in samples inoculated with diluted anaerobic digester sludge; >90% bioconversion of dibutyl phthalate was observed in samples inoculated with either anaerobic freshwater or salt marsh sediment (13).

Among 77 microbial cultures, *Rhodococcus* spp. dominated among isolates actively degrading dibutyl phthalate (14).

In soils containing 0.1 g kg⁻¹, 14.1% was degraded in 50 days. *Pseudomonas fluorescens* and *Xanthomonas campestris* were among the degrading microorganisms (15).

BOD₅ 0.43 mg l⁻¹ O₂ (16).

ThOD 2.24 mg l⁻¹ O₂ (17).

Phthalate esters undergo ≥50% ultimate degradation within 28 days in standardised aerobic biodegradation tests with sewage sludge inocula. Biodegradation is expected to be the dominant loss mechanism in surface water, soils and sediments (18).

Abiotic removal

36-44% removal of 100 µg l⁻¹ from waste water by 25-50 mg l⁻¹ aluminium sulfate (19).

Vapour phase dibutyl phthalate undergoes degradation by reaction with photochemically produced hydroxyl ions with an estimated t_{1/2} of 18 hr (20).

Estimated photolysis t_{1/2} in natural waters is 144 days (21).

Evaporation rate relative to *n*-butyl acetate, which has been assigned a value of 1 at 25°C, is <0.005 (22).

85% removal of 100 µg l⁻¹ from waste water by powdered activated carbon at concentrations of 50-100 mg l⁻¹ (19).

Adsorption and retention

The adsorption of all phthalates by the particulates is enhanced by the presence of salt in saline water. The adsorption process is fairly rapid (<2-3 hr) and the degree of adsorption depends on the characteristics of the particulates (23).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat >8 g kg⁻¹ (24).

LC₅₀ (2 hr) inhalation mouse 25 g m⁻³ (25).

LD_{Lo} dermal rat 6 g m⁻³ (25).

LD₅₀ intraperitoneal rat 3050 mg kg⁻¹ (26).

LD₅₀ intravenous mouse 720 mg kg⁻¹ (27).

Sub-acute and sub-chronic data

Oral ♂ rat 0.5-5.0% diet (period of exposure unspecified), growth depression, liver enlargement, testicular atrophy, decrease in succinate and pyruvate dehydrogenase activities in liver mitochondria and abnormal changes in biochemical markers in serum and in histological examination of the liver and testis in the 5% dose group reported. The same effects were also observed in rats fed diets containing 5% of monobutyl phthalate or bis(2-ethylhexyl) phthalate, but not phthalic acid (28).

LC₅₀ (5 day) oral mallard duck >5000 ppm (29).

Teratogenicity and reproductive effects

Oral ♂ rat, single oral dose (amount unspecified) caused sloughing of the testicular germ cells at 6 hr, with more severe sloughing at 24 and 48 hr. The metabolite mono-*n*-butyl phthalate caused decreases in the activities of succinate dehydrogenase in the Sertoli cells and sorbitol dehydrogenase in the germ cells, an increase in the activity of lactate dehydrogenase in the germ cells and seminiferous lumen, and a decrease in testicular zinc levels (30).

Gavage ♂ rat (15 days) 25, 500 or 1000 mg kg⁻¹ day⁻¹. A significant decrease in testes weight was observed at the 500 and 1000 mg kg⁻¹ doses (31).

Oral ♂ and ♀ mouse (7 days prior to and during a 98 day cohabitation period) 0-1.2% in diet resulted in a reduction in the numbers of litters pair⁻¹ and of live pups litter⁻¹ at 1.0% in the diet, but not at lower dose levels.

A cross-over mating trial demonstrated that only the ♀ mice were affected (32).

Oral pregnant ♀ rat (days 6-16 of pregnancy) 1500 mg kg⁻¹. A significant increase in post-implantation losses was observed, with increased skeletal and internal malformations of fetuses. Deformity of cervical vertebrae was observed after administration on day 8. Cleft palate and fusion of sternebrae were observed if administration was on day 15 (33).

Metabolism and toxicokinetics

Following dermal application to rat of 28 mg ¹⁴C-labelled substance, 50-60% was excreted in the urine and faeces within 7 days. Urine was the major route of excretion. After 7 days the percentage dose that remained in the body was minimal. Most of the unexcreted dose remained at the area of application (34).

Oral ♀ CD-1 mice (6-13 days gestation) 2500 mg kg⁻¹ day⁻¹. 10/50 animals exhibited maternal toxicity and litter viability was significantly affected (35).

Sensitisation

The use of dibutyl phthalate has been reported to cause occasional hypersensitivity reactions (36).

Genotoxicity

Salmonella typhimurium TA100, TA1535 without metabolic activation positive; with metabolic activation negative (37).

Legislation

Maximum permissible concentration in domestic water in former USSR 0.2 mg l⁻¹ (38).

Other comments

A xenoestrogen used commercially in large volumes as a plasticiser (39).

Environmental fate of dibutyl phthalate reviewed (40,18).

Experimental toxicology and human health effects reviewed (41).

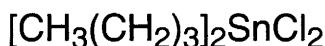
Degraded *in vitro* by tomatoes *Lycopersicon lycopersicum* via an as yet unidentified route to benzoic acid (42).
 Seedlings of radish (*Raphanus sativus*) and wheat (*Triticum aestivum*), atmospheric exposure (3 day) (concentration unspecified) toxic symptoms included carotenoid and chlorophyll deficiency in strong light, concomitant with chloroplast destruction and swollen mitochondria (10).
 Environmental health criteria reviewed (43).
 Aquatic toxicity of eighteen phthalate esters reviewed (2).
 Atmospheric pollutant from industrial plants. Found in incinerator ashes. Residues have been detected in water and sediments. The environmental fate of eighteen phthalate esters reviewed (18).

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D161 dibutyltin dichloride



$\text{C}_8\text{H}_{18}\text{Cl}_2\text{Sn}$

Mol. Wt. 303.85

CAS Registry No. 683-18-1

Synonyms dibutylchlorostannane; dibutylchlorotin; di-*n*-butyltin dichloride; dichlorodibutylstannane; dichlorodibutyltin

EINECS No. 211-670-0

RTECS No. WH 7100000

Uses Heat stabiliser in polymers. Resin polymerisation catalyst.

Physical properties

M. Pt. 39-41°C **B. Pt.** 135°C at 10 mmHg **Flash point** >110°C **Specific gravity** 1.36 at 50°C

Partition coefficient $\log P_{\text{ow}}$ 0.05 (1) **Volatility** v.p. 2 mmHg at 100°C; v.den. 10.5

Solubility Organic solvents: benzene, diethyl ether, ethanol

Occupational exposure

DE-MAK 0.1 mg m⁻³ (as Sn) (total dust)

SE-LEVL 0.1 mg m⁻³ (as Sn)

SE-STEL 0.2 mg m⁻³ (as Sn)

UK-LTEL 0.1 mg m⁻³ (as Sn)

UK-STEL 0.2 mg m⁻³ (as Sn)

US-TWA 0.1 mg m⁻³ (as Sn)

US-STEL 0.2 mg m⁻³ (as Sn)

UN No. 2788 (liquid); 3146 (solid) **HAZCHEM Code** 2X (solid) **Conveyance classification** toxic substance

Ecotoxicity

Fish toxicity

LC₅₀ (48 hr) red killifish 58 mg l⁻¹ (2).

Invertebrate toxicity

EC₅₀ (96 hr) *Scenedesmus obliquus* 16.7 µg l⁻¹ (3).

EC₅₀ (30 min) *Photobacterium phosphoreum* 0.215 ppm Microtox test (4).

Bioaccumulation

Bioconcentration factors in carp: liver 135; gallbladder, kidney 61; muscle 12; and vertebrae 46 (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 70, 100 mg kg⁻¹, respectively (5,6).

LD_{Lo} dermal rabbit 1360 mg kg⁻¹ (7).

LD₅₀ intravenous mouse 180 mg kg⁻¹ (8).

LD₅₀ intraperitoneal rat 7.5 mg kg⁻¹ (9).

Sub-acute and sub-chronic data

Inhalation rats (1 hr) 1470 mg m⁻³ caused hyperactivity, and ptosis and salivation, but no fatalities. Caused mortality in 6/20 weanling rats fed 150 mg kg⁻¹ in diet; severe liver, biliary changes and abdominal oedema were observed. Induced a dose-related reduction of thymus weight and weight of peripheral lymphoid tissues (9).

Oral rat (90 day) 0, 0.5, 1.0, 2.0 or 4.0 mg kg⁻¹ day⁻¹ caused slight growth and food intake reduction and anaemia at the highest dose. Tin was not found in urine from treated animals (10).

Intragastric rat (4 day) 10 or 20 mg kg⁻¹ day⁻¹ caused inflammation of portal tracts and biliary damage. Prolyl hydrolase activity was increased, and *in vitro* collagen synthesis was increased in high-dose group (11).

Teratogenicity and reproductive effects

Pregnant rats were administered 165 or 330 µmol kg⁻¹ on days 13-15 of pregnancy. All treated animals showed a decrease in maternal body weight gain and a significant decrease in foetal weight was also seen. No significantly increased incidences of postimplantation loss of foetuses with malformations were found following the treatment (12).

Pregnant rats were given 10 or 15 mg kg⁻¹ by gastric intubation on days 7 and 8 of pregnancy. The treatment resulted in a significantly lower maternal weight gain, lower foetal weight and higher postimplantation embryolethality. A significant increase of foetuses with malformations, such as cleft lip, ankyloglossia, club foot, deformity of the vertebral column in the cervical and thoracic regions and of the ribs, and anophthalmia or microphthalmia was also seen (13).

Pregnant rats were given 20 mg kg⁻¹ on days 7-9, 10-12 or 13-15 of pregnancy, or 20 or 40 mg kg⁻¹ on day 6, 7, 8 or 9 of pregnancy by gastric intubation. Treatment on days 7-9 was significantly teratogenic but no evidence of teratogenicity was detected following treatment on days 10-12 or 13-15. Treatment on day 7 or 8 resulted in an increased incidence of foetuses with malformations, with the highest incidence occurring on day 8. No malformations occurred following treatment on day 6 or 9. The incidence of malformed foetuses was proportional to the dose administered, with anomaly of tail, anal atresia, club foot, omphalocele, deformity of the vertebral column, defect of the ribs and anophthalmia or microphthalmia observed. It was concluded that, following maternal exposure, developing offspring are not susceptible to the teratogenic effects of dibutyltin dichloride on day 6, day 7 is the earliest susceptible period, day 8 is the highest susceptible period, and day 9 is no longer a susceptible period (15).

Metabolism and toxicokinetics

No bioaccumulation was observed in rats following 3 month oral administration of up to 100 mg kg⁻¹ (9). Intraperitoneal ♂ rat (duration and concentration unspecified) butyl(3-hydroxybutyl)tin dichloride, butyl-(4-hydroxybutyl)tin dichloride and butyltin trichloride were detected as acid-stable metabolites. The major metabolite, butyl(3-hydroxybutyl)tin dichloride showed a tendency to accumulate in the kidneys; butyl-(4-hydroxybutyl)tin dichloride was detected only in urine. Dibutyltin dichloride, butyl-(3-hydroxybutyl)tin dichloride and butyltin trichloride were found in brain (15).

Irritancy

In the enucleated eye test, using the eyes of slaughterhouse animals, dibutyltin dichloride showed a severe effect on corneal swelling, a moderate effect on corneal opacity and a severe effect on fluorescein retention (16).

Dermal rabbit (24 hr) 500 mg caused severe irritation and 50 µg instilled into rabbit eye caused severe irritation (17).

Skin lesions and some burns were observed among workers. The irritant effect appeared between 1 and 8 hr after contact. Healing was rapid after removal from exposure (18).

Genotoxicity

Escherichia coli PQ37 SOS chromotest without metabolic activation positive (20).

Bacillus subtilis H17 rec⁺, M45 rec⁻ assay positive (19).

In vitro human lymphocytes induction of aneuploidy positive (20).

Other effects

Any other adverse effects

Oral rat single dose 15 mg kg⁻¹ caused thymus atrophy which suppressed immune reactions. T-lymphocytes were also decreased (21).

♂ and ♀ Long Evans rats were administered a single oral dose of 75% of the LD₅₀. No distinct gender difference was seen during the first three days subsequent to the administration of the compound, with both sexes being severely affected. After the three days, ♀ recovered rapidly whereas ♂ continued to languish as evident from reduced food and water intake, weight loss, deaths and severe organ damage upon necropsy (22).

Intravenous and oral administration of dibutyltin dichloride to rats caused acute pancreatitis, with toxic concentrations in the pancreatic fluid producing progressive ultrastructural alterations in the pancreas (23). Shown to have an uncoupling effect on oxidative phosphorylation with succinate as the substrate in rat liver mitochondria (24).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Chlorides: guide level 25 mg l⁻¹ (25).

Other comments

Residues have been isolated from fish, marine organisms, water and sediments.

Ingestion after exposure to *N*-nitroso-bis(2-oxopropyl)amine significantly reduced the induction of pancreatic cancer in hamsters (26).

Oral mouse (7 day) 10-30 mg kg⁻¹ day⁻¹ inhibited the growth of subcutaneously implanted sarcoma 180.

Inhibition of the growth of P388 and L1210 leukaemia *in vitro* was also reported (27).

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D162 di-*tert*-butyltin dichloride



$\text{C}_8\text{H}_{18}\text{Cl}_2\text{Sn}$

Mol. Wt. 303.85

CAS Registry No. 19429-30-2

Synonyms dichlorobis(1,1-dimethylethyl)stannane; di-*tert*-butyltin chloride; di-*tert*-butyldichlorostannane; dichlorodi-*tert*-butylstannane; di-*tert*-butyldichlorotin

EINECS No. 243-051-6

RTECS No. BD 0560000

Physical properties

M. Pt. 42-43°C B. Pt. 66°C Flash point >110°C

Occupational exposure

DE-MAK 0.1 mg m⁻³ (as Sn) (total dust)

SE-LEVL 0.1 mg m⁻³ (as Sn)

SE-STEL 0.2 mg m⁻³ (as Sn)

UK-LTEL 0.1 mg m⁻³ (as Sn)

UK-STEL 0.2 mg m⁻³ (as Sn)

US-TWA 0.1 mg m⁻³ (as Sn)

US-STEL 0.2 mg m⁻³ (as Sn)

UN No. 2788 (liquid); 3146 (solid) HAZCHEM Code 2X (solid) Conveyance classification toxic substance

Other effects

Any other adverse effects

Extremely destructive to tissue of mucous membranes and upper respiratory tract, eyes and skin. Inhalation may be fatal as a result of spasm, inflammation and oedema of the larynx and bronchi, chemical pneumonitis and pulmonary oedema (species unspecified) (1).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (2).

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D163 dibutyltin dilaurate



$\text{C}_{32}\text{H}_{64}\text{O}_4\text{Sn}$

Mol. Wt. 631.57

CAS Registry No. 77-58-7

Synonyms butynorate; dibutylbis[(1-oxododecyl)oxy]stannane; dibutylbis(lauroyloxy)stannane; dibutylbis(lauroyloxy)tin; dibutylstannylene dilaurate; dibutyltin didodecanoate

EINECS No. 201-039-8

RTECS No. WH 7000000

Uses Catalyst for curing certain silicones. Cross-linking agent. Vulcanisation accelerator. Veterinary anthelmintic.

Physical properties

M. Pt. 23°C **B. Pt.** 205° at 12 mmHg **Flash point** 235°C (open cup) **Specific gravity** 1.066 at 20°C with respect to water at 20°C **Volatility** v.p. 0.2 mmHg at 160°C ; v.den. 21.8
Solubility Organic solvents: acetone, benzene, diethyl ether, petroleum ether, carbon tetrachloride

Occupational exposure

DE-MAK 0.1 mg m⁻³ (as Sn) (total dust)

SE-LEVL 0.1 mg m⁻³ (as Sn)

SE-STEEL 0.2 mg m⁻³ (as Sn)

UK-LTEL 0.1 mg m⁻³ (as Sn)

UK-STEEL 0.2 mg m⁻³ (as Sn)

US-TWA 0.1 mg m⁻³ (as Sn)

US-STEEL 0.2 mg m⁻³ (as Sn)

UN No. 2788 (liquid); 3146 (solid) **HAZCHEM Code** 2X (solid) **Conveyance classification** toxic substance

Ecotoxicity

Fish toxicity

LC₅₀ (48 hr) red killifish 17 mg l⁻¹ (1).

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 0.576 ppm Microtox test (2).

Bioaccumulation

No or low bioaccumulation level (3).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 175 mg kg⁻¹ (4).

LD_{Lo} intraperitoneal rat 85 mg kg⁻¹ (5).

Sub-acute and sub-chronic data

Dibutyltin dilaurate was administered to rats and mice by gavage, inhalation and dermal routes (dosages not specified). Reduced body weight and food intake were reported. Increased serum GPT and serum bilirubin and damaged liver cells were reported in rats administered by gavage (6).

Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation, and 10 mg instilled into rabbit eye (24 hr) caused moderate irritation (7).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535 with and without metabolic activation negative (8).

Legislation

Maximum permissible concentration in domestic water in former USSR 0.01 mg l⁻¹ (9).

Other comments

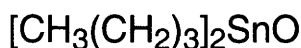
Experimental toxicology and human health effects reviewed (10).

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D164 dibutyltin oxide



$\text{C}_8\text{H}_{18}\text{OSn}$

Mol. Wt. 248.94

CAS Registry No. 818-08-6

Synonyms dibutylxostannane; dibutylxotin; dibutylstannane oxide; di-*n*-dibutyltin oxide

EINECS No. 212-449-1

RTECS No. WH 7175000

Uses Catalyst. Cross-linking agent.

Physical properties

M. Pt. >300°C Volatility v.den. 8.6

Occupational exposure

DE-MAK 0.1 mg m⁻³ (as Sn) (total dust)

SE-LEVL 0.1 mg m⁻³ (as Sn)

SE-STEEL 0.2 mg m⁻³ (as Sn)

UK-LTEL 0.1 mg m⁻³ (as Sn)

UK-STEEL 0.2 mg m⁻³ (as Sn)

US-TWA 0.1 mg m⁻³ (as Sn)

US-STEEL 0.2 mg m⁻³ (as Sn)

UN No. 2788 (liquid); 3146 (solid) HAZCHEM Code 2X (solid) Conveyance classification toxic substance

Ecotoxicity

Fish toxicity

LC₅₀ (48 hr) red killifish 8.4 mg l⁻¹ (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 4.5 mg kg⁻¹ (2).

LD₅₀ intraperitoneal rat 40 mg kg⁻¹ (3).

Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation, and 100 mg instilled into rabbit eye (24 hr) caused moderate irritation (2).

Other comments

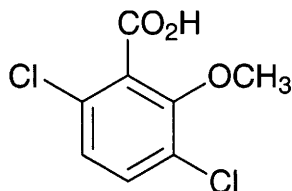
Reported to inhibit the growth of P388 and L1210 leukaemia *in vitro* cells (4).

Toxicity of organotin compounds to red killifish according to OECD test guidelines (1).

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D165 dicamba



$C_8H_6Cl_2O_3$

Mol. Wt. 221.04

CAS Registry No. 1918-00-9

Synonyms 2-methoxy-3,6-dichlorobenzoic acid; 3,6-dichloro-2-methoxybenzoic acid; 3,6-dichloro-*o*-anisic acid; MDBA

EINECS No. 217-635-6

RTECS No. DG 7525000

Uses Systemic herbicide.

Physical properties

M. Pt. 114-116°C **B. Pt.** 200°C (decomp.) **Specific gravity** 1.57 at 25°C **Partition coefficient** $\log P_{ow}$ -0.15 (pH 7) **Volatility** v.p. 3.75×10^{-3} mmHg at 1100°C

Solubility Water: 6.5 g l⁻¹ at 25°C. Organic solvents: acetone, cyclohexanol, dichloromethane, ethanol, toluene, xylene

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout and bluegill sunfish 135 mg l⁻¹ (1).

Invertebrate toxicity

LC₅₀ (48 hr) *Daphnia* 100 mg l⁻¹ (2).

Non-toxic to bees; LD₅₀ >100 µg bee⁻¹ (2).

LC₅₀ *Gammarus lacustris* 3.9 mg l⁻¹ (3).

Bioaccumulation

In an aquatic ecosystem study, dicamba did not bioaccumulate in algae, clam, crab, *Daphnia*, eloden mosquito fish, mosquito larvae or snails over a 32 day test period (4).

Environmental fate

Degradation studies

In soil, microbial degradation occurs with the principal metabolite being 3,6-dichlorosalicylic acid. $t_{1/2}$ <14 days under conditions favourable for degradation (1).

Dicamba had a $t_{1/2}$ 31 days with a 1st-order rate constant of 0.0224 day⁻¹ in a typical midwestern agricultural soil under aerobic conditions. It is completely mineralised to carbon dioxide with 3,6-dichlorosalicylic acid as the only major metabolite. Low levels of 2,5-dihydroxy-3,6-dichlorosalicylic acid were detected. Metabolism under aerobic conditions was similar except at a reduced rate, having a $t_{1/2}$ 50 days with a 1st order rate constant of 0.012 day⁻¹ (5).

Abiotic removal

$t_{1/2}$ for vapour phase reaction with photochemically produced hydroxyl radicals has been estimated to be 2.42 days (6).

Adsorption capacity of activated carbon is reported (7).

Adsorption and retention

Adsorption/desorption studies of dicamba and its metabolite, 3,6-dichlorosalicylic acid, in various soils under various conditions reported (8).

Dicamba adsorption by silt loam soils was reported to be minimal ($K_d < 0.22$) and not influenced by pH in the range 4.1-6.0 (9).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1040 mg kg⁻¹ (10).

LD₅₀ oral mouse, rabbit 1190, 2000 mg kg⁻¹, respectively (11).

LD₅₀ dermal rabbit >2000 mg kg⁻¹ (1).

Sub-acute and sub-chronic data

LC₅₀ (8 day) oral bobwhite quail, mallard duck >10 g kg⁻¹ diet (1).

Carcinogenicity and chronic effects

Oral rat, dog (2 yr) no adverse effect level 500 ppm in diet for rats and 50 ppm in diet for dogs. Oral mouse (period of exposure not specified) 100-10,000 mg kg⁻¹ diet, enlargement of liver cells was observed in a dose-dependent manner (12).

Oral rat (2 yr) 0-25 mg kg⁻¹ day⁻¹. The treated rats did not differ from controls with respect to the incidence, types and times of appearance of tumours (13).

Teratogenicity and reproductive effects

Oral rat, 3-generation study, no adverse effects were observed at the highest dose of 500 mg kg⁻¹ diet (1).

Metabolism and toxicokinetics

In mammals, following oral administration, dicamba is rapidly eliminated in the urine, partly as a glycine conjugate (1).

Irritancy

Intravaginal rabbit, single application of 100 mg caused inflammatory changes after 48 hr. The authors suggest that dicamba is not a primary irritant (14).

Dermal rabbit (21 day) 100 mg day⁻¹ caused slight to moderate irritation observed microscopically (12).

Sensitisation

Dicamba was reported to cause moderate dermal sensitisation in guinea pigs (15).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1515, TA1537, TA1538, with and without metabolic activation negative (16).

Escherichia coli PQ37, with and without metabolic activation negative (17).

In vitro human peripheral blood lymphocytes unscheduled DNA synthesis and sister chromatid exchange positive. Intraperitoneal rat, increased the unwinding rate of liver DNA (18).

Other effects

Other adverse effects (human)

Cohort mortality study of 1255 workers who had worked for ≥6 months in the forestry trade at a public utility. No deaths due to cancers such as soft-tissue sarcoma and non-Hodgkin's lymphoma (19).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (20).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (21).

EEC maximum residue level in maize 0.05 ppm (1).

UK DoE advisory level for drinking water 4 µg l⁻¹ (22).
WHO Toxicity Class Table 5 (23).
EPA Toxicity Class III (2).

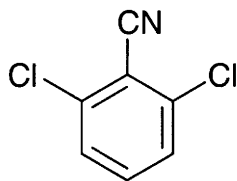
Other comments

Residues have been isolated from crops, water, soils and sediments.
In plants the degradation rate varies greatly with species. In wheat the major metabolite is 5-hydroxy-2-methoxy-3,6-dichlorobenzoic acid, whilst 3,6-dichlorosalicylic acid is also a metabolite (1).
Environmental fate reviewed (5).
Physical data, metabolism and toxicity of dicamba reviewed (24).
Metabolic pathways reviewed (25).

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D166 dichlobenil



$C_7H_3Cl_2N$

Mol. Wt. 172.01

CAS Registry No. 1194-65-6

Synonyms 2,6-dichlorobenzonitrile; 2,6-dichlorocyanobenzene; Casoron; DBN

EINECS No. 214-787-5

RTECS No. DI 3500000

Uses Systemic herbicide for selective weed control.

Physical properties

M. Pt. 145-146°C B. Pt. 270°C Partition coefficient $\log P_{ow}$ 2.70 (1) Volatility v.p. 3×10^{-6} mmHg at 20°C
Solubility Water: 25 mg l⁻¹ at 25°C. Organic solvents: acetone, dichloromethane, 1,4-dioxane, *o*-xylene

Occupational exposure

Supply classification harmful

Risk phrases Harmful in contact with skin (R21)

Safety phrases Keep out of reach of children (if sold to general public) – Wear suitable protective clothing and gloves (S2, S36/37)

Ecotoxicity

Fish toxicity

LC₅₀ (24, 48 hr) harlequin fish 7.2 ppm at 24 hr, 6.0 ppm at 48 hr (2).

LC₅₀ (48 hr) bluegill sunfish, rainbow trout 20-22 mg l⁻¹ (3).

Invertebrate toxicity

LC₅₀ (48 hr) *Daphnia magna* 10 mg l⁻¹ (4).

LC₅₀ (48 hr) *Asellus brevicaudus* 34 mg l⁻¹ (4).

LC₅₀ (96 hr) stonefly 7 mg l⁻¹ (5).

Chlorococcum sp. (10 day) 50% decrease in growth rate at 60 mg l⁻¹ (6).

Bioaccumulation

The bioaccumulative factor in algae and fish was reported to be 15-40 (7,8).

Environmental fate

Degradation studies

>99.9% dichlobenil was removed from soil at 35°C after 5 days under aerobic and anaerobic conditions (9).

Enzymic hydrolysis of dichlobenil has been demonstrated in the bacterium *Rhodococcus rhodochrous* (10).

Abiotic removal

Estimated $t_{1/2}$ for vapour phase reactions with photochemically produced hydroxyl radicals 92 days (11).

Loss from water by volatilisation >75% (12).

Adsorption and retention

Adsorption onto humic substances is reported to occur (12).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 2060-2710 mg kg⁻¹ (13,14).

LD₅₀ dermal rabbit 1350 mg kg⁻¹ (15).

LD₅₀ intraperitoneal ♀ mouse 603 mg kg⁻¹ (16).

Sub-acute and sub-chronic data

LC₅₀ (5 day) oral Japanese quail >5000 mg kg⁻¹ diet (17).

LC₅₀ (5 day) oral ring-necked pheasant 1500 mg kg⁻¹ diet (17).

Oral rat, rabbit (84 day) no adverse effect level was 50 mg kg⁻¹ diet (18).

Carcinogenicity and chronic effects

Oral rat (2 yr) no adverse effect level was 20 mg kg⁻¹ body weight⁻¹, administered via diet (16).

Subcutaneous, intraperitoneal ♂ Swiss albino mice (40 day) injected 0.5 µg injection⁻¹ (2 ppm concentration) administered every 3rd day, induced a significant increase of malignant tumours (lymphoma, mesothelioma, hepatocellular carcinoma and pulmonary alveologenic carcinoma) (19).

Metabolism and toxicokinetics

Following oral administration of ¹⁴C-labelled dichlobenil to rats and goats, radio-labelled metabolites were isolated from either urine or bile, 11 metabolites in rats, and 7 metabolites in goats. All metabolites were benzonitriles and the following ring substituents: dichlorohydroxy (3 isomers); dichlorodihydroxy; chlorodihydroxy; dichloro-S-(N-acetyl)cysteine; chloro-S-(N-acetyl)cysteine; chlorohydroxy-S-(N-acetyl) cysteine. No hydrolysis of the nitrile to an amide or an acid was detected. Urine was the major route for excretion, however enterohepatic circulation occurred. Whole body autoradiography in mice showed the presence of bound residues in the mucosa of the nasal cavity, trachea, tongue, oesophagus, kidney, liver and intestinal contents (20).

Genotoxicity

Escherichia coli PQ37 with or without metabolic activation negative (21).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (22).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No 472, 1991 (23).
WHO Class Table 5; EPA Toxicity Class III (18).

Other comments

Residues have been isolated from crops, soil and water.

In the soya-bean plant, metabolism occurred in the leaves but not in the roots (24).

The environmental fate of dichlobenil has been reviewed (25).

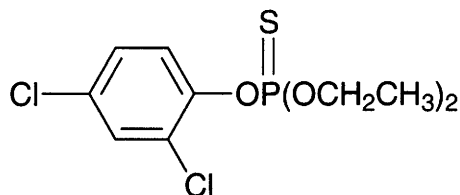
The effects of dichlobenil on the nasal passage, which includes necrosis of the olfactory mucosa, are reviewed (26).

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D167 dichlofenthion



$C_{10}H_{13}Cl_2O_3PS$

Mol. Wt. 315.16

CAS Registry No. 97-17-6

Synonyms O-(2,4-dichlorophenyl) O,O-diethyl phosphorothioate; phosphorothioic acid, O-(2,4-dichlorophenyl) O,O-diethyl ester; ECP

EINECS No. 202-564-5

RTECS No. TF 0350000

Uses Superseded insecticide and nematicide.

Physical properties

B. Pt. 166°C at 0.1 mmHg **Specific gravity** 1.3 at 20°C

Solubility Water: miscible. Organic solvents: acetone, diethyl ether, ethanol

Occupational exposure

Supply classification harmful, dangerous for the environment

Risk phrases Harmful if swallowed – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R22, R50/53)

Safety phrases Keep out of reach of children (if sold to general public) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S2, S60, S61)

Ecotoxicity

Bioaccumulation

Bioaccumulated preferentially into lipid-rich tissues of the Atlantic oyster and sheepshead minnow after exposure in water in contact with contaminated sediments (1).

Mammalian & avian toxicity

Acute data

- LD₅₀ oral quail 316 mg kg⁻¹ (2).
- LD₅₀ oral redwing blackbird 14-18 mg kg⁻¹ (3).
- LD₅₀ oral starling 80-2370 mg kg⁻¹ (3).
- LD₅₀ oral chicken 148 mg kg⁻¹ (4).
- LD₅₀ oral rat 250 mg kg⁻¹ (5).
- LD₅₀ dermal rabbit 6000 mg kg⁻¹ (6).

Other effects

Other adverse effects (human)

In 5 cases of attempted suicide by ingestion of dichlofenthion, severe cholinergic crises appeared after 40-48 hr and persisted for 5-48 days in the 3 survivors. This prolonged course was reported to be associated with persistence of residues in the blood and fat tissues (7).

Any other adverse effects

Cholinesterase inhibitor (8).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (9).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (10).

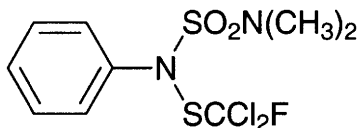
Other comments

Has been isolated from crops, soil and sediments. Detected in lanolin extracted from the wool of sheep grazed on treated pastures.

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D168 dichlofluanid



$C_9H_{11}Cl_2FN_2O_2S_2$

Mol. Wt. 333.23

CAS Registry No. 1085-98-9

Synonyms *N*-dichlorofluoromethanesulphenyl-*N,N'*-dimethyl-*N*-phenylsulfamide;
N-dichlorofluoromethylthio-*N,N'*-dimethyl-*N*-phenylsulfamide; 1,1-dichloro-*N*-[(dimethylamino)sulfonyl]-
1-fluoro-*N*-phenylmethanesulfenamide

EINECS No. 214-118-7

RTECS No. WO 6475000

Uses Algicide. Fungicide. Wood preservative.

Physical properties

M. Pt. 106°C **Partition coefficient** $\log P_{ow}$ 3.7 (1) **Volatility** v.p. 1×10^{-6} mmHg at 20°C

Solubility Water: 1.3 mg l⁻¹ at 20°C. Organic solvents: acetone, dichloromethane, *n*-hexane, isopropanol, methanol, xylene, toluene

Occupational exposure

Supply classification irritant, dangerous for the environment

Risk phrases Irritating to the eyes – May cause sensitisation by skin contact – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R36, R43, R50/53)

Safety phrases Keep out of reach of children (if sold to general public) – Do not breathe dust – Avoid contact with the skin – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S2, S22, S24, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (48 hr) carp, goldfish, Japanese ricefish 0.25-0.85 mg l⁻¹ (1).

LC₅₀ (96 hr) rainbow trout, bluegill sunfish, golden orfe 0.01, 0.03, 0.12 mg l⁻¹, respectively (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral starling 100 mg kg⁻¹ (3).

LD₅₀ oral Japanese quail, chicken >5000 mg kg⁻¹ (1,2).

LD₅₀ oral redwing blackbird >100 mg kg⁻¹ (2).

LD₅₀ oral rat, mouse 500, 1250 mg kg⁻¹, respectively (4,5).

LC₅₀ (4 hr) inhalation rat >0.3 mg l⁻¹ air (2).

LD₅₀ dermal rat >5000 mg kg⁻¹ (2).

Carcinogenicity and chronic effects

Oral rat, mouse, dog (2 yr) no adverse effect level for rats was 1500 mg kg⁻¹ diet, and for mice and dogs 1000 mg kg⁻¹ diet (1).

Metabolism and toxicokinetics

Following oral administration to rats, dichlofluanid is rapidly absorbed and excreted, mainly in the urine, with a small proportion in the faeces and via respiration. Metabolism is rapid and complete (1).

Genotoxicity

Salmonella typhimurium TA102, TA104 with and without metabolic activation negative (6).

Seven different endpoints: *Salmonella typhimurium* TA1535 *umu*-test; *in vitro* Friend's leukaemic cells; fluorescence analysis of DNA unwinding; *in vitro* human HeLa cells DNA synthesis inhibition; alkali viscosimetry; alkali filter elution; ³²P-postlabelling; and electron microscopy were used to demonstrate the DNA-altering properties of dichlofluanid. All tests were positive (7).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (8).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (9).

WHO Toxicity Class Table 5 (10).

EPA Toxicity Class III (1).

Tolerable Daily Intake (TDI) in humans 0.3 mg kg⁻¹ (1).

EEC MRL: salads, grapes, berries 10 ppm; other fruit and vegetables 5 ppm (1).

Other comments

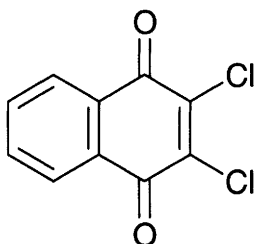
Residues have been isolated from crops and water. Air pollutant from emissions from preservative-treated wood. Experimental toxicology and human health effects reviewed (11).

In plants the dichlorofluoromethyl residue is cleared and *N,N'*-dimethyl-*N*-phenylsulfonyl diamine formed (1).

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D169 dichlone



$C_{10}H_4Cl_2O_2$

Mol. Wt. 227.05

CAS Registry No. 117-80-6

Synonyms 2,3-dichloro-1,4-naphthoquinone; 2,3-dichloro-1,4-naphthalenedione

EINECS No. 204-210-5

RTECS No. QL 7525000

Uses Superseded fungicide for agriculture and textiles; herbicide; antifouling agent.

Physical properties

M. Pt. 193°C (sublimes) **B. Pt.** 275°C at 2 mmHg **Partition coefficient** $\log P_{ow}$ 3.16 (est.) (1)

Volatility v.p. 1.1×10^{-6} mmHg at 25°C ; v.den. 7.8

Solubility Water: ~0.1 mg l⁻¹. Organic solvents: acetone, o-dichlorobenzene, 1,4-dioxane, xylene

Occupational exposure

Supply classification harmful

Risk phrases Harmful if swallowed – Irritating to eyes and skin (R22, R36/38)

Safety phrases Keep out of reach of children (if sold to general public) – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice (S2, S26)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) channel catfish 42 µg l⁻¹ (2).

LC₅₀ (48 hr) bluegill sunfish, largemouth bass 70-120 µg l⁻¹ (3,4).

Invertebrate toxicity

EC₅₀ (48 hr) *Daphnia magna* 25 µg l⁻¹ (5).

LC₅₀ (48 hr) *Gammarus fasciatus*, *Cypridopsis vidua* 100-120 µg l⁻¹ (5).

Bioaccumulation

Calculated bioconcentration factor of 2260 indicates that environmental accumulation is likely (6).

Environmental fate

Degradation studies

Dichlone was reported to be resistant to biodegradation in an inoculum derived from sewage, soil and surface water (7).

Abiotic removal

Reacts with photochemically produced hydroxyl radicals, $t_{1/2}$ ~4 days (8).

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird >316 mg kg⁻¹ (9).

LD₅₀ oral rat 160 mg kg⁻¹ (10).
LD₅₀ dermal rabbit 5000 mg kg⁻¹ (11).
LD₅₀ intraperitoneal mouse 30 mg kg⁻¹ (12).

Sub-acute and sub-chronic data

LD₅₀ (5 day) oral bobwhite quail, Japanese quail, mallard duck >5000 mg kg⁻¹ (13).

Carcinogenicity and chronic effects

Oral rat (2 yr) 1500 mg kg⁻¹ via diet. No adverse effects reported (14).

Legislation

Maximum permissible concentration in domestic water in former USSR 0.25 mg l⁻¹ (15).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (16).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No 472, 1991 (17).

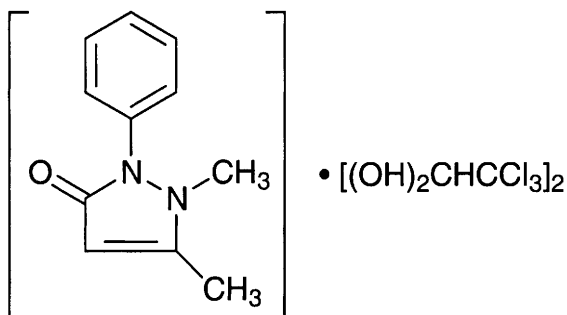
Other comments

The environmental fate of dichlone has been reviewed (8).

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D170 dichloralphenazone



$\text{C}_{15}\text{H}_{18}\text{Cl}_6\text{N}_2\text{O}_5$

Mol. Wt. 519.03

CAS Registry No. 480-30-8

Synonyms 1,2-dihydro-1,5-dimethyl-2-phenyl-3H-pyrazol-3-one, compound with 2,2,2-trichloro-1,1-ethanediol(1:2); dichloralantipyrine; Sominat

EINECS No. 207-546-0

RTECS No. CD 2600000

Uses Sedative. Hypnotic.

Physical properties

M. Pt. 68°C

Solubility Water: 10%. Organic solvents: chloroform, ethanol

Environmental fate

Abiotic removal

In aqueous solution hydrolyses to chloral hydrate and phenazone (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 1338, 1437 mg kg⁻¹, respectively (2).

LD₅₀ intraperitoneal mouse 980 mg kg⁻¹ (2).

Metabolism and toxicokinetics

Phase I metabolism via hydroxylation and *N*-demethylation; Phase II metabolism conjugation to form glucuronide; plasma $t_{1/2}$ ~5 hr as trichloroethanol (species unspecified) (3).

The concentration of the active metabolite, trichloroethanol, in the milk of a lactating mother taking 1.3 g dichloralphenazone orally at night was 60-80% of that in the plasma (4).

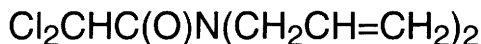
Sensitisation

Allergic responses in humans included severe bronchospasm, rash, pruritis and atrial fibrillation (1).

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D171 dichlormid



$\text{C}_8\text{H}_{11}\text{Cl}_2\text{NO}$

Mol. Wt. 208.09

CAS Registry No. 37764-25-3

Synonyms 2,2-dichloro-*N,N*-diallylacetamide; *N,N*-diallyl-2,2-dichloroacetamide; *N,N*-diallyldichloroacetamide; R 25788; 2,2-dichloro-*N,N*-di-2-propenylacetamide

EINECS No. 253-658-8

RTECS No. AB 6080000

Uses Safener used to increase the tolerance of maize to thiocarbamate herbicides.

Physical properties

M. Pt. 5.0-6.5°C (tech.) **B. Pt.** 130°C at 10 mmHg **Specific gravity** 1.202 at 20°C

Partition coefficient $\log P_{\text{ow}}$ 1.85 at 25°C (1) **Volatility** v.p. 6×10^{-3} mmHg at 25°C

Solubility Water: ~5 g l⁻¹. Organic solvents: kerosene; miscible with acetone, ethanol and xylene

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout 141 mg l⁻¹ (2).

Invertebrate toxicity

LC₅₀ (48 hr) *Daphnia* 161 mg l⁻¹ (2).

Environmental fate

Degradation studies

Persistence t_{1/2} in soil ~8 days at 27-29°C (2).

Mammalian & avian toxicity

Acute data

LC₅₀ (5 day) mallard duck, bobwhite quail 14,500, >10,000 mg kg⁻¹ in diet, respectively (2).

LD₅₀ oral rat ♂ 2816, ♀ 2146 mg kg⁻¹ (2).

LC₅₀ (1 hr) rat 5.5 mg l⁻¹ in air (1).

LD₅₀ dermal rabbit >5000 mg kg⁻¹ (1).

Sub-acute and sub-chronic data

LC₅₀ (5 day) oral bobwhite quail, mallard duck >10-14.5 g kg⁻¹ via diet (1).

Oral rat (90 day) no adverse effect level 20 mg kg⁻¹ administered via diet (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides. Maximum admissible concentration 0.1 µg l⁻¹ (3).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

WHO Toxicity Class III (5).

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D172 dichloroacetic acid



$\text{C}_2\text{H}_2\text{Cl}_2\text{O}_2$

Mol. Wt. 128.94

CAS Registry No. 79-43-6

Synonyms acetic acid, dichloro-; DCA; dichloroethanoic acid

EINECS No. 201-207-0

RTECS No. AG 6125000

Uses Topical astringent and keratolytic agent.

Physical properties

M. Pt. 9-11°C (purity 99+%) B. Pt. 193-194°C Specific gravity 1.563 at 20°C with respect to water at 4°C

Solubility Water: miscible. Organic solvents: miscible in diethyl ether, ethanol

Occupational exposure

UN No. 1764 HAZCHEM Code 2X Conveyance classification corrosive substance

Supply classification corrosive

Risk phrases Causes severe burns (R35)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S26, S45)

Ecotoxicity

Fish toxicity

Medaka exposed to 0.5 or 2.0 g l⁻¹ in ambient water for 4 weeks showed hepatocellular cytoplasmic vacuolation, cytomegaly, karyomegaly, nuclear atypia and hepatocellular necrosis (1).

Environmental fate

Nitrification inhibition

Does not inhibit nitrifying bacteria at 100 mg l⁻¹ (threshold concentration) (2).

Degradation studies

Degraded by treatment in oxygenated activated sludge (3).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat ≥5000 mg kg⁻¹ (4).

LD₅₀ intravenous dog 3500-5000 mg kg⁻¹ (4).

Carcinogenicity and chronic effects

Oral ♂ mouse (61 wk) 2 and 5 g l⁻¹ in drinking water induced hepatocellular carcinomas in 81% of animals.

Increased incidence of adenomas with and without initiation by ethyl nitrosourea (5).

Oral ♂ mouse (60-75 wk) 0.05-5 g l⁻¹ in drinking water; or 60 wk at concentration 3.5 g l⁻¹. Threshold for liver tumours 0.5 g l⁻¹ with a steep rise in incidence at 2 g l⁻¹ (6).

Oral mice 2 and 5 g l⁻¹ in drinking water, after initiation with ethyl nitrosourea, high incidence of liver tumours (7).

Oral ♂, ♀ mice 1 and 2 g l⁻¹ in drinking water induced hepatoproliferative lesions, nodules, adenomas, hepatocellular carcinomas in a dose-related manner over 12 months in ♂ mice. Considerable liver enlargement was seen and the significance of the enlargement has been assessed (8).

Teratogenicity and reproductive effects

Adult ♂ rats were administered single and multiple (up to 14 days) doses of dichloroacetic acid (54-3000 mg kg⁻¹). Single doses of 1500 and 3000 mg kg⁻¹ caused delayed spermiation and altered resorption of residual bodies. Testicular lesions occurred with greater potency as the duration of dosing increased (9).

Metabolism and toxicokinetics

Metabolised in humans to glyoxylic acid by ζ-glutathione transferase (10).

Genotoxicity

Escherichia coli PQ 37 SOS chromotest positive (11).

Salmonella typhimurium TA100 Ames fluctuation test positive (11).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level 1 µg l⁻¹ (12).

Other comments

Formed during water disinfection by chlorination.

The compound can lower lactic acid levels in several conditions including chronic sepsis (13) and cerebral ischaemia (14).

Liver and muscle pyruvate dehydrogenase activity are increased (13).

The pharmacokinetics of the sodium salt have been reviewed (15).

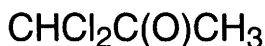
Miticidal activity has been reported (16).

The relative value of ozonation and membrane separation have been assessed in relation to groundwater (17).

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D173 1,1-dichloroacetone



$\text{C}_3\text{H}_4\text{Cl}_2\text{O}$

Mol. Wt. 126.97

CAS Registry No. 513-88-2

Synonyms 1,1-dichloro-2-propanone; dichloromethyl methyl ketone; α,α -dichloroacetone; 1,1-dichloropropan-2-one

EINECS No. 208-175-7

RTECS No. UC 1428000

Uses Used to cyclise heterocyclic thiocarboxamide derivatives in the preparation of antiprotozoal thiazoles.

Physical properties

B. Pt. 120°C **Flash point** 46°C (closed cup) **Specific gravity** 1.305 at 18°C with respect to water at 15°C

Solubility Water: miscible. Organic solvents: diethyl ether, ethanol

Environmental fate

Abiotic removal

Undergoes reduction (loss of halogen) in water treated with sodium sulfite by first order reaction kinetics (1). Removal from water reported to be effected by treatment with ozone. Membrane treatment was reported to be effective (2).

Mammalian & avian toxicity

Carcinogenicity and chronic effects

Dermal mouse (24 wk) 400, 600 or 800 mg kg⁻¹ applied 6 × over 2 wk. Two wk after the final dose, 1 µg 12-O-tetra-decanoylphorbol 13-acetate was applied 3 × wk⁻¹ for 20 wk. Did not initiate tumours when applied topically (3).

Genotoxicity

Salmonella typhimurium TA100, TA1535 with metabolic activation positive (4).

Other effects

Any other adverse effects

In vitro ♂ rat hepatocytes, cytotoxic in the range 60-1200 mg l⁻¹. Cytotoxicity was preceded by a rapid decline in cellular GSH levels (4).

Other comments

Residues have been detected in tap water, river water, coffee wastewaters. By-product of the chlorination of kraft pulp liquor (5-8).

Disinfectant by-product in chlorinated water supplies (9).

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D174 1,3-dichloroacetone



$\text{C}_3\text{H}_4\text{Cl}_2\text{O}$

Mol. Wt. 126.97

CAS Registry No. 534-07-6

Synonyms 1,3-dichloro-2-propanone; α,γ -dichloroacetone; *sym*-dichloroacetone; bis(chloromethyl)ketone; α,α' -dichloroacetone

EINECS No. 208-585-6

RTECS No. UC 1430000

Uses Intermediate in synthesis of drugs and agrochemicals.

Physical properties

M. Pt. 45°C B. Pt. 173°C Specific gravity 1.3826 at 46°C with respect to water at 4°C

Solubility Organic solvents: diethyl ether, ethanol

Occupational exposure

UN No. 2649 HAZCHEM Code 2WE Conveyance classification toxic substance

Ecotoxicity

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 0.197 ppm Microtox test (1).

Environmental fate

Degradation studies

Compound is dehalogenated by Gram-positive and Gram-negative cultures from freshwater sediment (2).

Mammalian & avian toxicity

Acute data

LC₅₀ (2 hr) inhalation rat, mouse 27-29 mg m⁻³ (3).

Carcinogenicity and chronic effects

Dermal mouse 400, 600 and 800 mg kg⁻¹ 6 applications over 2 wk period followed by 1 µg 12-O-tetradecanoylphorbol-13-acetate initiated skin tumours (4).

Single applications of 37.5 to 330 mg kg⁻¹ also initiated skin tumours, but oral dosing did not (4).

Metabolism and toxicokinetics

Reacts with hepatic cytosolic GSH to produce cytotoxic conjugates (5).

Cytotoxicity is preceded by a rapid decline in GSH (6).

Genotoxicity

Salmonella typhimurium without metabolic activation positive (7).

In vitro V79 cells with and without metabolic activation induced sister chromatid exchanges (8).

Drosophila melanogaster inhalation 100% v/v for 8 min caused sex chromosome loss and nondisjunction (9).

Saccharomyces cerevisiae microsomal mutagenicity assay positive and gene conversion positive (10).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level 1 µg l⁻¹ (11).

Other comments

Higher than average incidence of skin neoplasms in sea catfish and croaker in Pacific coastal waters receiving kraft pulpmill effluent (12).

Environmental pollutant. Residues have been detected in water samples.

Effects of pH, temperature and light on the degradation of 1,3-dichlororacetone discussed (13).

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D175 dichloroacetonitrile



$\text{C}_2\text{HCl}_2\text{N}$

Mol. Wt. 109.94

CAS Registry No. 3018-12-0

Synonyms acetonitrile, dichloro-; dichloromethyl cyanide

EINECS No. 221-159-4

RTECS No. AL 8465000

Uses Chemical intermediate.

Physical properties

B. Pt. 110-112°C

Environmental fate

Abiotic removal

Can be degraded by ozone treatment (1) and by Na_2SO_3 treatment (2).

Mammalian & avian toxicity

Carcinogenicity and chronic effects

Oral B6C3F1 mice 2 and 5 g kg^{-1} in drinking water after initiation with ethyl nitrosourea, shown to be a strong liver carcinogen (3).

Did not induce γ -glutamyltranspeptidase-positive foci in a rat liver foci bioassay (4).

Teratogenicity and reproductive effects

In vivo teratology screening program in rats from pre-conception to day 41 post-birth. Treatment caused reduced fertility, increased early implantation failure, reduced pup birth weight and decreased perinatal survival (dose and duration unspecified) (5).

Pregnant rats given 5-45 mg kg⁻¹ orally every day from day 6 to day 18 of pregnancy showed dose-related embryo toxicity to soft and skeletal tissue. The no-observed-adverse-effect level was 15 mg kg⁻¹. At higher doses there was a high level of resorption and the 45 mg kg⁻¹ dose was lethal in 9% of mothers (6).

Metabolism and toxicokinetics

Oral rat (3 doses) 0.2, 2 or 15 mg kg⁻¹ and oral mouse (2 doses) 2 or 15 mg kg⁻¹ [2-¹⁴C]-radiolabel in drinking water. Rats excreted 82-86% of the total radiolabel absorbed within 48 hr, 35-40% in urine, 10-13% in faeces and 33-34% as exhaled CO₂. Similar uptake, distribution and excretion was observed in mice. Rodents administered [1-¹⁴C]-radiolabel excreted only 62-73% within 6 days via urine, faeces and exhaled air (7).

Genotoxicity

Salmonella typhimurium TA100 with and without metabolic activation positive (8,9).

Fluctuation test, growth of *Klebsiella pneumoniae* decreased (9).

♀ *Drosophila melanogaster* inhalation exposure 8.6 ppm caused positive germline aneuploidy. Possible involvement of CN- metabolite (10).

Drosophila melanogaster sex-linked recessive lethal test positive (11).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level 1 µg l⁻¹ (12).

Other comments

Formed during chlorination of drinking water and fruit juices; and during bleaching of wood pulp (13).

Included in a computer-based assessment of risks in drinking water (14).

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D176 dichloroacetyl chloride



$\text{C}_2\text{HCl}_3\text{O}$

Mol. Wt. 147.39

CAS Registry No. 79-36-7

Synonyms acetyl chloride, dichloro-; 2,2-dichloroacetyl chloride; α,α -dichloroacetyl chloride; dichloroethanoyl chloride

EINECS No. 201-199-9

RTECS No. AO 6650000

Uses Intermediate in the synthesis of herbicides, amoebicides and other therapeutic products.

Physical properties

B. Pt. 107-108°C **Specific gravity** 1.5315 at 14°C with respect to water at 4°C **Volatility** v.den. 5.8

Solubility Organic solvents: miscible with diethyl ether

Occupational exposure

UN No. 1765 **HAZCHEM Code** 4WE **Conveyance classification** corrosive substance

Supply classification corrosive

Risk phrases Causes severe burns (R35)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Keep container in a well ventilated place – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S9, S26, S45)

Environmental fate

Abiotic removal

Decays on contact with water, $t_{1/2}$ 0.07 min (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 2.46 g kg⁻¹ (2).

Carcinogenicity and chronic effects

Inhalation ♂ rat (30 day) 6 hr day⁻¹, 5 day wk⁻¹ exposure concentration inversely proportional to hydrolysis rate caused less nasal cancer than expected. Dichloroacetyl chloride hydrolyses rapidly at *in vivo* temperatures ($t_{1/2} \leq 0.01$ min); therefore it may not reach target in DNA reactive form (1).

Dermal mouse repeated skin application (concentration unspecified) no skin tumours observed. Subcutaneous mouse 2-stage carcinogenesis study with PMA as promoter, marginally significant incidences of papillomas and carcinomas when tested as initiator (3).

Dermal ♀ mouse, painted with 250 µg 3 × wk⁻¹ for 576 days developed no papillomas, carcinomas or other tumours (4).

Subcutaneous ♀ mouse 50 µg 1 × wk⁻¹ for 560 days caused no significant incidence of tumours (4).

Teratogenicity and reproductive effects

In vivo teratology screen test using Long-Evans rats, evaluation to postnatal days 41-42. Intubation rats (days 7-21 of gestation) 0.1 ml 100 g⁻¹ body weight (solvent tricaprilyn oil) resulted in reduced fertility and increased early implantation failure. No effect on litter size in ♀ bearing live litters, but pup birth weight was reduced in all litters. Perinatal survival was adversely affected and postnatal growth to day 4 was reduced (5).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level 1 µg l⁻¹ (6).

Other comments

Contaminant in combustion gases and effluent from trichloroethylene production (7).

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D177 dichloroacetylene



C₂Cl₂

Mol. Wt. 94.93

CAS Registry No. 7572-29-4

Synonyms ethyne, dichloro-; acetylene, dichloro-; dichloroethyne

RTECS No. AP 1080000

Occurrence Occurs in volcanic gases.

Physical properties

M. Pt. -66°C **B. Pt.** 33°C

Solubility Organic solvents: acetone, diethyl ether, ethanol

Occupational exposure

UK-STEL 0.1 ppm (0.39 mg m⁻³)

US-STEL ceiling limit 0.1 ppm (0.39 mg m⁻³)

Supply classification explosive, harmful

Risk phrases Risk of explosion by shock, friction, fire or other sources of ignition – Possible risk of irreversible effects – Harmful: danger of serious damage to health by prolonged exposure through inhalation (R2, R40, R48/20)

Safety phrases Keep out of reach of children (if sold to general public) – Wear suitable protective clothing and gloves (S2, S36/37)

Mammalian & avian toxicity

Acute data

LC₅₀ (4 hr) inhalation rat 55 ppm (with trichloroethene stabiliser) (1).

LC₅₀ (4 hr) inhalation rat 219 ppm (with diethyl ether stabiliser) (1).

LC₅₀ (1 hr) inhalation mouse 124 ppm (with trichloroethene stabiliser) (2).

LC₅₀ (6 hr) inhalation mouse 19 ppm (with trichloroethene stabiliser) (2).

LC₅₀ (4 hr) inhalation guinea pig 15 ppm (with trichloroethene stabiliser) (1).

Death is associated with acute renal failure due to necrosis of kidney tubules (3).

Inhalation rabbit ≥ 126 ppm for 1 hr or 17 ppm for 6 hr caused neurotoxicity, nephrotoxicity and hepatotoxicity.

Sensory trigeminal nucleus severely affected and chromatolysis, cell shrinkage and Nissel body disintegration were detected (4).

Sub-acute and sub-chronic data

Inhalation rat ≥ 4.8 ppm 28 days continuous; or 15.5 ppm 6 wk, 6 hr day⁻¹, 5 day wk⁻¹, caused necrosis of kidney tubules in corticomedullary area (1,5).

Carcinogenicity and chronic effects

No adequate evidence for carcinogenicity to humans, limited evidence for carcinogenicity to animals, IARC classification group 3 (6).

Metabolism and toxicokinetics

When ¹⁴C-labelled dichloroacetylene was inhaled by rats, $\geq 60\%$ of radioactivity was collected in urine, 27% from faeces and 3% was retained in the carcass, major route of metabolism was biosynthesis of toxic GSH conjugates.

Cytochrome P₄₅₀-dependent pathways represent a minor route (7).

Genotoxicity

Salmonella typhimurium TA100, TA98 (in the presence of acetylene as stabiliser) 5000 ppm ≤ 9 hr with and without metabolic activation negative. In the absence of acetylene, TA100 positive (8).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level 1 $\mu\text{g l}^{-1}$ (9).

Other comments

An impurity and by-product. Degradation product of trichloroethylene.

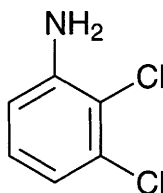
When unstabilised dichloroacetylene is in contact with air, reactive and toxic products are formed (10).

Metabolism reviewed (7).

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D178 2,3-dichloroaniline



$C_6H_5Cl_2N$

Mol. Wt. 162.02

CAS Registry No. 608-27-5

Synonyms benzenamine, 2,3-dichloro-; aniline, 2,3-dichloro-

EINECS No. 210-157-9

Uses Chemical intermediate used in the manufacture of pesticides and pharmaceuticals.

Physical properties

M. Pt. 23-24°C B. Pt. 252°C

Occupational exposure

UN No. 1590 HAZCHEM Code 2X Conveyance classification toxic substance

Ecotoxicity

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 2.75 ppm Microtox test (1).

Environmental fate

Abiotic removal

Removed from pharmaceutical wastes by adsorption onto polymeric adsorbents such as Wofatil EP61 and FP14 (2).

Mammalian & avian toxicity

Acute data

Intraperitoneal Fischer 344 rats 65-162 mg kg⁻¹ (as HCl) decreased urine volume, and caused proteinuria and haematuria (3).

Other effects

Any other adverse effects

Renal cortex slices exposed to ≤1 g l⁻¹ solutions accumulated *p*-aminohippurate and tetraethyl ammonium (3).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level 1 µg l⁻¹ (4).

Other comments

Environmental pollutant, particularly in seawater and wastewater.

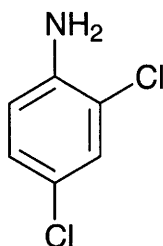
The relation of structure to toxicity in a variety of microorganisms, plants, protoplasts and *Daphnia* reviewed (5).

Toxicity to *Tetrahymena pyriformis* over 48 hr in static environment has been assessed (6).

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1. Kaiser, K. L. E. et al *Water Pollut. Res. J. Can.* 1991, **26**(3), 361-431.
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6. Arnold, J. M. *Chemosphere* 1990, **21**(1-2), 183-191

D179 2,4-dichloroaniline



$C_6H_5Cl_2N$

Mol. Wt. 162.02

CAS Registry No. 554-00-7

Synonyms benzenamine, 2,4-dichloro-; aniline, 2,4-dichloro-; *o,p*-dichloroaniline; 2,4-dichlorobenzenamine

EINECS No. 209-057-8

RTECS No. BX 2600000

Uses Chemical intermediate in synthesis of compounds including pharmaceuticals.

Physical properties

M. Pt. 59-62°C B. Pt. 245°C

Occupational exposure

UN No. 1590 HAZCHEM Code 2X Conveyance classification toxic substance

Ecotoxicity

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 4.67 ppm Microtox test (1).

Bioaccumulation

Bioaccumulation, uptake and elimination in zebrafish in a static environment fits a two-compartment model (2).

Environmental fate

Abiotic removal

Photolysis is judged to be an important degradation process for chloroanilines in estuarine water. Microbial rates are slower (3).

Mammalian & avian toxicity

Acute data

Intraperitoneal Fischer 344 rats 65-162 mg kg⁻¹ (as HCl) decreased urine volume and caused proteinuria and haematuria (4).

Metabolism and toxicokinetics

Renal cortex slices incubated in $\leq 1 \text{ g l}^{-1}$ solution accumulated *p*-aminohippurate and tetraethyl ammonium (4).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level $1 \mu\text{g l}^{-1}$ (5).

Other comments

Environmental pollutant, particularly in wastewater.

The relation of structure to toxicity in a variety of microorganisms, plants, protoplasts and *Daphnia* reviewed (6).

Effect on membrane proteins of yeast plasma membrane and Chinese hamster ovary cells, correlates with octanol/water partition coefficient (7).

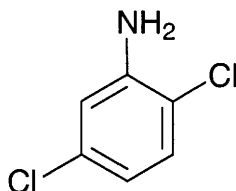
Four tropical species *Brachydanio*, *Jordanella floridae*, *Oryzias latipes* and *Poecilia reticulata* were studied in short- and long-term toxicity tests. Results reported (8).

Toxicity to crustaceans was investigated at different salinities. Toxicity decreased with time and increased with decreasing salinity (9).

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2. Kalsch, W. *Chemosphere* 1991, **22**(3-4), 351-363.
3. Hwang, H. M. et al *Water Res.* 1987, **21**(3), 309-316.
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D180 2,5-dichloroaniline



$\text{C}_6\text{H}_5\text{Cl}_2\text{N}$

Mol. Wt. 162.02

CAS Registry No. 95-82-9

Synonyms benzenamine, 2,5-dichloro-; aniline, 2,5-dichloro-; Amarthol Fast Scarlet GG Base; Azobase DCA; Hiltonil Fast Scarlet 2G Base; C.I. 37010

EINECS No. 202-455-2

RTECS No. BX 2610000

Uses Chemical intermediate.

Physical properties

M. Pt. $49\text{--}51^\circ\text{C}$ B. Pt. 251°C

Occupational exposure

UN No. 1590 HAZCHEM Code 2X Conveyance classification toxic substance

Ecotoxicity

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 3.80 ppm Microtox test (1).

Bioaccumulation

No or low bioaccumulation (2).

Mammalian & avian toxicity

Acute data

Intraperitoneal Fischer 344 rats 65-162 mg kg⁻¹ (as HCl) decreased urine volume, and caused proteinuria and haematuria (3).

Genotoxicity

In vitro rat liver hepatocytes DNA repair test negative (4).

Other effects

Any other adverse effects

Renal cortex slices exposed to ≤1 g l⁻¹ solutions accumulated *p*-aminohippurate and tetraethyl ammonium (3).

Legislation

Maximum permissible concentration in domestic water in Russia 0.05 mg l⁻¹ (5).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level 1 µg l⁻¹ (6).

Other comments

Environmental pollutant particularly in sea, river and groundwater.

The compound is a breakdown product of pentachloronitrobenzene (PCNB) in acclimated soil (7).

Effects of anilines on *Saccharomyces cerevisiae* growth, structural parameters are reported (8).

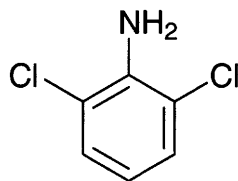
The relation of structure to toxicity in a variety of microorganisms, plants, protoplasts and *Daphnia* reviewed (9).

Anaerobic and aerobic degradation of azo dyestuffs reported (10).

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D181 2,6-dichloroaniline



$C_6H_5Cl_2N$

Mol. Wt. 162.02

CAS Registry No. 608-31-1

Synonyms benzenamine, 2,6-dichloro-; aniline, 2,6-dichloro-; 2,6-dichlorobenzenamine

EINECS No. 210-160-5

Uses Chemical intermediate in the manufacture of compounds, herbicides and pharmaceuticals.

Physical properties

M. Pt. 38-41°C

Occupational exposure

UN No. 1590 HAZCHEM Code 2X Conveyance classification toxic substance

Ecotoxicity

Fish toxicity

LC₀ (duration unspecified) *Leuciscus idus* 0.8 mg l⁻¹; LC₅₀ (duration unspecified) *Leuciscus idus* 1 mg l⁻¹;

LC₁₀₀ (duration unspecified) *Leuciscus idus* 113 mg l⁻¹ (1).

Invertebrate toxicity

EC₅₀ (48 hr) *Daphnia magna* 6 mg l⁻¹ (1).

EC₁₀ (duration unspecified) *Haematococcus pluvialis* 65 mg l⁻¹ (1).

EC₅₀ (30 min) *Photobacterium phosphoreum* 4 ppm Microtox test (2).

Environmental fate

Degradation studies

Decomposition can be effected by *Rhodococcus rhodochrous* (3).

Abiotic removal

Can be adsorbed onto polymeric adsorbents, e.g. Wofatil EP61 and FP14, for removal from pharmaceutical wastes (4).

Mammalian & avian toxicity

Acute data

Intraperitoneal Fischer 344 rats 65-162 mg kg⁻¹ (as HCl) decreased urine volume and caused proteinuria and haematuria (5).

Other effects

Any other adverse effects

Renal cortex slices exposed to ≤1 g l⁻¹ solutions accumulated *p*-aminohippurate and tetraethyl ammonium (5).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level 1 µg l⁻¹ (6).

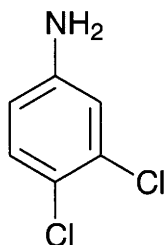
Other comments

Environmental pollutant, particularly in sea, river and groundwater.

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D182 3,4-dichloroaniline



$C_6H_5Cl_2N$

Mol. Wt. 162.02

CAS Registry No. 95-76-1

Synonyms benzenamine, 3,4-dichloro-; aniline, 3,4-dichloro-; DCA; 4,5-dichloroaniline; 3,4-dichlorobenzenamine; *m,p*-dichloroaniline

EINECS No. 202-448-4

RTECS No. BX 2625000

Uses Intermediate in synthesis of dyestuffs.

Physical properties

M. Pt. 71-72°C **B. Pt.** 272°C **Flash point** 166°C **Volatility** v.p. 1.0 mmHg at 80.5°C ; v.den. 5.59

Solubility Organic solvents: benzene, diethyl ether

Occupational exposure

UN No. 1590 **HAZCHEM Code** 2X **Conveyance classification** toxic substance

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects (R23/24/25, R33)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S36/37, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 7-10 mg l⁻¹ (1).

Zebra fish were exposed to 0.002, 0.02 and 0.2 mg l⁻¹, development after hatching was abnormal and death rate was high (2).

Juvenile rainbow trout were exposed to 0, 19, 39, 71, 120, 210 µg l⁻¹ for 20 days. Effects on length, weight and growth rates were detected after 14 and 28 days. After 14 days there were no significant effects on length or weight, but there was a highly significant depression of growth rate among fish exposed to the highest concentrations. At 28 days both length and growth rate were affected (3).

Invertebrate toxicity

EC₅₀ (48 hr) *Daphnia magna* 3 mg l⁻¹ (4).

EC₅₀ (30 min) *Photobacterium phosphoreum* 0.645 ppm Microtox test (5).

Environmental fate

Nitrification inhibition

Toxicity to *Nitrosomonas* sp. in soil, inhibitory at concentrations of 2.5 ppm and 150 ppm; toxicity to *Nitrobacter* in soil, not inhibitory at concentrations of 2.5 ppm (6).

Degradation studies

Effectively decomposed in soils containing adapted strains of *Pseudomonas diminuta* st INM1 KC-7 (7).

Dehalogenation of the compound can be effected by aerobic sediments to produce 3-chloroaniline (8).

Within 4 yr the capacity of grey forest soil for self purification decreased 1.7-fold; t_{1/2} 50 ng kg⁻¹ increased 4.2 to 7.3 days (9).

Mammalian & avian toxicity

Acute data

LC₅₀ oral redwing blackbird, starling 237, 562 mg l⁻¹ in diet, respectively (10).

LD₅₀ oral rat, mouse 648, 740 mg kg⁻¹, respectively (11,12).

LD₅₀ intraperitoneal rat 280 mg kg⁻¹ (13).

Intraperitoneal ♂ Fischer 344 rats 0.4, 0.8, or 1.0 mmol kg⁻¹ 3,4-dichloroaniline hydrochloride. Nephrotoxicity and cellular changes indicating damage to the liver and bladder apparent within 24 hr in rats receiving the two highest doses. The chemical form of the compound, free base or hydrochloride, did not modify *in vitro* renal cortical slice toxicity (14).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA104 with and without metabolic activation negative (15).

Chinese hamster ovary HGPRT assay with and without activation negative (16).

Clastogenicity, *in vitro* human lymphoma cells chromosomal aberrations negative; Chinese hamster V79 cells sister chromatid exchanges with metabolic activation positive (17).

In vitro rat liver DNA repair negative (18).

Other effects

Any other adverse effects

Weak inducer of cytochrome P₄₅₀ enzymes (19).

Legislation

Maximum permissible concentration in domestic water in Russia 0.05 mg l⁻¹ (20).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level 1 µg l⁻¹ (21).

Other comments

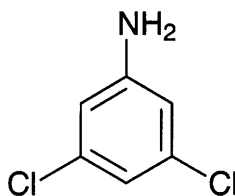
Pollutant in ground, river and seawater, in soil and in some root and other crops. Metabolite of *N*-(3,4-dichlorophenyl)propanamide in mammals and bacteria.

Thought to be a metabolite of *N*-(3,4-dichlorophenyl) propanamide formed as a result of hepatic microsomal activity, and may contribute to the methaemoglobinaemia produced by that compound (22,23).
The physico-chemical properties, fate and toxicity of 3,4-dichloroaniline in aquatic environments reviewed (24).

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D183 3,5-dichloroaniline



$C_6H_5Cl_2N$

Mol. Wt. 162.02

CAS Registry No. 626-43-7

Synonyms 3,5-dichlorobenzenamine

EINECS No. 210-948-9

RTECS No. XU 5111000

Physical properties

M. Pt. 51-53°C B. Pt. 259-260°C at 741 mmHg Flash point >110°C

Occupational exposure

UN No. 1590 HAZCHEM Code 2X Conveyance classification toxic substance

Ecotoxicity

Fish toxicity

LC₅₀ (14 day) guppy 3.9 mg l⁻¹ (1).

Invertebrate toxicity

EC₅₀ (5, 15, 30 min) *Photobacterium phosphoreum* 10.5 mg l⁻¹ Microtox test (2).

Bioaccumulation

Calculated bioconcentration factor 7 (3).

Environmental fate

Degradation studies

BOD₁₀ 3,5-dichloroaniline was highly resistant to biodegradation. In simulated activated-sludge process, ~97% is bioeliminated after 10-16 days adaptation time; approximately 15-20% dichloroaniline is removed by vaporisation, bioelimination and sorption by apparatus (4).

The effects on guelph loam were studied. 3,5-Dichloroaniline at concentrations of 5-100 µg g⁻¹ soil was inhibitory against the oxidation of ammonia to nitrite but not of nitrite to nitrate. Dichloroanilines were more persistent than aniline or the monochloroanilines (5).

No degradation was observed in an anaerobic-water screening test over a 28-day incubation period using digester sludge inocula (6).

Abiotic removal

Photochemical reaction with atmospheric hydroxyl radicals has been estimated to be 77.17×10^{-12} cm³ mol⁻¹ sec⁻¹ at 25°C, which corresponds to an atmospheric t_{1/2} of ~5 hr at an atmospheric concentration of 5×10^5 hydroxyl radicals per cm³ (7).

Adsorption and retention

Aromatic amines have been observed to undergo rapid and reversible covalent binding with humic materials in aqueous solution; the initial binding reaction is followed by a slower and much less reversible reaction believed to represent the addition of the amine to quinoidal structures, followed by oxidation of the product to give an amino-substituted quinone. These processes represent pathways by which aromatic amines may be converted into nascent forms in the biosphere (8).

Genotoxicity

Salmonella typhimurium TA100, TA98 with and without metabolic activation negative (9).

Salmonella typhimurium TA1535/pSK 1002 with and without metabolic activation negative in the *umu*-test (10).

Other effects

Any other adverse effects

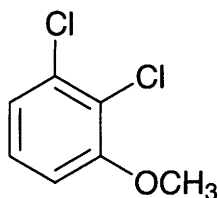
In vivo (48 hr) ♂ Fischer rat 65-160 mg kg⁻¹. Renal effects induced include decreased urine volume, increased proteinuria, haematuria, modest elevations in blood urea nitrogen concentrations, decreased accumulation of *p*-aminohippurate by renal cortical slices and no change or slight decrease in kidney weight (11).

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D184 2,3-dichloroanisole



$C_7H_6Cl_2O$

Mol. Wt. 177.03

CAS Registry No. 1984-59-4

Synonyms 1,2-dichloro-3-methoxybenzene

EINECS No. 217-853-1

Uses Bactericide.

Physical properties

M. Pt. 31-33°C Flash point >110°C

Ecotoxicity

Invertebrate toxicity

EC₅₀ (growth inhibition) (48 hr) *Minutocellus polymorphus* 0.57 mg l⁻¹. EC₅₀ (growth inhibition) (72 hr) *Skeletonema costatum* 3.7 mg l⁻¹ (1).

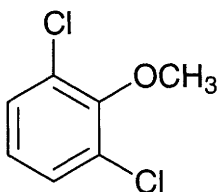
Other comments

Residues have been isolated from fish, waters and sediments.

References

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D185 2,6-dichloroanisole



$C_7H_6Cl_2O$

Mol. Wt. 177.03

CAS Registry No. 1984-65-2

Synonyms 1,3-dichloro-2-methoxybenzene

EINECS No. 217-855-2

Uses Bactericide.

Physical properties

M. Pt. 10.1°C Flash point 91°C Specific gravity 1.291 at 20°C

Ecotoxicity

Invertebrate toxicity

EC₅₀ (48 hr) *Minutocellus polymorphus* 1.4 mg l⁻¹ growth inhibition (1).

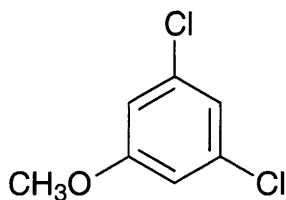
Other comments

Residues have been isolated from water and sediments.

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D186 3,5-dichloroanisole



$C_7H_6Cl_2O$

Mol. Wt. 177.03

CAS Registry No. 33719-74-3

Synonyms 1,3-dichloro-5-methoxybenzene; benzene, 1,3-dichloro-5-methoxy-; anisole, 3,5-dichloro-

EINECS No. 251-655-6

Environmental fate

Degradation studies

Biodegradation can be effected by bacterial cultures adapted to dechlorinate in freshwater (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level $1\text{ }\mu\text{g l}^{-1}$ (2).

Other comments

Environmental pollutant. Breakdown product of tetrachloroanisoles by anaerobic biodegradation.

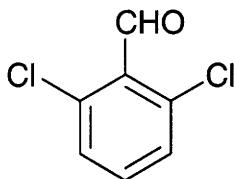
Compound has been detected in fish exposed to chlorinated water (3).

Compound has some antibacterial activity and has been assessed against 30 species (4).

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D187 2,6-dichlorobenzaldehyde



$\text{C}_7\text{H}_4\text{Cl}_2\text{O}$

Mol. Wt. 175.01

CAS Registry No. 83-38-5

Synonyms

EINECS No. 201-472-2

Uses Intermediate in organic synthesis.

Physical properties

M. Pt. $70\text{--}71^\circ\text{C}$

Solubility Organic solvents: diethyl ether, ethanol

Ecotoxicity

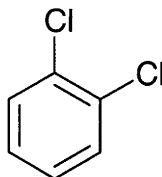
Bioaccumulation

No or low bioaccumulation (1).

References

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D188 1,2-dichlorobenzene



$C_6H_4Cl_2$

Mol. Wt. 147.00

CAS Registry No. 95-50-1

Synonyms *o*-dichlorobenzene; *o*-phenylene dichloride; DCB; Chloroben

EINECS No. 202-425-9

RTECS No. CZ 4500000

Uses Solvent. Insecticide. Fumigant. Heat-transfer medium intermediate. Intermediate in the production of 3,4-dichloroaniline dyestuffs.

Physical properties

M. Pt. $-17.3^{\circ}C$ B. Pt. $179-180^{\circ}C$ Flash point $65-67^{\circ}C$ (closed cup) Specific gravity 1.3059 at $20^{\circ}C$ with respect to water at $4^{\circ}C$ Partition coefficient $\log P_{ow}$ 3.38-3.56 (1-3) Volatility v.p. 1.5 mmHg at $25^{\circ}C$; v.den. 5.1

Solubility Water: 145-147 mg l^{-1} at $25^{\circ}C$. Organic solvents: benzene, diethyl ether, ethanol

Occupational exposure

DE-MAK 50 ppm (300 mg m^{-3})

FR-VLE 50 ppm (300 mg m^{-3})

JP-OEL 25 ppm (150 mg m^{-3})

SE-CEIL 50 ppm (300 mg m^{-3})

UK-STEL 50 ppm (306 mg m^{-3})

US-TWA 25 ppm (150 mg m^{-3})

US-STEL 50 ppm (301 mg m^{-3})

UN No. 1591 HAZCHEM Code 2Z Conveyance classification toxic substance

Supply classification harmful, dangerous for the environment

Risk phrases Harmful if swallowed – Irritating to eyes, respiratory system and skin – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R22, R36/37/38, R50/53)

Safety phrases Keep out of reach of children (if sold to general public) – Do not breathe vapour – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S2, S23, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) tide water silverside, bluegill sunfish 7.3, 27 ppm static bioassay, respectively (4).

LC₅₀ (24, 48, 96 hr) fathead minnow 105, 70, 57 mg l^{-1} , respectively (5).

LC₅₀ (96 hr) fathead minnow 17 mg l^{-1} (6).

Invertebrate toxicity

LC₅₀ (24, 48, 96 hr) *Palaemonetes pugio* 14.3, 10.3, 9.4 mg l^{-1} , respectively (5).

LC₅₀ (48 hr) grass shrimp 10 mg l^{-1} (5).

LC_{Lo} *Scenedesmus quadricauda* >100 mg l^{-1} threshold (7).

LC_{Lo} *Microcystis aeruginosa* 53 mg l^{-1} threshold (8).

EC₅₀ (30 min) *Photobacterium phosphoreum* 4.05-5.99 ppm Microtox test (9).

Bioaccumulation

Bioconcentration factor rainbow trout 270-560 (10).

Non-accumulative or low accumulative (11).

Environmental fate

Carbonaceous inhibition

EC₁₀₀ (72 hr) *Pseudomonas* sp. 200 mg l⁻¹. LC_{Lo} *Pseudomonas putida* 15 mg l⁻¹ threshold (7,12).

LC_{Lo} *Entosiphon sulcatum* >64 mg l⁻¹ threshold (7).

Anaerobic effects

Inhibition of anaerobic digestion laboratory scale, concentration 100 mg l⁻¹, 30% inhibition at 5 hr; 17% at 3 hr (13).

Degradation studies

Pseudomonas sp., *Alcaligenes* sp. and *Moraxella* sp. bacteria isolated from Rhine river water and industrial wastewater treatment plants were able to utilise 1,2-dichlorobenzene as a sole carbon source (14).

100% biodegradation occurred in 72 hr; initial concentration 100 mg l⁻¹, temperature 30°C *Pseudomonas* sp. parent; 26 hr using mutant strain (12).

Abiotic removal

Reported to be effectively removed from water by ozone treatment in a pilot plant scale (15).

t_{1/2} for volatilisation from river water 4.4 hr at 20°C (16).

t_{1/2} for vapour phase reaction with photochemically produced hydroxyl radicals in the atmosphere estimated to be 24 days (17).

Evaporation rate relative to *n*-butyl acetate, which has been assigned a value of 1 at 25°C, is 0.165 (18).

Adsorption and retention

Adsorption onto sands (from a New Jersey aquifer) demonstrated a partition coefficient of 121 (19).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rabbit, rat 500 mg kg⁻¹ (20,21).

LC_{Lo} (7 hr) inhalation rat 4946 mg m⁻³ (22).

LC_{Lo} (24 hr) inhalation guinea pig 4820 mg m⁻³ (23).

LD₅₀ intraperitoneal rat 840 mg kg⁻¹ (24).

LD_{Lo} intravenous mouse, rabbit 520-650 mg kg⁻¹ (23).

Single intraperitoneal injection rat 150, 300, 600 mg kg⁻¹ caused severe hepatotoxic effects as evidenced by plasma enzymes and histological changes. 72 hr after administration, protein droplets were observed in the tubular epithelial cells of the kidneys and plasma thyroxine levels decreased (25).

Sub-acute and sub-chronic data

Chronic inhalation exposure (duration unspecified) to 93 ppm in animals produced no adverse effects on organ weights, haematology or histopathology (26).

Inhalation mouse (4 hr) 180 ppm caused a 50% reduction in respiratory rate. A reflex bradypnoea indicative of irritation of the nasal cavity occurred within 15 min. After 4 hr exposure a reduction in the development of histochemical staining for liver glucose-6-phosphatase activity and an increase in the number of damaged tubules in cryostat kidney section stained for alkaline phosphatase activity were observed as a measure of toxicity (27).

Oral rat (28 wk) administration of maximum tolerated dose, 19-190 mg kg⁻¹ day⁻¹ 5 day wk⁻¹ caused minimal liver and kidney damage at high dose levels. Inhalation exposure was also reported to cause liver and kidney damage (22).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans and animals, IARC classification group 3 (28).

No evidence of carcinogenicity in ♂, ♀ mice when given in food for 2 yr (29).

One report of a series of 5 cases of blood disorders in humans exposed to 1,2- and 1,4-dichlorobenzene suggested an association with leukaemia (30).

Teratogenicity and reproductive effects

Rats and rabbits were exposed to 0, 100, 200, or 400 ppm, 6 hr day⁻¹ on days 6-15 of gestation (rats) or days 6-18 (rabbits). Maternal toxicity was reported in all exposed rats and in rabbits exposed to 400 ppm. Liver weight increased in rats exposed to 400 ppm. No fetotoxicity or teratogenicity was reported in rats or rabbits exposed to ≤ 400 ppm (31).

Metabolism and toxicokinetics

In rabbits 1,2-dichlorobenzene is metabolised to 3,4-dichlorophenol, 2,3-dichlorophenol, 3,4-dichlorophenylmercapturic acid, 3,4- and 4,5-dichlorocatechol (32).

Intraperitoneal ♂ rats, mice 1,2-dichlorobenzene was found to lead to formation of adducts of DNA, RNA and proteins of the liver, kidney, lung and stomach after 22 hr. The covalent binding index to liver DNA was typical of carcinogens classified as weak initiators (33).

The effect of inducers and inhibitors of microsomal mixed-function oxidases on the rate of metabolism and the extent of binding of 1,2- and 1,4-dichlorobenzene to cellular constituents suggests that arene oxides (epoxides) may be precursors of the excreted metabolites, and that these arene oxides may be responsible for the different biological properties of the isomers (34).

Irritancy

A 30 sec exposure by rinse to rabbit eye at 100 mg caused mild irritation (22).

Sensitisation

Inhalation rabbit (7 month) 50 mg m⁻³ 4 hr day⁻¹, 5 day wk⁻¹ caused sensitisation (35).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1537 with metabolic activation negative (36).

Escherichia coli WP2 *uvrA* mutagenicity assay with metabolic activation negative (36).

Aspergillus nidulans reverse mutation assay without metabolic activation negative (37).

In vivo mouse bone marrow micronucleus assay positive (38).

Clastogenic chromosomal aberrations were reported in 26 individuals following accidental exposure to 1,2-dichlorobenzene (39).

No evidence of mutagenic effects in bacteria or fungi (40).

Other effects

Other adverse effects (human)

No evidence of organic injury or untoward haematological effect has been found in workers exposed to 1,2-dichlorobenzene at concentrations ranging from 6-250 mg m⁻³ (average 90 mg m⁻³) for many years (22).

In humans, irritant to skin and mucous membranes, can cause conjunctivitis, headache, rhinitis, vertigo, anorexia, nausea, swelling of extremities, jaundice, anaemia, cataracts, eczema, tremor and increased tendon reflexes. High concentrations are narcotic and central nervous system depressant. Damage to liver, kidneys. Also causes cough, dyspnoea, skin sensitisation, and abdominal pain. Some evidence of acute myoblastic leukaemia and lymphoid leukaemia (26).

Any other adverse effects

Intraperitoneal rat, single dose 750 mg kg⁻¹ caused an increase in bile duct pancreatic fluid flow, 24 hr after exposure. The protein concentration of these secretions was decreased (41).

Legislation

Former USSR: maximum admissible concentration in air 20 mg m⁻³; in drinking water 2 µg l⁻¹ (42).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (43).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (44).

Other comments

Excised soybean roots were exposed to an aqueous solution of 1,2-dichlorobenzene. Effective equilibration was reached within 2.5 hr and the elimination rate constant was $>4.1 \text{ hr}^{-1}$ (45).

Contaminant in flue gases of waste incinerators and from building materials and consumer products. Residues have been isolated from natural waters and sediments (46,47).

Disinfection by-product in chlorinated water.

Physical properties, exposure limits, uses, biological hazards, first-aid and handling precautions of 1,2-dichlorobenzene reviewed (26,48).

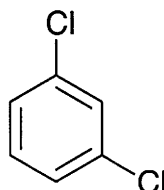
Environmental fate reviewed (17).

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D189 1,3-dichlorobenzene



$C_6H_4Cl_2$

Mol. Wt. 147.00

CAS Registry No. 541-73-1

Synonyms *m*-dichlorobenzene; *m*-phenylene dichloride; *m*-dichlorobenzol

EINECS No. 208-792-1

RTECS No. CZ 4499000

Uses Solvent. Chemical intermediate. Fumigant.

Physical properties

M. Pt. -25°C **B. Pt.** 172-173°C **Flash point** 63°C (closed cup) **Specific gravity** 1.2884 at 20°C with respect to water at 4°C **Partition coefficient** log P_{ow} 3.48-3.57 (1-3) **Volatility** v.p. 2.3 mmHg at 25°C
Solubility Water: 111 mg l⁻¹ at 20°C. Organic solvents: diethyl ether, ethanol

Occupational exposure

Supply classification harmful

Supply classification dangerous for the environment

Risk phrases Harmful if swallowed – Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R22, R51/53)

Safety phrases Keep out of reach of children (if sold to general public) – Avoid release to the environment. Refer to special instructions/safety data sheet (S2, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (14 day) guppy 7.4 ppm (4).

LC₅₀ (96 hr) fathead minnow 7.8 mg l⁻¹ (5).

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 5.1 ppm Microtox test (6).

Bioaccumulation

Bluegill sunfish bioconcentrated 1.82 over 28 days at 16°C (7).

Bioconcentration factor for fathead minnow was 97, in chronic toxicity tests (32-33 day duration) on embryo through early juvenile development (5).

Bioconcentration factor rainbow trout 420-740 (8).

Environmental fate

Anaerobic effects

Inhibition of anaerobic digestion in laboratory study; 20% in 5 hr at concentrations of 100 mg l⁻¹; 9% in 3 hr (9).

Degradation studies

Degradation by *Pseudomonas* spp. 200 mg l⁻¹, 30°C, 96 hr, 100% ring disruption (parent); 28 hr, 100% ring disruption (mutant strain) (10).

A Gram-negative bacterium tentatively identified as *Alcaligenes* sp. was isolated from a mixture of soil and water using 1,3-dichlorobenzene as the sole carbon source. During growth almost stoichiometric amounts of chloride were released. Degradation to 3,5-dichlorocatechol was indicated, via 3,4-dichloro-*cis*-1,2-dihydrocyclohexa-3,5-diene; 3,5-dichlorocatechol was subsequently cleaved yielding 2,4-dichloromuconate (11).

Abiotic removal

t_{1/2} for volatilisation from river water 4.1 hr at 20°C (12).

t_{1/2} for vapour phase reaction with photochemically produced hydroxyl radicals estimated to be 14 days (13).

Adsorption and retention

Adsorption onto sands from a New Jersey aquifer was demonstrated with a partition coefficient of 31 (14).

Mammalian & avian toxicity

Acute data

LD₅₀ intraperitoneal mouse 1060 mg kg⁻¹ (15).

Genotoxicity

Salmonella typhimurium TA100 without metabolic activation negative (16).

Salmonella typhimurium TA98, TA100, TA1537 with metabolic activation negative (17).

Escherichia coli WP2 *uvrA* mutagenicity assay with metabolic activation negative (17).

Escherichia coli Pol A DNA damage positive (17).

Saccharomyces cerevisiae gene conversion and mitotic recombination 5 ppm (18).

Legislation

Maximum admissible concentration in domestic water in former USSR 0.03 mg l⁻¹ (19).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level 1 µg l⁻¹ (20).

Other comments

Pollutant in industrial waste waters. Contaminant in flue gases of waste incinerators and from plastic building materials and consumer products. Residues have been isolated from water, soils and sediments. Residues have been detected in human breast milk among the Canadian population (21).

Environmental fate reviewed (13).

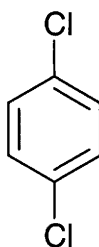
Toxicity and hazards reviewed (22).

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D190 1,4-dichlorobenzene



C₆H₄Cl₂

Mol. Wt. 147.00

CAS Registry No. 106-46-7

Synonyms *p*-dichlorobenzene; *p*-phenylene dichloride; PDCB; Paracide; Paramouth; dichloride

EINECS No. 203-400-5

RTECS No. CZ 4550000

Uses Insecticide. Fumigant. Mothproofing agent. Acaricide. Intermediate in the manufacture of deodorisers, dyestuffs and pharmaceuticals, especially in the production of 2,5-dichloroaniline and the polyphenylene sulfide resins. Solvent.

Physical properties

M. Pt. 53.5°C (α) sublimates at room temperature; 54°C (β) **B. Pt.** 173-174°C **Flash point** 65-66°C (closed cup)

Specific gravity 1.2475 at 20°C with respect to water at 4°C **Partition coefficient** log *P*_{ow} 3.4 (1,2)

Volatility v.p. 1.0 mmHg at 25°C

Solubility Water: 79 mg l⁻¹ at 25°C. Organic solvents: benzene, carbon disulfide, chloroform, diethyl ether

Occupational exposure

DE-MAK 50 ppm (300 mg m⁻³)

FR-VME 75 ppm (450 mg m⁻³)

JP-OEL 50 ppm (300 mg m⁻³)

FR-VLE 110 ppm (675 mg m⁻³)

SE-LEVL 75 ppm (450 mg m⁻³)

UK-LTEL 25 ppm (153 mg m⁻³)

US-TWA 10 ppm (60 mg m⁻³)

UN No. 1592

Supply classification harmful

Risk phrases Harmful if swallowed – Irritating to eyes and skin (R22, R36/38)

Safety phrases Keep out of reach of children (if sold to general public) – Do not breathe dust – Avoid contact with skin and eyes – If swallowed seek medical advice immediately and show this container or label (S2, S22, S24/25, S46)

Ecotoxicity

Fish toxicity

LC₅₀ (14 day) guppy 4 mg l⁻¹ (3).

LC₅₀ (24, 48, 96 hr) fathead minnow 35.4, 35.4, 33.7 mg l⁻¹, respectively (4).

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 5.34 ppm Microtox test (5).

Bioaccumulation

Bioconcentration factor guppy, rainbow trout (lipid content) 1800-2100 (6).

Bioconcentration factor rainbow trout (7, 21, 35, 50, 75, 96 day) 510, 390, 1000, 530, 220, 430, respectively, mean range 510-890 (2).

Bioconcentration factor fathead minnow 110, in chronic toxicity tests (32-33 day duration) on embryo through early juvenile development (7).

Environmental fate

Degradation studies

Degradation by *Pseudomonas* sp. 200 mg l⁻¹, 30°C; parent: 100% ring disruption 92 hr; mutant: 100% ring disruption 25 hr (8).

80% removal reported over 32 days incubation with mixed primary sewage sludge (9).

Confirmed biodegradable (10).

Abiotic removal

t_{1/2} volatilisation from river water 4.3 hr at 20°C (11).

Adsorption and retention

Adsorption onto sands from a New Jersey aquifer demonstrated with a partition coefficient of 35 (12).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 500->1000 mg kg⁻¹ (13).

LD₅₀ oral guinea pig, mouse 2800, 2950 mg kg⁻¹, respectively (14,15).

LD₅₀ intraperitoneal rat 2560 mg kg⁻¹ (16).

LD₅₀ subcutaneous mouse 5150 mg kg⁻¹ (17).

LD_{Lo} oral human 857 mg kg⁻¹ (18).

LD_{Lo} (route unspecified) human 221 mg kg⁻¹ (19).

Single intraperitoneal injection rat 1, 2, 4 mmol kg⁻¹ caused protein droplets to form in the kidney within 72 hr of administration. Reduction of plasma thyroxine levels was noted (20).

Sub-acute and sub-chronic data

Oral rat, guinea pig, rabbit, mouse (6-7 month) 96 ppm in diet, no adverse effects reported (21).

Gavage rat (192 day) 18.8 mg kg⁻¹ no adverse effect reported (21).

Gavage rat (4, 13 wk) 0, 75, 150, 300, 600 mg kg⁻¹ day⁻¹. Increased urinary lactate dehydrogenase and epithelial cell excretion and exacerbation of hyalin droplet accumulation in the cytoplasm of renal cells was observed in all

treated ♂ animals. Tubular single cell necrosis and dilated tubules with granular case formation in the outer zone of the medulla were evident in ♂ rats after 4 and 13 wk treatment with doses of 150-600 mg kg⁻¹ day⁻¹. There was no indication of nephrotoxicity in ♀ rats (22).

Intragastric rat (5 day) 770 mg kg⁻¹ day⁻¹ caused hepatic porphyria as demonstrated by increased urinary coproporphyrins, porphobilinogen and γ-aminolevulinic acid (23).

However, in another study, no porphyria occurred in ♀ rats fed 200 mg kg⁻¹ day⁻¹ for 120 days (24).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (25).

Oral ♂ rat and mouse (5 days wk⁻¹ for 1, 4 and 13 wks) 0, 25, 75, 150 or 300 mg kg⁻¹ and 0, 300 or 600 mg kg⁻¹, respectively. The two highest doses produced kidney tumours in rats and liver tumours in mice. A dose related increase in liver weight was observed in both rats and mice associated with centrilobular hypertrophy (26). One report of a series of 5 cases of blood disorders in humans exposed to *o*- and *p*-dichlorobenzene suggested an association with leukaemia (27).

Gastric intubation rat, mouse (2 yr) (dose unspecified) caused renal tubular cell adenocarcinomas in ♂ rats and hepatocellular carcinomas in ♂ and ♀ mice (28).

Inhalation rats, mice (concentration unspecified) no increase in tumour incidence but duration of exposure was reported to be limited (25,29).

Teratogenicity and reproductive effects

TC_{Lo} (6 hr) inhalation rabbit (6-18 day pregnancy) 800 ppm teratogen positive (30).

Inhalation rat (6-15 day gestation) 75, 200, or 500 ppm 6 hr day⁻¹, no evidence of embryotoxicity, foetotoxicity or teratogenicity (31).

Metabolism and toxicokinetics

Following inhalation exposure and oral and subcutaneous administration in rabbit and rat, ethereal sulfate and glucuronide conjugates of 2,5-dichlorophenol were found to be the major urinary metabolites. Small amounts of 2,5-dichlorohydroquinone were also detected. Unlike the rabbit, a mercapturic acid derivative of 2,5-dichlorophenol was also excreted in the rat (32,33).

Irritancy

Vapours irritate eyes, skin, throat, mucous membranes, respiratory tract. Causes little irritation to skin of humans. No complaints or injuries at 15-85 ppm. Painful to eyes, nose at 50-80 ppm. Severe discomfort at 160 ppm (16,21).

Sensitisation

A case of allergic purpura following occupational exposure has been reported (34).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535 with metabolic activation negative (35).

Aspergillus nidulans reverse mutation assay without metabolic activation positive (36).

In vitro human lymphocytes sister chromatid exchange positive (37).

In vivo mouse bone marrow micronucleus assay positive (38).

Mutagenic to fungi but not bacteria (39).

Other effects

Other adverse effects (human)

TD_{Lo} oral human 300 mg kg⁻¹ (eye, pulmonary, gastrointestinal) (40).

Any other adverse effects

Reversible binding to renal γ2-microglobulin was linked to nephrotoxicity of 1,4-dichlorobenzene (species unspecified) (41).

Intraperitoneal rats, mice (concentration and duration unspecified) 1,4-dichlorobenzene was found covalently bound to DNA from the liver, kidney, lung and stomach of mice, but not rats, 22 hr after injection. The covalent binding index classified 1,4-dichlorobenzene as a weak initiator of ooeogenicity (42).

Legislation

Maximum admissible concentration in domestic water in former USSR 0.002 mg l⁻¹ (43).
Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (44).
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (45).

Other comments

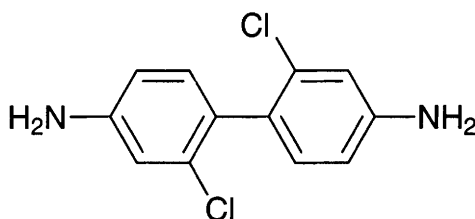
Pollutant in river water in the Netherlands (46).
Contaminant in flue gases of waste incinerators from plastic building materials and consumer products. Residues have been detected in water, soil and sediments. Residues have been detected in human breast milk among the Canadian population (47).
Degradation product of the pesticide γ-HCH (48).
Physical properties, occurrence, use, toxicity, carcinogenicity, metabolism and genotoxicity of *p*-dichlorobenzene reviewed (30,49,50).
Environmental fate reviewed (51).

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D191 2,2'-dichlorobenzidine



$C_{12}H_{10}Cl_2N_2$

Mol. Wt. 253.13

CAS Registry No. 84-68-4

Synonyms 1,1'-biphenyl-4,4'-diamine, 2,2'-dichloro-; o-dichlorobenzidine

EINECS No. 201-552-7

RTECS No. DD 0524000

Uses Manufacture of azo dyestuffs.

Physical properties

M. Pt. 165°C Volatility v.den. 8.73

Solubility Organic solvents: diethyl ether, ethanol

Occupational exposure

UK-LTEL MEL 0.1 mg m⁻³

Mammalian & avian toxicity

Carcinogenicity and chronic effects

Benzidine and its derivatives show sufficient evidence of carcinogenicity to humans and animals, IARC classification group 1 (1).

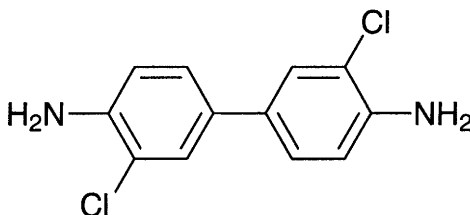
Genotoxicity

In vitro human HeLa cells with metabolic activity induced unscheduled DNA synthesis (2).

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D192 3,3'-dichlorobenzidine



$C_{12}H_{10}Cl_2N_2$

Mol. Wt. 253.13

CAS Registry No. 91-94-1

Synonyms 3,3'-Dichlorobiphenyl-4,4'-ylenediamine; 3,3'-dichloro-(1,1'-biphenyl)-4,4'-diamine; *o,o'*-dichlorobenzidine; 4,4'-diamino-3,3'-dichlorobiphenyl; C.I. 23060; Curithane C126

EINECS No. 202-109-0

RTECS No. DD 0525000

Uses Manufacture of azo dyestuffs. Intermediate for Benzidine Yellow pigments. Curing agent for polyurethane elastomers.

Physical properties

M. Pt. 132-133°C **Partition coefficient** $\log P_{ow}$ 3.51 (1) **Volatility** v.p. 4.2×10^{-7} mmHg at 25°C (est.) (2)

Solubility Water: 3.1 mg l⁻¹. Organic solvents: glacial acetic acid, benzene, diethyl ether, ethanol

Occupational exposure

UK-LTEL MEL 0.1 mg m⁻³

Supply classification toxic, dangerous for the environment

Risk phrases May cause cancer – Harmful in contact with skin – May cause sensitisation by skin contact – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R45, R21, R43, R50/53)

Safety phrases Restricted to professional users – Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S53, S45, S60, S61)

Ecotoxicity

Invertebrate toxicity

LC₅₀ (15 min) *Photobacterium phosphoreum* 0.0607 ppm at pH 6.7 Microtox Test (3).

Bioaccumulation

Bioaccumulation factor for bluegill sunfish ~500 in water containing 0.1 mg l⁻¹ (4).

Non-accumulative or low accumulative (5).

Environmental fate

Degradation studies

25% degradation occurred in 1 month when incubated with natural aquatic communities from eutrophic and mesotrophic lakes (6).

9-99% degradation occurred in 28 days using sewage seed when yeast extract was added at concentrations of 50-400 mg l⁻¹. No degradation occurred without addition of the nutrient (7).

Abiotic removal

Treatment by hydrogen peroxide and UV irradiation was reported to be effective in removing 3,3'-dichlorobenzidine from water (8).

t_{1/2} for photodegradation in surface layers of water 90 sec, forming 3-chlorobenzidine, benzidine and other water-insoluble coloured products (9).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 7 g kg⁻¹ (10).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (11).

Oral mouse (18 month) 1 g kg⁻¹ diet for 6 or 12 months. All treated animals had hepatomas. No controls developed hepatomas at 6 months, while 10% and 40% had hepatomas at 12 and 18 months, respectively (12,13). Oral rat (23 month) 10-20 mg day⁻¹ for 6 day wk⁻¹ for 12 months (total dose 4.5 g rat⁻¹). 23/50 animals developed tumours, including 7 tumours of the Zymbal gland, 3 skin tumours, 7 mammary gland tumours, 2 adenocarcinomas of the ileum, 3 bladder tumours, 3 tumours of the haematopoietic system, 2 tumours of the connective tissue, 2 tumours of the salivary gland, 1 tumour of the liver and 1 of the thyroid. No tumours were found in controls (14).

Oral rat (18 month) 100 mg kg⁻¹ diet for 50 wk. There was a statistically significant increase in granulocytic leukaemias, mammary adenocarcinomas and Zymbal gland carcinomas in ♂ rats, and mammary adenocarcinomas in ♀ rats (15).

Oral hamster (lifetime study), 1000 mg kg⁻¹ diet did not induce tumours. 4000 mg kg⁻¹ diet induced transitional cell carcinomas of the bladder and liver cell and cholangiomatous tumours (16).

Oral dog (7.1 yr), 100 mg 3 times wk⁻¹ for 6 wk, then 5 times wk⁻¹ continuously for up to 7.1 yr; the intake was between 9.1-12.8 kg⁻¹ per dose. One dog sacrificed after 3.5 yr had no tumour. Another sacrificed after 6.6 yr had an undifferentiated carcinoma of the urinary bladder. Of the dogs killed at 7.1 yr 4/4 had papillary transitional-cell carcinomas of the urinary bladder and 3/4 had hepatocellular carcinomas. None of 6 controls had these tumours at 8-9 yr, although 4/6 had major tumours of the mammary gland (17).

Oral ♀ dog (7 yr), 100 mg 3 × wk⁻¹ for 6 wk, then 5 × wk⁻¹ continuously for 7 yr. Serum glutamic pyruvic transaminase activities were elevated over the first 3 yr of the study, indicating the presence of liver injury (17).

Transplacental mouse (20 months) 10 mg animal⁻¹ administered subcutaneously with 5 injections during the last wk of pregnancy. There was a significant increase in the incidence of lymphoid leukaemias in the offspring. Lung adenomas and mammary tumours were observed, but there was no significant increase over controls (18).

Three retrospective epidemiological studies of exposed workers gave no evidence of carcinogenicity, but the studies were of insufficient quality or statistical power (13).

Metabolism and toxicokinetics

Dogs given 1 g intraperitoneally excreted <2% in faeces and <0.2% in urine as the parent compound, indicating rapid metabolism *in vivo* (13,19).

♂ rats, dogs and monkeys given 0.2 mg kg⁻¹ ¹⁴C-labelled 3,3'-dichlorobenzidine displayed multiphasic blood clearances. The final phase, predominantly 24 hr after treatment, had a t_{1/2} of 68 hr in rats and 86 hr in dogs. Faecal excretion was the major route of elimination, accounting for 30-85% of the administered dose within 7 day. 10-40% was eliminated in the urine. Urinary excretion was delayed for 3-5 hr after treatment. One metabolite obtained from monkey urine co-chromatographed with monoacetyl benzidine, a urinary metabolite of benzidine

in monkeys. Some parent compound was eliminated in the urine during the first few hours after treatment. The majority of the administered dose was recovered from bile, intestine and liver within 14 hr of treatment, indicating the importance of hepatobiliary excretion. By 7 or 14 days after treatment, residual radioactivity was recovered primarily from the excretory organs (kidney, bladder, liver, bile) or their products, but also from the adrenals in rats and the lungs in dogs (20).

Genotoxicity

Salmonella typhimurium TA98, TA100 with metabolic activation positive (21,22).

Escherichia coli WP2 without metabolic activation negative (23).

In vitro unscheduled DNA synthesis in transformed human cells, without metabolic activation negative, with metabolic activation weakly positive (24).

Following a single oral dose of 100 mg kg⁻¹ to rats and mice, DNA adducts were identified in the intestine, bladder and liver. t_{1/2} for adducts in the bladder and liver were 13-15 days and 5-6 days in the intestinal epithelium (25).

Other effects

Other adverse effects (human)

Dermal exposure has been reported to cause dermatitis in dyehouse workers (9).

Other comments

In the flue gases of waste incinerators. Residues have been isolated from soil, water and sediments.

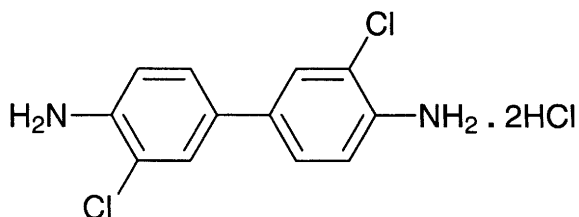
Physical properties, use, occurrence, analysis, toxicity, carcinogenicity, metabolism and genotoxicity of 3,3'-dichlorobenzidine reviewed (13).

Environmental fate of 3,3'-dichlorobenzidine reviewed (9).

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D193 3,3'-dichlorobenzidine dihydrochloride



C₁₂H₁₂Cl₄N₂

Mol. Wt. 326.05

CAS Registry No. 612-83-9

Synonyms 3,3'-dichloro-(1,1'-biphenyl)-4,4'-diamine dihydrochloride; 3,3'-dichloro-4,4'-diaminobiphenyl dihydrochloride

EINECS No. 210-323-0

RTECS No. DD 0550000

Uses Intermediate in the manufacture of organic pigments.

Physical properties

M. Pt. 132-133°C **Volatility** v.p. 0 mmHg at 25°C

Solubility Water: 4 mg l⁻¹ at 22°C. Organic solvents: ethanol

Occupational exposure

Supply classification toxic

Supply classification dangerous for the environment

Risk phrases May cause cancer – Harmful in contact with skin – May cause sensitisation by skin contact – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R45, R21, R43, R50/53)

Safety phrases Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S53, S45, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) bluegill sunfish ~0.5 mg l⁻¹ (1).

Bioaccumulation

Bioconcentration factor for bluegill sunfish 114-856 (1,2).

Environmental fate

Adsorption and retention

Distribution coefficient for various aquatic sediments 2670-12,800 (3).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 3.8 g kg⁻¹ (4).

Carcinogenicity and chronic effects

No adequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification 2B (5-7).

Oral ♀ rat (9 month) 10 doses of 30 mg by gastric intubation at intervals of 3 days. This was the maximum tolerated dose. No mammary and no other tumours were observed in treated rats (8).
Oral hamster (3 yr) 0.1% in diet (total dose 3 g yr⁻¹). There was no increase in cancer incidence compared with controls (3).

Genotoxicity

Salmonella typhimurium TA98, TA100 with and without metabolic activation positive (9).

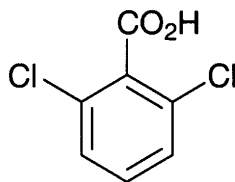
Other comments

Physical properties, toxicity, carcinogenicity, mutagenicity and environmental fate reviewed (3).

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D194 2,6-dichlorobenzoic acid



C₇H₄Cl₂O₂

Mol. Wt. 191.01

CAS Registry No. 50-30-6

EINECS No. 200-025-9

RTECS No. DG 7000000

Uses Catalyst. Herbicide.

Physical properties

M. Pt. 143-145°C

Solubility Water: miscible. Organic solvents: benzene, chloroform, diethyl ether, ethanol

Ecotoxicity

Bioaccumulation

No or low bioaccumulation (1).

Environmental fate

Degradation studies

Biodegradation was demonstrated by a *Pseudomonas* strain isolated from soil (2).

Mammalian & avian toxicity

Acute data

LD₅₀ subcutaneous mouse 1500 mg kg⁻¹ (3).

LD₅₀ intraperitoneal mouse 316 mg kg⁻¹ (4).

Legislation

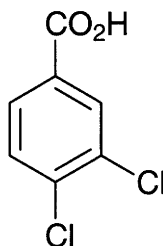
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (5).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (6).

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D195 3,4-dichlorobenzoic acid



C₇H₄Cl₂O₂

Mol. Wt. 191.01

CAS Registry No. 51-44-5

EINECS No. 200-099-2

RTECS No. DG 7175000

Uses Fungicide.

Physical properties

M. Pt. 207-209°C

Solubility Water: miscible. Organic solvents: diethyl ether, ethanol

Ecotoxicity

Bioaccumulation

No or low bioaccumulation (1).

Environmental fate

Degradation studies

Biodegradation was demonstrated by a *Pseudomonas* strain isolated from soil (2).

Mammalian & avian toxicity

Acute data

LD₅₀ subcutaneous mouse 400 mg kg⁻¹ (3).

Legislation

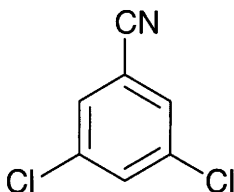
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (4).

Included in Schedule 6 (Release into Land: Prescribed Substances) of Statutory Instrument No. 472, 1991 (5).

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1. *JETOC Newsletter No.5* 1987, Japan Chemical Industry Ecology Toxicology and Information Centre, Tokyo, Japan.
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4. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985, Luxembourg.
5. *S.I. 1991 No. 472 The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D196 3,5-dichlorobenzonitrile



C₇H₃Cl₂N

Mol. Wt. 172.01

CAS Registry No. 6575-00-4

Synonyms 1,3-dichloro-5-cyanobenzene

EINECS No. 229-495-3

Uses Fungicide.

Physical properties

M. Pt. 64-66°C

Ecotoxicity

Invertebrate toxicity

LC₅₀ (30 min) *Photobacterium phosphoreum* 24.9 ppm Microtox test (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (2).

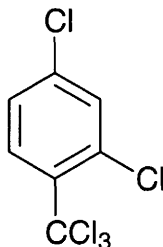
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D197 2,4-dichlorobenzotrichloride



$C_7H_3Cl_5$

Mol. Wt. 264.36

CAS Registry No. 13014-18-1

Synonyms 1,3-dichloro-4-(trichloromethyl)benzene; 2,4-dichloro-1-(trichloromethyl)benzene; 2,4-dichlorophenyltrichloromethane; $\alpha,\alpha,\alpha,2,4$ -pentachlorotoluene

EINECS No. 235-871-8

RTECS No. CZ 5475020

Physical properties

Solubility Organic solvents: dimethyl sulfoxide

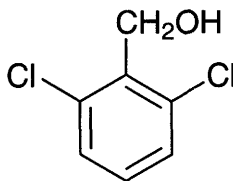
Genotoxicity

Salmonella typhimurium TA98, TA100 with metabolic activation positive (1).

References

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D198 2,6-dichlorobenzyl alcohol



$C_7H_6Cl_2O$

Mol. Wt. 177.03

CAS Registry No. 15258-73-8

Synonyms 2,6-dichlorobenzenemethanol

EINECS No. 239-300-3

RTECS No. DO 0900000

Physical properties

M. Pt. 96-98°C

Ecotoxicity

Bioaccumulation

No or low bioaccumulation (1).

Mammalian & avian toxicity

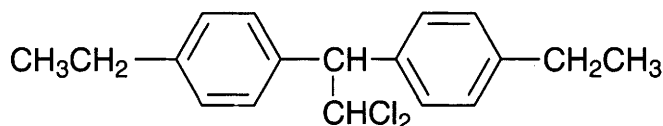
Acute data

LD₅₀ intraperitoneal rat 556 mg kg⁻¹ (2).

References

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D199 1,1-dichloro-2,2-bis(4-ethylphenyl)ethane



C₁₈H₂₀Cl₂

Mol. Wt. 307.26

CAS Registry No. 72-56-0

Synonyms diethyldiphenyldichloroethane; 1,1'-(2,2-dichloroethylidene)bis[4-ethylbenzene];

p,p'-ethyl DDD

EINECS No. 200-785-1

RTECS No. KH 5790000

Uses Insecticide.

Physical properties

M. Pt. 56-57°C

Solubility Water: <1 mg ml⁻¹ at 20°C. Organic solvents: acetone, benzene, ethanol

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout 4 µg l⁻¹ (1).

LC₅₀ (96 hr) bluegill sunfish 0.20 mg l⁻¹ (1).

Mammalian & avian toxicity

Acute data

LC₅₀ oral Japanese quail >500 mg kg⁻¹ (2).

LC₅₀ oral pheasant >5000 mg kg⁻¹ (3).

LC₅₀ oral mallard duck >5000 mg kg⁻¹ (3).

LD₅₀ oral rat, mouse 6600-8170 mg kg⁻¹ (1,2).

LC₅₀ intravenous rat, mouse 73-173 mg kg⁻¹ (4).

Sub-acute and sub-chronic data

In adult ♂ dogs given 25-100 mg kg⁻¹ diet for 7-34 days, damaged fascicular and reticular zone cells, and focal haemorrhage, degeneration and focal dystrophy of adrenal cortex reported (2).

Oral administration of 1000 mg kg⁻¹ to rats caused a significant increase in the weight of the liver, spleen and adrenals. Caused a decrease in number and irregular distribution of RNA, particularly in the liver (5).

Carcinogenicity and chronic effects

In a 2-yr feeding study, rats receiving 500 mg kg⁻¹ diet suffered no mortality or haematological ill-effects (2).

In ♀ mice, liver carcinomas and adenomas detected following parental administration. No evidence of carcinogenicity in ♂ mice and ♂ and ♀ rats (6).

Teratogenicity and reproductive effects

Lowest oral teratogenic dose to mice 210 g kg⁻¹ (2).

Irritancy

There is little evidence of percutaneous absorption, skin irritation or sensitisation (7).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation positive (8).

Legislation

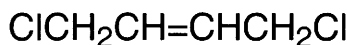
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (9).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (10).

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10. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D200 1,4-dichloro-2-butene



C₄H₆Cl₂

Mol. Wt. 125.00

CAS Registry No. 764-41-0

Synonyms 2-butylene dichloride; 1,4-dichlorobut-2-ene; 1,4-dichlorobutene-2; DCB

EINECS No. 212-121-8

RTECS No. EM 4900000

Uses Chemical intermediate. Manufacture of polychloroprene rubber.

Physical properties

M. Pt. 1-3°C **B. Pt.** 156°C **Flash point** 59°C **Specific gravity** 1.183 at 25°C with respect to water at 4°C

Volatility v.p. 20 mmHg at 55.5°C

Solubility Organic solvents: acetone, benzene, carbon tetrachloride, chloroform, diethyl ether, ethanol, tricaprylin

Occupational exposure

US-TWA 0.005 ppm (0.025 mg m⁻³)

Supply classification very toxic

Supply classification dangerous for the environment

Risk phrases May cause cancer – Toxic in contact with skin and if swallowed – Very toxic by inhalation – Causes burns – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R45, R24/25, R26, R34, R50/53)

Safety phrases Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet – Restricted to professional users (S53, S45, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (7 day) guppy <40 mg l⁻¹ (*trans*-isomer) (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 89, 190 mg kg⁻¹, respectively (2,3).

LC_{Lo} (4 hr) inhalation rat 62 ppm (2).

LD₅₀ dermal mouse 620 mg kg⁻¹ (2).

LD₅₀ intravenous mouse 56 mg kg⁻¹ (4).

Carcinogenicity and chronic effects

No adequate data for carcinogenicity to humans, inadequate evidence for carcinogenicity to animals, IARC classification group 3 (5).

Dermal mouse (77 wk) 1 mg *trans*-1,4-dichloro-2-butene 3 × wkly. No skin tumours were observed. Subcutaneous mouse (77 wk) 0.05 mg *trans*-1,4-dichloro-2-butene wkly. 3/30 mice developed local sarcomas compared to 0/50 controls. Intraperitoneal mouse (77 wk) 0.05 mg *trans*-1,4-dichloro-2-butene wkly. 2/30 mice developed local sarcomas compared to 0/30 controls (6).

Teratogenicity and reproductive effects

Inhalation rat (1-21 days gestation) 1.8 mg m⁻³ disturbed nucleic acid and carbohydrate metabolism in the embryos. Glycogen and RNA levels decreased in the hepatocytes. RNA also decreased in the cerebral glia and alveolar cells of the lungs and in the epithelium of the glomeruli. Post-implantation mortality was increased. Haemorrhages occurred in the diaphragm and stasis in the liver. Acid mucopolysaccharides increased in the swollen connective tissue stroma of placental liver. Chorionic epithelium showed dystrophy and RNA was decreased. The increased permeability of the placental vessels led to deterioration of the oxygen supply for the embryos which in turn caused swelling, haemorrhages and the decrease in RNA. The syndrome was aggravated by transplacental translocation of 1,4-dichlorobutene (7).

Irritancy

Dermal rabbit (24 hr) 10 mg caused severe irritation and 20 mg instilled into rabbit eye (24 hr) caused severe irritation (2).

Genotoxicity

Salmonella typhimurium TA100 with and without metabolic activation positive (8).

Escherichia coli mutagenicity assay positive (9).

Drosophila melanogaster sex-linked recessive lethal mutation assay positive (10).

Intraperitoneal rat chromatid breaks positive (11).

Other comments

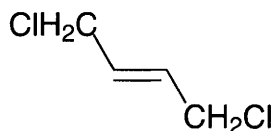
Commercially available as a mixture containing 95-98% of the *trans*-isomer and 2-5% of the *cis*-isomer (12).

Physical properties, use, carcinogenicity, acute toxicity and genotoxicity of 1,4-dichloro-2-butene reviewed (13).

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D201 *trans*-1,4-dichloro-2-butene



$C_4H_6Cl_2$

Mol. Wt. 125.00

CAS Registry No. 110-57-6

Synonyms *trans*-1,4-dichlorobutene; *trans*-1,4-dichlorobut-2-ene; *E*-1,4-dichloro-2-butene; 2-butylene dichloride

EINECS No. 203-779-7

RTECS No. EM 4903000

Uses Chemical intermediate.

Physical properties

M. Pt. 1-3°C **B. Pt.** 158°C; 74-76°C at 40 mmHg **Flash point** 53°C **Specific gravity** 1.183 at 25°C with respect to water at 4°C

Solubility Organic solvents: acetone, benzene, chloroform, diethyl ether, ethanol

Ecotoxicity

Fish toxicity

LC₅₀ (7 day) guppy <40 mg l⁻¹ (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 89 mg kg⁻¹ (2).

LC₅₀ (4 hr) inhalation rat 86 ppm (3).

Sub-acute and sub-chronic data

Inhalation rat single exposure (4 hr) 62 ppm caused mortality in 2/6 animals in 14 days (2).

Carcinogenicity and chronic effects

No adequate data for evaluation of carcinogenicity to humans, inadequate evidence for carcinogenicity to animals, IARC classification group 3 (4).

Dermal mouse (77 wk) 1 mg wk⁻¹. No skin tumours were observed (5).

Dermal mouse, 1 mg *trans*-1,4-dichloro-2-butene plus 2.5 µg phorbol myristyl acetate as a promoting agent. The results were 1/30 skin papillomas in the treated mice compared with 3/30 in mice treated with phorbol myristyl acetate alone, and 28/30 in positive controls treated with phorbol myristyl acetate and 7,12-dimethylbenz[*a*]anthracene (5). Subcutaneous mouse (77 wk), 0.05 mg wk⁻¹. 3/30 mice developed local sarcomas compared to 0/50 in controls (5). Intraperitoneal mouse (77 wk) 0.05 mg wk⁻¹. 2/30 mice developed local sarcomas compared to 0/30 in controls (5).

Genotoxicity

Salmonella typhimurium TA100 with and without metabolic activation positive (2).

Escherichia coli mutagenic assay positive (6).

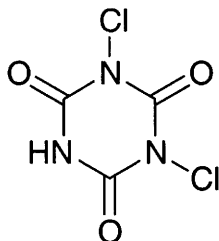
Other comments

Physical properties, use, carcinogenicity and toxicity of 1,4-dichloro-2-butene reviewed (7).

References

1. Konemann, W. H. *Quantitative Structure-Activity Relationships for Kinetics and Toxicity of Water Pollutants and their Mixtures to Fish* 1979, Univ. Utrecht, Netherlands.
2. Bartsch, H. et al *Proc. Am. Assoc. Cancer Res.* 1976, **17**, 17.
3. *Proc. Annu. Meet. Am. Ind. Hyg. Assoc.* 1968.
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D202 dichlorocyanuric acid



$C_3HCl_2N_3O_3$

Mol. Wt. 197.96

CAS Registry No. 2782-57-2

Synonyms dichloroisocyanuric acid; dichloro-1,3,5-triazinetriene; dichloroisocyanurate; troclosene; isocyanuric dichloride; 1,3-dichloro-s-triazine-2,4,6(1*H*,3*H*,5*H*)-trione

EINECS No. 220-487-5

RTECS No. XZ 1845000

Uses Disinfectant. Bleaching agent. Halogenating agent.

Physical properties

M. Pt. 225°C (decomp.)

Solubility Water: <1 g l⁻¹ at 27°C. Organic solvents: acetone, ethanol

Occupational exposure

Supply classification oxidising, harmful

Risk phrases Contact with combustible material may cause fire – Harmful if swallowed – Contact with acids liberates toxic gas – Irritating to eyes and respiratory system (R8, R22, R31, R36/37)

Safety phrases Keep out of reach of children (if sold to general public) – Keep container dry – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – In case of fire and/or explosion do not breathe fumes (S2, S8, S26, S41)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1170 mg kg⁻¹ (1).

Irritancy

Dermal rabbit, 500 mg caused severe irritation, and 100 mg instilled into rabbit eye caused severe irritation (periods of exposure unspecified) (2).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (3).

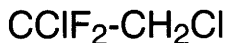
Other comments

Contains >39% available chlorine (4).

References

1. Marhold, J. V. *Registry of Toxic Effects of Chemical Substances* 29 Mar 1977.
2. Deichmann, W. B. *Toxicology of Drugs and Chemicals* 1969, 167, Academic Press, New York, USA.
3. Zeiger, E. et al *Environ. Mutagen.* 1987, 9(Suppl. 9), 1-110.
4. Hartley, G. G. *The Condensed Chemical Dictionary* 9th ed. 1977, 280, Van Nostrand Reinhold, New York, USA

D203 1,2-dichloro-1,1-difluoroethane



$\text{C}_2\text{H}_2\text{Cl}_2\text{F}_2$

Mol. Wt. 134.94

CAS Registry No. 1649-08-7

EINECS No. 216-714-2

Mammalian & avian toxicity

Acute data

LC_{Lo} (4 hr) inhalation rat 20,000 ppm (1).

Metabolism and toxicokinetics

Intraperitoneally injected ♂ Fischer 344 rats (10 mmol kg⁻¹) excreted metabolites of 1,2-dichloro-1,1-difluoroethane in the urine. These were 2-chloro-2,2-difluoroethyl glucuronide, 2-chloro-2,2-difluoroethyl sulfate, chlorodifluoroacetic acid, chlorodifluoroacetaldehyde hydrate, chlorodifluoroacetaldehyde-urea adduct and inorganic fluoride. The major urinary metabolite was 2-chloro-2,2-difluoroethyl glucuronide (2).

Other effects

Any other adverse effects

Metabolites of 1,2-dichloro-1,1-difluoroethane may have adverse biological effects. Chlorodifluoroacetaldehyde has been found to be toxic to rats; signs of cholinergic stimulation were found in dead animals (3).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorine compounds: guide level 1 µg l⁻¹ (4).

Included in Schedules 4 and 6 (Release into Air/Land: Prescribed Substances) of Statutory Instrument No. 472, 1991 (5).

Other comments

The National Toxicology Program tested rats via gavage; the short-term toxicity study report is available (6). Physico-chemical properties, human health effects, experimental toxicology, exposure levels, workplace experience, epidemiology and environmental effects reviewed (7).

References

1. *Toxicol. Appl. Pharmacol.* 1971, 19, 1.
2. Yin, H. et al *Chem. Res. Toxicol.* 1995, 8(2), 262-268.
3. Yin, H. et al *Chem. Res. Toxicol.* 1993, 6(5), 630-634.
4. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
5. *S. I. 1991 No. 472 The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
6. *National Toxicology Program Research and Testing Division* April 1997, Report No. TOX-45, NIEHS, Research Triangle Park, NC, USA.
7. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuyse (Bte 6), B-1160 Brussels, Belgium

D204 dichlorodifluoromethane



CCl_2F_2

Mol. Wt. 120.91

CAS Registry No. 75-71-8

Synonyms difluorodichloromethane; fluorocarbon 12; Freon 12; Arcton 6; Frigen 12; Genetron 12; R12; CF12

EINECS No. 200-893-9

RTECS No. PA 8200000

Uses Refrigerant. Aerosol propellant. Blowing agent for foam plastics. Etching agent. Solvent. Local anaesthetic.

Physical properties

M. Pt. -158°C B. Pt. -29.8°C Specific gravity 1.310 Volatility v.p. 4250 mmHg at 20°C

Solubility Water: $28\text{ }\mu\text{g l}^{-1}$ at 25°C . Organic solvents: diethyl ether, ethanol

Occupational exposure

DE-MAK 1000 ppm (5000 mg m^{-3})

FR-VME 1000 ppm (4950 mg m^{-3})

JP-OEL 500 ppm (2500 mg m^{-3})

SE-LEVL 500 ppm (2500 mg m^{-3})

SE-STEL 750 ppm (4000 mg m^{-3})

UK-LTEL 1000 ppm (5030 mg m^{-3})

UK-STEL 1250 ppm (6280 mg m^{-3})

US-TWA 1000 ppm (4950 mg m^{-3})

UN No. 1028 HAZCHEM Code 2RE Conveyance classification non-flammable non-toxic gas

Ecotoxicity

Invertebrate toxicity

Minimum concentration at which the development of saprophytic microflora in water reservoirs was affected 35 mg l^{-1} (1).

Environmental fate

Abiotic removal

Air stripping reported to be effective in the treatment of contaminated water (2).

Mammalian & avian toxicity

Acute data

LC_{50} (30 min) inhalation rat, mouse, rabbit, guinea pig 760,000-800,000 ppm (3).

LC_{50} (3 hr) inhalation rat 620,000 ppm (4).

Oral rat, no toxic effects observed following administration of 4 ml rat^{-1} (1).

Sub-acute and sub-chronic data

The no-adverse-effect level for 6-month oral administration to rats was $0.5\text{ mg kg}^{-1}\text{ day}^{-1}$ (1).

Inhalation rats, guinea pigs, rabbits, dogs and monkeys (90 day) no toxic effects at 810-840 ppm but some liver damage (5).

Carcinogenicity and chronic effects

σ , φ rats intragastric intubation (2 yr) $\leq 250\text{ mg kg}^{-1}$, showed no signs of clinical toxicity (6).

Inhalation rat, mouse (2 yr) 0, 1000, 5000 ppm 4 hr day^{-1} 5 day wk^{-1} no carcinogenic effect observed (7).

Genotoxicity

Bacillus subtilis equivocal results (8).

Other effects

Other adverse effects (human)

Inhalation (150 min) human volunteers 1000 ppm for 2.5 hr no adverse effects observed; (10 min) exposure to 110,000 ppm was harmful (9).

Legislation

Permitted as an extraction solvent for food (10).

Permitted for use in Food Statutory Instrument No. 1834, 1980 (11).

Maximum permissible concentration in domestic water in former USSR 10 mg l⁻¹ (12).

Tolerable Daily Intake (TDI) in humans 1.5 mg kg⁻¹ (13).

Other comments

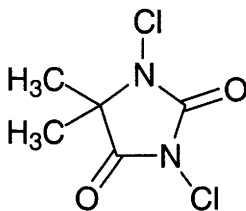
Water pollutant. Atmospheric pollutant, harmful to ozone layer.

Considered to adversely affect the ozone layer (14).

References

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4. *NCI Bioassay NCI-CG-TR-106* 1978, PB286-187.
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9. Azar, A. et al *Am. Ind. Hyg. Assoc. J.* 1972, **33**, 207.
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12. *Toxicological Data for Chemicals in Sources of Drinking Water* 1978, Technical Note 20, Central Water Planning Unit, Reading, UK.
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14. Longstaff, E. et al *Toxicol. Lett.* 1978, **2**, 1

D205 1,3-dichloro-5,5-dimethylhydantoin



C₅H₆Cl₂N₂O₂

Mol. Wt. 197.02

CAS Registry No. 118-52-5

Synonyms 2,4-imidazolidinedione, 1,3-dichloro-5,5-dimethyl-; hydantoin, 1,3-dichloro-5,5-dimethyl-; Dantoin; Hydan

EINECS No. 204-258-7

RTECS No. MU 0700000

Uses Chlorinating agent used as a disinfectant, bleach, industrial deodorant and in water treatment. Chemical intermediate. Stabiliser. Catalyst.

Physical properties

M. Pt. 134-136°C B. Pt. 212°C with decomposition Specific gravity 1.5 at 20°C Volatility v.den. 6.8
Solubility Water: 2.1 g l⁻¹. Organic solvents: benzene, carbon tetrachloride, chloroform

Occupational exposure

FR-VME 0.2 mg m⁻³

UK-LTEL 0.2 mg m⁻³

US-TWA 0.2 mg m⁻³

UK-STEL 0.4 mg m⁻³

US-STEL 0.4 mg m⁻³

Mammalian & avian toxicity

Acute data

LD₅₀ oral guinea pig, rabbit 1350, 1520 mg kg⁻¹, respectively (1).

Teratogenicity and reproductive effects

Oral mouse (days 6-13 gestation) 500 mg kg⁻¹. No adverse effects observed on litter size, viability, birth weight and weight gain (2).

Genotoxicity

Drosophila melanogaster sex-linked recessive lethal mutations negative (3).

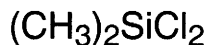
Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level 1 µg l⁻¹ (4).

References

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2. Hardin, B. D. et al Teratog., Carcinog., Mutagen. 1987, 47, 29-48.
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4. EC Directive Relating to the Quality of Water Intended for Human Consumption 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg

D206 dichlorodimethylsilane



C₂H₆Cl₂Si

Mol. Wt. 129.06

CAS Registry No. 75-78-5

Synonyms dimethyldichlorosilane; CD5550

EINECS No. 200-901-0

RTECS No. VV 3150000

Physical properties

B. Pt. 70°C Flash point -9°C (closed cup)

Occupational exposure

UN No. 1162 HAZCHEM Code 4WE Conveyance classification flammable liquid, corrosive

Supply classification highly flammable, irritant

Risk phrases Highly flammable – Irritating to eyes, respiratory system and skin (R11, R36/37/38)

Safety phrases Keep out of reach of children (if sold to general public) (S2)

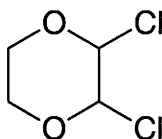
Other comments

Reviews on human health effects, experimental toxicology and physicochemical effects listed (1).

References

1. ECETOC Technical Report No. 71 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuysse (Bte 6), B-1160 Brussels, Belgium

D207 2,3-dichloro-*p*-dioxane



$C_4H_6Cl_2O_2$

Mol. Wt. 157.00

CAS Registry No. 95-59-0

Synonyms 2,3-dichloro-1,4-dioxane; *p*-dioxane, 2,3-dichloro-

EINECS No. 202-435-3

Uses Alkylating agent.

Physical properties

M. Pt. 30°C **B. Pt.** 80-82°C at 10 mmHg **Specific gravity** 1.468 at 20°C with respect to water at 4°C

Solubility Organic solvents: acetone, benzene, chloroform, diethyl ether, dioxane

Mammalian & avian toxicity

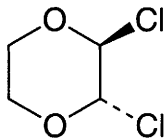
Carcinogenicity and chronic effects

Subcutaneous rabbit (dose unspecified) induced significant sarcomas at the site of injection (1).

References

1. van Duuren, B. L. et al *J. Natl. Cancer Inst.* 1974, 53(3), 695

D208 *trans*-2,3-dichloro-*p*-dioxane



$C_4H_6Cl_2O_2$

Mol. Wt. 157.00

CAS Registry No. 3883-43-0

Synonyms 1,4-dioxane, *trans*-2,3-dichloro-; *p*-dioxane, *trans*-2,3-dichloro-; *trans*-2,3-dichlorodioxane

RTECS No. JG 9800000

Uses Experimental carcinogen.

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 140 mg kg⁻¹ (1).

LD₅₀ dermal rabbit 440 mg kg⁻¹ (1).

Carcinogenicity and chronic effects

Subcutaneous (4 wk) ♀ 1CR/HA Swiss mice highest possible dose to give minimal cytotoxic effects. Significant incidences of sarcomas at the injection site. Dermal mouse (580 day) 0.5 mg in 0.1 ml acetone 3 × wk⁻¹ induced papillomas in 2/50 animals. Dermal mouse (580 day) 0.5 mg in 0.1 ml acetone single dose induced papillomas/carcinomas in 10/50 animals. Intraperitoneal mouse 0.5 mg in 0.05 ml Nujol once a wk induced papillary tumours of the lung (2).

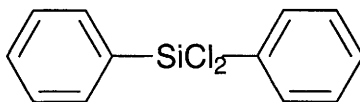
Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level 1 µg l⁻¹ (3).

References

1. *Annu. Meet. Am. Ind. Hyg. Assoc.* 1969, **30**, 470.
2. van Duuren, B. L. et al *J. Natl. Cancer Inst.* 1974, **53**, 695-700.
3. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg

D209 dichlorodiphenylsilane



$C_{12}H_{10}Cl_2Si$

Mol. Wt. 253.20

CAS Registry No. 80-10-4

Synonyms diphenyldichlorosilane; CD5950

EINECS No. 201-251-0

RTECS No. VV 3190000

Uses Preparation of prostaglandins and antibiotics and in catalytic polymerisation of olefins. Intermediate for silicone lubricants.

Physical properties

M. Pt. -22°C B. Pt. 305°C Flash point 157°C Specific gravity 1.204 at 20°C with respect to water at 4°C
Volatility v.den. 1.0

Occupational exposure

UN No. 1769 HAZCHEM Code 4XE Conveyance classification corrosive substance

Mammalian & avian toxicity

Irritancy

Dermal rabbit (24 hr) 500 mg caused moderate irritation and 5 mg instilled into rabbit eye (24 hr) caused severe irritation (1).

Other comments

Reviews on human health effects, experimental toxicology and workplace experience listed (2).

References

1. Marhold, J. *Prehled Prumyslove Toxikologie: Organické Latky* 1986, 1238, Prague, Czechoslovakia.
2. ECETOC Technical Report No. 71 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuysse (Bte 6), B-1160 Brussels, Belgium

D210 1,1-dichloroethane



C₂H₄Cl₂

Mol. Wt. 98.96

CAS Registry No. 75-34-3

Synonyms ethylidene chloride; chlorinated hydrochloric ether; ethylidene dichloride;
dichloromethylmethane

EINECS No. 200-863-5

RTECS No. KI 0175000

Uses Intermediate in the production of 1,1,1-trichloroethane from vinyl chloride. Formerly used as an anaesthetic. Solvent.

Physical properties

M. Pt. -97°C B. Pt. 57.3°C Flash point 14°C (open cup) Specific gravity 1.1757 at 20°C with respect to water at 4°C Partition coefficient log P_{ow} 1.79 (1) Volatility v.p. 230 mmHg at 215°C ; v.den. 3.44
Solubility Water: 5 g l⁻¹. Organic solvents: diethyl ether, ethanol, chlorinated hydrocarbons

Occupational exposure

DE-MAK 100 ppm (410 mg m⁻³)

FR-VME 200 ppm (810 mg m⁻³)

JP-OEL 100 ppm (400 mg m⁻³)

UK-LTEL 200 ppm (823 mg m⁻³)

UK-STEL 400 ppm (1650 mg m⁻³)

US-TWA 100 ppm (405 mg m⁻³)

UN No. 2362 HAZCHEM Code 2YE Conveyance classification flammable liquid

Supply classification highly flammable

Supply classification harmful

Risk phrases Highly flammable – Harmful if swallowed – Irritating to eyes and respiratory system – Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R11, R22, R36/37, R52/53)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from sources of ignition – No smoking – Do not breathe vapour – Avoid release to the environment. Refer to special instructions/safety data sheet (S2, S16, S23, S61)

Ecotoxicity**Fish toxicity**

LC₅₀ (96 hr, static) tidewater silverside and bluegill sunfish 480 and 550 mg l⁻¹, respectively (2).

Invertebrate toxicity

LC₅₀ (30 min) *Photobacterium phosphoreum* 351 ppm Microtox test (3).

Bioaccumulation

The calculated bioconcentration factor of 1.2 indicates that environmental accumulation is unlikely (4).

Environmental fate**Degradation studies**

Completely degraded with the release of stoichiometric amounts of chloride by the methanotrophic bacterium *Methylosinus trichosporium* grown in continuous culture (5).

Abiotic removal

Treatment of contaminated groundwater with UV radiation, ozone and hydrogen peroxide achieved >90% removal; air stripping was also reported to contribute towards removal (6).

Evaporation from water of 1 mg l⁻¹ at 25°C: 50% after 22 min, 90% after 109 min (7).

Evaporation rate relative to *n*-butyl acetate, which has been assigned a value of 1 at 25°C, is 9.14 (8).

t_{1/2} for volatilisation from pond water 6-9 day, lake water 5-8 day and river water 24-32 hr (9).

t_{1/2} for reaction with photochemically-produced hydroxyl radicals in the atmosphere 62 days (10).

Mammalian & avian toxicity**Acute data**

LD₅₀ oral rat 725 mg kg⁻¹ (11).

LC₅₀ (2 hr) inhalation mouse 17,300 ppm (12).

LC₅₀ (8 hr) inhalation rat 16,000 ppm (12).

Sub-acute and sub-chronic data

Inhalation cat, 6 hr day⁻¹ 500 ppm caused no adverse effects, at 1000 ppm kidney damage and slight liver damage were observed (period of exposure unspecified) (13).

Carcinogenicity and chronic effects

Did not initiate or promote activity in the rat liver foci bioassay (14).

Oral mouse (12 month) 835 or 2500 mg l⁻¹ in drinking water. There was no increase in the incidence of tumours compared to controls. Also, the incidence and number of liver and lung tumours which were initiated by treatment with diethylnitrosamine were not affected (15).

National Toxicology Program investigated 1,1-dichloroethane in rats and mice via gavage. Equivocal results were obtained for ♀ rats and mice. Negative results were obtained for ♂ rats and mice (16).

Teratogenicity and reproductive effects

Slight decreases in foetal weights and embryotoxicity have been noted in cats following inhalation exposure, but there was no evidence of teratogenicity (13).

Irritancy

Causes mild eye irritancy with corneal clouding, which is generally reversible (species unspecified) (13).

Genotoxicity

Aspergillus nidulans P1 chromosome malsegregation assay positive (17).

Other comments

Found in landfill gases and leachates. Residues have been isolated from soil and groundwater. Disinfection by-product in chlorinated water.

When applied to rabbit skin the solvent produces little effect and evaporates off. When evaporation is prevented, slight defatting of the skin occurs, but there is no evidence of absorption (13).

Physical properties, exposure limits, uses, biological hazards, first aid and handling precautions reviewed (13).

Environmental fate of 1,1-dichloroethane reviewed (9).

Ecotoxicology reviewed (18).

References

1. Hansch, C. et al *Medchem Project* 1985, Pomona College, Claremont, CA, USA.
2. Dawson, G. W. et al *J. Hazard. Mat.* 1975/77, **1**, 303.
3. Kaiser, K. L. E. et al *Water Pollut. Res. J. Can.* 1991, **26**(3), 361-431.
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18. Kross, B. C. et al *Toxicity Screening of Harmful Leachates* in Richardson, M. L. (Ed.) *Ecotoxicology Monitoring* 1993, 225-249, VCH Publishers, Weinheim, Germany

D211 1,2-dichloroethane



$\text{C}_2\text{H}_4\text{Cl}_2$

Mol. Wt. 98.96

CAS Registry No. 107-06-2

Synonyms ethylene dichloride; glycol dichloride; ethylene chloride; EDC; *sym*-dichloroethane; α,β -dichloroethane

EINECS No. 203-458-1

RTECS No. KI 0525000

Uses Chemical intermediate. Solvent. Gasoline lead scavenger. Fumigant for grain. Former upholstery and carpet cleaner.

Physical properties

M. Pt. -40°C **B. Pt.** 84°C **Flash point** 13°C (closed cup) **Specific gravity** 1.2569 at 20°C with respect to water at 4°C **Partition coefficient** $\log P_{ow}$ 1.48 (1) **Volatility** v.p. 64 mmHg at 20°C ; v.den. 3.4
Solubility Water: 8 g l⁻¹. Organic solvents: chloroform, diethyl ether, ethanol

Occupational exposure

FR-VME 10 ppm (40 mg m⁻³)

JP-OEL 10 ppm (40 mg m⁻³)

SE-LEVL 1 ppm (4 mg m⁻³)

SE-STEL 5 ppm (20 mg m⁻³)

UK-LTEL MEL 5 ppm (21 mg m⁻³)

US-TWA 10 ppm (40 mg m⁻³)

UN No. 1184 **HAZCHEM Code** 2YE **Conveyance classification** flammable liquid, toxic

Supply classification highly flammable, toxic

Risk phrases May cause cancer – Highly flammable – Harmful if swallowed – Irritating to eyes, respiratory system and skin (R45, R11, R22, R36/37/38)

Safety phrases Restricted to professional users – Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S53, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) guppy, fathead minnow 135, 185 mg l⁻¹, respectively (2,3).

LC₅₀ (7 day) guppy 106 mg l⁻¹ (4).

Invertebrate toxicity

LC₅₀ (96 hr) brown shrimp 65 mg l⁻¹ (2).

LC₅₀ (30 min) *Photobacterium phosphoreum* 924 ppm Microtox test (5).

Bioaccumulation

Bioconcentration factor for bluegill sunfish 0.30 (6).

Non-accumulative or low accumulative (7).

Environmental fate

Nitrification inhibition

Limiting concentration for nitrification inhibition, agar test, 125 mg l⁻¹ (8).

Degradation studies

Completely degraded with the release of stoichiometric amounts of chloride by the methanotrophic bacterium *Methylosinus trichosporium* grown in continuous culture (9).

COD 1.025 mg l⁻¹ O₂; ThOD 0.97 mg l⁻¹ O₂; BOD (20 day) 20% of ThOD (10).

Abiotic removal

The effectiveness of pilot-scale air stripping study is described (11).

t_{1/2} for evaporation of 1 mg l⁻¹ at 25°C at 6.5 cm depth 28 min (12).

t_{1/2} for reaction with photochemically produced hydroxyl radicals in the atmosphere ~1 month (13).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, rabbit and mouse 500-970 mg kg⁻¹ (14-16).

LC₅₀ (4 hr) inhalation rat 4000 mg m⁻³ (17).

LD₅₀ intraperitoneal rat 1000 mg kg⁻¹ (18).

Sub-acute and sub-chronic data

Acute exposure studies in rats, 1,2-dichloroethane caused disseminated haemorrhagic lesions, mainly in the liver. Chronic exposure caused degeneration of the liver and tubular damage and necrosis of the kidneys (dose and durations unspecified) (14).

Inhalation rat, 1200 mg m⁻³ produced depression of the central nervous system, with narcotic effects at higher concentrations (duration unspecified) (19).

Carcinogenicity and chronic effects

No adequate data for evaluation of carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (20).

Oral mouse (12 month) 835 or 2500 mg l⁻¹ in drinking water. There was no increase in the incidence of tumours compared to controls. Also, the incidence and number of liver and lung tumours initiated by treatment with diethylnitrosamine were not affected (21).

Inhalation rat (2 yr) 50 ppm for 7 hr day⁻¹, 5 day wk⁻¹. No significant increase in any tumours found (22).

Oral rat and mouse (2 yr) 75-400 mg kg⁻¹ day⁻¹ for 78 wk. In mice, treatment produced benign and malignant tumours of the lung and malignant lymphomas in animals of both sexes, hepatocellular carcinomas in ♂ and mammary and uterine adenocarcinomas in ♀. In rats it produced carcinomas of the forestomach in ♂, benign and malignant mammary tumours in ♀ and haemangiosarcomas in animals of both sexes (23).

Intraperitoneal mouse (24 wk) 20, 40 or 100 mg kg⁻¹ 3 × wk⁻¹ for 8 wk. There was no significant increase in the incidence of lung tumours, although this test has been regarded as inadequate (24,25).

National Toxicology Program investigated 1,2-dichloroethane in rats and mice via gavage. Positive results were obtained for both sexes of rats and mice (26).

Teratogenicity and reproductive effects

Foetotoxicity in pregnant rats and mice was reported (27).

Metabolism and toxicokinetics

Peak blood level in rat during dermal exposure for 24 hr 135 mg l⁻¹ (28).

1,2-Dichloroethane is metabolised in rat and mouse by 2 competing pathways, both of which involve GSH.

Oxidation gives chloroacetaldehyde which is detoxified by GSH. It also reacts directly with GSH to form S-(2-chloroethyl)glutathione. These are 2nd order reactions (29).

Following intraperitoneal injection of mouse, the alkyl purines 7-(2-oxoethyl)guanine and 7-[S-(2-cysteinyl)ethyl]guanine were found in DNA hydrolysates and in the urine. Chloroacetaldehyde and S-(2-chloroethyl)glutathione were found in haemoglobin (30).

Following intraperitoneal injection of 50-170 mg kg⁻¹ ¹⁴C-1,2-dichloroethane to mice, 10-42% was expired unchanged and 12-15% as carbon dioxide. Most of the remainder was excreted in the urine, primarily as chloroacetic acid (via chloroacetaldehyde), S-(carboxymethyl)cysteine and thiodiacetic acid (31).

Little dechlorination of 1,2-dichloroethane was found to occur in rat and rabbit liver preparations *in vitro* (32).

Irritancy

Dermal rabbit 600 mg (open) caused mild irritation and 63 mg instilled into rabbit eye caused severe irritation (periods of exposure unspecified) (33).

Genotoxicity

Salmonella typhimurium TA100, TA1535 with and without metabolic activation positive (34).

Escherichia coli K39 lysogeny induction negative (35).

Aspergillus nidulans P1 chromosome malsegregation assay positive (36).

Drosophila melanogaster sex-linked recessive lethal assay positive (37).

Increased the mutation frequency in barley (*Hordeum vulgare*) (38).

Other effects

Other adverse effects (human)

In humans, deaths due to ingestion and inhalation have been reported from circulatory and respiratory failure. In many cases of acute poisoning, hyperaemia and haemorrhagic lesions have been observed throughout the body;

these have been attributed to a reduction in the level of blood clotting factors and to thrombocytopenia. Repeated occupational exposure has been associated with anorexia, nausea, abdominal pain, irritation of the mucous membranes, liver and kidney dysfunction, and neurological disorders (25).

1,2-Dichloroethane was reported to induce premature birth in exposed women workers and in wives of male workers in China (27).

Legislation

Included in Schedule 5 (Release into Water: Prescribed Substances) Statutory Instrument No. 472, 1991 (39).

Maximum permissible concentration in domestic water in Russia and CIS 2.0 mg l⁻¹ (40).

Other comments

Present in the gases of waste incinerators and landfill gas and leachates. Residues have been isolated from water and sediments. Disinfection by-product in chlorinated water.

Physical properties, use, handling precautions, occurrence, carcinogenicity, toxicity, metabolism and mutagenicity of 1,2-dichloroethane reviewed (25,41).

Environmental fate of 1,2-dichloroethane reviewed (42,43).

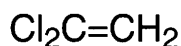
Reproductive toxicology reviewed (44).

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D212 1,1-dichloroethylene



$\text{C}_2\text{H}_2\text{Cl}_2$

Mol. Wt. 96.94

CAS Registry No. 75-35-4

Synonyms 1,1-dichloroethene; vinylidene chloride; *asym*-dichloroethylene

EINECS No. 200-864-0

RTECS No. KV 9275000

Uses Intermediate in the manufacture of vinylidene polymer plastics.

Physical properties

M. Pt. -122.5°C B. Pt. 31.7°C Flash point -28°C (closed cup) Specific gravity 1.2129 at 20°C with respect to water at 4°C Partition coefficient $\log P_{\text{ow}}$ 1.66 (1) Volatility v.p. 591 mmHg at 25°C ; v.den. 3.4
Solubility Water: 2.5 g l^{-1} at 25°C . Organic solvents: acetone, benzene, chloroform, diethyl ether, ethanol

Occupational exposure

DE-MAK 2 ppm (8.0 mg m^{-3})

FR-VME 5 ppm (20 mg m^{-3})

SE-LEVL 5 ppm (20 mg m^{-3})

SE-STEL 10 ppm (40 mg m^{-3})

UK-LTEL MEL 10 ppm (40 mg m^{-3})

US-TWA 5 ppm

UN No. 1150 HAZCHEM Code 3YE Conveyance classification flammable liquid

Supply classification extremely flammable, harmful

Risk phrases Extremely flammable – Harmful by inhalation – Possible risk of irreversible effects (R12, R20, R40)

Safety phrases Restricted to professional users – Keep out of reach of children (if sold to general public) – Keep container tightly closed – Keep away from sources of ignition – No smoking – Do not empty into drains (S2, S7, S16, S29)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 108 mg l⁻¹ flow-through bioassay (2).
LC₅₀ (48 hr) bluegill sunfish 79 mg l⁻¹ (3).
LC₅₀ (24 hr) sheeps head minnow 250 mg l⁻¹ static bioassay (4).
LC₅₀ (96 hr) tidewater silverside 250 mg l⁻¹ (5).

Invertebrate toxicity

EC₅₀ (24 hr) *Daphnia magna* 98 mg l⁻¹ (6).
LC₅₀ (50 day) methanogenic bacterial culture 7.7 mg l⁻¹ (7).

Bioaccumulation

Bioconcentration factors of 4-7 have been reported in fish (8).

Environmental fate

Nitrification inhibition

Does not inhibit nitrifying bacteria at 75 mg l⁻¹ (threshold concentration) (9).

Degradation studies

Partially degraded by the methanotrophic bacterium, *Methylosinus trichosporium*, grown in continuous culture (10).
Microbial degradation 78%; concentration 5 mg l⁻¹ following 7 day incubation at 25°C with settled domestic wastewater as microbial inoculum. At concentrations of 10 mg l⁻¹, 45% removal was reported. However, it has been suggested that volatilisation may have accounted for some of the measured loss (8,11).

Abiotic removal

Reacts with photochemically-produced hydroxyl radicals in the atmosphere, t_{1/2} ~2 day (12).
Volatilisation is reported to be the major process for removal from water; 1 g l⁻¹ in stirred solution with a depth of 6.5 cm at 25°C, t_{1/2} 27 min; static pond water calculated t_{1/2} ~6 day, river water ~1 day (8,13).
Evaporation rate relative to *n*-butyl acetate, which has been assigned a value of 1 at 25°C, is 15.7 (14).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1500 mg kg⁻¹ (15).
LD₅₀ oral mouse 200 mg kg⁻¹ (16).
LC₅₀ (4 hr) inhalation rat 500-15,000 ppm (2-60 g m⁻³) (17,18).

Sub-acute and sub-chronic data

Dermal rabbit treated with 2 ml for 24 hr; no toxic effects found during 14 day observation period (19).
LC₅₀ (10 day) pregnant rat and mouse exposed for 23 hr day⁻¹ 320 mg m⁻³ in mice and >1820 mg m⁻³ in rats (20).
Inhalation rat (20 day) 2000 mg m⁻³ for 6 hr day⁻¹ caused nasal irritation, reduced weight gain and histopathological changes in the liver (21).
Inhalation rat (90 day) 100 or 300 mg m⁻³ caused minimal toxicological effects in the liver (fatty liver changes and hepatocellular hypertrophy in the portal area) (22).
Oral mouse, 100-200 mg kg⁻¹ doses were reported to cause selective damage of pulmonary Clara cells (23).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans, limited evidence for carcinogenicity to animals, IARC classification group 3 (24).
Oral mouse (2 yr) 2 or 10 mg kg⁻¹ 5 × wk⁻¹. A reduction in body weight was observed in mice receiving the lower dose. There was a statistically significant increase in the combined incidence of lymphomas and leukaemia in the lower dose ♀ and in all treated ♂ mice. In rats given 1 or 5 mg kg⁻¹ no significant increase in tumours was observed (25).
Inhalation mouse (126 wk) 10 or 25 ppm for 4 hr day⁻¹, 4 or 5 day wk⁻¹ for 52 wk. Treated group showed an increase in the incidence of tumours at several sites: pulmonary adenomas, kidney adenocarcinomas in ♂ mice and mammary tumours in ♀ mice. Groups exposed to 50, 100 and 200 ppm suffered high mortality within 2-4 days of commencement of the study, these concentrations were withdrawn. In rats exposed to 10-100 ppm and

hamsters exposed to 25 ppm the pattern of neoplasms and their incidences were comparable among treated and control animals (26).

Dermal mouse (20 month) 40 or 121 mg applied $3 \times \text{wk}^{-1}$ for 440-594 days. No skin papilloma was observed on treated animals; papillomas of the forestomach were observed in 2/15 high-dose animals (27).

Subcutaneous mouse (78 wk) 2 mg wk^{-1} active as skin tumour initiator in 2-stage carcinogenesis assay (27).

♀ rats were given a single dose of 150 mg kg^{-1} by stomach tube on day 17 of gestation. Their progeny received wkly doses of 50 mg kg^{-1} at weaning for 120 wk. There was no statistically significant increase in the incidence of tumours in treated animals, although tumours that were not seen in controls appeared at a variety of sites in treated animals. Litter sizes, pre-weaning mortality, survival rates and body-weight gains were similar in treated and control groups. Hyperplastic liver nodules were found in 2/23 treated dams and 2/81 ♂ and 65/80 ♀ progeny. No such effect was seen in controls (28).

Oral rat (2 yr) 7-30 mg kg^{-1} . There was no statistically significant increase in tumour incidence in treated animals. Mortality and body-weight gain were also similar to control groups (22).

Oral rat (147 wk) 0.5-20 mg kg^{-1} by gastric intubation 4 or 5 day wk^{-1} for 52 wk. The pattern of different neoplasms and their incidences were comparable among treated and control animals (26).

Inhalation rat (12 month) 55 ppm for 6 hr day $^{-1}$ 5 day wk^{-1} for up to 12 months. Two rats developed angiosarcomas, one in a mesenteric lymph node and the other in subcutaneous tissue. No such tumours occurred in controls (29).

Inhalation rat (22 month) 55 ppm for 6 hr day $^{-1}$ 5 day wk^{-1} for 1, 3, 6 or 10 months. No treatment-related tumour was reported, although a single hepatic haemangiosarcoma was observed in a ♂ rat exposed for 6 months.

Survival rates were similar in treated and control groups (30).

Inhalation rat (2 yr) 10 or 40 ppm 6 hr day $^{-1}$ 5 day wk^{-1} for 1 month. Exposure was then increased to 25 or 75 ppm for 17 months because of the lack of treatment-related effects. There was no treatment-related effect on body weight gain or survival except for an increase in mortality among ♀ exposed to 75 ppm for 15, 17 and 21 months. No treatment-related neoplasms were observed (31).

Oral rat (2 yr) 5-40 mg kg^{-1} day $^{-1}$ via drinking water. No toxicological effect was observed except for a non-dose-related decrease in survival of ♂ rats at 10 and 24 months (32).

No excess of cancer was found among 138 US workers exposed to 1,1-dichloroethylene. A follow-up study was reported to be incomplete and 40% of the workers had less than 15 yr latency since first exposure (33).

In a study of 629 German workers there was no excess of cancers reported (34).

No specific association was found between exposure to 1,1-dichloroethylene and an excess of lung cancer in a US chemical plant (35).

Teratogenicity and reproductive effects

Inhalation rat, mouse, when inhalation was begun on day 7 of gestation, no litter was produced in mice exposed to 120 mg m^{-3} or rats exposed to 220 mg m^{-3} for 23 hr day $^{-1}$ (20).

Oral rat (3-generation) 50, 100 or 200 mg l^{-1} in drinking water, survival was comparable in treated and control groups and there was no evidence of teratogenic effects (36).

Metabolism and toxicokinetics

As the dose to rats is increased from 1 to 50 mg kg^{-1} orally or from 40-800 mg m^{-3} by inhalation, the metabolic pathways become saturated, so that a smaller percentage of the dose administered is metabolised and more is eliminated via the lungs. At the lowest doses there was no difference in the route of excretion in fed and fasted rats; with the highest doses there was a significant increase in excretion via the lungs and decrease in urinary excretion in fed versus fasted rats. This pattern is explained by a saturable dose-dependent metabolism of 1,1-dichloroethylene (37,32).

Comparative studies in rats and mice have revealed that mice, which are more susceptible to 1,1-dichloroethylene than rats, biotransform the chemical to a greater extent than rats (16,38).

The main excretory route for ^{14}C -1,1-dichloroethylene in rats after intragastric, intravenous or intraperitoneal administration is pulmonary: both unchanged substances and related carbon dioxide are excreted by that route. Other metabolites are eliminated via the kidneys. Thiodihydroxy acetic acid and an *N*-acetyl-S-cysteinyllacetyl derivative were the major urinary metabolites, together with substantial amounts of chloroacetic acid,

dithiohydroxyacetic acid and thiohydroxyacetic acid. Methylthioacetyl aminoethanol has also been isolated as a urinary metabolite, which is consistent with the observation of an increase in toxicity. Mice, but not rats, excreted a small amount of *N*-acetyl-S-(2-carboxymethyl)cysteine, and mice excreted more *N*-acetyl-S-derivative than rats (16,39,40).

Undergoes metabolic toxification in mouse liver. Cytochrome P₄₅₀ 2E1 isozyme is responsible for the metabolic activation. Conjugation with reduced glutathione (GSH) is a detoxification step (41).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (42).

Escherichia coli WP2 *uvrA* with metabolic activation positive (43).

Saccharomyces cerevisiae D7 with metabolic activation negative (44).

In vitro Chinese hamster V79 cells forward gene mutation with and without metabolic activation negative (45).

In vitro Chinese hamster ovary cells sister chromatid exchange with and without metabolic activation positive (46).

In vitro L5178Y mouse lymphoma forward mutation assay positive (47).

In vivo inhalation rat bone marrow cytogenetic assay negative (31).

Other effects

Any other adverse effects

Intraperitoneal rats (4 days) 200-800 mg kg⁻¹ daily. The activity of the P₄₅₀-dependent testosterone 2 α -hydroxylase in liver microsomes was remarkably decreased by 800 mg kg⁻¹ and the activities of 7-methoxyresorufin O-demethylase, 7-ethoxycoumarin O-deethylase, benzphetamine N-demethylase, chlorzoxazone 6-hydroxylase, and testosterone 6 β -hydroxylase were significantly decreased by the same dose. However, the activities of other P₄₅₀-dependent monooxygenases, viz. 7-ethoxyresorufin O-deethylase, 7-benzoyloxyresorufin O-debenzylase, aminopyrine N-demethylase, erythromycin N-demethylase, lauric acid meta-hydroxylase, and testosterone 7 α -hydroxylase were not affected at any dose (48).

1,1-Dichloroethylene is reported to increase serum alanine α -ketoglutarate transaminase activity and hepatic triglycerides, and decreases those of hepatic glucose-6-phosphatase and glutathione in rats. Lethality and hepatotoxicity are increased by fasting (which leads to decreased hepatic glutathione concentrations) and by phenobarbital and 3-methylcholanthrene (which induce microsomal enzymes) (17,49).

Skin contact caused irritation which may be due partly to the presence of hydroquinone monomethyl ether inhibitor (50).

Contact with the eyes causes conjunctivitis and transient corneal injury (51).

In one study, spirometry, blood chemistry (including liver and renal tests), haematological parameters and blood pressure measurements did not differ in exposed workers and controls. Measured past time-weighted mean concentrations ranged up to 280 mg m⁻³ (32).

Legislation

Limited under EC Directive for Drinking Water Quality 80/778/EEC. Organochlorines: guide level 1 μ g l⁻¹ (52).

Other comments

1,1-Dichloroethylene has been detected in air, wastewater and drinking water. Residues have been isolated from some foods and food packaging (37,8).

Hyperthyroidism potentiates the *in vivo* hepatotoxicity of 1,1-dichloroethylene in rats (53).

Environmental fate of 1,1-dichloroethylene reviewed (54).

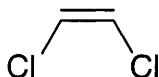
Physical properties, use, occurrence, analysis, environmental effects, carcinogenicity, mammalian toxicity, metabolism, genotoxicity and teratology of 1,1-dichloroethylene reviewed (37,8).

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D213 *cis*-1,2-dichloroethylene



$C_2H_2Cl_2$

Mol. Wt. 96.94

CAS Registry No. 156-59-2

Synonyms (Z)-1,2-dichloroethene; *cis*-1,2-dichloroethene; *cis*-acetylene dichloride

EINECS No. 205-859-7

RTECS No. KV 9420000

Uses Solvent. Organic synthesis.

Physical properties

M. Pt. $-81.5^{\circ}C$ B. Pt. $60^{\circ}C$ Flash point $6^{\circ}C$ Specific gravity 1.284 at $20^{\circ}C$

Partition coefficient $\log P_{ow}$ 1.86 (1) Volatility v.p. 200 mmHg at $25^{\circ}C$; v.den. 3.4

Solubility Water: 800 mg l^{-1} at $20^{\circ}C$. Organic solvents: acetone, benzene, chloroform, diethyl ether, ethanol

Occupational exposure

DE-MAK 200 ppm (800 mg m^{-3})

JP-OEL 150 ppm (590 mg m^{-3})

US-TWA 200 ppm (793 mg m^{-3})

UN No. 1150 HAZCHEM Code 3YE Conveyance classification flammable liquid

Supply classification highly flammable

Supply classification harmful

Risk phrases Highly flammable – Harmful by inhalation – Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R11, R20, R52/53)

Safety phrases Keep out of reach of children (if sold to general public) – Keep container tightly closed – Keep away from sources of ignition – No smoking – Do not empty into drains – Avoid release to the environment. Refer to special instructions/safety data sheet (S2, S7, S16, S29, S61)

Ecotoxicity

Invertebrate toxicity

LC_{50} (30 min) *Photobacterium phosphoreum* 905 ppm Microtox test (2).

Bioaccumulation

The calculated bioconcentration factor of 15 indicates that environmental accumulation is unlikely (3).

Environmental fate

Degradation studies

Completely degraded by the methanotrophic bacterium *Methylosinus trichosporium*, but not all the chloride was released because of the formation of *cis*-2,3-dichlorooxirane (4).

Abiotic removal

Evaporation from water at $25^{\circ}C$ of 1 mg l^{-1} solution, 50% after 18 min, 90% after 64 min (5).

$t_{1/2}$ for reaction with photochemically produced hydroxyl radicals 8 days (6).

Mammalian & avian toxicity

Acute data

LC_{Lo} (2 hr) inhalation mouse 65 g m⁻³ (7).

Carcinogenicity and chronic effects

Did not initiate or promote activity in the rat liver foci bioassay, which would indicate that *cis*-1,2-dichloroethene is not capable of initiating carcinogenesis (8).

Metabolism and toxicokinetics

Metabolism of *cis*-1,2-dichloroethene in isolated rat hepatocytes resulted in the production of 2,2-dichloroethanol and smaller amounts of dichloroacetic acid and dichloroacetaldehyde (9).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (10).

Saccharomyces cerevisiae D₇ with and without metabolic activation positive (11).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level 1 µg l⁻¹ (12).

Other comments

Component of commercial preparations of 1,2-dichloroethene.

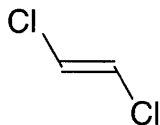
Environmental fate of *cis*-1,2-dichloroethene reviewed (3).

Autoignition temperature 441°C.

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D214 *trans*-1,2-dichloroethylene



$C_2H_2Cl_2$

Mol. Wt. 96.94

CAS Registry No. 156-60-5

Synonyms (*E*)-1,2-dichloroethene; *trans*-1,2-dichloroethene; *trans*-acetylene dichloride

EINECS No. 205-860-2

RTECS No. KV 9400000

Uses Solvent. Organic synthesis.

Physical properties

M. Pt. $-49.4^{\circ}C$ B. Pt. $48^{\circ}C$ Flash point $6^{\circ}C$ Specific gravity 1.257 at $20^{\circ}C$

Partition coefficient $\log P_{ow}$ 2.06 (1) Volatility v.p. 400 mmHg at $30.8^{\circ}C$; v.den. 3.4

Solubility Water: 600 mg l^{-1} at $25^{\circ}C$. Organic solvents: acetone, benzene, chloroform, diethyl ether, ethanol

Occupational exposure

DE-MAK 200 ppm (800 mg m^{-3})

JP-OEL 150 ppm (590 mg m^{-3})

US-TWA 200 ppm (793 mg m^{-3})

UN No. 1150 HAZCHEM Code 3YE Conveyance classification flammable liquid

Supply classification highly flammable

Supply classification harmful

Risk phrases Highly flammable – Harmful by inhalation – Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R11, R20, R52/53)

Safety phrases Keep out of reach of children (if sold to general public) – Keep container tightly closed – Keep away from sources of ignition – No smoking – Do not empty into drains – Avoid release to the environment. Refer to special instructions/safety data sheet (S2, S7, S16, S29, S61)

Ecotoxicity

Invertebrate toxicity

LC₅₀ (30 min) *Photobacterium phosphoreum* 1540 ppm Microtox test (2).

Bioaccumulation

The calculated bioconcentration factor of 22 indicates that environmental accumulation is unlikely (3).

Environmental fate

Nitrification inhibition

IC₅₀ (25 day) *Nitrosomonas* 80 mg l^{-1} (4).

Carbonaceous inhibition

IC₅₀ (50 day) methanogenic bacterial culture 48 mg l^{-1} (4).

Degradation studies

Completely degraded by the methanotrophic bacterium *Methylosinus trichosporium*, but not all the chloride was released because of the formation of *trans*-2,3-dichlorooxirane (5).

Abiotic removal

Bench scale tests conducted to assess the applicability of treatment with hydrogen peroxide and ozone in treating contaminated groundwater demonstrated that stripping was the primary mechanism of removal (6).

The effectiveness of a pilot scale air stripping study is described (7).

Evaporation from water at 25°C of 1 mg l⁻¹ solution, 50% after 24 min, 90% after 83 min (8).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 2 g kg⁻¹ (9).

LD₅₀ oral rat 8-10 g kg⁻¹ (10).

LC₅₀ (2 hr) inhalation mouse 75 g m⁻³ (11).

LD₅₀ intraperitoneal mouse, rat 4, 7.5 g kg⁻¹, respectively (12).

Sub-acute and sub-chronic data

Oral rat (90 day) 500, 1500 or 3000 mg kg⁻¹ day⁻¹ in drinking water. There were no significant compound-related adverse effects on the haematological, serological or urinary parameters studied, and no specific organ-site toxicity was identified (10).

Carcinogenicity and chronic effects

Did not initiate or promote activity in the rat liver foci bioassay which would indicate that *trans*-1,2-dichloroethene is not capable of initiating carcinogenesis (13).

Metabolism and toxicokinetics

Metabolism of *trans*-1,2-dichloroethene in isolated rat hepatocytes gave rise to dichloroacetic acid and traces of dichloroacetaldehyde and dichloroethanol (14).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (15).

Saccharomyces cerevisiae D61M without metabolic activation positive (16).

Other effects

Any other adverse effects

The effect on hepatic microsomal P450 enzymes in ♂ and ♀ rats following intraperitoneal injection of 7.5 mmol kg⁻¹ daily for four days was studied. Testosterone 2α-hydroxylase activity was decreased in ♂ rats for both the *cis*- and the *trans*-isomers. Testosterone 6β-hydroxylase activity was reduced by the *cis*- but not the *trans*-isomer. The *cis*-isomer decreased the activities of ethoxycoumarin *O*-deethylase, benzyloxyresorufin *O*-debenzylase, chlorzoxazone 6-hydroxylase, and testosterone 7α-hydroxylase, but the *trans*-isomer significantly increased the activities of 7-ethoxyresorufin *O*-deethylase and 7-methoxyresorufin *O*-demethylase in the ♂ rat. The activities of other P450-dependent monooxygenases in the ♂ rat, viz. benphetamine *N*-demethylase, aminopyrine *N*-demethylase, erythromycin *N*-demethylase, and lauric acid ω-hydroxylase, were not affected to any extent by either isomer. Neither isomer had any significant effect on P₄₅₀-dependent monooxygenase activities in the ♀ rat (17).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level 1 µg l⁻¹ (18).

Other comments

Component of commercial preparations of 1,2-dichloroethene.

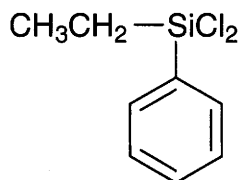
Environmental fate of *trans*-1,2-dichloroethylene reviewed (19).

Autoignition temperature 460°C.

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D215 dichloroethylphenylsilane



$\text{C}_8\text{H}_{10}\text{Cl}_2\text{Si}$

Mol. Wt. 205.16

CAS Registry No. 1125-27-5

Synonyms ethyl(phenyl)dichlorosilane

EINECS No. 214-407-8

RTECS No. VV 3270000

Physical properties

B. Pt. 229-230°C Flash point >71°C (open cup) Specific gravity 1.149-1.156 at 20°C Volatility v.den. 7.07

Occupational exposure

UN No. 2435 HAZCHEM Code 4WE Conveyance classification corrosive substance

Mammalian & avian toxicity

Irritancy

Inhalation exposure caused nose and throat irritation. Contact with the liquid caused severe burns to the eyes and skin. Ingestion caused severe burns to the mouth and stomach (species unspecified) (1).

References

1. Hawley, G. G. *The Condensed Chemical Dictionary* 9th ed., 1977, 367, Van Nostrand Reinhold, New York, USA

D216 dichlorofluoromethane



CHCl_2F

Mol. Wt. 102.92

CAS Registry No. 75-43-4

Synonyms fluorodichloromethane; Freon 21; Arcton 7; HCFC 21; R 21; FC 21; Genetron 21

EINECS No. 200-869-8

RTECS No. PA 8400000

Uses Refrigerant. Aerosol propellant. Blowing agent for polymers.

Physical properties

M. Pt. -135°C B. Pt. 8.9°C at 67 mmHg Specific gravity 1.405 at 9°C Volatility v.p. 1.19×10^3 mmHg at 21°C ; v.den. 4.57

Solubility Water: 0.95% at 25°C . Organic solvents: dimethyl phthalate, mineral oil, propylene glycol

Occupational exposure

DE-MAK 10 ppm (43 mg m^{-3})

FR-VME 10 ppm (40 mg m^{-3})

UK-LTEL 10 ppm (43 mg m^{-3})

US-TWA 10 ppm (42 mg m^{-3})

UN No. 1029 HAZCHEM Code 2RE Conveyance classification non-flammable non-toxic gas

Environmental fate

Abiotic removal

The estimated tropospheric lifetime of dichlorofluoromethane is ~ 2 yr. Reaction with photochemically produced hydroxyl radicals is likely to be the primary route of degradation (1).

Mammalian & avian toxicity

Acute data

LC₅₀ (4 hr) inhalation rat 49,900 ppm (2).

LC₅₀ (4 hr) inhalation rat 210 g m^{-3} (3).

LC_{Lo} (1 hr) inhalation guinea pig 100,000 ppm (4).

EC₅₀ (5 min) inhalation dog, cardiac arrhythmias 107 g m^{-3} (5).

Tachycardia, bronchoconstriction and loss of pulmonary compliance were also found at exposure levels of 107 g m^{-3} in anaesthetised dogs exposed for 7 min (6).

Sub-acute and sub-chronic data

At doses of 164 to 2240 $\text{mg kg}^{-1} \text{ day}^{-1}$ for 2 wk to 23 months, signs of sedation and mild depression were observed in rats, mice and dogs. These disappeared rapidly after cessation of exposure (7).

Inhalation rat, exposure to concentrations $>43 \text{ g m}^{-3}$ for >5 min exhibited signs typical of various stages of anaesthesia. Dyspnoea was observed at levels $>50 \text{ g m}^{-3}$. In addition to central nervous system depression, increased lachrymation, piloerection and mydriasis were observed (3).

Inhalation rat (90 day) 0, 0.21, 0.64 or 2.13 g m^{-3} for 6 hr day^{-1} , 5 day wk^{-1} . For the high-dose group, body weight gain was reduced during the early phase of the experiment, and leucocyte counts, serum alkaline phosphatase

activity and alanine aminotransferase activity were elevated. Histopathological examination revealed portal cirrhosis of the liver, interstitial oedema of the pancreas and degeneration of the seminiferous epithelium at all dose levels (8).

Teratogenicity and reproductive effects

0.1 and 1.0% v/v for 6 hr day⁻¹ to pregnant Sprague-Dawley rats caused adrenal effects, maternal weight gain, no implants or viable fetuses in 15/20 animals, but no teratogenic effects (9).

Metabolism and toxicokinetics

Partially metabolised in rats and dogs, probably by a cytochrome P₄₅₀-dependent pathway; fluoride was identified as a metabolite (10).

Inhalation pharmacokinetics studied in ♂ rats in a closed inhalation chamber. Dichlorofluoromethane was readily eliminated via metabolism. Exhalation curves were also analysed after intraperitoneal injection.

Dichlorofluoromethane was only partly exhaled, and then showed a consistent decline. Total clearance value from the closed chamber was 4400 ml hr⁻¹ kg⁻¹ (11).

Following inhalation exposure of rats to 2.13 g m⁻³ for 6 hr day⁻¹, 5 day wk⁻¹ for 90 days, urine volumes showed a tendency to increase. After 45 days treatment urine fluoride concentration increased. After 90 days a similar increase was observed for rats exposed to 0.64 g m⁻³ (8).

Irritancy

Dermal guinea pig, 25% solution in propylene glycol caused mild irritation (period of exposure unspecified) (12).

0.1 ml of a 50% solution in mineral oil or a 40% solution in propylene glycol or dimethyl phthalate instilled into rabbit eye caused mild irritation (the eyes were not washed after treatment). Some injury to the cornea, iris and conjunctivae were also observed. All the effects disappeared within 7 days (13,14).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537, TA1538 with and without metabolic activation negative (15).

Saccharomyces cerevisiae D4 mutagenicity assay negative (15).

Chromosomal aberrations in bone marrow cells in mouse (16).

Other effects

Any other adverse effects

Indirect adverse effects of dichlorofluoromethane to terrestrial life forms are due to its stratospheric ozone-depleting potential (1).

Legislation

Compound not acceptable as an extraction solvent for food (17).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorine compounds: guide level 1 µg l⁻¹ (18).

Other comments

Residues have been detected in tap water (19).

Background atmospheric concentrations of 4.3-8.6 ng m⁻³ (20,21).

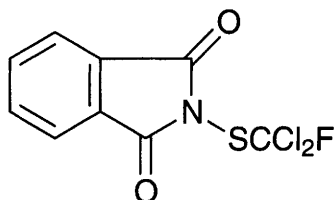
Physical properties, analytical methods, environmental exposure, toxicity and metabolism of dichlorofluoromethane reviewed (1).

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21. Cresentini, G. et al *Nature (London)* 1979, **279**, 311-312.

D217 N-(dichlorofluoromethylthio)phthalimide



C₉H₄Cl₂FNO₂S

Mol. Wt. 280.11

CAS Registry No. 719-96-0

Synonyms N-(fluorodichloromethylthio)phthalimide; 2-[(dichlorofluoromethyl)thio]-1H-isoindole-1,3-(2H)-dione; Preventol A3

EINECS No. 211-952-3

Uses Acaricide. Disinfectant. Antifouling agent.

Occupational exposure

Supply classification irritant

Risk phrases Irritating to the skin (R38)

Safety phrases Keep out of reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water (S2, S28)

Legislation

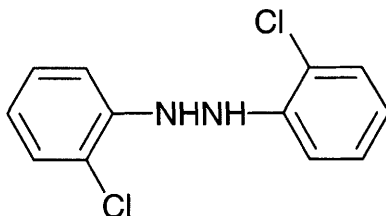
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (1).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (2).

References

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2. S. I. 1991, No. 472, *The Environmental Protection (Prescribed Processes and Substances) Regulations 1991*, HMSO, London, UK

D218 2,2-dichlorohydrazobenzene



$C_{12}H_{10}Cl_2N_2$

Mol. Wt. 253.13

CAS Registry No. 782-74-1

Synonyms 1,2-bis(2-chlorophenyl)hydrazine

EINECS No. 212-314-7

Ecotoxicity

Bioaccumulation

No or low bioaccumulation (1).

References

1. JETOC Newsletter No. 6 1988, Japan Chemical Industry Ecology Toxicology and Information Center, Tokyo, Japan

D219 dichlorohydrin



$C_3H_6Cl_2O$

Mol. Wt. 128.99

CAS Registry No. 26545-73-3

Synonyms dichloropropanol; glycerin dichlorohydrin; glycerol dichlorohydrin

EINECS No. 247-787-9

Uses Solvent for hard resins and nitrocellulose. Manufacture of photographic and Zapon lacquer. Cement for celluloid. Binding for watercolours.

Occupational exposure

UN No. 2750 HAZCHEM Code 2X Conveyance classification toxic substance

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 110 mg kg⁻¹ (1).

References

1. Smyth, H. F. et al *Am. Ind. Hyg. Assoc. J.* 1962, **23**, 95

D220 dichloriodomethane



CHCl₂I

Mol. Wt. 210.83

CAS Registry No. 594-04-7

Synonyms iododichloromethane

Physical properties

B. Pt. 131°C Specific gravity 2.39 at 25°C with respect to water at 4°C

Solubility Organic solvents: acetone, benzene, diethyl ether, ethanol

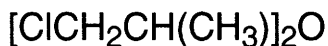
Other comments

Residue detected in various water resources (1-6).

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D221 dichloroisopropyl ether



C₆H₁₂Cl₂O

Mol. Wt. 171.07

CAS Registry No. 43031-79-4

Synonyms bis(β-chloroisopropyl) ether; 1-chloro-2-(β-chloroisopropoxy)propane

Uses Solvent. Chemical intermediate.

Physical properties

M. Pt. -102°C B. Pt. 189°C Flash point 85°C (open cup) Specific gravity 1.1122 at 20°C with respect to water at 20°C Volatility v.p. 0.85 mmHg at 20°C ; v.den. 6.0

Solubility Water: 1.7 g l⁻¹

Occupational exposure

UN No. 2490 HAZCHEM Code 2Z Conveyance classification toxic substance

Environmental fate

Abiotic removal

Activated carbon adsorption 200 mg g⁻¹ (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 240 mg kg⁻¹ (2).

LD₅₀ dermal rabbit 1.8-5.0 mg kg⁻¹ (2).

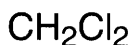
Sub-acute and sub-chronic data

Oral rat (31 day) 10 mg kg⁻¹ caused a reduction in weight gain (2).

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D222 dichloromethane



CH₂Cl₂

Mol. Wt. 84.93

CAS Registry No. 75-09-2

Synonyms methylene chloride; methylene dichloride

EINECS No. 200-838-9

RTECS No. PA 8050000

Uses Solvent. Paint stripper. Blowing agent. Aerosol propellant. Refrigerant. Post-harvest fumigant. Previously used as an anaesthetic.

Physical properties

M. Pt. -97°C B. Pt. 40°C Flash point none Specific gravity 1.3255 at 20°C with respect to water at 4°C

Partition coefficient log P_{ow} 1.25 Volatility v.p. 400 mmHg at 24°C ; v.den. 2.93

Solubility Water: 20 g l⁻¹. Organic solvents: acetone, carbon tetrachloride, chloroform, diethyl ether, dimethyl formamide, ethanol

Occupational exposure

DE-MAK 100 ppm (350 mg m⁻³)

FR-VME 50 ppm (180 mg m⁻³)

FR-VLE 100 ppm (350 mg m⁻³)

JP-OEL 50 ppm (170 mg m⁻³) (provisional value)

SE-LEVL 35 ppm (120 mg m⁻³)

SE-STEL 70 ppm (250 mg m⁻³)

UK-LTEL MEL 100 ppm (350 mg m⁻³)

UK-STEL MEL 300 ppm (1060 mg m⁻³)

US-TWA 50 ppm (174 mg m⁻³)

UN No. 1593 HAZCHEM Code 2Z Conveyance classification toxic substance

Supply classification harmful

Risk phrases Possible risk of irreversible effects (R40)

Safety phrases Keep out of reach of children (if sold to general public) – Do not breathe vapour – Avoid contact with skin and eyes – Wear suitable protective clothing and gloves (S2, S23, S24/25, S36/37)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow static bioassay 310 mg l⁻¹; flow-through bioassay 193 mg l⁻¹ (1).

Invertebrate toxicity

LC₅₀ (15 min) *Photobacterium phosphoreum* 1000-2880 ppm Microtox test (2).

Bioaccumulation

The calculated bioconcentration factor of 5 indicates that environmental accumulation is unlikely (3).

Environmental fate

Degradation studies

Degraded by *Methylosinus trichosporium*. Renovation of polluted aquifers is proposed by the injection of cultures into the subsurface with subsequent oxygenation of the soil and aquifer (4).

90% degradation of 25 mg l⁻¹ in 20 hr using adapted bacteria from a public sewage works (5).

Abiotic removal

Primary mechanism for removal from the atmosphere is by reaction with photochemically produced hydroxyl radicals, with estimated t_{1/2} of 77 days (6).

t_{1/2} for evaporation from 1 mg l⁻¹ aqueous solution in still air, at an average depth of 6.5 cm: 35 min at 1-2°C; 18-25 min at 25°C (7).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1.6 ml kg⁻¹ (2.10 g kg⁻¹) (8).

LC₅₀ (6 hr) inhalation mouse, guinea pig 12,000-16,000 ppm (40-56 g m⁻³) (4).

LC₅₀ (15 min) inhalation rat 200 g m⁻³ (9-11).

LD₅₀ subcutaneous mouse 64 g kg⁻¹ (12).

LD₅₀ intraperitoneal mouse, dog 1300-2000 mg kg⁻¹ (13).

Sub-acute and sub-chronic data

Inhalation rat (13 wk) 50, 200 or 2000 ppm for 6 hr day⁻¹, 5 day wk⁻¹, no neurotoxicological effects were observed (14).

Inhalation guinea pig (6 hr) 18,000 mg m⁻³ increased hepatic triglyceride concentrations (15).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (16).

Oral rat, mouse 0, 100 or 500 mg kg⁻¹ day⁻¹, 4-5 day wk⁻¹ for 64 wk, and inhalation rat 0 or 100 ppm 7 hr day⁻¹ 5 day wk⁻¹ for 2 yr. The studies reported an increased incidence of pulmonary tumours in ♂ mice and a non-significant increase in total malignant mammary tumours in ♀ rats administered 500 mg kg⁻¹ orally, and a nonsignificant increase in total malignant tumours in rats exposed by inhalation at 100 ppm (17).

Inhalation rat (2 yr) 0, 50, 200 or 500 ppm 6 hr day⁻¹ for 5 day wk⁻¹. The findings were a dose-dependent increase in blood carboxyhaemoglobin levels and histopathological lesions in the liver and mammary tissue of rats exposed to 500 ppm. ♀ rats exposed to 500 ppm also had an increased incidence of multinucleated hepatocytes and number of spontaneous benign mammary tumours. No increase in the number of malignant tumours was observed (18).

Inhalation rat, mouse (2 yr) 0, 1000, 2000 or 4000 ppm for 6 hr day⁻¹, 5 day wk⁻¹ caused a dose-related increase in lung and liver tumours in mice, and benign mammary gland tumours in rats of both sexes (19).

Intraperitoneal mouse (24 wk) 0, 160, 400 or 800 mg kg⁻¹ 3 × wk⁻¹. There was no increase in the incidence of lung tumours in treated mice (20).

It is postulated that the carcinogenicity seen in mice may be associated with the production of formaldehyde, an intermediate in the metabolism of the parent compound. The carcinogenicity may be species specific (21).

Teratogenicity and reproductive effects

Inhalation rat, mouse 0 or 4000 mg m⁻³ for 7 hr day⁻¹ on days 6-15 of gestation. There was no statistically significant increase in visceral anomalies in the foetuses of either species, but evidence of skeletal anomalies was observed as decreased incidence of lumbar spurs and delayed ossification of the sternbrae in rats and increased incidence of a single sternal ossification centre in mice (22).

Inhalation ♀ rat 0 or 15,600 mg m⁻³ either at 3 wk pregestational period or day 17 of gestation or both. There was no effect on litter size or viability, but foetal weight was reduced in both groups exposed during gestation. No treatment-related visceral or skeletal abnormalities were detected in the foetuses of any exposure group, but a greater proportion of litters exposed during both the pregestational and gestational periods had foetuses with rudimentary lumbar disks (23).

Injection of dichloromethane into the air space of 2, 3 and 6 day old chick embryos induced abnormalities and death, with an estimated LD₅₀ of >85 mg egg⁻¹ (24).

Metabolism and toxicokinetics

In rats, mice, hamster and human, dichloromethane is metabolised by two pathways, one dependent on oxidation by mixed-function oxidase, and the other mediated by glutathione-S-transferase. The former pathway leads to the formation of dichloromethanol, chloroformaldehyde, formic acid and carbon monoxide. Tumour incidence was correlated with the amount metabolised by the glutathione-S-transferase pathway but not by the mixed-function oxidase pathway (25).

Carbon dioxide produced is reversibly bound to haemoglobin and eliminated by exhalation. In rats, it was shown that 70% of dichloromethane was eliminated as carbon monoxide (26).

Inhalation mouse, no alkylation products were found in DNA of liver, kidney or lung (27).

Following intraperitoneal administration to rats of 10 and 50 mg kg⁻¹, t_{1/2} for elimination from the blood were 11.9 and 23.5 min, respectively. Following oral administration, absorption and distribution throughout the tissues was reported to be rapid (28).

Dichloromethane is absorbed rapidly and eliminated by the lungs in humans and is distributed in adipose tissues. It is absorbed through the skin (29-31).

Irritancy

Dermal rabbit (24 hr) 810 mg caused severe irritation, and 162 mg instilled into rabbit eye (period of exposure unspecified) caused moderate effects (32).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1950 with and without metabolic activation positive (33).

Saccharomyces cerevisiae reverse mutation and gene conversion positive (34).

Aspergillus nidulans P1 chromosome malsegregation assay positive (35).

Drosophila melanogaster sex-linked recessive lethal assay positive (36).

In vitro Chinese hamster cells with and without metabolic activation sister chromatid exchange negative, chromosome aberrations positive (37).

In vivo subcutaneous mouse sister chromatid exchange and chromosome aberrations in bone marrow negative; inhalation mouse sister chromatid exchange in lung cells and peripheral blood lymphocytes, and chromosome aberrations in lung and bone marrow positive (38).

Other effects

Other adverse effects (human)

In humans, dichloromethane is reported to act primarily on the central nervous system, causing narcosis at high doses. Temporary neurobehavioural effects have been reported after exposure to doses as low as 700 mg m⁻³ (39,40).

An exposure-related increase in serum bilirubin was reported in exposed workers, but no other sign of liver injury or haemolysis was reported. A cross-sectional study of 24 exposed workers showed no excess of

electroangiographic abnormalities following exposure to time weighted average concentrations of 210-1650 mg m⁻³ for 24 hr (41).

No excess of deaths due to ischaemic heart disease was found in a US cohort exposed to a time weighted average range of 106-416 mg m⁻³, as compared to an internal reference group. No excess was found in another study among 1271 employees exposed to time weighted averages of 486-1648 mg m⁻³ when compared to the general US population. A statistically significant increased risk was found in comparison with an internal reference group, in which, however, there were less than half the observed deaths expected from US statistics (41,42).

No excess of death from malignancies was observed in two cohort studies or in one proportional mortality study of exposed workers, but the studies were designed to have limited power to detect excess risk (43,44).

An excess of biliary tract and liver cancers previously detected in a cohort of employees exposed to methylene chloride (MC) used in the manufacture of cellulose triacetate fibre were re-evaluated with a further cohort of 3211 employees likewise exposed to MC. Mortality from the above cancers was not increased and there was no excess mortality from pancreatic cancers. Furthermore, mortality was not increased for lung or liver cancers, although tumours were induced in experimental animals exposed to MC. Men and women employed for >20 year exhibited increased mortalities from prostate and cervical cancers, respectively (45,46).

A study of possible causes of spontaneous abortions among women working in the pharmaceutical industry demonstrated an increased risk associated with exposure to several chemicals and solvents, including dichloromethane (47).

Inhalation exposure may cause headache and nausea. High concentrations depress the central nervous system. Pulmonary oedema and haemolysis have been reported. Neurological symptoms following chronic exposure include paraesthesias, respiratory irritation and gastrointestinal disturbance (48).

Formaldehyde formed by the metabolism of dichloromethane via glutathione S-transferase forms RNA-formaldehyde adducts in human hepatocytes (49).

Any other adverse effects

Inhalation rat (1 hr) 5000, 10,000 or 15,000 ppm head only exposure, caused a decrease in somatosensory-evoked potential amplitude, eliminated the N1 component of flash-evoked potential and significantly affected component latencies. An increase in component (P1 and P5) latencies and the P1-P5 interwave time for brainstem auditory-evoked response was also reported (50).

Inhalation mouse, continuous exposure to 17,400 mg m⁻³ caused swelling of the rough endoplasmic reticulum, fatty changes in the liver and necrosis of individual hepatocytes. The earliest lesion (polyribosome dissociation and swelling of hepatocyte rough endoplasmic reticulum) appeared at 12 hr of exposure. Balloon degeneration peaked at 2 days, then partially reversed. Liver fatty change was also partially reversible. Liver triglycerides increased 12-fold after 3 days exposure (51).

Formaldehyde formed by the metabolism of dichloromethane via glutathione S-transferase forms RNA-formaldehyde adducts in mouse, rat and hamster hepatocytes. DNA-protein cross-links are also formed in mice (49).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorine compounds: guide level 1 µg l⁻¹ (52).

Other comments

Present in flue gases of waste incinerators and in landfill gases. Residues have been isolated from soils, sediment and natural waters and in human and animal tissues. Disinfection by-product in chlorinated water (53).

Properties, uses, analysis, occurrence, handling precautions, toxicology, carcinogenicity, teratogenicity and metabolism of dichloromethane reviewed (53,54).

Reviews on experimental toxicology, human health effects, environmental effects, ecotoxicology, exposure levels, hazard assessment, epidemiology and workplace experience are listed (55).

Environmental fate of dichloromethane reviewed (56).

Environmental health criteria reviewed (57).

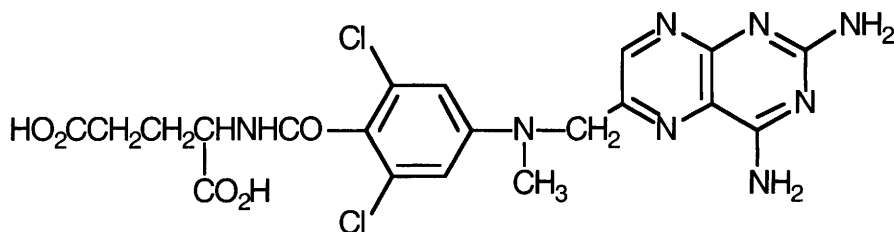
Autoignition temperature 605°C.

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D223 dichloromethotrexate



$C_{20}H_{20}Cl_2N_8O_5$

Mol. Wt. 523.34

CAS Registry No. 528-74-5

Synonyms 3',5'-dichloromethotrexate; 3',5'-dichloromethopterin; N-3,5-dichloro-4-[[[(2,4-diamino-6-pteridiny)methyl]methylamino]benzoyl-L-glutamic acid; 3',5'-dichloro-4-amino-4-deoxy-N₁₀-methylpteroglutamic acid

RTECS No. MA 1250000

Uses Folic acid antagonist. Antineoplastic agent.

Physical properties

Partition coefficient $\log P_{ow}$ 0.77 (calc.) (1)

Mammalian & avian toxicity

Acute data

LD₅₀ intraperitoneal mouse 655 mg kg⁻¹ (2).

LD₅₀ intravenous mouse 1020 mg kg⁻¹ (3).

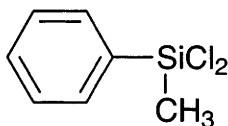
Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (4).

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D224 dichloromethylphenylsilane



C₇H₈Cl₂Si

Mol. Wt. 191.13

CAS Registry No. 149-74-6

Synonyms phenylmethylchlorosilane; methylphenyldichlorosilane

EINECS No. 205-746-2

RTECS No. VV 3530000

Uses Catalyst.

Physical properties

B. Pt. 205°C Flash point 82°C Specific gravity 1.176 at 20°C

Solubility Organic solvents: benzene, diethyl ether, methanol

Mammalian & avian toxicity

Acute data

LC_{Lo} (2 hr) inhalation mouse 200 mg m⁻³ (1).

LD_{Lo} intraperitoneal rat, mouse 100 mg kg⁻¹ (1).

LD_{Lo} subcutaneous mouse 100 mg kg⁻¹ (1).

References

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D225 dichloromethylsilane



CH₄Cl₂Si

Mol. Wt. 115.03

CAS Registry No. 75-54-7

Synonyms methylchlorosilane; dichlorohydridomethylsilicon; monomethylchlorosilane

EINECS No. 200-877-1

RTECS No. VV 3500000

Physical properties

M. Pt. -93°C B. Pt. 41°C Flash point -32°C Specific gravity 1.1 Volatility v.den. 4.0

Occupational exposure

UN No. 1242 HAZCHEM Code 4WE Conveyance classification substance which in contact with water emits flammable gas, danger of fire (flammable liquid), corrosive

Mammalian & avian toxicity

Acute data

LC_{Lo} (4 hr) inhalation rat 300 ppm (1).

Irritancy

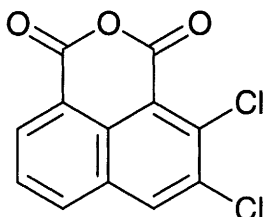
Dermal (24 hr) rabbit 500 mg caused severe irritation and 20 mg instilled into rabbit eye (24 hr) caused moderate irritation (1).

Legislation

Included in Schedule 4 (Release into Air: Prescribed Substances) Statutory Instrument No. 472, 1991 (2).

References

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2. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D226 4,5-dichloronaphthalene-1,8-dicarboxylic anhydride

$C_{12}H_4Cl_2O_3$

Mol. Wt. 267.07

CAS Registry No. 7267-14-3

Synonyms 4,5-dichloronaphthalic anhydride; 6,7-dichloro-1*H*,3*H*-naphtho[1,8-*cd*]pyran-1,3-dione

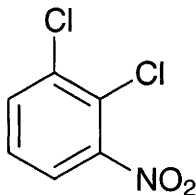
Ecotoxicity**Bioaccumulation**

No or low bioaccumulation (1).

References

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D227 2,3-dichloronitrobenzene



$C_6H_3Cl_2NO_2$

Mol. Wt. 192.00

CAS Registry No. 3209-22-1

Synonyms 1,2-dichloro-3-nitrobenzene; 2,3-dichloro-1-nitrobenzene; *o,m*-dichloronitrobenzene

EINECS No. 221-717-7

RTECS No. CZ 5240000

Uses Organic intermediate.

Physical properties

M. Pt. 60-62°C B. Pt. 257-258°C Flash point 123°C Specific gravity 1.721 at 14°C with respect to water at 4°C Partition coefficient $\log P_{ow}$ 3.27 (1) Volatility v.p. 1.65×10^{-3} mmHg at 25°C Solubility Organic solvents: acetone, acetic acid, benzene, diethyl ether, ethanol

Ecotoxicity

Fish toxicity

LC₅₀ (14 day) guppy 4 mg l⁻¹ (2).

Invertebrate toxicity

LC₅₀ (30 min) *Photobacterium phosphoreum* 1.46 ppm Microtox test (3).

IC₅₀ (immobilisation) (48 hr) *Daphnia magna* 4 mg l⁻¹ (4).

Bioaccumulation

Bioconcentration factor for guppies during 3 day exposure was 1020 (2).

Bioconcentration factor in rainbow trout during 5-36 day exposure to 0.8 µg l⁻¹ was 130-153 (1).

Environmental fate

Degradation studies

t_{1/2} in soil >4 wk (5).

Mammalian & avian toxicity

Metabolism and toxicokinetics

Oral rabbit 100 mg kg⁻¹, after 72 hr ~5% of the dose was recovered in the faeces unchanged and as dichloroaniline; ~84% was recovered in the urine in the form of amino- and nitrodichlorophenols (6).

Genotoxicity

Salmonella typhimurium TA100 without metabolic activation negative (7).

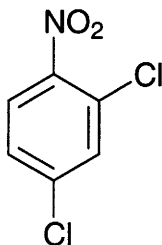
Other comments

Residues have been isolated from water and fish tissues.

References

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D228 2,4-dichloronitrobenzene



$C_6H_3Cl_2NO_2$

Mol. Wt. 192.00

CAS Registry No. 611-06-3

Synonyms 2,4-dichloro-1-nitrobenzene; 1,3-dichloro-4-nitrobenzene; 4-nitro-1,3-dichlorobenzene

EINECS No. 210-248-3

RTECS No. CZ 5420000

Uses Lubricating oil additive. In the manufacture of the pharmaceutical agent diazoxide.

Physical properties

M. Pt. 29-32°C **B. Pt.** 258°C **Flash point** 112°C **Specific gravity** 1.551 at 78°C with respect to water at 4°C

Partition coefficient log P_{ow} 3.29 (1)

Solubility Organic solvents: diethyl ether, ethanol

Ecotoxicity

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 3.19 mg l⁻¹ Microtox test (2).

Bioaccumulation

A 3-day exposure bioconcentration factor of 80 was determined for golden ide fish and a 1-day exposure bioconcentration factor of 150 was found for *Chlorella fusca* (3).

Environmental fate

Degradation studies

Less than 0.1% of applied 2,4-dichloronitrobenzene (concentration unspecified) was degraded in a 5-day biodegradation study using activated sludge from a municipal sewage treatment plant (3).

Degradation was investigated in *Mucor javanicus* and other fungi. Major metabolites were 2,4-dichloroaniline and chloro-2-nitrothioanisole (4).

Abiotic removal

Photodegradation induced by sunlight (5).

Photochemical reaction with atmospheric hydroxyl radicals has been estimated to be $1.237 \times 10^{-13} \text{ cm}^3 \text{ molecules sec}^{-1}$ at 25°C, which corresponds to an atmospheric $t_{1/2}$ of about 130 days at normal atmospheric concentrations (6).

Mammalian & avian toxicity

Metabolism and toxicokinetics

Metabolised in rats via glutathione S-aryl-transferase to form the conjugated compound (7).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537, TA1538 without metabolic activation positive (8,9).

Other effects

Other adverse effects (human)

Absorption into the body leads to the formation of methaemoglobin which in sufficient concentration causes cyanosis (10).

Legislation

Limited under EC Directive on Drinking Water: Quality 80/778/EEC. Organochlorine compounds: guide level $1 \mu\text{g l}^{-1}$ (11).

Halogens and their covalent compounds are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (12).

Other comments

Human health effects, experimental toxicology, environmental effects and ecotoxicology reviewed (13,14).

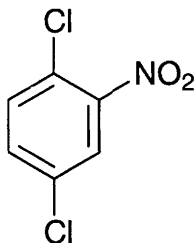
2,4-Dichloronitrobenzene has been qualitatively detected in drinking water concentrates collected from Cincinnati, OH, 1978 and Seattle, WA, 1976 (15).

Genotoxicity, biological properties and human exposure limits reported (16).

References

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D229 2,5-dichloronitrobenzene



$C_6H_3Cl_2NO_2$

Mol. Wt. 192.00

CAS Registry No. 89-61-2

Synonyms 1,4-dichloro-2-nitrobenzene

EINECS No. 201-923-3

RTECS No. CZ 5260000

Uses Used in the manufacture of dyestuff intermediates. In the manufacture of *p*-chloro-*o*-nitrophenol.

Physical properties

M. Pt. 54-57°C B. Pt. 266-269°C Specific gravity 1.669 at 22°C

Solubility Organic solvents: benzene, chloroform, diethyl ether, hot ethanol

Ecotoxicity

Fish toxicity

Rainbow trout and threespine stickleback exposed to 10 mg l⁻¹ suffered loss of equilibrium in 3-4 hr and death in 6-8 hr. Sockeye salmon exposed to 10 mg l⁻¹ suffered loss of equilibrium in 2-3 hr and death in 3-4 hr (1). Bluegill sunfish exposed to 5 ppm died within 2 hr and trout exposed to 5 ppm died within 23 hr (2).

Invertebrate toxicity

EC₅₀ (5, 15, 30 min) *Photobacterium phosphoreum* 8.78 mg l⁻¹ Microtox test (3).

Environmental fate

Degradation studies

Biodegradation by activated sludge was >99% (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 2850, 1210 mg kg⁻¹, respectively (5, 6).

Metabolism and toxicokinetics

Major metabolite is 2,5-dichloroaniline (7).

Irritancy

500 mg applied to rabbit skin for 24 hr caused mild irritation, while 100 mg instilled into rabbit eye for 24 hr caused moderate irritation (4,8).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA1535, TA1537, TA1538 without metabolic activation positive (9).

Induced SOS reactions in *Salmonella typhimurium* and *Escherichia coli* containing umu-lac fused gene. Mutagenic effects in *Salmonella typhimurium* were enhanced by plasmids pKM₁₀₁ and pSK₁₀₀₂ (10).

Salmonella typhimurium TA1535/pSK1002 with and without metabolic activation negative (umu-test) (11).

Other effects

Other adverse effects (human)

Absorption into blood stream may lead to methaemoglobinaemia, onset can be delayed 2-4 hr (12).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorine compounds: guide level $1 \mu\text{g l}^{-1}$ (13).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (14).

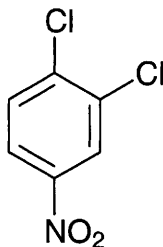
Other comments

Reviews on experimental toxicology listed (15).

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D230 3,4-dichloronitrobenzene



$\text{C}_6\text{H}_3\text{Cl}_2\text{N}_2\text{O}_2$

Mol. Wt. 192.00

CAS Registry No. 99-54-7

Synonyms 1,2-dichloro-4-nitrobenzene; benzene, 1,2-dichloro-4-nitro-

EINECS No. 202-764-2

RTECS No. CZ 5250000

Uses Chemical intermediate in synthesis of compounds including herbicides and pharmaceuticals.

Physical properties

M. Pt. 41-44°C B. Pt. 255-256°C Volatility v.den. 6.63

Ecotoxicity

Fish toxicity

LC₅₀ (duration unspecified) ide 3.1 mg l⁻¹ (1).

Invertebrate toxicity

EC₅₀ (48 hr) *Daphnia magna* 3 mg l⁻¹ (1).

EC₅₀ (30 min) *Photobacterium phosphoreum* 10.1 ppm Microtox test (2).

Bioaccumulation

No or low bioaccumulation (3).

Environmental fate

Degradation studies

Strains of *Pseudomonas*, *Alcaligenes* and *Moraxella* can oxidatively dehalogenate the compound (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 643 mg kg⁻¹ (5).

Metabolism and toxicokinetics

Hepatic cystolic glutathione S-transferase metabolised the compound in different species, mouse, rat and hamster at different rates (6).

Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation and 100 mg instilled into rabbit eye (24 hr) caused moderate irritation (5).

Genotoxicity

Drosophila melanogaster feed study for mutation negative; adult injection induction of sex-linked recessive lethal mutation positive (7).

Other effects

Any other adverse effects

Compound interferes with microtubule organisation in mouse 3T3 and human AG1522 skin fibroblasts at micromolar doses, in a manner typical of skin sensitisers (8).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level 1 µg l⁻¹ (9).

Other comments

Present in wastewater as a pollutant.

Mutagenicity and biological properties were investigated in *Salmonella typhimurium* and *Escherichia coli* (10).

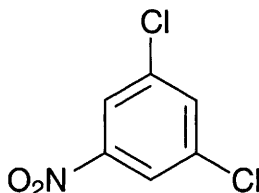
Bioconcentration factor of 14 monochloro- to pentachloronitrobenzenes were examined in rainbow trout and dietary exposure studies. Bioconcentration factor was not significantly correlated with K_{ow} for this chemical group (11).

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D231 3,5-dichloronitrobenzene



$C_6H_3Cl_2NO_2$

Mol. Wt. 192.00

CAS Registry No. 618-62-2

Synonyms 1,3-dichloro-5-nitrobenzene

EINECS No. 210-557-3

Physical properties

M. Pt. 64-65°C Specific gravity 1.69 at 14°C with respect to water at 4°C

Solubility Organic solvents: diethyl ether, ethanol

Ecotoxicity

Invertebrate toxicity

EC₅₀ (5, 15, 30 min) *Photobacterium phosphoreum* 17.1 mg l⁻¹ Microtox test (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level 1 µg l⁻¹ (2).

Halogens and their covalent compounds are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (3).

Other comments

Reviews on experimental toxicology listed (4).

References

1. Kaiser, K. L. E. et al *Water Pollut. Res. J. Canada* 1991, **26**(3), 361-431.
2. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.
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D232 1,1-dichloro-1-nitroethane



$\text{C}_2\text{H}_3\text{Cl}_2\text{NO}_2$

Mol. Wt. 143.96

CAS Registry No. 594-72-9

Synonyms dichloronitroethane; ethide

EINECS No. 209-854-0

RTECS No. KI 1050000

Uses Insecticide. Grain fumigant. Solvent. Organic synthesis.

Physical properties

B. Pt. 124°C **Flash point** 76°C (open cup) **Specific gravity** 1.4153 at 20°C with respect to water at 20°C

Volatility v.p. 16 mmHg at 25°C ; v.den. 4.97

Solubility Water: 2.5 mg l⁻¹ at 20°C. Organic solvents: acetone, diethyl ether, dimethyl sulfoxide, ethanol

Occupational exposure

DE-MAK 10 ppm (60 mg m⁻³)

FR-VME 2 ppm (10 mg m⁻³)

US-TWA 2 ppm (12 mg m⁻³)

UN No. 2650 **HAZCHEM Code** 2Y **Conveyance classification** toxic substance

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed (R23/24/25)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S26, S45)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 410 mg kg⁻¹ (1).

LC₅₀ (6 hr) inhalation rabbit and guinea pig 580 mg m⁻³ (2).

LD₅₀ intraperitoneal mouse 240 mg kg⁻¹ (3).

Irritancy

Dermal rabbit and guinea pig, two applications on successive days caused severe irritation (4).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, with and without metabolic activation positive (5).

Other effects

Any other adverse effects

Inhalation rabbit (4 hr) 34 ppm caused lachrymation, sneezing, cough, weakness, pulmonary oedema, congestion, haemorrhage and acute bronchitis. Heart, liver, kidney and blood vessel damage was also reported on autopsy (6,7).

Legislation

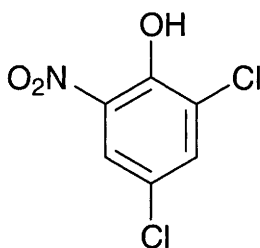
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (8).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (9).

References

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D233 2,4-dichloro-6-nitrophenol



$C_6H_3Cl_2NO_3$

Mol. Wt. 208.00

CAS Registry No. 609-89-2

Synonyms phenol, 2,4-dichloro-6-nitro-

EINECS No. 210-202-2

RTECS No. SL 0350000

Uses Intermediate in chemical synthesis.

Physical properties

M. Pt. 118-120°C

Ecotoxicity

Toxicity to other species

Oxidative uncoupling in *Acer pseudoplatanus* using whole cells or mitochondrial fraction reported (1).

Bioaccumulation

No or low bioaccumulation (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 129 mg kg⁻¹ (3).

Irritancy

100 mg instilled into rabbit eye for 24 hr caused severe irritation (3).

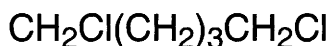
Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level 1 µg l⁻¹ (4).

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D234 1,5-dichloropentane



$\text{C}_5\text{H}_{10}\text{Cl}_2$

Mol. Wt. 141.04

CAS Registry No. 628-76-2

Synonyms pentamethylene chloride

EINECS No. 211-053-6

RTECS No. SA 0350000

Physical properties

M. Pt. -72°C B. Pt. 180°C ; 63-66°C at 10 mmHg Flash point 26°C Specific gravity 1.1006 at 22°C with respect to water at 4°C Partition coefficient $\log P_{\text{ow}}$ 2.77 (1) Volatility v.den. 4.9
Solubility Organic solvents: benzene, carbon tetrachloride, chloroform, diethyl ether, ethanol

Occupational exposure

UN No. 1152 HAZCHEM Code 3 $\frac{+}{-}$ Conveyance classification flammable liquid

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 25 mg l⁻¹ flow-through bioassay (2).

LC₅₀ (7 day) guppy <11 mg l⁻¹ (3).

Invertebrate toxicity

LC₅₀ (30 min) *Photobacterium phosphoreum* 21 ppm Microtox test (4).

Environmental fate

Nitrification inhibition

IC₅₀ (25 day) *Nitrosomonas* sp. 13 mg l⁻¹ (2).

Carbonaceous inhibition

IC₅₀ (50 day) methanogenic bacterial culture 77 mg l⁻¹ (2).

Mammalian & avian toxicity

Acute data

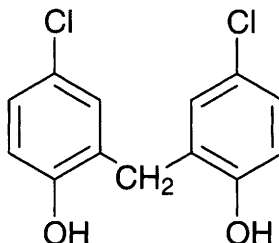
LD_{Lo} intraperitoneal mouse 64 mg kg⁻¹ (5).

References

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D235 dichlorophen



C₁₃H₁₀Cl₂O₂

Mol. Wt. 269.13

CAS Registry No. 97-23-4

Synonyms 4,4'-dichloro-2,2'-methylenediphenol; 2,2'-methylenebis(4-chlorophenol); bis(chlorohydroxyphenyl)methane; 5,5'-dichloro-2,2'-dihydroxydiphenylmethane; DDDM; Preventol; Panacide

EINECS No. 202-567-1

RTECS No. SM 0175000

Uses Disinfectant. Algicide and agricultural fungicide. Veterinary anthelmintic and antiprotozoan.

Physical properties

M. Pt. 177-178°C **Volatility** v.p. 7.8×10^{-11} mmHg at 25°C

Solubility Water: 30 mg l⁻¹ at 25°C. Organic solvents: acetone, diethyl ether, isopropyl ether, petroleum ether, methanol, ethanol, toluene

Occupational exposure

Supply classification harmful, dangerous for the environment

Risk phrases Harmful if swallowed – Irritating to the eyes – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R22, R36, R50/53)

Safety phrases Keep out of reach of children (if sold to general public) – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S2, S26, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 23 mg l⁻¹ (1).

Invertebrate toxicity

LC₅₀ (15 min) *Photobacterium phosphoreum* 0.055 ppm Microtox test (2).

Environmental fate

Abiotic removal

Slowly oxidised in air (3).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse, guinea pig, dog 1000-2700 mg kg⁻¹ (3,4).

LD₅₀ intravenous rat 17 mg kg⁻¹ (5).

Sub-acute and sub-chronic data

Oral rat (90 day) dietary levels of 2000 mg kg⁻¹ caused no ill-effects (3).

Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation and 50 µg instilled into rabbit eye for 24 hr caused severe irritation (6).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (7).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (8).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (9).

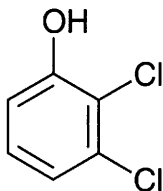
WHO Toxicity Class III (10).

EPA Toxicity Class III (3).

References

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2. Kaiser, K. L. E. et al *Water Pollut. Res. J. Can.* 1991, **26**(3), 361-431.
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D236 2,3-dichlorophenol



C₆H₄Cl₂O

Mol. Wt. 163.00

CAS Registry No. 576-24-9

EINECS No. 209-399-8

RTECS No. SK 8450000

Physical properties

M. Pt. 58-60°C **B. Pt.** 206°C **Partition coefficient** $\log P_{ow}$ 2.39 (1) **Volatility** v.p. 0.18 mmHg at 25°C
Solubility Organic solvents: hot benzene, diethyl ether, hot petroleum ether, ethanol

Occupational exposure

UN No. 2020 (solid); 2021 (liquid) **HAZCHEM Code** 2X **Conveyance classification** toxic substance

Ecotoxicity

Invertebrate toxicity

EC₅₀ (96 hr) *Selenastrum capricornutum* 5.0 ppm (2).

LC₅₀ (30 min) *Photobacterium phosphoreum* 4.92-5.27 ppm Microtox test (3).

Environmental fate

Nitrification inhibition

IC₅₀ (25 day) *Nitrosomonas* sp. 0.42 mg l⁻¹ (4).

Carbonaceous inhibition

IC₅₀ (50 day) methanogenic bacterial culture 58 mg l⁻¹ (4).

Abiotic removal

Reported to be removed from water by photocatalytic oxidation, using titanium oxide irradiated with UV light (5).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 2380 mg kg⁻¹ (6).

Genotoxicity

Salmonella typhimurium TA100 without metabolic activation negative (7).

Other comments

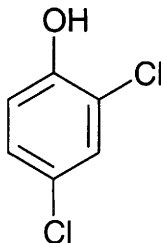
Metabolite of the pesticide lindane. Residues have been isolated from river water (8).

Taste threshold concentration 0.04 µg l⁻¹; odour threshold concentration 30 µg l⁻¹ (9).

References

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D237 2,4-dichlorophenol



$C_6H_4Cl_2O$

Mol. Wt. 163.00

CAS Registry No. 120-83-2

Synonyms 4,6-dichlorophenol; DCP

EINECS No. 204-429-6

RTECS No. SK 8575000

Uses Disinfectant. Intermediate in organic synthesis.

Physical properties

M. Pt. 42-43°C **B. Pt.** 209-210°C **Flash point** 113°C **Specific gravity** 1.383 at 60°C with respect to water at 25°C **Partition coefficient** $\log P_{ow}$ 2.92 (1) **Volatility** v.p. 1 mmHg at 53°C ; v.den. 5.6
Solubility Water: 4.5 g l⁻¹ at 25°C. Organic solvents: benzene, carbon tetrachloride, chloroform, diethyl ether, ethanol

Occupational exposure

UN No. 2020 (solid)

UN No. 2021 (liquid) **HAZCHEM Code** 2X **Conveyance classification** toxic substance

Supply classification corrosive

Supply classification harmful for the environment

Risk phrases Harmful in contact with skin and if swallowed – Causes burns – Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R21/22, R34, R51/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – Wear suitable protective clothing, gloves and eye/face protection – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S26, S36/37/39, S45, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 6.7 mg l⁻¹ flow-through bioassay (2).

LC₅₀ (24 hr) guppy, goldfish 4.2-7.8 mg l⁻¹ (3,4).

Invertebrate toxicity

LC₅₀ (30 min) *Photobacterium phosphoreum* 1.24-5.52 ppm Microtox test (5).

EC₅₀ (21 day) *Daphnia magna* 1.1 mg l⁻¹ at 20°C (6).

EC₅₀ (96 hr) *Selenastrum capricornutum* and *Chlorella vulgaris* 9.2-14 mg l⁻¹ (7).

Bioaccumulation

Non-accumulative or low accumulative (8).

Goldfish bioconcentration factor 34 (3).

Environmental fate

Nitrification inhibition

Inhibition of anaerobic digestion. Lab scale 100% at 5 hr at 100 mg l⁻¹ (9).

IC₅₀ (25 day) *Nitrosomonas* sp. 0.79 mg l⁻¹ (2).

Carbonaceous inhibition

IC₅₀ (50 day) methanogenic bacterial culture 63 mg l⁻¹ (2).

Degradation studies

98% COD removal at 10.5 mg O₂ g⁻¹ activated sludge inoculum hr⁻¹ at 20°C (10).

Degradation by *Pseudomonas* sp. at 200 mg l⁻¹ at 30°C: 100% ring disruption in 96 hr by parent strains; 100% ring disruption in 34 hr by mutant strains (11).

Biodegradable (8).

Abiotic removal

Removed from water by photocatalytic oxidation, using titanium oxide irradiated with UV light (12).

Removal from contaminated soil effected by pyrolysis at 2200°C (13).

Removal from waste water containing 430 mg l⁻¹ by adsorption onto Amberlite XAD-4 reported (11).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse, guinea pig 500-1100 mg kg⁻¹ (14,15).

LD₅₀ intraperitoneal mouse, rat 150, 430 mg kg⁻¹, respectively (16,17).

Carcinogenicity and chronic effects

Limited evidence for carcinogenicity to humans, no adequate data for carcinogenicity to animals, IARC classification group 2B (18).

National Toxicology Program tested 2,4-dichlorophenol in rats and mice via oral administration. No evidence for carcinogenicity was found in rats and mice (19).

Teratogenicity and reproductive effects

Oral rat 0, 200, 375 or 750 mg kg⁻¹ day⁻¹ on days 6-15 of gestation. Maternal body weight gain was reduced in all treated groups and some fatalities in the high-dose group. A slight degree of foetal toxicity was indicated in the high-dose group by reduced foetal weight, intra-uterine survival and retarded ossification. No teratogenic effects were observed (20).

Metabolism and toxicokinetics

The metabolism of 2,4-dichlorophenol was studied using microsomal fractions and whole cells of *Saccharomyces cerevisiae* containing human cytochrome P450 3A4. Two major metabolites were identified as 2-chloro-1,4-hydroxyquinone and 2-chloro-1,4-benzoquinone in microsomal fractions and whole cells. A further metabolite, 1,2,4-hydroxybenzene, was also detected during biotransformations by whole cells but was not observed in microsomal fractions (21).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (22,23).

In vitro mouse lymphoma L5187Y cells mutagenicity assay positive (24).

In vitro Chinese hamster ovary cells induced sister chromatid exchanges but did not induce chromosome aberrations (24).

In vitro rat primary hepatocytes unscheduled DNA synthesis negative (25).

Other effects

Other adverse effects (human)

2,4-Dichlorophenol has been shown to bind reversibly to human serum albumin (26).

Occupational exposure of chlorophenols reviewed (27).

A Danish cohort study of workers, potentially exposed to 2,4-dichlorophenol during chlorophenoxy herbicide production, did not reveal any increase in the total incidence of cancers. There were statistically significant increased risks of soft-tissue sarcoma and lung cancer in some subcohorts (28).

Legislation

Maximum permissible concentration in domestic water in former USSR $2 \mu\text{g l}^{-1}$ (29).

Other comments

Odour threshold concentration $6.5 \mu\text{g l}^{-1}$; taste threshold concentration $20 \mu\text{g l}^{-1}$ (30).

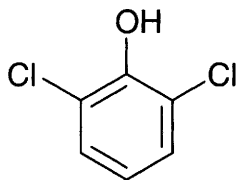
Experimental toxicology and human health effects reviewed (31).

Metabolite of 2,4-D. Present in flue gases of waste incinerators. Residues have been detected in water.

References

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31. *BIBRA Toxicity Profiles* 1990, British Industrial Biological Research Association, Carshalton, UK

D238 2,6-dichlorophenol



$C_6H_4Cl_2O$

Mol. Wt. 163.00

CAS Registry No. 87-65-0

EINECS No. 201-761-3

RTECS No. SK 8750000

Occurrence Sex pheromone of the lone star tick *Amblyomma americanum* (1).

Physical properties

M. Pt. 65-68°C B. Pt. 218-220°C Partition coefficient $\log P_{ow}$ 2.64 (2)

Solubility Organic solvents: benzene, diethyl ether, petroleum ether, ethanol

Occupational exposure

UN No. 2020 (solid)

UN No. 2021 (liquid) HAZCHEM Code 2X Conveyance classification toxic substance

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) guppy 7.8 mg l⁻¹ (3).

LC₅₀ (48 hr) *Leuciscus idus melanotus* 4 mg l⁻¹ (4).

Invertebrate toxicity

EC₅₀ (96 hr) *Selenastrum capricornutum* and *Chlorella vulgaris* 9.7-29 mg l⁻¹ (5).

LC₅₀ (5 min) *Photobacterium phosphoreum* 10 ppm Microtox test (6).

Environmental fate

Nitrification inhibition

IC₅₀ (25 day) *Nitrosomonas* sp. 8.1 mg l⁻¹ (7).

Carbonaceous inhibition

IC₅₀ (50 day) methanogenic bacterial culture 150 mg l⁻¹ (7)

Degradation studies

Degraded by an *Azobacter* sp. isolated from soil (8).

Biodegradable (9).

Abiotic removal

Removed from water by photocatalytic oxidation using titanium oxide irradiated with UV light (10).

Mammalian & avian toxicity

Acute data

LD₅₀ mouse, rat 2120, 2940 mg kg⁻¹, respectively (11,12).

LD₅₀ intraperitoneal rat 390 mg kg⁻¹ (13).

Irritancy

Dermal rabbit (24 hr) 500 mg caused severe irritation and 250 µg instilled into rabbit eye for 24 hr caused severe irritation (11).

Genotoxicity

Salmonella typhimurium TA100 with metabolic activation negative (14).

Other comments

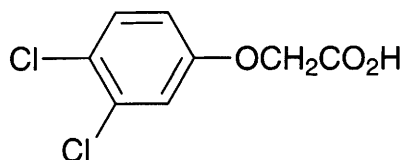
Present in flue gases from waste incineration.

Experimental toxicology and human health effects reviewed (15).

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D239 3,4-dichlorophenoxyacetic acid



$C_8H_6Cl_2O_3$

Mol. Wt. 221.04

CAS Registry No. 588-22-7

Synonyms (3,4-dichlorophenoxy)acetic acid; 3,4-D; 3,4-DA

EINECS No. 209-612-4

RTECS No. AG 6830000

Uses Plant growth regulator.

Physical properties

M. Pt. 138-140°C

Solubility Organic solvents: acetone

Environmental fate

Degradation studies

Biodegradation in soil suspension >205 days for ring cleavage (1).

Mammalian & avian toxicity

Teratogenicity and reproductive effects

Oral mouse, lowest toxic dose for teratogenic effects 1990 mg kg⁻¹ day⁻¹ on days 7-15 of gestation (2).

Irritancy

Causes eye and skin irritation. Material is irritating to mucous membranes and upper respiratory tract. May cause allergic skin reaction (species unspecified) (3).

Legislation

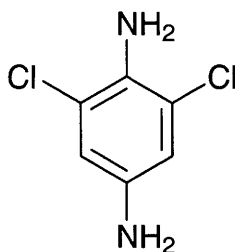
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (4).

Prescribed concentration or value for individual pesticides, UK Water Supply (Water Quality) Regulations 1989 0.1 µg l⁻¹ (5).

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D240 2,6-dichloro-*p*-phenylenediamine



C₆H₄Cl₂N₂

Mol. Wt. 177.03

CAS Registry No. 609-20-1

Synonyms 1,4-benzenediamine, 2,6-dichloro-; *p*-phenylenediamine, 2,6-dichloro-; C.I. 37020

EINECS No. 210-184-6

RTECS No. SS 9175000

Uses Chemical intermediate for C.I. Azoic Diazo Component 117 used in the preparation of certain polyamide fibres. Curing agent for polyurethane.

Physical properties

M. Pt. 124-126°C

Solubility Organic solvents: acetone, benzene, diethyl ether, ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 700 mg kg⁻¹ (1).

Sub-acute and sub-chronic data

Oral mice (13 wk) 625-7000 mg kg⁻¹ via diet caused weight gain deficit in all animals except lowest dose ♀ (1).

Oral rat (13 wk) 1000-8000 mg kg⁻¹ via diet, some weight gain deficit with papillary necrosis, pyelonephrosis and transitional cell hyperplasia (1).

Carcinogenicity and chronic effects

No adequate evidence for carcinogenicity to humans, limited evidence for carcinogenicity to animals, IARC classification group 3 (2).

Oral ♂ mice liver adenomas and carcinomas were detected when administered via food (dose unspecified). No evidence for carcinogenicity in ♂ or ♀ rats (3).

Site-specific analysis showed carcinogenicity in ♂ and ♀ mice (4).

Oral B6C3F mice (103 wk) 1000 and 3000 mg kg⁻¹ via diet. Survival was similar to control groups for all doses.

Increased incidence of hepatocellular adenomas and carcinomas in both sexes (1).

Oral Fischer 344/N rats (103 wk) 1000 and 2000 mg kg⁻¹ via diet. No treatment-related neoplasms observed but pronounced weight-gain deficits seen at higher dose for both sexes. 1000 and 2000 mg kg⁻¹ and higher doses, nephropathy was seen in some animals and ectopic hepatocytes were visible, associated with pancreatic islets (1).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1537 with metabolic activation positive; TA1535 with metabolic activation equivocal (5).

Mouse lymphoma L5178Y tk+/tk- without metabolic activation positive (6).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Organochlorines: guide level 1 µg l⁻¹ (7).

Other comments

Contaminant in soil and plants. Occurs as a metabolite in several mammalian species, including humans.

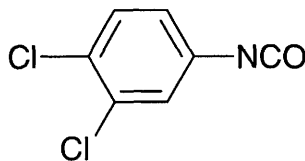
Metabolite of the herbicide 2,6-dichloro-4-nitroaniline.

Toxicity and carcinogenicity reviewed (8).

References

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7. EC Directive Relating to the Quality of Water Intended for Human Consumption 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
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D241 3,4-dichlorophenyl isocyanate



$C_7H_3Cl_2NO$

Mol. Wt. 188.01

CAS Registry No. 102-36-3

Synonyms isocyanic acid, 3,4-dichlorophenyl ester

EINECS No. 203-026-2

RTECS No. NQ 8760000

Physical properties

M. Pt. 42-44°C B. Pt. 118-120°C at 18 mmHg Flash point >110°C

Occupational exposure

SE-LEVL 0.005 ppm

SE-CEIL 0.01 ppm

UK-LTEL MEL 0.02 mg m⁻³ (as NCO)

UK-STEL MEL 0.07 mg m⁻³ (as NCO)

Ecotoxicity

Invertebrate toxicity

EC₅₀ (5-30 min) *Photobacterium phosphoreum* 0.964 ppm Microtox test (1).

Mammalian & avian toxicity

Acute data

LC_{Lo} (2 min, 4 min) inhalation mouse, rat 140 mg m⁻³ (2).

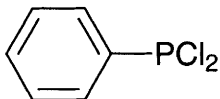
Other comments

Lachrymator.

References

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D242 dichlorophenylphosphine



$C_6H_5Cl_2P$

Mol. Wt. 178.98

CAS Registry No. 644-97-3

Synonyms phenylphosphonous dichloride; phenyldichlorophosphine; phenylphosphine dichloride; phenylphosphonous acid dichloride

EINECS No. 211-425-8

RTECS No. TB 2478000

Uses Catalyst.

Physical properties

M. Pt. $-51^{\circ}C$ B. Pt. $225^{\circ}C$ Flash point $>110^{\circ}C$ Specific gravity 1.319 at $20^{\circ}C$ with respect to water at $4^{\circ}C$

Volatility v.den. 6.17

Solubility Organic solvents: benzene, carbon disulfide

Ecotoxicity

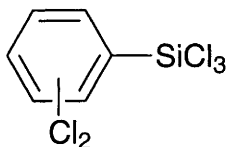
Bioaccumulation

No or low bioaccumulation (1).

References

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D243 dichlorophenyltrichlorosilane



$C_6H_3Cl_5Si$

Mol. Wt. 280.44

CAS Registry No. 27137-85-5

Synonyms trichloro(dichlorophenyl)silane

EINECS No. 248-254-3

RTECS No. VV 3540000

Physical properties

B. Pt. $260^{\circ}C$ Flash point $146^{\circ}C$ Specific gravity 1.562 at $20^{\circ}C$

Solubility Organic solvents: benzene, perchloroethylene

Occupational exposure

UN No. 1766 HAZCHEM Code 4XE Conveyance classification corrosive substance

Mammalian & avian toxicity

Acute data

- LD_{Lo} oral mouse 100 mg kg⁻¹ (1).
LC_{Lo} (2 hr) inhalation mouse 80 mg m⁻³ (1).
LD_{Lo} intraperitoneal rat, mouse 100 mg kg⁻¹ (1).
LD_{Lo} subcutaneous mouse 100 mg kg⁻¹ (1).

References

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D244 1,1-dichloropropane



C₃H₆Cl₂

Mol. Wt. 112.99

CAS Registry No. 78-99-9

Synonyms propylidene chloride

EINECS No. 201-165-3

RTECS No. TX 9450000

Uses Solvent.

Physical properties

B. Pt. 88°C Flash point 7°C Specific gravity 1.1321 at 20°C with respect to water at 4°C

Volatility v.den. 3.9

Solubility Water: miscible. Organic solvents: benzene, chloroform, diethyl ether, ethanol

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) bluegill sunfish 98 mg l⁻¹ (1).

Invertebrate toxicity

EC₅₀ (96 hr) *Daphnia magna* 23 mg l⁻¹ (1).

Bioaccumulation

Calculated bioaccumulation factor of 19.4 indicates that environmental accumulation is unlikely (2).

Environmental fate

Abiotic removal

t_{1/2} for volatilisation from river water 3.1 hr (3).

Mammalian & avian toxicity

Acute data

- LD₅₀ oral rat 6.5 g kg⁻¹ (4).
LC_{Lo} inhalation rat (4 hr) 4000 ppm (4).
LD₅₀ dermal rabbit 14 g kg⁻¹ (4).

Metabolism and toxicokinetics

Undergoes enzymatic dechlorination in rabbit, rat and guinea pig liver microsomes (5).

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4. Smyth, H. F. et al *Arch. Ind. Hyg. Occup. Med.* 1954, **10**, 61.
5. van Dyke, R. A. et al *Biochem. Pharmacol.* 1971, **20**(2), 463-470

D245 1,2-dichloropropane



$\text{C}_3\text{H}_6\text{Cl}_2$

Mol. Wt. 112.99

CAS Registry No. 78-87-5

Synonyms propylene chloride; propylene dichloride

EINECS No. 201-152-2

RTECS No. TX 9625000

Uses Solvent. Soil fumigant. Chemical intermediate.

Physical properties

M. Pt. -100°C **B. Pt.** $95-96^\circ\text{C}$ **Flash point** 4°C **Specific gravity** 1.1560 at 20°C with respect to water at 4°C

Partition coefficient $\log P_{\text{ow}}$ 2.00 (1) **Volatility** v.p. 40 mmHg at 19.4°C ; v.den. 3.9

Solubility Water: 2.7 g l^{-1} at 20°C . Organic solvents: benzene, chloroform, diethyl ether, ethanol

Occupational exposure

FR-VME 75 ppm (350 mg m^{-3})

US-TWA 75 ppm (347 mg m^{-3})

US-STEL 110 ppm (508 mg m^{-3})

UN No. 1279 HAZCHEM Code 2YE Conveyance classification flammable liquid

Supply classification highly flammable, harmful

Risk phrases Highly flammable – Harmful by inhalation and if swallowed (R11, R20/22)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from sources of ignition – No smoking – Avoid contact with the skin (S2, S16, S24)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow, bluegill sunfish, inland silverside 130-430 mg l^{-1} (2,3).

LC₅₀ (7 day) guppy 116 mg l^{-1} (4).

Invertebrate toxicity

LC₅₀ (30 min) *Photobacterium phosphoreum* 94 ppm Microtox test (5).

EC₅₀ (24 hr) *Daphnia magna* 79 mg l^{-1} (6).

Bioaccumulation

The calculated bioconcentration factor of 18 indicates that environmental concentration is unlikely (7).

Environmental fate

Nitrification inhibition

IC₅₀ (25 day) *Nitrosomonas* sp. 43 mg l^{-1} (2).

Carbonaceous inhibition

IC₅₀ (50 day) methanogenic bacterial culture 180 mg l⁻¹ (2).

Degradation studies

Reported to be degraded by the nitrifying soil bacteria *Nitrosomonas europaea*, *Nitrosococcus oceanus* and *Nitrosolobus multiformis* (8).

Completely degraded by the methanotrophic bacteria *Methylosinus trichosporium* and *Pseudomonas fluorescens* in laboratory studies (9,10).

Abiotic removal

Absorption capacity for activated carbon 0.183 g g⁻¹ (11).

t_{1/2} for volatilisation from water at 1 m depth 8.3 hr (12).

t_{1/2} for reaction with photochemically produced hydroxyl radicals in the atmosphere >23 days (13).

Adsorption and retention

K_{oc} in silt loam soil 47 (14).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 2196 mg kg⁻¹ (15).

LC₅₀ (8 hr) inhalation rat 14,000 mg m⁻³ (16).

LC₅₀ (10 hr) inhalation rat 3300 mg m⁻³ (17).

LD₅₀ dermal rat 10 mg kg⁻¹ (15).

Sub-acute and sub-chronic data

Gavage rat (10 day) 0, 100, 250, 500 and 1000 mg kg⁻¹ day⁻¹ caused body weight loss and central nervous system depression. Morphological changes to the liver centrilobular cells and elevated serum enzyme activity were observed in the 500 and 1000 mg kg⁻¹ dosed rats. Nucleolar enlargement of hepatocytes was observed for all dose levels after 5 days. Haemolytic anaemia was indicated by erythrophagocytosis in the liver, splenic haemosiderosis and hyperplasia of erythropoietic elements of the red pulp, renal tubular cell haemosiderosis and hyperbilirubinaemia. No nephrotoxicity was observed (18).

Gavage rat (13 wk) 0, 100, 250, 500 or 750 mg kg⁻¹ 5 × wk⁻¹. 50% of the high-dose group died within 10 days.

Histopathological changes identified in these included mild hepatitis and splenic haemosiderosis, adrenal medullary vacuolisation, cortical lipidosis, testicular degeneration and a reduction in sperm count, and an increased number of degenerate spermatogonia in the epididymis of some animals. No deaths occurred in the 100 or 250 mg kg⁻¹ groups (18).

Carcinogenicity and chronic effects

No adequate data for carcinogenicity to humans, limited evidence for carcinogenicity to animals, IARC classification group 3 (19).

National Toxicology Program tested rats and mice via gavage. Some evidence for carcinogenicity (increased incidence of chemically related neoplasms, malignant, benign or combined) in mice, equivocal evidence in ♀ rats, and no evidence of carcinogenicity in ♂ rats (20).

Teratogenicity and reproductive effects

Oral ♀ rats and rabbits (days 6-15 and 7-19 of gestation, respectively) 0, 10, 30 or 125 and 0, 15, 50 or 150 mg kg⁻¹ day⁻¹, respectively, via gavage. Foetuses were examined on day 20 (rats) and 28 (rabbits) of gestation. No signs of teratogenicity were observed. Slight foetal toxicity occurred at high doses, but this was considered to be due to reduced maternal growth (21).

Metabolism and toxicokinetics

♂ and ♀ rats were administered single oral doses of 3.5-5.3 mg kg⁻¹ [1-¹⁴C]-1,2-dichloropropane. Within 24 hr ~50% of the radioactivity was excreted in the urine and 5% in the faeces. Little additional excretion was observed during the following 72 hr. After 96 hr ~5% of the radioactivity was present in the gut, skin, and carcass. A total of 19% of the dose was expired as ¹⁴CO₂ and 23% as other radioactive volatiles (22).

Following oral administration to rats, the major urinary product was *N*-acetyl-S-(2-hydroxypropyl)cysteine;

β -chlorolactate and *N*-acetyl-S-(2,3-dihydroxypropyl)cysteine were identified as minor metabolites. No parent compound was detected in the urine. The parent compound was detected in the expired air of rats following intraperitoneal administration (23).

Irritancy

Four cases of allergic dermatitis in workers were attributed to 1,2-dichloropropane exposure (24).

Genotoxicity

Salmonella typhimurium TA100, TA1535 with and without metabolic activation positive (25,26).

Drosophila melanogaster sex-linked recessive lethal mutation negative (27).

In vitro mouse lymphoma L5178Y cells mutagenicity assay positive (28).

In vitro Chinese hamster ovary cells sister chromatid exchange and chromosome aberration positive (28).

In vitro V79 cells sister chromatid exchange without metabolic activation positive (29).

Other effects

Other adverse effects (human)

Toxic effects in humans have been investigated mainly with respect to accidental ingestion, self-poisoning and sniffing. Some fatalities have been reported. The main target organs were the liver and kidney. The severity of toxicity ranged from temporary elevation of serum liver enzymes to death from liver failure. Tubular necrosis of the kidney and, in some cases, renal failure has occurred. Disseminating intravascular coagulation and haemolytic anaemia have also been reported (30,31).

Any other adverse effects

In acute inhalation studies in rats, increases in the levels of serum glutamate-oxaloacetate transaminase and glutamate-pyruvate transaminase were reported (dose and exposure duration unspecified) (17).

Inhalation rat (4hr) 15-4900 mg m⁻³.

For concentrations of <100 mg m⁻³ liver non-thiol content was significantly reduced.

At 100-1000 mg m⁻³ liver non-thiol content was not affected, but was increased in the liver of rats exposed to >1000 mg m⁻³.

Hepatic liver peroxidation was not observed and total protein content was not altered.

Changes in liver cell thiol homeostasis are likely to reflect the action of reactive intermediates formed during 1,2-dichloropropane metabolism (32).

Legislation

Maximum admissible concentration in domestic drinking water in Russia 0.4 mg l⁻¹ (33).

WHO provisional guideline value for drinking water 20 µg l⁻¹ (34).

Other comments

Residues have been isolated from water and sediments (30,35).

Physical properties, use, occurrence, analysis, carcinogenicity, toxicity, metabolism and genotoxicity of 1,2-dichloropropane reviewed (30,36).

Environmental fate of 1,2-dichloropropane reviewed (35).

Autoignition temperature 555°C.

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D246 1,3-dichloropropane



$\text{C}_3\text{H}_6\text{Cl}_2$

Mol. Wt. 112.99

CAS Registry No. 142-28-9

Synonyms trimethylene dichloride

EINECS No. 205-531-3

RTECS No. TX 9660000

Uses Solvent.

Physical properties

M. Pt. -99°C B. Pt. $120-122^\circ\text{C}$ Flash point 32°C Specific gravity 1.1876 at 20°C with respect to water at 4°C Partition coefficient $\log P_{\text{ow}}$ 1.707 (1) Volatility v.den. 3.90
Solubility Water: miscible. Organic solvents: benzene, chloroform, diethyl ether, ethanol

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 110 mg l⁻¹ flow-through bioassay (2).

LC₅₀ (24 hr) goldfish 160 mg l⁻¹ (3).

LC₅₀ (7 day) guppy 84 mg l⁻¹ (4).

Invertebrate toxicity

LC₅₀ (30 min) *Photobacterium phosphoreum* 121 ppm Microtox test (5).

Environmental fate

Nitrification inhibition

IC₅₀ (25 day) *Nitrosomonas* sp. 4.8 mg l⁻¹ (2).

Carbonaceous inhibition

IC₅₀ (5 day) methanogenic bacterial culture 18 mg l⁻¹ (2).

Degradation studies

Degraded by *Acinetobacter* sp. isolated from sewage sludge (6).

Mammalian & avian toxicity

Acute data

LD_{Lo} oral dog 3 g kg⁻¹ (7).

Sub-acute and sub-chronic data

Gavage rats (14 day) 200, 600 or 1800 mg kg⁻¹ day⁻¹, all high-dose animals died. Treatment-associated symptoms in high-dose group included languid behaviour, salivation, dyspnoea and prostration. No differences found between animals in the low- or mid-dose groups compared to controls when studied for body-weight, food consumption, haematology and gross post-mortem and histopathology data (8).

Gavage rats (90 day) 50, 200 or 800 mg kg⁻¹ day⁻¹. All animals survived to termination. ♂ in high-dose group exhibited significant body weight decrease and ♀ had urine-stained fur. No treatment-related effects found in food consumption or haematological data. Activities of alkaline phosphatase, alanine aminotransferase (♂ only), and levels of albumin and total protein for high-dose animals were increased. Microscopic evaluations revealed centrilobular hepatocellular hypertrophy and chronic progressive nephropathy in high- and mid-dose animals (8). Fischer 344 rats and B6C3F1 mice were given 0-100 or 0-175 mg kg⁻¹ day⁻¹ racemic 1,3-dichloropropane, respectively, as microcapsules in their diets for 13 wk. Treatment-related decreased body-weight gain and organ weights were observed, together with slight histological effects in the non-glandular stomach mucosa of rats consistent with the irritant properties of 1,3-dichloropropane. Most treatment-related changes were reversed after a 4-wk recovery period. The no-observed-adverse-effect levels for ♂ rats and both sexes of mice were 5 and 15 mg kg⁻¹ day⁻¹, respectively. A no-observed-effect level of 5 mg kg⁻¹ day⁻¹ was established for ♀ rats (9).

Genotoxicity

Salmonella typhimurium TA100 with and without metabolic activation positive (10).

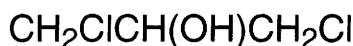
In vitro V79 cells sister chromatid exchanges with and without metabolic activation positive (11).

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D247 1,3-dichloro-2-propanol



$\text{C}_3\text{H}_6\text{Cl}_2\text{O}$

Mol. Wt. 128.99

CAS Registry No. 96-23-1

Synonyms 1,3-dichloropropan-2-ol; α,γ -dichlorohydrin; 1,3-dichlorohydrin; 1,3-dichloropropanol; glycol 1,3-dichlorohydrin; 1,3-dichloroisopropanol; propylene dichlorohydrin

EINECS No. 202-491-9

RTECS No. UB 1400000

Uses Cross-linking agent. Solvent. Intermediate in organic synthesis.

Physical properties

M. Pt. -4°C **B. Pt.** 174.3°C **Flash point** 85°C **Specific gravity** 1.3506 at 17°C with respect to water at 4°C
Partition coefficient $\log P_{\text{ow}}$ 0.20 (1) **Volatility** v.p. 7 mmHg at 20°C ; v.den. 4.45
Solubility Water: 10%. Organic solvents: acetone, diethyl ether, ethanol, vegetable oil

Occupational exposure

UN No. 2750 HAZCHEM Code 2X Conveyance classification toxic substance

Supply classification toxic

Risk phrases May cause cancer – Harmful in contact with skin – Toxic if swallowed (R45, R21, R25)

Safety phrases Restricted to professional users – Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S53, S45)

Ecotoxicity

Fish toxicity

LC_{50} (24 hr) goldfish 170 mg l^{-1} (2).

Invertebrate toxicity

EC_{50} (24 hr) *Daphnia* 980 mg l^{-1} (3).

Environmental fate

Degradation studies

Bacterial cultures isolated from freshwater sediments were reported to degrade 1,3-dichloro-2-propanol by dehalogenation to yield the epoxides (4).

Mammalian & avian toxicity

Acute data

LD_{50} oral mouse, rat 100, 110 mg kg^{-1} , respectively (5,6).

LC_{Lo} (4 hr) inhalation rat 125 ppm (5).

LD_{50} dermal rabbit 800 mg kg^{-1} (5).

Sub-acute and sub-chronic data

Oral ♂ rat (14 day) 0, 15 or 60 mg kg⁻¹. The only significant treatment-related effect was the appearance of small spermatocoele or sperm granuloma formation in the ductuli efferentes and/or epididymides. Testes weight was not affected (7).

Metabolism and toxicokinetics

The urinary metabolites in rats are *N,N'*-diacetyl-*S,S'*-(1,3-dicysteinyl)propan-2-ol and *N*-acetyl-*S*-(2,3-dihydroxypropyl)cysteine (route of administration unspecified) (7).

Irritancy

Dermal rabbit (24 hr) 10 mg caused mild irritation (5).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation positive (8).

In vitro V-79 cells sister chromatid exchanges without metabolic activation positive (9).

In vitro human HeLa cells inhibition of DNA synthesis with metabolic activation positive (10).

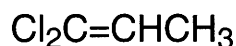
Other comments

Studies using the SOS chromotest and the Ames test demonstrated that the genotoxic effects of 1,3-dichloropropanol are related to the formation of epichlorohydrin (11).

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D248 1,1-dichloropropene



C₃H₄Cl₂

Mol. Wt. 110.97

CAS Registry No. 563-58-6

Synonyms 1,1-dichloro-1-propene; 1,1-dichloroprop-1-ene; 1,1-dichloropropylene

EINECS No. 209-253-3

RTECS No. UC 2890000

Physical properties

B. Pt. 76-77°C Flash point 0.5°C Specific gravity 1.169 at 25°C with respect to water at 4°C

Solubility Organic solvents: acetone, chloroform, diethyl ether

Occupational exposure

UN No. 2047 **HAZCHEM Code 2W** (flash point $\geq 23^{\circ}\text{C}$, $\leq 61^{\circ}\text{C}$, initial boiling point $> 35^{\circ}\text{C}$)

HAZCHEM Code 2WE (flash point $< 23^{\circ}\text{C}$, initial boiling point $> 35^{\circ}\text{C}$) **Conveyance classification** flammable liquid

Supply classification highly flammable, toxic

Risk phrases Highly flammable – Toxic if swallowed – Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R11, R25, R52/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Keep away from sources of ignition – No smoking – Do not empty into drains – Take precautionary measures against static discharges – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S16, S29, S33, S45, S61)

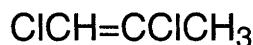
Genotoxicity

Salmonella typhimurium TA100 with metabolic activation positive (1).

References

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D249 1,2-dichloropropene



$\text{C}_3\text{H}_4\text{Cl}_2$

Mol. Wt. 110.97

CAS Registry No. 563-54-2

Synonyms 1,2-dichloro-1-propene; 1,2-dichloroprop-1-ene; 1,2-dichloro-1-propylene

RTECS No. UC 8300000

Uses Component of the soil fumigant DD.

Physical properties

B. Pt. 75°C **Volatility** v.p. 91 mmHg

Solubility Water: 4.4 g l⁻¹. Organic solvents: carbon tetrachloride, ethanol, methanol

Occupational exposure

UN No. 2047 **HAZCHEM Code 2W** (flash point $\geq 23^{\circ}\text{C}$, $\leq 61^{\circ}\text{C}$, initial boiling point $> 35^{\circ}\text{C}$)

HAZCHEM Code 2WE (flash point $< 23^{\circ}\text{C}$, initial boiling point $> 35^{\circ}\text{C}$)

Conveyance classification flammable liquid

Supply classification highly flammable, toxic

Risk phrases Highly flammable – Toxic if swallowed (R11, R25)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Keep away from sources of ignition – No smoking – Do not empty into drains – Take precautionary measures against static discharges – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S16, S29, S33, S45)

Ecotoxicity

Bioaccumulation

The calculated bioconcentration factor of 1.32 indicates that environmental accumulation is unlikely (1).

Environmental fate

Abiotic removal

$t_{1/2}$ for volatilisation in river water 3.4 hr (2).

$t_{1/2}$ for reaction with photochemically produced hydroxyl radicals in the atmosphere 10.4 hr (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 2 g kg⁻¹ (3).

LD₅₀ dermal rabbit 8750 mg kg⁻¹ (4).

Genotoxicity

Salmonella typhimurium TA100 with metabolic activation positive (5).

In vitro Chinese hamster ovary cells, chromosomal aberrations negative, sister chromatid exchange positive (6).

In vitro mouse lymphoma L5178Y cell mutation assay positive (6).

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D250 1,3-dichloropropene



C₃H₄Cl₂

Mol. Wt. 110.97

CAS Registry No. 542-75-6

Synonyms 1,3-dichloroprop-1-ene; 3-chloroallyl chloride; γ -chloroallyl chloride; 1,3-dichloropropylene; 1,3-D; DCP

EINECS No. 208-826-5

RTECS No. UC 8310000

Uses Nematicide. Fumigant.

Physical properties

M. Pt. <-50°C **B. Pt.** 108°C **Flash point** 25°C (closed cup) **Specific gravity** 1.214 at 20°C **Partition coefficient** log P_{ow} 1.82 at 20°C **Volatility** v.p. 2.78×10^{-5} mmHg at 20°C ; v.den. 3.83

Solubility Water: 2 g l⁻¹ at 20°C. Organic solvents: miscible with hydrocarbons, halogenated solvents, esters and ketones

Occupational exposure

US-TWA 1 ppm (4.5 mg m⁻³)

UN No. 2047 **HAZCHEM Code** 2W (flash point $\geq 23^\circ\text{C}$, $\leq 61^\circ\text{C}$, initial boiling point $> 35^\circ\text{C}$)

HAZCHEM Code 2WE (flash point $< 23^\circ\text{C}$, initial boiling point $> 35^\circ\text{C}$) **Conveyance classification** flammable liquid

Supply classification toxic

Supply classification harmful for the environment

Risk phrases Flammable – Harmful by inhalation and in contact with skin – Toxic if swallowed – Irritating to eyes, respiratory system and skin – May cause sensitisation by skin contact – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R10, R20/21, R25, R36/37/38, R43, R50/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S36/37, S45, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout, bluegill sunfish 4, 7 mg l⁻¹, respectively (1).

Invertebrate toxicity

EC₅₀ (48 hr) *Daphnia magna* 6.2 mg l⁻¹ (1).

EC₅₀ (30 min) *Photobacterium phosphoreum* 5.1 mg l⁻¹ Microtox test (2).

LD₅₀ (90 hr) 6.6 µg bee⁻¹ (1).

Environmental fate

Nitrification inhibition

Inhibitory in soil at 133 ppm for up to 4-8 wk (3).

Degradation studies

Ultimate degradation to carbon dioxide and water-soluble products was reported in soil after 28 days (4).

Abiotic removal

Rate of hydrolysis in sterile water was independent of pH, with t_{1/2} of 3.1, 11.3 and 51 days at 30, 20 and 10°C, respectively (5).

Rate of evaporation from wastewater at 25°C for 1 mg l⁻¹ solution, 50% after 31 min, 90% after 98 min (6).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 325 mg kg⁻¹ (7).

LC₅₀ (2 hr) inhalation mouse 4650 mg m⁻³ (8).

LD₅₀ dermal rat 504 mg kg⁻¹ (9).

LD₅₀ intraperitoneal rat 175 mg kg⁻¹ (7).

Sub-acute and sub-chronic data

LC₅₀ (8 day) oral mallard duck, bobwhite quail >10 g kg⁻¹ diet (1).

Inhalation rat, guinea pig (4 wk) 50 ppm for 7 hr day⁻¹ 5 days wk⁻¹ caused liver and kidney necrosis (9).

Inhalation rat, mouse (13 wk) 0, 10, 30, 90 or 150 ppm 6 hr day⁻¹ 5 days wk⁻¹. The primary target tissues were the nasal mucosa of both sexes of rats and mice, and the urinary bladder in ♀ mice. In addition, depressed growth rates of all animals exposed to 90 or 150 ppm (up to 20% in rats and 12% in mice) resulted in a variety of alterations in haematological and clinical chemistry parameters and changes in organ weights. Nasal mucosa effects consisted of dose-related slight degenerative changes in nasal olfactory epithelium or a mild hyperplasia of the respiratory epithelium or both in all animals exposed to 90 or 150 ppm and 2/10 rats exposed to 30 ppm. Urinary bladder effects consisted of a diffuse, moderate hyperplasia of the transitional epithelium in ♀ mice exposed to 90 or 150 ppm (10).

Oral mouse, single administration of 100 or 300 mg kg⁻¹. The high dose increased plasma glutamate-oxaloacetate transaminase and glutamate-pyruvate transaminase activities as well as hepatic centrilobular swelling 15 hr after administration. These effects were significantly decreased by pre-treatment with piperonyl butoxide which inhibited cytochrome P₄₅₀. After pretreatment with buthionine sulfoximine which inhibits GSH synthesis, plasma

glutamate-oxaloacetate transaminase activity significantly increased in animals receiving 100 mg kg⁻¹ whereas glutathione S-transferase activity decreased. The data suggest that 1,3-dichloro-1-propene is transformed via cytochrome P₄₅₀, the metabolites induce liver damage, and GSH plays an important role in detoxification (11). Inhalation rat, guinea pig (4 wk) 50 ppm for 7 hr day⁻¹ 5 days wk⁻¹ caused liver and kidney necrosis (9).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (12).

Two cases of malignant histiocytic lymphoma were reported among nine firefighters accidentally exposed 6 yr prior to diagnosis. Because firefighters are exposed to a large number of chemicals, the precise role of 1,3-dichloro-1-propene cannot be evaluated (12,13).

A case of acute myelomonocytic leukaemia was reported in a farmer less than 1 yr after accidental exposure (13).

Inhalation rat, mouse (2 yr) 0, 5, 20, 60 ppm 6 hr day⁻¹, 5 days wk⁻¹. No increased tumour incidence was observed in treated rats. The only neoplastic response observed in mice was an increased incidence of benign lung tumours (bronchioalveolar adenomas) in ♂ mice exposed to 60 ppm. Non-neoplastic changes were morphological alterations in the nasal tissues of rats exposed to 60 ppm and mice exposed to 20 or 60 ppm (14).

Gavage mouse (104 wk) 0, 50 or 100 mg kg⁻¹ Telone II [containing ~88% 1,3-dichloro-1-propene (mixed isomers); 2.5% dichloropropane; 1.5% trichloropropene (mixed isomers); 1% epichlorohydrin; and 7.5% of 9 other impurities]. The findings included a significant increase in epithelial hyperplasia of the forestomach in the high-dose group, a significant dose-related incidence of epithelial hyperplasia in the urinary bladder and of alveolar/bronchial adenomas in both sexes, and a significant dose-related incidence of transitional-cell carcinoma of the urinary bladder in ♀ mice. In rats administered 0, 25 or 50 mg kg⁻¹ by gavage (104 wk) an increased incidence of epithelial hyperplasia of the forestomach was observed. In ♂ rats there was a significant increase in papillomas and carcinomas in the forestomach and of liver neoplastic nodules. One carcinoma of the liver was observed in the high-dose group. The presence in the test compound of 1% epichlorohydrin, which has been shown to produce forestomach tumours in rats, was noted (15-17).

Dermal mouse (20 month) wkly doses of 41 or 122 mg *cis*-1,3-dichloro-1-propene. An insignificant increase in skin tumours was observed in the high-dose group. No skin tumour was observed in the lower-dose group or in controls. Subcutaneous mouse (18 month) wkly injection of 3 mg *cis*-1,3-dichloropropene 6/30 mice developed fibrosarcomas at the site of injection. No skin tumour was observed in the 30 vehicle-treated or 100 controls (18).

Teratogenicity and reproductive effects

Inhalation ♂ and ♀ rat (two-generation study) 0, 10, 30 or 90 ppm, 6 hr day⁻¹ 5 days wk⁻¹. No adverse effects were observed on reproductive function (fertility, pup survival, gestation length, litter size and pup sex ratio) or neonatal growth or survival. Parental effects were limited to rats exposed to 90 ppm and included decreased body weights and histopathological effects on the nasal mucosa in both sexes (19).

Metabolism and toxicokinetics

Inhalation rat 30-900 ppm, an initial rapid elimination from blood with a $t_{1/2}$ of 2-3 min was observed, followed by a second, slower phase with a $t_{1/2}$ of ~40 min (20).

Oral rat 8.3-13.5 mg kg⁻¹ of *cis*- or *trans*-[2-¹⁴C] 1,3-dichloro-1-propene, 80% of the *cis* and 57% of the *trans*-radioactivity was excreted in the urine in 24 hr. Little further urinary excretion occurred over the next 72 hr. After 96 hr, 2-5% of the *cis*-isomer and 23-24% of the *trans*-isomer were expired as ¹⁴CO₂; exhalation of other radioactive compounds was minor. Little faecal excretion was observed (21).

In another experiment rats and mice administered mixed isomers of [¹⁴C]-1,3-dichloro-1-propene excreted 51-61% and 63-79% of the oral dose, respectively, in the urine in 48 hr (22).

The major urinary metabolite (~90% of the radioactivity) of *cis*-1,3-dichloro-1-propene in rats is *N*-acetyl-S-(*cis*-3-chloroprop-2-enyl)cysteine. *In vitro* 1,3-dichloro-1-propene forms a conjugate with glutathione in the presence of rat liver cytosol: the glutathione- and cytosol-dependent degradation of the *cis*-isomer occurs 4-5 times faster than that of the *trans*-isomer (23).

Studies with 4-(*p*-nitrobenzyl) pyridine have shown that 1,3-dichloropropene is an alkylating agent and that the *trans*-isomer is less reactive than the *cis*-isomer (24).

Genotoxicity

Salmonella typhimurium TA100, TA1535 with and without metabolic activation positive (25).

Drosophila melanogaster sex-linked recessive lethal mutations positive, heritable translocation test negative (26).

In vitro transformed human HeLa cells, unscheduled DNA synthesis, without metabolic activation positive (27).

In vitro Chinese hamster V79 cells, sister chromatid exchange without metabolic activation positive (28).

Other effects

Other adverse effects (human)

Among 26 cases of accidental eye and skin exposure in California, the most common findings were conjunctivitis and burns; six patients developed systemic illness characterised by weakness, difficulty in breathing, headache and nausea (29).

In 46 people examined after accidental exposure to fumes of the pesticide Telone II (which contains 92% 1,3-dichloro-1-propene and 8% other chlorinated hydrocarbons) the most common symptoms were headache, chest discomfort, mucous membrane irritation, dizziness, nausea and vomiting. Slightly elevated activities of serum transaminases were observed in 11 persons. 1-2 wk after the accident, 28 persons interviewed still had headache, abdominal discomfort, chest discomfort and malaise. Of 21 persons examined 2 yr later, 10 had headaches, 10 had chest pain and 13 reported psychological changes (30).

In a study of 64 ♂ production workers (time-weighted average exposures, <1 ppm 1,3-dichloro-1-propene, 3.1 mg m⁻³ allyl chloride and 3.8 mg m⁻³ epichlorohydrin) sperm counts and percentages of normal sperm were similar in the study group and among 63 controls (31).

Subclinical nephrotoxicity in workers may be associated with 1,3-dichloropropene (DCP) exposure. The effect of DCP on the kidney was very weak, but the potential for injury in humans exists (32).

Any other adverse effects

Oral rat, 175-325 mg kg⁻¹ and intraperitoneal rat 75-200 mg kg⁻¹. Single doses were reported to depress renal ion transport (7).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (33).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (34).

EPA Toxicity Class (formulation) III (1).

WHO guideline for drinking water quality 20 µg l⁻¹ (35).

Other comments

Residues have been isolated from crops, water, sediments and soil.

Use, occurrence, analysis, carcinogenicity, toxicity, mutagenicity and metabolism of 1,3-dichloro-1-propene reviewed (17).

Component of the pesticides D-D, Vidden D and Telone (1).

The behaviour of 1,3-dichloropropene in soil and aquifers, including properties and applications, degradation, adsorption, behaviour in soil, accumulation in the saturated and unsaturated zones reviewed (36).

Potential adverse health effects from occupational exposure to 1,3-dichloropropene (DCP) are discussed and hazards assessed. Safety considerations when handling the material are included (37).

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D251 2,3-dichloropropene



$\text{C}_3\text{H}_4\text{Cl}_2$

Mol. Wt. 110.97

CAS Registry No. 78-88-6

Synonyms 2,3-dichloro-1-propene; 2,3-dichloroprop-1-ene; 2,3-dichloropropylene

EINECS No. 201-153-8

RTECS No. UC 8400000

Uses Catalyst.

Physical properties

B. Pt. 94°C Flash point 10°C Specific gravity 1.211 at 20°C with respect to water at 4°C

Volatility v.p. 53 mmHg at 25°C ; v.den. 3.8

Solubility Water: 2.15 g l⁻¹. Organic solvents: benzene, chloroform, diethyl ether, ethanol

Occupational exposure

UN No. 2047 **HAZCHEM Code 2W** (flash point $\geq 23^{\circ}\text{C}$, $\leq 61^{\circ}\text{C}$, initial boiling point $>35^{\circ}\text{C}$)

HAZCHEM Code 2WE (flash point $<23^{\circ}\text{C}$, initial boiling point $>35^{\circ}\text{C}$) **Conveyance classification** flammable liquid

Supply classification highly flammable, harmful

Risk phrases Highly flammable – Harmful by inhalation, in contact with skin and if swallowed – Irritating to respiratory system and skin – Possible risk of irreversible effects – Risk of serious damage to eyes – Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R11, R20/21/22, R37/38, R40, R41, R52/53)

Safety phrases Keep out of reach of children (if sold to general public) – Keep container in a well ventilated place – Keep away from sources of ignition – No smoking – Do not breathe vapour – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – Wear suitable protective clothing, gloves and eye/face protection – Avoid release to the environment. Refer to special instructions/safety data sheet (S2, S9, S16, S23, S26, S36/37/39, S61)

Ecotoxicity

Fish toxicity

No observable adverse effects or death to brown trout, bluegill sunfish, yellow perch or goldfish at 5 ppm for 24 hr. Test conditions: pH 7; dissolved oxygen content 7.5 ppm; total hardness (soap method) 300 ppm; methyl orange alkalinity 310 ppm; free carbon dioxide 5 ppm; temperature 12.8°C (1).

Environmental fate

Abiotic removal

Rate of evaporation from water, concentration 1 mg l⁻¹, 25 °C, 50% removed after 20 min, 90% after 68 min (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 250-320 mg kg⁻¹ (3,4).

LC₅₀ (2 hr) inhalation mouse 3100 mg m⁻³ (5).

LD₅₀ dermal rabbit 1580 mg kg⁻¹ (4).

Sub-acute and sub-chronic data

Inhalation rat (13 wk) 0, 1, 5 or 15 ppm for 6 hr day⁻¹, 5 day wk⁻¹. Nasal irritation and a 15% increase in spleen weight of rats exposed to 15 ppm reported (6).

Teratogenicity and reproductive effects

Inhalation rat 0, 1 or 5 ppm for 6 hr day⁻¹, 5 day wk⁻¹ for 10 wk prior to mating and the first 14 days (♀ only) of gestation. No reproductive or teratogenic effects were observed (6).

Metabolism and toxicokinetics

Oral ♀ rats 175 mg kg⁻¹ of 1,3-[¹⁴C]-labelled 2,3-dichloropropene, ~57% of the radioactivity was excreted in the urine, 1.6% in faeces, 5.3% was exhaled as unchanged substance and 0.3% as carbon dioxide, and 31.3% remained in the organs and the carcass after 20 hr. The metabolic pathways were established and included conjugation with GSH, leading to S-(2-chloro-2-propenyl)mercapturic acid formation and the cytochrome P₄₅₀ induced epoxidation with subsequent rearrangement to highly mutagenic 1,3-dichloropropanone. 1,3-Dichloropropanone was further converted into dimercapturic acid, 1,3-(2-propanone)-bis-S-(N-acetylcysteine). Additionally, hydrolysis of 2-chloroallyl alcohol occurred followed by alcohol dehydrogenase catalysed formation of the highly mutagenic 2-chloroacrolein. 2-Chloroallyl alcohol is excreted directly in the urine as the glucuronide. 2-Chloroacrolein is further oxidised to E-chloroacrylic acid which is also excreted in the urine (7).

Irritancy

Dermal rabbit (24 hr) 10 mg caused severe irritation (4).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation positive (8).
In vitro V79 cells sister chromatid exchange without metabolic activation positive (9).
In vitro human HeLA cells, unscheduled DNA synthesis positive (10).

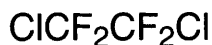
Legislation

Maximum permissible concentration in domestic water in former USSR 0.4 mg l⁻¹ (11).

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D252 1,2-dichlorotetrafluoroethane



C₂Cl₂F₄

Mol. Wt. 170.92

CAS Registry No. 76-14-2

Synonyms 1,2-dichloro-1,1,2,2-tetrafluoroethane

EINECS No. 200-937-7

RTECS No. KI 1101000

Uses Aerosol propellant. Blowing agent. Refrigerant. Solvent.

Physical properties

M. Pt. -94°C B. Pt. 3.8°C Specific gravity 1.5312 (liquid) at 0°C Partition coefficient log P_{ow} 2.82 (1)

Volatility v.p. 2014 mmHg at 25°C ; v.den. 5.9

Solubility Water: 130 mg l⁻¹ at 25 °C. Organic solvents: diethyl ether, ethanol

Occupational exposure

DE-MAK 1000 ppm (7100 mg m⁻³)

FR-VME 1000 ppm (7000 mg m⁻³)

UK-LTEL 1000 ppm (7110 mg m⁻³)

UK-STEL 1250 ppm (8890 mg m⁻³)

US-TWA 1000 ppm (6990 mg m⁻³)

UN No. 1958 HAZCHEM Code 2RE Conveyance classification non-flammable non-toxic gas

Environmental fate

Abiotic removal

t_{1/2} for volatilisation in river model, 4 hr (2).

In the stratosphere, this compound is slowly photolysed to release chlorine atoms, which participate in the catalytic removal of stratospheric ozone (3).

Stratospheric lifetime has been estimated to range from 126-310 yr, with direct photolysis and reaction with singlet oxygen being the significant removal mechanisms (4).

Adsorption and retention

Soil absorption coefficient 300-815 (2).

Mammalian & avian toxicity

Acute data

LC₅₀ (30 min) inhalation rat, mouse, rabbit 70-75 pph (5).

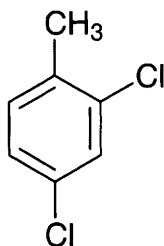
Other comments

Environmental fate of 1,2-dichlorotetrafluoroethane reviewed (6).

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D253 2,4-dichlorotoluene



C₇H₆Cl₂

Mol. Wt. 161.03

CAS Registry No. 95-73-8

Synonyms 2,4-dichloro-1-methylbenzene

EINECS No. 202-445-8

RTECS No. XT 0730000

Uses In the manufacture of chlorophenoxy herbicides.

Physical properties

M. Pt. -13.5°C B. Pt. 200°C Flash point 79°C Specific gravity 1.2498 at 20°C with respect to water at 20°C

Partition coefficient log P_{ow} 4.24 (1) Volatility v.p. 0.416 mmHg at 25°C

Solubility Organic solvents: carbon tetrachloride

Occupational exposure

UN No. 2238 HAZCHEM Code 3  Conveyance classification flammable liquid

Ecotoxicity

Fish toxicity

LC₅₀ (14 day) guppy 14.6 mg l⁻¹ (2).

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 2.67 ppm Microtox test (3).

Bioaccumulation

The calculated bioconcentration factor of 983 indicates that environmental accumulation is likely (4).

Environmental fate

Abiotic removal

t_{1/2} for reaction with photochemically produced hydroxyl radicals in the atmosphere is ≈12 days (5).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse, guinea pig 2900-5000 mg kg⁻¹ (6).

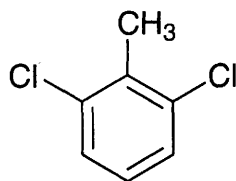
Other comments

Degradation product of 2,4-D (7).

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D254 2,6-dichlorotoluene



C₇H₆Cl₂

Mol. Wt. 161.03

CAS Registry No. 118-69-4

Synonyms 1,3-dichloro-2-methylbenzene

EINECS No. 204-269-7

Uses Chemical intermediate. Manufacture of dyestuffs and herbicides.

Physical properties

B. Pt. 196-203°C Flash point 82°C Specific gravity 1.268 at 20°C Partition coefficient log P_{ow} 4.29 (1)

Solubility Organic solvents: chloroform

Occupational exposure

UN No. 2238 HAZCHEM Code 3  Conveyance classification flammable liquid

Ecotoxicity

Bioaccumulation

Calculated bioconcentration factor of 1070 indicates that environmental accumulation may be expected (2).

Environmental fate

Abiotic removal

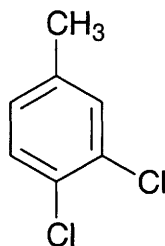
$t_{1/2}$ for volatilisation in model river water 4.0 hr (3).

$t_{1/2}$ for reaction with photochemically produced hydroxyl radicals in the atmosphere is 11.6 days (4).

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D255 3,4-dichlorotoluene



$C_7H_6Cl_2$

Mol. Wt. 161.03

CAS Registry No. 95-75-0

Synonyms 3,4-dichloro-1-methylbenzene; 1,2-dichloro-4-methylbenzene

EINECS No. 202-447-9

Uses Chemical intermediate.

Physical properties

M. Pt. -15.2°C B. Pt. 208.9°C Flash point 85°C Specific gravity 1.2564 at 20°C with respect to water at 4°C

Solubility Organic solvents: acetone, benzene, carbon tetrachloride, diethyl ether, ethanol, ligroin

Occupational exposure

UN No. 2238 HAZCHEM Code 3  Conveyance classification flammable liquid

Ecotoxicity

Fish toxicity

LC_{50} (7 day) guppy 5 mg l^{-1} (1).

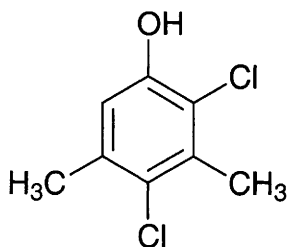
Invertebrate toxicity

EC₅₀ (15 min) *Photobacterium phosphoreum* 1.40 ppm Microtox test (2).

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D256 2,4-dichloro-3,5-xyleneol



C₈H₈Cl₂O

Mol. Wt. 191.06

CAS Registry No. 133-53-9

Synonyms 2,4-dichloro-3,5-dimethylphenol; dichloroxylenol; Prinsyl

EINECS No. 205-109-9

Uses Disinfectant. Preservative. Fungicide.

Physical properties

M. Pt. 95-96°C

Solubility Water: 0.2 mg l⁻¹. Organic solvents: acetone, benzene, chloroform, diethyl ketone, petroleum ether, toluene, carbon tetrachloride

Mammalian & avian toxicity

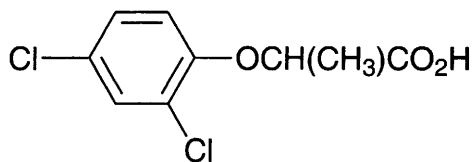
Acute data

LD₅₀ oral redwing blackbird >113 mg kg⁻¹ (1).

References

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D257 dichlorprop



$C_9H_8Cl_2O_3$

Mol. Wt. 235.07

CAS Registry No. 120-36-5

Synonyms 2-(2,4-dichlorophenoxy)propanoic acid; 2-(2,4-dichlorophenoxy)propionic acid; α -(2,4-dichlorophenoxy)propionic acid; 2,4-DP; dichloroprop; Celatop DP; Celefour DP; Clementgros; Corasil; Dromone; Envert; Fixofruit

EINECS No. 204-390-5

RTECS No. UF 1050000

Uses Herbicide. Growth regulator.

Physical properties

M. Pt. 116-117.5°C Specific gravity 1.42 at 20°C Partition coefficient $\log P_{ow}$ 1.772

Solubility Water: 350 mg l⁻¹ at 20°C. Organic solvents: acetone, benzene, isopropanol, toluene, xylene

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout 521 mg l⁻¹ (1).

Invertebrate toxicity

LC₅₀ (9 hr) *Colpoda cucullus*, *Blepharisma undulans* and *Oikomonas termo* >100 mg l⁻¹ (2).

Not toxic to bees (1).

Environmental fate

Degradation studies

Metabolised by a *Flavobacterium* sp. isolated from the soil. Metabolites are 2,4-dichlorophenol which undergoes further degradation via O-hydroxylation and O-cleavage to yield 3,5-dichlorocatechol (3).

Biodegradation in soil suspension, >205 days for ring cleavage (4).

Abiotic removal

Photodecomposes slowly on dry soil surfaces. On moist soil surfaces photodecomposition occurs in two days, with transformation kinetics fitting the Hoerl function (5).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 825-1470 mg kg⁻¹ (6).

LD₅₀ oral mouse 400 mg kg⁻¹ (6).

LC₅₀ (4 hr) inhalation rat >650 mg m⁻³ air (1).

LD₅₀ dermal rat, mouse >4000, 1400 mg kg⁻¹, respectively (1,7).

Sub-acute and sub-chronic data

Oral rat (3 month) 12.4 mg kg⁻¹ day⁻¹ caused no ill-effects, 50 mg kg⁻¹ day⁻¹ caused slight liver hypertrophy (1).

Carcinogenicity and chronic effects

Limited evidence for carcinogenicity of chlorophenoxy herbicides to humans, inadequate evidence for carcinogenicity to animals, IARC classification group 2B (7).

Oral rat (2 yr) NOEL 3.6-4.2 mg kg⁻¹ day⁻¹ (1).

Metabolism and toxicokinetics

Following oral administration to mammals, >90% is excreted unchanged in the urine, although, at high concentrations, elimination is delayed and amino acid conjugates are formed, which are eliminated via the bile (1).

Irritancy

Eye and skin irritant in rabbits (6).

Genotoxicity

Salmonella typhimurium microsome assay negative (strains and metabolic activation unspecified) (8).

Other effects

Other adverse effects (human)

In a Danish cohort study of chemical workers exposed to chlorophenoxy herbicides, including dichlorprop, as well as other chemicals, no overall increase in cancer incidence was observed, but there were significantly increased risks for soft-tissue sarcoma and lung cancer in some sub-cohorts (9).

Legislation

Advisory level for drinking water in UK 40 µg l⁻¹ (10).

WHO guideline value for drinking water 100 µg l⁻¹ (11).

WHO Toxicity Class III (12).

EPA Toxicity Class III (formulation) (1).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (13).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (14).

EC maximum residue level on fruit and vegetables 0.05 ppm (1).

Other comments

Residues have been detected in water (10).

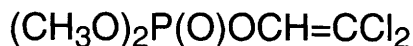
Dichlorprop exists as a racemate of two optically active forms of which only the (+)-isomer (dichlorprop-P) is active herbicidally (1).

In cereals and field grass, dichlorprop glucose conjugates and 2,4-dichlorophenol were identified as major metabolites. Maximum concentrations were found within the 1st wk after application (15).

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D258 dichlorvos



$\text{C}_4\text{H}_7\text{Cl}_2\text{O}_4\text{P}$

Mol. Wt. 220.98

CAS Registry No. 62-73-7

Synonyms 2,2-dichloroethenyl dimethyl phosphate; DDVP; dimethyl 2,2-dichlorovinyl phosphate; 2,2-dichlorovinyl dimethyl phosphate; phosphoric acid, 2,2-dichloroethenyl dimethyl ester; Aerovan; Alphos; Benfos; Canogard; Dede vap

EINECS No. 200-547-7

Uses Anthelmintic. Insecticide. Fumigant.

Physical properties

M. Pt. $<-60^\circ\text{C}$ B. Pt. 117°C at 10 mmHg Specific gravity 1.422 at 25°C with respect to water at 4°C

Partition coefficient $\log P_{\text{ow}}$ 1.47 (1) Volatility v.p. 2.15×10^{-3} mmHg at 20°C

Solubility Water: $\approx 1\%$ at 20°C . Organic solvents: miscible with ethanol and most non-polar organic solvents

Occupational exposure

DE-MAK 0.11 ppm (1.0 mg m^{-3})

FR-VME 0.1 ppm (1 mg m^{-3})

UK-LTEL 0.1 ppm (0.92 mg m^{-3})

UK-STEL 0.3 ppm (2.8 mg m^{-3})

US-TWA 0.9 mg m^{-3}

Supply classification toxic

Risk phrases Toxic in contact with skin and if swallowed (R24/25)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Do not breathe vapour – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S23, S36/37, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (48 hr) harlequin fish 7.8 mg l^{-1} (1).

LC₅₀ (96 hr) bluegill sunfish, mummichog, striped killifish, Atlantic silverside, bluehead, northern puffer $0.9\text{--}2.7 \text{ mg l}^{-1}$ (2,3).

Invertebrate toxicity

LC₅₀ (96 hr) *Gammarus fasciatus* $0.40 \text{ }\mu\text{g l}^{-1}$ (4).

LC₅₀ (48 hr) *Daphnia pulex* $0.07 \text{ }\mu\text{g l}^{-1}$ (5).

LC₅₀ (96 hr) sand shrimp, grass shrimp, hermit crab $4\text{--}45 \text{ }\mu\text{g l}^{-1}$ (6).

LD₅₀ oral bee $0.03 \text{ }\mu\text{g bee}^{-1}$ (7).

LD₅₀ contact bee $0.065 \text{ }\mu\text{g bee}^{-1}$ (7).

Bioaccumulation

The calculated bioconcentration factor of 1.9 indicates that environmental accumulation is unlikely (8). No or low accumulation (9).

Environmental fate

Nitrification inhibition

Negligible inhibition of nitrification to reservoir water at 20 mg l^{-1} (10).

Degradation studies

Degraded by *Bacillus* sp., *Pseudomonas* sp. and *Trichoderma* sp. with formation of water soluble metabolites, including dichloroethanol, dichloroacetic acid and ethyl dichloroacetate (11-13).

In a soil column perfused with an aqueous solution of dichlorvos, 30% of the loss of the compound was attributable to microbial action (11).

Abiotic removal

Photocatalytic degradation occurred in the presence of titanium oxide by illumination with UV irradiation or by exposure to sunlight. The addition of hydrogen peroxide enhanced the rate of degradation ten-fold. The final degradation products were chloride, phosphate, H^+ and carbon dioxide (14).

Undergoes hydrolysis in water to give dimethyl phosphoric acid and dichloroacetic acid. $t_{1/2}$ in water 5 hr at pH 8, ~8 hr at pH 7, 35 hr at pH 6, 77 hr at pH 5.4 (15).

$t_{1/2}$ for reaction with photochemically produced hydroxyl radicals in the atmosphere ~2 days (16).

Adsorption and retention

The calculated K_{oc} of 28 indicates low adsorption to soil (8).

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird 13.3-17.8 mg kg⁻¹ (17).

LD₅₀ oral starling 11.0-42.2 mg kg⁻¹ (17).

LD₅₀ oral rat 25-80 mg kg⁻¹ (18,19).

LD₅₀ oral mouse 140-275 mg kg⁻¹ (20).

LC₅₀ (4 hr) inhalation rat, mouse 13, 15 mg m⁻³, respectively (21).

LD₅₀ dermal rat 75-900 mg kg⁻¹ (the large range suggests that skin absorption is vehicle dependent) (22,23).

LD₅₀ subcutaneous rat 11 mg kg⁻¹ (24).

LD₅₀ intraperitoneal rat, mouse 22, 23 mg kg⁻¹, respectively (25,26).

Sub-acute and sub-chronic data

LC₅₀ (8 day) oral Japanese quail, ring-necked pheasant, mallard 300-1320 mg kg⁻¹ diet (27).

Oral rabbit (6 wk) 0.31-2.5 mg kg⁻¹ 5 day wk⁻¹ caused inhibition of both humoral immune response and cell-mediated immunity (28).

Oral rat (2 wk) 2 mg l⁻¹ in drinking water (\approx 0.3 mg kg⁻¹ day⁻¹) altered the diurnal rhythm of the pituitary/adrenal axis, causing changes in plasma adrenocorticotrophic hormone levels and adrenal cholesterol ester concentrations (29).

Oral man (3 wk) 1-32 mg kg⁻¹ for 1 or 2-7 day, or 1-16 mg kg⁻¹ day⁻¹ for 3 wk. Maximal plasma cholinesterase depression occurred at \approx 6 mg kg⁻¹ (single dose) and 1 mg kg⁻¹ day⁻¹ for 3 wk. The single-dose threshold for plasma cholinesterase depression was \approx 1-3 mg kg⁻¹. Red blood cell cholinesterase activity was depressed at doses ~fourfold higher. While the incidence of transient gastro-intestinal and central nervous system related subjective effects which accompany the cholinesterase depression was relatively low at the lowest dose rates, they were sufficiently adverse to cause subjects given repeated doses of 8-32 mg kg⁻¹ day⁻¹ to withdraw from the study (30).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (31).

No evidence of carcinogenicity in σ^7 and φ rats or mice when administered via food (32).

National Toxicology Program investigated dichlorvos in rats and mice via food. Negative results were reported (33).

National Toxicology Program tested rats and mice via gavage. Clear evidence of carcinogenicity (increased incidence of dose-related malignant and benign neoplasms) in φ mice, some evidence (increased incidence of chemically related neoplasms, malignant or benign or combined) in σ^7 rats and mice, equivocal evidence in φ rats (34).

Oral rat (60 wk) 0.1 mg, 1, 2 or 3 \times wk⁻¹. High-dose σ^7 rats exhibited increased incidences of bile duct and liver oval cell proliferation, and φ rats an increased incidence of adrenal gland and mammary tumour formation (35).

Oral mouse (94 wk) 300 or 600 mg kg⁻¹ diet for 78 wk. The average weight of treated mice was up to 10% less than controls. Some oesophageal squamous-cell tumours were observed in treated animals (36).

Oral rat (2 yr) 150 or 325 mg kg⁻¹ diet. Weight gain was consistently lower in the high-dose group. There was a

statistically significant increase in the incidence of malignant fibrous histiocytomas in treated ♂ rats (36).
Gavage rat (111 wk) 0.1 mg 3 × wk⁻¹ for 60 wk. Some squamous cell papillomas of the forestomach and the urinary bladder were found in treated animals (22,34).
Oral rat (2 yr) no-adverse-effect level was 10 mg kg⁻¹ diet (2).
Inhalation rat (2 yr) 0.05, 0.5 or 5.0 mg m⁻³. All treated groups showed a decreased weight gain compared to controls and cholinesterase activity depression. No significant increase in tumour incidence was observed (37).

Teratogenicity and reproductive effects

Intraperitoneal rat, 15 mg kg⁻¹ on day-11 of gestation. At doses producing toxic symptoms in mothers dichlorvos caused foetal malformations or decreased foetal and placental weights (38).
Gavage rabbit 5 or 60 mg kg⁻¹ day⁻¹ and inhalation rabbit 4 mg m⁻³ for 7 hr day⁻¹ on days 6-18 of gestation. No adverse developmental effect was observed (39).
Oral pig 5 or 25 mg kg⁻¹ day⁻¹ for the last 30 days of gestation. No teratogenic effect was reported. Plasma and red cell cholinesterase activities and, at the high dose, myometrial acetylcholinesterase activity, were decreased in sows. The rhombencephalic acetylcholinesterase activity was increased in foetuses (40).

Metabolism and toxicokinetics

Dichlorvos is rapidly hydrolysed in human blood with t_{1/2} of 7-11 min (41).
Urinary metabolites identified following voluntary human ingestion of ¹⁴C-labelled dichlorvos included demethyl dichlorvos, urea and hippuric acid. ¹⁴C-carbon dioxide was eliminated by exhalation (42).
Dimethylphosphate has been identified in the urine of exposed workers (43).
Following oral and inhalation exposure in rats, mice, hamsters and humans, two metabolic pathways have been identified: ester hydrolysis of the PO-vinyl group to yield dimethylphosphate and dichloroacetaldehyde, and oxidative O-demethylation to desmethyldichlorvos and formaldehyde. An alternative pathway for O-demethylation involves conjugation with glutathione. Hydrolysis of the O-demethylated metabolite yields methylphosphate and, eventually, phosphoric acid and methanol. Radiolabel from [¹⁴C-methyl]- and [¹⁴C-vinyl]-dichlorvos ultimately enters the 1- and 2-carbon metabolic pools, resulting in the incorporation and labelling of amino acids, proteins and purines (22,44).

Sensitisation

Accidental skin contact of a worker resulted in symptomatic effects followed by the development of persistent contact dermatitis (45).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation positive (46).
Escherichia coli microscreen phage induction assay with and without metabolic activation positive (47).
Capsicum annuum chromosome aberrations and chlorophyll mutations positive (48).
Drosophila melanogaster sex-linked recessive lethal assay positive (49).
In vitro mouse lymphoma L5178Y cell mutagenicity assay positive (50).
In vitro Chinese hamster ovary cells, sister chromatid exchanges and chromosomal aberrations positive (50).
In vitro chicken bone marrow cells, inhibition of DNA synthesis positive (51).
In vivo rat hepatocytes, unscheduled DNA synthesis negative (52).
In vivo mouse spermatocytes, chromosome aberrations negative (53).
In vivo mouse lymphocytes, sister chromatid exchanges negative (54).
Among workers handling dichlorvos, there was no significant alteration in cell cycles, but there were significant elevations in chromosomal aberrations and sister chromatid exchanges (55).

Other effects

Other adverse effects (human)

Lethal exposures to dichlorvos have been reported in connection with accidental splashing of a concentrated formulation on workers, coupled with failure to wash the material off (56).
Five children with aplastic anaemia and one with acute lymphoblastic leukaemia had been exposed to dichlorvos with propoxur; one of the children had also been exposed to pyrethrin (57).

An operator whose clothing became contaminated with dichlorvos developed erythema and bullae on exposed areas of the skin. He also complained of tiredness and constipation, and blood cholinesterase activity was reduced to 36% of normal levels (58).

Any other adverse effects

Dichlorvos is a phosphorylating and alkylating agent. 4-Nitrobenzylpyridine and methyl methylsulfonate are alkylated. *In vivo* the esterase phosphorylation of DNA is more important than its methylation (22).

Legislation

WHO Class 1b; EPA Toxicity Class I (58).

Maximum permissible concentration in domestic water in former USSR 1 mg l⁻¹ (59).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (60).

Included in Schedules 5 and 6 (Release into Water and Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (61).

EEC maximum residue levels – wheat 2 ppm, fruit and vegetables 0.1 ppm (2).

WHO Toxicity Class 1b (62).

Tolerable daily intake (TDI) (human) 0.004 mg kg⁻¹ (7).

Other comments

Residues have been isolated from water, crops, milk and meat products (22,44).

Metabolite of the insecticide trichlorfon (44).

Environmental fate of dichlorvos reviewed (42).

The carcinogenic risk to humans of dichlorvos reviewed (63).

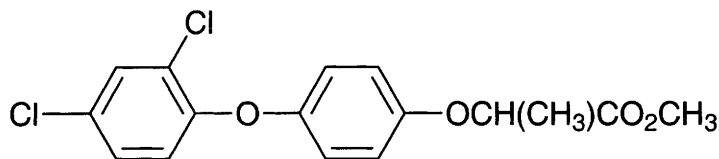
Physical properties, analysis, use, occurrence, regulations, carcinogenicity, mammalian toxicity, teratogenicity and metabolism of dichlorvos reviewed (22).

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D259 diclofop-methyl



$C_{16}H_{14}Cl_2O_4$

Mol. Wt. 341.19

CAS Registry No. 51338-27-3

Synonyms 2-[4-(2,4-dichlorophenoxy)phenoxy]propanoic acid, methyl ester;

methyl 2-[4-(2,4-dichlorophenoxy)phenoxy]propanoate; Colt; Hoegrass; Hoelon; Illoxan

EINECS No. 257-141-8

RTECS No. UF 1180000

Uses Herbicide.

Physical properties

M. Pt. 39-41°C B. Pt. 175-176°C at 0.1 mmHg **Specific gravity** 1.30 at 40°C

Partition coefficient $\log P_{ow}$ 4.58 (1) **Volatility** v.p. 2.6×10^{-7} mmHg at 20°C

Solubility Water: 3 mg l⁻¹ at 22°C. Organic solvents: acetone, diethyl ether, ethanol, xylene

Occupational exposure

Supply classification harmful

Risk phrases Harmful if swallowed (R22)

Safety phrases Keep out of reach of children (if sold to general public) (S2)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout 0.23 mg l⁻¹ (2).

Invertebrate toxicity

LC₅₀ (48 hr) *Daphnia magna* 0.23 mg l⁻¹ (2).

EC₅₀ (72 hr) *Scenedesmus suspicatus* 1.5 mg l⁻¹ (2).

Non-toxic to bees under field conditions and an application rate of 1.134 kg hectare⁻¹ (2).

Environmental fate

Degradation studies

In soil, diclofop-methyl is metabolised to diclofop, which then undergoes further degradation to 4-(2,4-dichlorophenoxy)phenol and hydroxylated free acids (1).

t_{1/2} in soil 4.3-6.0 days (3).

Abiotic removal

Undergoes decomposition under UV irradiation (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral Japanese quail >10,000 mg kg⁻¹ (2).

LD₅₀ oral rat 481-693 mg kg⁻¹ (2).

LD₅₀ dermal rabbit 180 mg kg⁻¹ (1).

LD₅₀ dermal ♀ rat >5000 mg kg⁻¹ (2).

Sub-acute and sub-chronic data

LC₅₀ (8 day) oral mallard duck, bobwhite quail 13, >20 g kg⁻¹ diet, respectively (1).

Carcinogenicity and chronic effects

Oral rat (2 yr) no-adverse-effect level 20 mg kg⁻¹ diet (1).

Metabolism and toxicokinetics

Oral rat (concentration unspecified) 80% is eliminated in the faeces and 15% in the urine as conjugates, glucuronides and sulfuric esters. After cleavage of the conjugates, two degradation products 2',4'-dichloro-5-hydroxy and 2,4'-dichloro-6-hydroxy account for 80%. The 5% remaining in the body is subject to slow metabolism and elimination (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (4).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No 472, 1991 (5).

WHO Class III (6).

EPA Toxicity Class III (2).

Other comments

t_{1/2} in plants ≈3 days (3).

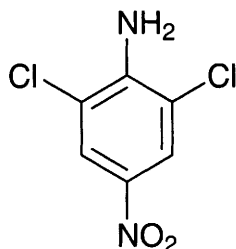
Metabolism in wheat is by ring hydroxylation followed by glucoside conjugation, then acid hydrolysis to give the 2,3-dichloro-4-hydroxy, 2,5-dichloro-4-hydroxy and 2,4-dichloro-4-hydroxy isomers (7).

In isolated oat protoplasts, accumulation of diclofop-methyl was found in membrane fractions of the protoplast plasma membrane. Comparatively small amounts of diclofop were also found in association with the protoplasts (8).

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D260 dicloran



$C_6H_4Cl_2N_2O_2$

Mol. Wt. 207.02

CAS Registry No. 99-30-9

Synonyms 2,6-dichloro-4-nitrobenzenamine; 2,6-dichloro-4-nitroaniline; Allisan; Resisan; Curital; Fubotran; Fungiclor; Grimacit; Marisan; Regesan

EINECS No. 202-746-4

RTECS No. BX 2975000

Uses Fungicide, used in crop protection.

Physical properties

M. Pt. 195°C **B. Pt.** 130°C at 2 mmHg **Partition coefficient** $\log P_{ow}$ 1.8 (1) **Volatility** v.p. 1.2×10^{-6} mmHg at 20°C

Solubility Water: 6.3 mg l⁻¹ at 20°C. Organic solvents: acetone, chloroform, cyclohexane, dimethyl sulfoxide, 1,4-dioxane, ethyl acetate, xylene

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout 1.6 mg kg⁻¹ (2).

LC₅₀ (96 hr) goldfish, bluegill sunfish 32, 37 mg kg⁻¹, respectively (2).

Invertebrate toxicity

LD₅₀ contact bee 0.18 mg bee⁻¹ (1).

EC₅₀ (48 hr) *Daphnia* sp. 2 mg l⁻¹ (3).

LC₅₀ (48 hr) juvenile grass shrimp 1.9 mg l⁻¹ (4).

EC₅₀ (30 min) *Photobacterium phosphoreum* 3.68 ppm Microtox test (5).

Environmental fate

Nitrification inhibition

Nitrification was completely inhibited in soil for 30 days at concentrations of 1000 ppm, and partially inhibited at 10 ppm (6).

Degradation studies

Microbial degradation involves reduction of the nitro-group to amino, yielding 4-amino-2,6-dichloroaniline (2). $t_{1/2}$ in soil was 6-18 hr; under flooded soil conditions $t_{1/2}$ was 5-30 days (1).

Abiotic removal

Removal from waste water was reported by treatment with hydrogen peroxide and UV light (7).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mallard duck >2000 mg kg⁻¹ (1).

LD₅₀ oral redwing blackbird >100 mg kg⁻¹ (8).

LD₅₀ oral rat 4040 mg kg⁻¹ (2).

LD₅₀ oral mouse, guinea pig 1500-2500 mg kg⁻¹ (2).
LC₅₀ (1 hr) inhalation rat >22 mg l⁻¹ (3).
LD₅₀ dermal rabbit, mouse >2000 and >5000 mg kg⁻¹, respectively (1).
LD₅₀ intravenous mouse 56 mg kg⁻¹ (9).

Sub-acute and sub-chronic data

LC₅₀ (5 day) oral bobwhite quail 1435 mg kg⁻¹ diet (1).
Oral rat (6 month) 0.22-88 mg kg⁻¹ day⁻¹ blood methaemoglobin concentration was increased and erythrocyte activity decreased. Serum enzymes indicated liver damage (10).

Carcinogenicity and chronic effects

Oral rat, mouse, dog (2 yr) no-adverse-effect level for rat 1000 mg kg⁻¹ diet, for mouse 175 mg kg⁻¹ diet and for dog 100 mg kg⁻¹ diet (1).

Metabolism and toxicokinetics

Metabolism to 3,5-dichloro-4-nitroaniline initiated by cytochrome P₄₅₀ in rat hepatic microsomes (11).
In rats, following oral administration dicloran is rapidly metabolised and excreted in the urine as the sulfate conjugate of 4-amino-2,6-dichlorophenol (1).

Genotoxicity

Salmonella typhimurium TA98, TA100 with and without metabolic activation positive (12).
Induced cross-over mutations in *Aspergillus nidulans in vitro* (13).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (14).
Pesticides included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (15).
WHO Toxicity Class Table 5 (16).
EPA Toxicity Class IV, tolerable daily intake (TDI) in humans 0.03 mg kg⁻¹ (2).

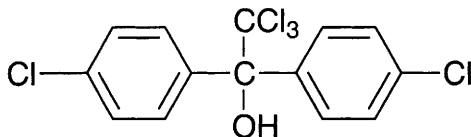
Other comments

Residues have been isolated from water, waste water, soil and crops.
In plants the principal metabolites are 4-amino-3,5-dichlorophenol, 4-amino-2,6-dichloroacetanilide and 4-amino-2,6-dichloroaniline (1).

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D261 dicofol



$C_{14}H_9Cl_5O$

Mol. Wt. 370.49

CAS Registry No. 115-32-2

Synonyms 1,1-bis(*p*-chlorophenyl)-2,2,2-trichloroethanol; 2,2,2-trichloro-1,1-bis(4-chlorophenyl)ethanol; 4-chloro- α -(4-chlorophenyl)- α -(trichloromethyl)benzenemethanol; *p,p'*-dicofol; di-(*p*-chlorophenyl)-trichloromethylcarbinol; 4,4'-dichloro- α -(trichloromethyl)benzhydrol; Acared; Acarfen; Agrex K; Carbox; Cekudifol; Dicokelt; Dimop

EINECS No. 204-082-0

RTECS No. DC 8400000

Uses Acaricide. Antifouling agent.

Physical properties

M. Pt. 78.5-79.5°C **B. Pt.** 193°C at 360 mmHg **Specific gravity** 1.45 at 25°C **Partition coefficient** log P_{ow} 4.28 (1)

Solubility Water: 0.8 mg l⁻¹ at 25°C. Organic solvents: acetone, ethyl acetate, hexane, isopropanol, methanol, toluene

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) bluegill sunfish, channel catfish 0.36, 0.52 mg l⁻¹, respectively (2).

LC₅₀ (24 hr) rainbow trout 0.11 mg l⁻¹ (2).

Invertebrate toxicity

EC₅₀ (5 min) *Photobacterium phosphoreum* 0.445 ppm Microtox test (3).

LC₅₀ (48 hr) grass shrimp 0.59 mg l⁻¹ (4).

Toxicity to other species

Lake Apopka, Florida, was the site of a massive spill of dicofol and DDT and its metabolites in 1980. Such hormonally active substances may be adversely affecting the reproductive systems of the lake fauna. ♂ Alligators maturing in Lake Apopka suffer a range of reproductive abnormalities, including small or non-existent penises and altered steroid production (5).

Bioaccumulation

Bioconcentration factor fathead minnow 9500-18,900 (6).

Environmental fate

Degradation studies

Dicofol was reported to be degraded in a soil ecosystem by genetically engineered *Pseudomonas aeruginosa* BS827 (7). Degraded in water by the aquatic plants *Vallisneria natans*, *Engeria densa*, and *Trapa natans* (8).

Abiotic removal

Irradiation with UV and sunlight yields 4,4'-dichlorobenzophenone (9).

$t_{1/2}$ for hydrolysis to 4,4'-dichlorobenzophenone for 0.4 mg l⁻¹ was 60 min at pH 8.2; and 3 min at pH 10.2 (10).

Reacts with photochemically produced hydroxyl radicals in the atmosphere, $t_{1/2}$ ~3 days (11).

Adsorption and retention

Soil adsorption K_{oc} 8383 (sand), 8073 (sandy loam), 5868 (silty loam), 5917 (clay loam). No mobility of parent or metabolites detected (12).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 570-595 mg kg⁻¹ (2).

LD₅₀ oral rabbit, guinea pig 1810-1870 mg kg⁻¹ (2).

LC₅₀ (4 hr) inhalation rat >5 g m⁻³ (12).

LD₅₀ dermal rabbit 2100 mg kg⁻¹ (13).

LD₅₀ intraperitoneal rat 1150 mg kg⁻¹ (14).

Sub-acute and sub-chronic data

LC₅₀ (5 day) oral Japanese quail, bobwhite quail, ring-necked pheasant, mallard duck 1400-3010 mg kg⁻¹ in diet (15).

Oral administration to breeding ♀ kestrels of 0.3 or 3.0 mg kg⁻¹ day⁻¹ for 39 days caused eggshell thinning similar to that for DDE (16).

Oral dog (1 yr), no-adverse-effect level was 30 mg kg⁻¹ diet (2).

Carcinogenicity and chronic effects

No adequate data for evaluation of carcinogenicity to humans, limited evidence of carcinogenicity to animals, IARC classification group 3 (9).

National Toxicology Program investigated dicofol in rats and mice via oral administration. Negative results were reported for rats and for ♂ mice while positive results were reported for ♀ mice (17).

Oral mouse (93 wk) 125-525 mg kg⁻¹ diet for 78 wk. The only dose-related effect observed was an increased incidence of hepatocellular carcinomas in ♂ mice (18).

Oral rat (2 yr) no-effect level in oncogenic trials was 5 mg kg⁻¹ diet (2).

Teratogenicity and reproductive effects

Oral mouse (five generation) 7-500 mg kg⁻¹ diet. In the fifth generation, the high dose caused reductions in body weight of offspring, in litter size and high post-natal mortality. Concentrations of 225 mg kg⁻¹ and lower produced no effects (19).

Oral rat (2 month) 5 or 10 mg kg⁻¹ day⁻¹ resulted in a higher ratio of non-pregnant to total inseminated rats compared to controls (20,17).

Metabolism and toxicokinetics

Breeding kestrels were administered 0.3 or 3.0 mg kg⁻¹ day⁻¹ by gavage for 39 days. Residues of dicofol, *p,p'*-dichlorobenzophenone, *p,p'*-dichlorobenzhydrol, 1,1-bis(4-chlorophenyl)-2,2-dichloroethanol and DDE were found in the liver, fat, brain and oviducts. The major hepatic metabolite was 1,1-bis(4-chlorophenyl)-2,2-dichloroethanol, but most organochlorine stored in the tissues was unmetabolised dicofol (16).

Following intraperitoneal and oral administration to rats, dicofol and 4,4'-dichlorobenzophenone were found to be stored in fat and muscle tissue. These compounds were also found to be excreted, predominantly via the faeces. In an acute study dicofol and 4,4'-dichlorobenzophenone accumulated initially in the liver, the concentration then declined after 15 days. In this study 1,1-dichloro-2,2-bis(*p*-chlorophenyl)ethylene was also found in various tissues and in the faeces (21).

In rats fed 10 mg kg⁻¹ diet for 10 wk, the concentration in adipose tissue was 31.2 mg kg⁻¹ in ♀ and 13.9 mg kg⁻¹ in ♂ rats (2).

Sensitisation

Greenhouse workers exposed to dicofol and trichlorfon were reported to suffer frequently from allergic dermatitis (20,14).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (22).

Escherichia coli WP2 *trp*⁻ without metabolic activation negative (23,24).

Bacillus subtilis H17 *rec*⁺ and M45 *rec*⁻ with and without metabolic activation negative (25).

In vitro Chinese hamster lung fibroblast cells, chromosomal aberrations negative (26).

In vitro rat bone marrow cells, micronucleus test positive (26).

In vitro Chinese hamster ovary cells, sister chromatid exchanges and chromosomal aberrations with and without metabolic activation negative (27).
In vitro *Vicia faba* root meristem cells, anaphase bridges and relatively scarce micronuclei were induced (28).
A joint FAP/WHO Meeting on Pesticide Residues concluded that dicofol was not genotoxic (29).

Other effects

Any other adverse effects

In vivo rat studies, 37 mg dose strongly interfered with the T₄ binding site of transthyretin, and reduced T₄ plasma levels (route of administration unspecified) (30).
Endocrine disrupting effects reported in wildlife. Avian reproduction impaired (31).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (32).
Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (33).
EEC Maximum residue levels: fruit 2 ppm; vegetables 0.5 ppm (2).
EPA Toxicity Class II or III (2).
WHO Toxicity Class III (34).
Tolerable daily intake (TDI) (human) 0.025 mg kg⁻¹ (2).

Other comments

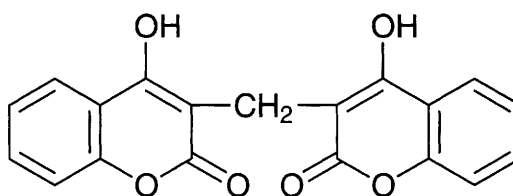
Residues have been isolated from water, crops, soil and sediments (20,35).
Physical properties, use, occurrence, analysis, carcinogenicity, mammalian toxicity, metabolism and mutagenicity of dicofol reviewed (20).
Toxicity of dicofol reviewed (29).
Environmental fate of dicofol reviewed (35).
The principal metabolite in plants is 4,4'-dichlorobenzophenone (2).
Toxicity and hazards reviewed (36).

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D262 dicoumarin



$C_{19}H_{12}O_6$

Mol. Wt. 336.30

CAS Registry No. 66-76-2

Synonyms 3,3'-methylenebis(4-hydroxy-2H-1-benzopyran-2-one); 3,3'-methylenebis(4-hydroxycoumarin); bishydroxycoumarin; Dicumarol; Melitoxin

EINECS No. 200-632-9

RTECS No. GN 7875000

Uses Anticoagulant. Rodenticide

Physical properties

M. Pt. 290-292°C Partition coefficient $\log P_{ow}$ 3.40 (1)

Solubility Organic solvents: benzene, chloroform, pyridine

Occupational exposure

Supply classification toxic, dangerous for the environment

Risk phrases Harmful if swallowed – Toxic: danger of serious damage to health by prolonged exposure if swallowed – Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R22, R48/25, R51/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S37, S45, S61)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 230, 540 mg kg⁻¹, respectively (2).

LD₅₀ intraperitoneal mouse 91 mg kg⁻¹ (3).

LD₅₀ intravenous mouse, rat 42, 52 mg kg⁻¹, respectively (2,4).

LD₅₀ subcutaneous mouse 50 mg kg⁻¹ (5).

Metabolism and toxicokinetics

In humans, dicoumarin is absorbed irregularly from the gastro-intestinal tract, depending on the food consumed, and is extensively bound to plasma protein. It is metabolised in the liver, and is excreted via the urine, mainly as metabolites (unspecified) (6).

Genotoxicity

Salmonella typhimurium TA102, TA104 with and without metabolic activation negative (7).

Other effects

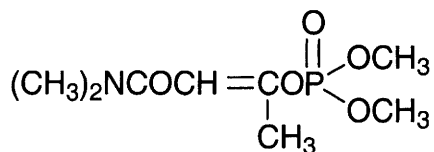
Other adverse effects (human)

It is reported that serum lactate dehydrogenase activity in some patients administered dicoumarin can be as high as that produced by an episode of acute myocardial infarction (8).

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D263 dicrotophos



C₈H₁₆NO₅P

Mol. Wt. 237.19

CAS Registry No. 141-66-2

Synonyms dimethyl *cis*-2-dimethylcarbamoyl-1-methylvinyl phosphate; (*E*)-3-(dimethylamino)-1-methyl-3-oxo-1-propenylphosphoric acid, dimethyl ester; (*E*)-2-dimethylcarbamoyl-1-methylvinyl dimethyl phosphate; 3-dimethoxyphosphinoyloxy-*N,N*-dimethylisocrotonamide; Bidrin; Carbicron; Dicron; Ektafos

EINECS No. 205-494-3

RTECS No. TC 3850000

Uses Insecticide. Acaricide.

Physical properties

B. Pt. 400°C at 760 mmHg; 130°C at 0.1 mmHg **Specific gravity** 1.216 at 20°C

Volatility v.p. 7.0×10^{-5} mmHg at 20°C

Solubility Water: miscible. Organic solvents: miscible with acetone, alcohols, acetonitrile, chloroform, dichloromethane, xylene

Occupational exposure

FR-VME 0.25 mg m⁻³

US-TWA 0.25 mg m⁻³

Supply classification very toxic, dangerous for the environment

Risk phrases Toxic in contact with skin – Very toxic if swallowed – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R24, R28, R50/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S28, S36/37, S45, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (24 hr) mosquito fish 200 mg l⁻¹ (1).

LC₅₀ (24 hr) harlequin fish >1000 mg l⁻¹ (1).

Environmental fate

Degradation studies

Persistence in a sandy loam soil, t_{1/2} was 3 days. *N,N*-dimethylacetoacetamide and 3-hydroxy-*N,N*-dimethylbutyramide were the major degradation products (2).

Abiotic removal

Hydrolysis t_{1/2} in soil was 117 days at pH 5, 72 days at pH 7 and 28 days at pH 9. *N,N*-dimethylacetoacetamide and *O*-desmethyldicrotophos were the major products. Aquatic and soil surface studies showed that dicrotophos was not degraded by light exposure (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird, starling, coturnix 1-10 mg kg⁻¹ (3).

LD₅₀ oral rat, mouse 11-22 mg kg⁻¹ (1,4,5).

LC₅₀ (4 hr) inhalation rat 90 mg m⁻³ (6).

LD₅₀ dermal rat, rabbit 42, 225 mg kg⁻¹, respectively (1,4).

LD₅₀ subcutaneous rat, mouse 8, 12 mg kg⁻¹, respectively (7,8).

LD₅₀ intravenous mouse 10 mg kg⁻¹ (8).

Carcinogenicity and chronic effects

Oral rat, dog (2 yr) no-adverse-effect level for rats 1 mg kg⁻¹ and for dogs 1.6 mg kg⁻¹ diet (1).

Teratogenicity and reproductive effects

Oral rat three-generations study, dose tested 2 mg kg⁻¹ day⁻¹; no teratogenic effects observed (1).

Legislation

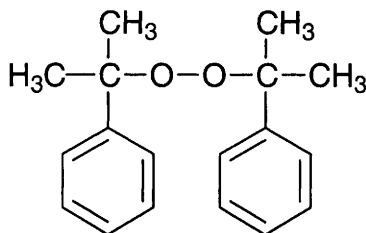
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (9).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (10).
WHO Toxicity Class 1b (11).
EPA Toxicity Class I (formulation) (12).

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D264 dicumyl peroxide



$C_{18}H_{22}O_2$

Mol. Wt. 270.37

CAS Registry No. 80-43-3

Synonyms bis(α,α -dimethylbenzyl) peroxide; bis(1-methyl-1-phenylethyl) peroxide; cumene peroxide; isopropylbenzene peroxide; di- α -cumyl peroxide; Luperco; Luperox; Percumyl D; Di-Cup; Perkadox BC; Polyvel PLC-20

EINECS No. 201-279-3

RTECS No. SD 8150000

Uses Polymerisation catalyst and vulcanising agent. Cross-linking agent. Has weak antimalarial properties.

Physical properties

M. Pt. 39-41°C **Flash point** >110°C **Specific gravity** 1.02 at 20°C

Solubility Water: <1 g l⁻¹ at 23°C. Organic solvents: acetone, dimethyl sulfoxide, ethanol

Occupational exposure

Supply classification oxidising, irritant, dangerous for the environment

Risk phrases May cause fire – Irritating to eyes and skin – Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R7, R36/38, R51/53)

Safety phrases Keep out of reach of children (if sold to general public) – Keep container tightly closed in a cool place – Keep away from acids – Wear suitable protective clothing, gloves and eye/face protection – Avoid release to the environment. Refer to special instructions/safety data sheet (S2, S3/7, S14, S36/37/39, S61)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 4100 mg kg⁻¹ (1).

Irritancy

Irritant to skin, eyes and mucous membranes (species unspecified) (2).

In 200 human volunteers patch-tested with technical grade (90% dicumyl peroxide) slight irritation observed, no information on exposure condition provided (3).

Genotoxicity

Salmonella typhimurium TA100, TA1535, TA1537, TA97, TA98 with and without metabolic activation negative (4).

Other comments

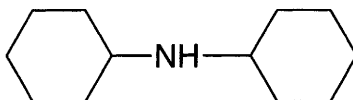
Toxicity reviewed (3).

Strong oxidising material, may ignite organic compounds on contact. Self-accelerating decomposition temperature 118°C.

References

1. *Soc. Plast. Ind. Bull.* 1975, 1, 19B.
2. Keith, L. H. et al *Compendium of Safety Data Sheets for Research and Industrial Chemists* 1987, 5, 2350-2351.
3. *BIBRA Toxicity Profile* 1990, British Industrial Biological Research Association, Carshalton, UK.
4. Zeiger, E. *Environ. Mol. Mutagen.* 1988, 11(Suppl. 12), 1-157

D265 dicyclohexylamine



C₁₂H₂₃N

Mol. Wt. 181.32

CAS Registry No. 101-83-7

Synonyms *N*-cyclohexylcyclohexanamine; aminodicyclohexane; *N,N*-dicyclohexylamine; dodecahydrodiphenylamine

EINECS No. 202-980-7

RTECS No. HY 4025000

Uses Oil additive. Catalyst. Corrosion inhibitor. Anti-oxidant. Solvent. Chemical intermediate.

Physical properties

M. Pt. -2°C **B. Pt.** 256°C **Flash point** 91°C **Specific gravity** 0.9104 at 25°C with respect to water at 25°C

Volatility v.p. 12 mmHg at 37.7°C ; v.den. 6.25

Solubility Water: miscible. Organic solvents: cyclohexylamine, diethyl ether, ethanol, vegetable oils

Occupational exposure

UN No. 2565 **HAZCHEM Code** 3X **Conveyance classification** corrosive substance

Supply classification corrosive

Supply classification dangerous for the environment

Risk phrases Harmful if swallowed – Causes burns – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R22, R34, R50/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Wear suitable protective clothing, gloves and eye/face protection – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice (S1/2, S36/37/39, S45, S60, S61, S26)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 375, 500 mg kg⁻¹, respectively (1).

LD₅₀ subcutaneous mouse 135 mg kg⁻¹ (2).

Subcutaneous mouse, single injection of 0.12 mg produced convulsion immediately after administration (3).

Carcinogenicity and chronic effects

Oral rat (17 month) 1 ml day⁻¹ 6 day wk⁻¹ for 12 months (total dose 9180 mg), one rat developed a mesenteric sarcoma (3,4).

Subcutaneous mouse (13 month) 0.05 ml day⁻¹ (total dose 80 mg), 4/15 mice developed sarcomas at the site of injection (3,4).

Irritancy

Dermal rabbit (24 hr) 2 mg caused severe irritation and 750 µg instilled into rabbit eye for 24 hr caused severe irritation (1).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (5).

In vitro human lymphocytes, chromosomal aberrations negative (6).

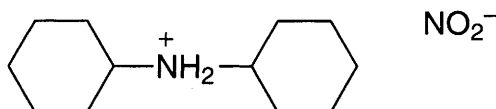
Other comments

Physical properties, uses, analysis, carcinogenicity, teratogenicity, mammalian toxicity, metabolism and mutagenicity of cyclamates, including dicyclohexylamine, reviewed (1).

References

1. Marhold, J. V. *Prehled Prumyslove Toxikologie: Organicke Latky* 1986, 486, Prague, Czechoslovakia.
2. *Vopr. Onkol.* 1958, 4, 659.
3. Pliss, G. B. *Vopr. Onkol.* 1958, 3, 659-668.
4. *IARC Mongraph* 1980, 22, 55-109.
5. Mortelmans, K. et al *Environ. Mutagen.* 1986, 8(Suppl. 7), 1-119.
6. Stoltz, et al *IARC Monograph* 1986, Suppl. 6, 240-241

D266 dicyclohexylammonium nitrite



C₁₂H₂₄N₂O₂

Mol. Wt. 228.33

CAS Registry No. 3129-91-7

Synonyms dicyclohexylamine nitrite; N-cyclohexylcyclohexanamine nitrite

EINECS No. 221-515-9

RTECS No. HY 4200000

Uses Corrosion inhibitor.

Physical properties

M. Pt. 182-183°C (decomp.)

Solubility Water: 10-50 g l⁻¹ at 23°C. Organic solvents: dimethyl sulfoxide, ethanol

Occupational exposure

UN No. 2687 Conveyance classification flammable solid

Supply classification harmful

Risk phrases Harmful by inhalation and if swallowed (R20/22)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from heat – In case of fire and/or explosion do not breathe fumes (S2, S15, S41)

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 80, 284 mg kg⁻¹, respectively (1-3).

LD₅₀ subcutaneous mouse 155 mg kg⁻¹ (3).

Carcinogenicity and chronic effects

Subcutaneous mouse (13 month) 0.1 ml day⁻¹ 5/23 mice developed neoplasms: 2 hepatocellular adenomas, 1 papillary cystadenoma of the lung, 1 papillary adenoma of the lung and 1 cavernous haemangioma of the liver (3,4).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation positive (5).

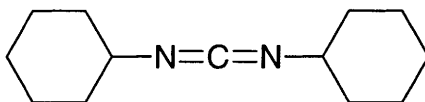
Other comments

Carcinogenicity of cyclamates, including dicyclohexylammonium nitrite, reviewed (4).

References

1. Marhold, J. V. *Sbornik Vysledku Toxikologickeho Vysetreni Latek A Pripravku* 1972, 68, Prague, Czechoslovakia.
2. *Gig. Sanit.* 1965, 30(8), 35.
3. Pliss, G. B. *Vopr. Onkol.* 1958, 3, 659-668.
4. *IARC Monograph* 1980, 22, 55-109.
5. Zeiger, E. et al *Environ. Mol. Mutagen.* 1988, 11(Suppl 12), 1-158

D267 dicyclohexylcarbodiimide



C₁₃H₂₂N₂

Mol. Wt. 206.33

CAS Registry No. 538-75-0

Synonyms *N,N'*-methanetetraylbis(cyclohexanamine); bis(cyclohexyl)carbodiimide; carbodicyclohexylimide; DCC; DCCD; DCCI; 1,3-dicyclohexylcarbodiimide; dicyclocarbodiimide; *N,N'*-dicyclohexylcarbodiimide

EINECS No. 208-704-1

Uses Catalyst. Defoliant. Chemical intermediate. Coupling reagent in protein synthesis.

Physical properties

M. Pt. 34-35°C B. Pt. 122-124°C at 6 mmHg Flash point >110°C

Occupational exposure

Supply classification toxic

Risk phrases Harmful if swallowed – Toxic in contact with skin – Risk of serious damage to eyes – May cause sensitisation by skin contact (R22, R24, R41, R43)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Avoid contact with the skin – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – Wear suitable gloves and eye/face protection – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S24, S26, S37/39, S45)

Ecotoxicity

Bioaccumulation

No or low bioaccumulation (1).

Environmental fate

Nitrification inhibition

50% inhibition of NH₃ oxidation – pure culture *Nitrosomonas europaea* at 110 mg l⁻¹ (2).

Mammalian & avian toxicity

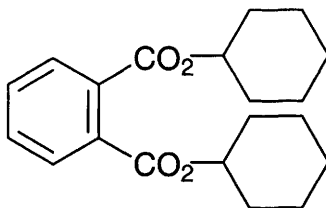
Irritancy

Shown to be an irritant and contact sensitizer using the Mouse Ear Swelling Test and the murine Local Lymph Node Assay (3).

References

1. JETOC Newsletter No. 5 1987, Japan Chemical Industry Ecology Toxicology and Information Centre, Tokyo, Japan.
2. Hooper, A. et al *J. Bacteriol.* 1973, **115**, 480.
3. Hayes, B. B. et al *Drug Chem. Toxicol.* 1998, **21**(2), 195-206

D268 dicyclohexyl phthalate



C₂₀H₂₆O₄

Mol. Wt. 330.42

CAS Registry No. 84-61-7

Synonyms 1,2-benzenedicarboxylic acid, dicyclohexyl ester; phthalic acid, dicyclohexyl ester; Morflex 150; Uniplex 250; Unimoll 66M (DCHP)

EINECS No. 201-545-9

RTECS No. TI 0889000

Uses Catalyst. Preparation of inks for jet printing. Plasticiser. Solvent.

Physical properties

M. Pt. 64-66°C B. Pt. 222-228°C at 4 mmHg Flash point 107°C Specific gravity 1.383 at 20°C with respect to water at 4°C Volatility v.p. 8.68×10^{-7} mmHg at 25°C
Solubility Water: 0.94 g l⁻¹ at 25°C. Organic solvents: castor oil, diethyl ether, ethanol, linseed oil

Occupational exposure

SE-LEVL 3 mg m⁻³

SE-STEL 5 mg m⁻³

UK-LTEL 5 mg m⁻³

Ecotoxicity

Bioaccumulation

The calculated bioconcentration factor of 640 indicates that moderate environmental bioaccumulation is likely (1).

Environmental fate

Degradation studies

Metabolised by *Pseudomonas acidovorans* as sole carbon source under aerobic conditions to yield phthalic acid and cyclohexyl alcohol (2).

Adsorption and retention

Calculated soil adsorption coefficient of 4,520 indicates that slight soil mobility is likely (3).

Mammalian & avian toxicity

Sub-acute and sub-chronic data

LD₅₀ (7 day) oral rat, rabbit, dog 30 mg kg⁻¹ (4).

Carcinogenicity and chronic effects

Oral rat (18 month) 5, 10, 100 mg kg⁻¹ diet, no carcinogenic effects were observed (4).

Teratogenicity and reproductive effects

In a three-generation study, rats given 100 mg kg⁻¹ diet showed no adverse reproductive or foetotoxic effects (4).

References

1. Lyman, W. J. et al *Handbook of Chemical Estimation Methods*, 1982, 5.1-5.30, McGraw-Hill, New York, USA.
2. Kevare, R. et al *Agric. Biol. Chem.* 1977, **41**, 2119-2123.
3. Swann, R. L. et al *Residue Rev.* 1983, **85**, 17-28.
4. Lefaux, R. *Practical Toxicology of Plastics* 1968, CRC Press Inc., 349-350, Cleveland, OH, USA

D269 N,N'-dicyclohexylthiourea



C₁₃H₂₄N₂S

Mol. Wt. 240.41

CAS Registry No. 1212-29-9

Synonyms 1,3-dicyclohexyl-2-thiourea; 1,3-bis(cyclohexyl)thiourea; N,N'-dicyclohexylthiocarbamide; dicyclohexylthiourea; *sym*-dicyclohexylthiourea

EINECS No. 214-920-7

RTECS No. YS 9300000

Uses Corrosion inhibition. Bactericide.

Physical properties

Partition coefficient $\log P_{ow}$ 3.83 (calc.) (1)

Solubility Water: $<1 \text{ g l}^{-1}$ at 21°C . Organic solvents: acetone, dimethyl sulfoxide, ethanol

Ecotoxicity

Bioaccumulation

No or low bioaccumulation (2).

Mammalian & avian toxicity

Carcinogenicity and chronic effects

National Toxicology Program investigated *N,N'*-dicyclohexylthiourea in rats and mice via oral administration. Negative results were reported (3).

Oral rat, mouse (109 wk) 25 or 50 g kg^{-1} diet increased hyperplasia of follicular cells of the thyroid. No carcinogenic activity was observed (4).

Irritancy

100 mg instilled into rabbit eye caused mild irritation (period of exposure unspecified) (5).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (6).

In vitro mouse lymphoma L5178Y tk⁺/tk⁻ cell forward mutation assay without metabolic activation positive (7).

In vitro Chinese hamster ovary cells sister chromatid exchanges and chromosomal aberrations negative (8).

References

1. Klopman, G. et al *J. Comput. Chem.* 1985, 6, 28-38.
2. *JETOC Newsletter* No. 5 1987, Japan Chemical Industry Ecology Toxicology and Information Center, Tokyo, Japan.
3. *National Toxicology Program Research and Testing Division* 1992, Report No. TR-056, NIEHS, Research Triangle Park, NC, USA.
4. *Bioassay of N,N-dicyclohexylthiourea for Possible Carcinogenicity Report* ISS NCI-CG-TR-S6, DHEW/PUB/NIH-78-1362, Order No. 281539.
5. Deichman, W. B. *Toxicology of Drugs and Chemicals* 1969, 214, Academic Press, New York, USA.
6. Zeiger, E. et al *Environ. Mol. Mutagen.* 1988, 11(Suppl. 12), 1-158.
7. McGregor, D. B. et al *Environ. Mutagen.* 1987, 9(2), 143-160.
8. Rosenkranz, H. S. et al *Mutagenesis* 1990, 5(6), 559-571

D270 *N,N'*-dicyclohexylurea



$\text{C}_{13}\text{H}_{24}\text{N}_2\text{O}$

Mol. Wt. 224.35

CAS Registry No. 2387-23-7

Synonyms 1,3-dicyclohexylurea

EINECS No. 219-213-7

Physical properties

M. Pt. $232\text{--}233^\circ\text{C}$

Ecotoxicity

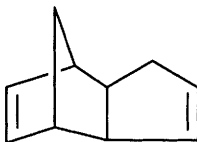
Bioaccumulation

No or low bioaccumulation (1).

References

1. *JETOC Newsletter No. 5* 1987, Japan Chemical Industry Ecology Toxicology and Information Center, Tokyo, Japan

D271 dicyclopentadiene



$C_{10}H_{12}$

Mol. Wt. 132.21

CAS Registry No. 77-73-6

Synonyms bicyclopentadiene; 1,3-cyclopentadiene, dimer; biscyclopentadiene

EINECS No. 201-052-9

RTECS No. PC 1050000

Uses Animal repellent.

Physical properties

M. Pt. 32.7°C B. Pt. 172°C Flash point 26°C Specific gravity 0.9766 at 33°C Volatility v.p. 2.47 mmHg at 25°C ; v.den. 4.57

Solubility Organic solvents: acetone, dichloromethane, ethyl acetate, hexane, toluene

Occupational exposure

DE-MAK 0.5 ppm (2.7 mg m⁻³)

FR-VME 5 ppm (30 mg m⁻³)

UK-LTEL 5 ppm (27 mg m⁻³)

US-TWA 5 ppm (27 mg m⁻³)

Supply classification highly flammable

Supply classification harmful

Supply classification dangerous for the environment

Risk phrases Highly flammable – Harmful by inhalation and if swallowed – Irritating to eyes, respiratory system and skin – Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R11, R20/22, R36/37/38, R51/53)

Safety phrases Keep out of reach of children (if sold to general public) – Wear suitable protective clothing and gloves – Avoid release to the environment. Refer to special instructions/safety data sheet (S2, S36/37, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout 22.8 mg l⁻¹; carp 62.2 mg l⁻¹ (1).

Threespine stickleback were exposed to 1 mg l⁻¹ (with the addition of chlorine in acetic acid) 24 hr static bioassay; the fish died within 1-2 hr. Test conditions: artesian well water; total hardness 67-120 mg l⁻¹; methyl orange alkalinity 151-183 mg l⁻¹; total dissolved solids 160-175 mg l⁻¹ and pH 7.1 (2).

Environmental fate

Adsorption and retention

Absorption from air by coated concrete, wood, metals and linoleum increased with increasing concentration and exposure duration, and was highest for surfaces coated with oil and silicate paints (maximum 0.15-0.5 g dm⁻²) and the lowest for ceramic tiles, glass and linoleum (maximum <0.1 mg dm⁻²) at biscyclopentadiene concentrations of 100 mg m⁻³ (3).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 190 mg kg⁻¹ (4).

LD₅₀ oral rat 350 mg kg⁻¹ (5).

LC₅₀ (4 hr) inhalation rat 660 ppm (5).

LD₅₀ dermal rabbit 5080-6720 mg kg⁻¹ (1,6).

LD₅₀ intraperitoneal rat, mouse 200 mg kg⁻¹ (7).

Sub-acute and sub-chronic data

♂, ♀ rats were administered (route unspecified) 8, 40, and 200 mg kg⁻¹ for 28 days. Inhibition of body weight gain in high-dose ♂, ♀ and intermediate-dose ♂ animals, inhibition in ♀ recovered after 17 days. High-dose animals also exhibited increased liver and adrenal weights and decreased thymus weight; ♂ given 40 and 200 mg kg⁻¹ also had increased kidney weights. Hypertrophy of adrenal cortex and foamy cytoplasm in hepatocytes were found in both ♂, ♀ animals. Repair of lesions occurred within 14 days of withdrawal. No-effect level established at 8 mg kg⁻¹ (8).

Metabolism and toxicokinetics

In vitro incubation with immobilised rabbit liver cytochrome P₄₅₀, two monoepoxides were identified as metabolites (9).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (10).

Other comments

Waste product detected in groundwater at an arsenal manufacturing site. Derivatives were also detected.

Establishing chronic toxicity parameters by extrapolating the results of short-term toxicity tests is discussed (11).

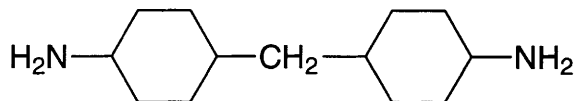
Uses of C₅ fractions including biscyclopentadiene reviewed (12).

Reviews on health effects, experimental toxicology and ecotoxicology listed (13).

References

1. *The Agrochemicals Handbook* 3rd ed., 1991, The Royal Society of Chemistry, London, UK.
2. *Lethal Effects of 2014 Chemicals Upon Sockeye Salmon, Steelhead Trout and Threespine Stickleback* 1989, US EPA 560/6-89-001, PB 89-156715, Washington, DC, USA.
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5. Kennedy, G. L. et al *Toxicol. Lett.* 1991, **56**, 317-326.
6. *Toxicol. Appl. Pharmacol.* 1971, **20**, 552.
7. *Progress Report Contract No. PH-43-64-886* Jan 1965, Natl. Cancer Inst., USA.
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10. Zeiger, E. et al *Environ. Mutagen.* 1987, **9**(Suppl. 9), 1-109.
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D272 dicykan



$C_{13}H_{26}N_2$

Mol. Wt. 210.36

CAS Registry No. 1761-71-3

Synonyms 4,4'-methylenedicyclohexylamine; 4,4'-methylenedicyclohexylamine; bis(4-aminocyclohexyl)methane; bis(*p*-aminocyclohexyl)methane; 4,4'-diaminodicyclohexylmethane; methylenebis(4-aminocyclohexane)

EINECS No. 217-168-8

RTECS No. GX 1530000

Uses Catalyst. Cross-linking agent.

Physical properties

M. Pt. 15°C **B. Pt.** 320°C **Flash point** 33°C **Specific gravity** 0.9608 at 25°C with respect to water at 4°C

Volatility v.p. <0.1 mmHg at 38°C

Solubility Water: <1 g l⁻¹ at 19°C. Organic solvents: dimethyl sulfoxide

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 670-1000 mg kg⁻¹ (1).

LC₅₀ (4 hr) inhalation mouse 400 mg m⁻³ (2).

Carcinogenicity and chronic effects

Oral dog (18 month) 50 mg kg⁻¹ 5 day wk⁻¹ caused kidney and liver damage together with severe local irritation of the gastrointestinal tract (1).

Irritancy

10 mg instilled into rabbit eye produced severe irritation and injury. The damage was not reduced by rinsing the eye with water (period of exposure unspecified) (1).

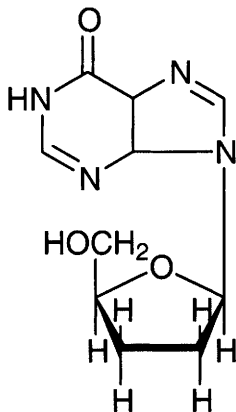
Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (3).

References

1. Kennedy, G. L. *J. Appl. Toxicol.* 1991, 11(5), 367-371.
2. Marhold, J. V. *Prehled Prumyslove Toxikologie: Organické Latky* 1986, 481, Prague, Czechoslovakia.
3. Zeiger, E. et al *Environ. Mutagen.* 1987, 9(Suppl. 9), 1-110

D273 didanosine



$C_{10}H_{12}N_4O_3$

Mol. Wt. 236.23

CAS Registry No. 69655-05-6

Synonyms 2',3'-dideoxyinosine; ddIno; ddI; DDI

RTECS No. NM 7460700

Uses As an antiviral agent against retroviruses including HIV.

Physical properties

M. Pt. 160-163°C

Mammalian & avian toxicity

Metabolism and toxicokinetics

Serum concentrations of didanosine in the human foetus of 14 and 19% of the maternal blood concentration have been reported (1).

Didanosine is rapidly hydrolysed by stomach acids unless orally administered with antacids or pH buffers. Bioavailability ranges from 20 to 40%, and is reduced by administration with or after food. Maximum plasma concentration occurs about 1 hr after oral administration, and binding to plasma proteins is less than 5%. The plasma elimination half-life is 0.5 to 4 hr. Didanosine is reported not to cross the blood-brain barrier, although the concentration in cerebrospinal fluid may be 20% of that in plasma after intravenous infusion. Intracellular metabolism leads to the formation of the antiviral triphosphate, which halts DNA synthesis by retroviruses by competitive inhibition of reverse transcriptase and incorporation into viral DNA. About half of the administered dose is excreted in the urine (2).

Genotoxicity

Escherichia coli induction of the SOS response positive (3).

Other effects

Other adverse effects (human)

Peripheral neuropathy occurs in 13 to 34% of patients receiving didanosine treatment, and potentially fatal pancreatitis in 7 to 9% of patients. In children who received a high-dose treatment, retinal depigmentation has been reported. Vomiting, nausea and abdominal pain, which may be symptoms of pancreatitis, have been reported; other adverse effects include diarrhoea, headache, insomnia, myalgia, rash, hyperuricaemia and central nervous system depression (2).

Any other adverse effects

In vitro testing with primary cultures of rat, rabbit, dog and monkey hepatocytes found a 24 hr IC_{50} (the

concentration of didanosine inhibiting an endpoint by 50% control values) of >2880 mg l⁻¹, which was considered to be too high to be biologically relevant for potential hepatotoxicity *in vivo*. The endpoints assessed were cell membrane integrity, cell viability, protein synthesis and energy status (4).

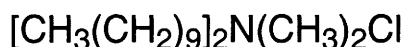
Other comments

A metabolite of dideoxyadenosine.

References

1. Pons, J. C. et al *Lancet* 1991, **337**, 732.
2. *Martindale: The Extra Pharmacopoeia* 31st ed., 1996, The Royal Pharmaceutical Society, London, UK.
3. Mamber, S. W. et al *Antimicrob. Agents Chemother.* 1990, **34**(6), 1237-1243.
4. Lubinski, J. et al *In Vitro Toxicol.* 1993, **6**(4), 279-289

D274 didecyldimethylammonium chloride



C₂₂H₄₈NCl

Mol. Wt. 362.08

CAS Registry No. 7173-51-5

Synonyms *N*-decyl-*N,N*-dimethyl-1-decanaminium chloride; dimethyldidecylammonium chloride

EINECS No. 230-525-2

RTECS No. BP 6560000

Uses Disinfectant. Wood preservative.

Physical properties

Solubility Water: miscible. Organic solvents: acetone, benzene

Occupational exposure

Supply classification corrosive

Risk phrases Harmful if swallowed – Causes burns (R22, R34)

Safety phrases Keep out of reach of children (if sold to general public) – in case of contact with eyes, rinse immediately with plenty of water and seek medical advice – Wear suitable protective clothing, gloves and eye/face protection – in case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S2, S26, S36/37/39, S45)

Environmental fate

Carbonaceous inhibition

The COD and transparency of the effluent, accumulation of mixed liquor suspended solids and faunal characteristics of microorganisms, protozoa and metazoa, were investigated. The critical concentration at which effluent COD deteriorated in an activated sludge process was 2 mg l⁻¹. *Aspidisca*, *Vorticella* and *Trachelophyllum* were inhibited at this concentration, while *Opercularia* was resistant. Concentration of didecyldimethylammonium chloride should not exceed 2 mg l⁻¹ for preventing deterioration of treatment efficacy (1).

Degradation studies

95% removed by activated sludge sewage treatment plant model, concentration of 5 mg l⁻¹; inhibitory concentration 15 mg l⁻¹. Using a trickling filter 94% was removed, concentration 22 mg l⁻¹ (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 84, 270 mg kg⁻¹, respectively (3).

LD₅₀ intraperitoneal mouse, rat 11, 45 mg kg⁻¹, respectively (3).

Irritancy

Dermal rabbit 500 mg caused severe irritation (period of exposure unspecified) (3).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Chlorides: guide level 25 mg l⁻¹ (4).

Maximum admissible concentration for chlorides in drinking water in the United Kingdom 400 mg l⁻¹ (12-monthly average) (5).

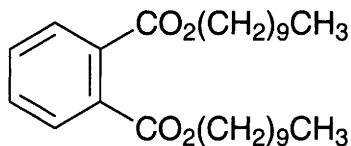
Other comments

Experimental toxicology and human health effects reviewed (6).

References

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2. Gerike, P. et al *Chemosphere* 1990, 21(6), 799-812.
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D275 didecyl phthalate



C₂₈H₄₆O₄

Mol. Wt. 446.67

CAS Registry No. 84-77-5

Synonyms 1,2-benzenedicarboxylic acid, didecyl ester; phthalic acid, didecyl ester; di-*n*-decyl phthalate; decyl phthalate

EINECS No. 201-561-6

RTECS No. TI 0900000

Uses Solvent, plasticiser

Physical properties

B. Pt. 240-247°C at 3 mmHg Flash point 168°C Specific gravity 0.966 at 20°C with respect to water at 4°C

Volatility v.p. 0.3 mmHg at 200°C

Solubility Water: 0.3 mg l⁻¹ at 24°C. Organic solvents: carbon tetrachloride

Occupational exposure

SE-LEVL 3 mg m⁻³

SE-STEL 5 mg m⁻³

Environmental fate

Degradation studies

1% biodegradation in 15 days in settled domestic wastewater inoculum and 10% biodegradation in 15 days after acclimation of inoculum (1).

Adsorption and retention

Estimated K_{oc} of 8000 indicates that didecyl phthalate is essentially immobile in soil (2).

Mammalian & avian toxicity

Acute data

LD₅₀ dermal rabbit 17 g kg⁻¹ (3).

LD_{Lo} intraperitoneal mouse 2233 mg kg⁻¹ (4).

Irritancy

Dermal rabbit (24 hr) 10 mg caused mild irritation (3).

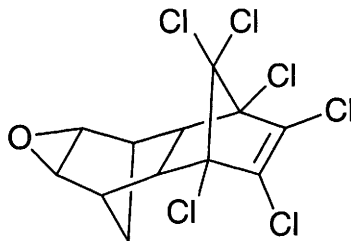
Other comments

Residues have been isolated from surface waters (5).

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D276 dieldrin



C₁₂H₈Cl₆O

Mol. Wt. 380.91

CAS Registry No. 60-57-1

Synonyms 1,2,3,4,10,10-hexachloro-1*R*,4*S*,4*aS*,5*R*,6*R*,7*S*,8*S*,8*aR*-octahydro-6,7-epoxy-1,4:5,8-dimethanonaphthalene; 3,4,5,6,9,9-hexachloro-1*a*,2,2*a*,3,6,6*a*,7,7*a*-octahydro-2,7:3,6-dimethanonaphth[2,3-*b*]oxirene; alvit; ENT 16225; HEOD

EINECS No. 200-484-5

RTECS No. IO 1750000

Uses Formerly used as an insecticide.

Physical properties

M. Pt. 175-176°C **Specific gravity** 1.75 at 20°C **Partition coefficient** log P_{ow} 6.45 (1)

Volatility v.p. 3.1×10^{-6} mmHg at 20°C ; v.den. 13.2

Solubility Water: 0.25 mg l⁻¹. Organic solvents: acetone, benzene, ethanol, methanol, olive oil

Occupational exposure

DE-MAK 0.25 mg m⁻³ (inhalable fraction or aerosol)

FR-VME 0.25 mg m⁻³

UK-LTEL 0.25 mg m⁻³

UK-STEL 0.75 mg m⁻³

US-TWA 0.25 mg m⁻³

Supply classification very toxic, dangerous for the environment

Risk phrases Toxic if swallowed – Very toxic in contact with skin – Possible risk of irreversible effects – Toxic: danger of serious damage to health by prolonged exposure if swallowed – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R25, R27, R40, R48/25, R50/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Do not breathe dust – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S22, S36/37, S45, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) bluegill sunfish, rainbow trout, coho salmon, king salmon, goldfish 6-37 µg l⁻¹ (2,3).

Bluegill sunfish exposed to 1.5-5.0 µg l⁻¹ had a significant increase in ventilation rate within 15-20 min (4).

Invertebrate toxicity

EC₅₀ (48 hr) *Daphnia magna* 230 µg l⁻¹ (5).

LC₅₀ (96 hr) *Palaemonetes kadiakensis*, *Asellus brevicaudus*, *Orconectes nais*, *Gammarus fasciatus* 5-740 µg l⁻¹ (6).

Bioaccumulation

Bioconcentration factor for catfish and oysters 2300-3500 (6,7).

Environmental fate

Degradation studies

t_{1/2} 3-25 yr for biodegradation in soils (8,9).

64% removal by activated sludge at a concentration of 0.098 µg l⁻¹ in 9 days (10).

Abiotic removal

t_{1/2} 723 day for evaporation from water at 1 m depth (11).

Coagulation with ferric chloride and alum have been reported to achieve 40-55% reduction at dieldrin concentrations of 1-10 µg l⁻¹ (12,13).

Ozonation of water containing 10 µg l⁻¹ effected reductions of 15 and 50% for ozone doses of 11 and 36 mg l⁻¹, respectively (13).

Dose of powdered activated carbon required to reduce dieldrin concentration in river water from 10 to 0.1 µg l⁻¹ was 126 mg l⁻¹ (13).

Photooxidation by UV light in aqueous medium at 90-95°C, time for formation of CO₂: 25% in 2.9 hr; 50% in 4.8 hr; 75% in 12.5 hr (14).

Sunlight degrades dieldrin to photodieldrin, t_{1/2} 2 months in distilled water. Photodegradation is aided by rotenone and to a lesser extent by natural triplet sensitizers such as chlorophyll (15,16).

Adsorption and retention

Measured log K_{oc} of 3.87-4.08 demonstrates that dieldrin will be immobile in most soils (17,18).

Mammalian & avian toxicity

Acute data

LD₅₀ oral starling 240 mg kg⁻¹ (19).

LD₅₀ oral rat, mouse, redwing blackbird, quail 38-56 mg kg⁻¹ (20,19).

LD₅₀ oral monkey 3 mg kg⁻¹ (23).

LC₅₀ (4 hr) inhalation cat 80 mg m⁻³ (24).

LD₅₀ dermal rat 56 mg kg⁻¹ (25).

LD₅₀ intraperitoneal rat 35 mg kg⁻¹ (26).

LD₅₀ intravenous rat, mouse 9, 11 mg kg⁻¹, respectively (27,28).

Sub-acute and sub-chronic data

LC₅₀ (5 day) oral bobwhite quail, Japanese quail, pheasant, mallard 37-170 mg kg⁻¹ diet (29).

Carcinogenicity and chronic effects

National Toxicology Program tested rats and mice via gavage. Equivocal results reported in ♂ mice, negative results reported in ♀ mice and ♂ and ♀ rats (30,31).

Oral rat (27 month) 0, 1, 5 or 10 mg kg⁻¹ diet induced liver tumours. Exposure to dieldrin enhanced nuclear polyploidy in the liver in a dose-dependent manner (32).

Oral rat (2 yr) 0, 0.005, 0.05 or 0.5 mg kg⁻¹ day⁻¹. No effects on mortality, body weight, food intake, haematology and blood and urine chemistries were observed. At the high-dose level, all animals became irritable after 8-13 wk and developed tremors and occasional convulsions. Liver weight was significantly increased in ♀ rats receiving the 0.05 and 0.5 mg kg⁻¹ day⁻¹ dose levels. Pathological examination revealed changes in the liver of 1 ♂ and 6 ♀ among 25 rats receiving the high dose. No evidence of carcinogenicity was found (33).

Oral mouse (132 wk) 0.015, 0.15 or 1.5 mg kg⁻¹ day⁻¹. An increased incidence of liver tumours was observed at all dose levels tested compared with controls (33).

Oral dog (2 yr) 0, 0.005 or 0.05 mg kg⁻¹ day⁻¹ caused no observable adverse effects. A significant increase in plasma alkaline phosphatase activity in both sexes and a significant decrease in serum protein concentration in ♂ dogs receiving the high-dose were not associated with any chemical or pathological change. Liver weight was significantly increased in high-dose ♀ dogs (33).

Oral rat (2 yr) 0, 0.025, 0.1, 0.5, 2.5, 5.0 or 7.5 mg kg⁻¹ day⁻¹. Survival was markedly reduced at 2.5 mg kg⁻¹ day⁻¹ and above. Liver to body weight ratios were increased in all treated ♀ and in ♂ rats at 0.5 mg kg⁻¹ day⁻¹ and above. ♂ rats at the 2 highest dose levels developed haemorrhagic and/or distended urinary bladders, usually associated with considerable nephritis (34).

Teratogenicity and reproductive effects

Oral rat 0 or 4 mg kg⁻¹ day⁻¹ on days 15-21 of gestation. No foetotoxic or teratogenic effects were observed (35).

Oral hamster 30 mg kg⁻¹ on days 7, 8 or 9 of gestation caused a significant increase in foetal deaths, a decrease in live foetal weight and an increased incidence of webbed foot, cleft palate and open eye (36).

Oral rat and mouse 1.5, 3.0 or 6.0 mg kg⁻¹ day⁻¹ on days 7-16 of gestation. Maternal toxicity in rats was demonstrated by 41% mortality and significant decrease in weight gain in the high-dose group. High-dose mice also showed a significant decrease in weight gain and an increase in liver-to-body weight ratio. Foetal toxicity was demonstrated by a significant decrease in the numbers of caudal ossification centres at the high-dose level and a significant increase in the number of supernumerary ribs at the 3.0 and 6.0 mg kg⁻¹ day⁻¹ dose levels (37).

Metabolism and toxicokinetics

♀ rats infused with total doses of 8-16 mg dieldrin excreted ~70% of the dose in the faeces and 10% in the urine over 42 days. Excretion was markedly increased by restriction of the diet, indicating that blood concentrations increased as fat was mobilised (28).

Metabolised to photodieldrin in the liver and kidney of chicken (38).

Following oral administration of 10 mg kg⁻¹ to rats, dieldrin was detectable in the fat, muscle, liver, blood, brain and kidney. Highest concentrations were found in fat, lowest in the kidney (39).

Following oral administration rats and mice metabolised dieldrin to 9-hydroxydieldrin, 6,7-*trans*-dihydroaldrindiol, and some unidentified metabolites. The rat, but not the mouse, also metabolised dieldrin to the pentachloroketone (40).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537, TA1538 with and without metabolic activation negative (41).

In vitro Chinese hamster ovary cells, sister chromatid exchanges positive, chromosome aberrations negative (42).

In vitro human WI-38 embryonic lung cells, chromosomal aberrations positive (43).

In vitro mouse bone marrow cells, chromosomal aberrations and inhibition of mitotic index positive (43).

Other effects

Any other adverse effects

Causes an increase in general central nervous system excitability, which may relate to persistent behavioural stimulation (44).

Intraperitoneal mouse, single injection of 36 mg kg⁻¹. After 7 days, lymphoid cells were transformed into H-2-incompatible F1 hybrids. A marked inhibition of the graft-*v*-host reaction was observed (45).

Dieldrin (100 µM) caused 25% inhibition of specific binding of [3H]5α-DHT to rat androgen-binding protein (46). Attributed endocrine disruption effects in wildlife. Avian reproduction impaired (47).

Even at high concentrations dieldrin (525 µmol kg⁻¹) administered intramuscularly to white leghorn roosters had neither oestrogenic nor antioestrogenic activity as measured by its effect on oestrogen-related mRNA stabilising factor (48).

Legislation

WHO Guideline Value for total of aldrin and dieldrin in drinking water 0.03 µg l⁻¹ (49).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (50).

Included in Schedule 5 (Release into Water: Prescribed Substances) and Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (51).

EEC maximum residue levels – cereals 0.01 ppm; meat, meat preparations and fat 0.2 ppm; raw cow's milk and cream 0.006 ppm; all feedstuffs except fats 0.01 ppm (fats 0.2 ppm); fruit and vegetables 0.01 ppm (52).

The log P_{ow} value exceeds the European Community recommended level 3.0 (6th and 7th amendments) (53).

Quality objective under EC Directive 86/280/EEC and 88/347/EEC 0.01 µg l⁻¹ (annual mean) for all waters. A 'standstill' provision applies to concentrations in sediments, molluscs, shellfish and/or fish. Limit value under EC Directives 86/280/EEC and 88/347/EEC 2 µg l⁻¹ in effluent, and 3 g tonne⁻¹ of total production capacity (monthly average), 10⁴ µg l⁻¹ in effluent, and 15 g tonne⁻¹ of total production capacity (daily average) for industrial plants producing dieldrin (54).

Other comments

Studies conducted to investigate a possible synergistic increase in oestrogenic potency between the weakly oestrogenic organochlorines dieldrin and endosulfan showed no synergism in the displacement of 3H-E2 from rat uterine oestrogen receptors, nor in inducing the proliferation of MCF-7 breast cancer cells (an oestrogen-dependent response). In addition, endosulfan or dieldrin (0.1 mg animal⁻¹ day⁻¹) alone or in combination, injected intraperitoneally for 3 days, did not stimulate any uterotrophic activity and had no effect on pituitary prolactin or other endocrine-related endpoints in immature ♀ rats (55).

Metabolite of the insecticide aldrin. Residues have been detected in natural waters, soils, sediments, crops, meat, fish and dairy products (56,57).

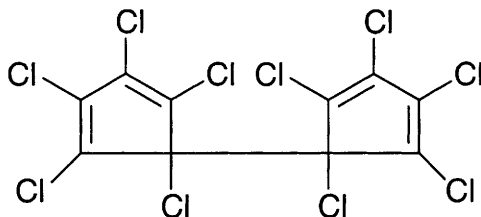
Physical properties, occurrence, environmental fate, metabolism, mammalian toxicity, carcinogenicity, teratogenicity, mutagenicity and health advisories reviewed (56-59).

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D277 **dienochlor**



C₁₀Cl₁₀

Mol. Wt. 474.64

CAS Registry No. 2227-17-0

Synonyms 1,1',2,2',3,3',4,4',5,5'-decachlorobis(2,4-cyclopentadien-1-yl); decachlorobis(2,4-cyclopentadien-1-yl); bis(pentachlorocyclopentadienyl); decachlor; Pentac

EINECS No. 218-763-5

RTECS No. DT 8225000

Uses Acaricide.

Physical properties

M. Pt. 122-123°C **B. Pt.** 250°C (decomp.) **Flash point** 187.8°C (open cup) **Specific gravity** 1.923 (tech.) at 25°C **Partition coefficient** log *P*_{ow} 3.23 at 25°C (1) **Volatility** v.p. 2.18 × 10⁻⁶ mmHg (extrapolated to 25°C) **Solubility** Water: 25 ppb. Organic solvents: acetonitrile, isooctane, *n*-octanol, tetrahydrofuran, toluene

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) bluegill sunfish, rainbow trout 0.6-2.1 mg l⁻¹ (1).

Invertebrate toxicity

EC₅₀ (48 hr) *Daphnia* sp. 1.2 mg l⁻¹ (duration of experiment not given) (2).

Environmental fate

Degradation studies

Readily degraded in soil; DT₅₀ 1-6 days under aerobic conditions; only very slightly degraded under anaerobic sterilised conditions (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1200 mg kg⁻¹ (3).

LD₅₀ oral bobwhite quail 4319 mg kg⁻¹ (2).

LD₅₀ dermal rabbit, rat >3160, >5000 mg kg⁻¹, respectively (1).

Sub-acute and sub-chronic data

LC₅₀ (8 day) oral mallard 4000 mg kg⁻¹ diet (1).

LC₅₀ (8 day) oral bobwhite quail >5620 mg kg⁻¹ diet (1).

Irritancy

3 mg instilled into rabbit eye produced slight irritation which subsided after 6 days (4).

Genotoxicity

Salmonella typhimurium TA100 without metabolic activation positive (5).

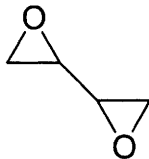
Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration $0.1 \mu\text{g l}^{-1}$ (6).
Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (7).
WHO Toxicity Class III (8).
EPA Toxicity Class I (2).

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D278 1,2:3,4-diepoxybutane



$\text{C}_4\text{H}_6\text{O}_2$

Mol. Wt. 86.09

CAS Registry No. 1464-53-5

Synonyms butadiene diepoxide; diepoxybutane; 2,2'-bioxirane; bioxirane; 1,1'-bis(ethylene oxide); 1,3-butadiene diepoxide; butadiene dioxide; butane diepoxide; erythritol anhydride

EINECS No. 215-979-1

RTECS No. EJ 8225000

Uses Cross-linking agent. Curing polymers.

Physical properties

M. Pt. -19°C (*meso* form CAS RN 564-00-1); 4°C (DL form CAS RN 298-18-0) **B. Pt.** 138°C ; $140\text{--}142^\circ\text{C}$ at 761 mmHg (*meso*) **Specific gravity** 1.113 at 18°C with respect to water at 4°C **Volatility** v.p. 3.9 mmHg at 20°C
Solubility Water: miscible, hydrolyses to erythritol. Organic solvents: acetone

Occupational exposure

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Irritating to eyes, respiratory system and skin – Possible risk of irreversible effects – May cause sensitisation by inhalation and skin contact (R23/24/25, R36/37/38, R40, R42/43)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Do not breathe vapour – Avoid contact with the skin – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S23, S24, S45)

Ecotoxicity

Bioaccumulation

The calculated bioconcentration factor of 0.024 indicates that environmental accumulation is unlikely (1).

Environmental fate

Abiotic removal

Slowly hydrolysed in water yielding erythritol and threitol (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 72, 78 mg kg⁻¹, respectively (3,4).

LC₅₀ (4 hr) inhalation rat 90 ppm (4).

LD₅₀ dermal rabbit 80 mg kg⁻¹ (3).

LD₅₀ intraperitoneal mouse 31 mg kg⁻¹ (5).

Carcinogenicity and chronic effects

No adequate data for evaluation of carcinogenicity to humans, sufficient evidence for carcinogenicity to animals for all individual isomers, IARC classification group 2B (6).

Metabolism and toxicokinetics

Following an intravenous dose of 523 µmol kg⁻¹ to adult ♂ Sprague-Dawley rats the following pharmacokinetic parameters were recorded: distribution half-life 2.7 minutes, terminal elimination t_{1/2} 14 minutes, volume of distribution at steady state of 0.73±0.06 kg⁻¹ and systemic clearance of 76±0.8 ml min⁻¹ kg⁻¹ (7).

Irritancy

Dermal rabbit (24 hr) 10 mg caused severe irritation and 250 µg instilled into rabbit eye caused severe irritation (period of exposure unspecified) (3).

Genotoxicity

Escherichia coli k-12 prophage induction positive (8).

Drosophila melanogaster sex-linked recessive lethal mutations and translocations positive (9,10).

In vitro rat and mouse hepatocytes, unscheduled DNA synthesis negative (11).

Big Blue Rat 2 cells *in vitro* exposed to concentrations of 0, 2, 5, or 10 µM for 24 hr had survival rates of approximately 100, 50, and 10%, respectively, compared with controls. A concentration-dependent increase in micronuclei was observed, but only weak mutagenicity at the lacI transgene (12).

Neurospora crassa 38701, reverse mutation induction positive (13).

In vivo mouse and Chinese hamster bone marrow cells chromosomal aberrations and sister chromatid exchanges positive (14).

In vitro mouse lymphoma cell, L5178Y tk⁺/tk⁻ forward mutation assay positive (15).

Superovulated ♀ mice were injected intraperitoneally with 26-52 mg kg⁻¹ and mated with untreated ♂s (oocyte exposure around 1.5 days before ovulation). A dose-dependent induction of chromosome aberrations was seen in C-banded metaphases of one-cell embryos (16).

Other effects

Any other adverse effects

Diepoxybutene alkylates DNA primarily at the N-7 position of guanine (17).

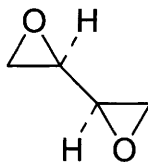
Other comments

Physical properties, carcinogenicity and mammalian toxicity reviewed (2).

References

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D279 DL-1,2:3,4-diepoxybutane



$C_4H_6O_2$

Mol. Wt. 86.09

CAS Registry No. 298-18-0

Synonyms (*R*,R**)-(±)-2,2'-bioxirane; (±)-1,2:3,4-diepoxybutane; 1,2:3,4-dianhydroerythritol; DL-diepoxybutane

EINECS No. 206-060-6

RTECS No. EJ 8400000

Uses Cross-linking agent for textile fibres. Curing of polymers. Prevention of microbial spoilage.

Occurrence Proposed hydrolysis product of treosulfan.

Physical properties

M. Pt. 2-4°C **B. Pt.** 138°C **Specific gravity** 1.112 at 18°C with respect to water at 14°C

Solubility Water: miscible. Organic solvents: acetone, arachis oil, tricaprilin

Occupational exposure

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Irritating to eyes, respiratory system and skin – Possible risk of irreversible effects – May cause sensitisation by inhalation and skin contact (R23/24/25, R36/37/38, R40, R42/43)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Do not breathe vapour – Avoid contact with the skin – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S23, S24, S45)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 210 mg kg⁻¹ (1).

LC₅₀ (4 hr) inhalation rat 56 ppm (1).

LD₅₀ dermal rabbit 800 mg kg⁻¹ (1).

Sub-acute and sub-chronic data

Intragastric rat, 5 mg 1 × wk⁻¹ for 1 yr was found to be non-toxic (2).

Carcinogenicity and chronic effects

No adequate data for evaluation of carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (3,4).

Dermal mouse, 10 mg 3 × wk⁻¹ for life. 2/30 mice developed skin tumours, one of which was a squamous-cell carcinoma. 8/90 controls developed skin papillomas (5).

Dermal mouse, 3 or 10 mg 3 × wk⁻¹ for life. Among the high-dose group, 1/30 developed a skin papilloma; the mean survival time was 165 days. For the lower-dose group, 10/30 mice developed skin papillomas and 6/30 developed squamous-cell carcinomas of the skin; mean survival time 475 days. No skin tumours were observed in 60 controls (6).

Subcutaneous mouse (1 yr) 0.1 or 1.1 mg animal⁻¹ wk⁻¹. 5/50 and 5/30 mice, respectively, developed local fibrosarcomas. The mean survival times were 456 and 328 days, respectively. No local sarcomas developed in controls (2).

Irritancy

In humans, minor accidental exposure to diepoxybutane (mixed isomers) caused swelling of the eyelids, severe eye irritation and upper respiratory tract irritation within 6 hr (7).

Genotoxicity

Salmonella typhimurium TA100, TA1535 with and without metabolic activation positive (8).

In vitro L5178Y tk⁺/tk⁻ mouse lymphoma cell forward mutation assay positive (9).

Produced sex-linked recessive lethal mutations, visible mutations, semi-lethal mutations, translocations and mutations in *Drosophila melanogaster* (mixed isomers) (3).

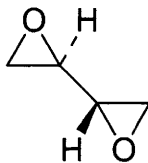
Other comments

Physical properties, use, carcinogenicity and mammalian toxicity of DL-diepoxybutane reviewed (4).

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D280 *meso*-1,2:3,4-diepoxybutane



$C_4H_6O_2$

Mol. Wt. 86.09

CAS Registry No. 564-00-1

Synonyms (*R*,S**)-2,2'-bioxirane; erythritol anhydride; *meso*-diepoxybutane

RTECS No. EJ 8750000

Uses Chemical intermediate. Cross-linking agent.

Physical properties

M. Pt. -19°C B. Pt. $140\text{--}142^{\circ}\text{C}$

Solubility Water: miscible. Organic solvents: acetone, arachis oil, tricaprilin

Occupational exposure

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Irritating to eyes, respiratory system and skin – Possible risk of irreversible effects – May cause sensitisation by inhalation and skin contact (R23/24/25, R36/37/38, R40, R42/43)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Do not breathe vapour – Avoid contact with the skin – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S23, S24, S45)

Environmental fate

Abiotic removal

Slowly hydrolysed in water yielding erythritol and threitol (1).

Mammalian & avian toxicity

Acute data

LD_{50} oral rat 70 mg kg^{-1} (2).

LD_{Lo} dermal mouse 400 mg kg^{-1} (3).

Carcinogenicity and chronic effects

No adequate data for evaluation of carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (1,4).

Dermal mouse $10\text{ mg } 3 \times \text{wk}^{-1}$ for life. 6/30 mice developed skin tumours, four of which were squamous-cell carcinomas. 8/90 controls developed skin papillomas (3).

Dermal mouse 3 or $10\text{ mg } 3 \times \text{wk}^{-1}$ for life. The median survival time was 154 days. At the high dose 5/30 mice developed skin tumours, four of which were squamous cell carcinomas. At the low dose one animal developed a skin papilloma. No skin tumours were reported in 60 controls (5).

Genotoxicity

Salmonella typhimurium TA1535 with and without metabolic activation positive (6).

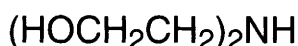
Other comments

Physical properties, use, carcinogenicity and mammalian toxicity of *meso*-1,2:3,4-diepoxybutane reviewed (1).
Reported to produce 55% inhibition of the growth of Walker carcinoma cells in rats (7).

References

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D281 diethanolamine



$\text{C}_4\text{H}_{11}\text{NO}_2$

Mol. Wt. 105.14

CAS Registry No. 111-42-2

Synonyms 2,2'-iminodiethanol; 2,2'-iminobis(ethanol); bis(2-hydroxyethyl)amine; *N,N*-diethanolamine; 2,2'-dihydroxydiethylamine; diolamine

EINECS No. 203-868-0

RTECS No. KL 2975000

Uses Used to scrub gases. Chemical intermediate. Emulsifier. Plasticiser.

Physical properties

M. Pt. 27-30°C **B. Pt.** 269°C **Flash point** 138°C (open cup) **Specific gravity** 1.0881 at 30°C with respect to water at 4°C **Partition coefficient** $\log P_{\text{OW}} -1.43$ (1) **Volatility** v.p. <0.01 mmHg at 20°C ; v.den. 3.6
Solubility Water: miscible. Organic solvents: acetone, benzene, diethyl ether, carbon tetrachloride, methanol, ethanol, *n*-heptane

Occupational exposure

FR-VME 3 ppm (15 mg m⁻³)

SE-LEVL 3 ppm (15 mg m⁻³)

SE-STEL 6 ppm (30 mg m⁻³)

UK-LTEL 3 ppm (13 mg m⁻³)

US-TWA 2 mg m⁻³

Supply classification irritant

Risk phrases Irritating to eyes and skin (R36/38)

Safety phrases Keep out of reach of children (if sold to general public) – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice (S2, S26)

Ecotoxicity

Fish toxicity

LC₅₀ (24 hr) goldfish 800 mg l⁻¹ at pH 9.6, >5000 mg l⁻¹ at pH 7.0 (2).

Invertebrate toxicity

EC₅₀ *Daphnia magna* 289 mg l⁻¹ (3).

EC₅₀ (5 min) *Photobacterium phosphoreum* 73 ppm Microtox test (4).

Bioaccumulation

The calculated bioconcentration factor of <1.0 indicates that environmental accumulation is unlikely (5).

Environmental fate

Nitrification inhibition

Does not inhibit ammonia oxidation by *Nitrosomonas* sp. at 100 mg l⁻¹ (6).

Degradation studies

COD 1.52 mg kg⁻¹ O₂ (2).

ThOD 2.13 mg kg⁻¹ O₂ (7).

BOD₁₅ 3.5% of ThOD (8).

97% degradation as sole carbon source in adapted activated sludge at 19.5 mg COD g⁻¹ dry inoculum hr⁻¹ (9).

Confirmed biodegradable (10).

Abiotic removal

t_{1/2} for reaction with photochemically-produced hydroxyl radicals 4 hr (11).

Evaporation rate relative to *n*-butyl acetate, which has been assigned a value of 1 at 25°C, is <0.001 (12).

Adsorption capacity of activated carbon 0.057 g g⁻¹ carbon (13).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 710, 3300 mg kg⁻¹, respectively (14-16).

LD₅₀ dermal rabbit 12.2 g kg⁻¹ (17).

LD₅₀ intraperitoneal mouse 2300 mg kg⁻¹ (18).

Metabolism and toxicokinetics

Gavage rat 7 mg kg⁻¹ dose, once or daily repeat doses for up to 8 wk. Oral doses were well absorbed but excreted very slowly and accumulated to high concentrations in the liver and kidneys. The steady-state of bioaccumulation was approached only after several weeks of repeat oral dosing, and elimination t_{1/2} was approximately 1 wk (19).

Dermal rat 2-28 mg kg⁻¹, doses were absorbed slowly (3-16% in 48 hr) (19).

Dermal mouse 8-80 mg kg⁻¹, doses were 25-60% absorbed in 48 hr of exposure (19).

Oral or intravenous mouse, single doses of diethanolamine were excreted slowly in the urine (22-25% in 48 hr) predominantly as the parent compound. After several weeks of repeat oral dosing the profile of metabolites appearing in the urine changed with significant amounts of *N*-methyldiethanolamine and more cationic metabolites appearing along with unchanged parent compound (19).

Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation and 750 µg instilled into rabbit eye (24 hr) caused severe irritation (20).

Legislation

Maximum permissible concentration in domestic water in Russia 0.8 mg l⁻¹ (21).

Other comments

Environmental fate of diethanolamine reviewed (22).

Experimental toxicology and human health effects reviewed (23).

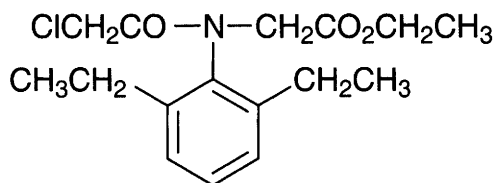
Autoignition temperature 662°C.

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22. Howard, P. H. *Handbook of Environmental Fate of Organic Chemicals* 1991, **2**, 197-201, Lewis Publishers, Chelsea, MI, USA.
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D282 diethatyl-ethyl



$C_{16}H_{22}ClNO_3$

Mol. Wt. 311.81

CAS Registry No. 38727-55-8

Synonyms N-(chloroacetyl)-N-(2,6-diethylphenyl)glycine, ethyl ester; Antor; Diethacine-ethyl

EINECS No. 254-105-3

RTECS No. MB 9200000

Uses Herbicide. Chemical intermediate.

Physical properties

M. Pt. 49-50°C **Specific gravity** 1.38 at 25°C **Partition coefficient** $\log P_{ow}$ 3.6 (1) **Volatility** v.p. 3.16×10^{-6} mmHg at 30°C

Solubility Water: 105 mg l⁻¹ at 25°C. Organic solvents: acetone, chloroform, ethanol, isopropanol, kerosene, methyl isobutyl ketone, xylene

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout, bluegill sunfish 1.82, 3.34 mg l⁻¹, respectively (1).

Invertebrate toxicity

Not toxic to bees at 43.5 µg bee⁻¹ (1).

Environmental fate

Degradation studies

$t_{1/2}$ in soil ~60 day (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 1650-4100 mg kg⁻¹ (1).

LD₅₀ oral bobwhite quail, mallard duck >10 g kg⁻¹ (1).

LD₅₀ dermal rabbit >4 g kg⁻¹ (1).

Carcinogenicity and chronic effects

Oral rat, mouse, dog (2 yr), no-adverse-effect level for rat and mouse 1000 mg kg⁻¹ diet, and for dog 50 mg kg⁻¹ diet (1).

Legislation

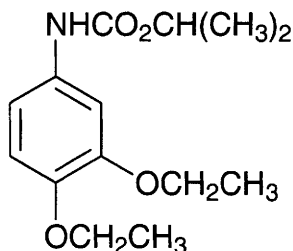
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (3).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

References

1. *The Agrochemicals Handbook* 3rd ed., 1991, The Royal Society of Chemistry, London, UK.
2. *The Pesticide Manual* 11th ed., 1997, British Crop Protection Council, Farnham, UK.
3. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
4. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D283 diethofencarb



C₁₄H₂₁NO₄

Mol. Wt. 267.33

CAS Registry No. 87130-20-9

Synonyms (3,4-diethoxyphenyl)carbamic acid, 1-methylethyl ester; isopropyl 3,4-diethoxycarbanilate; isopropyl N-(3,4-diethoxyphenyl)carbamate

RTECS No. EZ 4215700

Uses Fungicide.

Physical properties

M. Pt. 100.3°C Flash point 140°C Specific gravity 1.19 at 23°C Partition coefficient log P_{ow} 3.02 at 25°C

(1) Volatility v.p. 6.3 × 10⁻⁵ mmHg at 20°C

Solubility Water: 26.6 mg l⁻¹ at 20°C. Organic solvents: hexane, methanol, xylene

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) carp 8.3 mg l⁻¹ (1).

LC₅₀ (96 hr) rainbow trout >18 mg l⁻¹ (1).

Invertebrate toxicity

LC₅₀ (3 hr) *Daphnia pulex* >10 mg l⁻¹ (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mallard duck, quail >2250 mg kg⁻¹ (2).

LD₅₀ oral rat, mouse >5 g kg⁻¹ (1,3).

LC₅₀ (4 hr) inhalation rat >1050 mg m⁻³ (4).

LD₅₀ dermal rat, mouse >5 g kg⁻¹ (1,3).

Metabolism and toxicokinetics

Following a single oral dose of 500 mg kg⁻¹ ¹⁴C-diethofencarb to rats, 86-98% of the ¹⁴C was eliminated in the urine in 7 days. Sulfated, acetylated and diethylated metabolites were identified. Glucuronide and sulfate conjugates are formed (1,5).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (6).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (7).

References

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7. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D284 diethoxydimethylsilane



C₆H₁₆O₂Si

Mol. Wt. 148.28

CAS Registry No. 78-62-6

Synonyms dimethyldiethoxysilane; silane, diethoxydimethyl-,

EINECS No. 201-127-6

RTECS No. VV 3590000

Uses Catalyst for propylene polymerisation. In corrosion-resistant steel coatings and water-repellent optical lens coatings.

Physical properties

B. Pt. 113.5°C Flash point 11°C Specific gravity 0.834 at 20°C with respect to water at 4°C Volatility v.p. 10 mmHg at 13.3°C ; v.den. 5.1

Occupational exposure

UN No. 2380 HAZCHEM Code 3ME Conveyance classification flammable liquid

Ecotoxicity

Invertebrate toxicity

EC₅₀ (48 hr) *Daphnia pulex* 1.25-2.147 mg l⁻¹ (1,2).

Mammalian & avian toxicity

Acute data

LD_{Lo} oral rat 9280 mg kg⁻¹ (3).

LC_{Lo} (4 hr) inhalation rat 8000 ppm (3).

Irritancy

A skin and eye irritant. Dermal rabbit (24 hr) 500 mg, and 500 mg instilled into rabbits' eyes both caused mild irritation (3).

Genotoxicity

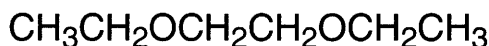
Salmonella typhimurium TA1535, TA1537, TA1538, TA98, TA100, *Saccharomyces cerevisiae* D4, *Escherichia coli* pol A⁻/pol A⁺ with and without metabolic activation negative (4).

Mouse lymphoma L5178Y cell assay with and without metabolic activation sister chromatid exchange positive, chromosome aberrations negative (4).

References

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3. Marhold, J. V. *Sbornik Vysledku Toxikologickeho Vyetreni Latek A Pripravku* 1972, 218, Prague, Czechoslovakia.
4. Isquith, A. et al *Food Chem. Toxicol.* 1988, 26(3), 255-261

D285 1,2-diethoxyethane



C₆H₁₄O₂

Mol. Wt. 118.18

CAS Registry No. 629-14-1

Synonyms diethyl cellosolve; 3,6-dioxaoctane; 2-ethoxyethyl ethyl ether; ethylene glycol diethyl ether; glycol diethyl ether

EINECS No. 211-076-1

RTECS No. KI 1225000

Uses Blowing agent. Solvent.

Physical properties

M. Pt. -74°C **B. Pt.** 121°C **Specific gravity** 0.8489 at 20°C **Volatility** v.p. 9.4 mmHg at 20°C ; v.den. 4.07
Solubility Water: 2%. Organic solvents: acetone, benzene, diethyl ether, ethanol, oils

Occupational exposure

UN No. 1153 HAZCHEM Code 3ME Conveyance classification flammable liquid

Mammalian & avian toxicity

Sub-acute and sub-chronic data

Subcutaneous dog (7 day) 9.5 ml day⁻¹ caused no observable ill-effects, but autopsy revealed injury to vasculature, liver, brain, testes, and particularly to the kidneys (1).

Inhalation rabbit, cat, guinea pig (1 hr) 10,000 ppm caused irritation of the mucous membranes and central nervous system depression. Exposure to this concentration for 8 hr day⁻¹ for 12 days was fatal to cats and rabbits, but not to mice and guinea pigs (1).

Teratogenicity and reproductive effects

Oral rabbit, 0, 25, 50 or 100 mg kg⁻¹ on days 6-19 of gestation. Developmental toxicity was observed for doses of 50 and 100 mg kg⁻¹ in the absence of maternal toxicity (2).

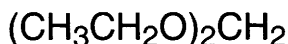
Other comments

Autoignition temperature 205°C.

References

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D286 diethoxymethane



C₅H₁₂O₂

Mol. Wt. 104.15

CAS Registry No. 462-95-3

Synonyms 1,1'-[methylenebis(oxy)]bisethane; 1,1-diethoxymethane; diethylformal; ethoxymethyl ethyl ether; ethylal; formaldehyde diethyl acetal

EINECS No. 207-330-6

RTECS No. PA 8500000

Uses Solvent.

Physical properties

M. Pt. -66.5°C **B. Pt.** 87-88°C **Flash point** -5°C **Specific gravity** 0.8319 at 20°C with respect to water at 4°C

Solubility Water: miscible. Organic solvents: acetone, benzene, chloroform, diethyl ether, ethanol

Occupational exposure

UN No. 2373 HAZCHEM Code 3WE Conveyance classification flammable liquid

Mammalian & avian toxicity

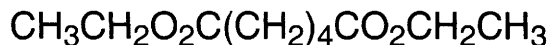
Acute data

LD₅₀ oral rabbit 2600 mg kg⁻¹ (1).

References

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D287 diethyl adipate



$\text{C}_{10}\text{H}_{18}\text{O}_4$

Mol. Wt. 202.25

CAS Registry No. 141-28-6

Synonyms hexanedioic acid, diethyl ester; diethyl hexanedioate; ethyl adipate; ethyl δ -(carboethoxyvalerate)

EINECS No. 205-477-0

RTECS No. AV 1100000

Uses Coupling agent. Food preservative. Plasticiser.

Physical properties

M. Pt. -18°C **B. Pt.** 251°C **Flash point** $>110^\circ\text{C}$ **Specific gravity** 1.009 at 20°C

Solubility Organic solvents: diethyl ether, ethanol

Mammalian & avian toxicity

Acute data

LD_{50} oral rat $>1600 \text{ mg kg}^{-1}$ (1).

LD_{50} intraperitoneal mouse 2190 mg kg^{-1} (2).

Teratogenicity and reproductive effects

Intraperitoneal administration of single doses to mated σ^7 mice produced dose-dependent antifertility and dominant lethal mutagenic effects, as indicated by reduced percentages of pregnancies and increased number of early foetal deaths. Mutagenic effects were reported to occur mainly during postmeiotic stages of spermatogenesis (2).

References

1. Clayton, G. D. et al (Eds.) *Patty's Industrial Hygiene and Toxicology* 3rd ed., 1982, 2, 2330, Interscience Publishers, New York, USA.
2. Singh, A. R. et al *Toxicol. Appl. Pharmacol.* 1975, 32(3), 566

D288 diethylamine



$\text{C}_4\text{H}_{11}\text{N}$

Mol. Wt. 73.14

CAS Registry No. 109-89-7

Synonyms ethanamine, *N*-ethyl-; *N,N*-diethylamine; DEA

EINECS No. 203-716-3

RTECS No. HZ 8750000

Uses Used in the rubber and petroleum industries, in flotation agents, resins, dyestuffs and pharmaceuticals.

Physical properties

M. Pt. -50°C **B. Pt.** 55.5°C **Flash point** $<-28^\circ\text{C}$ **Specific gravity** 0.7074 at 20°C with respect to water at 4°C **Partition coefficient** $\log P_{\text{ow}}$ 0.58 **Volatility** v.p. 400 mmHg at 38°C ; v.den. 2.53

Solubility Water: miscible. Organic solvents: miscible with ethanol

Occupational exposure

DE-MAK 5 ppm (15 mg m⁻³)

FR-VLE 10 ppm (30 mg m⁻³)

JP-OEL 10 ppm (30 mg m⁻³)

SE-LEVL 10 ppm (30 mg m⁻³)

UK-LTEL 10 ppm (30 mg m⁻³)

US-TWA 5 ppm (15 mg m⁻³)

SE-STEEL 15 ppm (45 mg m⁻³)

UK-STEEL 25 ppm (76 mg m⁻³)

US-STEEL 15 ppm (45 mg m⁻³)

UN No. 1154 HAZCHEM Code 2WE Conveyance classification flammable liquid, corrosive

Supply classification highly flammable

Supply classification corrosive

Risk phrases Highly flammable – Harmful by inhalation, in contact with skin and if swallowed – Causes severe burns (R11, R20/21/22, R35)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Keep in a cool place – Keep away from sources of ignition – No smoking – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – Do not empty into drains – Wear suitable protective clothing, gloves and eye/face protection – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S3, S16, S26, S29, S36/37/39, S45)

Ecotoxicity

Invertebrate toxicity

EC₅₀ (15 min) *Photobacterium phosphoreum* 21.6 ppm Microtox test (1).

Environmental fate

Nitrification inhibition

Does not inhibit ammonia oxidation, *Nitrosomonas* sp. at concentrations of 100 mg l⁻¹; threshold concentration 50 mg l⁻¹, no inhibition of nitrifying bacteria (2).

Abiotic removal

Can be removed from manufacturing waste water by use of an oxidising agent followed by UV irradiation (3). Evaporation rate relative to *n*-butyl acetate, which has been assigned a value of 1 at 25°C, is 0.97 (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 540 mg kg⁻¹ (5).

LC₅₀ (4 hr) inhalation rat 4000 ppm (5).

Inhalation mouse, irritation of the respiratory tract occurred after exposure to 78-184 ppm (6).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (7).

Legislation

Maximum permissible concentration in domestic water in the former USSR 2.0 mg l⁻¹ (8).

Included in Schedule 4 (Release into Air: Prescribed Substances) Statutory Instrument No 472, 1991 (9).

Other comments

Environmental pollutant, particularly in air and waste water.

Diethylamine can serve as a precursor both *in vitro* and *in vivo* for the formation of *N*-nitroso compounds in food (10).

Reviews on toxicology and human health effects listed (11).

References

1. Kaiser, K. L. E. *Water Pollut. Res. J. Can.* 1991, **26**(3), 361-431.
2. Richardson, M. *Nitrification Inhibition: the Treatment of Sewage* 1985, The Royal Society of Chemistry, London, Thames Water, Reading, UK.
3. Shmizu, S. et al *Jpn. Kokai Tokkyo Koho* JP63175689 [88,175,689].
4. *Texaco Chemical UK* 1992, 195 Knightsbridge, London, UK.
5. *Arch. Environ. Health* 1960, **1**, 343.
6. Nielsen, G. D. *Chem.-Biol. Interact.* 1989, **71**(2-3), 223-244.
7. Zeiger, E. *Environ. Mol. Mutagen.* 1987, **9**, 1-109.
8. *Russian Toxicological Data for Chemicals in Sources of Drinking Water* 1978, Technical Note No. 20, Central Water Planning Unit, Reading, UK.
9. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
10. Zhukova, G. F. et al *Vopr. Pitan.* 1990, (3), 43-47.
11. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuysse (Bte 6), B-1160 Brussels, Belgium

D289 2-diethylaminoethanol



$\text{C}_6\text{H}_{15}\text{NO}$

Mol. Wt. 117.19

CAS Registry No. 100-37-8

Synonyms ethanol, 2-(diethylamino)-; DEAE; β -(diethylamino)ethyl alcohol; 2-hydroxytriethylamine; *N,N*-diethylethanolamine; Pennad 150

EINECS No. 202-845-2

RTECS No. KK 5075000

Uses Used in the manufacture of pharmaceuticals. Chemical intermediate.

Physical properties

M. Pt. -70°C **B. Pt.** 163°C **Flash point** 48°C (open cup) **Specific gravity** 0.880 at 25°C

Volatility v.p. 1.4 mmHg at 20°C ; v.den. 4.03

Occupational exposure

DE-MAK 5 ppm (24 mg m^{-3})

FR-VME 10 ppm (50 mg m^{-3})

SE-LEVL 2 ppm (10 mg m^{-3})

SE-STEL 10 ppm (50 mg m^{-3})

UK-LTEL 10 ppm (49 mg m^{-3})

US-TWA 2 ppm (9.6 mg m^{-3})

UN No. 2686 **HAZCHEM Code** 2Y **Conveyance classification** flammable liquid

Supply classification irritant

Risk phrases Irritating to eyes, respiratory system and skin (R36/37/38)

Safety phrases Keep out of reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water (S2, S28)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1.3 g kg^{-1} (1).

LD₅₀ dermal guinea pig 884 mg kg^{-1} (1).

Metabolism and toxicokinetics

When administered as the malate to humans, good absorption of 2-diethylaminoethanol observed, with peak plasma levels at 30 min. Within 48 hr, 39% had been excreted in urine (2).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (3).

Legislation

Included in Schedule 4 (Release into Air: Prescribed Substances) Statutory Instrument No 472, 1991 (4).

Other comments

Environmental pollutant.

Can bind to cholinergic, muscarinic receptors (5).

Toxicology and human health effects reviewed (6).

Suitable precautions should be taken to prevent absorption through the skin (7).

References

1. *J. Ind. Hyg. Toxicol.* 1941, **26**, 269.
2. Bismut, F. et al *Sem. Hop.* 1986, **62**(39), 3117-3120 (Fr.) (*Chem. Abstr.* **106**, 95518u).
3. Zeiger, E. *Environ. Mol. Mutagen.* 1987, **9**(9), 1-109.
4. S. I. 1991 No 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
5. Martindale. *The Extra Pharmacopoeia* 30th ed., 1993, The Pharmaceutical Press, London, UK.
6. Aarbakke, J. et al *J. Pharm. Pharmacol.* 1986, **38**(12), 928-930.
7. *ECETOC Technical Report No. 30*(4) 1991, European Chemical Industry Ecology and Toxicology Centre, B-1160 Brussels, Belgium

D290 3-diethylaminopropylamine



C₇H₁₈N₂

Mol. Wt. 130.23

CAS Registry No. 104-78-9

Synonyms *N,N*-diethyl-1,3-propanediamine; *N,N*-diethyl-1,3-diaminopropane; 3-aminopropyldiethylamine

EINECS No. 203-236-4

RTECS No. TX 7350000

Uses Used as a hardening agent in epoxy resins.

Physical properties

B. Pt. 159°C Flash point 58°C Specific gravity 0.8264 Volatility v.den. 4.48

Occupational exposure

UN No. 2684 HAZCHEM Code 2P Conveyance classification corrosive substance

Supply classification corrosive

Risk phrases Flammable – Harmful in contact with skin and if swallowed – Causes burns – May cause sensitisation by skin contact (R10, R21/22, R34, R43)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – Wear suitable protective clothing, gloves and eye/face protection – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S26, S36/37/39, S45)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1410 mg kg⁻¹ (1).

LD₅₀ dermal rabbit 750 mg kg⁻¹ (2).

Irritancy

Dermal rabbit (24 hr) 100 µg caused irritant effects (2).

Dermatitis can occur either by primary irritation or allergic sensitisation. Symptoms of skin contact include skin rash, tenderness and eczema. Exposure to vapours can cause erythema of the face, oedema and pruritus (species unspecified) (3).

Genotoxicity

Salmonella typhimurium TA98, TA100 with and without metabolic activation negative (4).

Other effects

Other adverse effects (human)

Significant cross-reactions to aliphatic polyamines were observed in patients allergic to topical ethylenediamine. Antihistamines given topically or orally failed to inhibit ethylenediamine-induced allergic dermatitis (5).

Other comments

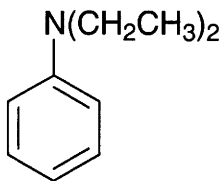
Reviews on experimental toxicology, physico-chemical properties and human health effects listed (6).

Incompatible with acids, acid chlorides, acid anhydrides and strong oxidising materials.

References

1. *Union Carbide Safety Datasheet* 27 Feb 1967, Union Carbide Corporation, New York, USA.
2. *Am. Ind. Hyg. Assoc. J.* 1962, **95**, 23.
3. *Chemical Safety Data Sheets* 1990, **3**, 79-81, The Royal Society of Chemistry, London, UK.
4. Takahashi, A. et al *Chem. Express* 1993, **8**(9), 785-788.
5. Balato, N. et al *Contact Dermatitis* 1986, **15**(5), 263-265.
6. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuyse (Bte 6), B-1160 Brussels, Belgium

D291 *N,N*-diethylaniline



C₁₀H₁₅N

Mol. Wt. 149.24

CAS Registry No. 91-66-7

Synonyms benzenamine, *N,N*-diethyl-; diethylaniline; *N,N*-diethylbenzenamine; *N,N*-diethylaminobenzene; aniline, *N,N*-diethyl-

EINECS No. 202-088-8

RTECS No. BX 3400000

Uses Dyestuff intermediate. Intermediate in organic synthesis.

Physical properties

M. Pt. -38°C **B. Pt.** 215-216°C **Flash point** 97°C **Specific gravity** 0.9302 at 25°C with respect to water at 4°C **Partition coefficient** $\log P_{ow}$ 3.31 **Volatility** v.p. 5.2 mmHg ; v.den. 5.2
Solubility Water: 14.3 g l⁻¹ at 12°C. Organic solvents: chloroform, ethanol

Occupational exposure

UN No. 2432 **HAZCHEM Code** 3X **Conveyance classification** toxic substance

Supply classification toxic, dangerous for the environment

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects – Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R23/24/25, R33, R51/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S28, S37, S45, S61)

Environmental fate

Degradation studies

Confirmed nonbiodegradable (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 782 mg kg⁻¹ (2).

LD₅₀ intraperitoneal rat 420 mg kg⁻¹ (3).

Genotoxicity

Salmonella typhimurium TA100 with metabolic activation weakly positive (4).

In vitro rat hepatocytes, induction of DNA repair negative (5).

Human peripheral blood lymphocytes with and without metabolic activation, sister chromatid exchanges positive (6).

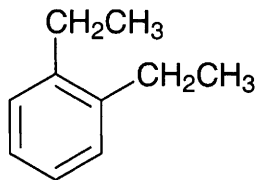
Legislation

Included in Schedule 4 (Release into Air: Prescribed Substances) Statutory Instrument No 472, 1991 (7).

References

1. Ministry of International Trade and Industry (MITI) 1984, Japan.
2. Lenga, R. E. *The Sigma-Aldrich Library of Chemical Data* 2nd ed., 1988, Sigma Aldrich, Milwaukee, WI, USA.
3. *Arch. Gewerbepathol. Gewerbehyg.* 1957, **15**, 447.
4. Shimuzu, H. et al in Orford, R. R. et al (Eds.) *Occupational Health in Chemical Industry* 1983, 497-506, MEDICHEM, Edmonton, AB, Canada.
5. Yoshima, N. et al *Mutat. Res.* 1988, **206**(2), 183-91.
6. Li, Q. et al *Mutat. Res.* 1997, **395**(2,3), 151-157.
7. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D292 1,2-diethylbenzene



C₁₀H₁₄

Mol. Wt. 134.22

CAS Registry No. 135-01-3

Synonyms benzene, 1,2-diethyl-; o-diethylbenzene

EINECS No. 205-170-1

RTECS No. CZ 5640000

Uses Intermediate in chemical synthesis.

Occupational exposure

UN No. 2049 HAZCHEM Code 3  Conveyance classification flammable liquid

Ecotoxicity

Invertebrate toxicity

Toxicity threshold cell multiplication inhibition test, *Pseudomonas putida* >20 mg l⁻¹ (1).

Toxicity threshold cell multiplication inhibition test, green algae >20 mg l⁻¹ (1).

Toxicity threshold cell multiplication inhibition test, *Entosiphon sulcatum* 6.9 mg l⁻¹ (1).

Environmental fate

Degradation studies

The fungus *Mortierella isabellina* converted the compound into 1-phenylethanol by benzylic hydroxylation (2).

Mammalian & avian toxicity

Sub-acute and sub-chronic data

Oral rat (8 wk) 100 mg kg⁻¹ 4 day wk⁻¹ caused neurotoxicity that appeared to be associated with an (unspecified) blue coloured urinary metabolite (3).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537, TA1538 with and without metabolic activation negative (4).

Legislation

Included in Schedule 4 (Release into Air: Prescribed Substances) Statutory Instrument No. 472, 1991 (5).

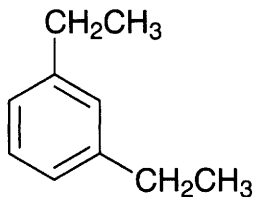
Other comments

Environmental pollutant, particularly in waste gases.

References

1. Bringmann, G. et al *Water Res.* 1980, **14**, 231-241.
2. Holland, H. L. et al *Can. J. Chem.* 1987, **65**(3), 502-507.
3. Gagnaire, F. et al *J. Appl. Toxicol.* 1990, **10**(2), 105-112.
4. Burghardtova, K. et al *Cesk. Hyg.* 1986, **31**(6), 361-365 (Slo.) (*Chem. Abstr.* **106**, 14453u).
5. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations 1991*, HMSO, London, UK

D293 1,3-diethylbenzene



C₁₀H₁₄

Mol. Wt. 134.22

CAS Registry No. 141-93-5

Synonyms benzene, 1,3-diethyl-; *m*-ethylethylbenzene; *m*-diethylbenzene

EINECS No. 205-511-4

RTECS No. CZ 5620000

Physical properties

M. Pt. -84°C B. Pt. 180-181°C Flash point 56°C Specific gravity 0.86 at 20°C with respect to water at 4°C
Volatility v.den. 4.6

Occupational exposure

UN No. 2049 HAZCHEM Code 3  Conveyance classification flammable liquid

Environmental fate

Degradation studies

The fungus *Mortierella isabellina* converted the compound into 1-phenylethanol by benzylic hydroxylation (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 5 g kg⁻¹ (2).

Sub-acute and sub-chronic data

♂ rats receiving ≤500 mg kg⁻¹ orally, 4 day wk⁻¹ for 8 wk developed no neurotoxicological effects (3).

Legislation

Included in Schedule 4 (Release into Air: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

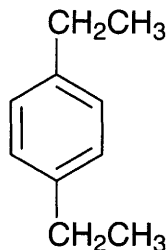
Other comments

Photooxidation increased toxicity to *Phaeodactylum tricornutum* (5,6).

References

1. Holland, H. L. et al *Can. J. Chem.* 1987, **65**(3), 502.
2. Gerarde, H. (Ed.) *Toxicity and Biochemistry of Aromatic Hydrocarbons* 1960, Elsevier, New York, USA.
3. Gagnaire, F. et al *J. Appl. Toxicol.* 1990, **10**(2), 105-112.
4. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
5. Ducreux, J. et al *Sci. Eau* 1987, **6**(2), 179-194 (Fr.) (*Chem. Abstr.* **107**, 213098c).
6. Lacaze, J. C. et al *Sci. Eau* 1987, **6**(4), 415-433 (Fr.) (*Chem. Abstr.* **108**, 33175n).

D294 1,4-diethylbenzene



C₁₀H₁₄

Mol. Wt. 134.22

CAS Registry No. 105-05-5

Synonyms benzene, 1,4-diethyl-; *p*-xylene, α,α' -dimethyl-; benzene, *p*-diethyl-; *p*-ethylethylbenzene; *p*-diethylbenzene

EINECS No. 203-265-2

Physical properties

M. Pt. -35°C B. Pt. 183.7°C Specific gravity 0.862 at 20°C

Occupational exposure

UN No. 2049 HAZCHEM Code 3  Conveyance classification flammable liquid

Mammalian & avian toxicity

Sub-acute and sub-chronic data

Oral ♂ rats (8 wk) ≤ 500 mg kg⁻¹ 4 day wk⁻¹ caused no neurotoxicological effects (1).

Legislation

Included in Schedule 4 (Release into Air: Prescribed Substances) Statutory Instrument No. 472, 1991 (2).

Other comments

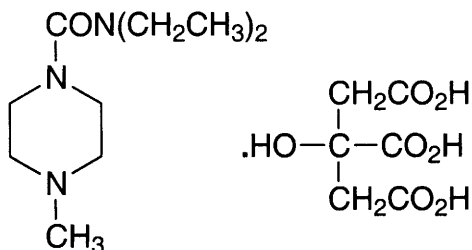
Pollutant in wastewater and drinking water.

Photooxidation increased toxicity to *Phaeodactylum tricornutum* (3,4).

References

1. Gagnaire, F. et al *J. Appl. Toxicol.* 1990, **10**(2), 105-112.
2. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
3. Ducreux, J. et al *Sci. Eau* 1987, **6**(2), 179-194 (Fr.) (*Chem. Abstr.* **107**, 213098c).
4. Lacaze, J. C. et al *Sci. Eau* 1987, **6**(4), 415-433 (Fr.) (*Chem. Abstr.* **108**, 33175n)

D295 diethylcarbamazine citrate



$C_{16}H_{29}N_3O_8$

Mol. Wt. 391.42

CAS Registry No. 1642-54-2

Synonyms 1-piperazinecarboxamide, *N,N*-diethyl-4-methyl-, 2-hydroxy-1,2,3-propanetricarboxylate (1:1); Banocide; Ditrazine; Franocide; Caricide; Franozan; Diroicide

EINECS No. 216-696-6

RTECS No. TL 1225000

Uses Anthelmintic in human medicine for oral or topical use, particularly for ascaris and microfilariae.

Physical properties

M. Pt. 141-143°C

Solubility Organic solvents: ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1.4 g kg⁻¹ (1).

Teratogenicity and reproductive effects

Toxicity reported in rats receiving 1.8 g kg⁻¹ orally during days 8-16 of gestation (2).

Metabolism and toxicokinetics

Following oral administration of 200 mg to human volunteers, plasma levels rose rapidly reaching maximum concentrations 1-2 hr later. Increasing the dose to 400 or 800 mg led to a nonlinear increase in plasma levels. Once a maximum maintenance dose had been reached, the plasma levels remained constant, showing no accumulation on prolonged dosing (3).

Can penetrate the skin (4).

Sensitisation

Hypersensitivity has occasionally been reported, but the basis of the effect is not yet clear (5).

Allergic reactions often seen after death of parasites (4).

Other effects

Other adverse effects (human)

Proteinuria has been reported as an occasional side-effect in humans (6).

Other comments

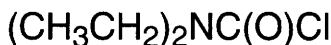
A variety of pharmacological effects have been reported, including an anti-inflammatory action (7).

References

1. *Arzneim.-Forsch.* 1973, **17**, 108.
2. *Indian J. Med. Res.* 1972, **60**, 1529.
3. Ree, G. H. et al *Trans. R. Soc. Trop. Med. Hyg.* 1977, **71**(6), 542-543.

4. *Martindale: The Extra Pharmacopoeia* 31st ed., 1996, The Royal Pharmaceutical Society, London, UK.
5. Ayala, L. E. J. *Pharm. Pharmacol.* 1988, **40**(3), 188-191.
6. Green, B. M. et al *Lancet* 1980, **1**, 254.
7. Zhu, L. et al *Zhongguo Yaoli Xuebao* 1989, **10**(1), 81-4 (Ch.) (*Chem. Abstr.* **110**, 88212u)

D296 diethylcarbamoyl chloride



$\text{C}_5\text{H}_{10}\text{ClNO}$

Mol. Wt. 135.59

CAS Registry No. 88-10-8

Synonyms carbamic chloride, diethyl-; *N,N*-diethylcarbamoyl chloride; carbamoyl chloride, diethyl-

EINECS No. 201-798-5

RTECS No. FD 4025000

Physical properties

M. Pt. -32°C B. Pt. $190-195^\circ\text{C}$ Flash point 75°C Specific gravity 1.070

Occupational exposure

Supply classification harmful

Risk phrases Harmful by inhalation and if swallowed – Irritating to eyes, respiratory system and skin – Possible risk of irreversible effects (R20/22, R36/37/38, R40)

Safety phrases Keep out of reach of children (if sold to general public) – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – Wear suitable protective clothing and gloves (S2, S26, S36/37)

Mammalian & avian toxicity

Acute data

LD_{50} intraperitoneal mouse 750 mg kg^{-1} (1).

Carcinogenicity and chronic effects

Dermal mouse (72 wk) total dose 43 g kg^{-1} induced marginally significant incidences of papillomas and carcinomas when tested as initiator (2).

Legislation

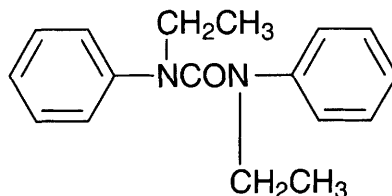
Included in Schedule 4 (Release into Air: Prescribed Substances) Statutory Instrument No. 472, 1991 (3).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Chlorides: guide level 25 mg l^{-1} (4).

References

1. *NTIS Report* AD 691-490, Natl. Tech. Inf. Ser., Springfield, VA, USA.
2. *J. Am. Coll. Toxicol.* 1987, **6**(4), 479.
3. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
4. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg

D297 *N,N'*-diethylcarbanilide



C₁₇H₂₀N₂O

Mol. Wt. 268.36

CAS Registry No. 85-98-3

Synonyms urea, *N,N'*-diethyl-*N,N'*-diphenyl-; ethyl centralite; carbanilide, *N,N'*-diethyl-; Carbamite; Centralite

EINECS No. 201-645-2

RTECS No. FE 0350000

Uses Used in gunpowder as a propellant. Stabiliser in rocket fuels.

Physical properties

M. Pt. 79°C B. Pt. 326°C Flash point 150°C

Mammalian & avian toxicity

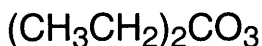
Acute data

LD₅₀ intraperitoneal mouse 200 mg kg⁻¹ (1).

References

1. NTIS Report AD 277-689, Natl. Tech. Inf. Ser., Springfield, VA, USA

D298 diethyl carbonate



C₅H₁₀O₃

Mol. Wt. 118.13

CAS Registry No. 105-58-8

Synonyms carbonic acid, diethyl ester; diatol; ethyl carbonate

EINECS No. 203-311-1

RTECS No. FF 9800000

Uses Catalyst. Solvent.

Physical properties

M. Pt. -43°C B. Pt. 126-128°C Flash point 31°C Specific gravity 0.9754 at 20°C with respect to water at 4°C Partition coefficient log P_{ow} 1.21 Volatility v.p. 10 mmHg at 23.8°C ; v.den. 4.1
Solubility Organic solvents: ethanol, diethyl ether

Occupational exposure

UN No. 2366 HAZCHEM Code 3Y Conveyance classification flammable liquid

Mammalian & avian toxicity

Acute data

LD₅₀ subcutaneous rat 8500 mg kg⁻¹ (1).

Carcinogenicity and chronic effects

Dermal mouse (210 day) 290 mg 10 × wk⁻¹ did not cause a significant increase in the occurrence of papillomas (2).
Oral rat (38 wk) 0, 50, 250 or 1000 mg l⁻¹ in drinking water (0-140 mg kg⁻¹ day⁻¹). The study reported no effect on mortality, body weight gain or incidence of histopathological findings, including tumours (3).

Teratogenicity and reproductive effects

Lowest toxic dose, teratogenic effects, intraperitoneal hamster (8 day) 496 mg kg⁻¹ (4).

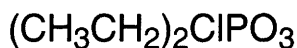
Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (5).

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D299 diethyl chlorophosphate



C₄H₁₀ClO₃P

Mol. Wt. 172.55

CAS Registry No. 814-49-3

Synonyms diethyl chlorophosphonate; phosphorochloridic acid, diethyl ester; chlorodiethoxyphosphine oxide; diethoxyphosphorus oxychloride; O,O-diethyl chloridophosphate; diethylphosphoric acid chloride; diethyl phosphorochloride

EINECS No. 212-396-4

RTECS No. TD 1400000

Physical properties

B. Pt. 60°C at 2 mmHg **Flash point** 61°C **Specific gravity** 1.194 at 20°C **Volatility** v.den. 5.94
Solubility Organic solvents: ethanol, methanol

Occupational exposure

UN No. 3278

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 11 mg kg⁻¹ (1).

LD₅₀ dermal rabbit 7.9 mg kg⁻¹ (1).

Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation (2).

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2. Marhold, J. V. *Prehled Prumyslove Toxikologie: Organické Latky* 1986, 1142, Prague, Czechoslovakia

D300 diethyl chlorothiophosphate



$\text{C}_4\text{H}_{10}\text{ClO}_2\text{PS}$

Mol. Wt. 188.61

CAS Registry No. 2524-04-1

Synonyms diethyl thiophosphoryl chloride; phosphorochloridothioic acid, *O,O*-diethyl ester; *O,O*-diethyl chlorothiophosphate; *O,O*-diethyl thiophosphorochloridate; diethyl phosphorothionochloridate

EINECS No. 219-755-4

RTECS No. TD 1780000

Uses Chemical intermediate in pesticide manufacture.

Physical properties

B. Pt. 45°C at 3 mmHg Flash point >110°C Specific gravity 1.200 at 20°C

Occupational exposure

UN No. 2751 Conveyance classification corrosive substance

Mammalian & avian toxicity

Acute data

LD_{Lo} (4 hr) inhalation rat 20 ppm (1).

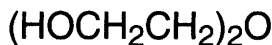
Legislation

Included in Schedule 4 (Release into Air: Prescribed Substances) Statutory Instrument No. 472, 1991 (2).

References

1. Marhold, J. V. *Sbornik Vysledku Toxikologickeho Vysetreni Latek A Pripravku* 1972, Prague, Czechoslovakia.
2. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D301 diethylene glycol



$\text{C}_4\text{H}_{10}\text{O}_3$

Mol. Wt. 106.12

CAS Registry No. 111-46-6

Synonyms ethanol, 2,2'-oxybis-; bis(2-hydroxyethyl) ether; 2,2'-oxydiethanol; DEG; Dioxitol

EINECS No. 203-872-2

RTECS No. ID 5950000

Uses Used in antifreeze solutions. Lubricant and finishing agent for wool and other fabrics. Solvent for dyestuffs. Used in composition corks, glues. Pharmaceuticals and toiletries.

Physical properties

M. Pt. -10°C **B. Pt.** 244-245°C **Flash point** 143°C (open cup) **Specific gravity** 1.118 at 20°C with respect to water at 20°C **Volatility** v.p. 1 mmHg at 91.8°C ; v.den. 3.66
Solubility Water: miscible. Organic solvents: miscible with acetone, diethyl ether, ethanol

Occupational exposure

DE-MAK 10 ppm (44 mg m⁻³)
SE-LEVL 10 ppm (45 mg m⁻³) **SE-STEL** 20 ppm (90 mg m⁻³)
UK-LTEL 23 ppm (101 mg m⁻³)

Ecotoxicity

Invertebrate toxicity

EC₅₀ (15 min) *Photobacterium phosphoreum* 29,228 ppm Microtox test (1).

Environmental fate

Degradation studies

Oxidising bacteria *Alcaligenes* sp., *Achromobacter* sp. and *Mycobacterium* sp. can completely degrade diethylene glycol. *Alcaligenes paradoxus* was the most effective (2).
Biodegradable (3).

Abiotic removal

Evaporation rate relative to *n*-butyl acetate, which has been assigned a value of 1 at 25°C, is <0.01 (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 20.7 g kg⁻¹ (5).

LD₅₀ oral dog 9 g kg⁻¹ (6).

LD₅₀ oral guinea pig 7.8 g kg⁻¹ (7).

Carcinogenicity and chronic effects

Oral mice receiving 3-30 mg mouse⁻¹ wk⁻¹ for 100 wk showed no evidence of systemic or local tumours (8).

Mice receiving 1-10% in drinking water for ≤6 months developed dose-dependent liver damage, as indicated by changes in nuclei and presence of fatty deposits (9).

Rats receiving diethylene glycol in diet for a total of 6 wk did not develop additional putative preneoplastic hepatocellular foci nor show hepatocellular or biliary toxicity in a tumour promotion test with *N*-nitroso-diethylamine as initiator (10).

Teratogenicity and reproductive effects

Oral mice (6-13 days gestation) 11.2 mg kg⁻¹ day⁻¹ showed no evidence of developmental toxicity. There were slight effects on viability (11).

Mice as breeding pairs receiving 0.25-2.5% for 14 wk showed effects up to and including 5th litter. Reduction in number of litters per pair, live pups per litter, live births and birth weight occurred (12).

Metabolism and toxicokinetics

Oral rats, guinea pigs (dose unspecified) resulted in maximum blood concentrations at 1 hr, after which time concentrations declined. 55% of dose was eliminated in urine, but the compound was detected in bile and milk. Also shown to be absorbed through skin (13).

Major metabolite in rat is (2-hydroxyethoxy)acetic acid. The ether linkage is not degraded. Metabolism can be inhibited by ethanol or aldehyde dehydrogenase inhibitors (14).

Metabolism and urinary elimination are dose-dependent in rats (15).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (16,17).
Escherichia coli PQ37 with and without metabolic activation SOS chromotest negative (16).
In vitro Chinese hamster cells, chromosome aberrations negative (18).

Other effects

Other adverse effects (human)

Doses of 60-70 ml administered to humans for several wk have been found to be fatal, post-mortem features were the same for rats, rabbits and dogs receiving comparable doses (19).

Legislation

Maximum permissible concentration in domestic water in former USSR 1.0 mg l⁻¹ (20).
Included in Schedule 4 (Release into Air: Prescribed Substances) Statutory Instrument No. 472, 1991 (21).

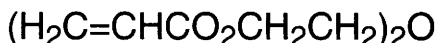
Other comments

Contaminant in food and beverages. Environmental pollutant.
Metabolism, toxicity and treatment of poisoning reviewed (22).
Reviews on toxicology and human health effects listed (23).
Daphnia magna immobilisation tests studied for the potential toxic action of water pollutants (24).

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D302 diethylene glycol diacrylate



$C_{10}H_{14}O_5$

Mol. Wt. 214.22

CAS Registry No. 4074-88-8

Synonyms 2,2'-oxydiethyl diacrylate; acrylic acid, oxydiethylene ester; oxydiethylene diacrylate

EINECS No. 223-791-6

RTECS No. AS 9450000

Uses Cross-linking agent.

Physical properties

B. Pt. 200°C **Specific gravity** 1.1110 at 25°C

Occupational exposure

Supply classification toxic

Risk phrases Toxic in contact with skin – Irritating to eyes and skin – May cause sensitisation by skin contact (R24, R36/38, R43)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear eye/face protection – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S39, S45)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 400 mg kg⁻¹ (1).

LD₅₀ dermal rabbit 180 mg kg⁻¹ (2).

Irritancy

Dermal rabbit 500 mg caused severe irritation and 100 mg instilled into rabbit eye caused severe irritation (periods of exposure unspecified) (3).

Sensitisation

Skin sensitisation has been reported in the guinea pig maximisation test (4).

Other tests have proved negative (3,5).

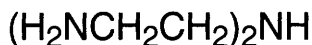
Other comments

Physical data, toxicity and health hazards reviewed (6).

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D303 diethylenetriamine



$C_4H_{13}N_3$

Mol. Wt. 103.17

CAS Registry No. 111-40-0

Synonyms *N*-(2-aminoethyl)ethane-1,2-diamine; bis(2-aminoethyl)amine; 2,2'-diaminodiethylamine; 3-azapentane-1,5-diamine; 2,2'-iminodiethylamine

EINECS No. 203-865-4

RTECS No. IE 1225000

Uses Catalyst. Intermediate in chemical synthesis. Chelating agent. Corrosion inhibitor. Preparation of colestipol anion exchange resin. Solvent.

Physical properties

M. Pt. -35°C **B. Pt.** 199-209°C **Flash point** 94°C **Specific gravity** 0.9586 at 20°C with respect to water at 20°C **Volatility** v.p. 22 mmHg at 20°C; v.den. 3.48
Solubility Water: 2.1 mg l⁻¹ at 20°C. Organic solvents: ethanol, hydrocarbons, petroleum ether

Occupational exposure

FR-VME 1 ppm (4 mg m⁻³)

SE-LEVL 1 ppm (4.5 mg m⁻³)

SE-STEL 2 ppm (10 mg m⁻³)

UK-LTEL 1 ppm (4.3 mg m⁻³)

US-TWA 1 ppm (4.2 mg m⁻³)

UN No. 2079 **HAZCHEM Code** 2X **Conveyance classification** corrosive substance

Supply classification corrosive

Risk phrases Harmful in contact with skin and if swallowed – Causes burns – May cause sensitisation by skin contact (R21/22, R34, R43)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – Wear suitable protective clothing, gloves and eye/face protection – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S26, S36/37/39, S45)

Ecotoxicity

Invertebrate toxicity

EC₅₀ (24 hr) *Daphnia magna* 330 mg l⁻¹ (1).

Environmental fate

Degradation studies

BOD 0% of ThOD when incubated with sewage for 20 days. However, the BOD increased to 70% of ThOD with an inoculum composed of treated petrochemical effluent, sewage or soil which had been acclimated for 45-60 days (2).

Abiotic removal

Evaporation rate relative to *n*-butyl acetate, which has been assigned a value of 1 at 25°C, is 0.005 (3).

Adsorption capacity for activated carbon 0.062 g g⁻¹. For waste water containing 1000 mg l⁻¹ activated carbon treatment effected a 29.4% reduction (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1080-1400 mg kg⁻¹ (5,6).

LD₅₀ dermal rabbit 1090 mg kg⁻¹ (7).

LD₅₀ dermal guinea pig 162 mg kg⁻¹ (8).

LD₅₀ intraperitoneal mouse, rat 71-74 mg kg⁻¹ (5).

Sub-acute and sub-chronic data

Oral Fischer 344 rats (90 days) 1000, 7500, 15,000 ppm (in diet). Decreases in food consumption were observed throughout the dose period at 15,000 ppm. Dose-related decreases in body weight were seen at 7500 and 15,000 ppm, along with increased mean corpuscular volumes in ♂s and ♀s and increases in total leukocytes and urinary pH in ♀s. In ♀s the kidney, brain and liver weights increased at 7500 ppm and 15,000 ppm and the relative heart and adrenal weights were elevated at 15,000 ppm (9).

Carcinogenicity and chronic effects

Dermal mouse 25 µl aliquots of 5% aqueous solution 3 × wk⁻¹ until death of the animals. No treatment-related skin tumours were observed, nor was there evidence of increased incidence of any internal tumour. Mean survival time was 587 days, which was not significantly different from that of controls (10).

Metabolism and toxicokinetics

Following oral administration of ¹⁴C-diethylenetriamine to rats, 40% of the dose was excreted in faeces and 31% in the urine within 48 hr; < 2% was eliminated as carbon dioxide (11).

Oral or endotracheal ♂Fisher 344 rats 50 or 500 mg kg⁻¹ as the trihydrochloride. Dose was readily absorbed from gut or lung, with bioavailabilities of 95% and 90%, respectively. Excretion was rapid and mainly via the faeces and urine; > 96% of the dose was eliminated within 48 hr. The compound did not appear to be extensively metabolised and there was no evidence that conversion into ethylenediamine or the acid conjugates occurred. An intravenously administered dose of 50 mg kg⁻¹ resulted in an apparent volume of distribution of 486 ml kg⁻¹ consistent with distribution in the total body water (12).

Irritancy

Dermal rabbit (24 hr) 10 mg caused severe irritation and 750 µg instilled into rabbit eye caused severe irritation (period of exposure unspecified) (7).

Sensitisation

Sensitisation was demonstrated in patch tests on patients allergic to drilling muds (13).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (14,15).

Saccharomyces cerevisiae D4 with and without metabolic activation negative (15).

In vitro Chinese hamster ovary cells induction of mutation with and without metabolic activation negative (16).

In vitro Chinese hamster ovary cells, sister chromatid exchanges positive (16).

In vitro primary rat hepatocytes, DNA repair assay negative (16).

Other effects

Other adverse effects (human)

Ingestion may lead to burns of the digestive tract, nausea, vomiting and abdominal pain (17).

Any other adverse effects

Doses at or above LD₅₀ values are reported to produce severe lung haemorrhage, mottled livers and kidneys and irritation of the stomach and intestine (species unspecified) (18).

Inhalation rat, 300 ppm caused no adverse effects (period of exposure unspecified) (19).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (20).

Other comments

Experimental toxicology and human health effects reviewed (21).

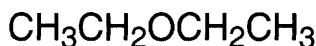
Solubility parameter $SP_o=12.6$. SP_o is calculated by taking the square root of the sum of the squares of the Hansen solubility parameters SP_d , SP_p and SP_h ($\text{cal}^{1/2}\text{cm}^{-3/2}$) (3).

Physical properties, toxicity and health hazards reviewed (18).

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D304 diethyl ether



$\text{C}_4\text{H}_{10}\text{O}$

Mol. Wt. 74.12

CAS Registry No. 60-29-7

Synonyms 1,1'-oxybis[ethane]; anaesthetic ether; ethyl ether; ethoxyethane; 3-oxapentane

EINECS No. 200-467-2

RTECS No. KI 5775000

Uses Anaesthetic. Solvent. Primer for gasoline engines.

Physical properties

M. Pt. -116.2°C B. Pt. 34.6°C Flash point -45°C Specific gravity 0.7135 at 20°C with respect to water at 4°C Partition coefficient $\log P_{ow}$ 0.89 Volatility v.p. 442 mmHg at 20°C ; v.den. 2.56
Solubility Water: 8.43% at 15°C . Organic solvents: benzene, chloroform

Occupational exposure

DE-MAK 400 ppm (1200 mg m^{-3})

FR-VME 400 ppm (1200 mg m^{-3})

FR-VLE 500 ppm (1500 mg m^{-3})

JP-OEL 400 ppm (1200 mg m^{-3})

SE-LEVL 300 ppm (900 mg m⁻³)

UK-LTEL 400 ppm (1230 mg m⁻³)

US-TWA 400 ppm (1210 mg m⁻³)

SE-STEL 400 ppm (1200 mg m⁻³)

UK-STEL 500 ppm (1540 mg m⁻³)

US-STEL 500 ppm (1520 mg m⁻³)

UN No. 1155 HAZCHEM Code 3YE Conveyance classification flammable liquid

Supply classification extremely flammable

Risk phrases Extremely flammable – May form explosive peroxides (R12, R19)

Safety phrases Keep out of reach of children (if sold to general public) – Keep container in a well ventilated place

– Keep away from sources of ignition – No smoking – Do not empty into drains – Take precautionary measures against static discharges (S2, S9, S16, S29, S33)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 2600 mg l⁻¹ flow-through bioassay (1).

LC₅₀ (14 day) guppy 2140 mg l⁻¹ (2).

LC₅₀ (48 hr) golden orfe 2800 mg l⁻¹ static bioassay (3).

Invertebrate toxicity

EC₅₀ (15 min) *Photobacterium phosphoreum* 5625 ppm Microtox test (4).

Bioaccumulation

Calculated bioconcentration factor 2.8 indicated that environmental accumulation is unlikely (5).

Environmental fate

Carbonaceous inhibition

LC₅₀ (5 day) aerobic heterotrophic bacteria isolated from activated sludge 17,000 mg l⁻¹ (1).

Degradation studies

Oxidised to acetic acid by thermophilic methane oxidising bacterium H-2 (type I) (6).

Abiotic removal

Volatilisation from model river water, t_{1/2} (calc.) ~3 hr at 25°C and 36 hr from pond water (5,7).

Reaction with photochemically produced hydroxyl radicals in the atmosphere, t_{1/2} (calc.) 29 hr (8).

Adsorption and retention

Estimated K_{oc} 73 indicated that adsorption to soil and sediments is unlikely (5).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1213 mg kg⁻¹ (9).

LC₅₀ (2 hr) inhalation rat 73,000 ppm (10).

LD₅₀ intraperitoneal mouse 2420 mg kg⁻¹ (11).

LD₅₀ intravenous mouse 996 mg kg⁻¹ (12).

Teratogenicity and reproductive effects

In rats, ethyl ether administered between 13.5-15.3 days gestation did not cause cleft palate in foetuses, but the compound did cross the placental barrier as indicated by flaccid, limp, apnoeic and unresponsive foetuses (13).

Metabolism and toxicokinetics

Metabolised by rat hepatic microsomal monooxygenase to acetaldehyde (14).

Irritancy

Dermal guinea pig (24 hr) 50 mg caused severe irritation (15).

100 mg instilled into rabbit eye caused moderate irritation (duration unspecified) (16).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537, TA1538 with and without metabolic activation marginally positive (17).

Drosophila melanogaster induction of bithorax phenocopies pro- to mesothoracic leg transformations, abdominal anomalies, development of 7th tergite in ♂, and other developmental abnormalities were observed (18).

In vitro Chinese hamster ovary cells sister chromatid exchanges, with metabolic activation, negative (19).

Other effects

Other adverse effects (human)

A slight increase in miscarriage rate has been reported in women exposed to solvents including ethyl ether (20).

Legislation

Organic solvents are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (21).

Other comments

Physical properties and toxicity reviewed (22,23).

Reviews on toxicity listed (24).

Autoignition temperature 160°C.

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D305 *N,N*-diethylethylenediamine



$\text{C}_6\text{H}_{16}\text{N}_2$

Mol. Wt. 116.21

CAS Registry No. 100-36-7

Synonyms *N,N*-diethyl-1,2-ethanediamine; *N*-(2-diethylaminoethyl)amine; 2-(diethylamino)ethylamine

EINECS No. 202-844-7

RTECS No. KV 3500000

Uses Catalyst. Solvent.

Physical properties

B. Pt. 145-147°C; 60°C at 40 mmHg **Flash point** 30°C **Specific gravity** 0.8280 at 20°C with respect to water at 20°C **Volatility** v.den. 4.00

Solubility Water: miscible. Organic solvents: carbon tetrachloride, diethyl ether, ethanol, toluene

Occupational exposure

UN No. 2685 **HAZCHEM Code** 2W **Conveyance classification** corrosive substance, danger of fire (flammable liquid)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 2830 mg kg⁻¹ (1).

LD₅₀ dermal rabbit 820 mg kg⁻¹ (1).

LD₅₀ intraperitoneal mouse 300 mg kg⁻¹ (2).

Irritancy

Dermal rabbit (24 hr) 10 mg caused irritation and 50 µg instilled into rabbit eye (period of exposure unspecified) caused severe irritation (1).

References

1. Smyth, H. F. et al *AMA Arch. Ind. Hyg. Occup. Med.* 1954, **10**, 61.
2. *NTIS 40277-689* Natl. Tech. Inf. Ser., Springfield, VA, USA

D306 1,2-diethylhydrazine



$\text{C}_4\text{H}_{12}\text{N}_2$

Mol. Wt. 88.15

CAS Registry No. 1615-80-1

Synonyms *N,N'*-diethylhydrazine; *sym*-diethylhydrazine; hydrozoethane; hydroazoethen

EINECS No. 216-567-4

RTECS No. MV 2275000

Uses Photographic developer. Intermediate in chemical synthesis.

Physical properties

B. Pt. 86°C **Specific gravity** 0.797 at 26°C

Solubility Water: miscible. Organic solvents: acetone, benzene, diethyl ether, ethanol

Mammalian & avian toxicity

Carcinogenicity and chronic effects

No adequate data for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (1).

Subcutaneous rat (30 wk) 25, 50 or 100 mg kg⁻¹ 1× wk⁻¹ induced tumours of the brain, olfactory bulbs, mammary glands and liver in 43/45 rats. The average latent period ranged from 250 days for the lowest dose to 215 days for the highest dose (2,3).

Pre-natal rat, intravenous administration of 50 or 150 mg kg⁻¹ on day-15 of gestation. The death of offspring occurred between 125-500 days *post partum* with tumours of the brain, spinal cord and peripheral nervous system (3-5).

Teratogenicity and reproductive effects

Lowest toxic dose of 50 mg kg⁻¹ administered on day-15 of gestation caused teratogenic effects (6).

Other comments

Metabolite of furzalidine.

Physical properties, use, analysis and carcinogenicity of 1,2-diethylhydrazine reviewed (3).

References

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2. Druckrey, H. et al *Naturwissenschaften* 1966, **53**, 557.
3. IARC Monograph 1974, **4**, 153-157.
4. Druckrey, H. *Experientia* 1968, **24**, 561.
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6. *Food Cosmet. Toxicol.* 1968, **6**, 584

D307 diethyl ketone



C₅H₁₀O

Mol. Wt. 86.13

CAS Registry No. 96-22-0

Synonyms pentan-3-one; 3-pentanone; dimethylacetone; ethyl ketone

EINECS No. 202-490-3

RTECS No. SA 8050000

Uses Catalyst. Solvent.

Occurrence Identified as a flavour component in the shrimp and occurs in a number of soft woods and other plants (1,2).

Physical properties

M. Pt. -40°C **B. Pt.** 102°C **Flash point** 6°C **Specific gravity** 0.8138 at 20°C with respect to water at 4°C

Partition coefficient log P_{ow} 0.82 **Volatility** v.p. 35.43 mmHg at 25°C ; v.den. 3.0

Solubility Water: ~40 g l⁻¹. Organic solvents: acetone, diethyl ether, ethanol

Occupational exposure

FR-VME 200 ppm (705 mg m⁻³)

UK-LTEL 200 ppm (716 mg m⁻³)

US-TWA 200 ppm

UK-STEL 250 ppm (895 mg m⁻³)

US-STEL 300 ppm

UN No. 1156 HAZCHEM Code 3/E Conveyance classification flammable liquid

Supply classification highly flammable

Risk phrases Highly flammable (R11)

Safety phrases Keep out of reach of children (if sold to general public) – Keep container in a well ventilated place – Keep away from sources of ignition – No smoking – Take precautionary measures against static discharges (S2, S9, S16, S33)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 1540 mg l⁻¹ (3).

LC₅₀ (24 hr) goldfish 1200 mg l⁻¹ (4).

Invertebrate toxicity

EC₅₀ (5 min) *Photobacterium phosphoreum* 842 ppm Microtox test (5).

Bioaccumulation

The calculated bioconcentration factor of 3.31 indicates that environmental pollution is unlikely (6).

Environmental fate

Degradation studies

BOD₂₀ 12.3%; ThOD, 2.5 mg O₂ l⁻¹ (7).

66% of ThOD removed by acclimated cultures after 5 days (8).

Abiotic removal

t_{1/2} for volatilisation in model river water ~13 hr (9).

Reacts with photochemically produced hydroxyl radicals in the atmosphere t_{1/2} ~6 days (10).

Evaporation rate relative to *n*-butyl acetate, which has been assigned a value of 1 at 25°C, is 2.30 (11).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 2.1 g kg⁻¹ (11).

LC_{Lo} (4 hr) inhalation rat 8000 ppm (12).

LD₅₀ dermal rabbit 20 g kg⁻¹ (12).

LD₅₀ intravenous mouse 513 mg kg⁻¹ (13).

Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation and 100 mg instilled into rabbit eye (24 hr) caused moderate irritation (14).

Genotoxicity

Saccharomyces cerevisiae D61M induction of aneuploidy positive (15).

Other comments

Reviews on experimental toxicology and human health effects listed (16).

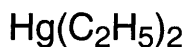
Autoignition temperature 445°C.

References

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2. Isadonov, V. A. et al *Atmos. Environ.* 1985, 19, 1-8.
3. Brook, L. T. et al *Acute Toxicities of Organic Chemicals to Fathead Minnows* 1984, 123, Centre of Lake Superior Environmental Studies, University of Wisconsin, Superior, WI, USA.
4. Lipnick, R. L. et al *Xenobiotica* 1987, 17(8), 1011-1025.
5. Kaiser, K. L. E. et al *Water Pollut. Res. J. Can.* 1991, 26(3), 361-431.

6. Lyman, W. J. et al *Handbook of Chemical Estimation Methods* 1982, McGraw-Hill, New York, USA.
7. Ettinger, M. B. *Ind. Eng. Chem.* 1956, **48**, 256-259.
8. Bridie, A. L. et al *Water Res.* 1979, **13**, 627-630.
9. *Hawley's Condensed Chemical Dictionary* 11th ed., 1987, 394, Van Nostrand Reinhold, New York, USA.
10. Cox, R. A. et al *Environ. Sci. Technol.* 1981, **15**, 587-592.
11. *Texaco Chemical UK* 1992, 195 Knightsbridge, London, UK.
12. Smyth, H. F. et al *Arch. Ind. Hyg. Occup. Med.* 1954, **10**, 61.
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14. Marhold, J. V. *Prehled Prumyslove Toxikologie: Organické Latky* 1986, 282, Prague, Czechoslovakia.
15. Zimmerman, R. A. et al *Mutat. Res.* 1985, **149**(3), 339-351.
16. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuyse (Bte 6), B-1160 Brussels, Belgium

D308 diethylmercury



$\text{C}_4\text{H}_{10}\text{Hg}$

Mol. Wt. 258.71

CAS Registry No. 627-44-1

Synonyms ethylmercury

EINECS No. 211-000-7

RTECS No. OW 2350000

Physical properties

B. Pt. 159°C Specific gravity 2.4660 at 20°C

Occupational exposure

DE-MAK 0.01 mg m⁻³ (as Hg) (total dust)

FR-VME 0.01 mg m⁻³ (as Hg)

SE-LEVL 0.01 mg m⁻³ (as Hg)

UK-LTEL 0.01 mg m⁻³ (as Hg)

UK-STEL 0.03 mg m⁻³ (as Hg)

US-TWA 0.01 mg m⁻³ (as Hg)

US-STEL 0.03 mg m⁻³ (as Hg)

UN No. 2024 (liquid); 2025 (solid) Conveyance classification toxic substance

Supply classification very toxic

Risk phrases Very toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects (R26/27/28, R33)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S13, S28, S36, S45)

Ecotoxicity

Invertebrate toxicity

Significantly reduced emergence and hatching of the brine shrimp *Artemia franciscana* at 2.59 mg l⁻¹, the lowest concentration tested (1).

Environmental fate

Degradation studies

Threshold concentration in water reservoirs (in former USSR) BOD 5 µg l⁻¹ (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 44, 51 mg kg⁻¹, respectively (3).

LC₅₀ (duration unspecified) inhalation mouse, rat 90, 260 mg m⁻³, respectively (4).

LD₅₀ intraperitoneal mouse 45 mg kg⁻¹ (5).

Teratogenicity and reproductive effects

Continuous exposure to the vapour at 6.43 µg mg⁻³ for 115 days caused reduced sperm count and motility in ♂ rats. In ♀ rats 5.92 µg mg⁻³ prolonged oestrus and reduced conception rate. Rats born to exposed parents had reduced life-span, reduced development, and morphofunctional and biochemical gonad changes (6).

Other effects

Other adverse effects (human)

Two fatal cases of poisoning occurred in two women stenographers working in a warehouse in which diethyl mercury was stored (7).

In persons occupationally exposed, the circulation of mercury and urinary clearance was observed for weeks and sometimes months after exposure had ceased (8).

Legislation

Community Right-To-Know List. Limited under EC Directive on Drinking Water Quality 80/778/EEC. Mercury: maximum admissible concentration 1 µg l⁻¹ (9).

Included in Schedule 4 and 6 (Release into Air/Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (10).

Quality objectives under EC Directives 82/176/EEC and 84/156/EEC 0.3 mg kg⁻¹ (wet weight) in a representative sample of fish flesh; 1 µg l⁻¹ (annual mean) total mercury in inland surface waters; 0.5 µg l⁻¹ (annual mean) dissolved mercury in estuarine waters; 0.3 µg l⁻¹ (annual mean) dissolved mercury in marine waters. A 'standstill' provision applies to concentrations in shellfish or sediments. Limit values under EC Directive 84/156/EEC 0.05 mg l⁻¹ effluent and 0.1 g l⁻¹ vinyl chloride production capacity for chemical industries using mercury catalysts in vinyl chloride production; 0.05 mg l⁻¹ effluent and 5 g kg⁻¹ mercury processed for chemical industries using mercury catalysts in other processes; 0.05 mg l⁻¹ effluent and 0.7 g kg⁻¹ mercury processed for manufacture of mercury catalysts used in vinyl chloride production; 0.05 mg l⁻¹ effluent and 0.05 g kg⁻¹ mercury processed for manufacture of organic and non-organic mercury compounds (other than mercury catalysts for vinyl chloride production); 0.05 mg l⁻¹ effluent and 0.03 g kg⁻¹ mercury processed for manufacture of primary batteries containing mercury; 0.05 mg l⁻¹ effluent for mercury recovery plants and extraction and refining of non-ferrous metals; 0.05 mg l⁻¹ effluent for plants treating toxic wastes containing mercury (11).

Maximum admissible concentration in working zone atmosphere (in former USSR) 0.005 mg m⁻³. Hazard class 1: dangerous by absorption through skin (8).

Other comments

Reviews on physico-chemical properties, human health effects, experimental toxicity, environmental effects, ecotoxicology, exposure levels and workplace experience listed (12).

Toxicity and hazards reviewed (8).

Aquatic toxicology reviewed (13).

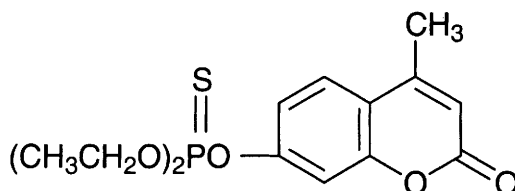
Saturation concentration 6250 mg m⁻³.

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10. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
11. DoE Circular 7/89: *Water and the environment. The implementation of EC directives on pollution caused by certain dangerous substances discharged into the aquatic environment* 1989, HMSO, London, UK.
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D309 O,O-diethyl O-(4-methylcoumarin-7-yl) phosphorothioate



$C_{14}H_{17}O_5PS$

Mol. Wt. 328.33

CAS Registry No. 299-45-6

Synonyms phosphorothioic acid, O,O-diethyl O-(4-methyl-2-oxo-2H-1-benzopyran-7-yl) ester; 7-hydroxy-4-methylcoumarin, O-ester with O,O-diethyl phosphorothioate; Hymecromone O,O-diethyl phosphorothioate

RTECS No. GN 7525000

Uses Superseded insecticide.

Physical properties

M. Pt. 38°C **Specific gravity** 1.260 at 38°C with respect to water at 4°C

Solubility Water: miscible. Organic solvents: diethyl ether, ethanol, petroleum ether

Occupational exposure

Supply classification very toxic

Risk phrases Very toxic by inhalation, in contact with skin and if swallowed (R26/27/28)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs – After contact with skin, wash immediately with plenty of water – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S13, S28, S45)

Environmental fate

Abiotic removal

UV irradiation at $\lambda > 313$ nm yields 2-oxo-2H-1-benzopyran phosphate (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse, guinea pig 15-99 mg kg⁻¹ (2,3).

LD₅₀ dermal rabbit 300 mg kg⁻¹ (4).

LD₅₀ subcutaneous mouse 25 mg kg⁻¹ (5).

LD₅₀ intraperitoneal rat 15 mg kg⁻¹ (6).

Other effects

Any other adverse effects

Cholinesterase inhibitor (7).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (8).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (9).

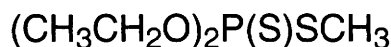
Other comments

Anaerobic degradation product of coumaphos (10).

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2. Marhold, J. V. *Prehled Prumyslove Toxikologie: Organicke Latky* 1986, 1169, Prague, Czechoslovakia.
3. *J. Pharmacol. Exp. Ther.* 1952, **105**, 156.
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5. *Pharmacol. Rev.* 1959, **11**, 636.
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D310 O,O-diethyl S-methyl dithiophosphate



C₅H₁₃O₂PS₂

Mol. Wt. 200.26

CAS Registry No. 3288-58-2

Synonyms ethyl methyl phosphorodithioate

RTECS No. TD 9670000

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 156 mg kg⁻¹ (1).

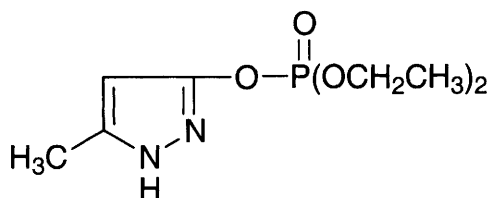
Other comments

Photodegradation product of phosalone (2).

References

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D311 diethyl 3-methylpyrazol-5-yl phosphate



$C_8H_{15}N_2O_4P$

Mol. Wt. 234.19

CAS Registry No. 108-34-9

Synonyms phosphoric acid, diethyl 5-methyl-1H-pyrazol-3-yl ester

RTECS No. TC 1750000

Uses Superseded pesticide.

Occupational exposure

Supply classification very toxic

Risk phrases Very toxic by inhalation, in contact with skin and if swallowed (R26/27/28)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs – After contact with skin, wash immediately with plenty of water – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S13, S28, S45)

Mammalian & avian toxicity

Acute data

LD₅₀ oral starling 40 mg kg⁻¹ (1).

LD₅₀ oral mouse 4 mg kg⁻¹ (2).

LD₅₀ subcutaneous rat 7 mg kg⁻¹ (3).

Legislation

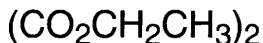
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (4).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (5).

References

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4. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
5. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D312 diethyl oxalate



$\text{C}_6\text{H}_{10}\text{O}_4$

Mol. Wt. 146.14

CAS Registry No. 95-92-1

Synonyms diethyl ethanedioate; ethyl oxalate; Bisomer DEO

EINECS No. 202-464-1

RTECS No. RO 2800000

Uses Acylating agent. Cross-linking agent. Solvent.

Physical properties

M. Pt. -40.6°C B. Pt. 185.7°C Flash point 75°C (open cup) Specific gravity 1.0785 at 20°C with respect to water at 4°C Volatility v.p. 1 mmHg at 47°C ; v.den. 5.04

Solubility Organic solvents: acetone, diethyl ether, ethanol, ethyl acetate

Occupational exposure

UN No. 2525 HAZCHEM Code 3X Conveyance classification toxic substance

Supply classification harmful

Risk phrases Harmful if swallowed – Irritating to the eyes (R22, R36)

Safety phrases Keep out of reach of children (if sold to general public) – Do not breathe vapour (S2, S23)

Mammalian & avian toxicity

Acute data

LD_{50} oral mouse 2000 mg kg^{-1} (1).

Metabolism and toxicokinetics

In mammals hydrolysed to form oxalic acid which accounts for its toxicity (2).

Irritancy

Dermal guinea pig (24 hr) 500 mg caused mild irritation (3).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

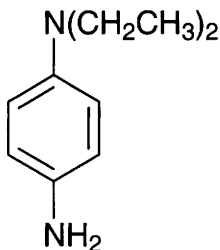
Other comments

Reviews on experimental toxicology and human health effects listed (5).

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5. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuysse (Bte 6), B-1160 Brussels, Belgium

D313 *N,N*-diethyl-*p*-phenylenediamine



C₁₀H₁₆N₂

Mol. Wt. 164.25

CAS Registry No. 93-05-0

Synonyms 4-amino-*N,N*-diethylaniline; *N,N'*-diethyl-1,4-benzenediamine; *p*-aminodiethylaniline; *N,N*-diethyl-1,4-diaminobenzene

EINECS No. 202-214-1

RTECS No. SS 9275000

Uses Photography. Analytical reagent to detect chlorine residues in water. As a dyestuff intermediate and as a source of diazonium compounds in diazo copying processes.

Physical properties

M. Pt. 19-21°C **B. Pt.** 260-262°C **Flash point** >107°C **Specific gravity** 1.00

Occupational exposure

Supply classification toxic

Risk phrases Toxic if swallowed – Causes burns (R25, R34)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – Wear suitable protective clothing – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S26, S36, S45)

Mammalian & avian toxicity

Acute data

LD_{Lo} oral rabbit 450 mg kg⁻¹ (1).

LD_{Lo} dermal rabbit 125 mg kg⁻¹ (1).

LD_{Lo} subcutaneous rat, rabbit, guinea pig 100-250 mg kg⁻¹ (1).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100 with metabolic activation positive, TA97 without metabolic activation weakly positive (2).

In vitro Chinese hamster lung and ovary cells chromosome aberrations with metabolic activation negative, without metabolic activation weakly positive for lung cells and distinctly positive for ovary cells (3).

Other effects

Any other adverse effects

Toxic effects are expected to be similar to those of *p*-phenylenediamine, causing eye and skin irritation and dermatitis (4).

Following *in vivo* application to guinea pig skin, binding to epidermal proteins was demonstrated, although it was relatively labile and no oligopeptide could be isolated (4).

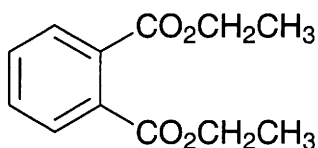
Other comments

Physico-chemical properties, human health effects, ecotoxicology, and experimental toxicology reviewed (5,6).

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6. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuysse (Bte 6), B-1160 Brussels, Belgium

D314 diethyl phthalate



$C_{12}H_{14}O_4$

Mol. Wt. 222.24

CAS Registry No. 84-66-2

Synonyms 1,2-benzenedicarboxylic acid, diethyl ester; ethyl phthalate; DEP; diethyl 1,2-benzenedicarboxylate

EINECS No. 201-550-6

RTECS No. TI 1050000

Uses Catalyst. Plasticiser. Solvent. Explosive component (propellant). Denaturant alcohol (e.g. in surgical spirit).

Physical properties

M. Pt. $-3^{\circ}C$ **B. Pt.** $296-299^{\circ}C$ **Flash point** $160^{\circ}C$ (closed cup) **Specific gravity** 1.120 at $25^{\circ}C$ with respect to water at $25^{\circ}C$ **Partition coefficient** $\log P_{ow}$ 3.2 (1) **Volatility** v.p. 1.65×10^{-3} mmHg at $25^{\circ}C$; v.den. 7.7 **Solubility** Organic solvents: acetone, benzene, diethyl ether, ethanol, vegetable oils

Occupational exposure

FR-VME 5 mg m^{-3}

JP-OEL 5 mg m^{-3}

SE-LEVL 3 mg m^{-3}

UK-LTEL 5 mg m^{-3}

US-TWA 5 mg m^{-3}

SE-STEL 5 mg m^{-3}

UK-STEL 10 mg m^{-3}

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow, sheepshead minnow 30-120 mg l^{-1} (3,4).

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 111 ppm Microtox test (5).

EC₅₀ (96 hr) *Selenastrum capricornutum* and *Skeletonema costatum* 66-90 mg l^{-1} (6).

LC₅₀ (24 hr) *Daphnia magna* 86 mg l^{-1} ; survival/reproduction NOEC 13 mg l^{-1} (7).

Water fleas *Daphnia magna* exposed to diethyl phthalate took significantly more time to complete four moults than did controls. The authors suggest that some xenobiotics which are endocrine disruptors in vertebrates can also interfere with the hormonally regulated moulting process in arthropods by acting as antagonists of endogenous ecdysteroids by binding to and thereby blocking the ecdysteroid receptor (8).

Bioaccumulation

Bioconcentration factor for bluegill sunfish 117 and for mullet 16 (9,10).

Environmental fate

Degradation studies

At initial concentrations of 20 mg l⁻¹, 75-110% biodegradation by methanogenic municipal digester sludge inoculum in 50 days. With higher concentrations 100-200 mg l⁻¹, 25-50% biodegradation was reported (11). Phthalate esters undergo ≥ 50% ultimate degradation within 28 days in standardized aerobic biodegradation tests with sewage sludge inocula. Biodegradation is expected to be the dominant loss mechanism in surface water, soils and sediments (12).

Strains of *Mycobacterium* and *Nocardia* were reported to utilise diethyl phthalate as sole carbon source (13).

Biodegradation in river water, concentration 25 ppm t_{1/2} ~3 day (14).

Abiotic removal

Evaporation rate relative to *n*-butyl acetate, which has been assigned a value of 1 at 25°C, is <0.005 (15).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse, guinea pig 6200-8600 mg kg⁻¹ (16,17).

LD₅₀ intraperitoneal mouse, rat 2750, 5060 mg kg⁻¹, respectively (18,19).

Carcinogenicity and chronic effects

Oral rat (2 yr) 0.5, 2.5 or 5% via diet. The high dose resulted in a small but significant decrease in growth rate without any effect on food consumption (20).

Teratogenicity and reproductive effects

Intragastric rat (30 day) 0.1 or 1.0 g day⁻¹. No embryotoxic or gonadotoxic effects were observed (21).

Metabolism and toxicokinetics

Following dermal application of ¹⁴C-labelled substance to rats, 26% of the ¹⁴C was excreted in the urine within 24 hr and 50-60% in 7 day (22).

The major urinary metabolite identified following oral administration to rats was the mono-ester, which is reported to be 4 times more toxic (23).

Genotoxicity

Salmonella typhimurium TA98, TA100 without metabolic activation positive (24,25).

In vitro Chinese hamster ovary cells, chromosomal aberrations negative (26).

Other effects

Other adverse effects (human)

Reported to be an irritant and in high concentrations cause central nervous system depression (27).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (28).

Other comments

Aquatic toxicity of eighteen phthalate esters reviewed (2).

Experimental toxicology and human health effects reviewed (29).

Environmental fate of diethyl phthalate reviewed (30,12).

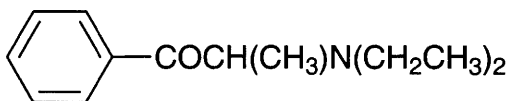
Autoignition temperature 457°C.

Residues have been isolated from water, soil, sediments and sea foods (30).

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D315 diethylpropion



C₁₃H₁₉NO

Mol. Wt. 205.30

CAS Registry No. 90-84-6

Synonyms 2-(diethylamino)-1-phenyl-1-propanone; 2-(diethylamino)-propiophenone; 1-phenyl-2-diethylamino-1-propanone; Adiposon; Ampfepramone; α-benzoyltriethylamine; Cegramine; Derfon; Neobis; Noprapiophenone; Obesitex; Silutin

EINECS No. 202-019-1

RTECS No. UG 9450000

Uses Anorectic, normally used as the hydrochloride.

Physical properties

B. Pt. 110-112°C at 14 mmHg

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 160 mg kg⁻¹ (1).

LD₅₀ intraperitoneal mouse 120 mg kg⁻¹ (2).

Metabolism and toxicokinetics

Following oral administration to humans, mono-*N*-deethylation is the major pathway (~35% of the dose). Direct carbonyl reduction occurs to ~20% of the dose. The study reported that ~30% of the dose, which cannot be accounted for from the sum of amines recovered in the urine, is probably metabolised by oxidative deamination, followed by conjugation to yield hippuric acid (3).

Diethylpropion crosses the blood-brain barrier and the placenta in humans (4).

Other effects

Any other adverse effects

Overdoses of diethylpropion are reported to cause hyperventilation, motor hyperactivity, excitability, mydriasis, flushing and tachycardia (5).

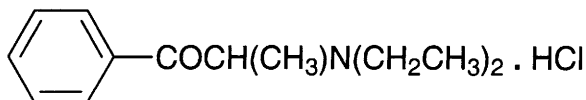
Legislation

Controlled substance (stimulant) listed in the US Code of Federal Regulations, Title 21, Part 1308.14, 1987 (6).

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D316 diethylpropion hydrochloride



C₁₃H₂₀NOCl

Mol. Wt. 241.76

CAS Registry No. 134-80-5

Synonyms 1-propanone, 2-(diethylamino)-1-phenyl-, hydrochloride; propiophenone, 2-(diethylamino)-, hydrochloride; Keramin; Tenuate; Tylinol; Amfepramone

EINECS No. 205-156-5

RTECS No. UH 0360000

Uses Anorectic. Administered by mouth to facilitate weight loss.

Physical properties

M. Pt. 175°C

Solubility Water: 2 g ml⁻¹. Organic solvents: chloroform, ethanol

Mammalian & avian toxicity

Metabolism and toxicokinetics

Readily absorbed from the gastro-intestinal tract. Extensively metabolised in the liver and possibly the gastro-intestinal tract. The compound can cross the blood brain barrier and the placenta (species unspecified) (1). Metabolised by removal of *N*-ethyl groups and reduction of the keto group, yielding basic, aromatic, non-hydrolysed metabolites which are excreted in urine (2,3).

Other effects

Other adverse effects (human)

The compound is prone to abuse, because of its stimulant action on the central nervous system (1). The compound is a centrally acting anorectic agent with actions resembling those of amphetamine. Side-effects in humans include depression, psychoses, hallucinations and symptoms associated with stimulation of the central nervous system (1). A variety of psychiatric disorders have been developed in persons receiving the compound (4).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Chloride: guide level 25 mg l⁻¹ (5). In the UK the compound is classified as a Controlled Drug as defined by the Misuse of Drugs Act, 1971. In the USA, the compound is a controlled substance (stimulant) listed in the US Code of Federal Regulations Title 21, Part 130 8.14, 1987.

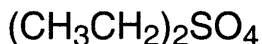
Other comments

The pharmacology of the compound reviewed (6).

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D317 diethyl sulfate



C₄H₁₀O₄S

Mol. Wt. 154.19

CAS Registry No. 64-67-5

Synonyms sulfuric acid, diethyl ester; ethyl sulfate

EINECS No. 200-589-6

RTECS No. WS 7875000

Uses Ethylating agent. Accelerator in the sulfonation of ethylene. Chemical intermediate. Mutagen in plant breeding.

Physical properties

M. Pt. -25°C **B. Pt.** 208°C **Specific gravity** 1.175 at 25°C

Solubility Organic solvents: diethyl ether, ethanol

Occupational exposure

UK-LTEL MEL 0.05 ppm (0.32 mg m⁻³)

UN No. 1594 **HAZCHEM Code 2X** Conveyance classification toxic substance

Supply classification toxic

Risk phrases May cause cancer – May cause heritable genetic damage – Harmful by inhalation, in contact with skin and if swallowed – Causes burns (R45, R46, R20/21/22, R34)

Safety phrases Restricted to professional users – Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S53, S45)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 880 mg kg⁻¹ (1).

Carcinogenicity and chronic effects

Limited evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2A (2).

Subcutaneous BD rat unspecified dose × wk⁻¹ induced dose-dependent local sarcomas. Inactive via oral and intravenous routes (3).

Teratogenicity and reproductive effects

In transplacental experiments, a single dose (unspecified) administered to pregnant rats on day 15 of gestation produced malignant tumours, mostly of the nervous system in 7/59 adults and 2/30 offspring (3).

Genotoxicity

Salmonella typhimurium TA98 with and without metabolic activation negative (4).

Salmonella typhimurium TA100 with and without metabolic activation positive (4).

Drosophila melanogaster chromosomal aberration and translocation positive (5).

In vitro rat primary hepatocytes unscheduled DNA synthesis without metabolic activation positive (6).

In vitro Chinese hamster V79 cells sister chromatid exchange positive (7).

In vivo mouse dominant lethal and specific-locus mutations in sperm positive (8).

N-alkylation of DNA in late stages of spermatogenesis is particularly significant (9).

Other effects

Other adverse effects (human)

In workers at an ethanol manufacturing unit, diethyl sulfate appeared to be the primary carcinogen responsible for the excess upper respiratory cancer (10).

Any other adverse effects

Single exposure of rats resulted in DNA damage and fragmentation in central nervous system tissue (11).

Legislation

Included in Schedule 4 (Release into Air: Prescribed Substances) Statutory Instrument No 472, 1991 (12).

Other comments

Environmental pollutant.

Upper respiratory cancers in workers exposed to high levels of diethyl sulfate reviewed (13).

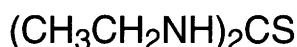
Toxicology and human health effects reviewed (14).

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D318 1,3-diethylthiourea



$\text{C}_5\text{H}_{12}\text{N}_2\text{S}$

Mol. Wt. 132.23

CAS Registry No. 105-55-5

Synonyms *N,N'*-diethylthiourea; 1,3-diethyl-2-thiourea; *N,N'*-diethylthiocarbamide; Pennezone E 0686; Rhenogran DETU-80

EINECS No. 203-308-5

RTECS No. YS 9800000

Uses Antioxidant. Vulcanising agent.

Physical properties

M. Pt. 76-78°C **Partition coefficient** log P_{ow} 0.95 (1)

Solubility Water: miscible. Organic solvents: acetone, benzene, diethyl ether, ethyl acetate

Ecotoxicity

Fish toxicity

Critical range for creek chub (24 hr) 100-300 mg l^{-1} (2).

LC_{50} (60 day) rainbow trout 135 mg l^{-1} (3).

Invertebrate toxicity

EC_{50} (15 min) *Photobacterium phosphoreum* 761 ppm Microtox test (4).

Mammalian & avian toxicity

Acute data

LD_{50} oral rat 316 mg kg^{-1} (5).

LD_{50} intraperitoneal mouse 500 mg kg^{-1} (6).

Carcinogenicity and chronic effects

National Toxicology Program tested rats and mice via food. Tumours found in thyroid gland in ♂ and ♀ rats. No evidence of carcinogenicity in ♂ and ♀ mice (7).

Sensitisation

Reported to be a potent skin sensitiser, but it has not been established whether this may have any relationship to keratitis (8).

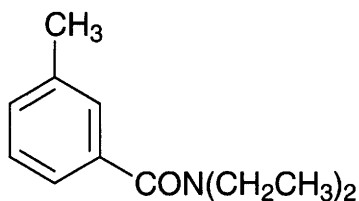
Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (9).
In vitro mouse lymphoma L5178Y tk⁺/tk⁻ forward mutation assay positive (10).

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D319 *N,N*-diethyl-*m*-toluamide



C₁₂H₁₇NO

Mol. Wt. 191.27

CAS Registry No. 134-62-3

Synonyms *N,N*-diethyl-3-methylbenzamide; DEET; DETA; Flypel; metadelphene; *m*-toluic acid, diethylamide; diethyltoluamide

EINECS No. 205-149-7

RTECS No. XS 3675000

Uses Insect repellent. Acaricide. Insecticide. Also used in pharmaceuticals as a skin penetration enhancer.

Physical properties

B. Pt. 111°C at 1 mmHg **Specific gravity** 0.996 at 20°C with respect to water at 4°C **Partition coefficient** log P_{ow} 2.02 (1)

Solubility Organic solvents: benzene, diethyl ether, ethanol

Occupational exposure

Supply classification harmful

Risk phrases Harmful if swallowed – Irritating to eyes and skin (R22, R36/38)

Safety phrases Keep out of reach of children (if sold to general public) (S2)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) cichlid 120-150 ppm. After 96 hours, glutathione levels in liver, kidney and gills were raised (1).

Invertebrate toxicity

EC₅₀ (5 min) *Photobacterium phosphoreum* 67.9 ppm Microtox test (2).

Environmental fate

Degradation studies

Decomposition can be effected by biodegradation under anaerobic conditions (3).

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird 500 mg kg⁻¹ (4).

LD₅₀ oral rat 2 g kg⁻¹ (5).

Intraperitoneal rats and dogs ≤225 mg kg⁻¹ caused cardiovascular effects including reductions of blood pressure and heart rate (6).

Sub-acute and sub-chronic data

Oral rat (28 days) 1.6-0.6 g kg⁻¹ day⁻¹ developed signs of neurotoxicity as indicated by an effect on the refractory period for nerve conduction (7).

Oral rat (200 days) 10 g kg⁻¹ in diet, no adverse effects reported (5).

Irritancy

Rabbit eye, a Draize test lasting 3 wk demonstrated moderate irritation when applied in a cream (8).

Other effects

Other adverse effects (human)

Hypersensitivity and anaphylaxis has been described in one patient after exposure (9).

Toxic encephalopathy has been noted in children who received liberal applications of this compound; seizures have also been reported (10,11).

Toxic reactions including death have been reported following the ingestion of large amounts of diethyltoluamide-containing insecticides (12).

Any other adverse effects

Metabolism is predominantly effected by liver microsomal fraction in the rat, and differences are seen between ♂ and ♀ (13).

In vitro conversion of ammonia into urea, and lactate to glucose is inhibited in rat hepatocytes (14).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (15).

Included in Schedule 4 (Release into Air) and Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (16).

Other comments

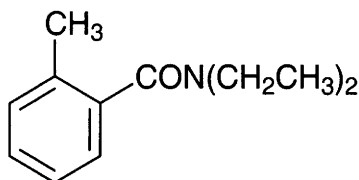
Environmental pollutant.

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D320 *N,N*-diethyl-*o*-toluamide



$C_{12}H_{17}NO$

Mol. Wt. 191.27

CAS Registry No. 2728-04-3

Synonyms *N,N*-diethyl-2-methylbenzamide; *o*-DEET; *o*-DETA

RTECS No. XS 3850000

Uses Has been used as insect repellent, but less effective than *m*-isomer.

Physical properties

Partition coefficient $\log P_{ow}$ 2.62

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1.2 g kg⁻¹ (1).

Dermal rabbit, minimum toxic dose 2 mg kg⁻¹ (2).

Legislation

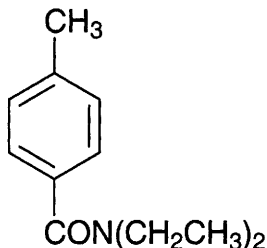
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (3).

Included in Schedule 4 (Release into Air) and Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

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4. *S. I. 1991 No. 472 The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D321 *N,N*-diethyl-*p*-toluamide



C₁₂H₁₇NO

Mol. Wt. 191.27

CAS Registry No. 2728-05-4

Synonyms *N,N*-diethyl-4-methylbenzamide; *p*-DEET; *p*-DETA

RTECS No. XS 4025000

Uses Has been used as insect repellent, but less effective than *m*-isomer.

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (1).

Included in Schedule 4 (Release into Air) and Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (2).

References

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D322 diethylzinc



C₄H₁₀Zn

Mol. Wt. 123.51

CAS Registry No. 557-20-0

Synonyms

EINECS No. 209-161-3

RTECS No. BD 2050000

Uses Catalyst. Intermediate in organic synthesis. Preservation of archival papers.

Physical properties

M. Pt. -28°C **B. Pt.** 117°C **Specific gravity** 1.2065 at 20°C with respect to water at 4°C

Solubility Organic solvents: benzene, diethyl ether, hexane, petroleum ether, toluene

Occupational exposure

UN No. 1366 **HAZCHEM Code** 4WE **Conveyance classification** spontaneously combustible substance

Mammalian & avian toxicity

Irritancy

Inhalation of mist or vapour and skin and eye contact with mist, vapour or liquid is reported to cause immediate irritation in humans (1).

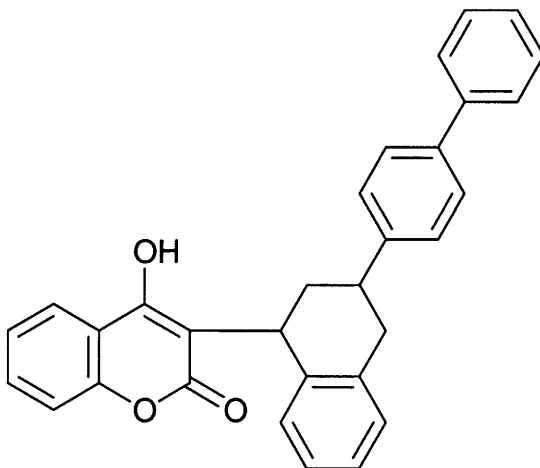
Legislation

Organometallic compounds are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (2).

References

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D323 difenacoum



$C_{31}H_{24}O_3$

Mol. Wt. 444.53

CAS Registry No. 56073-07-5

Synonyms 3-(3-[1,1'-biphenyl]-4-yl)-1,2,3,4-tetrahydro-1-naphthalenyl)-4-hydroxy-2H-1-benzopyran-2-one; Neosorex; 3-(3-[1,1'-biphenyl-4-yl]-1,2,3,4-tetrahydro-1-naphthyl)-4-hydroxycoumarin

EINECS No. 259-978-4

RTECS No. GN 4934500

Uses Rodenticide.

Physical properties

M. Pt. 215-217°C **Partition coefficient** $\log P_{ow} > 7$ **Volatility** v.p. 1.2×10^{-6} mmHg at 45°C

Solubility Water: $2.5 \mu\text{g l}^{-1}$ at pH 7.3 and 20°C. Organic solvents: acetone, benzene, chloroform, ethanol, ethyl acetate

Occupational exposure

Supply classification very toxic

Risk phrases Very toxic if swallowed – Toxic: danger of serious damage to health by prolonged exposure if swallowed (R28, R48/25)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S36/37, S45)

Mammalian & avian toxicity

Acute data

LD₅₀ oral chicken >50 mg kg⁻¹ (1).

LD₅₀ oral ♂ mouse, ♂ rat, rabbit, ♀ rat 0.8, 1.8, 2.0, 2.45 mg kg⁻¹, respectively (2).

LD₅₀ (5 day) oral rat 0.16 mg kg⁻¹ day⁻¹ (2).

LD₅₀ oral ♀ guinea pig, pig, cat 50, >50, 100 mg kg⁻¹, respectively (2).

LD₅₀ dermal rabbit 1000 mg kg⁻¹ (2).

Oral mouse, single dose of 0.5 mg kg⁻¹ caused the death of 50% ♂ mice within 9 days. No ♀ mice died in this study (3).

Intraperitoneal rat, single dose of 0.4 mg kg⁻¹ caused a fall in prothrombin complex activity over the first 24 hr. Activity was reduced more in ♂ rats. This correlated with lower levels of vitamin K in the liver of ♂ rats (3).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (4).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (5).

WHO Toxicity Class Ia (6).

EPA Toxicity Class I (2).

Other comments

Residues have been isolated from rodent predators (7).

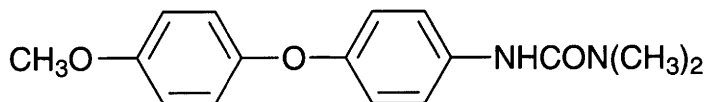
Second-generation anticoagulant rodenticide, inhibiting the vitamin K-dependent steps in the synthesis of clotting factors II, VII, IX and X (2).

Reported to be stable in sunlight at 30°C for 3 days (1).

References

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4. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
5. *S. I. 1991 No. 472 the Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
6. *The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification* 1998-1999 WHO/PCS/98.21.
7. Newton, I. et al *Environ. Pollut.* 1990, 68(1-2), 101-107

D324 difenoxuron



C₁₆H₁₈N₂O₃

Mol. Wt. 286.33

CAS Registry No. 14214-32-5

Synonyms *N'*-[4-(4-methoxyphenoxy)phenyl]-*N,N*-dimethylurea; 3-[*p*-(*p*-methoxyphenoxy)phenyl]-1,1-dimethylurea; Lironion; 1,1-dimethyl-3-[4-(4-methoxyphenoxy)phenyl]urea

EINECS No. 238-068-0

RTECS No. YT 0180000

Uses Disinfectant. Superseded herbicide

Physical properties

M. Pt. 138-139°C **Specific gravity** 1.30 at 20°C (1) **Partition coefficient** log *P*_{ow} 3.2 (2) **Volatility** v.p. 9.3 × 10⁻⁶ mmHg at 20°C

Solubility Water: 20 mg l⁻¹ at 20°C. Organic solvents: acetone, benzene, dichloromethane, hexane, isopropanol

Ecotoxicity

Fish toxicity

LC₅₀ (48 hr) trout 5-10 mg l⁻¹ (1,3).

Environmental fate

Degradation studies

t_{1/2} in soil 12 day (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 800 mg kg⁻¹ (2).

LC₅₀ (6 hr) inhalation rat > 0.66 g m⁻³ (1,3).

LD₅₀ dermal rat > 2150 mg kg⁻¹ (1,3)

Sub-acute and sub-chronic data

No-adverse-effect level, in 90-day feeding trials, 50 mg kg⁻¹ day⁻¹ for rats and 200 mg kg⁻¹ day⁻¹ for dogs (1,3).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (4).

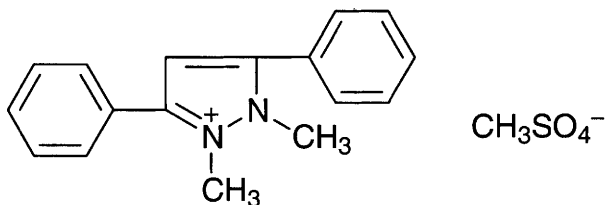
Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (5).

The log *P*_{ow} exceeds the European Community recommended level of 3.0 (6).

References

1. *The Agrochemicals Handbook* 3rd ed. 1991, The Royal Society of Chemistry, London, UK.
2. Nendza, M. *Chemosphere* 1991, 22(5-6), 613-623.
3. *The Pesticide Manual* 9th ed. 1991, British Crop Protection Council, Farnham, UK.
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5. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
6. 1967 *Directive on Classification, Packaging, and Labelling of Dangerous Substances* 67/548/EEC; 6th Amendment EEC Directive 79/831/EEC; 7th Amendment EEC Directive 91/32/EEC 1991, HMSO, London, UK

D325 difenzoquat metilsulfate



$\text{C}_{18}\text{H}_{20}\text{N}_2\text{O}_4\text{S}$

Mol. Wt. 360.43

CAS Registry No. 43222-48-6

Synonyms difenzoquat methyl sulfate; 1,2-dimethyl-3,5-diphenyl-1H-pyrazolium methyl sulfate; Avenge

EINECS No. 256-152-5

RTECS No. UQ 9820000

Uses Herbicide. Antidote for heterocyclic phenyl ether herbicides.

Physical properties

M. Pt. 150-160°C **Partition coefficient** $\log P_{\text{ow}}$ -1.38 at pH 7.0 (1) **Volatility** v.p. 9.8×10^{-8} mmHg at 20°C

Solubility Water: 765 g l⁻¹ at 25°C. Organic solvents: acetone, chloroform, benzene, dichloromethane, 1,4-dioxane, methanol, xylene

Occupational exposure

Supply classification harmful

Risk phrases Harmful if swallowed (R22)

Safety phrases Keep out of reach of children (if sold to general public) (S2)

Ecotoxicity

Fish toxicity

LD₅₀ (96 hr) bluegill sunfish, rainbow trout 695 mg l⁻¹ (1,2).

Invertebrate toxicity

LD₅₀ contact bee 0.036 mg bee⁻¹ (1,2).

Environmental fate

Degradation studies

No significant microbial degradation occurs (1).

Abiotic removal

Photolytic demethylation occurs readily, yielding a monomethyl pyrazole (1).

t_{1/2} in soil ~3 months (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 270-470 mg kg⁻¹ (1-3).

LD₅₀ oral mouse 31-44 mg kg⁻¹ (1).

LD₅₀ dermal rabbit 3540 mg kg⁻¹ (2,3)

Sub-acute and sub-chronic data

LC₅₀ (8 day) mallard duck >10.4 g kg⁻¹ (1,2).

LC₅₀ (8 day) oral bobwhite quail >4640 mg kg⁻¹ diet (1,2).

Carcinogenicity and chronic effects

Oral rat (104 wk) 5, 25, 125 or 250 mg kg⁻¹ diet. Body weight gain was depressed for the 125 and 250 mg kg⁻¹ diet doses (4).

Teratogenicity and reproductive effects

Oral rat (three-generation study) 125 mg kg⁻¹ diet caused a decrease in pup weight at both birth and weaning (5).

Metabolism and toxicokinetics

Following oral administration to rats, difenzoquat methyl sulfate is excreted unchanged in the urine (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (6).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (7).

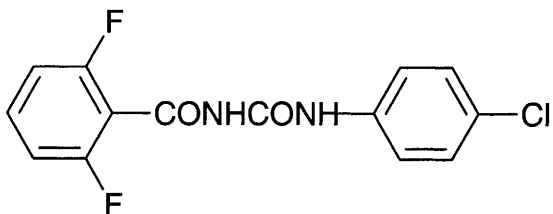
Other comments

Mammalian toxicity reviewed (8).

References

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2. *The Pesticide Manual* 11th ed., 1997, The British Crop Protection Council, Farnham, UK.
3. *Farm Chemicals Handbook* 1983, C20, Meister Publ. Co, Willoughby, OH, USA.
4. American Cyanamid Co, 1975, MRID No. 00037923, (available from EPA, Washington, DC, USA).
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7. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
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D326 diflubenzuron



C₁₄H₉ClF₂N₂O₂

Mol. Wt. 310.69

CAS Registry No. 35367-38-5

Synonyms 1-(4-chlorophenyl)-3-(2,6-difluorobenzoyl)urea; N-[[[4-chlorophenyl]amino]carbonyl]-2,6-difluorobenzamide; Arbofog; Astonex; Dimilin; Dimiter; Du-Min; Dumil; Fluben

EINECS No. 252-529-3

RTECS No. YS 6200000

Uses Acaricide. Insecticide.

Physical properties

M. Pt. 230-232°C (decomp.) **Partition coefficient** log P_{ow} 3.10 (1) **Volatility** v.p. 2.5 × 10⁻⁵ mmHg at 50°C

Solubility Water: 0.08 mg l⁻¹ pH 5.5 at 20 °C (2). Organic solvents: acetone, dimethylformamide, 1,4-dioxane

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout, fathead minnow, bluegill sunfish, channel catfish 135-660 mg l⁻¹ (1-4).

LC₅₀ (96 hr) mummichog 33 mg l⁻¹ (5).

Invertebrate toxicity

LC₅₀ (96 hr) adult grass shrimp 7.0 mg l⁻¹, larvae grass shrimp 1.44 µg l⁻¹ (6).

LC₅₀ (96 hr) mysid shrimp 2.1 µg l⁻¹ (7).

Bioaccumulation

White crappies and bluegill sunfish exposed to water containing 10 ppb for 24 hr accumulated levels of ≤80-fold. Accumulation was concentration-dependent with concentrations of 1-10 ppb. Rapidly eliminated by fish when placed in clean water (8).

Oreochromis niloticus fingerlings exposed to ambient concentrations of 2.5-5 mg l⁻¹ for 21 days accumulated 77-99 × the water content. Accumulated in liver and gills (9).

Environmental fate

Nitrification inhibition

Stimulated *Azobacter* nitrogen fixation under aerobic conditions at soil concentrations of 100-500 mg kg⁻¹ (10).

Degradation studies

Rapidly degraded in soil with a t_{1/2} of < 7 day (11).

Degraded by the soil microorganisms *Fusarium*, *Cephalosporium*, *Penicillium* and *Rhodotorula* species. Degradation products included 2,6-difluorobenzoic acid, 4-chloroaniline, 4-chlorophenylurea, 4-chloroacetanilide, acetanilide and 4-chlorophenol (12).

Abiotic removal

Undergoes hydrolysis to *p*-chlorophenylurea at > pH 9. Light sensitive in solution but stable to sunlight as a solid (3,13).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 4640 mg kg⁻¹ (13).

LD₅₀ dermal rabbit 2000 mg kg⁻¹ (13).

LD₅₀ intraperitoneal mouse > 2150 mg kg⁻¹ (3).

Sub-acute and sub-chronic data

LC₅₀ (8 day) oral bobwhite quail, mallard duck >4640 mg kg⁻¹ diet (3,2).

Carcinogenicity and chronic effects

No-adverse-effect level (2 yr) oral rat 40 mg kg⁻¹ diet (3).

Metabolism and toxicokinetics

Metabolites in mice include 3-hydroxy- and 2-hydroxydiflubenzuran and 4-chlorophenylurea (14).

Following oral administration to rats, elimination is partly as the unchanged parent compound in the faeces and partly as hydroxylated metabolites (~80%) and as 4-chlorophenylurea plus 2,6-difluorobenzoic acid (~20%).

Intestinal absorption is related to dosage; at higher doses proportionately higher amounts are excreted unchanged in the faeces (11).

Other effects

Any other adverse effects

In vivo rabbit, protein and RNA synthesis were significantly stimulated in the liver and inhibited in the muscle. The maximum effect on both tissues was at 5 µg ml⁻¹ for protein synthesis and 0.2 µg l⁻¹ for RNA synthesis (15). Attributed endocrine disruption effects in wildlife. Reduced testosterone in birds; arthropod cuticle deposition disruption (16).

Legislation

EEC maximum residue level for pome fruit 1 ppm (3).
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration $0.1 \mu\text{g l}^{-1}$ (17).
Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (18).
The log P_{ow} value exceeds the European Community recommended level 3.0 (19).
WHO Class Table 5 (20).
EPA Toxicity Class III (3).
Tolerable daily intake (TDI) human 0.02 mg kg^{-1} (3,2).

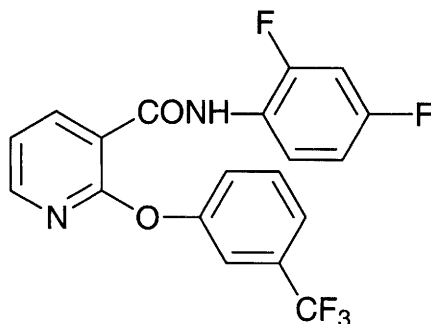
Other comments

Five daily injections of 800 mg kg^{-1} into mice with B16 melanomas induced a decrease in tumour volume by 11-20%. The metabolite 2-hydroxydiflubenzuron had a similar effect (14).

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18. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
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20. *The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification* 1998-1999 WHO/PCS/98.21

D327 diflufenican



$C_{19}H_{11}F_5N_2O_2$

Mol. Wt. 394.30

CAS Registry No. 83164-33-4

Synonyms *N*-(2,4-difluorophenyl)-2-[3-(trifluoromethyl)phenoxy]-3-pyridinecarboxamide; 2',4'-difluoro-2-(α,α,α -trifluoro-*m*-tolylloxy)nicotinilide; Diflufenicanil; Ardent; Brodal; RPA 41670H

RTECS No. US 4589800

Uses Herbicide.

Physical properties

M. Pt. 159-161°C **Partition coefficient** $\log P_{ow}$ 4.9 **Volatility** v.p. 3.19×10^{-8} mmHg (25°C, gas saturation method)

Solubility Water: $<50 \mu\text{g l}^{-1}$ at 25°C. Organic solvents: acetone, acetophenone, cyclohexane, cyclohexanone, dimethylformamide, 2-ethoxyethanol, kerosene, 3,5,5-trimethylcyclohex-2-enone, xylene

Occupational exposure

Risk phrases Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R52/53)

Safety phrases Avoid release to the environment. Refer to special instructions/data sheet (S61)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) carp, rainbow trout 56-105 mg l⁻¹ (1).

Environmental fate

Degradation studies

When applied to soil in autumn $t_{1/2}$ 4.6-6.2 months, whereas when applied in spring and summer $t_{1/2}$ 2.5-3.6 months. Identified soil metabolites included 2-[3-(trifluoromethyl)-phenoxy]-3-pyridinecarboxylic acid, *N*-(2,4-difluorophenyl)-2-hydroxy-3-pyridine carboxamide, and 2-hydroxy-3-carboxypyridine. No diflufenican or metabolites were detected in wheat grain or edible parts of sugar beet and vegetable crops (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mallard duck $>4000 \text{ mg kg}^{-1}$ (1).

LD₅₀ oral mouse >1000 rat, quail >2000 ; rabbit $>5000 \mu\text{g l}^{-1} \text{ kg}^{-1}$ (1,3,4).

LC₅₀ (4 hr) inhalation rat $>2.34 \text{ g m}^{-3}$ (1).

LD₅₀ dermal rat $>2000 \text{ mg kg}^{-1}$ (1,3).

Sub-acute and sub-chronic data

Oral rat (14 day) no-adverse-effect level 1600 mg kg⁻¹ (3).

Oral dog (90 day), no effect level 1000 mg kg⁻¹ day⁻¹ (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (5).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (6).

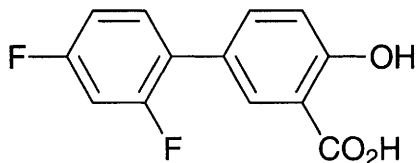
WHO Toxicity Class Table 5 (7).

EPA Toxicity Class III (formulation) (3).

References

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7. *The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification* 1998-1999 WHO/PCS/98.21

D328 diflunisal



C₁₃H₈F₂O₃

Mol. Wt. 250.20

CAS Registry No. 22494-42-4

Synonyms 2',4'-difluoro-4-hydroxy-[1,1'-biphenyl]-3-carboxylic acid; 2',4'-difluoro-4-hydroxy-3-biphenylcarboxylic acid; 5-(2,4-difluorophenyl)salicylic acid; Dolobid

EINECS No. 245-034-9

RTECS No. DV 2030000

Uses Anti-inflammatory agent. Analgesic.

Physical properties

M. Pt. 210-211°C

Solubility Organic solvents: acetone, diethyl ether, ethanol, ethyl acetate, methanol, toluene

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse, rabbit 392, 439, 603 mg kg⁻¹, respectively (1,2).

In humans a dose of 15 g has been reported to be fatal (3).

LD₅₀ subcutaneous rat, mouse 185, 220 mg kg⁻¹, respectively (1).

LD₅₀ intraperitoneal mouse, rat 124, 159 mg kg⁻¹, respectively (1).

Teratogenicity and reproductive effects

Oral monkey 20 or 80 mg kg⁻¹ day⁻¹ on days 25-48 of gestation. There was no evidence of maternal toxicity, increased abortion rate, foetal growth retardation or malformation (4).

Metabolism and toxicokinetics

Diffenhydramine is metabolised in rats and humans to its acyl, glucuronide, phenolic glucuronide and sulfate conjugates (5).

Absorption from the gastro-intestinal tract was enhanced by buffering stomach contents by the administration of sodium hydrogen carbonate (6).

t_{1/2} 10 days for diffenhydramine protein adduct in the plasma in humans (7).

Oral pregnant monkey at a dosage rate of 60 mg kg⁻¹ peak plasma levels were found 1 hr after administration.

Urinary excretion of diffenhydramine and its metabolites was 67% of the dosage over the first 4 days post-administration compared with 0.8% in faeces. Embryo concentrations on days 35-37 of gestation were 0.7 and 1.1 % of maternal plasma level at 4 hr post-administration of 20 or 60 mg kg⁻¹, respectively (4).

Sensitisation

Three cases of hypersensitivity in human patients have been reported in which the main clinical features were fever, elevated liver enzyme activities, erythroderma and eosinophilia (8).

Other effects

Other adverse effects (human)

Moderately active reversible inhibitor of prostaglandin synthetase and decreases the production of prostaglandin E and F *in vitro* and *in vivo*. Major urinary metabolites of prostaglandin E₁ and prostaglandin E₂ were 7 α -hydroxy-5,11-diketotetranorpropane-1,16-dioic acid; in normal subjects 375 mg 2 \times day⁻¹ for 5 days was reduced by 70% (9).

The most common adverse effects in patients taking diffenhydramine are perforated duodenal ulcers and gastro-intestinal bleeding (10,11).

Acute interstitial nephritis, presenting as acute oliguric renal failure, erythroderma and eosinophilia have been reported following therapeutic administration of diffenhydramine (12).

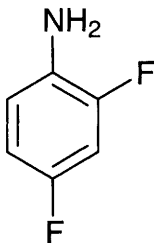
Any other adverse effects

EC₅₀ for inhibition of Ca²⁺ uptake in isolated mitochondria ~0.5 mg l⁻¹ (species unspecified) (13).

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D329 2,4-difluoroaniline



C₆H₅F₂N

Mol. Wt. 129.11

CAS Registry No. 367-25-9

Synonyms 2,4-difluorobenzenamine

EINECS No. 206-687-5

RTECS No. BX 3680000

Uses Pharmaceutical intermediate. Intermediate in organic synthesis.

Physical properties

M. Pt. -7.5°C B. Pt. 170°C at 753 mmHg Flash point 62-70°C Specific gravity 1.268 at 20°C

Solubility Water: 10-50 g l⁻¹ at 20°C. Organic solvents: acetone, dimethyl sulfoxide, ethanol

Occupational exposure

UN No. 2941 HAZCHEM Code 2W Conveyance classification toxic substance

Ecotoxicity

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 93.5 ppm Microtox test (1).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (2,3).

Other effects

Other adverse effects (human)

In the few *in vivo* studies reported, humans are more susceptible than rats to methaemoglobinaemia produced by exposure to aniline and its substituents (4), but are less susceptible to dosing with acetanilide (5).

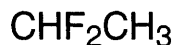
Other comments

Found in sewage effluent.

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3. Zeiger, E. et al *Environ. Mol. Mutagen* 1988, **11**(Suppl. 12), 1-158.
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D330 1,1-difluoroethane



$\text{C}_2\text{H}_4\text{F}_2$

Mol. Wt. 66.05

CAS Registry No. 75-37-6

Synonyms ethylidene fluoride

EINECS No. 200-866-1

RTECS No. KI 1410000

Uses Blowing agent. Cooling agent. Aerosol propellant. Refrigerant.

Physical properties

M. Pt. -117°C B. Pt. -25°C Specific gravity 1.004 at 25°C Volatility v.p. 4437 mmHg at 25°C ; v.den. 2.28

Solubility Water: 3235 mg l^{-1} at 25°C

Occupational exposure

UN No. 1030 HAZCHEM Code 2WE Conveyance classification flammable gas

Ecotoxicity

Bioaccumulation

The calculated bioconcentration factor of 6.5 indicates that environmental accumulation is unlikely (1).

Environmental fate

Abiotic removal

$t_{1/2}$ for volatilisation from a model river 2.4 hr (2).

$t_{1/2}$ for reaction with photochemically produced hydroxyl radicals in the troposphere 472 day (3).

Mammalian & avian toxicity

Acute data

LC_{50} (2 hr) inhalation mouse 977 mg m^{-3} (4).

Genotoxicity

Drosophila melanogaster sex-linked recessive lethal assay positive (5).

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4. Izmerov, N. F. et al *Toxicometric Parameters of Industrial Toxic Chemicals Under Single Exposure* 1982, 54, CIP, Moscow, USSR.
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D331 1,2-difluoroethane



$\text{C}_2\text{H}_4\text{F}_2$

Mol. Wt. 66.05

CAS Registry No. 624-72-6

Synonyms Freon 152

RTECS No. KI 1410500

Uses Blowing agent. Solvent.

Physical properties

Solubility Organic solvents: benzene, chloroform, diethyl ether

Occupational exposure

UN No. 1030 HAZCHEM Code 2WE Conveyance classification flammable gas

Mammalian & avian toxicity

Acute data

LC₅₀ (4 hr) inhalation mouse, rat 65-75 ppm (1).

Genotoxicity

Salmonella typhimurium TA100, TA1535 with and without metabolic activation negative (2).

Other effects

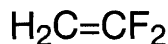
Any other adverse effects

Clinical studies of rats, mice and spectroscopic studies suggest the toxicity of 1,2-difluoroethane may be the result of metabolic conversion into fluorocitrate, an inhibitor of the citric acid cycle (1).

References

1. Lieder, P. et al *Chem. Eng. News* 1992, 70(19), 2.
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D332 1,1-difluoroethylene



$\text{C}_2\text{H}_2\text{F}_2$

Mol. Wt. 64.03

CAS Registry No. 75-38-7

Synonyms 1,1-difluoroethene; vinylidene difluoride; vinylidene fluoride; VDF

EINECS No. 200-867-7

RTECS No. KW 0560000

Uses Manufacture of copolymers.

Physical properties

M. Pt. -144°C B. Pt. -83°C Specific gravity 0.617 at 24°C Volatility v.p. 28 mmHg at 28°C ; v.den. 2.2

Solubility Water: 180 mg l⁻¹ at 25°C. Organic solvents: diethyl ether, ethanol

Occupational exposure

US-TWA 500 ppm

UN No. 1959 HAZCHEM Code 2PE Conveyance classification flammable gas

Mammalian & avian toxicity

Acute data

LC_{Lo} (4 hr) inhalation rat 128,000 ppm (1).

Carcinogenicity and chronic effects

No adequate evidence for carcinogenicity to humans, inadequate evidence of carcinogenicity to animals IARC classification group 3 (2).

Gavage rat (141 wk) 4.12 or 8.25 mg kg⁻¹ 4-5 day wk⁻¹ for 52 wk. Lipomas and liposarcomas of the adipose tissue at a frequency of 9% were reported for the high-dose group. Tumours were also reported in subcutaneous tissues and the abdominal cavity (3).

Metabolism and toxicokinetics

Following inhalation exposure of rats to concentrations up to 16000 ppm, tissue/air partition coefficients were found to be 0.18 for blood, 0.8 for liver, 1.0 for fatty tissues and 0.29 for muscles. Time to reach steady-state blood levels was <15 min (4).

Oxidative metabolism mediated by cytochrome P₄₅₀ leads to the formation of epoxides and the inactivation of haemoprotein. In phenobarbital-induced rat hepatic microsomes ≤ 17% cytochrome P₄₅₀ inactivation was reported (5).

Following inhalation exposure of rats, acetone exhalation was increased (6).

Genotoxicity

Salmonella typhimurium TA100 with metabolic activation marginally positive (7).

Other effects

Any other adverse effects

Inhalation rat (6 hr) 800,000 ppm induced deep, rapid laboured breathing and lethargy after 1 hr exposure; 7/10 rats had died after 4.5 hr. 1 hr after termination of exposure, the survivors appeared normal and exhibited no signs of toxicity during a 14-day observation period (8).

Inhalation rat (3.5 hr) 82,000 ppm produced no sign of hepatotoxicity. However, rats pretreated with Aroclor 1254 on three consecutive days and then exposed for 6 hr to 25,000 ppm had elevated serum levels of sorbitol dehydrogenase and histological signs of liver damage (9,10).

Other comments

Physical properties, use, carcinogenicity, mutagenicity, mammalian toxicity and metabolism reviewed (11).

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D333 1,1-difluorotetrachloroethane



$\text{C}_2\text{Cl}_4\text{F}_2$

Mol. Wt. 203.83

CAS Registry No. 76-11-9

Synonyms 1,1,1,2-tetrachloro-2,2-difluoroethane; difluorotetrachloroethane; 1,1-difluoroperchloroethane; tetrachlorodifluoroethane

EINECS No. 200-934-0

RTECS No. KI 1425000

Uses Refrigerant. Solvent.

Physical properties

M. Pt. 40.6°C B. Pt. 91.5°C Specific gravity 1.65 Volatility v.p. 40 mmHg at 20°C ; v.den. 7.0

Solubility Water: 100 mg l⁻¹ at 25°C. Organic solvents: chloroform, diethyl ether, ethanol

Occupational exposure

DE-MAK 1000 ppm (8500 mg m⁻³)

FR-VME 500 ppm (4170 mg m⁻³)

UK-LTEL 100 ppm (847 mg m⁻³)

UK-STEL 100 ppm (847 mg m⁻³)

US-TWA 500 ppm (4170 mg m⁻³)

Ecotoxicity

Bioaccumulation

Estimated bioconcentration factor of 46 indicates that environmental accumulation would not be significant (1).

Environmental fate

Degradation studies

Does not degrade in the troposphere. Diffusion into the stratosphere occurs with $t_{1/2}$ 20 yr. In the stratosphere, may undergo direct photolysis, producing chlorine atoms which participate in the catalytic removal of stratospheric ozone, or it may react with singlet oxygen. Stratospheric lifetime is predicted to be on the order of several decades (2).

Abiotic removal

Estimated volatilisation $t_{1/2}$ 4 hr from model river water (1).

Does not degrade in the troposphere. Diffusion into the stratosphere occurs with $t_{1/2}$ 20 yr. In the stratosphere, may undergo direct photolysis, producing chlorine atoms which participate in the catalytic removal of stratospheric ozone, or it may react with singlet oxygen. Stratospheric lifetime is predicted to be on the order of several decades (2).

Adsorption and retention

Estimated K_{oc} of 347 indicates that adsorption to soil and sediments would be moderate (1,3).

Mammalian & avian toxicity

Acute data

LC_{Lo} (30 min) inhalation rat 20,000 ppm (4). Inhalation rat 1% v/v for 1.5 hr caused slight central nervous depression; 2-3% was fatal in 2.5 hr (5).

Sub-acute and sub-chronic data

Oral rat 2000 mg kg⁻¹ day⁻¹ for 23-33 days caused no apparent toxic effects (5).

Other effects

Other adverse effects (human)

May be harmful by inhalation, ingestion or skin absorption. Prolonged exposure can cause narcotic effects (6).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (7).

Other comments

Reviews on human health effects, experimental toxicology, physico-chemical properties listed (8).

References

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2. Diling, W. in Conway, R. A. (Ed.) *Environmental Risk Analysis for Chemicals* 1982, 154-197, Van Nostrand Reinhold, New York, USA.
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6. Lenga, R. E. (Ed.) *Sigma-Aldrich Library of Chemical Safety Data* 2nd ed., 1988, 1, 1253, Sigma-Aldrich, Milwaukee, WI, USA.
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8. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuyse (Bte 6), B-1160 Brussels, Belgium

D334 1,2-difluorotetrachloroethane



$\text{C}_2\text{Cl}_4\text{F}_2$

Mol. Wt. 203.83

CAS Registry No. 76-12-0

Synonyms 1,1,2,2-tetrachloro-1,2-difluoroethane; ethane, tetrachlorodifluoro-

EINECS No. 200-935-6

RTECS No. KI 1420000

Uses Solvent. Refrigerant. Veterinary anthelmintic.

Physical properties

M. Pt. 58°C B. Pt. 62-63°C Specific gravity 1.6447 at 25°C with respect to water at 4°C

Partition coefficient $\log P_{\text{ow}}$ 3.73 (1) Volatility v.p. 65.8 mmHg at 20°C ; v.den. 7.03

Solubility Water: 120 mg l⁻¹ at 25°C. Organic solvents: chloroform, diethyl ether, ethanol

Occupational exposure

DE-MAK 200 ppm (1700 mg m⁻³)

FR-VME 500 ppm (4170 mg m⁻³)

UK-LTEL 100 ppm (847 mg m⁻³)

UK-STEL 100 ppm (847 mg m⁻³)

US-TWA 500 ppm (4170 mg m⁻³)

Ecotoxicity

Bioaccumulation

Estimated bioconcentration factor of 42 indicates that environmental accumulation would not be significant (2).

Environmental fate

Abiotic removal

Does not degrade in the troposphere. Diffusion to stratosphere occurs with $t_{1/2}$ 20 yr. In the stratosphere, undergoes slow direct photolysis, producing chlorine atoms which participate in catalytic removal of stratospheric ozone, or it may react with singlet oxygen. Stratospheric lifetime estimated to be of the order of several decades (3).

Estimated volatilisation $t_{1/2}$ 4 hr from model river water (2).

Adsorption and retention

Estimated K_{oc} of 314 indicates that adsorption to soil and sediments would be moderate (2,4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 800 mg kg⁻¹ (5).

LC₅₀ (2 hr) inhalation mouse 12,000 mg m⁻³ (5).

Inhalation rat (2.5 hr) 10,000, 20,000 or 30,000 ppm. At the low dose there were slight signs of intoxication but no loss of reflexes. The higher doses were fatal within 1.0-2.5 hr (6).

Sub-acute and sub-chronic data

Oral rat 2000 mg kg⁻¹ day⁻¹ for 23-33 days caused no toxic effects (6).

Inhalation rat 1000 ppm 18 hr day⁻¹ for 16 days caused no toxic effects (6).

Irritancy

Dermal guinea pig (24 hr) 100 mg liquid caused mild irritation and 100 mg instilled into guinea pig eye for 20 sec caused mild irritation (7).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (8).

The log P_{ow} value exceeds the European Community recommended level of 3.0 (6th and 7th Amendments) (9).

Other comments

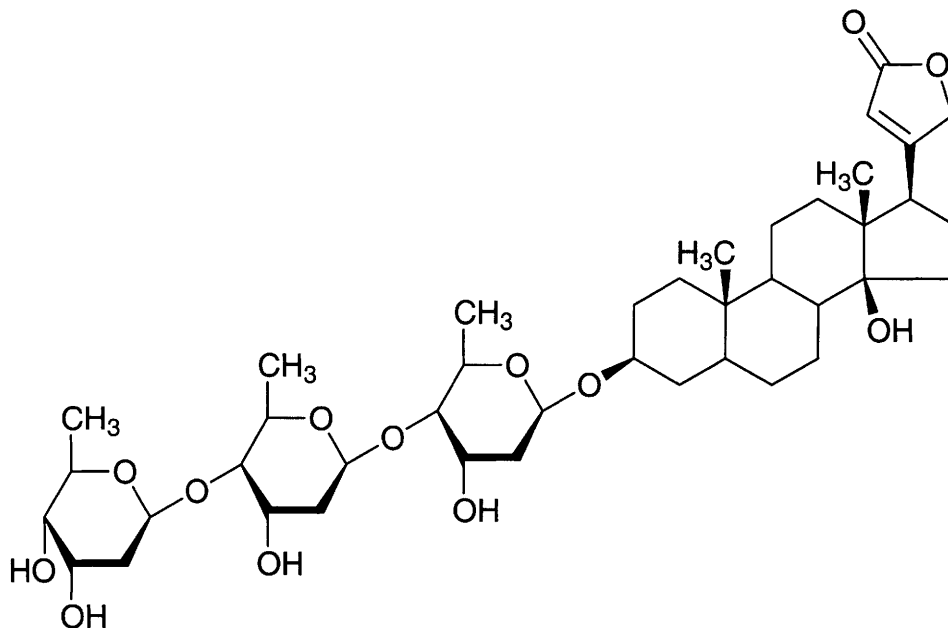
Environmental fate reviewed (10).

Reviews on human health effects, experimental toxicology, physico-chemical properties listed (11).

References

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2. Lyman, W. K. et al *Handbook of Chemical Property Estimation Methods Environmental Behaviour of Organic Compounds* 1982, McGraw-Hill, New York, USA.
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10. Howard, P. H. *Handbook of Environmental Fate and Exposure Data for Organic Chemicals* 1991, **2**, 401-404, Lewis, Chelsea, MI, USA.
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D335 digitoxin



C₄₁H₆₄O₁₃

Mol. Wt. 764.95

CAS Registry No. 71-63-6

Synonyms Cardigin; Carditoxin; Crystodigin; Digisidin; Digitphyllin; Digitoxigenin tridigitoxoside; Digitrin; Glucodigin; Purodigin; Purpurid; Unidigin

EINECS No. 200-760-5

RTECS No. IH 2275000

Uses Cardiotonic.

Occurrence Extracted from *Digitalis* species.

Physical properties

M. Pt. 240°C (decomp.) **Partition coefficient** log P_{ow} 2.82 (1)

Solubility Water: 10 mg l⁻¹ at 20°C. Organic solvents: acetone, amyl alcohol, chloroform, diethyl ether, ethanol, ethyl acetate, petroleum, pyridine

Occupational exposure

Supply classification toxic

Risk phrases Toxic by inhalation and if swallowed – Danger of cumulative effects (R23/25, R33)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S45)

Environmental fate

Abiotic removal

UV irradiation of digitoxin yields the epoxide predominantly (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 5, 56 mg kg⁻¹, respectively (3,4).

LD₅₀ subcutaneous mouse 22 mg kg⁻¹ (5).

LD₅₀ intraperitoneal mouse 3.9 mg kg⁻¹ (6).

LD₅₀ intravenous rat, mouse 3.9, 4.1 mg kg⁻¹, respectively (4).

Sub-acute and sub-chronic data

Subcutaneous pregnant rat (4 day) 10 mg kg⁻¹ day⁻¹ produced duodenal ulcers. The high incidence of these ulcers was concluded to be due to acid hypersecretion (7).

Metabolism and toxicokinetics

In vitro investigations on human liver tissue show that the digitoxin sugar chain can only be cleaved after preceding oxidation of the terminal sugar. The resulting dehydrodigitoxosyl is split off by β -elimination. The initial oxidation is catalysed by the cytochrome P₄₅₀ system. The rate-limiting step in this metabolic pathway is the first oxidation to 15'-dehydrodigitoxin (8).

Digitoxin is readily and completely absorbed from the gastro-intestinal tract when administered at therapeutic concentrations, giving plasma concentrations of 10-35 μ g l⁻¹. It is bound extensively to plasma protein.

Enterohepatic recycling occurs and digitoxin is excreted in the urine, mainly as metabolites. The elimination t_{1/2} is >7 days (9).

Irritancy

1% solution instilled into dog eye for 24 hr caused irritation (10).

Other effects

Other adverse effects (human)

Adverse effects in humans include nausea, vomiting, anorexia, diarrhoea and abdominal pain. Fatality may occur due to cardiac toxicity (9).

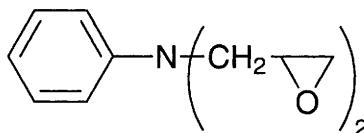
Other comments

Toxicity involves inhibition of the sodium-potassium ATPase pump (11).

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D336 *N,N*-diglycidylaniline



$C_{12}H_{15}NO_2$

Mol. Wt. 205.26

CAS Registry No. 2095-06-9

Synonyms *N,N*-bis(2,3-epoxypropyl)aniline; bis(2,3-epoxypropyl)aniline; bis(epoxypropyl)phenylamine; *N*-(oxiranylmethyl)-*N*-phenyl-oxiranemethanamine

EINECS No. 218-259-5

RTECS No. BW 8925000

Uses Intermediate in polymer synthesis.

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1620 mg kg⁻¹ (1).

LD₅₀ dermal rabbit 3560 mg kg⁻¹ (1).

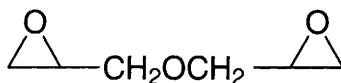
Irritancy

500 mg applied to rabbit skin and 500 mg instilled into rabbit eye for 24 hr caused severe irritation (2).

References

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D337 diglycidyl ether



$C_6H_{10}O_3$

Mol. Wt. 130.14

CAS Registry No. 2238-07-5

Synonyms 2,2'-[oxybis(methylene)]bisoxirane; bis(2,3-epoxypropyl) ether; glycidyl ether

EINECS No. 218-802-6

RTECS No. KN 2350000

Uses Cross-linking agent.

Physical properties

B. Pt. 260°C Flash point 64°C Specific gravity 1.1195 at 20°C with respect to water at 4°C

Volatility v.p. 0.09 mmHg at 25°C ; v.den. 3.78 at 25°C

Occupational exposure

DE-MAK 0.1 ppm (0.54 mg m⁻³)

FR-VME 0.1 ppm (0.5 mg m⁻³)

UK-LTEL 0.1 ppm (0.54 mg m⁻³)

US-TWA 0.1 ppm (0.53 mg m⁻³)

SE-CEIL 0.2 ppm (1.1 mg m⁻³)

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 170, 450 mg kg⁻¹, respectively (1).

LC₅₀ (4 hr) inhalation mouse 30 ppm (1).

LD₅₀ dermal rabbit 1500 mg kg⁻¹ (1).

LD₅₀ intravenous mouse, rabbit 100, 140 mg kg⁻¹, respectively (2,3).

Sub-acute and sub-chronic data

Inhalation rat (4 day) 20 ppm for 4 hr day⁻¹ caused severe respiratory irritation, loss of body weight, a decrease in leucocyte count and involution of the thymus and spleen (3).

Dermal rat (20 day) 60 mg kg⁻¹ day⁻¹ induced a drop in marrow nucleated cells and in white blood cell count at doses of 125 mg kg⁻¹ day⁻¹ (4).

Carcinogenicity and chronic effects

Dermal mouse (1 yr) application 3 × wk⁻¹ caused suppression of sebaceous glands, hyperkeratosis, epithelial hyperplasia and skin cancers (dosage not specified) (5).

Irritancy

Dermal rabbit (3 day) 563 mg caused severe irritation, and 113 mg instilled into rabbit eye (period of exposure unspecified) caused severe irritation (1).

Sensitisation

Reported to be a strong skin sensitiser (6).

Genotoxicity

Salmonella typhimurium TA100 with and without metabolic activation positive (7).

Vicia faba chromosomal aberrations positive (8).

Other effects

Any other adverse effects

Intravenous rabbit, single injections of 50, 100 or 200 mg kg⁻¹ caused leucopenia due to a decrease in polynuclear cells, and an increase in nucleated red cells (3).

References

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D338 diglyme



$\text{C}_6\text{H}_{14}\text{O}_3$

Mol. Wt. 134.18

CAS Registry No. 111-96-6

Synonyms bis(2-methoxyethyl) ether; diethylene glycol dimethyl ether; dimethyl carbinol; (2-methoxyethyl) ether; 2,5,8-trioxanonane; 1,1'-oxybis[2-methoxyethane]

EINECS No. 203-924-4

RTECS No. KN 3339000

Uses Solvent. Reaction medium for Grignard synthesis.

Physical properties

M. Pt. -64°C **B. Pt.** 162°C **Flash point** 70°C (open cup) **Specific gravity** 0.937 at 20°C with respect to water at 4°C

Solubility Water: miscible with water. Organic solvents: diethyl ether, ethanol, hydrocarbons

Occupational exposure

DE-MAK 5 ppm (28 mg m^{-3})

Mammalian & avian toxicity

Teratogenicity and reproductive effects

σ rats were exposed to 0, 110, 370 or 1100 ppm 6 hr day $^{-1}$ and 5 days wk $^{-1}$ for 2 wk then sacrificed 10, 14, 42 or 84 days post-exposure. Diglyme affected spermatocytes in pachytene and meiotic division at 100 ppm, round spermatids at 370 ppm and marked testicular atrophy affecting all spermatogenic stages at 1100 ppm. Most had normal morphology 84 days after exposure (1).

Inhalation φ rat (6 hr day $^{-1}$ for days 7 to 16 of gestation) 0, 25, 100, or 400 ppm. Rats were euthanised at day-21 of gestation. Maternal toxicity was observed as depressed feed consumption at 400 ppm and increased liver weight at 100 ppm. There were no live foetuses in the 400 ppm group. Embryo viability was not affected by concentrations up to 100 ppm, but a low incidence of malformations was observed in all groups (2).

Metabolism and toxicokinetics

Rats given oral doses of 683 or 6.83 mg kg $^{-1}$ [1,2-ethylene- ^{14}C]diglyme excreted 86-90% of radioactivity in urine in 96 hr, principally as 2-methoxyacetic acid, with a small amount of methoxyacetic acid (3).

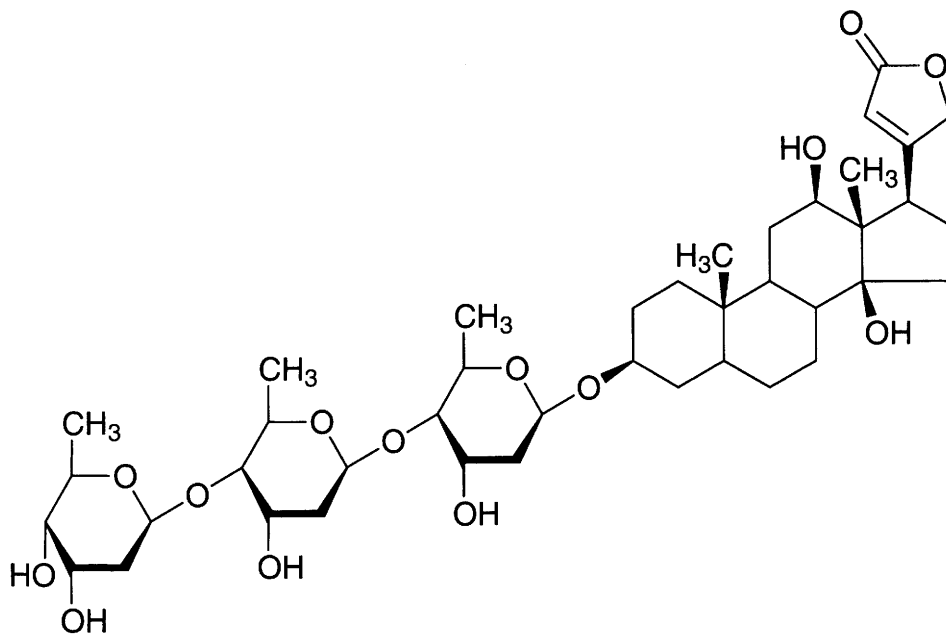
Legislation

Included in Schedule 4 (Release into Air: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

References

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D339 digoxin



$C_{41}H_{64}O_{14}$

Mol. Wt. 780.95

CAS Registry No. 20830-75-5

Synonyms Cardioreg; Coragoxine; Digacin; Lanacard; Lanacordin; Lenoxin; Novodigal

EINECS No. 244-068-1

RTECS No. IH 6125000

Uses Cardiotoxin.

Occurrence Isolated from *Digitalis lanata*.

Physical properties

M. Pt. 248-250°C (decomp.) **Partition coefficient** $\log P_{ow}$ 1.67 (1)

Solubility Organic solvents: chloroform, ethanol, methanol, pyridine

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 17.8 mg kg⁻¹ (2).

LD₅₀ intraperitoneal mouse 4.0 mg kg⁻¹ (3).

LD₅₀ intravenous rat, mouse 8, 25 mg kg⁻¹, respectively (2,4).

LD₅₀ subcutaneous rat, mouse 13, 30 mg kg⁻¹, respectively (2,5).

Teratogenicity and reproductive effects

In humans, no teratogenic effects have been reported, despite extensive antenatal use of digoxin (6).

Metabolism and toxicokinetics

Following intravenous administration of 0.6 mg tritiated digoxin, 81.3% radioactivity was found in the urine and 17.1% in faeces. Recovery of digoxin and metabolites in urine was 75.6% digoxin, 2.8% dihydrodigoxin, 1.6% digoxigenin bisdigitoxoside and 1.5% other metabolites. Following oral administration 65.7% radioactivity was recovered in the urine and 31.6% in faeces. Maximum plasma concentrations were 4.3 and 9.5 ng ml⁻¹ 40 min after oral administration for doses of 0.6 and 1.2 mg, respectively (7).

In therapeutic doses 70-90% is absorbed from the gastro-intestinal tract, giving plasma concentrations of 0.5-2.0 µg l⁻¹. It is widely distributed in body tissues including the heart, brain, erythrocytes and skeletal muscle. 20-30% is bound to plasma protein. The elimination t_{1/2} is 1.5-2 days. It is reported to cross the placenta freely. Digoxin is excreted mainly unchanged in the urine (8).

Other effects

Other adverse effects (human)

Adverse effects in humans include nausea, vomiting, anorexia, diarrhoea and abdominal pain. Fatality may occur due to cardiac toxicity (8).

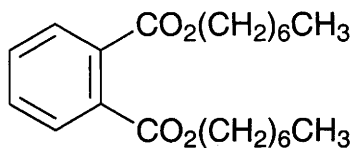
Any other adverse effects

Mice injected with digoxin (1 mg kg⁻¹ followed by 1-methyl-4-phenyl-1,2,5,6-tetrahydropyridine (MPTP) (20 mg kg⁻¹ were killed 1-8 days later and dopamine levels in the striatum were measured. MPTP alone caused a significant 35-45% reduction in striatal dopamine levels compared to those with control mice. However, pretreatment with digoxin completely prevented the MPTP-induced dopamine depletion. This was an unexpected result and suggests that cardiac glycosides may protect against MPTP neurotoxicity (9).

References

1. Atkinson, H. C. et al *J. Pharm. Sci.* 1988, **77**(9), 796-798.
2. *Arch. Int. Pharmacodyn. Ther.* 1965, **153**, 436.
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6. Rotmensch, H. H. et al *Ann. Intern. Med.* 1983, **98**, 487-497.
7. Hinderling, P. H. et al *Ther. Drug Monit.* 1991, **13**(5), 381-401.
8. *Martindale: The Extra Pharmacopoeia* 31st ed., 1996, The Royal Pharmaceutical Society, London, UK.
9. Johnson, S.W. et al *Neurotoxicol. Teratol.* 1997, **19**(5), 413-415

D340 diheptyl phthalate



C₂₂H₃₄O₄

Mol. Wt. 362.51

CAS Registry No. 3648-21-3

Synonyms 1,2-benzenedicarboxylic acid, diheptyl ester; di-*n*-heptyl phthalate; heptyl phthalate

EINECS No. 222-885-4

RTECS No. TI 1090000

Uses Plasticiser.

Physical properties

B. Pt. 360°C

Solubility Water: 0.01%. Organic solvents: benzene, kerosene, mineral oils, petrol, toluene

Occupational exposure

SE-LEVL 3 mg m⁻³

SE-STEL 5 mg m⁻³

Ecotoxicity

Bioaccumulation

No or low accumulation (1).

Environmental fate

Degradation studies

Biodegradable (1).

Mammalian & avian toxicity

Sub-acute and sub-chronic data

Oral rat (4 day) 2.6 g day^{-1} did not produce testicular atrophy or increased zinc excretion in the urine (2).

Teratogenicity and reproductive effects

Oral mouse $0.94\text{--}7.5 \text{ ml kg}^{-1}$ on days 7, 8, 9, 10 or 11 of gestation. Embryo/foetal toxicity was highest in days 7 and 8 with all foetuses being resorbed on day 8 when treated with 7.5 ml kg^{-1} . Foetal abnormalities, which included exencephaly, open eyelid, cleft palate, oligodactylia, tail anomaly, haematoma and skeletal malformation, were found in animals treated with 2.5 and 7.5 ml kg^{-1} on day 8 and 9 (3).

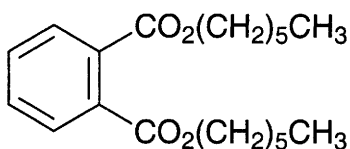
Other comments

Residues have been isolated from groundwaters, oil, soil and air (4).

References

1. Ministry of International Trade and Industry (MITI) 1984, Japan.
2. Foster, P. M. D. et al *Toxicol. Appl. Pharmacol.* 1980, **54**(3), 392-398.
3. Nakashima, K. et al. *Teratology* 1977, **28**(1-2), 167-180.
4. Calahan, M. A. et al *Water-Related Environmental Fate of 129 Priority Pollutants* 1979, **2**, 94-1, EPA-440/4-79-029b, Washington, DC, USA

D341 dihexyl phthalate



$\text{C}_{20}\text{H}_{30}\text{O}_4$

Mol. Wt. 334.46

CAS Registry No. 84-75-3

Synonyms 1,2-benzenedicarboxylic acid, dihexyl ester; di-*n*-hexyl phthalate; Jayflex DHP

EINECS No. 201-559-5

RTECS No. TI 1100000

Uses Plasticiser.

Physical properties

M. Pt. -58°C B. Pt. 210°C at 5 mmHg Flash point 177°C Specific gravity 0.995 at 20°C with respect to water at 4°C Partition coefficient $\log P_{\text{ow}}$ 5.8 (measured) (1) Volatility v.p. $1.4 \times 10^{-5} \text{ mmHg}$; v.den. 11.5 Solubility Water: 0.05 mg l^{-1} (2). Organic solvents: benzene, diethyl ether

Occupational exposure

SE-LEVL 3 mg m⁻³

SE-STEL 5 mg m⁻³

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr, static) bluegill, fathead minnow >0.11, >0.10 mg l⁻¹, respectively; NOEC 0.11, <0.10 mg l⁻¹, respectively (3-5).

Invertebrate toxicity

LC₅₀ (96 hr, static) *Daphnia magna* >0.18 mg l⁻¹; NOEC 0.03 mg l⁻¹ (3,6).

Bioaccumulation

Bioconcentration factor for *Daphnia* 1066-3254 (7).

Environmental fate

Degradation studies

Degraded by acclimated inoculum of soil, sewage and activated sludge after 28 days (8).

Phthalate esters undergo ≥ 50% ultimate degradation within 28 days in standardised aerobic biodegradation tests with sewage sludge inocula. Biodegradation is expected to be the dominant loss mechanism in surface water, soils and sediments (9).

Abiotic removal

Estimated t_{1/2} for reaction with photochemically produced hydroxyl radicals in the atmosphere 1.1 day (10).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 29.6 g kg⁻¹ (11).

LD₅₀ dermal rabbit 20 g kg⁻¹ (12).

Sub-acute and sub-chronic data

Oral rat (3 wk) 20 g kg⁻¹ diet, resulted in slight liver enlargement (13).

Teratogenicity and reproductive effects

Oral ♂ rat (4 day) 2 g kg⁻¹ day⁻¹ produced testicular atrophy, increased urinary excretion of zinc and decreased testicular zinc content. Histological examination revealed severe atrophy of the seminiferous tubules, most of which completely lacked spermatocytes and spermatids (14).

Oral mouse 0.3, 0.6 or 1.2% diet continuously caused a decrease in the frequency of fertile matings at the highest dose, associated with an increase in abnormal sperm and decrease in mobile sperm. Litter sizes were also reduced (15).

Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation, and 500 mg instilled into rabbit eye (24 hr) caused mild irritation (16).

Legislation

The log P_{ow} value exceeds the European Community recommended level 3.0 (17).

Other comments

Aquatic toxicity of eighteen phthalate esters reviewed (2).

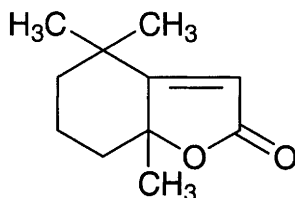
The environmental fate of eighteen phthalate esters reviewed (9).

References

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2. Staples, C. A. et al *Environ. Toxicol. Chem.* 1997, **16**(5), 875-891.

3. Adams, W. J. et al *Environ. Toxicol. Chem.* 1995, **14**, 1569-1574.
4. *Acute toxicity of thirteen phthalate esters to bluegill *Lepomis macrochirus** 1983, Springborn Bionomics, Chemical Manufacturers Association, Washington, DC, USA.
5. *Acute toxicity of fourteen phthalate esters to fathead minnows *Pimephales promelas** 1983, Springborn Bionomics, Chemical Manufacturers Association, Washington, DC, USA.
6. *Acute toxicity of fourteen phthalate esters to *Daphnia magna** 1984, Springborn Bionomics, Chemical Manufacturers Association, Washington, DC, USA.
7. Gloss, S. P. et al *ASTM Spec. Tech. Publ.* 854 1985, 202-213.
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9. Staples, C. A. *Chemosphere* 1997, **35**(4), 667-749.
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12. *Environ. Health Perspect.* 1973, **4**, 3.
13. Mann, A. H. et al *Toxicol. Appl. Pharmacol.* 1986, **77**(1), 116-132.
14. Foster, P. M. D. et al *Toxicol. Appl. Pharmacol.* 1980, **54**, 392-398.
15. Lamb, J. C. et al *Toxicol. Appl. Pharmacol.* 1987, **88**(2), 255-269.
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17. 1967 Directive on Classification, Packaging and Labelling of Dangerous Substances 67/548/EEC; 6th Amendment EEC Directive 79/831/EEC; 7th Amendment EEC Directive 91/32/EEC 1991, HMSO, London, UK

D342 dihydroactinidolide



$C_{11}H_{16}O_2$

Mol. Wt. 180.25

CAS Registry No. 17092-92-1

Synonyms 5,6,7,7a-tetrahydro-4,4,7a-trimethyl-2(4H)-benzofuranone

Occurrence Constituent of several fruit and tea aromas. Degradation product of carotenoids.

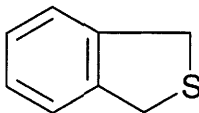
Other comments

Formed by marine sediments as a degradation product of carotenoids (1).

References

1. Repeta, D. J. *Geochim. Cosmochim. Acta* 1989, **53**(3), 699-707

D343 1,3-dihydrobenzo[c]thiophene



C_8H_8S

Mol. Wt. 136.22

CAS Registry No. 2471-92-3

Synonyms benzo[c]thiophene, 1,3-dihydro-; *o*-xylylene sulfide; 2-thiaindone; 2-thioindan

Uses Intermediate in production of electrochemical polymers.

Occurrence In shale oils and petroleum fractions (1).

Physical properties

M. Pt. 26°C B. Pt. 108°C at 14 mmHg Specific gravity 1.14 at 26°C with respect to water at 4°C

Other effects

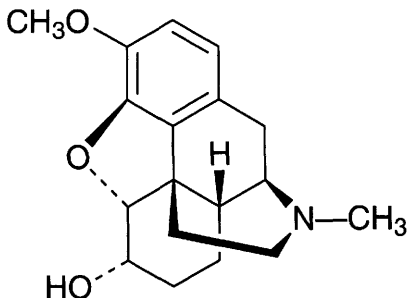
Any other adverse effects

Causes convulsions when administered to cats, rabbits, mice and guinea pigs. Doses of 10-25 mg kg⁻¹ decreased arterial blood pressure by 30-60 mmHg which persisted for 20-60 min (1).

References

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D344 dihydrocodeine



$C_{18}H_{23}NO_3$

Mol. Wt. 301.39

CAS Registry No. 125-28-0

Synonyms 4,5 α -epoxy-3-methoxy-17-methyl-morphinan-6 α -ol; Dihydrin; Dihydroneopine; Paracodin; Cohydrin

EINECS No. 204-732-3

RTECS No. QD 1680000

Uses Used in narcotic analgesic and antitussive medicines.

Physical properties

M. Pt. 112-113°C B. Pt. 248°C at 15 mmHg

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 240 mg kg⁻¹ (1).

LD₅₀ oral rabbit 400 mg kg⁻¹ (2).

LD₅₀ subcutaneous guinea pig, mouse 80-135 mg kg⁻¹, respectively (2,3).

LD₅₀ intravenous mouse 80 mg kg⁻¹ (3).

Metabolism and toxicokinetics

Metabolism considered to be similar to codeine. $t_{1/2}$ humans 3.5-4.5 hr, but only 20% of dose may get into systemic circulation, owing to first-pass metabolism in gut wall and/or liver, after oral dosing (4).

Metabolism is poorly described in humans, but the compound can be *O*-demethylated in the 3-position in the same manner as codeine. Inhibits *O*-demethylation of codeine by rat liver microsomal preparations (5).

Other effects

Other adverse effects (human)

Tolerance to analgesic and antitussive activities can develop (6,7).

Constipation is frequently seen, respiratory depression is not (6).

May cause dependence (6).

Legislation

Designated as a Controlled Drug; misuse of Drugs Act 1971.

Other comments

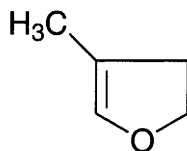
Commercial form is the tartrate, phosphate or hydrochloride salts available for oral or parenteral administration.

Side-effects are those of opiates in general, but to a lesser extent. Compound is frequently abused by opiate addicts (6).

References

1. *Toxicol. Appl. Pharmacol.* 1959, **1**, 42.
2. *Abdernalden's Handbuch der Biologischen Arbeitsmethoden* 1935, **4**, 1289, Leipzig, Germany.
3. *Therapie* 1951, **6**, 146.
4. *Eur. J. Clin. Pharmacol.* 1983, **25**, 419-424.
5. Mikus, G. *Biochem. Pharmacol.* 1991, **41**(5), 757-762.
6. *Martindale: The Extra Pharmacopoeia* 31st ed., 1996, The Royal Pharmaceutical Society, London, UK.
7. Kamei, J. *Jpn. J. Pharmacol.* 1991, **55**(3), 403-406

D345 2,3-dihydro-4-methylfuran



C₅H₈O

Mol. Wt. 84.12

CAS Registry No. 34314-83-5

Synonyms 2,3-dihydro-4-methylfuran; 4-methyl-2,3-dihydrofuran

Occurrence Present in aroma of several cooked meats and some fruits including ripe tomatoes.

Mammalian & avian toxicity

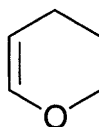
Metabolism and toxicokinetics

In mice, metabolic activation is necessary before toxicity to liver, kidney and lungs occurs (1).

References

1. Zenk, P. et al *Toxicology* 1990, **61**, 47-57

D346 dihydropyran



C₅H₈O

Mol. Wt. 84.12

CAS Registry No. 110-87-2

Synonyms Δ²-dihydropyran; 3,4-dihydro-2H-pyran

EINECS No. 203-810-4

Uses Chemical intermediate for variety of purposes including synthesis of pharmaceuticals and insecticides.

Hydroxyl group protecting agent.

Occurrence Produced by some fungi.

Physical properties

M. Pt. -70°C **B. Pt.** 85.6°C **Flash point** -15°C **Specific gravity** 0.923 at 20°C with respect to water at 4°C

Volatility v.den. 2.9

Occupational exposure

UN No. 2376 **HAZCHEM Code** 2YE **Conveyance classification** flammable liquid

Mammalian & avian toxicity

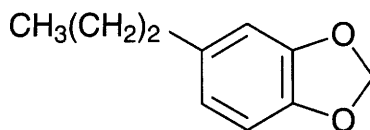
Acute data

LD₅₀ intraperitoneal mouse 256 mg kg⁻¹ (1).

References

1. *Summary Tables of Biological Tests* 1950, 2, 135, Council Chemical Biological Coordination Center, Washington, DC, USA

D347 dihydrosafrole



C₁₀H₁₂O₂

Mol. Wt. 164.20

CAS Registry No. 94-58-6

Synonyms 5-propyl-1,3-benzodioxole; 1,2-(methylenedioxy)-4-propylbenzene; 2',3'-dihydrosafrole; 3,4-methylenedioxypropylbenzene; 4-propyl-1,2-(methylenedioxy)benzene

EINECS No. 202-344-9

RTECS No. DA 6125000

Uses Flavour and fragrance properties (not currently used).

Physical properties

B. Pt. 228°C **Specific gravity** 1.0695 at 20°C with respect to water at 4°C

Solubility Organic solvents: acetic acid, benzene, diethyl ether, miscible ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 2.26, 3.7 g kg⁻¹, respectively (1).

Sub-acute and sub-chronic data

Oral rat (4 day) 770 mg kg⁻¹ caused macroscopic liver lesions and some deaths (2).

Carcinogenicity and chronic effects

No adequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (3).

Oral mice (82 wk) 1.4 g kg⁻¹ in diet showed evidence of increased liver cell tumours in ♂ only. The incidence of pulmonary tumours was significantly increased only when data from ♂ and ♀ were combined (4).

Oral rats (2 yr) 10 g kg⁻¹ in diet, developed tumours of the oesophagus (papillomas and epidermoid carcinomas) at doses above 1 g kg⁻¹. No tumours of the oesophagus were seen at lower doses and very few liver tumours were seen at any dose (1).

Oral mice, long-term study (concentration unspecified), developed hyperplasia and carcinomas of the forestomach, but generally no liver neoplasms (5).

Metabolism and toxicokinetics

Compound is metabolised in mice via the liver NADPH system, mainly by demethylation (6).

Metabolites include piperonylic acid detected in urine (6,7).

Genotoxicity

Salmonella typhimurium TA1535, TA100 with and without metabolic activation negative (8).

Other effects

Any other adverse effects

Compound binds directly to cytochrome P₄₅₀ and can inhibit benzo[a]pyrene hydroxylase and ethoxyresorufin-O-demethylase activity in hepatic microsomes (9).

Intraperitoneal mice (3 day) 300 mg kg⁻¹ produced induction of hepatic cytochrome P₄₅₀ (10).

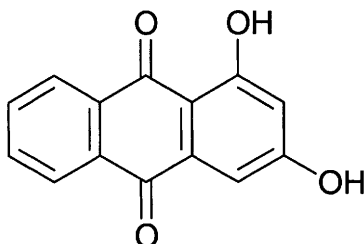
Other comments

Toxicology and human health effects reviewed (11).

References

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10. Lewandowski, M. J. *Biochem. Toxicol.* 1990, 5(1), 47-55.
11. IARC Monograph 1976, 10, 231-244

D348 1,3-dihydroxyanthraquinone



C₁₄H₈O₄

Mol. Wt. 240.22

CAS Registry No. 518-83-2

Synonyms 1,3-dihydroxy-9,10-anthracenedione

RTECS No. CB 6590000

Uses Dyestuff intermediate.

Occurrence Occurs naturally in plants such as root of *Rubia oncotricha* (1).

Physical properties

M. Pt. 268-270°C

Solubility Organic solvents: acetic acid, acetone, benzene, ethanol, nitrobenzene

Genotoxicity

Salmonella typhimurium TA1537 with and without metabolic activation positive; TA102 with and without metabolic activation negative (2).

In vitro studies with primary rat hepatocytes gave positive results in an unscheduled DNA synthesis test (2).

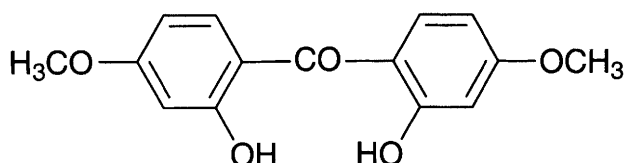
Transformation tests with C3H/m2 cells gave positive results (2).

Tumour promotion studies using rat hepatocytes and mouse fibroblast cells gave negative results (3).

References

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2. Westendorf, J. *Mutat. Res.* 1990, **240**(1), 1-12.
3. Woelfe, D. et al *Cancer Res.* 1990, **50**(20), 6540-6544

D349 2,2'-dihydroxy-4,4'-dimethoxybenzophenone



C₁₅H₁₄O₅

Mol. Wt. 274.27

CAS Registry No. 131-54-4

Synonyms bis(2-hydroxy-4-methoxyphenyl)methanone; benzophenone 6; Uvinul D-49

EINECS No. 205-027-3

RTECS No. DJ 0900000

Uses Ultraviolet protecting agent, used in sunscreen and cosmetics.

Physical properties

M. Pt. 139-140°C

Solubility Organic solvents: ethanol, toluene

Other effects

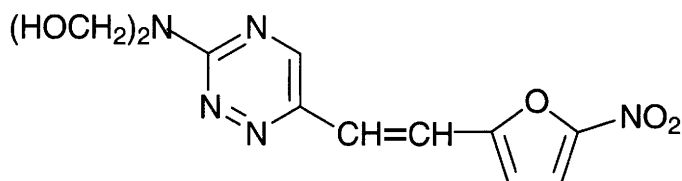
Any other adverse effects

Can cause contact sensitisation (1,2).

References

1. Pariser, R. J. *Contact Dermatitis* 1977, **3**, 172.
2. Thompson, G. et al *Arch. Derm.* 1977, **113**, 1252

D350 dihydroxymethylfuratrizine



$\text{C}_{11}\text{H}_{11}\text{N}_2\text{O}_5$

Mol. Wt. 251.22

CAS Registry No. 794-93-4

Synonyms bis(hydroxymethyl)furatrizine; Panfuran-S; Furatone

RTECS No. PC 3200000

Uses Antibacterial agent.

Physical properties

M. Pt. 157°C

Solubility Organic solvents: dimethylformamide

Mammalian & avian toxicity

Acute data

LD_{50} subcutaneous mouse 28 g kg^{-1} (1).

Sub-acute and sub-chronic data

Subcutaneous mouse (7 day) 7 mg mouse^{-1} caused weight loss and diarrhoea (1).

Carcinogenicity and chronic effects

No adequate evidence for carcinogenicity to humans, insufficient evidence for carcinogenicity to animals, IARC classification group 3 (2).

Oral rats (80 wk) 0.1% Panfuran-S in diet showed no overall increase in tumour incidence compared with controls. Two sarcomas and one adenocarcinoma were found in the small intestine of test animals (3).

Oral rats (35-37 wk) 1750-3500 ppm Panfuran-S in diet developed forestomach papillomas, duodenal adenocarcinomas and jejunal adenocarcinomas (4).

Oral mice (35 wk) ≥ 350 -3500 ppm Panfuran-S in diet developed oesophageal papillomas, oesophageal squamous-cell carcinomas, forestomach papillomas, forestomach squamous-cell carcinomas, duodenal/jejunal adenocarcinomas and urinary bladder transitional-cell carcinomas (5).

Metabolism and toxicokinetics

Oral rats ^{14}C -labelled dose (dose unspecified) completely eliminated radiolabel within 120 hr. Absorption was estimated at 40-50% and a maximum plasma level of 1.3 $\mu\text{g ml}^{-1}$ was reached after 2 hr. ^{14}C label was highest in the liver, bladder, stomach and intestine (6).

Other comments

Panfuran-S is the commercial formulation containing 200 g kg^{-1} dihydroxymethylfuratrizine and sucrose, sodium saccharin, methyl cellulose and spices (4).

Carcinogenicity and toxicity of dihydroxymethylfuratrizine and Panfuran-S reviewed (7).

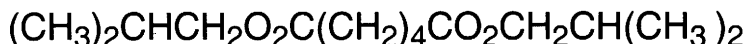
Antibacterial agent claimed to be effective against Gram-negative and -positive bacteria. No longer in use.

References

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3. Takai, A. et al *Chemotherapy (Tokyo)* 1974, **22**, 1171-1179.

4. Konishi, Y. et al *J. Natl. Cancer Inst.* 1978, **60**, 1339-1343.
5. Konishi, Y. et al *Onkologie* 1979, **2**, 41-42.
6. Takai, A. et al *Chemotherapy (Tokyo)* 1974, **22**, 1165-1170.
7. *IARC Monograph* 1980, **24**, 77-83

D351 diisobutyl adipate



$\text{C}_{14}\text{H}_{26}\text{O}_4$

Mol. Wt. 258.36

CAS Registry No. 141-04-8

Synonyms isobutyl adipate; hexanedioic acid, bis(2-methylpropyl) ester; adipic acid, diisobutyl ester; DIBA; Hall Tress DIBA

EINECS No. 205-450-3

RTECS No. AV 1480000

Uses Emolient and microemulsant in pharmaceuticals and toiletries. Used in insecticidal preparations.

Mammalian & avian toxicity

Acute data

LD₅₀ oral guinea pig 12.3 g kg⁻¹ (1).

LD₅₀ intraperitoneal rat 5.95 g kg⁻¹ (2).

Other comments

Air pollutant from building materials and furnishing materials.

References

1. *German Offenlegungsschrift Patent Documentation* 2703360 (Ger.) (*Chem. Abstr.* 87, 122647h).
2. *J. Pharm. Sci.* 1973, **62**, 1596

D352 diisobutylamine



$\text{C}_8\text{H}_{19}\text{N}$

Mol. Wt. 129.25

CAS Registry No. 110-96-3

Synonyms 2-methyl-N-(2-methylpropyl)-1-propanamine

EINECS No. 203-819-3

RTECS No. TX 1750000

Physical properties

M. Pt. -77 to -70°C B. Pt. 137-139°C Flash point 29°C Specific gravity 0.740 at 20°C with respect to water at 4°C Volatility v.p. 10 mmHg at 30.6°C

Occupational exposure

UN No. 2361 HAZCHEM Code 3WE Conveyance classification flammable liquid, corrosive

Ecotoxicity

Fish toxicity

Creek chub (24 hr) critical toxic concentration of 20-40 mg l⁻¹ (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, guinea pig, mouse 258, 620, 629 mg l⁻¹, respectively (2).

Genotoxicity

Salmonella typhimurium TA100, TA1535, TA1537, TA98 with and without metabolic activation negative (3).

Legislation

Maximum permissible concentration in domestic water in former USSR 0.07 mg l⁻¹ (4).

Other comments

Occurs in aroma of some cooked foods such as boiled shrimp and in river and sea water and sediments. Indoor air pollutant (5,6).

Some inhibitory effect has been observed against acetylcholinesterase activity, which is attributed to the quarternary nitrogen moiety (7).

Concentrations up to 100 × greater than control values have been detected in the air of buildings where casein floor coatings have been attacked by alkali-resistant *Clostridium* bacteria; sick-building syndrome has been reported in the occupants (8).

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D353 diisobutyl ketone



C₉H₁₈O

Mol. Wt. 142.24

CAS Registry No. 108-83-8

Synonyms 2,6-dimethylheptan-4-one; isovalerone; isobutyl ketone; s-diisopropylacetone; DIBK

EINECS No. 203-620-1

RTECS No. MJ 5775000

Uses Solvent for synthetic resins, coatings, nitrocellulose, lacquers and rubber. Intermediate in organic synthesis. Developer.

Physical properties

B. Pt. 169°C **Flash point** 45°C (closed cup) **Specific gravity** 0.806 at 20°C with respect to water at 4°C
Volatility v.p. 1.7 mmHg at 20°C ; v.den. 4.9
Solubility Water: 500 mg l⁻¹ at 20°C. Organic solvents: miscible with chloroform, diethyl ether, ethanol

Occupational exposure

FR-VME 25 ppm (250 mg m⁻³)
UK-LTEL 25 ppm (148 mg m⁻³)
US-TWA 25 ppm (145 mg m⁻³)
UN No. 1157 **HAZCHEM Code** 3 $\frac{+}{-}$ **Conveyance classification** flammable liquid
Supply classification irritant
Risk phrases Flammable – Irritating to the respiratory system (R10, R37)
Safety phrases Keep out of reach of children (if sold to general public) – Avoid contact with the skin (S2, S24)

Environmental fate

Degradation studies
BOD₅ using acclimated microbial cultures 4.86 mmol O₂ mmol⁻¹ chemical; 37% ThoD (1).
BOD₅ using acclimated mixed microbial cultures 6.08 mmol O₂ mmol⁻¹ chemical; 13% ThoD (2).
Abiotic removal
Evaporation rate relative to *n*-butyl acetate, which has been assigned a value of 1 at 25°C, is 0.176 (3).

Mammalian & avian toxicity

Acute data
LD₅₀ oral mouse, rat 1420, 5800 mg kg⁻¹, respectively (4,5).
LC₅₀ (4 hr) inhalation rat 2000 ppm (6).
LD₅₀ dermal rabbit 16 g kg⁻¹ (7).
Sub-acute and sub-chronic data
Kidney and liver damage were observed in rats following repeated exposure at 250 ppm (unspecified duration), but the animals survived saturated vapour concentrations of 3200 ppm (4).
Irritancy
Dermal rabbit (24 hr) 10 mg caused mild irritation (6).
Mildly irritating to the eyes of rabbits causing conjunctivitis, swelling and discharge. Contact with the skin produces reddening, cracking and dermatitis (4).
In volunteers, slight irritation of eyes, nose and throat was experienced at vapour concentrations of 50 ppm and 100 ppm for 3 hr (4).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic negative (8).
In vitro rat hepatocytes, Chinese hamster ovary cells chromosomal damage tests, bacterial mutation tests and mutation conversion tests with yeast all negative (9).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (10).

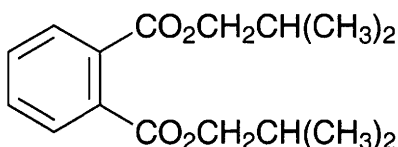
Other comments

Pollutant in air and waste water.
Reviews on toxicology and human health effects listed (11).

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4. *Chemical Safety Data Sheets: Solvents* 1989, **1**, The Royal Society of Chemistry, London, UK.
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7. *Raw Material Data Handbook* 1974, **1**, 23.
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11. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuysse (Bte 6), B-1160 Brussels, Belgium

D354 diisobutyl phthalate



$\text{C}_{16}\text{H}_{22}\text{O}_4$

Mol. Wt. 278.35

CAS Registry No. 84-69-5

Synonyms 1,2-benzenedicarboxylic acid, bis(2-methylpropyl) ester; phthalic acid, diisobutyl ester; isobutyl phthalate; Palatinol IC; Kodaflex DIBP; Uniplex 155; Corflex 440

EINECS No. 201-553-2

RTECS No. TI 1225000

Uses Plasticiser.

Physical properties

B. Pt. 327°C **Flash point** 185°C (open cup) **Specific gravity** 1.039-1.043

Solubility Water: 20 mg l⁻¹ (1)

Occupational exposure

SE-LEVL 3 mg m⁻³

SE-STEL 5 mg m⁻³

UK-LTEL 5 mg m⁻³

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr, flow-through) 0.9 (0.73-1.1) mg l⁻¹ (2).

Invertebrate toxicity

LC₅₀ (96 hr) *Nitocra spinipes* 3.0 (2.5-3.6) mg l⁻¹ (3).

Environmental fate

Degradation studies

Phthalate esters undergo ≥ 50% ultimate degradation within 28 days in standardised aerobic biodegradation tests with sewage sludge inocula. Biodegradation is expected to be the dominant loss mechanism in surface water, soils and sediments (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 13, 15 g kg⁻¹, respectively (5,6).
LD₅₀ intraperitoneal rat 3.75 g kg⁻¹ (7).
LD₅₀ dermal guinea pig 10 g kg⁻¹ (6).
Intraspecies variation in toxicity is reported to be small (8).

Teratogenicity and reproductive effects

Oral rats (7 day) 8.4 mg kg⁻¹ in diet developed severe testicular atrophy. High testosterone and low zinc levels were found in testes (9).
Oral mice (6-13 days gestation) 4 g kg⁻¹ produced no viable litters and 54% maternal death occurred (10). Results in rats were inconclusive (7).
A prediction of risk to humans has been made (11).

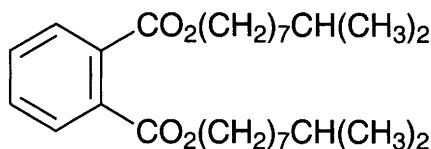
Other comments

Aquatic toxicity of eighteen phthalate esters reviewed (1).
The environmental fate of eighteen phthalate esters reviewed (4).
Pollutant in waste water and soil.

References

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5. *Environ. Health Perspect.* 1973, **3**, 131.
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D355 diisodecyl phthalate



C₂₈H₄₆O₄

Mol. Wt. 446.67

CAS Registry No. 26761-40-0

Synonyms 1,2-benzenedicarboxylic acid, diisodecyl ester; bis(isodecyl) phthalate; DIDP; Jayflex DIDP; Kodaflex DIDP; Palatinol DIDP; PX-120

EINECS No. 247-977-1

RTECS No. TI 1270000

Uses Plasticiser particularly in PVC products. Solvent.

Physical properties

M. Pt. -50°C B. Pt. 250-257°C Flash point 232°C
Solubility Water: <0.0013mg l⁻¹ (1)

Occupational exposure

SE-LEVL 3 mg m⁻³ SE-STEL 5 mg m⁻³
UK-LTEL 5 mg m⁻³

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr flow-through) rainbow trout, fathead minnow >0.62, >1.0 mg l⁻¹, respectively (2).

Invertebrate toxicity

LC₅₀ (48 hr, static) *Daphnia magna* >0.02 mg l⁻¹; NOEC 0.07 mg l⁻¹ (2,3).

Bioaccumulation

Non-accumulative or low accumulative (4).

Environmental fate

Degradation studies

Phthalate esters undergo ≥ 50% ultimate degradation within 28 days in standardised aerobic biodegradation tests with sewage sludge inocula. Biodegradation is expected to be the dominant loss mechanism in surface water, soils and sediments (4).

Mammalian & avian toxicity

Teratogenicity and reproductive effects

Oral mice (6-13 days gestation) receiving 9.65 g kg⁻¹ showed no adverse effects and litters did not differ from controls in respect of weight change, survival, or size (5).

Results with rats were inconclusive (6).

Gavage rats (6-15 day gestation) 0, 40, 200 and 1000 mg kg⁻¹ day⁻¹. Foetal effects of borderline significance observed at 1000 mg kg⁻¹ day⁻¹ (7).

Other comments

Water pollutant.

Reviews on experimental toxicology and human health effects are listed (8).

Aquatic toxicity of eighteen phthalate esters reviewed (1).

The environmental fate of eighteen phthalate esters reviewed (4).

References

1. Staples, C. A. et al *Environ. Toxicol. Chem.* 1997, **16**(5), 871-891.
2. Adams, W. J. et al *Environ. Toxicol. Chem.* 1995, **14**, 1569-1574.
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D356 diisopropanolamine



$\text{C}_6\text{H}_{15}\text{NO}_2$

Mol. Wt. 133.19

CAS Registry No. 110-97-4

Synonyms 1,1'-iminodipropan-2-ol; 1,1'-iminodi-2-propanol; 1,1'-iminobis-2-propanol; bis(2-hydroxypropyl)amine; bis(2-propanol)amine; DIPA

EINECS No. 203-820-9

RTECS No. UB 6600000

Uses Absorbent for the removal of hydrogen sulfide and carbon dioxide. Component of analgesic ointments. Catalyst. Corrosion inhibitor.

Physical properties

M. Pt. 44.5-45.5°C **B. Pt.** 249-250°C at 745 mmHg **Flash point** 127°C (open cup)

Specific gravity 1.004 at 20°C with respect to water at 4°C **Volatility** v.p. 0.02 mmHg at 42°C ; v.den. 4.6

Solubility Water: 870 g l⁻¹. Organic solvents: diethyl ether, ethanol

Occupational exposure

Supply classification irritant

Risk phrases Irritating to the eyes (R36)

Safety phrases Keep out of reach of children (if sold to general public) – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice (S2, S26)

Ecotoxicity

Invertebrate toxicity

LC₅₀ (48 hr) *Xenopus laevis* 410 mg l⁻¹ (1).

Environmental fate

Abiotic removal

Adsorption capacity on activated carbon 91 mg g⁻¹ carbon. Concentration of 1000 mg l⁻¹ in an incinerator effected 53.3% reduction (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 6.7 g kg⁻¹ (3).

LD₅₀ intraperitoneal mouse 96 mg kg⁻¹ (4).

Irritancy

Dermal rabbit, 500 mg caused mild irritation, and 50 mg instilled into rabbit eye caused severe irritation (periods of exposure unspecified) (3).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (5).

Other comments

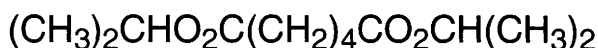
Reviews on experimental toxicology and human health effects listed (6).

Autoignition temperature 374°C.

References

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2. Guisti, D. M. et al *J. Water Pollut. Control Fed.* 1974, **46**(5), 947-965.
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D357 diisopropyl adipate



$\text{C}_{12}\text{H}_{22}\text{O}_4$

Mol. Wt. 230.30

CAS Registry No. 6938-94-9

Synonyms bis(1-methylethyl) adipate; adipic acid, diisopropyl ester; isopropyl adipate; hexanedioic acid, bis(1-methylethyl) ester; Unimate DIPA; Crodomol DA; Ceraphyl 230; Nikkol DID; Schercemol DIA

EINECS No. 230-072-0

RTECS No. AV 1575000

Uses In preparation of skin ointments and creams.

Physical properties

M. Pt. -1.1°C B. Pt. 120°C Specific gravity 0.9569 at 20°C

Solubility Organic solvents: acetone, diethyl ether, ethanol

Mammalian & avian toxicity

Acute data

LD_{50} intravenous rat 640 mg kg^{-1} (1).

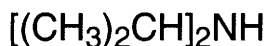
Irritancy

Dermal rabbit (24 hr) 100 mg caused mild irritation (2).

References

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D358 diisopropylamine



$\text{C}_6\text{H}_{15}\text{N}$

Mol. Wt. 101.19

CAS Registry No. 108-18-9

Synonyms *N*-(1-methylethyl)-2-propanamine; *N,N*-diisopropylamine

EINECS No. 203-558-5

RTECS No. IM 4025000

Uses Adsorption agent for hydrogen sulfide and carbon dioxide, catalyst, corrosion inhibitor, heat stabiliser for azeotropes, in organic synthesis.

Physical properties

M. Pt. -61°C **B. Pt.** 84°C **Flash point** -6°C (open cup) **Specific gravity** 0.722 at 22°C with respect to water at 4°C **Partition coefficient** $\log P_{ow}$ 1.73 (1) **Volatility** v.p. 70 mmHg at 20°C ; v.den. 3.5
Solubility Water: miscible. Organic solvents: acetone, benzene, diethyl ether, ethanol

Occupational exposure

FR-VME 5 ppm (20 mg m⁻³)

SE-LEVL 5 ppm (20 mg m⁻³)

SE-STEL 10 ppm (40 mg m⁻³)

UK-LTEL 5 ppm (21 mg m⁻³)

US-TWA 5 ppm (21 mg m⁻³)

UN No. 1158 **HAZCHEM Code** 3WE **Conveyance classification** flammable liquid, corrosive

Supply classification highly flammable

Supply classification corrosive

Risk phrases Highly flammable – Harmful by inhalation and if swallowed – Causes burns (R11, R20/22, R34)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Keep away from sources of ignition – No smoking – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – Wear suitable protective clothing, gloves and eye/face protection – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S16, S26, S36/37/39, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (24 hr) creek chub ~50 mg l⁻¹ (2).

Invertebrate toxicity

EC₅₀ (24 hr) *Daphnia magna* 53 mg l⁻¹ (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 770 mg kg⁻¹ (3).

LD₅₀ oral mouse, guinea pig, rabbit 2120, 2800, 4700 mg kg⁻¹, respectively (4).

LC₅₀ (2 hr) inhalation rat 4800 mg m⁻³ (5).

Irritancy

750 µg instilled into rabbit eye caused severe irritation (period of exposure unspecified) (3).

Genotoxicity

Salmonella typhimurium TA87, TA88, TA100, TA1535, TA1537 with and without metabolic activation negative (6).

Other effects

Other adverse effects (human)

Reported to cause nausea, headache and visual impairment among workers exposed to 25-50 ppm (7).

Any other adverse effects

Intravenous rat, single dose of 30 mg kg⁻¹ reduced blood pressure by 34% with a corresponding reduction in heart rate of 40 beats min⁻¹ (8).

Concentrations of 600 ppm or above caused hydropic degeneration and cloudy swelling of the corneal epithelium and partial or total blindness in animal studies (7).

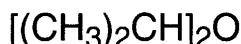
Other comments

Physical properties, toxicity and safety procedures reviewed (9).

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D359 diisopropyl ether



C₆H₁₄O

Mol. Wt. 102.18

CAS Registry No. 108-20-3

Synonyms 2,2'-oxybispropane; isopropyl ether; bis(isopropyl) ether; diisopropyl oxide; 2-isopropoxypropane; 2,4-dimethyl-3-oxapentane

EINECS No. 203-560-6

RTECS No. TZ 5425000

Uses Solvent. Fuel additive. Catalyst.

Physical properties

M. Pt. -60°C **B. Pt.** 68.5°C **Flash point** -28°C **Specific gravity** 0.7258 at 20°C with respect to water at 4°C
Partition coefficient log P_{ow} 1.52 **Volatility** v.p. 150 mmHg at 25°C ; v.den. 3.5
Solubility Water: 0.2% at 20°C. Organic solvents: acetone, diethyl ether, ethanol

Occupational exposure

DE-MAK 500 ppm (2100 mg m⁻³)

FR-VME 250 ppm (1050 mg m⁻³)

UK-LTEL 250 ppm (1060 mg m⁻³)

UK-STEL 310 ppm (1310 mg m⁻³)

US-TWA 250 ppm (1040 mg m⁻³)

US-STEL 310 ppm (1300 mg m⁻³)

UN No. 1159 **HAZCHEM Code** 3WE **Conveyance classification** flammable liquid

Supply classification highly flammable

Risk phrases Highly flammable – May form explosive peroxides (R11, R19)

Safety phrases Keep out of reach of children (if sold to general public) – Keep container in a well ventilated place – Keep away from sources of ignition – No smoking – Take precautionary measures against static discharges (S2, S9, S16, S33)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr flowthrough) fathead minnow 92 mg l⁻¹ (1).

LC₅₀ (24 hr) goldfish 380 mg l⁻¹ (2).

LC₅₀ (96 hr static) bluegill sunfish, inland silverside 6600-7000 mg l⁻¹ (3).

Invertebrate toxicity

EC₅₀ (5 min) *Photobacterium phosphoreum* 500ppm Microtox test (4).

Environmental fate

Nitrification inhibition

IC₅₀ (25 day) *Nitrosomonas* 610 mg l⁻¹ (1).

Carbonaceous inhibition

IC₅₀ (50 day) methanogenic bacterial culture 4200 mg l⁻¹ (1).

Degradation studies

Permanganate value 0.013 mg O₂ l⁻¹; ThOD 2.833 mg O₂ l⁻¹ (5).

Abiotic removal

98% removal from ventilation waste gases from the manufacture of polyurethane shoe soles by combustion at 800-830°C (6).

Absorption capacity of activated carbon 162 mg g⁻¹ carbon. 80% reduction of waste water at a concentration of 1023 mg l⁻¹ (7).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 8470 mg kg⁻¹ (8).

LC₅₀ inhalation rabbit, rat, mouse 121, 131, 162 g m⁻³, respectively (9).

LD₅₀ dermal rabbit 20 g kg⁻¹ (8).

LD₅₀ intraperitoneal mouse 812 mg kg⁻¹ (10).

Sub-acute and sub-chronic data

Rats of each sex were exposed by inhalation to 0, 480, 3300 or 7100 ppm for 6 hr day⁻¹, 5 days wk⁻¹ for about 90 days. Exposure did not adversely affect clinical signs, body weight, serum chemistry, haematology or the number of sperm or spermatids. Exposure of ♂s to 7100 ppm resulted in hypertrophy of liver cells associated with increased liver and kidney weight and increased incidence of hyaline droplets in the proximal tubules of the kidney. Female rats showed increased liver and kidney weight but no morphological changes, as did males at 3300 ppm. No changes were observed at 480 ppm (11).

Teratogenicity and reproductive effects

In a developmental toxicity study, pregnant rats (22 group⁻¹) were exposed by inhalation to 0, 430, 3095 or 6745 ppm for 6 hr day⁻¹ on gestation days 6-15 and sacrificed on day-20. With 6745 ppm, dams had a slight reduction in body weight gain and a significant decrease in food consumption. A concentration-related increase in the presence of rudimentary 14th ribs was observed, but its significance was uncertain. There was no apparent maternal or foetal toxicity at the lowest concentration. This study and a sub-chronic study (see entry above) indicate a low order of toxicity for diisopropyl ether (11).

Irritancy

Dermal rabbit 363 mg caused mild irritation (period of exposure unspecified) (8).

Vapour concentration of 800 ppm for 5 min produced eye and nasal irritation in humans, with respiratory discomfort and anaesthesia. Concentrations below 300 ppm are reported not to be irritant (12).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537, TA1538 with and without metabolic activation negative (13).

Saccharomyces cerevisiae JD1, mitotic gene conversion negative (13).

In vitro Chinese hamster ovary cells chromosomal damage negative (13).

Other effects

Any other adverse effects

Major physiological response among exposed mammals is general anaesthesia (14).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (15).

Other comments

Forms unstable peroxides in air, producing a serious explosion hazard (14).

Physical properties, toxicity and safety procedures for diisopropyl ether reviewed (14).

Toxicology reviewed (16).

Explosive limits 1.4-7.9%; autoignition temperature 443°C.

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15. *S. I.* 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
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D360 diisopropyl peroxydicarbonate



$\text{C}_8\text{H}_{14}\text{O}_6$

Mol. Wt. 206.20

CAS Registry No. 105-64-6

Synonyms peroxydicarbonic acid, bis(1-methylethyl) ester; peroxydicarbonic acid, diisopropyl ester; diisopropyl peroxydiformate; isopropyl peroxydicarbonate; diisopropyl perdicarbonate; IPP

EINECS No. 203-317-4

RTECS No. SD 9800000

Uses Catalyst.

Physical properties

M. Pt. 8-10°C Specific gravity 1.080 at 15°C with respect to water at 4°C

Solubility Organic solvents: benzene, carbon tetrachloride, chloroform, diethyl ether, toluene

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 2140 mg kg⁻¹ (1).

LD₅₀ dermal rabbit 2025 mg kg⁻¹ (2).

Irritancy

500 mg instilled into rabbit eye caused severe irritation (period of exposure unspecified) (1).

Legislation

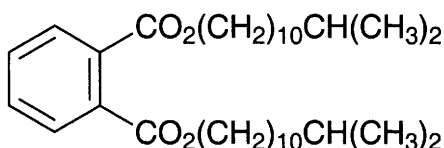
Oxidising agents are included in Schedule 6 (Release in Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (3).

Other comments

Self accelerating decomposition temperature 10°C.

References

1. *Ind. Hyg. Found. Am., Chem. Toxicol. Ser., Bull.* 1967, **6**, 1.
2. *Soc. Plast. Ind. Bull.* 1/75-19 B.
3. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D361 diisotridecyl phthalate

$\text{C}_{34}\text{H}_{58}\text{O}_4$

Mol. Wt. 530.83

CAS Registry No. 27253-26-5

Synonyms

EINECS No. 248-368-3

RTECS No. TI 1380000

Uses Fuel additive. Plasticiser

Occupational exposure

SE-LEVL 3 mg m⁻³

SE-STEL 5 mg m⁻³

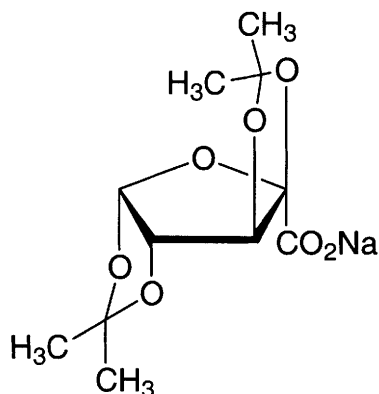
Mammalian & avian toxicity**Acute data**

LD₅₀ oral rat 31 g kg⁻¹ (1).

References

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D362 dikegulac-sodium



$C_{12}H_{17}NaO_7$

Mol. Wt. 296.25

CAS Registry No. 52508-35-7

Synonyms 2,3:4,6-di-*O*-isopropylidene-2-keto-L-gulonic acid, sodium salt; 2,3:4,6-bis-*O*-(1-methylethylidene)- α -L-xylo-2-hexulofuranosonic acid, sodium salt; Atrinal; ACR 1139A; Ro 7-6145

EINECS No. 257-976-8

RTECS No. MQ 3570000

Uses Plant growth regulator.

Physical properties

M. Pt. $>300^{\circ}\text{C}$ **Volatility** v.p. $<9.75 \times 10^{-9}$ mmHg at 25°C

Solubility Water: 590 g l^{-1} at 25°C . Organic solvents: acetone, chloroform, cyclohexane, dioxane, ethanol, hexane, methanol

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) bluegill sunfish >10 g l^{-1} (1).

LC₅₀ (96 hr) rainbow trout, goldfish, harlequin fish >5 g l^{-1} (1).

Invertebrate toxicity

LD₅₀ oral, topical bee >0.1 mg bee⁻¹ (1).

Environmental fate

Abiotic removal

Undergoes hydrolysis to sodium 2,3-*O*-isopropylidene-2-keto-L-gulonate, the acid is formed in acidic media (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 18 g kg^{-1} (2).

LD₅₀ dermal rat >1 g kg^{-1} (3).

Sub-acute and sub-chronic data

LC₅₀ (5 days) oral mallard duck, chicken, Japanese quail >50 g kg^{-1} diet (1).

Oral rat and dog (90 day) rats receiving 2 g kg^{-1} day⁻¹ and dogs receiving 3 g kg^{-1} day⁻¹ showed no ill-effects (1).

Legislation

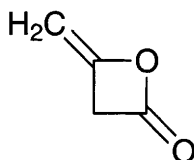
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration $0.1 \mu\text{g l}^{-1}$ (4).

Include in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (5).

References

1. *The Agrochemicals Handbook* 3rd ed. 1991, The Royal Society of Chemistry, London, UK.
2. *Farm Chemicals Handbook* 1991, C107, Meister Publ., Willoughby, OH, USA.
3. *The Pesticide Manual* 11th ed., 1997, The British Crop Protection Council, Farnham, UK.
4. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
5. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D363 diketene



$\text{C}_4\text{H}_4\text{O}_2$

Mol. Wt. 84.07

CAS Registry No. 674-82-8

Synonyms acetyl ketene; 3-buten- β -lactone; 4-methylene-2-oxetanone; diketene

EINECS No. 211-617-1

RTECS No. RQ 8225000

Uses Used in the manufacture of pigments and in the synthesis of acetoacetic acid esters. Bactericide.

Physical properties

M. Pt. -6.5°C **B. Pt.** 127.4°C ; $69-70^\circ\text{C}$ at 100 mmHg **Flash point** 45°C **Specific gravity** 1.0897 at 20°C with respect to water at 20°C **Volatility** v.p. 8 mmHg (temperature unspecified) ; v.den. 2.9 at 20°C

Solubility Water: decomp.

Occupational exposure

UN No. 2521 HAZCHEM Code 2Y **Conveyance classification** toxic substance, danger of fire (flammable liquid)

Supply classification harmful

Risk phrases Flammable – Harmful by inhalation (R10, R20)

Safety phrases Keep out of reach of children (if sold to general public) – Keep in a cool place (S2, S3)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 560 mg kg⁻¹ (1).

LC₅₀ (24 hr) inhalation guinea pig 3 mg m⁻³ (2).

LC₅₀ (1 hr) inhalation rat 2000 ppm (3).

LD₅₀ dermal rabbit 2830 mg kg⁻¹ (1).

Other comments

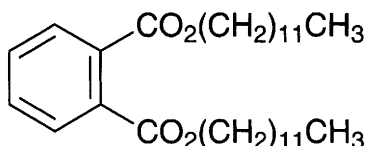
Polymerisation occurs slowly on standing. Violent polymerisation is catalysed by acids and bases. Storage hazard (4).

Reviews on physico-chemical properties, ecotoxicology, experimental toxicology and human health effects listed (5).

References

1. Carpenter, C. I. et al *Toxicol. Appl. Pharmacol.* 1974, **28**, 313.
2. Demel, I. et al *Wochenbl. Papierfabr.* 1983, **111**(3), 95-102.
3. *Ind. Hyg. Found. Am. Chem. Toxicol. Ser. Bull.* 1961, **26**, 1.
4. *Union Carbide Data Sheet* 1963, Union Carbide Corp. New York, USA.
5. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuysse (Bte 6), B-1160 Brussels, Belgium

D364 dilauryl phthalate



$C_{32}H_{54}O_4$

Mol. Wt. 502.78

CAS Registry No. 2432-90-8

Synonyms 1,2-benzenedicarboxylic acid, didodecyl ester; didodecyl phthalate; di-*n*-dodecyl phthalate

EINECS No. 219-415-5

RTECS No. TI 0930000

Uses Solvent, plasticiser.

Physical properties

M. Pt. 22-24°C

Occupational exposure

SE-LEVL 3 mg m⁻³

SE-STEL 5 mg m⁻³

Ecotoxicity

Toxicity to other species

In vitro toad bladder, did not significantly affect water flow across the bladder membrane. Sodium transport was inhibited by ≈ 30% at a concentration of 500 mg l⁻¹ after 4 hr incubation (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat and mouse 1500 mg kg⁻¹ (2).

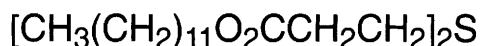
Legislation

Organic solvents are included in Schedule 6 (Release into Land: Prescribed Substances) of Statutory Instrument No. 472, 1991 (3).

References

1. Sabatini, S. et al *J. Pharmacol. Exp. Ther.* 1989, **250**(3), 910-914.
2. Izmerov, N. F. et al *Toxicometric Parameters of Industrial Toxic Chemicals Under Single Exposure* 1982, 49, CIP, Moscow, USSR.
3. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D365 dilauryl 3,3'-thiodipropionate



$\text{C}_{30}\text{H}_{58}\text{O}_4\text{S}$

Mol. Wt. 514.85

CAS Registry No. 123-28-4

Synonyms 3,3'-thiobispropanoic acid, didodecyl ester; didodecyl 3,3'-thiopropionate; dilauryl β,β' -thiopropionate; thiobis(dodecyl propionate); DLT; DLTDP; DLTP; Carstab DLTDP; Cyanox LTDP; Wytox LT; PAG DLTDP

EINECS No. 204-614-1

RTECS No. UF 8000000

Uses Antioxidant. Heat stabiliser. Polymerisation inhibitor. Food additive.

Physical properties

M. Pt. 39-40°C B. Pt. 240°C at 1 mmHg Flash point 148°C Specific gravity 0.916 at 20°C

Solubility Organic solvents: acetone, benzene, chloroform, diethyl ether, ethanol, toluene

Mammalian & avian toxicity

Teratogenicity and reproductive effects

Oral mouse, 1600 mg kg^{-1} on 10 consecutive days of gestation had no teratogenic or foetotoxic effect (1).

Metabolism and toxicokinetics

Readily absorbed from the intestinal tract of the dog, rabbit and rat. Predominantly eliminated in the urine as thiodipropionic acid (2).

Irritancy

500 mg instilled into rabbit eye for 24 hr caused moderate irritation (3).

Genotoxicity

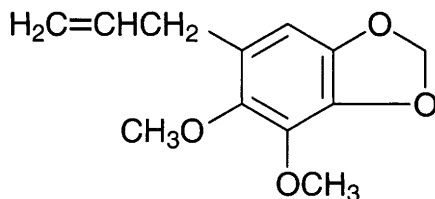
Salmonella typhimurium TA98, TA100, TA1535, TA1537, TA1538 with and without metabolic activation negative (4).

Escherichia coli WP2 with and without metabolic activation negative (4).

References

1. Food and Drug Res. Lab. 1972, US NTIS PB Report PB-221 776, 40.
2. Lefaux, R. *Practical Toxicology of Plastics* 1968, 402, CRC Press Cleveland, OH, USA.
3. Marhold, J. V. *Sbornik Vysledku Toxikologickeho Vysetroni Latek A Priprovku* 1972, 174, Prague, Czechoslovakia.
4. Prival, M. J. et al *Mutat. Res.* 1991, **260**(4), 321-329

D366 dill apiole



C₁₂H₁₄O₄

Mol. Wt. 222.24

CAS Registry No. 484-31-1

Synonyms 4,5-dimethoxy-6-(2-propenyl)-1,3-benzodioxole; 1-allyl-2,3-dimethoxy-4,5-(methylenedioxy)benzene

RTECS No. CY 2490000

Uses Insecticide. Nematicide.

Occurrence Isolated from dill (*Anethum graveolens*) seed (1).

Physical properties

M. Pt. 29.5°C **B. Pt.** 285°C **Specific gravity** 1.1598 at 15°C with respect to water at 15°C

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 1000 mg kg⁻¹ (2).

Other effects

Any other adverse effects

Following intraperitoneal administration to mice, DNA adducts were formed in the liver (3).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (4).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (5).

References

1. Su, H. C. F. et al *J. Agric. Food Chem.* 1988, **36**(4), 752-753.
2. *Indian J. Pharm.* 1972, **34**, 69.
3. Randerath, K. et al *Carcinogenesis (London)* 1984, **5**(12), 1613-1622.
4. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
5. *S. I. 1991 No. 472 The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

**C₄H₁₂FN₂OP****Mol. Wt.** 154.12**CAS Registry No.** 115-26-4**Synonyms** *N,N,N',N'*-tetramethylphosphorodiamidic fluoride; tetramethylphosphorodiamidic fluoride; bis(dimethylamido)fluorophosphate**EINECS No.** 204-076-8**RTECS No.** TD 4025000**Uses** Superseded insecticide and acaricide.

Physical properties

B. Pt. 67°C at 4 mmHg **Specific gravity** 1.1151 at 20°C with respect to water at 4°C**Volatility** v.p. 0.36 mmHg at 25°C**Solubility** Water: miscible. Organic solvents: benzene, chloroform, diethyl ether

Occupational exposure

Supply classification very toxic**Risk phrases** Very toxic in contact with skin and if swallowed (R27/28)**Safety phrases** Keep locked up and out of the reach of children (if sold to general public) – Do not breathe vapour – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of insufficient ventilation, wear suitable respiratory equipment – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S23, S28, S36/37, S38, S45)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1.0-7.5 mg kg⁻¹ (1-3).LC₅₀ (10 min) inhalation mouse 950 mg m⁻³ (3).LD₅₀ dermal rat 2 mg kg⁻¹ (4).LD₅₀ intraperitoneal mouse, rat 1.4, 5.0 mg kg⁻¹, respectively (1,5).LD₅₀ subcutaneous mouse 1 mg kg⁻¹ (3).

Metabolism and toxicokinetics

In rats, undergoes hydrolysis at the fluorine atom and demethylation of the dimethylamino group. Following oral administration, eliminated via the urine (6).

Other effects

Other adverse effects (human)

In humans, cholinesterase activity is lowered by 8 hr exposure to 0.1 mg m⁻³ (6).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (7).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (8).

References

1. Okinaka, A. J. et al *J. Pharmacol. Exp. Ther.* 1954, **112**, 231.
2. *Bull. Entomol. Soc. Am.* 1966, **12**, 161.
3. *National Technical Information Service* PB158-508, Springfield, VA, USA.
4. *World Rev. Pest Control* 1970, **9**, 119.

5. *AMA Arch. Ind. Hyg. Occup. Med.* 1952, 6, 9.
6. *The Agrochemicals Handbook* 1st ed., 1983, The Royal Society of Chemistry, London, UK.
7. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
8. *S. I.* 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D368 dimefuron



C₁₅H₁₉ClN₄O₃

Mol. Wt. 338.79

CAS Registry No. 34205-21-5

Synonyms *N'*-[3-chloro-4-[5-(1,1-dimethylethyl)-2-oxo-1,3,4-oxadiazol-3(2*H*)-yl]phenyl]-*N,N*-dimethylurea ; 3-[4-(2-*tert*-butyl-5-oxo-Δ²-1,3,4-oxadiazolin-4-yl)-3-chlorophenyl]-1,1-dimethylurea; Ranger; Scorpio

EINECS No. 251-879-4

RTECS No. YS 4000000

Uses Herbicide.

Physical properties

M. Pt. 193°C **Partition coefficient** log *P*_{ow} 2.51 (1) **Volatility** v.p. 0.75 × 10⁻⁶ mmHg at 20°C

Solubility Water: 16 mg l⁻¹ at 20°C. Organic solvents: acetone, acetonitrile, acetophenone, benzene, chloroform, ethanol, toluene, xylene

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout, bluegill sunfish >1000 mg l⁻¹ (1).

Invertebrate toxicity

LD₅₀ (48 hr) contact >500 μg formulation bee⁻¹, oral >2563 μg formulation bee⁻¹ (2).

Environmental fate

Degradation studies

Residual activity persists in the soil for 3-6 months following application in late autumn or winter. Microbial degradation increases rapidly in the spring as temperature rises (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, dog 1-2 g kg⁻¹ (3,2).

LD₅₀ oral mouse 10 mg kg⁻¹ (3).

LD₅₀ dermal rabbit >1 g kg⁻¹ (1).

LD₅₀ intraperitoneal rat ≈4 g kg⁻¹ (1).

Sub-acute and sub-chronic data

Oral rat and dog (90 day) no-effect level for rats was 150 mg kg⁻¹ day⁻¹ and for dogs 20 mg kg⁻¹ (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration $0.1 \mu\text{g l}^{-1}$ (4).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (5).
WHO Toxicity Class Table 5 (6).

Other comments

Mode of action is via photosynthetic electron flow inhibition (2).

Metabolic pathways reviewed (7).

References

1. *The Agrochemicals Handbook* 3rd ed., 1991, The Royal Society of Chemistry, London, UK.
2. *The Pesticide Manual* 11th ed., 1997, The British Crop Protection Council, Farnham, UK.
3. *Farm Chemicals Handbook* 1991, C108, Meister Publ., Willoughby, OH, USA.
4. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
5. S. I. 1991 No 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
6. *The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification* 1998-1999 WHO/PCS/98.21.
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D369 dimercaprol



$\text{C}_3\text{H}_8\text{OS}_2$

Mol. Wt. 124.23

CAS Registry No. 59-52-9

Synonyms 2,3-dimercapto-1-propanol; dimercaptol; dimercaptopropanol; dithioglycerol; Antoxol; BAL; British Anti-Lewisite; Sulfactin

EINECS No. 200-433-7

RTECS No. UB 2625000

Uses Anti-gas warfare agent. Antidote to arsenic, gold and mercury poisoning. Chelating agent in veterinary medicine.

Physical properties

B. Pt. 60°C at 0.2 mmHg **Specific gravity** 1.2385 at 25°C with respect to water at 4°C **Volatility** v.den. 4.3

Solubility Water: 8.7 g 100 ml^{-1} . Organic solvents: diethyl ether, ethanol, vegetable oils

Mammalian & avian toxicity

Acute data

LD_{50} subcutaneous rat 2 g kg^{-1} (1).

LD_{50} intramuscular rabbit, rat 50, 86.7-105 mg kg^{-1} , respectively (2-4).

LD_{50} intraperitoneal mouse, rat 56, 105 mg kg^{-1} , respectively (1,5).

LD_{50} intravenous rabbit, mouse 50, 56 mg kg^{-1} , respectively (2,6).

Metabolism and toxicokinetics

Maximum blood concentrations, following intramuscular injection, may occur within 30 to 60 min in humans. Metabolism is fast with the chelated metals and metabolites excreted in bile and urine. Within 4 hr of a single dose, elimination is complete (7).

Irritancy

Caused erythema and oedema to skin and is highly irritating to the eyes (species unspecified) (8).

Other effects

Other adverse effects (human)

High doses raise temperature and cause restlessness, rapid pulse, nausea, increased blood pressure, vomiting and convulsions (8).

Tachycardia and hypertension are the most frequent side-effects; others include rhinorrhoea, conjunctivitis, abdominal pain, headache and lachrymation and salivation. Transient reductions in the leucocyte count have been reported. Although relatively frequent and dose-related, side-effects are usually reversible (7).

Any other adverse effects

At low concentrations it inhibits and at higher concentration it enhances Na⁺, K⁺ ATPase activity (9).

Other comments

Increased rate of C mitosis in *Allium cepa* roots (10).

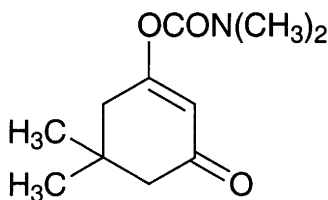
Acts as a metal chelating agent in humans, mammals, bacteria and plants (8,11).

Reactivates enzymes, including pyruvate dehydrogenase, ATPase and carboxylase, that are inhibited by As³⁺ (12).

References

1. *Ann. Pharm. Fr.* 1947, 5, 172.
2. *Biochem. J.* 1947, 41, 325.
3. Zvirblis, P. et al *Toxicol. Appl. Pharmacol.* 1976, 36, 297.
4. Schwetz, B. A. et al *Toxicol. Appl. Pharmacol.* 1974, 27(3), 621.
5. *NTIS Report AD277-689 Natl. Tech. Inf. Ser.*, Springfield, VA, USA.
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8. Clayton, G. D. et al (Eds.) *Patty's Industrial Hygiene and Toxicology* 3rd ed., 1981, 2082-2083, Interscience Publishers, New York, USA.
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D370 dimetan



C₁₁H₁₇NO₃

Mol. Wt. 211.26

CAS Registry No. 122-15-6

Synonyms 5,5-dimethyl-3-oxocyclohex-1-en-1-yl dimethylcarbamate; dimethylcarbamic acid, ester with 3-hydroxy-5,5-dimethyl-2-cyclohexen-1-one; ENT 24725; G 19258; Geigy 19258

EINECS No. 204-525-8

RTECS No. FA 1500000

Uses Superseded insecticide.

Physical properties

M. Pt. 45-46°C B. Pt. 170-180°C at 11 mmHg

Solubility Water: 31.5 g l⁻¹ at 20°C. Organic solvents: acetone, cyclohexane, diethyl ether, ethanol, gasoline, petroleum ether

Occupational exposure

Supply classification toxic

Risk phrases Toxic if swallowed (R25)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S36/37, S45)

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 90, 120 mg kg⁻¹, respectively (1,2).

Other effects

Any other adverse effects

Inhibits cholinesterase activity (3).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (4).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (5).

References

1. *World Rev. Pest Control* 1970, 9, 119.
2. Perkow, W. *Wirksubstanzen der Pflanzenschutz und Schaedlingsbekaempfungsmittel* 1976, Verlag, Paul Parey, Berlin, Germany.
3. *The Merck Index* 12th ed., 1996, Merck & Co., Inc., Whitehouse Station, NJ, USA.
4. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
5. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D371 dimethachlor



C₁₃H₁₈ClNO₂

Mol. Wt. 255.74

CAS Registry No. 50563-36-5

Synonyms 2,6-dimethyl-N-(2-methoxyethyl)chloroacetanilide; 2-chloro-N-(2,6-dimethylphenyl)-N-(2-methoxyethyl)acetamide; A 4766; A 5089; CGA 17020; Teridox

EINECS No. 256-625-6

RTECS No. AB 5438000

Uses Herbicide.

Physical properties

M. Pt. 45.8–46.7°C **B. Pt.** ~320°C (decomp. ~300°C) **Specific gravity** 1.23 at 20°C

Partition coefficient $\log P_{ow}$ 2.17 (1) **Volatility** v.p. 1.125×10^{-5} mmHg at 25°C

Solubility Water: 2.3 g l⁻¹ at 25°C. Organic solvents: acetone, benzene, carbon tetrachloride, dichloromethane, ethanol, methanol, toluene

Occupational exposure

Supply classification harmful, dangerous for the environment

Risk phrases Harmful if swallowed – May cause sensitisation by skin contact – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R22, R43, R50/53)

Safety phrases Keep out of reach of children (if sold to general public) – Avoid contact with skin – Wear suitable gloves – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S2, S24, S37, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout, crucian carp, bluegill sunfish 3.9, 8, 15 mg l⁻¹, respectively (1).

Environmental fate

Degradation studies

t_{1/2} in soil 14–60 days (1).

Abiotic removal

t_{1/2} for hydrolysis >200 days (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1600 mg kg⁻¹ (1).

LC₅₀ (2 hr) inhalation rat >750 mg m⁻³ (1).

LD₅₀ dermal rat >3170 mg kg⁻¹ (1).

Sub-acute and sub-chronic data

Oral rat, dog (90 day) no-effect level for rats was 700 mg kg⁻¹ diet, and for dogs 350 mg kg⁻¹ diet (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (3).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

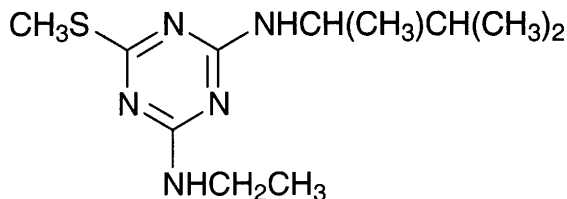
Other comments

Residues have been found in surface waters (5).

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D372 dimethametryn



$C_{11}H_{21}N_5S$

Mol. Wt. 255.39

CAS Registry No. 22936-75-0

Synonyms *N*-(1,2-dimethylpropyl)-*N'*-ethyl-6-(methylthio)-1,3,5-triazine-2,4-diamine;
2-[(1,2-dimethylpropyl)amino]-4-(ethylamino)-6-(methylthio)-s-triazine; Dimepax; Sparkstar

EINECS No. 245-337-6

Uses Herbicide.

Physical properties

M. Pt. 65°C B. Pt. 151-53°C at 0.05 mmHg Specific gravity 1.098 at 20°C Partition coefficient $\log P_{ow}$ 3.8

(1) Volatility v.p. 1.40×10^{-6} mmHg at 20°C

Solubility Water: 50 mg l⁻¹ at 20°C. Organic solvents: acetone, dichloromethane, hexane, methanol, *n*-octanol, toluene

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) crucian carp and rainbow trout 5, 8 mg l⁻¹, respectively (1).

Environmental fate

Degradation studies

$t_{1/2}$ in soils \approx 140 days (2).

Abiotic removal

No significant hydrolysis occurs within 28 days (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 3000 mg kg⁻¹ (1).

LD₅₀ dermal rat > 2150 mg kg⁻¹ (1).

Sub-acute and sub-chronic data

Oral rat and dog (90 day) no-effect level for dogs was > 1000 mg kg⁻¹ diet and for rats 300 mg kg⁻¹ diet (1).

Metabolism and toxicokinetics

Major metabolic pathways in the rat include *S*-demethylation followed by conjugation with glucuronic acid, *N*-deethylation and *S*-oxide formation followed by conjugation with reduced glutathione. Competitive reactions include hydrolysis of the transient sulfoxide derivatives and *N*-dealkylation of the dimethylpropyl side-chain (3).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (4).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (5).

The log P_{ow} value exceeds the European Community recommended level 3.0 (6).
WHO Toxicity Class III (7).
EPA Toxicity Class II (formulation) (1).
ADI 0.01 mg kg⁻¹ (1).

Other comments

Metabolic pathways reviewed (8).

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2. *The Pesticide Manual* 11th ed., 1997, The British Crop Protection Council, Farnham, UK.
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7. *The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification* 1998-1999 WHO/PCS/98.21.
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D373 dimethicone

CAS Registry No. 9006-65-9

Synonyms dimethylsiloxane; dimethylpolysiloxane; methyl polysiloxane; Dimethicone 350; Dimeticone; Belsil CM 1000; CPS034; Sentry Dimethicone; Dow Corning 360 Medical Fluid

Uses Used in topical barrier preparations for protecting the skin against water soluble irritants. Used topically as wound dressing.

Physical properties

Solubility Organic solvents: carbon tetrachloride, chloroform, diethyl ether, ethanol, ethyl acetate, methyl ethyl ketone, toluene

Other effects

Other adverse effects (human)

Accidental intravascular injection has been fatal (1).

Foreign-body reactions have been reported following use in joint implants. Other implants are reported to carry the risk of migration with cyst formation. Granulomatous reactions, pneumonitis and pulmonary oedema have occurred (2).

Other comments

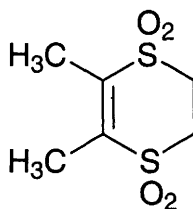
Retrospective results and complications of 47 treatments with fluid dimethylpolysiloxane (silicone). Tissue reactions and aesthetic results described. Different types of complications and their management discussed. The study concludes that fluid dimethylpolysiloxane has not proved to be a proper material for plastic reconstructive and aesthetic treatment in the head and neck region (3).

Breast implant materials and the connection between polydimethylsiloxane and polyurethane to human adjuvant disease and carcinogenesis reviewed (4).

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4. Dunn, K. W. et al *Br. J. Plast. Surg.* 1992, **45**(4), 315-321

D374 dimethipin



$C_6H_{10}O_4S_2$

Mol. Wt. 210.28

CAS Registry No. 55290-64-7

Synonyms 2,3-dihydro-5,6-dimethyl-1,4-dithiin, 1,1,4,4-tetraoxide; Harvade; Defanet

EINECS No. 259-572-7

RTECS No. JO 5090000

Uses Defoliant. Plant growth regulator.

Physical properties

M. Pt. 167-169°C **Specific gravity** 1.59 g cm⁻³ at 23°C (1) **Partition coefficient** log P_{ow} -0.17 at 24°C (1)

Volatility v.p. 3.8 × 10⁻⁷ mmHg at 25°C

Solubility Water: 4.6 g l⁻¹ at 25°C. Organic solvents: acetone, acetonitrile, toluene, xylene

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) sheepshead minnow, bluegill sunfish, rainbow trout 17.8, 20.9, 52.8 mg l⁻¹, respectively (1).

Invertebrate toxicity

LC₅₀ (48 hr) *Daphnia* sp. 21.3 mg l⁻¹ (1).

LC₅₀ (96 hr) *Mysidopsis bahia* 13.9 mg l⁻¹ (1).

LD₅₀ >100 µg bee⁻¹ (25% formulation) (1).

Environmental fate

Degradation studies

t_{1/2} in soil 104-149 day (2).

Abiotic removal

Undergoes UV photolysis. Sodium ethanedisulfonate was the only decomposition product that could be identified (3).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 440, 1180 mg kg⁻¹, respectively (2).

LC₅₀ (1 hr) inhalation rat >20 g m⁻³ (1).

LD₅₀ dermal rabbit >12 g kg⁻¹ (2).

Sub-acute and sub-chronic data

LC₅₀ (8 day) oral bobwhite quail 4522 mg kg⁻¹ diet (2).

LC₅₀ (8 day) mallard duck >10,000 mg kg⁻¹ diet (2).

Carcinogenicity and chronic effects

Oral mouse (18 month) no-adverse-effect level 80 mg kg⁻¹ diet (2).

Oral rat (2 yr) no-adverse-effect level 40 mg kg⁻¹ (2).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (4).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (5).

WHO Toxicity Class III (6).

EPA Toxicity Class I (formulation) (1).

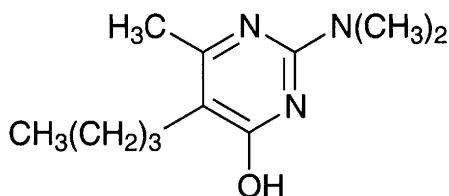
Tolerable Daily Intake (TDI) in humans 0.02 mg kg⁻¹ (1).

Other comments

Toxicity and hazards reviewed (7).

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D375 dimethirimol

C₁₁H₁₉N₃O

Mol. Wt. 209.29

CAS Registry No. 5221-53-4

Synonyms 5-butyl-2-(dimethylamino)-6-methyl-4(1H)-pyrimidinone; 5-butyl-2-(dimethylamino)-6-methyl-4-pyrimidinol; melkeb; methyrimol; Milcurb

EINECS No. 226-021-7

RTECS No. UW 6025000

Uses Fungicide.

Physical properties

M. Pt. 102°C **Partition coefficient** $\log P_{ow}$ 1.9 (1) **Volatility** v.p. 1.1×10^{-5} mmHg at 30°C
Solubility Water: 1.2 g l⁻¹ at 25°C. Organic solvents: acetone, chloroform, ethanol, xylene

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) brown trout 28 mg l⁻¹ (1).

Invertebrate toxicity

LD₅₀ oral bee 4000 mg kg⁻¹ (2).

Environmental fate

Abiotic removal

Decomposes under sunlight in aqueous solution with a $t_{1/2}$ of ~7 day (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral hen 4000 mg kg⁻¹ (3).

LD₅₀ oral rat >4000 mg kg⁻¹ (3).

LD₅₀ oral guinea pig, mouse 500, 1600 mg kg⁻¹, respectively (1).

LD₅₀ intraperitoneal rat 200-400 mg kg⁻¹ (3).

Sub-acute and sub-chronic data

Dermal rabbit (14 day) 500 mg kg⁻¹ caused no adverse effect (2).

Carcinogenicity and chronic effects

Oral rat and dog (2 yr) no-adverse-effect level for rats 300 mg kg⁻¹ diet and for dogs 25 mg kg⁻¹ diet (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (4).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (5).

WHO Toxicity Class Table 5 (6).

EPA Toxicity Class (formulation) (1).

References

1. *The Agrochemicals Handbook* 3rd ed., 1991, The Royal Society of Chemistry, London, UK.
2. *The Pesticide Manual* 11th ed., 1997, The British Crop Protection Council, Farnham, UK.
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4. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
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6. *The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification* 1998-1999 WHO/PCS/98.21

D376 dimethoate



$\text{C}_5\text{H}_{12}\text{NO}_3\text{PS}_2$

Mol. Wt. 229.26

CAS Registry No. 60-51-5

Synonyms *O,O*-dimethyl *S*-(*N*-methylcarbamoyl)methyl phosphorodithioate; phosphorodithioic acid, *O,O*-dimethyl ester, *S*-ester with 2-mercapto-*N*-methylacetamide; Aadimethoat; Ace-Thios; Afidrex; Agrex R; Bi 58; Blattlaus Spray; Callidim; Chimigor; Cygon

EINECS No. 200-480-3

RTECS No. TE 1750000

Uses Insecticide. Acaricide.

Physical properties

M. Pt. 49°C **B. Pt.** 117°C at 0.1 mmHg **Specific gravity** 1.2777 at 65°C with respect to water at 4°C

Partition coefficient $\log P_{\text{ow}}$ 0.704 (1) **Volatility** v.p. 5.1×10^{-6} mmHg at 25°C

Solubility Water: 25 g l⁻¹ at pH 9 and 20°C. Organic solvents: acetone, benzene, carbon tetrachloride, chloroform, dichloromethane, diethyl ether, ethanol, toluene

Occupational exposure

Supply classification harmful

Risk phrases Harmful in contact with skin and if swallowed (R21/22)

Safety phrases Keep out of reach of children (if sold to general public) – Wear suitable protective clothing and gloves (S2, S36/37)

Ecotoxicity

Fish toxicity

LC₅₀ (24 hr) bluegill sunfish, rainbow trout, mosquito fish 6, 6.2, 40-60 mg l⁻¹, respectively (2).

A presumed safe concentration of 2.73×10^{-7} g l⁻¹ was established using 96 hr exposure data for *Daphnia* sp., scud, mullet fry, *Cyclops strennus*, *Biomphalaria alexandria*, *Bulinus truncatus*, and *Tilapia nilotica* (3).

Invertebrate toxicity

LC₅₀ *Asellus aquaticus* 3.1 mg l⁻¹ (time of exposure unspecified) (4).

EC₅₀ (24 hr) *Artemia* sp. (Artoxkit M) 303 mg l⁻¹, *Brachionus plicatilis* (Rotokit M) 244 mg l⁻¹ (5).

♂ Shore crabs (*Carcinus maenas*) exposed to 0-2.0 mg l⁻¹ dimethoate suffered concentration-dependent reductions in heart rate and haemolymph acetylcholinesterase activity (6).

LD₅₀ oral, contact honeybee 0.1-0.2 µg bee⁻¹ (7,8).

Bioaccumulation

A calculated bioconcentration factor of 2 indicates that environmental accumulation is unlikely (9).

Bioconcentration (12 hr) initial concentration in water 1 µg l⁻¹ *Tetrahymena pyriformis* concentrated dimethoate to 3547 µg g⁻¹ dry weight (10).

Bioaccumulation of dimethoate (16.66 mg l⁻¹) in the gill tissue of *Clarias batrachus* increased from 24 hr (4.04 µg g⁻¹ wet weight) to 48 hr (13.39 µg g⁻¹ wet weight) then decreased until 192 hr. Dimethoate was completely eliminated from gill tissue 192 hr after release into fresh water (11).

Environmental fate

Degradation studies

Degradation in clay loam soil in 2 wk, 77% in unsterilised soil, 18% in autoclaved soil. The significance of biodegradation depends on soil type, with $t_{1/2}$ 11-122 days (9).

Methylotrophic bacteria MB 127 (Zimet No. 11070) aerobically cultured can be used to eliminate dimethoate from waste water (12).

Soil type influenced degradation, clay loam soils showed an atypical 1-2 day delay before decay commenced (13).

Abiotic removal

Rate of removal in waste water with activated carbon for COD and organic phosphorus 50-55% and 90%, respectively (14).

Average losses from soil due to evaporation in 6 days were 40, 32, 23 and 25% in sand, sandy clay loam, loam and clay loam, respectively. Losses were directly proportional to water losses (15).

$t_{1/2}$ for hydrolysis in river water at 70°C was 22 hr at pH 8. It was estimated that hydrolysis rates would be several hundred times slower at environmentally relevant temperatures (16).

$t_{1/2}$ for reaction with photochemically produced hydroxyl radicals in the atmosphere 2.8 hr (17).

Activated carbon can remove dimethoate from waste water (14).

Ozonation (1.5-2.3 mg l⁻¹) is more effective than chlorination in removing dimethoate from water if the concentration is ≤ 0.6 mg l⁻¹ (18).

$t_{1/2}$ in surface or groundwater 99 days (19).

Adsorption and retention

K_f for various soils 1.06-8.95. Adsorption is conditioned by surface area and cation exchange capacity of the soil (20).

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird, 6.6-17.8 mg kg⁻¹ (21).

LD₅₀ oral starling 31.6 mg kg⁻¹ (21).

LD₅₀ oral rat 387 mg kg⁻¹ (7).

LC₅₀ (4 hr) inhalation rat >1.6 mg m⁻³ air (7).

LD₅₀ dermal rat 353 mg kg⁻¹ (22).

LD₅₀ subcutaneous rat 350 mg kg⁻¹ (22).

LD₅₀ intraperitoneal rat, mouse 45, 100 mg kg⁻¹, respectively (22).

LD₅₀ intravenous rat 450 mg kg⁻¹ (22).

Sub-acute and sub-chronic data

LC₅₀ (5 day) oral Japanese quail, ring-necked pheasant, mallard duck 332-1010 mg kg⁻¹ (23).

Oral rat (90 day-1 yr) ≤ 15 mg day⁻¹ diet, no inhibition of cholinesterase activity (8).

Carcinogenicity and chronic effects

National Toxicology Program tested rats and mice via feed. Negative results were reported in rats and mice (24).

Oral rat (2 yr) 0, 2, 20 or 200 mg kg⁻¹ diet. Neither leukemogenic nor carcinogenic effects were observed (25).

Teratogenicity and reproductive effects

Oral mice (five-generation study) 60 ppm in drinking water, litters were normal for size and weight. Pup mortality was increased and growth rate decreased. No teratological effects observed (26).

Oral pregnant rats (day-18 gestation) 21.5 mg kg⁻¹ showed less inhibition of acetylcholinesterase activity in blood, brain and liver than did fetuses, due to inability of the latter to metabolise the compound well. Significant inhibition was seen within 1 hr of dosing (27).

Metabolism and toxicokinetics

In mammals undergoes oxidation to the phosphorothioate and hydrolysis to *O,O*-dimethyl phosphorodithioate, *O,O*-dimethyl phosphorothioate and *O,O*-dimethyl phosphate. The ester group is demethylated and the methylamino group is hydrolytically cleaved. Oxidation of the phosphorothioate gives the corresponding oxone which is highly toxic and a strong cholinesterase inhibitor, and which appears to be more persistent than dimethoate (7).

Sensitisation

In dermatitis patch tests on volunteer farm workers no significant effects were observed (28).

Genotoxicity

Salmonella typhimurium TA98 with metabolic activation positive (29).

Escherichia coli SOS Chromotest, with and without metabolic activation negative (30).

Drosophila melanogaster sex-linked recessive lethal assay, eye and ♀ mosaic assays positive (31).
In vitro Chinese hamster ovary cells, chromosomal aberrations positive, sister chromatid exchange positive (32).
In vivo mouse dominant lethal mutation assay negative (33).
Allium cepa and barley, chromosomal aberrations in meristem positive (34).

Other effects

Any other adverse effects

In treated rats, collagen content reduced if the skin tensile strength and shrinkage temperature decreased. The activities of acid and alkaline phosphatase activities in the bone were also decreased (35).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration $0.1 \mu\text{g l}^{-1}$ (36).
 Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (37).
 ADI in humans 0.002 mg kg^{-1} (7).
 EPA Toxicity Class II (formulation) (7).
 WHO Class II (38).
 UK advisory level for drinking water $3 \mu\text{g l}^{-1}$ (39).

Other comments

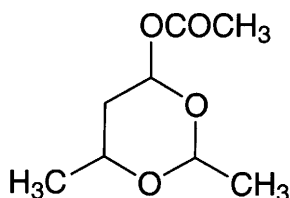
Residues have been isolated from water, soil, fish and crops (9).
 Cholinesterase inhibitor (7).
 Environmental fate of dimethoate reviewed (9).
 Toxicity and hazards reviewed (40,41).

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D377 dimethoxane



$C_8H_{14}O_4$

Mol. Wt. 174.20

CAS Registry No. 828-00-2

Synonyms 2,6-dimethyl-1,3-dioxan-4-ol acetate; acetomethoxane; 2,6-dimethyl-*m*-dioxan-4-ol acetate; 2,4-dimethyl-6-acetoxy-1,3-dioxane; 2,4-dimethyl-*m*-dioxanyl 6-acetate

EINECS No. 212-579-9

RTECS No. AH 1350000

Uses Disinfectant. Preservative in cutting oils, resin emulsions, water based paints, cosmetics and inks. Fuel additive.

Physical properties

M. Pt. <25°C **B. Pt.** 74-75°C at 6 mmHg **Flash point** <-25°C **Specific gravity** 1.0655 at 20°C with respect to water at 4°C

Solubility Water: miscible. Organic solvents: acetone, ethanol

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) harlequin fish 44 mg l⁻¹ (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird >98 mg kg⁻¹ (2).

LD₅₀ oral rat 1930 mg kg⁻¹ (3).

Carcinogenicity and chronic effects

No adequate data for evaluation of carcinogenicity to humans, limited evidence for carcinogenicity to animals, IARC classification group 3 (4).

National Toxicology Program tested rats and mice via gavage. No evidence of carcinogenicity in rats and mice (5). Oral ♂ rat (23 month) 1% solution in drinking water for 613 days to give an average total dose of 237 g animal⁻¹. Malignant tumours developed in 14/25 rats: 8 hepatomas, 2 lymphosarcomas, 1 transitional-cell carcinoma of the kidney, 1 leukaemia, 1 epidermoid carcinoma of the neck and 1 subcutaneous fibrosarcoma. One lymphosarcoma was detected in the 14 controls (6).

Genotoxicity

Salmonella typhimurium TA100 with and without metabolic activation positive (7).

Drosophila melanogaster sex-linked recessive lethal assay positive (8).

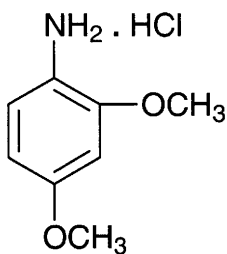
Other comments

Physical properties, uses and carcinogenicity reviewed (9).

References

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6. Hoch-Ligeti, C. et al *J. Natl. Cancer Inst.* 1974, **53**, 791-794.
7. Mortelmans, K. et al *Environ. Mutagen.* 1986, **8**(Suppl. 7), 1-119.
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9. *IARC Monograph* 1977, **15**, 177-181.

D378 2,4-dimethoxyaniline hydrochloride



C₈H₁₂NO₂Cl

Mol. Wt. 189.64

CAS Registry No. 54150-69-5

Synonyms 2,4-dimethoxybenzenamine hydrochloride; 2-methoxy-*p*-anisidine hydrochloride; 4-methoxy-*o*-anisidine hydrochloride

RTECS No. BX 4574000

Uses Manufacture of dyestuffs and inks.

Physical properties

M. Pt. 230°C (decomp.)

Solubility Water: <1 g l⁻¹ at 23°C. Organic solvents: acetone, dimethyl sulfoxide, ethanol

Mammalian & avian toxicity

Carcinogenicity and chronic effects

National Toxicology Program tested rats and mice oral administration in diet. Mice were given 2500-5000 ppm and rats 1500-3000 ppm. No carcinogenic effects reported in either species (1,2).

Genotoxicity

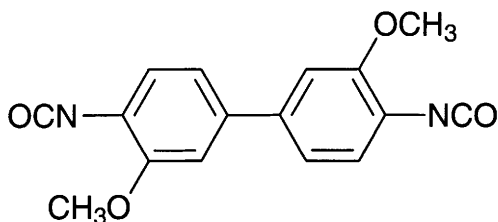
Salmonella typhimurium TA98, TA100 with and without metabolic activation positive (3).

In vitro L5178 tk+/tk- mouse lymphoma cell forward mutation assay positive (4).

References

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D379 3,3'-dimethoxybenzidine 4,4'-diisocyanate



$C_{16}H_{12}N_2O_4$

Mol. Wt. 296.28

CAS Registry No. 91-93-0

Synonyms 4,4'-diisocyanato-3,3'-dimethoxy-1,1'-biphenyl; isocyanic acid, 3,3'-dimethoxy-4,4'-biphenylene ester; 3,3'-dimethoxy-4,4'-biphenylene diisocyanate; dianisidine diisocyanate; DADI

RTECS No. NQ 8800000

Uses Component of polyurethane elastomers and isocyanate-based adhesives.

Physical properties

M. Pt. 112°C **Partition coefficient** $\log P_{ow}$ -0.59 (1)

Solubility Organic solvents: ketones and esters (details not specified in literature)

Occupational exposure

SE-LEVL 0.005 ppm

SE-CEIL 0.01 ppm

UK-LETL MEL 0.02 mg m⁻³ (as NCO)

UK-STEL MEL 0.07 mg m⁻³ (as NCO)

Supply classification toxic

Risk phrases May cause cancer – Harmful if swallowed (R45, R22)

Safety phrases Restricted to professional users – Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S53, S45)

Environmental fate

Abiotic removal

Undergoes hydrolysis to 3,3'-dimethoxybenzidine (2).

Mammalian & avian toxicity

Acute data

LD₅₀ intravenous rat 180 mg kg⁻¹ (3).

Carcinogenicity and chronic effects

No adequate data for evaluation of carcinogenicity to humans, limited evidence for carcinogenicity to animals, IARC classification group 3 (4).

National Toxicology Program tested rats and mice via oral administration. Tumours in haematopoietic system, skin and Zymbal gland in ♂ rats and haematopoietic system and Zymbal gland in ♀ rats. No evidence of carcinogenicity in ♂ and ♀ mice (5).

Oral mouse (2 yr) 22 or 44 g kg⁻¹ diet (total dose). There was no significant increase in treatment-related tumours nor any significant difference in survival rates compared to controls (6).

Gavage rat (2 yr) 1.5 or 3.0 g kg⁻¹ 5 day wk⁻¹ for 22 wk. The animals were subsequently given 22 or 44 g kg⁻¹ diet for a further 56 wk. A dose-related decrease in survival rates and a significant increase in leukaemias, malignant lymphomas and skin tumours was reported. A treatment-related increase in Zymbal gland tumours was also reported. ♀ rats also showed a dose-related increased incidence of endometrial stromal polyps (6).

Genotoxicity

Salmonella typhimurium TA98 with metabolic activation positive (7).

In vitro Chinese hamster ovary cells sister chromatid exchanges and chromosomal aberrations positive (8).

Other comments

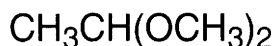
Physical properties, uses, analysis, carcinogenicity and mutagenicity reviewed (2).

There is sufficient evidence for the carcinogenicity of the hydrolysis product 3,3'-dimethoxybenzidine to experimental animals (2).

References

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2. *IARC Monograph* 1986, **39**, 279-286.
3. U.S. Army Armament Research and Development Command, Chemical Systems Laboratory, NIOSH Exchange Chemicals, Report NX 02411, Aberdeen Proving Ground, MD, USA.
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D380 1,1-dimethoxyethane



$\text{C}_4\text{H}_{10}\text{O}_2$

Mol. Wt. 90.12

CAS Registry No. 534-15-6

Synonyms dimethylacetal; dimethyl acetal acetaldehyde; acetaldehyde dimethyl acetal; ethylidene dimethyl ether

EINECS No. 208-589-8

RTECS No. AB 2825000

Uses Catalyst. Organic synthesis. Flavouring agent.

Occurrence Isolated from blackberries (*Rubus laciniatus*) (1).

Physical properties

M. Pt. -113.2°C **B. Pt.** 64.5°C **Flash point** -17°C (open cup) **Specific gravity** 0.8516 at 20°C with respect to water at 4°C **Volatility** v.p. 61 mmHg at 20°C ; v.den. 3.1

Solubility Water: miscible. Organic solvents: chloroform, diethyl ether, ethanol

Occupational exposure

UN No. 2377 **HAZCHEM Code** 2ME **Conveyance classification** flammable liquid

Supply classification highly flammable

Risk phrases Highly flammable (R11)

Safety phrases Keep out of reach of children (if sold to general public) – Keep container in a well ventilated place – Keep away from sources of ignition – No smoking – Take precautionary measures against static discharges (S2, S9, S16, S33)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 6.5 g kg⁻¹ (2).

LC₅₀ (4 hr) inhalation rat 3000 ppm (3).

LD₅₀ dermal rabbit 20 g kg⁻¹ (2).

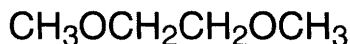
Irritancy

Dermal rabbit (24 hr) 10 mg caused mild irritation (2).

References

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2. Smyth, H. F. et al *J. Ind. Hyg. Toxicol.* 1949, **31**, 60.
3. *AMA Arch. Ind. Health* 1955, **12**, 623

D381 1,2-dimethoxyethane



$\text{C}_4\text{H}_{10}\text{O}_2$

Mol. Wt. 90.12

CAS Registry No. 110-71-4

Synonyms dimethoxyethane; α,β -dimethoxyethane; dimethyl cellosolve; 2,5-dioxahexane; ethylene dimethyl ether; ethylene glycol dimethyl ether; glycol dimethyl ether; glyme; monoglyme; Ansol E-121

EINECS No. 203-794-9

RTECS No. KI 1451000

Uses Absorbent for carbon dioxide and hydrogen sulfide. Catalyst. Corrosion inhibitor. Electrolyte. Solvent. Animal repellent.

Physical properties

M. Pt. -58°C **B. Pt.** $82\text{--}86^\circ\text{C}$ **Flash point** 1°C **Specific gravity** 0.86285 at 20°C with respect to water at 4°C

Volatility v.p. 48 mmHg at 20°C ; v.den. 3.1

Solubility Water: miscible. Organic solvents: acetone, benzene, carbon tetrachloride, dichloroethane, diethyl ether, ethanol

Occupational exposure

UN No. 2252 HAZCHEM Code 2 **S** E **Conveyance classification** flammable liquid

Supply classification harmful

Risk phrases Flammable – May form explosive peroxides – Harmful by inhalation (R10, R19, R20)

Safety phrases Keep out of reach of children (if sold to general public) – Avoid contact with skin and eyes (S2, S24/25)

Mammalian & avian toxicity

Sub-acute and sub-chronic data

Inhalation rat 1000 and 2010 ppm 4 hr day⁻¹ 5 day wk⁻¹. All animals survived but showed significant decrease in avoidance response. Complete recovery from behavioural effects occurred within a few days after cessation of exposure. A dose-related reduction in growth was also observed (1).

Carcinogenicity and chronic effects

Gavage mice, long-term effects included haematological damage and testicular atrophy (2).

Teratogenicity and reproductive effects

Gavage rat, 30, 60, 120, 250, 500 or 1000 mg kg⁻¹ day⁻¹ on day 8-18 of gestation caused dose-related maternal and foetal fatality. Foetotoxicity was related to the lack of ossified bone, but there was no evidence of soft-tissue anomalies (3).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

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3. Leonhardt, D. E. et al *Reprod. Toxicol.* 1991, 5(2), 157-162.
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D382 dimethoxymethane



$\text{C}_3\text{H}_8\text{O}_2$

Mol. Wt. 76.10

CAS Registry No. 109-87-5

Synonyms dimethyl formal; 2,4-dioxapentane; formal; formaldehyde dimethyl acetal; methylal

EINECS No. 203-714-2

RTECS No. PA 8750000

Uses Special-purpose fuel and as a solvent for perfumes, coatings, adhesives and resins.

Physical properties

M. Pt. -105°C **B. Pt.** 41.6°C at 754 mmHg **Flash point** -18°C (closed cup) **Specific gravity** 0.8593 at 20°C with respect to water at 4°C **Partition coefficient** $\log P_{\text{ow}}$ 0.0 (1) **Volatility** v.p. 300 mmHg at 20°C , 400 mmHg at 25°C ; v.den. 2.6

Solubility Water: 330 g l $^{-1}$. Organic solvents: miscible with diethyl ether, ethanol

Occupational exposure

DE-MAK 1000 ppm (3200 mg m $^{-3}$)

FR-VME 1000 ppm (3100 mg m $^{-3}$)

UK-LTEL 1000 ppm (3160 mg m $^{-3}$)

UK-STEL 1250 ppm (3950 mg m $^{-3}$)

US-TWA 1000 ppm (3110 mg m $^{-3}$)

UN No. 1234 **HAZCHEM Code** 2ME **Conveyance classification** flammable liquid

Risk phrases Flammable – May form explosive peroxides – Harmful by inhalation (R10, R19, R20)

Safety phrases Avoid contact with skin and eyes (S24/25)

Ecotoxicity

Fish toxicity

Non-toxic at 5 ppm (24 hr) to salmon, bluegill sunfish, yellow perch and goldfish. Test conditions: pH, 7.0; dissolved oxygen, 7.5 ppm; total hardness (soap method), 300 ppm; methyl orange alkalinity, 310 ppm; phenolphthalein alkalinity, 0; free carbon dioxide, 5 ppm; temperature, 12.8°C (2).

Environmental fate

Degradation studies

Waste water treatment: bench scale activated sludge, fill and draw operations, COD, feed 333 mg l $^{-1}$ O $_2$ at 20°C , 30 days acclimation, 88% removed (3).

Mammalian & avian toxicity

Acute data

LD $_{50}$ oral rabbit 5708 mg kg $^{-1}$ (4).

LC $_{50}$ (7 hr) inhalation mouse 18,000 ppm (5).

LD $_{50}$ subcutaneous guinea pig 5 g kg $^{-1}$ (5).

LD $_{Lo}$ subcutaneous guinea pig 3013 mg kg $^{-1}$ (6).

Sub-acute and sub-chronic data

Inhalation (7 hr) guinea pig for five days at 45,000 ppm showed no significant histopathological effects (7).

Inhalation (7 hr) mouse for 15 exposures up to 14,000 ppm (individual dose) showed occasional slight fatty changes in the kidneys and pulmonary oedema (7).

Carcinogenicity and chronic effects

If metabolised to formaldehyde it has been suggested that it may pose a carcinogenic risk. Studies examining the link between inhalation and carcinogenicity have not confirmed the relationship (8,9).

Metabolism and toxicokinetics

Metabolised to methanol (8).

Irritancy

Causes irritation to the eyes and skin (species unspecified) (8).

Sensitisation

Causes dermatitis, defatting and necrosis of the skin, but does not cause sensitisation (species unspecified) (8).

Other effects

Other adverse effects (human)

As an air pollutant, attributed as the cause of stomach troubles in workers manufacturing anion exchangers (10). Likely to cause vomiting, diarrhoea, gastro-intestinal upsets and narcosis with systemic toxicity to kidneys and liver if swallowed (8).

Any other adverse effects

Absorbed through the skin of rabbits and guinea pigs. Causes anaesthesia and respiratory tract irritation, with systemic toxicity to the kidney, heart and liver at high concentrations (8).

Inhalation by laboratory animals at concentrations above 1400 ppm caused anaesthesia. Side-effects include blood in the urine and variations in blood glucose levels (11).

No adverse effects were seen at 4000 ppm in acute inhalation toxicity studies (species and duration unspecified) (12).

Mice died at inhaled levels 18,000 to 153,000 ppm with eye irritancy, lung congestion, respiratory tract irritancy and bronchopneumonia effects. Liver, heart, lungs and kidney showed severe fatty degeneration (7).

Absorbed readily through the skin – a more toxic route than vapour inhalation (8).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (13).

Other comments

Detected in drinking water of cities (14).

Reviews on experimental toxicology, epidemiology, human health effects and workplace experience listed (15).

Hazards reviewed (16).

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14. US EPA *Preliminary Assessment of Suspected Carcinogens in Drinking Water* 1975, Office of Toxic Substances.
15. ECETOC *Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuyse (Bte 6), B-1160 Brussels, Belgium.
16. *Dangerous Prop. Ind. Mater. Rep.* 1987, **7**(6), 76-80

D383 *N,N*-dimethylacetamide



$\text{C}_4\text{H}_9\text{NO}$

Mol. Wt. 87.12

CAS Registry No. 127-19-5

Synonyms acetdimethylamide; dimethylacetamide; dimethylamide acetate; dimethylacetone amide; DMA

EINECS No. 204-826-4

RTECS No. AB 7700000

Uses Organic synthesis. Solvent. Catalyst. Plasticiser. Antineoplastic agent.

Physical properties

M. Pt. -20°C **B. Pt.** $164.5\text{--}166^\circ\text{C}$ **Flash point** 70°C **Specific gravity** 0.937 at 20°C with respect to water at 4°C **Partition coefficient** $\log P_{\text{ow}} -0.77$ **Volatility** v.p. 1.3 mmHg at 25°C ; v.den. 3.01
Solubility Water: miscible. Organic solvents: acetone, benzene, chloroform, diethyl ether, ethanol, toluene

Occupational exposure

DE-MAK 10 ppm (36 mg m^{-3})

FR-VME 10 ppm (35 mg m^{-3})

JP-OEL 10 ppm (36 mg m^{-3})

SE-LEVL 10 ppm (35 mg m^{-3})

SE-STEEL 20 ppm (70 mg m^{-3})

UK-LTEL 10 ppm (36 mg m^{-3})

UK-STEEL 20 ppm (72 mg m^{-3})

US-TWA 10 ppm (36 mg m^{-3})

Supply classification harmful

Risk phrases Harmful by inhalation and in contact with skin – Irritating to the eyes (R20/21, R36)

Safety phrases Keep out of reach of children (if sold to general public) – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing (S2, S26, S28, S36)

Ecotoxicity

Invertebrate toxicity

EC₅₀ (5 min) *Photobacterium phosphoreum* 4800 mg l⁻¹ Microtox test (1).

Environmental fate

Degradation studies

Penicillium funiculosum, *Alternaria aleraceae* and *Verticilliastrum* in sludge degrade dimethylacetamide. Optimum pH 6.5–8.0. When the concentration of dimethylacetamide reaches 15–30 mg l⁻¹ *Cladosporium lignicola*, *Penicillium terrestre*, *Scopulariopsis brevicaulis* Bain, *Aspergillus versicolor* and *Trichoderma lignorum* are added to facilitate removal (2).

Abiotic removal

Evaporation rate relative to *n*-butyl acetate, which has been assigned a value of 1 at 25°C , is 0.138 (3).

Removed from water by adsorption onto activated carbon which is then treated with chloroform.

Dimethylacetamide is recovered by distillation (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 4600, 4900 mg kg⁻¹, respectively (5,6).

LC₅₀ (1 hr) inhalation rat 2475 ppm (5).

LD₅₀ dermal rabbit, mouse 2240, 9600 mg kg⁻¹, respectively (7,8).

LD₅₀ intraperitoneal rat, mouse 2800 mg kg⁻¹ (9,10).
LD₅₀ intravenous rat, mouse 2640, 3020 mg kg⁻¹, respectively (6).

Sub-acute and sub-chronic data

Inhalation rat repeated exposure to 100-200 ppm reported to cause liver damage (period of exposure unspecified) (11).

Pubescent ♂ mice (35-days-old) were exposed to 30, 100, 310, 490 or 700 ppm dimethylacetamide for 6 hr day⁻¹, 5 days wk⁻¹ for 10 days. Levels of 490 ppm and above caused mortality, severe clinical signs affecting the nervous system, haematological and organ weight changes and testicular damage. When young adult mice (62-days-old) and rats (47-days-old) were exposed to 0, 52, 150, 300 or 480 ppm dimethylacetamide, no mice died and less severe testicular lesions were found only at 480 ppm. No adverse effects were observed in rats. NOEC pubescent mice 100 ppm and 300 ppm mature mice (12).

Teratogenicity and reproductive effects

Inhalation rat 32, 100 or 282 ppm, 6 hr day⁻¹ on day 6-15 of gestation. For the high-dose group, maternal and foetal weight gain were significantly reduced. Foetal resorptions were not increased in any group. Teratogenic effects were similar in treated and control groups (13).

Gavage mouse 0, 65, 160 or 400 mg kg⁻¹ day⁻¹ on day 6-19 of gestation. Maternal body weight gain was significantly reduced in the 400 mg treated group and in the foetuses of 160 and 400 mg groups. Lactotoxicity, reduced ossification, anasarca and malformations of the heart, major vessels and oral cavity were observed for the 400 mg group (14).

Metabolism and toxicokinetics

In humans, metabolised to *N*-methylacetamide and acetamide which are detectable in the urine (15).

Irritancy

Dermal rabbit (24 hr) 10 mg caused mild irritation (7).

100 mg instilled into rabbit eye caused mild irritation (period of exposure unspecified) (5).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535 with and without metabolic activation negative (16).

Other effects

Any other adverse effects

In humans, exposure has produced systemic injury, particularly to the liver, but also to the heart, lungs and kidneys. Jaundice has been reported among exposed workers (15).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (17).

Other comments

Experimental toxicology and human health effects reviewed (18).

Physical properties, toxicity and safety procedures reviewed (15).

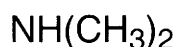
Explosive limits 2-11.5%. Autoignition temperature 490°C.

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D384 dimethylamine



C₂H₇N

Mol. Wt. 45.08

CAS Registry No. 124-40-3

Synonyms N-methylmethanamine; DMA

EINECS No. 204-697-4 (aqueous solution)

RTECS No. IP 8750000

Uses Vulcanisation accelerator. Used in the tanning industry and the manufacture of soap. Insect attractant used to control boll weevils. Analytical reagent. Solvent.

Occurrence Occurs naturally in many foods (1).

Formed as a volatile component in cattle manure (2).

Residues have been isolated from water and sediments (3).

Physical properties

M. Pt. -93°C **B. Pt.** 7°C **Flash point** -6°C **Specific gravity** 0.898 at 20°C **Partition coefficient** log P_{ow} -0.38 **Volatility** v.p. 1520 mmHg at 10°C ; v.den. 1.6

Solubility Water: 212 g l⁻¹ at 21°C. Organic solvents: aniline, diethyl ether, ethanol, glycerol

Occupational exposure

DE-MAK 2 ppm (3.7 mg m⁻³)

FR-VLE 10 ppm (18 mg m⁻³)

JP-OEL 10 ppm (18 mg m⁻³)

UK-LTEL 10 ppm (19 mg m⁻³)

US-TWA 5 ppm (9.2 mg m⁻³)

US-STEL 15 ppm (27.6 mg m⁻³)

UN No. 1032 (anhydrous); 1160 (solution) **HAZCHEM Code** 2PE **Conveyance classification** flammable gas (anhydrous) **Conveyance classification** flammable liquid, corrosive (solution)

Supply classification extremely flammable

Supply classification corrosive

Risk phrases Extremely flammable – Harmful by inhalation and if swallowed – Causes burns (R12, R20/22, R34)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Keep in a cool place – Keep away from sources of ignition – No smoking – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – Do not empty into drains – Wear suitable protective clothing, gloves and eye/face protection – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S3, S16, S26, S29, S36/37/39, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (24 hr) creek chub ~40 mg l⁻¹ (4).

Invertebrate toxicity

EC₅₀ (15 min) *Photobacterium phosphoreum* 27 ppm Microtox test (5).

Bioaccumulation

A calculated bioconcentration factor of 0.3 indicates that environmental accumulation is unlikely (6).

Environmental fate

Degradation studies

BOD₅ 1.3 mg O₂ l⁻¹; BOD₂₀ 2.0 mg O₂ l⁻¹; ThOD 2.006 mg O₂ l⁻¹. Permanganate value 0.024 mg O₂ l⁻¹ (7).

Abiotic removal

Reaction with photochemically produced hydroxyl radicals in the atmosphere, t_{1/2} ~6 hr (8).

t_{1/2} for volatilisation from a model river water ~35 hr (6).

Adsorption and retention

Mean K_{oc} in five soils was 435 (9).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rabbit, guinea pig, mouse, rat 240, 240, 320, 700 mg kg⁻¹, respectively (10).

LC₅₀ (6 hr) inhalation rat 4540 ppm (11).

LD₅₀ intravenous rabbit 4000 mg kg⁻¹ (12).

Sub-acute and sub-chronic data

Inhalation rat, rabbit, guinea pig (20 wk) 97 or 183 ppm, 7 hr day⁻¹ 5 day wk⁻¹ caused corneal damage in rabbits and guinea pigs after 9 days, and centrilobular fatty degeneration and necrosis of liver parenchymal cells in all three species (13).

Metabolism and toxicokinetics

Rats fed 24 mg kg⁻¹ diet for 7 days excreted an excess of dimethylamine in the urine. The excess of excretion was probably caused by the formation of dimethylamine by the demethylation of trimethylamine in the body.

Dimethylamine has been reported as a normal urinary constituent in mammals (14,15).

Irritancy

Irritating to the skin and mucous membranes (12).

Genotoxicity

Salmonella typhimurium TA98, TA100 with metabolic activation positive; without metabolic activation weakly positive (16).

In vitro Chinese hamster ovary cells chromosomal aberrations and sister chromatid exchanges negative (17).

In vitro rat bone marrow, increased the frequency of aneuploidy (18).

Other effects

Any other adverse effects

Inhibits pancreatic transglutaminase activity and insulin release in mammals (19).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (20).

Other comments

Physical properties, occurrence and environmental fate, safe handling and toxicity reviewed (3,21,22).
Reviews on toxicology listed (23).
Autoignition temperature 400°C.

References

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16. Ohe, T. *Mutat. Res.* 1982, **101**(3), 175-187.
17. Hsie, A. W. et al *Mol. Toxicol.* 1987, **1**(2-3), 217-234.
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20. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
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22. *Ethel Browning's Toxicity and Metabolism of Industrial Solvents* 2nd ed., 1990, **2**, 73-82, Elsevier, Amsterdam, Netherlands.
23. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuysse (Bte 6), B-1160 Brussels, Belgium

D385 2-dimethylaminoacetonitrile



$\text{C}_4\text{H}_8\text{N}_2$

Mol. Wt. 84.12

CAS Registry No. 926-64-7

Synonyms *N,N*-dimethylglycinonitrile; *N*-(cyanomethyl)dimethylamine; (dimethylamino)acetonitrile; dimethylcyanomethylamine

EINECS No. 213-140-4

RTECS No. AL 9450000

Physical properties

B. Pt. 137-138°C Flash point 36°C Specific gravity 0.86 at 20°C Volatility v.p. 760 mmHg at 137°C

Occupational exposure

UN No. 2378 HAZCHEM Code 2W Conveyance classification flammable liquid, toxic

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 50 mg kg⁻¹ (1).

LC₂₀ (4 hr) inhalation rat 250 ppm (1).

LD₅₀ dermal rabbit 170 mg kg⁻¹ (2).

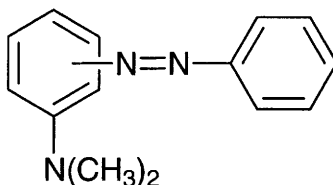
Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation and 20 mg instilled into rabbit eye for 24 hr caused moderate irritation (3).

References

1. *Am. Ind. Hyg. Assoc. J.* 1962, **23**, 95.
2. US EPA, FYI-OTS-0483, 0238, Office of Pesticides and Toxic Substances, Washington, DC, USA.
3. Marhold, J. V. *Prehled Prumyslove Toxikologie: Organické Latky* 1983, 923, Prague, Czechoslovakia

D386 *N,N*-dimethylaminoazobenzene



C₁₄H₁₅N₃

Mol. Wt. 225.29

CAS Registry No. 29387-92-6

Synonyms (dimethylamino)azobenzene; *N,N*-dimethyl(phenylazo)benzenamine

RTECS No. BX 7340000

Uses Dispersing agent.

Environmental fate

Nitrification inhibition

Does not inhibit ammonia oxidation by *Nitrosomonas* spp. at 100 mg l⁻¹ (1).

Mammalian & avian toxicity

Metabolism and toxicokinetics

In rat liver, undergoes azo-reduction, *N*-demethylation and ring hydroxylation (2).

Genotoxicity

Salmonella typhimurium TA98 with metabolic activation positive (3).

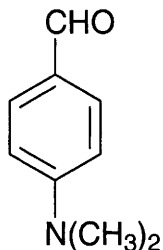
Other comments

Residues have been identified in river and marine sediments (3).

References

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2. Haider, R. et al *Biochem. Pharmacol.* 1987, **36**(5), 774-778.
3. Grifold, M. et al *Arch. Environ. Contam. Toxicol.* 1990, **19**, 775-778

D387 4-(dimethylamino)benzaldehyde



C₉H₁₁NO

Mol. Wt. 149.19

CAS Registry No. 100-10-7

Synonyms *p*-(dimethylamino)benzaldehyde; 4-(dimethylamino)benzenecarbal; *p*-formyldimethylaniline; *p*-DAB; Ehrlich's reagent

EINECS No. 202-819-0

RTECS No. CU 5775000

Uses Catalyst. Chemical intermediate. Hair dyestuff component. Analytical reagent.

Physical properties

M. Pt. 73-75°C **B. Pt.** 176-177°C at 17 mmHg

Solubility Water: miscible. Organic solvents: acetic acid, chloroform, diethyl ether, ethanol

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 44 mg l⁻¹ (1).

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 0.88 ppm Microtox test (2).

Mammalian & avian toxicity

Acute data

LD_{Lo} oral rat 500 mg kg⁻¹ (3).

LD₅₀ intraperitoneal rat 620 mg kg⁻¹ (4).

References

1. Protic, M. et al *Aquat. Toxicol.* 1989, **14**(1), 47-64.
2. Kaiser, K. L. E. et al *Water Pollut. Res. J. Can.* 1991, **26**(3), 361-431.
3. *J. Pharmacol. Exp. Ther.* 1947, **90**, 260.
4. *Hine Laboratory Report* 1964, AF33 (657)-11756, San Francisco, CA, USA

D388 2-dimethylaminoethanol



$\text{C}_4\text{H}_{11}\text{NO}$

Mol. Wt. 89.14

CAS Registry No. 108-01-0

Synonyms (dimethylamino)ethanol; *N,N*-(dimethylamino)ethanol; *N,N*-dimethylaminoethanol; β -dimethylaminoethyl alcohol; dimethylethanolamine; *N,N*-dimethylethanolamine; dimethyl(2-hydroxymethyl)amine; dimethylmonoethanolamine; (2-hydroxyethyl)dimethylamine; DMAE; Alkanolamine; Texacat DME; Toyocat-DMA

EINECS No. 203-542-8

RTECS No. KK 6125000

Uses Absorbent for carbon dioxide. Catalyst. Used in the manufacture of surface coatings and polyurethane foam. Corrosion inhibitor. Antidepressant.

Physical properties

M. Pt. -70°C **B. Pt.** $133\text{--}134^\circ\text{C}$ **Flash point** 40.5°C (open cup) **Specific gravity** 0.8866 at 20°C with respect to water at 4°C **Volatility** v.p. 4 mmHg at 20°C ; v.den. 3.3

Solubility Water: miscible. Organic solvents: acetone, benzene, diethyl ether, dimethyl sulfoxide, ethanol

Occupational exposure

UK-LTEL 2 ppm (7.4 mg m^{-3})

UK-STEL 6 ppm (22 mg m^{-3})

UN No. 2051 **HAZCHEM Code** 2Y **Conveyance classification** corrosive substance, danger of fire (flammable liquid)

Supply classification irritant

Risk phrases Flammable – Irritating to eyes, respiratory system and skin (R10, R36/37/38)

Safety phrases Keep out of reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water (S2, S28)

Ecotoxicity

Fish toxicity

Not toxic to brown trout, bluegill sunfish, yellow perch exposed to 5 ppm for 24 hr. Test conditions: pH 7; dissolved oxygen content 7.5 ppm; total hardness (soap method) 300 ppm; methyl orange alkalinity 310 ppm; free carbon dioxide 5 ppm; temperature 12.8°C (1).

Environmental fate

Abiotic removal

Evaporation rate relative to *n*-butyl acetate, which has been assigned a value of 1 at 25°C , is 0.157 (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 2000 mg kg^{-1} (3).

LC₅₀ (4 hr) inhalation rat 1640 ppm (4).

LD₅₀ dermal rabbit 1370 mg kg^{-1} (5).

LD₅₀ intraperitoneal rat 1080 mg kg^{-1} (6).

LD₅₀ subcutaneous mouse 960 mg kg^{-1} (7).

Sub-acute and sub-chronic data

Inhalation rat (9 day) 0, 98, 288 or 586 ppm for 6 hr day⁻¹ caused respiratory and ocular irritation. All the high-dose group of rats and 4/15 of the 288 ppm treated rats died. Reduced body weight gain was also reported. Rats

exposed to 76 ppm 6 hr day⁻¹ 5 day wk⁻¹ for 13 wk suffered transient corneal opacity, decreased weight gain, respiratory tract and olfactory epithelial lesions. In the 13 wk study the no-adverse-effect level was 24 ppm (3).

Carcinogenicity and chronic effects

No increased incidence of neoplasms in ♀ C3H mice treated with 890-1340 mg kg⁻¹ for life (8).

Teratogenicity and reproductive effects

Oral rat, 1% diet throughout pregnancy resulted in most of the offspring dying within 36 hr of birth with elevated brain levels of choline and acetylcholine (9).

Metabolism and toxicokinetics

Following intracerebral injection to rats of ¹⁴C-labelled substance, 30, 27 and 16% of radioactivity of the label remained in the brain after 0.5, 1.0 and 7 hr. Brain level phosphomethylaminoethanol increased to a maximum after 1-2 hr, decreasing thereafter, whereas the brain content of phosphatidylethanolamine increased throughout the 7 hr period of observation and the levels were 10-40 × higher than those of phosphodimethylaminoethanol (10).

Irritancy

Dermal rabbit 445 mg caused mild irritation (11).

750 µg instilled into rabbit eye caused severe irritation (5).

Clinical signs of nasal and ocular irritation observed in rats exposed to ≥1668 ppm for 4 hr. In 2-wk studies rats exposed to 98-586 ppm for 9 days (6 hr day⁻¹) during an 11 day period showed signs of respiratory irritation. Eye irritation occurred at 288 or 586 ppm (4).

Sensitisation

Laboratory challenge testing showed dual asthmatic responses to 2% dimethylaminoethanol and to a whole paint preparation of 98% methyl methacrylate emulsion and 2% dimethylaminoethanol (12).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (13).

Other effects

Other adverse effects (human)

Combined occupational exposure to unspecified levels of dimethylethanolamine, ethylenediamine, propylene oxide and 4,4'-diphenylmethane diisocyanate during polyurethane foam manufacture caused respiratory tract and nervous system disorders and immune system changes (14).

Other comments

Ethanolamine phosphokinase inhibitor (15).

Physical properties, safe handling and toxicity reviewed (16,17).

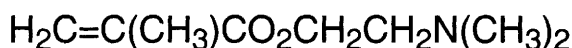
Autoignition temperature 2.95°C.

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16. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuyse (Bte 6), B-1160 Brussels, Belgium.
17. *Chemical Safety Data Sheets* 1992, 5, 107-110, The Royal Society of Chemistry, London, UK

D389 2-dimethylaminoethyl methacrylate



$\text{C}_8\text{H}_{15}\text{NO}_2$

Mol. Wt. 157.21

CAS Registry No. 2867-47-2

Synonyms 2-(dimethylamino)ethyl methacrylate; 2-(dimethylamino)ethyl 2-methyl-2-propenoate; β -(dimethylamino)ethyl methacrylate; dimethylaminoethyl methacrylate

EINECS No. 220-688-8

RTECS No. OZ 4200000

Uses Catalyst. Manufacture of copolymer. Reducing agent.

Physical properties

B. Pt. 182-192°C **Flash point** 70°C **Specific gravity** 0.933 at 25°C with respect to water at 5°C

Volatility v.den. 5.4

Solubility Water: miscible

Occupational exposure

Supply classification harmful

Risk phrases Harmful in contact with skin and if swallowed – Irritating to eyes and skin – May cause sensitisation by skin contact (R21/22, R36/38, R43)

Safety phrases Keep out of reach of children (if sold to general public) – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – After contact with skin, wash immediately with plenty of water (S2, S26, S28)

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird 98 mg kg⁻¹ (1).

LD₅₀ oral rat 1750 mg kg⁻¹ (2).

LC₅₀ (4 hr) inhalation rat, mouse 620, 1800 mg m⁻³, respectively (2).

LD₅₀ intraperitoneal mouse 25 mg kg⁻¹ (3).

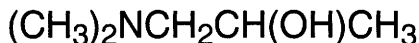
Other comments

Reviews on toxicology and human health effects listed (4).

References

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D390 1-dimethylamino-2-propanol



$\text{C}_5\text{H}_{13}\text{NO}$

Mol. Wt. 103.16

CAS Registry No. 108-16-7

Synonyms 1-dimethylaminopropan-2-ol; dimethyl(2-hydroxypropyl)amine; dimethylisopropanolamine; *N,N*-dimethylisopropanolamine; dimepranol

EINECS No. 203-556-4

RTECS No. UB 3150000

Uses Corrosion inhibitor.

Physical properties

B. Pt. 121-127°C **Flash point** 35°C **Specific gravity** 0.850 at 25°C with respect to water at 25°C

Volatility v.den. 3.52

Solubility Water: miscible. Organic solvents: carbon tetrachloride

Occupational exposure

Supply classification corrosive

Risk phrases Flammable – Harmful if swallowed – Causes burns (R10, R22, R34)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Do not breathe vapour – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – Wear suitable protective clothing – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S23, S26, S36, S45)

Ecotoxicity

Fish toxicity

Not toxic to brown trout, bluegill sunfish or yellow perch at 5 ppm for 24 hr. Test conditions: pH 7.0; dissolved oxygen concentration 7.5 ppm; total hardness (soap method) 300 ppm; free carbon dioxide 5 ppm; temperature 12.8°C (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1890 mg kg⁻¹ (2).

Irritancy

Dermal rabbit (24 hr) 10 mg caused mild irritation (2).

100 mg instilled into rabbit eye (4 sec, rinsed) caused severe irritation (3).

References

1. Wood, E. M. *The Toxicity of 3400 Chemicals to Fish* 1987, EPA 560/6-87-002; PB 87-200-275, Washington, DC, USA.
2. *Arch. Ind. Hyg. Occup. Med.* 1954, 10, 61.
3. *Food Chem. Toxicol.* 1982, 20, 573

D391 3-(dimethylamino)propionitrile



$\text{C}_5\text{H}_{10}\text{N}_2$

Mol. Wt. 98.15

CAS Registry No. 1738-25-6

Synonyms 3-(dimethylamino)propanenitrile; β -(dimethylamino)propionitrile;

β -(N-dimethylamino)propionitrile; dimethylaminopropionitrile; DMAPN

EINECS No. 217-090-4

RTECS No. UG 1575000

Uses Catalyst.

Physical properties

M. Pt. -43°C **B. Pt.** $172\text{--}174^\circ\text{C}$ **Flash point** 63°C (open cup) **Specific gravity** 0.870 at 20°C

Volatility v.p. 10 mmHg at 57°C ; v.den. 3.35

Solubility Water: miscible. Organic solvents: ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 1500, 2600 mg kg⁻¹, respectively (1,2).

LD₅₀ dermal rabbit 1410 mg kg⁻¹ (3).

LD₅₀ intravenous mouse 180 mg kg⁻¹ (4).

Sub-acute and sub-chronic data

Gavage rat, mouse (3 day) single doses of 175-700 mg kg⁻¹ caused loss of body weight, reduced water consumption, reduced bladder urine retention and bladder injury. Biochemical effects included depletion of glutathione and increased lipid peroxidation in the urinary bladder and kidneys (5).

Metabolism and toxicokinetics

Following oral administration of 525 mg kg⁻¹ to rats, 44% was excreted unchanged in the urine within 5 days. Urinary metabolites included β -aminopropionitrile and cyanoacetic acid. *In vitro* studies showed that metabolism to cyanide, formaldehyde and cyanoacetic acid was localised mostly in the microsomal fraction of liver, kidney and urinary bladder, requiring NADPH and oxygen for maximal activity (6).

Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation and 20 mg instilled into rabbit eye for 24 hr caused moderate irritation (2).

Other effects

Any other adverse effects

Neurotoxin (7).

Other comments

Reviews on toxicology and human health effects listed (8).

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8. ECETOC Technical Report No. 71 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuysse (Bte 6), B-1160 Brussels, Belgium

D392 3-dimethylaminopropylamine



$\text{C}_5\text{H}_{14}\text{N}_2$

Mol. Wt. 102.18

CAS Registry No. 109-55-7

Synonyms *N,N*-dimethyl-1,3-propanediamine; *N,N*-dimethyl-1,3-diaminopropane; 3-dimethylamino-1-propylamine; 3-aminopropyldimethylamine

EINECS No. 203-680-9

RTECS No. TX 7525000

Uses As a hardener for epoxy resins, a dispersant-detergent for high quality motor oils and in antistatic agents for synthetic fibres.

Physical properties

M. Pt. $<-70^\circ\text{C}$ **B. Pt.** 133°C **Flash point** 38°C **Specific gravity** 0.817 at 30°C **Volatility** v.p. 10 mmHg at 30°C ; v.den. 3.52

Occupational exposure

Supply classification corrosive

Risk phrases Flammable – Harmful if swallowed – Causes burns – May cause sensitisation by skin contact (R10, R22, R34, R43)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – Wear suitable protective clothing, gloves and eye/face protection – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S26, S36/37/39, S45)

Mammalian & avian toxicity

Acute data

LD_{50} oral rat 1870 mg kg^{-1} (1).

Irritancy

5 mg instilled into rabbit eye (duration unspecified) caused moderate irritant effects (2).

Dermal rabbit (duration unspecified) 0.5 ml of a 1% solution caused severe burns (3).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (4,5).

Other effects

Other adverse effects (human)

Significant cross-reactions to aliphatic polyamines were observed in patients allergic to topical ethylenediamine. Antihistamines given topically or orally, failed to inhibit ethylenediamine-induced allergic dermatitis (6).

Any other adverse effects

Corrosive to mucous membranes and upper respiratory tract. Inhalation can cause bronchial spasm, inflammation, oedema and death (species unspecified) (3).

Other comments

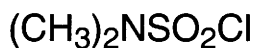
Manufacture and industrial applications, environmental effects, ecotoxicology, experimental toxicology and human health effects reviewed (7,8).

Lachrymatory. Reacts with 1,2-dichloromethane to form acetylene gas. Incompatible with acids, acid chlorides and acid anhydrides. Ignites spontaneously in contact with cellulose nitrate.

References

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D393 dimethylaminosulfonyl chloride



$\text{C}_2\text{H}_6\text{ClNO}_2\text{S}$

Mol. Wt. 143.59

CAS Registry No. 13360-57-1

Synonyms dimethylamidosulfonyl chloride; dimethylsulfamoyl chloride; *N,N*-dimethylsulfamoyl chloride; *N,N*-dimethylsulfamyl chloride

EINECS No. 236-412-4

RTECS No. WO 7185500

Uses Chemical intermediate.

Physical properties

B. Pt. 114°C at 75 mmHg **Flash point** 94°C **Specific gravity** 1.337 at 20°C

Occupational exposure

Supply classification very toxic

Risk phrases May cause cancer – Harmful in contact with skin and if swallowed – Very toxic by inhalation –

Causes burns (R45, R21/22, R26, R34)

Safety phrases Restricted to professional users – Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S53, S45)

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 900 mg kg⁻¹ (1).

LC₅₀ (10 min) inhalation mouse >300 mg m⁻³ (2).

Other effects

Other adverse effects (human)

Inhalation may be fatal as a result of spasm, inflammation and oedema of the larynx and bronchi, chemical pneumonitis and pulmonary oedema (3).

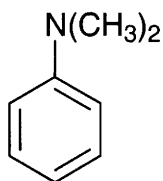
Other comments

Reviews on toxicology listed (4).

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D394 *N,N*-dimethylaniline



C₈H₁₁N

Mol. Wt. 121.18

CAS Registry No. 121-69-7

Synonyms (dimethylamino)benzene; dimethylphenylamine; *N,N*-dimethylbenzenamine; *N,N*-dimethylaminobenzene; dimethylaniline; *N,N*-dimethylphenylamine

EINECS No. 204-493-5

RTECS No. BX 4725000

Uses Analytical chemistry determination of peroxides (1), and iron (2). Manufacture of vanillin. Manufacture of dyestuffs. Solvent.

Physical properties

M. Pt. 1.5-2.5°C **B. Pt.** 193-194°C **Flash point** 62°C **Specific gravity** 0.9557 at 20°C with respect to water at 4°C **Partition coefficient** log *P*_{ow} 2.31 **Volatility** v.p. 1 mmHg at 29.5°C ; v.den. 4.2

Solubility Water: insoluble. Organic solvents: acetone, benzene, carbon tetrachloride, chloroform, diethyl ether, ethanol

Occupational exposure

DE-MAK 5 ppm (25 mg m⁻³)

FR-VME 5 ppm (25 mg m⁻³)

JP-OEL 5 ppm (25 mg m⁻³)

SE-LEVL 1 ppm (5 mg m⁻³)

SE-STEL 2 ppm (10 mg m⁻³)

UK-LTEL 5 ppm (25 mg m⁻³)

UK-STEL 10 ppm (50 mg m⁻³)

US-TWA 5 ppm (25 mg m⁻³)

US-STEL 10 ppm (50 mg m⁻³)

UN No. 2253 **HAZCHEM Code** 3X **Conveyance classification** toxic substance

Supply classification toxic

Supply classification harmful for the environment

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Possible risk of irreversible effects – Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R23/24/25, R40, R51/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S28, S36/37, S45, S61)

Ecotoxicity

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 13.6 ppm Microtox test (3).

Environmental fate

Degradation studies

0-3% depletion at 20 mg l⁻¹ after 6 hr at 25°C by a Warburg technique using activated sludge from a mixed domestic/industrial plant (4).

BOD₅ 10% of ThOD; COD 96% of ThOD; ThOD 2.640 mg O₂ l⁻¹ (5,6).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1410 mg kg⁻¹ (7).

LC_{Lo} (4 hr) inhalation rat 250 mg m⁻³ (8).

LD₅₀ dermal rabbit 1770 mg kg⁻¹ (7).

LD_{Lo} oral human 50 mg kg⁻¹ (9).

Sub-acute and sub-chronic data

Gavage rat, mouse (13 wk) 31, 62, 125, 250 or 500 mg kg⁻¹ day⁻¹ 5 day wk⁻¹. No compound-related mortality was observed. Body weight gain was significantly reduced in ♂ of both species given 250 and 500 mg kg⁻¹. Dose-related occurrence of splenomegaly, cyanosis and a decrease in motor activity was evident in all groups. Microscopic examination revealed the presence of haemosiderin in the spleen, liver, testes and kidneys. Bone marrow hyperplasia and increased haematopoiesis in the spleen occurred in treated rats, and haematopoiesis was increased in the spleen of treated mice (10).

Inhalation rat (100 day) 0.3 mg m⁻³ continuously, led to anaemia, methaemoglobinaemia, leucopenia and significant pathological changes in the central nervous system (11).

Carcinogenicity and chronic effects

Gavage rat, mouse (2 yr) 0, 3, 15 or 30 mg kg⁻¹ day⁻¹ for 5 day wk⁻¹. There was some evidence of carcinogenicity for ♂ rats as indicated by increased incidence of sarcomas or osteosarcomas (combined) of the spleen. There was equivocal evidence of carcinogenicity in ♀ mice, as indicated by an increased incidence of squamous cell papillomas of the forestomach. There was no evidence of carcinogenicity in ♀ rats and ♂ mice (12).

Teratogenicity and reproductive effects

♀ CD-1 mice 365 mg kg⁻¹ day⁻¹ gestation days 6, 13 no observed effect on developmental toxicology (13).

Metabolism and toxicokinetics

Undergoes demethylation yielding aniline and *N*-methylaniline by rabbit liver microsomal cytochrome P₄₅₀ (14).

Incubation with isolated rat hepatocytes resulted in the production of *N*-methylaniline, aniline, *N,N*-dimethylaniline *N*-oxide and a metabolite tentatively identified as *N*-methylaniline *N*-glucuronide (15).

Irritancy

Dermal rabbit (24 hr) 10 mg caused mild irritation (7).

Scored 5 (on a 10-grade ordinal series based on the resulting corneal necrosis) when instilled into rabbit eye, indicating a severe burn from the application of 0.005 ml solution (7).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1537, TA1538 with and without metabolic activation negative (16).
In vitro Chinese hamster ovary cells sister chromatid exchanges and chromosomal aberrations positive (17).
In vitro primary rat hepatocytes DNA repair test negative (18).

Other effects

Any other adverse effects

Readily adsorbed through the skin of mammals (19).

Legislation

Organic solvents are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (20).

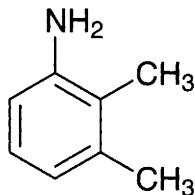
Other comments

Residues have been isolated from waste waters and surface waters (5).
Reviews on toxicology listed (21).
Physical properties, safe handling, metabolism and toxicology reviewed (22,23).

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D395 2,3-dimethylaniline



C₈H₁₁N

Mol. Wt. 121.18

CAS Registry No. 87-59-2

Synonyms 1-amino-2,3-dimethylbenzene; 2,3-xylidine; 2,3-dimethylphenylamine; *o*-xylidine; 2,3-xylylamine; 2,3-dimethylbenzenamine

EINECS No. 201-755-0

RTECS No. ZE 8750000

Uses Dyestuffs manufacture.

Physical properties

M. Pt. 2.5°C **B. Pt.** 221-222°C **Flash point** 96°C (closed cup) **Specific gravity** 0.993

Partition coefficient log *P*_{ow} 2.21 (1) **Volatility** v.p. 0.1 mmHg at 25°C

Solubility Water: slightly soluble. Organic solvents: carbon tetrachloride, diethyl ether, dimethyl sulfoxide, ethanol

Occupational exposure

UK-LTEL 2 ppm (10 mg m⁻³)

UK-STEL 10 ppm (50 mg m⁻³)

US-TWA 0.5 ppm (2.5 mg m⁻³) (mixed isomers)

Supply classification toxic

Supply classification dangerous for the environment

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects – Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R23/24/25, R33, R51/53)

Safety phrases After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet (S28, S36/37, S45, S61)

Ecotoxicity

Invertebrate toxicity

EC₅₀ (48 hr) *Tetrahymena pyriformis* 325 mg l⁻¹ (1).

EC₅₀ (30 min) *Photobacterium phosphoreum* 47 ppm Microtox test (2).

EC₅₀ (24 hr) *Daphnia magna* 0.9 mg l⁻¹ and 21-day reproduction test, NOEC 0.004 mg l⁻¹ (minimum value) (3).

EC₅₀ (48 hr) *Scenedesmus subspicatus* 44 mg l⁻¹ (4).

Environmental fate

Degradation studies

96.5% COD removal at 12.7 mg COD g dry inoculum⁻¹ hr⁻¹ at 20°C (5).

Biodegradable (6).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 933, 1072 mg kg⁻¹, respectively (7).

Irritancy

Vapour or mist irritated skin, eyes, mucous membranes and upper respiratory tract (species unspecified) (8).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535 with and without metabolic activation positive (9).

Other effects

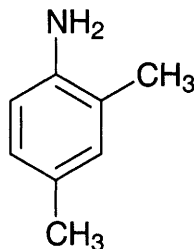
Any other adverse effects

Absorption into the body leads to the formation of methaemoglobin which in sufficient concentrations causes cyanosis (species unspecified) (8).

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D396 2,4-dimethylaniline



$C_8H_{11}N$

Mol. Wt. 121.18

CAS Registry No. 95-68-1

Synonyms 1-amino-2,4-dimethylbenzene; 2,4-xylylidine; 4-amino-1,3-dimethylbenzene; 4-amino-3-methyltoluene; 4-amino-1,3-xylene; *m*-xylylidine; 2-methyl-*p*-toluidine; 2,4-dimethylbenzenamine; 2,4-dimethylphenylamine; 2,4-xylylamine

EINECS No. 202-440-0

RTECS No. ZE 8925000

Uses Dyestuffs synthesis.

Physical properties

M. Pt. 16°C B. Pt. 218°C Flash point 90°C Specific gravity 0.980 Partition coefficient $\log P_{ow}$ 1.68
Volatility v.p. 1mmHg at 52.6°C ; v.den. 4.2

Occupational exposure

UK-LTEL 2 ppm (10 mg m⁻³)

UK-STEL 10 ppm (50 mg m⁻³)

US-TWA 0.5 ppm (2.5 mg m⁻³) (mixed isomers)

Supply classification toxic

Supply classification dangerous for the environment

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects – Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R23/24/25, R33, R51/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S28, S36/37, S45, S61)

Ecotoxicity

Invertebrate toxicity

Toxicity threshold cell multiplication inhibition test *Pseudomonas putida* 8 mg l⁻¹; *Scenedesmus quadricauda* 5 mg l⁻¹; *Entosiphon sulcatum* 9.8 mg l⁻¹ (1).

Toxicity threshold cell multiplication inhibition test *Uronema parduczi* 12 mg l⁻¹ (2).

EC₅₀ (48 hr) *Tetrahymena pyriformis* 241 mg l⁻¹ (3).

EC₅₀ (30 min) *Photobacterium phosphoreum* 17.1 ppm Microtox test (4).

IC₅₀ (48 hr) *Escherichia coli* 300 mg l⁻¹ (5).

EC₅₀ (24 hr) *Daphnia magna* 18 mg l⁻¹ (6).

Bioaccumulation

Non-accumulative or low accumulative (7).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 250-265 mg kg⁻¹ (8).

LD₅₀ oral ♂ Osborne-Mendel rat 1259 mg kg⁻¹ (as HCl) (9).

Sub-acute and sub-chronic data

Oral dog (4 wk) 50 mg kg⁻¹ caused slight enlargement of the liver with fatty degeneration (10).

Carcinogenicity and chronic effects

No adequate data for evaluation of carcinogenicity to humans, insufficient evidence for carcinogenicity to animals, IARC classification group 3 (11).

Oral rat (2 yr) subcutaneous fibromas and fibrosarcomas occurred in 39% of treated animals compared with 16% in controls. An excess of hepatomas also occurred in treated rats (dosage rate unspecified) (12).

Metabolism and toxicokinetics

In a study investigating the toxicity in rats and dogs, the major urinary metabolite in rats was found to be 4-(N-acetylamino)-3-methylbenzoic acid while in the dog it was found to be 6-hydroxy-2,4-dimethylaniline. In dog, also metabolised to methylbenzoic acid and its glycine conjugate (13).

Irritancy

Vapour or mist irritating to the skin, eyes, mucous membranes and upper respiratory tract (species unspecified) (14).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation positive (15).

In vitro alkaline single cell gel electrophoresis 'comet' assay in bone marrow cells of B6C3F1 mice positive (16).

In vitro primary rat hepatocytes DNA repair assay positive (17).

Other effects

Any other adverse effects

Intravenous rat, single injection of 20 mg increased the blood methaemoglobin level from 1.5 to 3.5% after 1 hr (9). Oral rat 2500 mg kg⁻¹ diet reduced weight gain, and 10,000 mg kg⁻¹ diet caused cholangiofibrosis, bile-duct proliferation, hepatic cell necrosis and hyperplasia, and kidney damage, including tubular atrophy, interstitial fibrosis, inflammation and papillary oedema (18).

Produced hepatic cholangiofibrosis, bile duct proliferation, and foci of cellular hyperplasia and degeneration in the rat, but was innocuous in the dog (duration and concentrations unspecified) (13).

Absorption into the body leads to the formation of methaemoglobin which in sufficient concentration causes cyanosis (14).

Other comments

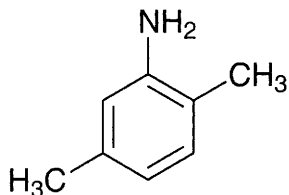
Physical properties, use, analysis, carcinogenicity and mammalian toxicity reviewed (19).

Health and environmental effects reviewed (20).

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D397 2,5-dimethylaniline



$C_8H_{11}N$

Mol. Wt. 121.18

CAS Registry No. 95-78-3

Synonyms 2-amino-1,4-dimethylbenzene; 2,5-xylydine; 1-amino-2,5-dimethylbenzene; 2-amino-1,4-xylene; 5-methyl-*o*-toluidine; *p*-xylydine; 2,5-dimethylbenzenamine; 2,5-dimethylphenylamine

EINECS No. 202-451-0

RTECS No. ZE 9100000

Uses Dyestuff synthesis.

Occurrence Has been detected in the steam distillate of Latakia tobacco (1).

Physical properties

M. Pt. 11.5°C **B. Pt.** 218°C **Flash point** 93°C **Specific gravity** 0.973

Solubility Water: slightly soluble. Organic solvents: diethyl ether, ethanol, carbon tetrachloride, dimethyl sulfoxide

Occupational exposure

UK-LTEL 2 ppm (10 mg m⁻³)

UK-STEL 10 ppm (50 mg m⁻³)

US-TWA 0.5 ppm (2.5 mg m⁻³) (mixed isomers)

Supply classification toxic

Supply classification dangerous for the environment

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects – Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R23/24/25, R33, R51/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S28, S36/37, S45, S61)

Ecotoxicity

Invertebrate toxicity

EC₅₀ (48 hr) *Tetrahymena pyriformis* 268 mg l⁻¹ (2).

EC₅₀ (30 min) *Photobacterium phosphoreum* 22.1 ppm Microtox test (3).

Environmental fate

Degradation studies

3.6 mg COD g l⁻¹ dry inoculum hr⁻¹ utilised as sole carbon source, 96.5% COD removal (activated sludge 20°C) (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 840, 1300 mg kg⁻¹, respectively (5).

Sub-acute and sub-chronic data

Oral rat (4 wk) 400-500 mg kg⁻¹ day⁻¹ caused hepatomegaly, decreased glycogen levels and glucose-6-phosphatase activity, increased microsomal protein, cytochrome P₄₅₀ levels and glucuronyltransferase and aniline hydroxylase activities (6).

Carcinogenicity and chronic effects

No adequate data for evaluation of carcinogenicity to humans, insufficient evidence for carcinogenicity to animals, IARC classification group 3 (7).

Oral rat (2 yr) subcutaneous fibromas or fibrosarcomas occurred in 24% of treated animals compared to 116% in controls. Treated rats also developed hepatomas (dosage rate not specified) (8).

Metabolism and toxicokinetics

Gavage ♂ Osborne-Mendel rats 200 mg kg⁻¹ day⁻¹ (HCl) metabolised to 4-hydroxy-2,5-dimethylaniline and its conjugates in the urine together with some 2-methylaminobenzoic acid and 4-methyl-3-aminobenzoic acid (9).

Irritancy

Vapour or mist irritates the skin, eyes, mucous membranes and upper respiratory tract (species unspecified) (10).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1537 with and without metabolic activation positive (11).

Oral mouse 200 mg kg⁻¹ DNA inhibition (12).

Other effects

Any other adverse effects

Intravenous rat, single injection of 20 mg increased the blood methaemoglobin level from 1.5 to 3.5% after 3 hr (13).

Absorption into the body leads to the formation of methaemoglobin which in sufficient concentration causes cyanosis (10).

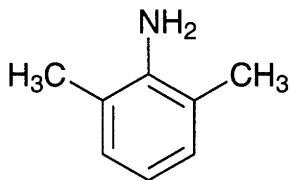
Other comments

Physical properties, use, analysis, carcinogenicity and mammalian toxicity reviewed (14).

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D398 2,6-dimethylaniline



$C_8H_{11}N$

Mol. Wt. 121.18

CAS Registry No. 87-62-7

Synonyms 2-amino-1,3-dimethylbenzene; 2,6-xylidine; 2,6-dimethylbenzenamine; *o*-xylidine; 2,6-xylylamine

EINECS No. 201-758-7

RTECS No. ZE 9275000

Uses Chemical intermediate used principally in the production of dyestuffs.

Physical properties

M. Pt. 10-12°C **B. Pt.** 214°C at 739 mmHg **Flash point** 91°C **Specific gravity** 0.984 at 20°C

Volatility v.p. 0.125 mmHg at 25°C

Solubility Water: 8240 mg l⁻¹ at 25°C. Organic solvents: carbon tetrachloride, diethyl ether, dimethyl sulfoxide, ethanol

Occupational exposure

UK-LTEL 2 ppm (10 mg m⁻³)

UK-STEL 10 ppm (50 mg m⁻³)

US-TWA 0.5 ppm (2.5 mg m⁻³) (mixed isomers)

Supply classification toxic

Supply classification dangerous for the environment

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects – Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R23/24/25, R33, R51/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S28, S36/37, S45, S61)

Ecotoxicity

Invertebrate toxicity

EC₅₀ (48 hr) *Tetrahymena pyriformis* 330 mg l⁻¹ (1).

EC₅₀ (30 min) *Photobacterium phosphoreum* 26.5 ppm Microtox test (2).

Environmental fate

Degradation studies

24-30% depletion of activated sludge by Warburg procedure at 20 mg l⁻¹ after 6 hr at 25°C (3).

Abiotic removal

Effectively removed from water by foam flotation with sodium dodecylsulfate (4).

t_{1/2} for reaction with photochemically produced hydroxyl radicals in the atmosphere 2 hr (5).

Mammalian & avian toxicity

Acute data

LD₅₀ mouse, oral rat 705, 840 mg kg⁻¹, respectively (6,7).

Carcinogenicity and chronic effects

Oral rat (2 yr) 0, 300, 1000 or 3000 mg kg⁻¹ diet. Clear evidence of carcinogenicity in rats with a significant increase in the incidence of adenomas and carcinomas of the nasal cavity. Insignificant increase in the occurrence of subcutaneous fibromas and fibrosarcomas in both sexes and neoplastic nodules of the liver in ♀ rats were also observed (8).

Metabolism and toxicokinetics

In a study investigating the toxicity of 2,6-dimethylaniline, the major urinary metabolite in rats and dogs was 4-hydroxy-2,6-dimethylaniline, but the dog also produced significant amounts of 2-amino-3-methylbenzoic acid, with trace amounts of the glycine conjugate of the latter and 2,6-dimethylnitrosobenzene (9).

Irritancy

Vapour or mist irritates the skin, eyes, mucous membranes and upper respiratory tract (species unspecified) (10).

Genotoxicity

Salmonella typhimurium TA100 with and without metabolic activation positive (11).

Drosophila melanogaster sex-linked recessive lethal assay negative (12).

In vitro rat primary hepatocyte unscheduled DNA synthesis negative (13).

In vitro Chinese hamster ovary cells sister chromatid exchanges and chromosomal aberrations positive (14).

In vivo mouse bone marrow cells micronucleus induction negative (15).

Other effects

Any other adverse effects

Absorption into the body leads to the formation of methaemoglobin which in sufficient concentration causes cyanosis (10).

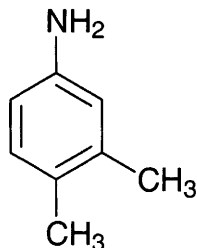
Other comments

Component of tobacco smoke. Degradation product of aniline-based pesticides (16).

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D399 3,4-dimethylaniline



C₈H₁₁N

Mol. Wt. 121.18

CAS Registry No. 95-64-7

Synonyms 4-amino-1,2-dimethylbenzene; 3,4-xylylidine; 3,4-dimethylaminobenzene;
3,4-dimethylphenylamine; 3,4-xylylamine; 3,4-dimethylbenzenamine

EINECS No. 202-437-4

RTECS No. ZE 9450000

Uses Dyestuff synthesis. Chemical intermediate.

Physical properties

M. Pt. 49-51°C **B. Pt.** 226°C **Flash point** 98°C **Specific gravity** 1.076 at 18°C

Solubility Organic solvents: chloroform, diethyl ether, dimethyl sulfoxide, lignoin, petroleum ether

Occupational exposure

UK-LTEL 2 ppm (10 mg m⁻³)

UK-STEL 10 ppm (50 mg m⁻³)

US-TWA 0.5 ppm (2.5 mg m⁻³) (mixed isomers)

Supply classification toxic

Supply classification dangerous for the environment

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects – Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R23/24/25, R33, R51/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S28, S36/37, S45, S61)

Ecotoxicity

Invertebrate toxicity

EC₅₀ (48 hr) *Tetrahymena pyriformis* 234 mg l⁻¹ (1).

EC₅₀ (30 min) *Photobacterium phosphoreum* 0.963 ppm Microtox test (2).

EC₅₀ (24 hr) *Daphnia magna* 2.9 mg l⁻¹; 21 day NOEC *Daphnia* reproduction test, minimum value 0.01 mg l⁻¹ (3).

EC₅₀ (48 hr) *Scenedesmus subspicatus* 24 mg l⁻¹ (4).

Bioaccumulation

Non-accumulative or low accumulative (5).

Environmental fate

Degradation studies

30 mg COD g⁻¹ dry inoculum hr⁻¹ utilised as sole carbon source; 76% COD removal by activated sludge process at 20°C (6).

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird, starling 5.6, 10.0 mg kg⁻¹, respectively (7).

LD₅₀ oral mouse, rat 705, 815 mg kg⁻¹, respectively (8,9).

Metabolism and toxicokinetics

Metabolised by rat to yield 2-amino-4,5-dimethylphenol, 3,4-dimethylacetanilide and 3,4-dimethylphenyl sulfamate (routes of administration and excretion unspecified) (10).

Irritancy

Vapour or mist irritating to the skin, eyes, mucous membranes and upper respiratory tract (species unspecified) (11).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535 with and without metabolic activation positive (12).

Other effects

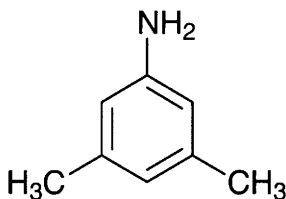
Any other adverse effects

Absorption into the body leads to the formation of methaemoglobin which in sufficient concentration leads to cyanosis (11).

References

1. Arnold, J. M. et al *Chemosphere* 1990, **21**(1-2), 183-191.
2. Kaiser, K. L. E. et al *Water Pollut. Res. J. Can.* 1991, **26**(3), 361-431.
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7. Schafer, E. W. et al *Arch. Environ. Contam. Toxicol.* 1983, **12**, 355-382.
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12. Zeiger, E. et al *Environ. Mol. Mutagen.* 1988, **11**(Suppl.12), 1-158

D400 3,5-dimethylaniline



C₈H₁₁N

Mol. Wt. 121.18

CAS Registry No. 108-69-0

Synonyms 1-amino-3,5-dimethylbenzene; 3,5-xylylidine; 3,5-dimethylphenylamine; 3,5-dimethylbenzenamine; 3,5-xylylamine

EINECS No. 203-607-0

RTECS No. ZE 9625000

Uses Chemical intermediate.

Physical properties

M. Pt. 9.8°C B. Pt. 220-221°C; 104-105°C at 15 mmHg Flash point 93°C Specific gravity 0.972
Solubility Organic solvents: carbon tetrachloride, diethyl ether, dimethyl sulfoxide

Occupational exposure

UK-LTEL 2 ppm (10 mg m⁻³)

UK-STEL 10 ppm (50 mg m⁻³)

US-TWA 0.5 ppm (2.5 mg m⁻³) (mixed isomers)

Supply classification toxic

Supply classification dangerous for the environment

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects – Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R23/24/25, R33, R51/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S28, S36/37, S45, S61)

Ecotoxicity

Invertebrate toxicity

EC₅₀ (48 hr) *Tetrahymena pyriformis* 284 mg l⁻¹ (1).

EC₅₀ (30 min) *Photobacterium phosphoreum* 19.2 ppm Microtox test (2).

Environmental fate

Degradation studies

46-60% depletion of 20 mg l⁻¹ after (6 hr) at 25°C by a Warburg technique using activated sludge from a mixed domestic/industrial plant (3).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 420, 705 mg kg⁻¹, respectively (4).

Irritancy

Vapour or mist irritates the skin, eyes, mucous membranes and upper respiratory tract (species unspecified) (5).

Genotoxicity

Salmonella typhimurium TA100 with and without metabolic activation positive (6).

Other effects

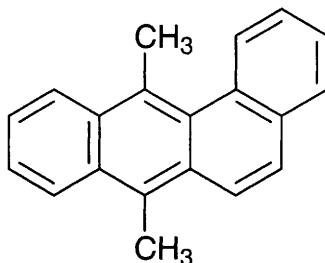
Any other adverse effects

Absorption into the body leads to the formation of methaemoglobin which in sufficient concentration causes cyanosis (5).

References

1. Arnold, J. M. et al *Chemosphere* 1990, 21(1-2), 183-191.
2. Kaiser, K. L. E. et al *Water Pollut. Res. J. Can.* 1991, 26(3), 361-431.
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6. Zeiger, E. et al *Environ. Mol. Mutagen.* 1988, 11(Suppl. 12), 1-158

D401 7,12-dimethylbenz[a]anthracene



C₂₀H₁₆

Mol. Wt. 256.35

CAS Registry No. 57-97-6

Synonyms dimethylbenzanthracene; dimethylbenz[a]anthracene; 9,10-dimethyl-1,2-benzanthracene; DMBA; 7,12-DMBA

EINECS No. 200-359-5

Physical properties

M. Pt. 121-123°C **Partition coefficient** log P_{ow} 5.80

Solubility Water: 0.055 mg l⁻¹ at 24°C. Organic solvents: acetone, benzene, ethanol

Occupational exposure

UN No. 2811

Ecotoxicity

Fish toxicity

Japanese medaka and guppy (6-10 days old) were exposed to 150-250 µg l⁻¹ in water for 6 hr wk⁻¹ for 2-4 wk; hepatic neoplasms were induced in both species (1).

Intraperitoneal *Oreochromis niloticus* (sub-chronic doses) suffered reduction in spleen and pronephros total white blood cell counts, usually in a dose-related manner. The lymphoid regions of the spleen displayed marked hypocellularity. The activity of spleen phagocytes was not altered except at higher doses associated with signs of chemical toxicity (reduced swimming and feeding activity, increased cutaneous pigmentation, and increased mortality). (The authors propose that total leukocyte counts in tilapia haematopoietic organs may be a more sensitive indicator of environmental PAH exposure than the activity of phagocytes isolated from these organs.) (2).

Environmental fate

Degradation studies

Metabolites formed in non-acclimated sandy loam soil include, 4-hydroxy-, 5-hydroxy- and 10-hydroxydimethylbenzanthracene, and 7,12-dihydro-12-methyl-7-methylenebenz[a]anthracene (3).

Abiotic removal

100% removed from waste water reported after 1 min contact with ozone (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird >100 mg kg⁻¹ (5).

LD₅₀ oral starling >316 mg kg⁻¹ (5).

LD₅₀ oral rat, mouse 325, 340 mg kg⁻¹, respectively (6,7).

LD₅₀ intravenous rat 54 mg kg⁻¹ (7).

LD₅₀ intraperitoneal mouse 54 mg kg⁻¹ (8).

Carcinogenicity and chronic effects

Gavage rat, single dose of 20 mg kg⁻¹ caused a significant increase in the incidence of mammary adenomas and fibroadenomas. The incidence was enhanced with increasing dietary fat intake. Protein intake did not affect tumour incidence (9).

♀ Sprague-Dawley rats (50-day-old) were injected intraperitoneally with 30 or 60 mg kg⁻¹ 7,12-dimethyl[*a*]anthracene (DMBA) alone, 30 or 60 mg kg⁻¹ *N*-nitro-*N*-nitrosourea (MNU) alone, or 30 mg kg⁻¹ MNU followed by 30 mg kg⁻¹ DMBA. Another group received 30 mg kg⁻¹ intraperitoneal MNU followed by 30 mg kg⁻¹ intravenous DMBA. At 30 wk of age the animals were killed. Intraperitoneal MNU alone caused no deaths, intraperitoneal DMBA treatments all induced death due to peritonitis, but intravenous DMBA suppressed these deaths. All tumours caused by MNU were mammary adenocarcinomas, whereas DMBA produced tumours of other than mammary origin. Combined treatment with DMBA and MNU increased the mammary carcinogenic effect significantly (10).

Dermal BALB/c mice single application 0.5 mg (56 wk) induced sebaceous adenomas distributed at random over entire body (11).

♀ Sprague-Dawley rats were administered 5 mg rat⁻¹ on day-1 and then at wkly intervals to a total dose of 20 mg rat⁻¹. At 13 wk rats were killed and examined for mammary tumours. The experiment was performed four times, starting in different seasons of the year. Tumour incidence and burden were seasonally dependent with the highest incidence (61%) obtained during spring and summer, the lowest incidence (34%) in winter (12).

Metabolism and toxicokinetics

An antibody inhibition study using rat and human liver microsomal membranes demonstrated that cytochrome P₄₅₀ CYP2C isoenzymes accounted for up to 90% formation of the carcinogen dimethylbenzanthracene-3,4-diol and the 5,6- and 8,9-diols (13).

Metabolised in follicles and corpora lutea of porcine ovaries by the microsomal and mitochondrial fraction (14).

Irritancy

Dermal mouse 64 µg caused mild irritation (period of exposure unspecified) (15).

Genotoxicity

Salmonella typhimurium TA98, TA100 with and without metabolic activation positive (16).

In vitro mouse lymphoma L5178Y cells mutagenicity assay positive (17).

In vitro Chinese hamster ovary cells, chromosomal aberrations and sister chromatid exchanges positive (17).

In vivo mouse induction of micronucleated polychromatic erythrocytes positive (18).

Other effects

Other adverse effects (human)

In a few epidemiological studies on oil refinery workers, a slight excess of melanoma incidence has been reported. To determine if a link exists between exposure to PAHs contained in refinery streams, data on PAH exposure, UV light and melanoma induction in experimental animals and humans was reviewed. 7,12-

Dimethylbenz[*a*]anthracene was capable of inducing melanomas in hamsters, mice and guinea pigs, but only under certain experimental conditions and at high concentrations. Evidence suggested that other carcinogenic PAHs were unable to induce melanomas. It was not considered that the amounts present in refinery streams would be sufficient to account for an increase in melanoma incidence in exposed workers (19).

Any other adverse effects

In vitro mouse splenocytes, 0.256-2650 µg l⁻¹ suppressed the T cell-dependent humoral immune response to sheep red blood cells. The 3,4-diol metabolite was found to be 65× more potent while the 5,6-diol metabolite had no effect (20).

Causes necrosis in endocrine organs (species unspecified) (14).

Intramammary injection of 0.25 µmol gland⁻¹ in rats produced one major and four minor DNA adducts. The pattern of adducts was similar in non-target tissues (21).

Following dermal application to mice, covalent DNA adducts were identified in the skin tissues (22).
Reported to bind to the cytoplasmic receptor for oestrogens in laboratory animals (23).
Following intraduodenal administration to rats ~ 25% was recovered in the bile and ~ 5% in the intestinal lymph within 24 hr (24).

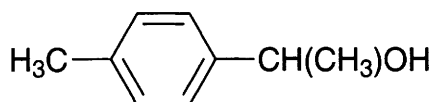
Legislation

The log P_{ow} value exceeds the European Community recommended level of 3.0 (25).

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D402 α ,4-dimethylbenzyl alcohol



$C_9H_{12}O$

Mol. Wt. 136.19

CAS Registry No. 536-50-5

Synonyms α ,4-dimethylbenzenemethanol; α ,*p*-dimethylbenzyl alcohol; 4-(α -hydroxyethyl)toluene; 1-(4-methylphenyl)ethanol; 4-methylphenylmethylcarbinol; methyl-*p*-tolylcarbinol; 1-(*p*-tolyl)ethanol; *p*-tolylmethylcarbinol

EINECS No. 208-637-8

RTECS No. DO 4565000

Uses Solvent.

Occurrence Photo-oxidation product of fossil fuels in seawater (1).

Physical properties

M. Pt. 35-37°C **B. Pt.** 218-220°C **Specific gravity** 0.9668 at 15.5°C with respect to water at 4°C
Solubility Water: miscible. Organic solvents: acetic acid, benzene, diethyl ether, ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 2800 mg kg⁻¹ (2).
LD₅₀ intramuscular rat 1000 mg kg⁻¹ (3).

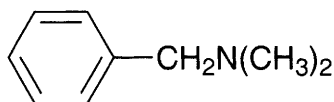
Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) of Statutory Instrument No. 472, 1991 (4).

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2. *Arzneim.-Forsch.* 1962, **12**, 347.
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4. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations 1991*, HMSO, London, UK

D403 *N,N*-dimethylbenzylamine



C₉H₁₃N

Mol. Wt. 135.21

CAS Registry No. 103-83-3

Synonyms benzyldimethylamine; dimethylbenzylamine; *N*-(phenylmethyl)dimethylamine;
N,N-dimethylbenzenemethanamine

EINECS No. 203-149-1

RTECS No. DP 4500000

Uses Cross-linking aid for epoxy resins, heat-sensitive adhesive laminator. Disinfectant. Catalyst. Fuel additive.
Templating agent and buffer in the sequential analysis of proteins.

Occurrence

Isolated from the essential oil of *Erythroxylum coca* (1).

Physical properties

M. Pt. -75°C **B. Pt.** 183-184°C **Flash point** 54°C **Specific gravity** 0.900 at 20°C
Partition coefficient log P_{ow} 1.98
Solubility Water: slightly soluble. Organic solvents: diethyl ether, ethanol

Occupational exposure

Supply classification corrosive

Risk phrases Flammable – Harmful by inhalation, in contact with skin and if swallowed – Causes burns –
Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R10, R20/21/22,
R34, R52/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – Wear suitable protective clothing – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S26, S36, S45, S61)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 265 mg kg⁻¹ (2).

LC₅₀ (4 hr) inhalation rat 2062 mg m⁻³ (3).

LC₅₀ (2 hr) inhalation mouse 800 mg m⁻³ (4).

LD₅₀ dermal rabbit 1660 mg kg⁻¹ (3).

Sub-acute and sub-chronic data

Rats were administered 7 or 70 mg kg⁻¹ day⁻¹ for 4 wk (route of administration unspecified). Hypertrophy of the thymus and a significant weight decrease in the adrenal gland were reported. A 30-40% decrease in cholesterol of the adrenal gland indicated a stress effect on the hypothalamus-hypophysis axis. A significant decrease of leucine in brain proteins (hemisphere) suggested some pathobiochemical changes of the central nervous system.

Depression of acetylcholinesterase activity in the cerebellum and basal ganglia correlated with the disturbances of the functional activity of the neurocholinergic system which induced abnormal behaviour of the rats (5).

Irritancy

Dermal rabbit (4 hr) 500 mg caused severe irritation and 5 mg instilled into rabbit eye caused severe irritation (period of exposure unspecified) (3).

Sensitisation

Has been reported to cause skin and respiratory allergies (species unspecified) (6).

Other effects

Any other adverse effects

Inhalation may be fatal as a result of spasm, inflammation and oedema of the larynx and bronchi, chemical pneumonitis and pulmonary oedema (species unspecified) (6).

Other comments

Can be oxidised to benzaldehyde by cytochrome P₄₅₀ (7).

Reviews on toxicology listed (8).

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D404 1,3-dimethylbutylamine



$\text{C}_6\text{H}_{15}\text{N}$

Mol. Wt. 101.19

CAS Registry No. 108-09-8

Synonyms 1,3-dimethylbutanamine; 4-methyl-2-pentanamine

EINECS No. 203-549-6

RTECS No. EO 4460000

Uses Organic intermediate.

Physical properties

B. Pt. 106-109°C Flash point -3°C Specific gravity 0.750 at 20°C with respect to water at 20°C

Volatility v.den. 3.5

Solubility Organic solvents: acetone, benzene, diethyl ether, dimethyl sulfoxide, ethanol

Occupational exposure

UN No. 2379 HAZCHEM Code 3WE Conveyance classification flammable liquid, corrosive

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 470 mg kg⁻¹ (1).

LC_{Lo} (15 min) inhalation mouse 1278 ppm (1).

LD_{Lo} dermal rabbit 600 mg kg⁻¹ (1).

LD₅₀ intravenous mouse 80 mg kg⁻¹ (2).

Irritancy

Dermal rabbit 500 mg caused severe irritation (period of exposure unspecified) (1).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with metabolic activation negative (3).

Other effects

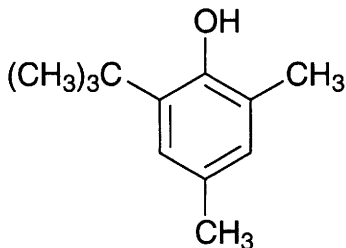
Any other adverse effects

Inhalation may be fatal as a result of spasm, inflammation, oedema of the larynx and bronchi, chemical pneumonitis and pulmonary oedema (species unspecified) (4).

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4. Lenga, R. E. (Ed.) *The Sigma-Aldrich Library of Chemical Safety Data* 2nd ed. 1988, 1, 1360, Sigma-Aldrich, Milwaukee, WI, USA

D405 2,4-dimethyl-6-*tert*-butylphenol



C₁₂H₁₈O

Mol. Wt. 178.27

CAS Registry No. 1879-09-0

Synonyms 6-*tert*-butyl-2,4-xlenol; 2-(1,1-dimethylethyl)-4,6-dimethylphenol; Topanol

EINECS No. 217-533-1

RTECS No. ZE 6825000

Uses Antioxidant.

Physical properties

M. Pt. 22-23°C **B. Pt.** 249°C **Flash point** 111°C **Specific gravity** 0.917 at 20°C

Partition coefficient log P_{ow} 4.75 (1)

Solubility Organic solvents: acetone, benzene, carbon tetrachloride, diethyl ether, ethanol

Ecotoxicity

Invertebrate toxicity

EC₅₀ (48 hr) *Tetrahymena pyriformis* 31 mg l⁻¹ (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 530 mg kg⁻¹ (2).

LD_{Lo} dermal guinea pig 7100 mg kg⁻¹ (2).

Other effects

Any other adverse effects

Extremely destructive to tissues of the mucous membranes, upper respiratory tract, eyes and skin. Inhalation may be fatal as a result of spasm, inflammation and oedema of the larynx, chemical pneumonitis and pulmonary oedema (species unspecified) (3).

Legislation

The log P_{ow} value exceeds the European Community recommended level of 3.0 (4).

References

1. Schultz, T. W. et al *Bull. Environ. Contam. Toxicol.* 1989, 43(2), 193-198.
2. *J. Am. Pharm. Assoc.* 1949, 38, 366.
3. Lenga, R. E. (Ed.) *The Sigma-Aldrich Library of Chemical Safety Data* 2nd ed., 1988, 1, 627, Sigma-Aldrich, Milwaukee, WI, USA.
4. 1967 Directive on Classification, Packaging, and Labelling of Dangerous Substances 67/548/EEC; 6th Amendment EEC Directive 79/831/EEC; 7th Amendment EEC Directive 91/32/EEC 1991, HMSO, London, UK

D406 dimethylcarbamyl chloride



$\text{C}_3\text{H}_6\text{ClNO}$

Mol. Wt. 107.54

CAS Registry No. 79-44-7

Synonyms dimethylcarbamoyl chloride; dimethylcarbamic chloride; *N,N*-dimethylaminocarbonyl chloride; *N,N*-dimethylcarbamidoyl chloride; *N,N*-dimethylcarbamy l chloride

EINECS No. 201-208-6

RTECS No. FD 4200000

Uses Chemical intermediate, used in the manufacture of drugs and pesticides.

Physical properties

M. Pt. -33°C **B. Pt.** $167\text{--}168^\circ\text{C}$ at 775 mmHg **Flash point** 68°C **Specific gravity** 1.1678 at 20°C with respect to water at 4°C **Volatility** v.den. 3.73
Solubility Organic solvents: acetone

Occupational exposure

UN No. 2262 HAZCHEM Code 2X Conveyance classification corrosive substance

Supply classification toxic

Risk phrases May cause cancer – Harmful if swallowed – Toxic by inhalation – Irritating to eyes, respiratory system and skin (R45, R22, R23, R36/37/38)

Safety phrases Restricted to professional users – Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S53, S45)

Environmental fate

Abiotic removal

Rapidly hydrolysed in water to dimethylamine, carbon dioxide and hydrogen chloride. $t_{1/2}$ ~6 min at 0°C (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1170 mg kg⁻¹ (2).

LC₅₀ (6 hr) inhalation rat 180 ppm (3).

LD₅₀ intraperitoneal mouse 350 mg kg⁻¹ (2).

Inhalation rat, 8 min exposure to an atmosphere saturated at 20°C was tolerated. The animals survived 14 days post-exposure. When exposed for 1 and 2 hr, 5/6 and 6/6 died, respectively. Damage to the mucous membranes of the nose, throat and lungs and breathing difficulty were reported (2).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2A (4).

Dermal mouse (18 month) 2 mg animal⁻¹, 3 × wk⁻¹ for 70 wk 40/50 treated mice developed skin papillomas, 30 of which progressed to skin carcinomas. The median survival time was 386 days compared to 543 days for controls (1).

Subcutaneous mouse (18 month) 5 mg animal⁻¹ wk⁻¹ for 26 weeks. 36/50 developed local sarcomas and 3 had local squamous-cell carcinomas. The median survival time was 280 days compared to 493 days for controls. 1/50 controls developed a sarcoma (5).

Intraperitoneal mouse 1 mg animal⁻¹ wk⁻¹ for up to 450 days. At this time 14/30 developed papillary tumours of the lungs compared to 10/30 controls. Eight treated mice and one control developed local sarcomas and one treated mouse developed a squamous-cell carcinoma of the skin (5).

Irritancy

Single application dermal rat, rabbit (concentration unspecified) caused purulent skin irritation, with subsequent degeneration of the epidermis and other dermal structures; the mucous tissue of the eye became inflamed, causing keratitis (2).

Sensitisation

Negative in skin sensitisation tests in the guinea pig (2).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537, with and without metabolic activation positive (6).

Saccharomyces cerevisiae gene conversion assay, without metabolic activation positive (7).

Drosophila melanogaster sex-linked recessive lethal assay negative (8).

In vitro Chinese hamster ovary cells, sister chromatid exchanges negative, chromosomal aberrations positive (9).

In vitro human fibroblasts unscheduled DNA synthesis with and without metabolic activation negative (10).

In vivo mouse micronucleus test positive (11).

Other effects

Other adverse effects (human)

No deaths from cancer were reported in an investigation of 39 dimethylcarbaryl chloride production workers, 26 process workers, and 42 ex-workers aged 17-65 exposed for periods ranging from 6 months to 12 yr (2,12).

Any other adverse effects

Absorbed through skin. Inhalation exposure damages the mucous tissue of the respiratory organs, as well as causing difficulty in breathing which often occurs only after a latent period of some days (species unspecified) (2). Binds to DNA of rat nasal mucosa following inhalation exposure (13).

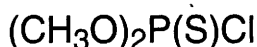
Other comments

Physical properties, use, analysis, carcinogenicity, mammalian toxicity and genotoxicity reviewed (12).

References

1. van Duuren, B. L. et al *J. Natl. Cancer Inst.* 1972, **48**, 1539-1541.
2. von Hey, W. et al *Zentralbl. Arbeitsmed. Arbeitsschutz* 1974, **24**(3), 71-77 (Ger.) (*Chem. Abstr.* **81**(8), 41033d).
3. *J. Environ. Pathol. Toxicol.* 1980, **4**(1), 107.
4. *IARC Monograph* 1987, **Suppl. 7**, 199-200.
5. van Duuren, B. L. et al *J. Natl. Cancer Inst.* 1974, **53**, 695-700.
6. Haworth, S. et al *Environ. Mol. Mutagen.* 1983, **5**(Suppl. 1), 3-142.
7. Zimmerman, F. K. et al *Prog. Mutat. Res.* 1981, **1**, 481-490.
8. Wuergeer, F. E. et al *Prog. Mutat. Res.* 1981, **1**, 666-672.
9. Natarajan, A. T. et al *Prog. Mutat. Res.* 1981, **1**, 551-559.
10. Robinson, D. E. et al *Prog. Mutat. Res.* 1981, **1**, 517-527.
11. Salome, M. F. et al *Prog. Mutat. Res.* 1981, **1**, 686-697.
12. *IARC Monograph* 1976, **12**, 77-84.
13. Stoner, G. D. et al *Cancer Lett. (Shannon, Irel.)* 1986, **33**(2), 167-173.

D407 dimethyl chlorothiophosphate



$\text{C}_2\text{H}_6\text{ClO}_2\text{PS}$

Mol. Wt. 160.56

CAS Registry No. 2524-03-0

Synonyms dimethyl phosphorochloridothioate; *O,O*-dimethyl phosphorochloridothioate; chlorodimethoxyphosphine sulfide; dimethoxythiophosphonyl chloride; dimethyl chlorothionophosphate; *O,O*-dimethyl chlorothionophosphate; *O,O*-dimethyl chlorothiophosphate

EINECS No. 219-754-9

RTECS No. TD 1830000

Uses Chemical intermediate. Fuel additive. Corrosion inhibitor. Plasticiser. Flame retardant. Flotation agent.

Physical properties

B. Pt. 66-67°C at 16 mmHg **Flash point** 105°C **Specific gravity** 1.322 at 20°C

Solubility Organic solvents: acetone, benzene, carbon tetrachloride, chloroform, ethanol, ethyl acetate, hexane

Occupational exposure

UN No. 2267

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 1800 mg kg⁻¹ (1).

LC₅₀ (4 hr) inhalation rat 340 mg m⁻³ (1).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537, TA1538 with and without metabolic activation negative (2).

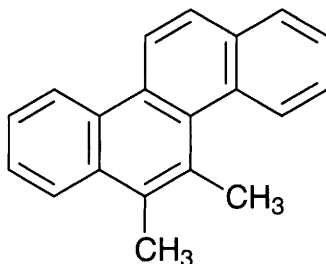
In vitro Chinese hamster ovary cells, chromosomal aberrations without metabolic activation positive (3).

In vivo mouse bone marrow micronucleus induction negative (4).

References

1. Izmerov, N. F. *Toxicometric Parameters of Industrial Toxic Chemicals Under Single Exposure* 1982, 56, CIP, Moscow, USSR.
2. *Dimethyl Phosphorochloridothioate, Mutagenicity Evaluation in Salmonella Typhimurium* 1982, Stauffer Chemical Co., EPA Document No. FYI-OTS-0884-0249.
3. *Mutagenicity Evaluation of DMPCT in Chinese Hamster Ovary Cytogenetic Assay* 1983, Stauffer Chemical Co., EPA Document No. FYI-OTS-0884-0249.
4. *Genetic Toxicology Micronucleus Test* 1980, Pharmakon Laboratories, EPA Document No. 88-8100220

D408 5,6-dimethylchrysene



C₂₀H₁₆

Mol. Wt. 256.35

CAS Registry No. 3697-27-6

Mammalian & avian toxicity

Carcinogenicity and chronic effects

Tumour-initiator on skin of ♀ CD-1 mice treated with a single initiating dose of 33 nmol, followed 10 days later by application of 2.5 µg 12-O-tetradecanoylphorbol-13-acetate 3 × wk⁻¹ for 20 wk (1).

Two lung adenomas reported in 10 ♂ C3H mice 23 wk after a single injection of 2 mg (2).

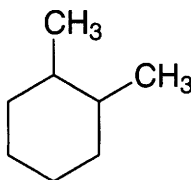
Metabolism and toxicokinetics

Metabolised to monomethyl chrysenes, chrysene and the hydroxyalkyl-substituted chrysenes in rat liver cytosol *in vitro* and rat subcutaneous tissue *in vivo* (3).

References

1. Amin, S. et al *Cancer Lett. (Shannon, Irel.)* 1990, 51(1), 17-20.
2. Dunlap, C. E. et al *Cancer Res.* 1943, 3, 606-607.
3. Myers, S. R. et al *Chem.-Biol. Interact.* 1991, 77(2), 203-221

D409 1,2-dimethylcyclohexane



C₈H₁₆

Mol. Wt. 112.22

CAS Registry No. 583-57-3

Synonyms o-dimethylcyclohexane

EINECS No. 209-509-4

Physical properties

B. Pt. 124°C Flash point 15°C (closed cup) Specific gravity 0.778 at 20°C with respect to water at 4°C

Occupational exposure

UN No. 2263 HAZCHEM Code 3☒E Conveyance classification flammable liquid

Environmental fate

Degradation studies

Biodegradation at 0.16 µg l⁻¹ initial concentration, 26% after 8 days (1).

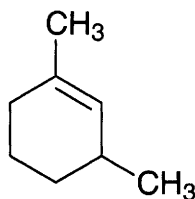
Other comments

This is a commercial mixture of *cis* and *trans* isomers.

References

1. Jamison, U. W. et al *Proceedings of the Third International Biodegradation Symposium* 1976, Applied Science Publishers

D410 1,3-dimethylcyclohexene



C₈H₁₄

Mol. Wt. 110.20

CAS Registry No. 2808-76-6

Synonyms 1,3-dimethyl-1-cyclohexene

Physical properties

B. Pt. 124-126°C Flash point 12°C Specific gravity 0.081 at 20°C with respect to water at 4°C

Mammalian & avian toxicity

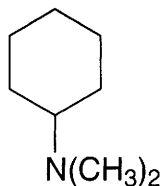
Irritancy

Vapour or mist is irritating to the skin, eyes, mucous membranes and upper respiratory tract (species unspecified) (1).

References

1. Lenga, R. E. (Ed.) *The Sigma-Aldrich Library of Chemical Safety Data* 2nd ed., 1988, 1, 1366, Sigma-Aldrich, Milwaukee, WI, USA

D411 *N,N*-dimethylcyclohexylamine



$\text{C}_8\text{H}_{17}\text{N}$

Mol. Wt. 127.23

CAS Registry No. 98-94-2

Synonyms dimethylcyclohexanamine; cyclohexyldimethylamine; *N*-cyclohexyldimethylamine; (dimethylamino)cyclohexane; *N,N*-dimethylaminocyclohexane; Toyocat-DMCH

EINECS No. 202-715-5

RTECS No. GX 1198000

Uses Catalyst.

Physical properties

B. Pt. 158-159°C Flash point 42°C Specific gravity 0.849

Occupational exposure

UN No. 2264 HAZCHEM Code 3W Conveyance classification corrosive substance, danger of fire (flammable liquid)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, rabbit 350, 620 mg kg⁻¹, respectively (1).

LC₅₀ (2 hr) inhalation mouse, rat 1100, 1890 mg l⁻¹, respectively (1).

References

1. *Z. Gesamte Hyg. Ihre Grenzgeb.* 1974, **20**, 393

D412 dimethyl disulfide



$\text{C}_2\text{H}_6\text{S}_2$

Mol. Wt. 94.20

CAS Registry No. 624-92-0

Synonyms 2,3-dithiabutane; methyl disulfide; methyldithiomethane

EINECS No. 210-871-0

RTECS No. JO 1927500

Uses Catalyst. Solvent.

Occurrence Produced by soil microorganisms (1).

Physical properties

M. Pt. -85°C **B. Pt.** 109.7°C **Flash point** 24°C (closed cup) **Specific gravity** 1.046 at 20°C with respect to water at 4°C **Partition coefficient** $\log P_{ow}$ 1.77 (2) **Volatility** v.p. 28.6 mmHg at 25°C ; v.den. 3.24
Solubility Organic solvents: diethyl ether, ethanol

Occupational exposure

SE-LEVL 1 ppm

UN No. 2381 **HAZCHEM Code** 3YE **Conveyance classification** flammable liquid

Environmental fate

Degradation studies

Degraded by the methanogenic bacterium *Thiobacillus thioparus* isolated from peat (3).

Mammalian & avian toxicity

Acute data

LC₅₀ (2 hr) inhalation mouse, rat 12.3, 15.9 mg m⁻³, respectively (4).

Legislation

Maximum permissible concentration in domestic water in 0.04 mg l⁻¹ (5).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (6).

References

1. Adams, D. F. J. *Air Pollut. Control Assoc.* 1979, **29**(4), 380-383.
2. Verschuuren, K. *Handbook of Environmental Data on Organic Chemicals* 2nd ed., 1983, 55, Van Nostrand Reinhold, New York, USA.
3. Cho, K. S. et al *J. Ferment. Bioeng.* 1991, **71**(6), 384-389.
4. *Gig. Tr. Prof. Zabol.* 1972, **16**(6), 46.
5. *Russian Toxicological Data for Chemicals in Sources of Drinking Water* 1978, Technical Note No. 20, Central Water Planning Unit, Reading, UK.
6. S. I. 1991 No.472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D413 dimethyl ether



C₂H₆O

Mol. Wt. 46.07

CAS Registry No. 115-10-6

Synonyms dimethyl oxide; methyl ether; methoxymethane; 2-oxapropane; oxybismethane; wood ether; Demeon D

EINECS No. 204-065-8

RTECS No. PM 4780000

Uses Propellant in cosmetic preparations. Blowing agent. Catalyst. Fuel additive. Refrigerant. Solvent.

Physical properties

M. Pt. -141°C **B. Pt.** -24.8°C **Flash point** -41°C **Partition coefficient** $\log P_{ow}$ 0.10 **Volatility** v.p. 3982 mmHg at 20°C ; v.den. 1.617

Solubility Water: 1 volume of water takes up 37 volumes of gas. Organic solvents: acetone, benzene, chloroform, diethyl ether, ethanol

Occupational exposure

DE-MAK 1000 ppm (1900 mg m⁻³)

SE-LEVL 500 ppm (950 mg m⁻³)

UK-LTEL 400 ppm (766 mg m⁻³)

SE-STEL 800 ppm (1500 mg m⁻³)

UK-STEL 500 ppm (958 mg m⁻³)

UN No. 1033 HAZCHEM Code 2WE Conveyance classification flammable gas

Supply classification extremely flammable

Risk phrases Extremely flammable (R12)

Safety phrases Keep out of reach of children (if sold to general public) – Keep container in a well ventilated place – Keep away from sources of ignition – No smoking – Take precautionary measures against static discharges (S2, S9, S16, S33)

Environmental fate

Abiotic removal

Estimated t_{1/2} for volatilisation 2.6 hr in model river and 30 hr in pond water (1,2).

t_{1/2} for reaction with photochemically produced hydroxyl radicals 22 days (3).

Mammalian & avian toxicity

Acute data

LC₅₀ (15 min) inhalation mouse 386 ppm (4).

Sub-acute and sub-chronic data

Inhalation rat 0.02, 0.20 or 2.0% v/v in air, 6 hr day⁻¹ for 5 days wk⁻¹. The high-dose level caused a reduction in liver weight gain in ♂ rats. Increased serum glutamate pyruvate transaminase activity levels observed in both sexes at the high dose (5).

Other effects

Other adverse effects (human)

Liquid causes severe frostbite on contact with the skin. Central nervous depression in man may be seen at concentrations of 5-10% in air (6).

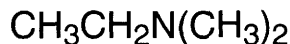
Other comments

Residues have been found in drinking water supplies, but may be an artefact from the analysis method (7).
Autoignition temperature 350°C.

References

1. Lyman, W. J. et al *Handbook of Chemical Property Estimation Methods* 1982, McGraw-Hill, New York, USA.
2. EXAMS II *Computer Simulation* 1987, US EPA, Washington, DC, USA.
3. Sabljic, A. et al *Atmos. Environ.* 1990, **24A**, 73-78.
4. *Eur. J. Toxicol. Environ. Hyg.* 1975, **8**, 287.
5. Collins, C. J. et al *Toxicology* 1978, **11**(1), 65.
6. Gosselin, R. E. et al *Clinical Toxicology of Commercial Products* 5th ed., 1984, **2**, 184, Williams & Wilkins, Baltimore, MD, USA.
7. *Preliminary Assessment of Suspected Carcinogens in Drinking Water; Interim Report to Congress* 1975, (December), US EPA, Washington, DC, USA

D414 *N,N*-dimethylethylamine



$\text{C}_4\text{H}_{11}\text{N}$

Mol. Wt. 73.14

CAS Registry No. 598-56-1

Synonyms *N,N*-dimethylethanamine; *N*-ethyldimethylamine

EINECS No. 209-940-8

Uses Catalyst.

Physical properties

M. Pt. -36°C B. Pt. $36-38^\circ\text{C}$ Flash point -36°C Specific gravity 0.675 at 20°C

Partition coefficient $\log P_{\text{ow}}$ 0.70

Occupational exposure

DE-MAK 25 ppm (76 mg m^{-3})

FR-VME 5 ppm (15 mg m^{-3})

SE-LEVL 2 ppm (6 mg m^{-3})

UK-LTEL 10 ppm (30 mg m^{-3})

FR-VLE 25 ppm (75 mg m^{-3})

SE-STEL 5 ppm (15 mg m^{-3})

UK-STEL 15 ppm (46 mg m^{-3})

Supply classification extremely flammable, corrosive

Risk phrases Extremely flammable – Harmful by inhalation and if swallowed – Causes burns (R12, R20/22, R34)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Keep in a cool place – Keep away from sources of ignition – No smoking – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – Wear suitable protective clothing – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S3, S16, S26, S36, S45)

Mammalian & avian toxicity

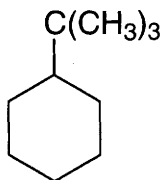
Irritancy

Inhalation mouse (15 min) 161 ppm caused pulmonary irritation within 1 min of exposure (1).

References

1. Gagnaire, F. et al *J. Appl. Toxicol.* 1989, 9(5), 301-304

D415 1,1-dimethylethylcyclohexane



$\text{C}_{10}\text{H}_{20}$

Mol. Wt. 140.27

CAS Registry No. 3178-22-1

Synonyms *tert*-butylcyclohexane

EINECS No. 221-652-4

Uses Solvent.

Mammalian & avian toxicity

Metabolism and toxicokinetics

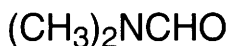
Small amounts (<3%) of the glucuronide of 4-*tert*-butylcyclohexanol detected in bile of rainbow trout 6 days after oral exposure (dose unspecified) (1).

Urinary metabolites in rats are 2-methyl-2-cyclohexylpropanoic acid, 2-methyl-2-cyclohexyl-1,3-propanediol; 2-hydroxy-4-*tert*-butylcyclohexanol, and *cis*-4-*tert*-butylcyclohexanol. Preferential sites of oxidative metabolism were observed that could potentially be related to the pathogenesis of kidney damage in ♂ rat (2).

References

1. Hellon, J. et al *Environ. Toxicol. Chem.* 1989, 8(10), 871-876.
2. Henningsen, G. M. et al *Toxicol. Lett.* 1987, 39(2-3), 313-318

D416 dimethylformamide



C₃H₇NO

Mol. Wt. 73.09

CAS Registry No. 68-12-2

Synonyms *N,N*-dimethylformamide; *N,N*-dimethylmethanamide; *N*-formyldimethylamine; DMF; DMF (amide)

EINECS No. 200-679-5

RTECS No. AB 5425000

Uses Disinfectant. Solvent. Organic synthesis.

Physical properties

M. Pt. -61°C **B. Pt.** 153°C **Flash point** 65°C (open cup) **Specific gravity** 0.9445 at 25°C with respect to water at 4°C **Partition coefficient** log P_{ow} -1.01 **Volatility** v.p. 3.7 mmHg at 25°C ; v.den. 2.51

Solubility Water: miscible. Organic solvents: acetone, benzene, carbon tetrachloride, chloroform, diethyl ether, ethanol, methanol, toluene

Occupational exposure

DE-MAK 10 ppm (30 mg m⁻³)

FR-VME 10 ppm (30 mg m⁻³)

JP-OEL 10 ppm (30 mg m⁻³)

SE-LEVL 10 ppm (30 mg m⁻³)

UK-LTEL 10 ppm (30 mg m⁻³)

US-TWA 10 ppm (30 mg m⁻³)

SE-STEL 15 ppm (45 mg m⁻³)

UK-STEL 20 ppm (61 mg m⁻³)

UN No. 2265 **HAZCHEM Code** 2W **Conveyance classification** flammable liquid

Supply classification toxic

Risk phrases May cause harm to the unborn child – Harmful by inhalation and in contact with skin – Irritating to the eyes (R61, R20/21, R36)

Safety phrases Restricted to professional users – Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S53, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) bluegill sunfish, rainbow trout, fathead minnow 7.1-10.6 g l⁻¹ (1).

Invertebrate toxicity

EC₅₀ (5 min) *Photobacterium phosphoreum* 20,100 ppm Microtox test (2).

EC₅₀ *Nostoc* and *Anabaena* species <0.05% (duration of exposure unspecified) (3).

EC₅₀ (48 hr) *Daphnia magna*, *Paratanytarsus parthenogeneticus* 14.5-36.2 g l⁻¹ (1).

LC₁₀₀ (12 min), LC₅₀ (4 hr) *Paramecium caudatum* 8% v/v and 2.2% v/v, respectively (4).

Environmental fate

Nitrification inhibition

Limiting concentration for inhibition of nitrification, agar test, 9.5 g l⁻¹ (5).

Degradation studies

Permanganate value 0.042 mg O₂ l⁻¹; ThOD 1.863 mg O₂ l⁻¹ (6).

Nonbiodegradable (7).

DMF-using bacteria were isolated from soils in a DMF production plant. Two isolates resembled *Paracoccus denitrificans* and one resembled *Pseudomonas aminovorans*. One of the former completely degraded 1% DMF in continuous culture at a dilution rate of <0.2 hr⁻¹ (8,9).

A strain of *Mycobacterium methanolica* capable of using DMF has been isolated and may be useful for waste treatment (10).

Abiotic removal

Evaporation rate relative to *n*-butyl acetate, which has been assigned a value of 1 at 25°C, is 0.20 (11).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 2800, 3750 mg kg⁻¹, respectively (12,13).

LC₅₀ (2 hr) inhalation mouse 9400 mg m⁻³ (13).

LD₅₀ dermal rabbit 4720 mg kg⁻¹ (14).

LD₅₀ subcutaneous rat, mouse 3800, 4500 mg kg⁻¹, respectively (15).

LD₅₀ intraperitoneal mouse, rat 650, 1400 mg kg⁻¹, respectively (14,16).

LD₅₀ intravenous rat, mouse 2000, 2500 mg kg⁻¹, respectively (12,15).

Rats were administered a single intraperitoneal injection (0.01-1.5 g kg⁻¹) or vapour by inhalation (75-900 ppm) for 4 hr. Both routes of administration caused dose-dependent elevations in liver enzymes over a 72 hr period (17).

Sub-acute and sub-chronic data

Oral mouse 160, 540 or 1850 mg kg⁻¹ diet and oral rat 215, 750 or 2500 mg kg⁻¹ diet for 100 days caused a slight increase in liver weights in both species but no evidence of histopathological damage in the liver or other tissues (18).

Inhalation rat (120 day) 100-1200 ppm, liver toxicity was reported for the higher concentrations (19,20).

Carcinogenicity and chronic effects

Limited evidence for carcinogenicity to humans, inadequate evidence for carcinogenicity to animals, IARC classification group 2B (21).

Inhalation carcinogenicity studies in rats and mice in progress (22).

Oral mouse (107 wk) 75 or 150 mg kg⁻¹ day⁻¹ in drinking water: mean survival time 76 wk, no tumours observed (12).

Subcutaneous rat (109 wk) 200 or 400 mg kg⁻¹; no tumours observed (12).

Intraperitoneal rat (115 wk) 1 ml (95 mg) wk⁻¹ for 10 wk. Median survival times were 87 wk for treated ♂, 96 wk for treated ♀. In the treated groups 9/18 ♂ and 11/19 ♀ had tumours at different sites compared to 4/14 in control ♂ and 5/14 in control ♀. A total of 13 tumours (3 malignant) occurred in treated ♂ and 17 (9 malignant) in treated ♀. Uncommon tumours reported in treated animals included an embryonal-cell carcinoma of the testes in 1 ♂ and 3 colon adenocarcinomas and a squamous-cell carcinoma of the rectum in ♀ (23).

Teratogenicity and reproductive effects

In vitro chick embryos and zebra fish embryos, 0.01-1.5% v/v in the incubation medium throughout embryonic development induced changes of the vertebral column, neural tube, heart and blood vessels, with general growth retardation (24).

Dermal rat, 1-2 ml kg⁻¹ on days 6-15 or 1-20 of gestation caused a reduction in body weight gain and pregnancy rate of dams. A reduction in the number of live foetuses and foetal weight gain and an increase in post-implantation loss was observed (25).

Intraperitoneal mouse 600 or 1080 mg kg⁻¹ on days 1-14 of gestation induced a high incidence of malformations including deficient ossification of the occipital and parietal bones, and open eyes (26).

Inhalation rat 0, 18 or 172 ppm (0, 54 or 515 mg m⁻³) for 6 hr day⁻¹ on days 6-15 of gestation. No systemic toxicity was observed in the dams, and no effect on foetal viability or morphology was observed, although there was reduced weight gain in the high-dose group (27).

Gavage rabbit, 0, 44, 65 or 190 mg kg⁻¹ on days 6-18 of gestation caused a dose-related increase in the incidence of internal hydrocephalus in foetuses. In the high-dose group, maternal toxicity, abortion, retardation of foetal growth and additional malformations (umbilical hernia, cleft palate, exophthalmos and abnormal positioning of limbs) were also observed (28).

Metabolism and toxicokinetics

Following inhalation exposure of human volunteers to 60 mg m⁻³ for 8 hr, 16-49% of the dose was excreted in the urine as *N*-(hydroxymethyl)-*N*-methylformamide, 8-24% as formamide and 10-23% as *N*-acetyl-S-(*N*-methylcarbamoyl)cysteine (AMCC). These metabolites were excreted at differing levels following intraperitoneal administration to rats, mice and hamsters. A quantitative difference appears to exist in the metabolic pathway of DMF to AMCC between rodents and humans; the authors suggest that hepatotoxicity of DMF may be linked to the extent of its metabolic conversion into AMCC (29).

AMCC is a minor metabolite in rodents, but a more important one in humans, hence the risk from DMF exposure in humans may be higher than that estimated from toxicological studies (30).

Studies on mouse microsomes suggest oxidation of the formyl moiety in *N*-alkylformamides is catalysed by cytochrome P₄₅₀ (31).

A linear relationship between total excretion of *N*-(hydroxymethyl)-*N*-methylformamide in two days versus exposure to 1-20% of the rat LD₅₀ (47-944 mg kg⁻¹) suggests this would be a method of biological monitoring of DMF exposure (32).

DMF crosses the placenta following inhalation exposure of rats (21,33).

The liquid or vapour is absorbed through intact human skin (34).

Metabolic acetaldehyde accumulation has been reported in rats, and suggested as a factor in ethanol intolerance in DMF-exposed workers (35).

Studies in rats found ethanol inhibited formation of the metabolite *N*-(hydroxymethyl)-*N*-methylformamide as well as its demethylation (36).

Irritancy

Dermal rabbit (24 hr) 10 mg caused irritation and 20 mg instilled into rabbit eye caused irritation (period of exposure unspecified) (37).

100 mg placed into rabbit eye caused irritation which persisted for >1 day but recovery was reported within 21 days (38).

DMF had a transient, slightly irritating effect on human skin when applied for 24 hr on a soaked rag or painted daily for 28 days. Instilled into rabbits' eyes a 25% solution had no effect, 50% was slightly irritating and 75-100% produced more severe inflammation (16).

Sensitisation

Skin sensitivity, allergic dermatitis, eczema and vitiligo have been reported among exposed workers (39,40).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (41).

Salmonella typhimurium TA98, TA1538 with metabolic activation positive (42).

Escherichia coli WP2 *uvrA* with and without metabolic activation negative (43).

Drosophila melanogaster sex-linked recessive lethal assay negative (44).

In vitro mouse lymphoma L5178Y tk⁺/tk⁻ mutation assay negative (45).

L5178Y tk⁺/tk⁻ forward mutation assay without metabolic activation marginally positive (46).

In vitro Chinese hamster ovary cells, chromosomal aberrations and sister chromatid exchanges negative (45).

Negative and slight positive effects reported in hepatocyte primary culture/DNA repair assay with mouse or hamster hepatocytes (21).

In vivo mouse bone marrow induction of micronuclei positive (47).

Other effects

Other adverse effects (human)

Gastro-intestinal effects include nausea, vomiting, loss of appetite and abdominal pain. Headache, dizziness and weakness, and liver damage have been reported in workers exposed to the liquid or vapour (34).

Moderate occupational DMF poisoning is reported to result in chronic gastritis and gastric ulcers later in life (48).

Changes in liver, kidney, cardiovascular and peripheral blood system function reported in exposed workers (49).

Clusters of toxic liver disease have been reported in DMF-exposed workers (50).

Two variants of liver injury have been found in solvent (particularly DMF) exposed workers: those exposed for <3 months suffer anorexia, abdominal pain, disulfiram-type reactions, markedly elevated aminotransferase, focal hepatocellular necrosis and microvesicular steatosis; those exposed for >1 yr had minimal symptoms and moderately elevated enzyme levels (51).

DMF affected the physical development and health status of children born to mothers after 1-5 yr occupational exposure. Lactation was also weakened (52).

An increased frequency of chromosomal aberrations was observed in peripheral lymphocytes of exposed workers (53).

Negative results have also been reported for chromosomal aberrations and sister chromatid exchange in human peripheral blood lymphocytes (21).

Studies in DMF-exposed workers at Du Pont found a statistically significant association between ever having been exposed to DMF and buccal cavity, pharynx, liver, prostate and testicular cancer, and malignant melanoma. No pattern suggestive of an association was found when highest DMF exposure rank, exposure duration and latency were assessed (54).

Three cases of germ-cell testicular tumour were reported among 153 workers repairing F4 Phantom jets, but none in 680 repair shops not using DMF (55).

Excess risk for buccal cavity and pharynx cancer, nonsignificant excess of lung cancer, but no excess risk for testicular cancer reported in DMF-exposed workers in an acrylic fibre manufacturing plant (56).

Any other adverse effects

Irritating to skin, eyes and mucous membranes in humans. Liver injury has been produced in experimental animals by prolonged inhalation at 100 ppm (57).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (58).

Permitted for use as a component of adhesives used in food packaging (21).

Other comments

Reviews on human health effects, experimental toxicology, physicochemical properties, environmental effects, ecotoxicology, exposure levels, epidemiology and workplace experience listed (59).

Exposure limits reviewed (60).

Physicochemical properties, toxicity and hazards listed (61).

Toxicology reviewed (62-64).

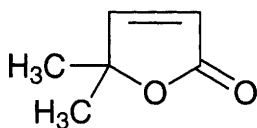
Hepatotoxicity reviewed (65).

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D417 5,5-dimethyl-2(5H)-furanone



C₆H₈O₂

Mol. Wt. 112.13

CAS Registry No. 20019-64-1

Synonyms 4,4-dimethylbutenolide; 4,4-dimethylcrotonolactone; 4-hydroxy-4-methyl-2-pentenoic acid γ -lactone

Occurrence

Occurs in lactone fraction of *Lantana indica* and lavender oil *Lavandula vera* (1,2).
Isolated from the essential oils of hops (3).

Physical properties

B. Pt. 80°C at 10 mmHg

Other comments

Occurs in sewage effluent (4).

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D418 2,6-dimethyl-4-heptanol



$\text{C}_9\text{H}_{20}\text{O}$

Mol. Wt. 144.26

CAS Registry No. 108-82-7

Synonyms diisobutylcarbinol; sec-nonyl alcohol

EINECS No. 203-619-6

RTECS No. MJ 3325000

Uses Preparation of perfumes.

Occurrence Isolated from the essential oil of *Lysimachia capillipes* (1).

Physical properties

M. Pt. -65°C B. Pt. 178°C Flash point 84°C Specific gravity 0.806 at 20°C with respect to water at 20°C

Volatility v.p. 0.3 mmHg at 20°C ; v.den. 4.98

Solubility Organic solvents: diethyl ether, ethanol

Environmental fate

Abiotic removal

Evaporation rate relative to *n*-butyl acetate, which has been assigned a value of 1 at 25°C , is 0.02 (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 3160, 3530 mg kg⁻¹ respectively (3,4).

LD₅₀ dermal rabbit 4600 mg kg⁻¹ (5).

LD₅₀ intraperitoneal rat 800 mg kg⁻¹ (5).

Irritancy

Assigned a rabbit skin irritation potential, or primary irritation index, of 0 (maximum 8) calculated from erythema and oedema grades (6).

Dermal rabbit (24 hr) 10 mg caused mild irritation (3).

Vapour at a concentration of 5 ppm caused irritation to humans (7).

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D419 2,5-dimethyl-2,4-hexadiene



C_8H_{14}

Mol. Wt. 110.20

CAS Registry No. 764-13-6

Synonyms biisobutenyl; biisocrotyl; diisocrotyl

EINECS No. 212-115-5

Physical properties

M. Pt. -12 – -14°C B. Pt. 132 – 134°C Flash point 29°C Specific gravity 0.7625 at 20°C with respect to water at 4°C

Solubility Organic solvents: benzene, chloroform, diethyl ether, ethanol

Ecotoxicity

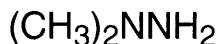
Bioaccumulation

No or low bioaccumulation (1).

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D420 1,1-dimethylhydrazine



$\text{C}_2\text{H}_8\text{N}_2$

Mol. Wt. 60.10

CAS Registry No. 57-14-7

Synonyms *N,N*-dimethylhydrazine; UDMH; *unsym*-dimethylhydrazine; *asym*-dimethylhydrazine; UDMH

EINECS No. 200-316-0

RTECS No. MV 2450000

Uses The base in rocket fuel formulations. Stabiliser for organic peroxide fuel additives. Absorbent for acid gases.

Occurrence Tobacco constituent.

Physical properties

M. Pt. -58°C B. Pt. 63.9°C Flash point -15°C (closed cup) Specific gravity 0.791 at 22°C with respect to water at 4°C

Solubility Organic solvents: miscible with alcohol, dimethyl formamide, ether, hydrocarbons

Occupational exposure

FR-VME 0.1 ppm (0.2 mg m^{-3})

SE-LEVL 0.1 ppm (0.2 mg m^{-3})

SE-STEL 0.2 ppm (0.5 mg m^{-3})

US-TWA 0.01 ppm (0.025 mg m^{-3})

UN No. 1163 HAZCHEM Code 2WE Conveyance classification toxic substance, danger of fire (flammable liquid), corrosive

Supply classification highly flammable, toxic

Risk phrases May cause cancer – Highly flammable – Toxic by inhalation and if swallowed – Causes burns (R45, R11, R23/25, R34)

Safety phrases Restricted to professional users – Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S53, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) guppy 26.5 mg l⁻¹ (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 122, 265 mg kg⁻¹, respectively (2).

LC₅₀ (4 hr) inhalation mouse, rat 172, 252 mg l⁻¹, respectively (3).

LD₅₀ intravenous rat, mouse 119, 250 mg kg⁻¹, respectively (2).

LD₅₀ intraperitoneal rat, mouse 102, 113 mg kg⁻¹, respectively (4,5).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (6).

Daily administration to Syrian golden hamsters in drinking water as 0.1% solution for life. Treatment reduced survival of ♀ but not ♂. Of treated, 20% of ♀ and 30% ♂ developed tumours of the caecum. Of treated, 4% of ♀ and 28% of ♂ had vascular tumours (7).

No increased incidence of pulmonary tumours in mice following wkly oral or intraperitoneal doses for 8 wk, total dose 7.2 and 3.6 mg mouse⁻¹, respectively (8).

Irritancy

Irritating to eyes, skin and mucous membranes. May cause central nervous system stimulation and convulsions (species unspecified) (9).

Genotoxicity

Mechanism of site-specific DNA damage investigated in the presence of copper(II) or manganese(II) (10).

Methylated DNA in rats 24 hr after gavage administration of 19 mg kg⁻¹ (11).

DNA-repair test on rat and mouse hepatocytes, negative and positive, respectively. Mouse hepatocytes are more susceptible to genotoxicity of hydrazine derivatives, in agreement with *in vivo* carcinogenicity studies (12).

Mouse bone marrow nucleus test negative, but caused a major increase in incidence of micronuclei in mouse hepatocytes in a test developed from Tate's model. Mice were treated twice, with an interval of 24 hr between, subjected to partial hepatectomy 24 hr after the second treatment and the incidence of micronucleated hepatocytes detected 96 hr after partial hepatectomy. The test is more appropriate for genotoxins with complex metabolic pathways (13).

Substantial amounts of the corresponding carcinogenic nitrosamine were formed when 1,1-dimethylhydrazine was exposed to air. Unoxidised samples were not mutagenic but oxidised samples were mutagenic in *Salmonella typhimurium* TA1530, TA1535 with and without metabolic activation (14).

Did not induce micronuclei in mice after intraperitoneal administration but the protocol used was not as extensive as officially recommended (15,16).

Legislation

Regulated in the USA as an occupational carcinogen in the OSHA Air Contaminants Standard based on noncarcinogenic health effects (17).

Land disposal regulated in the USA under the Federal Resource Conservation and Recovery Act (18).

Other comments

Reviews on human health effects, experimental toxicology, physicochemical effects, epidemiology, workplace experience, ecotoxicology, environmental effects and exposure levels listed (19).

Carcinogenicity reviewed (20).

Synthesis and industrial uses reviewed (21).

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D421 1,2-dimethylhydrazine



$\text{C}_2\text{H}_8\text{N}_2$

Mol. Wt. 60.10

CAS Registry No. 540-73-8

Synonyms *N,N'*-dimethylhydrazine; *sym*-dimethylhydrazine; hydrazomethane; DMH; SDMH

RTECS No. MV 2625000

Uses Rocket fuel. Model colon carcinogen in experimental animals.

Physical properties

M. Pt. -9°C **B. Pt.** 81°C **Specific gravity** 0.8274 at 20°C with respect to water at 4°C

Solubility Water: miscible. Organic solvents: miscible with alcohol, ether, dimethylformamide, hydrocarbons

Occupational exposure

SE-LEVL 0.1 ppm (0.2 mg m⁻³)

SE-STEL 0.2 ppm (0.5 mg m⁻³)

UN No. 2382 **HAZCHEM Code** 2WE **Conveyance classification** toxic substance, danger of fire (flammable liquid)

Supply classification toxic

Risk phrases May cause cancer – Toxic by inhalation, in contact with skin and if swallowed (R45, R23/24/25)

Safety phrases Restricted to professional users – Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S53, S45)

Mammalian & avian toxicity**Acute data**

LD₅₀ oral mouse, rat 36, 100 mg kg⁻¹, respectively (1,2).

LC_{Lo} (4 h) inhalation rat 280 ppm (3).

LD₅₀ subcutaneous mouse, rat 24, 220 mg kg⁻¹, respectively (4,5).

LD₅₀ intravenous mouse, dog, rat 29, 100, 176 mg kg⁻¹, respectively (1).

LD₅₀ intraperitoneal mouse, rat 35, 163 mg kg⁻¹, respectively (1).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (6).

Induced aberrant crypt foci in colons of rats and mice after administration by gavage twice with a 4-day interval and killed 3 wk later (7).

♂ Fischer 344 rats given 2 or 4 subcutaneous injections of 40 mg kg⁻¹, then fed a diet containing 0.5 % butylated hydroxytoluene (BHT). Dietary BHT enhanced development of gastro-intestinal tumours produced by 1,2-dimethylhydrazine (8).

Dose-dependent induction of renal epithelial tumours in mice; frequency of neoplasms peaked after 8 wk dosing at 8 mg kg⁻¹ wk⁻¹ (9).

Subcutaneous administration of 30 µg g⁻¹ to newborn mice; low frequencies of lung, liver, lymphatic, spleen and colon tumours developed after 1 yr (10).

A potent carcinogen with marked specificity for the colon. It induces carcinomas in rodents similar to those in cancer patients and its tumour induction is used as an experimental model (11).

Teratogenicity and reproductive effects

Persistent oestrus induced in ♀ mice 5-20 wk after subcutaneous injection of 8 mg kg⁻¹ wk⁻¹ for 20 wk (12).

Metabolism and toxicokinetics

Binding in small intestine lower than in the colon. In the former binding is mainly in crypt cell enriched fraction rather than villi (13).

Metabolised in rats *in vivo* to an alkylating intermediate; several further activation steps have been postulated, involving faecal microflora, dietary fat and proteins, cholesterol and bile acids. Although an organ-specific carcinogen, it is also metabolised by the liver, large intestine, stomach and kidney in mice. Methylation of macromolecules was found in these organs after administration, with the colon enriched in unusually methylated amino acids in nuclear proteins and O⁶-methylguanine (a pre-mutagenic product) in DNA (11).

1,2-Dimethylhydrazine may be metabolised to (methylazoxy)methanol, which is further transformed to methyldiazonium (an ultimate carcinogen) that methylates DNA. It is also thought that non-enzymatic activation by endogenous substances, such as metal ions, may play a role in producing active species causing DNA damage (14).

Genotoxicity

Salmonella typhimurium TA98, TA100 with and without metabolic activation negative (15).

Salmonella typhimurium TA1535/pSK1002 with and without metabolic activation negative (16).

Escherichia coli polA, recA, uvrB/recA with metabolic activation positive. DNA-repair host-mediated assay in *E. coli* recovered from spleen, liver, lungs, kidney and blood of treated mice positive (17).

Mechanism of site-specific DNA damage investigated in the presence of copper(II) or manganese(II). The order of DNA damage was correlated with the order of the ratio of hydrogen peroxide production to oxygen consumption during Cu(II)-catalysed autoxidation of methylhydrazines. It is suggested that the Cu(I)-peroxide complex rather than the methyl free radical plays a more important role in methylhydrazine plus Cu(II)-induced DNA damage (14).

Active in mouse bone marrow micronucleus test when administered via gavage as an aqueous solution (18).
 DNA-repair test on mouse and rat hepatocytes negative (19).
 Triple-dose test protocol of the rodent bone marrow micronucleus assay positive (20).
 Negative results also reported at 20-80% median LD₅₀ (21).
 Chronic administration (20 mg kg⁻¹ wk⁻¹ subcutaneously for 10 wk), but not single dose, induced mutations at the *Dlb-1* locus in mice. The authors claim this assay more accurately reflects the carcinogenic potential of 1,2-dimethylhydrazine than many other *in vitro* bioassays (22).
Saccharomyces cerevisiae C658-K42 with metabolic activation positive (23).
 Induced dose-dependent sister chromatid exchange in B6D2F₁ in murine bone marrow, alveolar macrophage, regenerating and intact liver and kidney tissues *in vivo* (24).
 Did not induce micronuclei in rats after oral administration, but the protocol was not as extensive as officially recommended elsewhere (25,26).
 Syrian hamster embryo cells clonal system positive (1 or 2 transformed colonies at a single concentration or 1 transformed colony at 2 non-consecutive concentrations) (27).

Legislation

Reportable quantities under US Federal Comprehensive Environmental Response, Compensation, and Liability Act promulgated (28).
 Land disposal regulated in USA under Federal Resource Conservation and Recovery Act (29).

Other comments

Reviews on human health effects, experimental toxicology, physicochemical effects, epidemiology, workplace experience and exposure levels listed (30).
 Mutagenicity reviewed (31).
 Role of dietary fat in enhancing 1,2-dimethylhydrazine tumour initiation reviewed (32).
 Genotoxicity in bone marrow micronucleus test under different protocols reviewed (33).

References

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D422 1,2-dimethylhydrazine dihydrochloride



$\text{C}_2\text{H}_{10}\text{N}_2\text{Cl}_2$

Mol. Wt. 133.02

CAS Registry No. 306-37-6

Synonyms *N,N'*-dimethylhydrazine dihydrochloride; dimethylhydrazinium dichloride;
1,2-dimethylhydrazinium dichloride; DMH

EINECS No. 206-183-5

RTECS No. MV 2800000

Uses Rocket fuel.

Physical properties

M. Pt. 167-169°C (decomp.)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 100 mg kg⁻¹ (1).

LD₅₀ subcutaneous mouse, hamster, rat 25, 100, 122 mg kg⁻¹, respectively (2,3).

♂ Fischer rats dosed with 35 mg kg⁻¹ by intubation showed significant decreases in serum sodium and potassium, ion balance, total protein, SGOT, SGPT and creatinine. Levels of CPK, serum albumin, phosphate and polymorphonuclear leukocytes were elevated. Statistically significant differences in total white blood cell number, and percentage of lymphocytes, eosinophils and segmented cells were also reported (4).

Carcinogenicity and chronic effects

High incidences of large intestine tumours reported in Swiss mice following 10 wkly subcutaneous injections of 20 µg g⁻¹ (5).

Vascular angiosarcomas induced in 89% of ♀ and 82% of ♂ Syrian golden hamsters given 0.001% in drinking water for life (6).

No pulmonary tumours reported in mice following wkly oral or intraperitoneal doses for 8 wk. Total oral dose 10.6 mg mouse⁻¹, total intraperitoneal dose 5.3 mg mouse⁻¹ (7).

Teratogenicity and reproductive effects

Intramuscular hamster (day-12 gestation) 220 mg 100 g⁻¹ as neutralised solution of 1,2-dimethylhydrazine dihydrochloride. Animals sacrificed on day-15 gestation and 2, 6, 10, 24 and 56 days after birth showed significant increase in Na, K-ATPase activity, indicating biochemical alterations in developing foetuses. No cleft palates or intestinal lesions were seen (8).

Genotoxicity

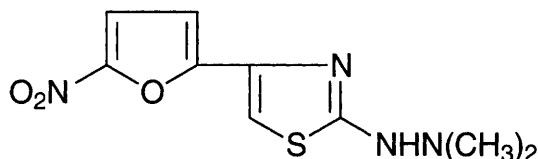
Dose-related clastogenic activity in mouse bone marrow micronucleus assay following intubation of an aqueous solution of 10 and 50 mg kg⁻¹ (9).

DNA-repair test on rat and mouse hepatocytes positive (10).

References

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D423 2-(2,2-dimethylhydrazino)-4-(5-nitro-2-furyl)thiazole



C₉H₁₀N₄O₃S

Mol. Wt. 254.27

CAS Registry No. 26049-69-4

Synonyms 4-(5-nitro-2-furyl)-2(3H)-thiazolone, dimethylhydrazone; DMNT

RTECS No. XJ 4600000

Physical properties

M. Pt. 157-159°C

Mammalian & avian toxicity

Carcinogenicity and chronic effects

Mammary and salivary gland adenocarcinomas occurred in ♀ Sprague-Dawley rats fed a cumulative dose of 0.8 g rat⁻¹ in the diet over 46 wk. Uterine fibrosarcomas, intestinal adenocarcinoma, ear duct and lip squamous-cell carcinomas were also reported, but at low levels (1).

High incidence of forestomach tumours (papillomas and carcinomas) reported in ♀ Swiss mice fed a cumulative dose of 0.37 g mouse⁻¹ in the diet over 17 wk. One kidney pelvis transitional cell carcinoma and one bladder transitional cell carcinoma were also reported (2).

Genotoxicity

Salmonella typhimurium TA100 without metabolic activation positive (3), TA1535, TA1536, TA1537, TA1538 without metabolic activation negative (4).

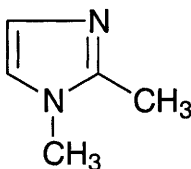
Escherichia coli WP2, *rec⁺/rec A*, *rec⁺/rec B*, B/rWP2try⁻, WP2try⁻¹, *hcr⁻* positive, WP2 *uvrA⁻¹* negative (4,5).

Escherichia coli T44(λ) 1 µg ml⁻¹ induced prophage leading to mass lysis (5).

References

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D424 1,2-dimethylimidazole



$C_5H_8N_2$

Mol. Wt. 96.13

CAS Registry No. 1739-84-0

Synonyms 1,2-dimethyl-1H-imidazole; N,2-dimethylimidazole

EINECS No. 217-101-2

Uses Catalyst.

Physical properties

M. Pt. 37-39°C B. Pt. 204°C Flash point 92°C Specific gravity 1.084

Occupational exposure

Supply classification harmful

Risk phrases Harmful if swallowed – Irritating to the skin – Risk of serious damage to eyes (R22, R38, R41)

Safety phrases Keep out of reach of children (if sold to general public) – Avoid contact with the skin – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice (S2, S24, S26)

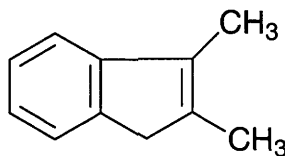
Other comments

Reviews on human health effects, experimental toxicology and physicochemical properties listed (1).

References

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D425 2,3-dimethylindene



$C_{11}H_{12}$

Mol. Wt. 144.22

CAS Registry No. 4773-82-4

Physical properties

M. Pt. 11°C B. Pt. 225°C Specific gravity 0.971 at 20°C

Genotoxicity

Salmonella typhimurium TA98 with and without metabolic activation negative (1).

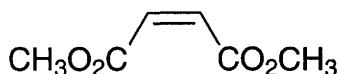
Other comments

Found in water samples.

References

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D426 dimethyl maleate



$C_6H_8O_4$

Mol. Wt. 144.13

CAS Registry No. 624-48-6

Synonyms 2-butenedioic acid, (Z)-, dimethyl ester; dimethyl (Z)-butenedioate; dimethyl *cis*-ethylenedicarboxylate; methyl maleate

EINECS No. 210-848-5

RTECS No. EM 6300000

Physical properties

M. Pt. -17.5°C B. Pt. 205°C Flash point 91°C Specific gravity 1.153 Volatility v.p. 1 mmHg at 45.7°C ; v.den. 4.97

Mammalian & avian toxicity

Acute data

LD_{Lo} oral rat 1410 mg kg⁻¹ (1).

LD₅₀ dermal rabbit 530 mg kg⁻¹ (1).

References

1. *Am. Ind. Hyg. Assoc. J.* 1962, 23, 93

D427 dimethylmercury



$\text{C}_2\text{H}_6\text{Hg}$

Mol. Wt. 230.66

CAS Registry No. 593-74-8

EINECS No. 209-805-3

RTECS No. OW 3010000

Uses Reagent.

Physical properties

B. Pt. 92°C at 740 mmHg Flash point 5°C Specific gravity 3.1874 at 20°C

Solubility Organic solvents: diethyl ether, ethanol

Occupational exposure

DE-MAK 0.01 mg m⁻³ (as Hg) (total dust)

FR-VME 0.01 mg m⁻³ (as Hg)

SE-LEVL 0.01 mg m⁻³ (as Hg)

UK-LTEL 0.01 mg m⁻³ (as Hg)

UK-STEL 0.03 mg m⁻³ (as Hg)

US-TWA 0.01 mg m⁻³ (as Hg)

US-STEL 0.03 mg m⁻³ (as Hg)

UN No. 1992 Conveyance classification toxic substance

Supply classification very toxic

Risk phrases Very toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects (R26/27/28, R33)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S13, S28, S36, S45)

Ecotoxicity

Invertebrate toxicity

Significantly reduced emergence and hatching of the brine shrimp *Artemia franciscana* at 2.59 mg l⁻¹, the lowest concentration tested (1).

Legislation

Community Right-To-Know List.

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Mercury: maximum admissible concentration 1 µg l⁻¹ 62(2).

Included in Schedule 4 and 6 (Release into Air/Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (3).

Quality objectives under EC Directives 82/176/EEC and 84/156/EEC 0.3 mg kg⁻¹ (wet weight) in a representative sample of fish flesh; 1 µg l⁻¹ (annual mean) total mercury in inland surface waters; 0.5 µg l⁻¹ (annual mean) dissolved mercury in estuarine waters; 0.3 µg l⁻¹ (annual mean) dissolved mercury in marine waters. A 'standstill' provision applies to concentrations in shellfish or sediments. Limit values under EC Directive 84/156/EEC 0.05 mg l⁻¹ effluent and 0.1 g l⁻¹ vinyl chloride production capacity for chemical industries using mercury catalysts in vinyl chloride production; 0.05 mg l⁻¹ effluent and 5 g kg⁻¹ mercury processed for chemical industries using mercury catalysts in other processes; 0.05 mg l⁻¹ effluent and 0.7 g kg⁻¹ mercury processed for manufacture of mercury catalysts used in vinyl chloride production; 0.05 mg l⁻¹ effluent and 0.05 g kg⁻¹ mercury processed for manufacture of organic and non-organic mercury compounds (other than mercury

catalysts for vinyl chloride production); 0.05 mg l⁻¹ effluent and 0.03 g kg⁻¹ mercury processed for manufacture of primary batteries containing mercury; 0.05 mg l⁻¹ effluent for mercury recovery plants and extraction and refining of non-ferrous metals; 0.05 mg l⁻¹ effluent for plants treating toxic wastes containing mercury (4).

Other comments

Formed in oceans by methylation of inorganic mercury. Environmental contaminant found in fish and birds. Reviews on physico-chemical properties, human health effects, experimental toxicity, environmental effects, ecotoxicology, exposure levels and workplace experience listed (5).

Toxicity and hazards reviewed (6).

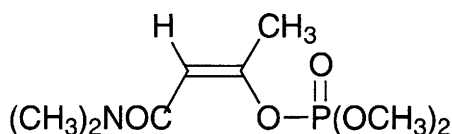
Aquatic toxicology reviewed (7).

At one time dimethyl mercury was considered as a possibly important mercurial chemical species, but so far it has only been observed in marine environments (8).

References

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3. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
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D428 dimethyl (Z)-1-methyl-2-dimethylcarbamoylvinyl phosphate



C₈H₁₆NO₅P

Mol. Wt. 237.19

CAS Registry No. 18250-63-0

Synonyms (Z)-3-(dimethylamino)-1-methyl-3-oxo-1-propenyl dimethyl phosphate

EINECS No. 242-127-6

Uses Insecticide.

Physical properties

B. Pt. ~130°C at 0.1 mmHg

Solubility Water: miscible. Organic solvents: dimethyl ether, ethanol

Mammalian & avian toxicity

Sub-acute and sub-chronic data

LC₅₀ (5 day) oral Japanese quail, ring-necked pheasant, mallard 32-144 mg kg⁻¹ diet (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration $0.1 \mu\text{g l}^{-1}$ (2).
Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (3).

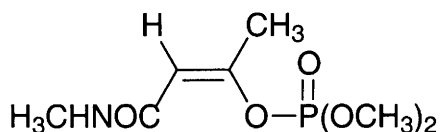
Other comments

(Z)-analogue of dicrotophos.

References

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3. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D429 dimethyl (Z)-1-methyl-2-methylcarbamoylvinyl phosphate



$\text{C}_7\text{H}_{14}\text{NO}_5\text{P}$

Mol. Wt. 223.17

CAS Registry No. 919-44-8

Synonyms (Z)-3-(methylamino)-1-methyl-1-oxo-1-propenyl dimethyl phosphate

EINECS No. 213-051-0

Mammalian & avian toxicity

Acute data

LD_{50} oral mouse 28 mg kg^{-1} (1).

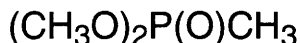
Other comments

(Z)-analogue of monocrotophos (2).

References

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D430 dimethyl methylphosphonate



$\text{C}_3\text{H}_9\text{O}_3\text{P}$

Mol. Wt. 124.08

CAS Registry No. 756-79-6

Synonyms dimethoxymethylphosphine oxide; dimethyl methanephosphonate; DMMP; Fyrol DMMP

EINECS No. 212-052-3

RTECS No. SZ 9120000

Uses Catalyst. Fireproofing agent. Organic synthesis.

Physical properties

B. Pt. 181°C **Flash point** 68°C **Specific gravity** 1.150 at 20°C with respect to water at 4°C

Partition coefficient $\log P_{\text{ow}}$ -0.48 (1) **Volatility** v.p. 0.61 mmHg at 25°C

Solubility Water: >100 g l⁻¹ at 21°C. Organic solvents: acetone, diethyl ether, dimethyl sulfoxide, ethanol

Environmental fate

Abiotic removal

$t_{1/2}$ for hydrolysis in soil 10.4 days. Hydrolysis products are the monoester and methanol (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral chicken 4000 mg kg⁻¹ (3).

LD₅₀ oral rat 8210 mg kg⁻¹ (3).

LD₅₀ intravenous mouse, rat 912, 1050 mg kg⁻¹, respectively (3).

Carcinogenicity and chronic effects

Gavage rat (2 yr) 0, 500 or 1000 mg kg⁻¹ and gavage mouse (2 yr) 0, 1000 or 2000 mg kg⁻¹ 5 day wk⁻¹. There was an increased incidence of tubular cell hyperplasia and adenocarcinomas, hyperplasia of the transition cell epithelium, and transition cell papillomas of the kidney in ♂ rats. Decreased survival among mice made this group inadequate for determination of carcinogenicity (4).

Teratogenicity and reproductive effects

Gavage ♂ rat (12 wk) 1750 mg day⁻¹ 5 day wk⁻¹ produced morphological alterations in Sertoli cells and elongated spermatids, and produced functional defects in spermatozoa (5).

Gavage mouse, 4175 mg kg⁻¹ day⁻¹ on days 6-13 of gestation. A reduction in birth weight was reported (6).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (7).

Drosophila melanogaster sex-linked recessive lethal mutations positive (4).

In vitro Chinese hamster ovary cells, chromosomal aberrations positive (8).

Other effects

Other adverse effects (human)

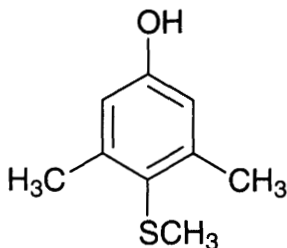
Weak cholinesterase inhibition. Symptoms of exposure include headache, giddiness, nervousness, blurred vision, weakness, nausea, cramp, diarrhoea and chest pain (9).

References

1. McCoy, G. D. et al *Carcinogenesis* (London) 1990, **11**(7), 1111-1117.
2. *Office of Toxic Substances Report* FYI-OTS-0483-024 2, EPA, Washington, DC, USA.
3. *Chemical Hazard Information Profile: Dimethylmethylphosphonate* 1983, Dynamac Corp., Rockville, MD, USA.

4. *National Toxicology Program* 1987, Report No. TR-323, NIH/PUB-88-2579, NIEHS, Research Triangle Park, NC, USA.
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9. Keith, L. H. et al *Compendium of Safety Data Sheets for Research and Industrial Chemicals* 1985, **2**, 694-695, VCH, New York, USA

D431 3,5-dimethyl-4-(methylthio)phenol



C₉H₁₂OS

Mol. Wt. 168.26

CAS Registry No. 7379-51-3

Synonyms 4-(methylthio)-3,5-xenol

EINECS No. 230-947-7

RTECS No. SL 2065000

Uses Manufacture of insecticides.

Physical properties

M. Pt. 64-65.5°C B. Pt. 155-160°C at 12-16 mmHg

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat >1000 mg kg⁻¹ (1).

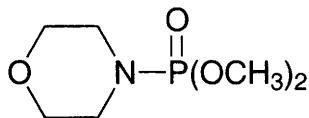
Other comments

Reviews on human health effects, experimental toxicity and environmental effects listed (2).

References

1. *Toxicol. Eur. Res.* 1979, **2**, 199.
2. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuyse (Bte 6), B-1160 Brussels, Belgium

D432 dimethyl morpholinophosphoramidate



$C_6H_{14}NO_4P$

Mol. Wt. 195.16

CAS Registry No. 597-25-1

Synonyms dimethyl morpholinophosphonate; 4-morpholinylphosphonic acid, dimethyl ester; morpholinophosphonic acid, dimethyl ester; **RTECS No.** SZ 9660000

Uses Anticholinesterase agent. Used to simulate warfare agents.

Physical properties

B. Pt. 205°C **Flash point** 43°C **Specific gravity** 1.2337 at 25°C with respect to water at 22°C

Partition coefficient $\log P_{ow}$ -1.81 (1)

Solubility Water: >100 g l⁻¹ at 18°C. Organic solvents: acetone, dimethyl sulfoxide, ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 3300, 6000 mg kg⁻¹, respectively (2).

LD₅₀ intraperitoneal rat, mouse 2400, 5000 mg kg⁻¹, respectively (2).

LD₅₀ intravenous rabbit, mouse 350, 400 mg kg⁻¹, respectively (2).

Carcinogenicity and chronic effects

National Toxicology Program tested rats and mice via gavage. No evidence of carcinogenicity found in mice, some evidence of carcinogenicity (increased incidence of treatment-related neoplasms, malignant, benign or combined) in ♂ and ♀ rats (2).

Irritancy

Dermal rabbit (100 day) 500 mg kg⁻¹ day⁻¹ caused no adverse effect (3).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537, with and without metabolic activation negative (4).

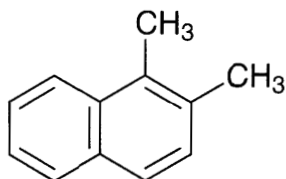
In vitro mouse lymphoma L5178Y tk⁺/tk⁻ mutation assay positive (5).

In vitro Chinese hamster ovary cells, chromosomal aberrations and sister chromatid exchanges positive (5).

References

1. McCoy, G. D. et al *Carcinogenesis (London)* 1990, **11**(7), 1111-1117.
2. *National Toxicology Program Research and Testing Division* 1998, Report No. TR-298, NIEHS, Research Triangle Park, NC, USA.
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4. Zeiger, E. et al *Environ. Mutagen.* 1987, **9**, 1-110.
5. Buzzi, R. et al *Mutat. Res.* 1990, **234**, 269-288

D433 1,2-dimethylnaphthalene



C₁₂H₁₂

Mol. Wt. 156.23

CAS Registry No. 573-98-8

EINECS No. 209-364-7

Physical properties

M. Pt. -1°C B. Pt. 266-267°C Flash point 110°C Specific gravity 1.013

Partition coefficient log P_{ow} 4.31 (1)

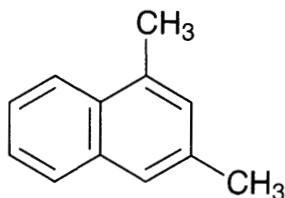
Other comments

In flue gases from waste plastic incineration (2).
Detected in water samples. In baked potato skins.
Inhibited skin tumorigenesis of benzo[a]pyrene (3).

References

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2. Tatsuichi, S. et al *Tokyo-to Kankyo Kagaku Kenkyusho Nenpo* 1991, 6-9 (Japan.) (*Chem. Abstr.* **115**, 238734k).
3. Malament, D. S. et al *Carcinogenesis (London)* 1981, **2**, 723

D434 1,3-dimethylnaphthalene



C₁₂H₁₂

Mol. Wt. 156.23

CAS Registry No. 575-41-7

EINECS No. 209-384-6

RTECS No. QS 4420000

Uses Solvent.

Occurrence Detected in water samples (1), fish (2), fossil fuels (3), cheese (2), and tobacco smoke (4,5).

Impurity in naphthalene. Constituent of naphtha and asphalt. Detected in wastewater from spent paper processing plants (6).

Physical properties

B. Pt. 263°C Flash point 109°C Specific gravity 0.982 Partition coefficient $\log P_{ow}$ 4.42 (7)
Solubility Water: 3.6 mg l⁻¹

Ecotoxicity

Fish toxicity

Experiments with sea urchin eggs and *Gadus morhua* embryos showed it to be less toxic than the 1,5- and 1,8-isomers (8).

LC₅₀ (96 hr) larval rainbow trout 1.7 mg l⁻¹ (9).

Invertebrate toxicity

t_{1/2} depuration oysters *Crassostrea virginica* 2 days (10).

EC₅₀ (48 hr) *Daphnia pulex* 0.35 mg l⁻¹ (11).

Bioaccumulation

Crassostrea virginica (oysters) (48 hr) 10 µg l⁻¹ of unspecified isomer of dimethylnaphthalene bioconcentrated 84 µg g⁻¹; accumulation factor oysters/water 8400. Oysters were transferred to clean water, depuration time 7 days oyster concentration 8 µg g⁻¹. Oysters (8 day) 2 µg l⁻¹ (unspecified isomer) bioconcentrated 72 µg g⁻¹; accumulation factor oysters/water 36,000. After transfer to clean water depuration time 7 days, oyster concentration 4 µg g⁻¹. Depuration time 23 days oyster concentration <0.5 µg g⁻¹, t_{1/2} depuration 2 days (12). Land treatment of an industrial oily waste studied to determine loss and immobilisation; earthworms did not accumulate naphthalenes present in the waste (13).

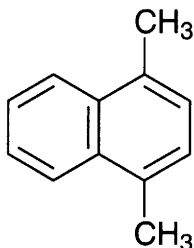
Other comments

In flue gases from waste plastic incineration (14).

References

1. Keith, L. H. (Ed.) *Identification and Analysis of Organic Pollutants in Water* 1982, Ann Arbor, MI, USA.
2. Webb, R. G. et al EPA-R2-73-277, 1973.
3. Guerin, M. R. et al *Compr. Surv., Iss. Polynucl. Aromat. Hydrocarbons* 1978, 3, 21.
4. Florin, I. et al *Toxicology* 1980, 18, 219.
5. Schmelty, I. et al *Trace Subst. Environ. Health* 1974, 8, 284.
6. Yamashita, K. et al *Kagoshima-ken Kankyo Senta Shoho* 1988, 4, 96-100 (Japan.) (*Chem. Abstr.* 112, 204253a).
7. Sangster, J. J. *Phys. Chem. Ref. Data* 1989, 18, 1111.
8. Falk-Petersen, I. B. et al *Sarsia* 1982, 67, 171.
9. Edsall, C. C. *Bull. Environ. Contam. Toxicol.* 1991, 46, 173-178.
10. Lee, R. F. et al *Environ. Sci. Technol.* 1978, 12, 832.
11. Passino, D. R. M. et al *Proc. 2nd Int. Workshop QSAR Environ. Toxicol.* 1987, 2, 261-270.
12. Richard, F. L. et al *Environ. Sci. Technol.* 1978, 12(7), 832-838.
13. Loehr, R. C. et al *Proc.-Int. Conf. New Front. Hazard. Waste Manage.* 1987, 2, 469-476.
14. Tatsuichi, S. et al *Tokyo-to Kankyo Kagaku Kenkyusho Nenpo* 1991, 6-9 (Japan.) (*Chem. Abstr.* 115, 238734k)

D435 1,4-dimethylnaphthalene



C₁₂H₁₂

Mol. Wt. 156.23

CAS Registry No. 571-58-4

EINECS No. 209-335-9

Physical properties

M. Pt. -18°C B. Pt. 262-264°C at 751 mmHg Flash point 110°C Specific gravity 1.016
Partition coefficient log P_{ow} 4.37 (1)

Environmental fate

Degradation studies

Potentially degradable under aerobic conditions (2).

Microbial adaptation to degradation of an initial concentration of 170 µg l⁻¹ in heavily gasoline polluted, slightly polluted and unpolluted groundwater examined. Lag periods were 5.9, 9.0 and 44 days, respectively, in tests using equal volumes of groundwater from three sites, and 6.3, 9.0 and 29 days respectively for tests where equal microbial numbers in the bottles were ensured by adding different volumes of groundwater (3).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535 and TA1537 with and without metabolic activation negative (4).

Other comments

Found in tobacco smoke (4,5).

Detected in water samples.

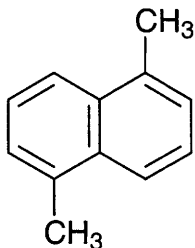
Retards development of epidermal carcinomas in hamster buccal pouch induced by DMBA in heavy mineral oil (6).

Moderate binding with nucleotides (7).

References

1. Sangster, J. J. *Phys. Chem. Ref. Data* 1989, **18**, 1111.
2. Arvin, E. et al *Int. Conf. Physicochem. Biol. Detoxif. Hazard. Wastes* 1988, **2**, 828-847.
3. Aamand, J. et al *J. Contam. Hydrol.* 1989, **4**, 299-312.
4. Florin, I. et al *Toxicology* 1980, **18**, 219.
5. Schmeltz, I. et al *Trace Subst. Environ. Health* 1974, **8**, 281.
6. Malament, D. G. et al *Carcinogenesis (London)* 1981, **2**, 723.
7. Harvey, R. G. et al *Cancer Res.* 1968, **28**, 2183

D436 1,5-dimethylnaphthalene



$C_{12}H_{12}$

Mol. Wt. 156.23

CAS Registry No. 571-61-9

EINECS No. 209-338-5

Physical properties

M. Pt. 80-82°C B. Pt. 265-266°C Partition coefficient $\log P_{ow}$ 4.38 (1)

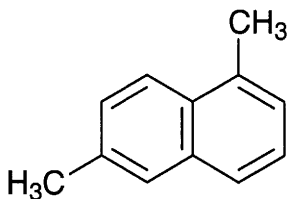
Other comments

Detected in water samples. In flue gases from waste plastic incineration (2).
Inhibited skin tumourigenesis of benzo[a]pyrene (3).

References

1. Sangster, J. J. *Phys. Chem. Ref. Data* 1989, **18**, 1111.
2. Tatsuichi, S. et al *Tokyo-to Kankyo Kagaku Kenkyusho Nenpo* 1991, 6-9 (Japan.) (*Chem. Abstr.*) **115**, 238734k).
3. Malcamenti, D. S. et al *Carcinogenesis (London)* 1981, **2**, 723

D437 1,6-dimethylnaphthalene



$C_{12}H_{12}$

Mol. Wt. 156.23

CAS Registry No. 575-43-9

EINECS No. 209-385-1

Physical properties

M. Pt. -17°C B. Pt. 265-266°C Flash point 110°C Specific gravity 1.002

Mammalian & avian toxicity

Acute data

LD_{Lo} oral rat 5000 mg l⁻¹ (1).

Carcinogenicity and chronic effects

In a CASE-SAR analysis of polycyclic aromatic hydrocarbon carcinogenicity, classified as a suspect carcinogen with a low moderate potency (2).

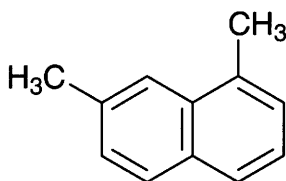
Other comments

Detected in water samples (3). Found in fish (4,5) and fossil fuels (6).

References

1. *AMA Arch. Ind. Health* 1964, 1.
2. Richard, A. M. et al *Mutat. Res.* 1990, **242**, 285-303.
3. Keith, L. H. (Ed.) *Identification and Analysis of Organic Pollutants in Water* 1982, Ann Arbor, MI, USA.
4. Neff, J. M. *Prepr. - Am. Chem. Soc., Div. Pet. Chem.* 1975, **20**, 839.
5. Ogata, M. et al *Water Res.* 1973, **13**, 613.
6. Guerin, M. R. et al *Carcinogr. Compr. Survey Ind. Polynucl. Aromat. Hydrocarbons* 1978, **3**, 21

D438 1,7-dimethylnaphthalene



C₁₂H₁₂

Mol. Wt. 156.23

CAS Registry No. 575-37-1

EINECS No. 209-382-5

Physical properties

M. Pt. -13°C B. Pt. 262-263°C Partition coefficient log P_{ow} 4.44 (1)

Solubility Organic solvents: benzene, diethyl ether

Mammalian & avian toxicity

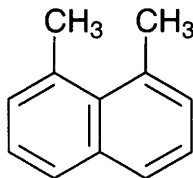
Carcinogenicity and chronic effects

In a CASE-SAR analysis of polycyclic aromatic hydrocarbon carcinogenicity, classified as a suspect carcinogen with a low moderate potency (2).

References

1. Sangster, J. J. *Phys. Chem. Ref. Data* 1989, **18**, 1111.
2. Richard, A. M. et al *Mutat. Res.* 1990, **242**, 285-303

D439 1,8-dimethylnaphthalene



C₁₂H₁₂

Mol. Wt. 156.23

CAS Registry No. 569-41-5

EINECS No. 209-314-4

Physical properties

M. Pt. 60-62°C B. Pt. 270°C Partition coefficient log P_{ow} 4.26 (1)

Mammalian & avian toxicity

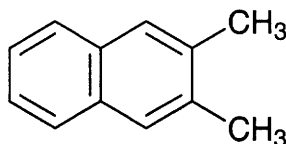
Carcinogenicity and chronic effects

In a CASE-SAR analysis of polycyclic aromatic hydrocarbon carcinogenicity, classified as a suspect carcinogen with a low moderate potency (2).

References

1. Sangster, J. J. *Phys. Chem. Ref. Data* 1989, **18**, 1111.
2. Richard, A. M. et al *Mutat. Res.* 1990, **242**, 285-303

D440 2,3-dimethylnaphthalene



C₁₂H₁₂

Mol. Wt. 156.23

CAS Registry No. 581-40-8

EINECS No. 209-463-5

Physical properties

M. Pt. 106°C B. Pt. 269°C Volatility v.p. 4.59×10^{-4} mmHg at 28°C

Environmental fate

Degradation studies

Biodegraded by soil bacteria after a short acclimation period (1).

4.2 g in creosote-contaminated quartz sand was biodegraded in landfarming chambers after 4 wk incubation (2).

Mammalian & avian toxicity

Carcinogenicity and chronic effects

In a CASE-SAR analysis of polycyclic aromatic hydrocarbon carcinogenicity, classified as a suspect carcinogen with a low moderate potency (3).

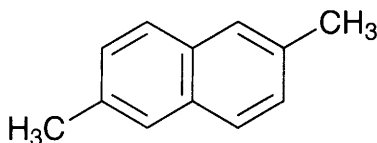
Other comments

IC₁₀, IC₅₀, IC₉₀ *Selenastrum capricornutum* 7, 12, 20 mg l⁻¹, respectively (4).

References

1. Mueller, J. G. et al *Appl. Environ. Microbiol.* 1991, **57**(5), 1277-1285.
2. Mueller, J. G. et al *Environ. Sci. Technol.* 1991, **25**(6), 1045-1055.
3. Richard, A. M. et al *Mutat. Res.* 1990, **242**, 285-303.
4. Gaur, P. *Acta Hydrochim. Hydrobiol.* 1988, **16**(6), 617-620

D441 2,6-dimethylnaphthalene



C₁₂H₁₂

Mol. Wt. 156.23

CAS Registry No. 581-42-0

EINECS No. 209-464-0

Uses Used with camphor in mothproofing.

Occurrence Found in fish (1), fossil fuels (2).

Physical properties

M. Pt. 108-110°C **B. Pt.** 262°C **Partition coefficient** log P_{ow} 4.31 (3)

Solubility Water: 2.4 ppm at 22°C

Ecotoxicity

Fish toxicity

Median threshold limit (96 hr) *Neanthes arenaceodentata* 2.6 ppm in seawater in static bioassay (4).

Invertebrate toxicity

LC₅₀ (duration unspecified) *Eurytemora affinis* 852 µg l⁻¹ (5).

Bioaccumulation

Estuarine exposure of juvenile chinook salmon to toxic aromatic hydrocarbons and polychlorinated biphenyls through the diet was investigated. Concentration in composites of stomach organisms (crustaceans, amphipods and small fish) was <0.1 µg g⁻¹ dry weight for 2,6-dimethylnaphthalene. Metabolism of aromatic hydrocarbons occurred rapidly in the liver preventing chemical analysis of liver tissue, however bile analysis indicated high levels of aromatic metabolites. Results suggest that the diet represents an important route of exposure in salmon (although uptake from water cannot be ruled out) and that bioaccumulation does occur (6).

Environmental fate

Degradation studies

Biodegraded by soil bacteria after a short acclimation period (7).

7.2 g in creosote-contaminated quartz sand was biodegraded in landfarming chambers after 12 wk incubation (8).

Mammalian & avian toxicity

Carcinogenicity and chronic effects

In a CASE-SAR analysis of polycyclic aromatic hydrocarbon carcinogenicity, classified as a suspect carcinogen with a low moderate potency (9).

Genotoxicity

Salmonella typhimurium TM677 with metabolic activation negative (10).

Other effects

Any other adverse effects

Moderate protein binding only (11).

Other comments

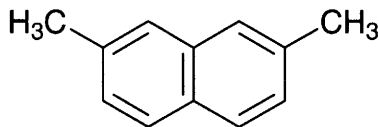
Detected in water samples (12).

Reviews on human health effects, experimental toxicology, environmental effects, ecotoxicology and exposure levels listed (13).

References

1. Neff, J. M. *Prepr. - Am. Chem. Soc., Div. Pet. Chem.* 1975, **20**, 839.
2. Ogatii, M. et al *Water Res.* 1979, **13**, 613.
3. Sangster, J. J. *Phys. Chem. Ref. Data* 1989, **18**, 1111.
4. Rossi, S. S. et al *Mar. Pollut. Bull.* 1978, **9**, 220-223.
5. Otl, F. S. et al *Mar. Environ. Res.* 1978, **1**, 49.
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8. Mueller, J. G. et al *Environ. Sci. Technol.* 1991, **25**(6), 1045-1055.
9. Richard, A. M. et al *Mutat. Res.* 1990, **242**, 285-303.
10. Kaden, D. A. et al *Cancer Res.* 1979, **39**, 4152.
11. Harvey, R. G. et al *Cancer Res.* 1968, **28**, 2183.
12. Webb, R. G. et al EPA-R2-73-277, 1973.
13. ECETOC Technical Report No. 71 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuyse (Bte 6), B-1160 Brussels, Belgium

D442 2,7-dimethylnaphthalene



$C_{12}H_{12}$

Mol. Wt. 156.23

CAS Registry No. 582-16-1

EINECS No. 209-477-1

Physical properties

M. Pt. 96-98°C B. Pt. 263°C

Mammalian & avian toxicity

Carcinogenicity and chronic effects

In a CASE-SAR analysis of polycyclic aromatic hydrocarbon carcinogenicity, classified as a suspect carcinogen with a low moderate potency (1).

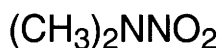
Other comments

Detected in water samples.

References

1. Richard, A. M. et al *Mutat. Res.* 1990, **242**, 285-303

D443 dimethylnitramine



$C_2H_6N_2O_2$

Mol. Wt. 90.08

CAS Registry No. 4164-28-7

Synonyms dimethylnitroamine; N-nitrodimethylamine; N-nitro DMA; N-methyl-N-nitromethanamine; N-nitrodimethylamine

RTECS No. IQ 0450000

Physical properties

M. Pt. 57-58°C B. Pt. 187°C Volatility v.p. 1.6 mmHg at 41.7°C

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1095 mg kg⁻¹ (1).

LD₅₀ intraperitoneal rat 897 mg kg⁻¹ (1).

Carcinogenicity and chronic effects

TD_{Lo} oral rat 20 g kg⁻¹ continuously for 1 yr, equivocal tumorigenic agent (2).

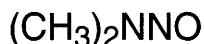
Genotoxicity

Salmonella typhimurium TA98, TA100, TA1530, TA1535, TA1538 with metabolic activation positive. *Salmonella typhimurium* TA1537 with metabolic activation negative (3).

References

1. *Toxicol. Appl. Pharmacol.* 1975, **33**, 185.
2. *J. Natl. Cancer Inst.* 1980, **64**, 1435.
3. Kudoley, V. V. et al *Arch. Geschwulstforsch.* 1987, **57**(6), 453-462

D444 dimethylnitrosamine



$\text{C}_2\text{H}_6\text{N}_2\text{O}$

Mol. Wt. 74.08

CAS Registry No. 62-75-9

Synonyms *N*-methyl-*N*-nitrosomethanamine; *N*-nitrosodimethylamine; DMN; DMNA; nitrosodimethylamine

EINECS No. 200-549-8

RTECS No. IQ 0525000

Uses Formerly in rocket fuel production. Antioxidant. Additive for lubricants. Softener of copolymers. Formerly intermediate in 1,1-dimethylhydrazine production.

Physical properties

B. Pt. 151-153°C at 774 mmHg **Flash point** 61°C **Specific gravity** 1.0048 at 20°C with respect to water at 4°C

Volatility v.den. 2.56

Solubility Water: miscible. Organic solvents: diethyl ether, ethanol

Occupational exposure

Supply classification very toxic

Supply classification dangerous for the environment

Risk phrases May cause cancer – Toxic if swallowed – Very toxic by inhalation – Toxic: danger of serious damage to health by prolonged exposure if swallowed – Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R45, R25, R26, R48/25, R51/53)

Safety phrases Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet – Restricted to professional users (S53, S45, S61)

Ecotoxicity

Fish toxicity

LD₅₀ intraperitoneal (10 day) rainbow trout 1770 mg kg⁻¹ (1).

Invertebrate toxicity

50-100 µg l⁻¹ had no effect on growth and development of *Scenedesmus obliquus*, *Chlorella saccharophila*, *Chlorella vulgaris* (2).

Environmental fate

Degradation studies

Metabolised by catabolic degradation by *Methylosinus trichosporium* OB3b when grown in a methane atmosphere to form carbon dioxide, or incorporated into cellular material (3).

Biodegradation in sea water at 0.01 mg l⁻¹ initial concentration 0% in dark, and 75% in daylight after 3 days; 91% in dark and 100% in daylight after 15 days. Biodegradation in fresh water at 0.01 mg l⁻¹ initial concentration 0% in dark and 75% in daylight after 3 days; 90% in dark and 100% in daylight after 15 days (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 58 mg kg⁻¹ (5).

LD₅₀ subcutaneous rat 45 mg kg⁻¹ (6).

LD₅₀ intraperitoneal mouse, rat 19, 26.5 mg kg⁻¹, respectively (7,8).

LC₅₀ (4 hr) inhalation dog, mouse, rat 16, 57, 78 ppm, respectively (9).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2A (10).

Intratracheal golden hamster (15 wk) 0.75, 1.5 mg caused respiratory tract tumours in 6% of both groups, liver cancers in 6% of the 0.75 mg group and 19% of the 1.5 mg group (11).

Inhalation rat 120, 600, 3000 µg m⁻³ induced significant reduction of median survival time (9 months) for 3000 µg m⁻³ group. Tumours occurred in nasal cavities; highest incidence in 600 and 3000 µg m⁻³ groups (12).

Oral ♀ rats 0.45, 1.1, 2.8, 7, 18, 45, 113 mg⁻¹ showed good correlation between biological behaviour (such as larger or multiple carcinomas) of liver and oesophageal neoplasms and dose. Treatment led to either an elevated incidence of upper gastro-intestinal tract neoplasms and liver tumours or to reduced survival, or both. Low-dose effects suggest highly potent carcinogen in rats (13).

Oral mice 50mg l⁻¹ in drinking water for 1 wk was sufficient to induce tumours in the kidney and lung (14).

Oral mice (8 wk) 0.001% in drinking water induced *Dlb-1* mutants in intestine, which were not observed during acute administration (15).

Zinc deficiency resulted in oesophageal tumours in rats exposed to dimethyl nitrosamine (16).

Intraperitoneal rat dose followed at 4 hr and on day-4 by intramuscular injection of CdCl₂, and intramuscular rat series of CdCl₂ injections over 13 days followed by dose after 24 hr showed significant synergistic increase of renal neoplasia, altered focal areas in liver and tumour incidence at sites other than kidney (17).

Intravesicular rat (30 wk) 4 mg wkly induced kidney tumours in 100% and lung tumours in 92% but no bladder tumours. Median wk of death 59 (18).

Gavage rat (30 wk) 4 mg wkly induced kidney tumours in 83%, lung tumours in 75% and liver tumours in 42% (18).

♂ 8-wk-old Big Blue mice were treated via intraperitoneal injection of 1 or 10 mg kg⁻¹ or a single injection of 5 or 10 mg kg⁻¹. All animals survived until wk-78. At wk-78 43% of mice in the 5 mg kg⁻¹ group had developed liver cell tumours, in the 1 mg kg⁻¹ × 5 group 43% of mice developed renal tubule dysplasia. 14% of the mice in the 1 mg kg⁻¹ group developed duodenal adenocarcinomas (19).

Teratogenicity and reproductive effects

Intraperitoneal CDI ♀ mice (day-15 gestation) 2, 10 mg kg⁻¹ caused slightly increased DNA damage in foetuses compared with controls. Damage increased two-fold when treated with intrafoetal injections of rat S9 activating fraction immediately before the same exposure to dimethylnitrosamine (20).

Metabolism and toxicokinetics

Oral domestic fowl 1.2 mg kg⁻¹ ¹⁴C-labelled dimethylnitrosamine, <10% was exhaled as ¹⁴CO₂ within 24 hr. DNA alkylation in chicken tissues was generally low, with highest values in the liver and kidney. Methyl purine concentrations in the gastro-intestinal tract were close to detection limits (21).

Intravenous swine, beagles 0.5, 1.0 mg kg⁻¹ caused declined blood concentration with t_{1/2} distribution, and t_{1/2} elimination of 7 and 28 min, respectively, for swine, and 19 and 73 min for beagles. Pharmacokinetics were first

order. Oral dose 1.0 and 5.0 mg kg⁻¹ showed pharmacokinetics no longer first order as metabolism saturated. High bioactivity of the 1.0 mg kg⁻¹ dose (67% swine, 93% beagle) indicates extrahepatic metabolism important in systemic clearance (22,23).

Intravenous bolus Syrian golden hamster 0.3 mg kg⁻¹ [¹⁴C] dimethylnitrosamine revealed biphasic first-order elimination with terminal t_{1/2} 8.7 min for unchanged and 31.5 min for total radioactivity. Evidence of conversion to polar metabolites. 31% of total radioactive elimination in urine (24).

Oral or intravenous 8-wk-old ♂ Fischer rats 0.6-1.1 mg kg⁻¹ ¹⁴C-labelled dimethylnitrosamine. Denitrosation was calculated to represent 21.3 ± 1.3% of total elimination indicating this is a major metabolic pathway for elimination (25).

Incubation with acetone- and ethanol-induced rat liver microsomes indicated metabolism involved competition between demethylation and denitrosation (26).

Hepatic metabolism mediated by cytochrome IIEI subfamily inducible by ethanol (27).

Genotoxicity

Salmonella typhimurium TA1537 with and without metabolic activation, preincubation test negative. *Salmonella typhimurium* TA100, TA1535 with metabolic activation positive. *Salmonella typhimurium* TA98 with metabolic activation, TA1538 with and without metabolic activation equivocal (28).

Escherichia coli WP-2uvrA with and without metabolic activation positive (28).

Chlamydomonas reinhardtii genotoxic effects at 0.014 to 0.14 mM (29).

Syrian hamster embryo cells clonal system positive (30).

RLV-infected rat embryo cells morphological transformation positive (30).

Drosophila melanogaster wing spot test and DNA-repair test positive (31).

Gene locus mutation assay with human lymphoblast cells AHH-1 with and without metabolic activation positive (32).

Other effects

Other adverse effects (human)

Detected in urine samples from patients with bladder cancer at 0.30-0.76 ppb compared with 0.07-0.133 ppb in normal patients. Also detected in lung samples from normal patients (33).

A 42-year-old woman poisoned criminally with 3 or 4 doses of 300 mg over 2 yr suffered initial symptoms of mild fever, sweating, nausea, vomiting, epigastric pain, diarrhoea, intestinal bleeding, haemorrhagic tracheitis, a sore throat, excessive salivation and weight loss. She died after developing a liver cirrhosis with multiple bleeding, a haemolytic syndrome and diabetes mellitus (34).

Any other adverse effects

Administration of 0.01 mmol to fertile eggs 2 days after incubation resulted in an increase in glutathione levels in the liver and kidney of chick embryos (35).

Other comments

Found in nitrite-cured meat, fish and cheese products. Trace amounts reported in tobacco smoke condensates (36). Also found in cider, brandies, cognacs, rums and armagnacs.

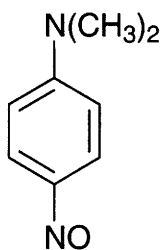
Reviews on human health effects, environmental toxicology, physicochemical effects, epidemiology, workplace experience and environmental effects are listed (37).

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2. Rubenchik, B. L. et al *Ukr. Bot. Zh.* 1990, **41**(1), 62-65 (Ukrain.) (*Chem. Abstr.* **113**, 110753g).
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5. *Toxicology* 1974, **27**, 380.
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D445 *N,N*-dimethyl-4-nitrosoaniline



$C_8H_{10}N_2O$

Mol. Wt. 150.18

CAS Registry No. 138-89-6

Synonyms *p*-nitrosodimethylaniline; 4-nitroso-*N,N*-dimethylaniline

EINECS No. 205-343-1

RTECS No. BX 7175000

Uses Organic synthesis. Manufacture of dyestuffs. Vulcanisation accelerator. In printing fabrics.

Physical properties

M. Pt. 85-87°C Specific gravity 1.145 at 20°C

Solubility Organic solvents: acetone, diethyl ether, ethanol

Occupational exposure

UN No. 1369 HAZCHEM Code 2X Conveyance classification spontaneously combustible substance

Ecotoxicity

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 0.017 ppm Microtox test (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 65 mg kg⁻¹ (2).

Subcutaneous ♂ rat, single injection (dose unspecified) induced an increase in urinary alkaline phosphatase after 48 hr. Urinary acid phosphatase and muramidase activities were significantly elevated soon after administration and remained elevated for up to 120 hr. Urinary protein and urine volume were markedly reduced. Serum protein was reduced while kidney and liver proteins were raised (3).

Carcinogenicity and chronic effects

Oral rat and mouse (2 yr) 300 mg l⁻¹ in drinking water for ~1/2 lifespan induced a significant increase in the occurrence of tumours of the lungs, kidneys and malignant lymphomas in rats, and tumours of the lungs and duodenum and malignant lymphoma in mice (4).

Sensitisation

Reported to cause dermatitis in humans (5).

Caused skin sensitisation in guinea pigs (6).

Genotoxicity

Salmonella typhimurium TA100 with metabolic activation positive (7).

Other effects

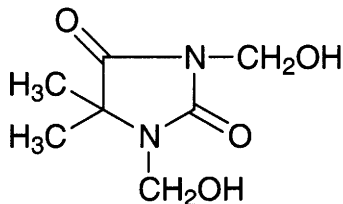
Other adverse effects (human)

Symptoms of exposure include weakness, tremors, cyanosis and drowsiness (5).

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D446 *N,N'*-dimethylol-5,5-dimethylhydantoin



$C_7H_{12}N_2O_4$

Mol. Wt. 188.18

CAS Registry No. 6440-58-0

Synonyms 1,3-bis(hydroxymethyl)-5,5-dimethyl-2,4-imidazolidinedione; 1,3-bis(hydroxymethyl)-5,5-dimethylhydantoin; dantoin DMDMH 55; DMDM hydantoin; Glydant

EINECS No. 229-222-8

RTECS No. MT 9191500

Physical properties

M. Pt. 100-102°C

Other effects

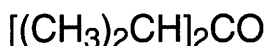
Other adverse effects (human)

A positive allergic reaction was found in >1% of 501 suspected contact dermatitis patients. Of six patients reacting to formaldehyde releaser DMDM hydantoin, four were positive to formaldehyde (1).

References

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D447 2,4-dimethyl-3-pentanone



$C_7H_{14}O$

Mol. Wt. 114.19

CAS Registry No. 565-80-0

Synonyms 2,4-dimethylpentan-3-one; diisopropyl ketone; isobutyron; isopropyl ketone

EINECS No. 209-294-7

RTECS No. SA 8575500

Physical properties

M. Pt. -80°C B. Pt. 124°C Flash point 15°C Specific gravity 0.806

Occupational exposure

Supply classification highly flammable

Risk phrases Highly flammable (R11)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from sources of ignition – No smoking – Do not breathe vapour (S2, S16, S23)

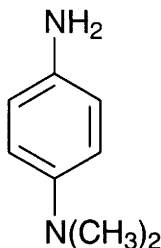
Other comments

Reviews on human health effects, experimental toxicology and physicochemical properties listed (1).

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1. ECETOC Technical Report No. 71 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuyse (Bte 6), B-1160 Brussels, Belgium

D448 *N,N*-dimethyl-*p*-phenylenediamine



$C_8H_{12}N_2$

Mol. Wt. 136.20

CAS Registry No. 99-98-9

Synonyms *N,N*-dimethyl-1,4-benzenediamine; 4-aminodimethylaniline; *p*-aminodimethylaniline; C.I. 76075; 4-(dimethylamino)aniline; DMPD

EINECS No. 202-807-5

RTECS No. ST 0874000

Uses Manufacture of hair dyestuffs. Chemical intermediate. Photographic developer. Analytical reagent (especially for chlorine residues in water).

Physical properties

M. Pt. 53°C **B. Pt.** 262°C **Flash point** 90°C **Specific gravity** 1.036 at 20°C with respect to water at 4°C

Partition coefficient $\log P_{ow}$ 1.11 (1) **Volatility** v.p. 1.9×10^{-3} mmHg at 25°C

Solubility Water: soluble. Organic solvents: benzene, chloroform, diethyl ether, dimethyl sulfoxide, ethanol, petroleum ether

Occupational exposure

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed (R23/24/25)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S45)

Ecotoxicity

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 0.84 ppm Microtox test (2).

Bioaccumulation

Estimated bioconcentration factors of 2.3-4.1 indicate that environmental concentration is unlikely (3).

Environmental fate

Abiotic removal

$t_{1/2}$ for photooxidation via hydroxyl and peroxy radicals in water 19-30 sunlight hr (4).

$t_{1/2}$ for reaction with photochemically produced hydroxyl radicals in the atmosphere 97 min (5).

Adsorption and retention

Estimated K_{oc} of 10-19 indicate negligible adsorption to soil (6).

Mammalian & avian toxicity

Acute data

LD_{Lo} oral rat 50 mg kg⁻¹ (7).

LD_{Lo} intraperitoneal mouse 50 mg kg⁻¹ (8).

Subcutaneous rat, 250 mg kg⁻¹ caused focal necrosis and myofibrillar contracture in skeletal muscles (9).

Teratogenicity and reproductive effects

Gavage rat (day 6-15 gestation) 12.5-500 mg kg⁻¹. No maternal toxicity was noted, and there was no significant difference in teratogenic effects compared to controls (10).

Irritancy

Irritating to skin, eyes, mucous membranes and upper respiratory tract (species unspecified) (11).

Genotoxicity

Salmonella typhimurium TA98 with metabolic activation positive (12).

In vitro Chinese hamster lung cells, chromosomal aberrations positive (13).

In vitro Chinese hamster ovary cells, chromosomal aberrations negative (13).

Other effects

Any other adverse effects

Absorption into the body leads to the formation of methaemoglobin which in sufficient concentration causes cyanosis (11).

Other comments

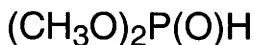
Reviews on human health effects, experimental toxicology, physicochemical effects and workplace experience listed (14).

Physical properties, safe handling and toxicity reviewed (15).

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D449 dimethyl phosphite



$\text{C}_2\text{H}_7\text{O}_3\text{P}$

Mol. Wt. 110.05

CAS Registry No. 868-85-9

Synonyms dimethyl hydrogen phosphite; phosphorous acid, dimethyl ester; dimethoxyphosphine oxide; dimethyl acid phosphite; dimethyl phosphonate

EINECS No. 212-783-8

RTECS No. SZ 7710000

Uses Chemical intermediate. Flame retardant. Lubricant additive. Has antifungal properties.

Physical properties

B. Pt. 170-171°C **Specific gravity** 1.20 at 20°C **Volatility** v.p. <1.0 mmHg at 20°C

Solubility Organic solvents: acetone, diethyl ether, ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 3100, 3200 mg kg⁻¹, respectively (1).

LD₅₀ dermal rabbit 2400 mg kg⁻¹ (1).

Sub-acute and sub-chronic data

Oral rat (4-6 wk) 200 mg kg⁻¹ developed reversible increases in forestomach weight involving thickening of stratified squamous epithelium, hyperplasia, hyperkeratosis and inflammation. Activity of angiotensin converting enzyme was increased as were non-protein sulfhydryls in the forestomach. Soluble carboxyl esters in lung and forestomach were reduced but microsomal enzyme activities from liver, lung, kidney, forestomach and glandular stomach were unaffected (2).

Oral rat (15 day) 500 mg kg⁻¹ or mice given 2 g kg⁻¹ suffered stomach damage and some animals died (3).

Oral rat (90 day) 25-400 mg kg⁻¹ and mice 45-1500 mg kg⁻¹ caused some toxic effects (unspecified) but no tumorigenic effects (3).

Carcinogenicity and chronic effects

No evidence for carcinogenicity to humans, limited evidence for carcinogenicity to animals, IARC classification group 3 (1).

National Toxicology Program tested rats and mice via gavage for 2 yr at 100 and 200 mg kg⁻¹. No evidence of carcinogenic activity was seen in mice, although some lack of weight gain was seen at the higher dose. Clear evidence of carcinogenic activity was seen in ♂ rats, and survival rates were lower than controls. Equivocal evidence of carcinogenic activity was found in ♀ rats. ♂ rats developed some squamous-cell carcinomas of the lung, and carcinoma of the forestomach. Some ♀ animals developed alveolar/bronchiolar carcinomas (3,4). Classified as a group B genotoxic carcinogen, i.e. carcinogenic only to a single species (rat) but causing tumours at two or more sites (unspecified) in that animal (5).

Genotoxicity

Salmonella typhimurium TA100 with metabolic activation positive (6).

In vitro mouse lymphoma cells, forward mutation assay weak positive result without metabolic activation; enhanced result with metabolic activation (7).

In vitro rat liver cells with metabolic activation, positive dose-dependent responses in a DNA repair test; without metabolic activation, negative (8).

Drosophila melanogaster sex-linked recessive mutation assay negative (4).

Other effects

Any other adverse effects

Gastric irritation reported at toxic doses in rodents (1).

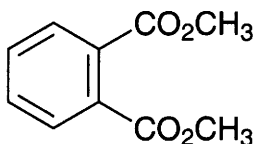
Other comments

Identified as a metabolite of vamidothion (9).

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D450 dimethyl phthalate



C₁₀H₁₀O₄

Mol. Wt. 194.19

CAS Registry No. 131-11-3

Synonyms dimethyl 1,2-benzenedicarboxylate; 1,2-benzenedicarboxylic acid, dimethyl ester; dimethyl benzeneorthodicarboxylate; methyl phthalate; Kodaflex DMP; Palatinol M

EINECS No. 205-011-6

RTECS No. TI 1575000

Uses Solvent and plasticiser in the manufacture of latex, cellulose and acetate film. Constituent of lacquers, plastics, rubber and coating agents. In the manufacture of safety glasses and moulding powders. Insect repellent. Acaricide. Catalyst. Chemiluminescent. Fixative in perfumes.

Physical properties

M. Pt. 5.5-6°C **B. Pt.** 283.7-284°C **Flash point** 146°C **Specific gravity** 1.19 at 25°C with respect to water at 25°C **Partition coefficient** log P_{ow} 1.56 (1) **Volatility** v.p. <0.01 mmHg at 20°C; v.den. 6.69

Solubility Water: 4.2 g l⁻¹ (2). Organic solvents: miscible with acetone, chloroform, diethyl ether, ethanol; soluble in mineral oil

Occupational exposure

FR-VME 5 mg m⁻³

SE-LEVL 3 mg m⁻³

UK-LTEL 5 mg m⁻³

US-TWA 5 mg m⁻³

SE-STEL 5 mg m⁻³

UK-STEL 10 mg m⁻³

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) bluegill sunfish, sheepshead minnow 50-58 mg l⁻¹ (3,4).

Invertebrate toxicity

LC₅₀ (24, 96 hr) *Artemia salina* >1000, 62 mg l⁻¹, respectively (5,6).

LC₅₀ (24 hr) *Streptocephalus proboscideus*, *S. rubricaudatus*, *S. texanus* 261.0, 319.9, 382.7 mg l⁻¹, respectively (5).

EC₅₀ (24, 48 hr) *Daphnia magna* 150, 33 mg l⁻¹, respectively (6,7).

EC₅₀ (96 hr) *Selenastrum capricornutum*, *S. costatum* 26.1, 42.7 mg l⁻¹, respectively (8).

EC₅₀ (96 hr) *Gymnodinium breve* 54-125 mg l⁻¹ (9,10).

EC₅₀ (5, 15, 30 min) *Photobacterium phosphoreum* 18.1 mg l⁻¹ Microtox test (11).

Bioaccumulation

Bioconcentration factors in brown shrimp, sheepshead minnow and bluegill sunfish are 4.7, 5.4 and 57, respectively. The former two demonstrating low concentration and the latter elevated because metabolites were included with the parent compound in the results (12,13).

Environmental fate

Degradation studies

Complete degradation occurred in undiluted and 10% municipal sludge in 1 and 10 days, respectively, with 82% mineralisation occurring in the 10% sludge (14).

Phthalate esters undergo ≥ 50% ultimate degradation within 28 days in standardised aerobic biodegradation tests with sewage sludge inocula. Biodegradation is expected to be the dominant loss mechanism in surface water, soils and sediments (15).

t_{1/2} 1.9 days after a 2.7-day lag using a soil/sewage inoculum. After 28 days, >99% had disappeared and 86% mineralisation had occurred (16).

Biodegradation is expected to be the principal loss process in lakes and ponds with an estimated t_{1/2} of 13-17 hr (17).

Bacillus spp. utilised dimethyl phthalate as a sole source of carbon isolated from garden soil with monomethylterephthalate and terephthalic acid as intermediates (18).

Abiotic removal

Photolytic t_{1/2} in surface waters estimated as 145 days (19).

t_{1/2} in pure water irradiated at >290 nm was 12.7 hr, reduced to 2.8 hr in the presence of nitrogen dioxide (20).

Hydrolytic t_{1/2} estimated as 3.2 yr at 30°C under neutral conditions. At pH 9, estimated t_{1/2} are 11.6 and 25 days at 30°C and 18°C, respectively (17,19).

Photochemical t_{1/2} estimated as 23.8 hr (21).

Adsorption and retention

Estimated soil adsorption coefficients of 160 and 44 indicate low adsorption to soil and sediment (17,22).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, guinea pig, mouse 2400, 2400, 7200 mg kg⁻¹, respectively (23).

LD₅₀ (9 day) dermal rat >4800 mg kg⁻¹ (24).

LD₅₀ intraperitoneal mouse, rat 1380, 3380 mg kg⁻¹, respectively (23).

Teratogenicity and reproductive effects

On gestational days 6-15, dietary concentrations of 0-5% were administered to Sprague-Dawley rats providing an average intake of 0-3.6 g kg⁻¹ day⁻¹. Results suggested the apparent toxic effects of high doses on body weight reflected the unpalatability of dimethyl phthalate in feed. The no-observed-adverse-effect level for maternal toxicity was 1% and for developmental toxicity was 5% (25).

Doses of 0.5, 1 and 2 ml day⁻¹ epicutaneously administered to rats did not induce any teratogenic effects (26).

Metabolism and toxicokinetics

After oral administration to mice and rats, absorption was rapid and excretion was mostly in urine and faeces in 12 hr. Maximum concentration was attained at 20 min in blood and organs, with kidney having the highest concentration followed by liver and fatty tissues. In 24 hr, 90.2% and 4.3% was excreted in urine and faeces, respectively (27).

In vitro studies of human and rat epidermal membranes found human skin to be the less permeable (28).

Intraperitoneal rats 2 g kg⁻¹, urine collected over 24 hr was not mutagenic to *Salmonella typhimurium* TA100 and contained an equivalent of 1.96 mg ml⁻¹ of the administered phthalate. More than 97% of the phthalic acid-containing derivatives present in the urine consisted of monomethyl phthalate (29).

Genotoxicity

Salmonella typhimurium TA100, TA1535 without metabolic activation weakly positive. Cytotoxic at high concentrations (30).

In a *Salmonella typhimurium* TA98 test system without metabolic activation, dimethyl phthalate had no influence on the mutagenicity of 2-nitrofluorene (2 µg); with metabolic activation, it had no influence on the mutagenicity of benzo[a]pyrene (2µg), and inhibited mutagenicity of Trp-P-1 (50 ng) (31).

Other effects

Any other adverse effects

Irritating to mucous membranes and eyes and can cause central nervous system depression when ingested (32).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (33).

Pesticides and organic solvents are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (34).

Other comments

Residues have been isolated from water, sediments and urban air (35).

Reviews on human health effects and experimental toxicology listed (36).

Toxicity and hazards reviewed (37).

Environmental fate reviewed (35).

Aquatic toxicity of eighteen phthalate esters reviewed (2).

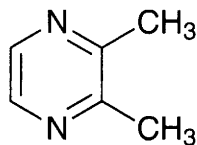
The environmental fate of eighteen phthalate esters reviewed (15).

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D451 2,3-dimethylpyrazine



$C_6H_8N_2$

Mol. Wt. 108.14

CAS Registry No. 5910-89-4

EINECS No. 227-630-0

RTECS No. UQ 2625000

Occurrence Loamy soil near Moscow (1).

Pyrolysis product from a number of foods including coffee and chocolate (2,3).

Odour of coffee, chocolate, peanuts and potato chips.

Residue detected in water in the Moscow area.

Physical properties

B. Pt. 156°C **Flash point** 54°C **Specific gravity** 1.022 at 25°C with respect to water at 4°C

Solubility Water: miscible. Organic solvents: diethyl ether, ethanol

Ecotoxicity

Invertebrate toxicity

EC₅₀ *Tetrahymena pyriformis* 8.6 mg l⁻¹ (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1020 mg kg⁻¹ (5).

LD₅₀ intraperitoneal mouse 1350 mg kg⁻¹ (3).

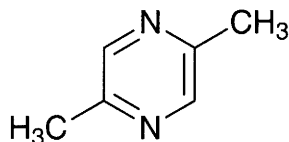
Genotoxicity

Salmonella typhimurium TA100, TA1537, TA98 with and without metabolic activation negative. Chinese hamster ovary cells (3 hr) with and without metabolic activation induced chromosome breaks and sister chromatid exchanges. *Saccharomyces cerevisiae* increased number of aberrant colonies, but not mitotic recombinants (6,7).

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D452 2,5-dimethylpyrazine



C₆H₈N₂

Mol. Wt. 108.14

CAS Registry No. 123-32-0

Synonyms 2,5-dimethyl-1,4-diazine; ketine

EINECS No. 204-618-3

RTECS No. UQ 2800000

Occurrence Identified in aroma of marine invertebrates (1).

Residue detected in water in the Moscow area.

Physical properties

B. Pt. 155°C Flash point 64°C (open cup) Specific gravity 0.9887 at 20°C with respect to water at 4°C

Volatility v.den. 3.7

Solubility Water: miscible. Organic solvents: acetone, diethyl ether, ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1020 mg kg⁻¹ (2).

LD₅₀ intraperitoneal mouse 1350 mg kg⁻¹ (3).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1537, with and without metabolic activation negative (4).

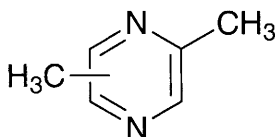
Saccharomyces cerevisiae increase in aberrant colonies, but not mitotic recombinants (4).

In vitro Chinese hamster ovary cells, chromosomal aberrations positive (4).

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D453 2,5(or 2,6)-dimethylpyrazine



C₆H₈N₂

Mol. Wt. 108.14

CAS Registry No. 36731-40-5

Occurrence Identified as a volatile component of smoked guinea fowl (1).

Physical properties

Solubility Water: miscible. Organic solvents: acetone, diethyl ether, ethanol

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1537 with and without metabolic activation negative (2).

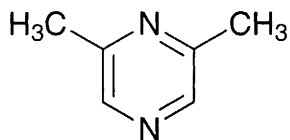
Saccharomyces cerevisiae increase in aberrant colonies, but not mitotic recombinants (2).

In vitro Chinese hamster ovary cells, chromosomal aberrations positive (2).

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D454 2,6-dimethylpyrazine



C₆H₈N₂

Mol. Wt. 108.14

CAS Registry No. 108-50-9

EINECS No. 203-589-4

RTECS No. UQ 2975000

Uses Contributes to organoleptic properties of many foods and drinks.

Occurrence Tobacco smoke (1,2).

In aromas and flavours of many cooked foods and drinks such as coffee, roast palm kernels and birch syrup.

Often formed by heating foods containing amino-acids and sugars. Thought to be present in the urine of the bob cat (3).

Physical properties

M. Pt. 35-40°C B. Pt. 154°C Flash point 52°C

Mammalian & avian toxicity

Acute data

LD₅₀ intraperitoneal mouse 1080 mg kg⁻¹ (4).

LD₅₀ oral rat 880 mg kg⁻¹ (5).

Genotoxicity

Salmonella typhimurium TA100, TA1537, TA98 with and without metabolic activation, negative. Chinese hamster ovary cells (3 hr) with and without metabolic activation, indication of chromosome breaks and exchanges.

Saccharomyces cerevisiae D5 induced aberrant colonies (6,7).

Compound is thought to contribute substantially to mutagenicity of coffee, as shown *in vitro* with *Salmonella typhimurium* (8).

Other effects

Any other adverse effects

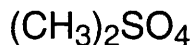
Compound has weak hypnotic and anticonvulsant properties (4).

Can aggregate blood platelets (species unspecified) (9).

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D455 dimethyl sulfate



$\text{C}_2\text{H}_6\text{O}_4\text{S}$

Mol. Wt. 126.13

CAS Registry No. 77-78-1

Synonyms sulfuric acid, dimethyl ester; methyl sulfate; DMS

EINECS No. 201-058-1

RTECS No. WS 8225000

Uses Methylating agent in chemical synthesis. Catalyst. War gas.

Physical properties

M. Pt. -32°C B. Pt. $\approx 188^\circ\text{C}$ (decomp.) Flash point 83°C (closed cup) Specific gravity 1.3322 at 20°C with respect to water at 4°C Volatility v.p. <1 mmHg at 20°C ; v.den. 4.35

Solubility Water: 28 g l^{-1} at 18°C . Organic solvents: acetone, benzene, diethyl ether, dioxane, toluene

Occupational exposure

FR-VME 0.1 ppm (0.5 mg m^{-3})

JP-OEL 0.1 ppm (0.52 mg m^{-3})

UK-LTEL MEL 0.05 ppm (0.26 mg m^{-3})

US-TWA 0.1 ppm (0.52 mg m^{-3})

UN No. 1595 HAZCHEM Code 2XE Conveyance classification toxic substance, corrosive

Supply classification very toxic

Risk phrases May cause cancer – Toxic if swallowed – Very toxic by inhalation – Causes burns (R45, R25, R26, R34)

Safety phrases Restricted to professional users – Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S53, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) bluegill sunfish, inland silverside 7.5, 15 mg l^{-1} , respectively static bioassay (1).

Environmental fate

Abiotic removal

Hydrolysis occurs rapidly above 18°C (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 205–440 mg kg^{-1} (3,4).

LC₅₀ (4 hr) inhalation rat 45 mg m^{-3} (5).

LD₅₀ subcutaneous rat 100 mg kg^{-1} (6).

Sub-acute and sub-chronic data

Inhalation rat (duration unspecified) 22 ppm. Sensory irritation and reduced respiratory rat and methylation of DNA in the respiratory tissue was observed (7).

Carcinogenicity and chronic effects

Insufficient evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2A (8).

In vivo exposure in rats, single equimolar dose induced increased DNA elution rate indicative of DNA fragmentation. Similar amounts of DNA fragmentation were produced by both potent and weak brain carcinogens (9).

Dermal ♀ ICR/Ha Swiss mice (15 month) 0.1 mg in 0.1 ml acetone 3 × wk (30 animals) no tumours (papillomas or carcinomas) reported (10).

Teratogenicity and reproductive effects

Inhalation pregnant Crl:CDBR rats were exposed nose-only to 0.1, 0.7, or 1.5 ppm dimethyl sulfate for 6 hr day⁻¹ from days 7-16 of gestation. The rats were euthanised on day-22 of gestation and the foetuses were examined. No unusual clinical signs were seen in the exposed rats and no statistically significant foetal effects were detected (11).

Irritancy

Dermal rabbit (24 hr) 10 mg caused severe irritation (2).

100 mg instilled into rabbit eye (4 sec) caused severe irritation (12).

Genotoxicity

Salmonella typhimurium Ara^r mutant strains BA13, BAL13 without metabolic activation forward mutation test positive (13).

Escherichia coli SOS chromotest positive (14).

Drosophila melanogaster sex-linked recessive lethal assay positive (15).

In vitro Chinese hamster ovary cells, sister chromatid exchanges and chromosomal aberrations positive (16).

Allium fistulosum seed, fumigation caused an increase in chromosomal aberrations (17).

Other effects

Other adverse effects (human)

Four cases of bronchial carcinomas were reported in men exposed occupationally (18).

Pulmonary carcinoma was reported in a man exposed to "small amounts" of dimethyl sulfate, but to larger amounts of bis(chloromethyl)ether and chloromethyl methyl ether. Choroidal melanoma was reported in a man exposed for 6 yr to dimethyl sulfate (6,19,20).

Any other adverse effects

Direct addition to naive B6C3F₁ murine splenocytes caused a dose-dependent suppression of the *in vitro* immune response (21).

Other comments

Detected at concentrations ≤830 ppm in fly ash and in airborne particulate matter from coal combustion processes (22).

Physical properties, use, occurrence, mammalian toxicity and carcinogenicity reviewed (18,23).

Toxicity and hazards reviewed (24).

Experimental toxicology and human health effects reviewed (25).

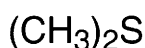
Autoignition temperature 189°C.

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D456 dimethyl sulfide



C₂H₆S

Mol. Wt. 62.14

CAS Registry No. 75-18-3

Synonyms dimethyl thioether; methyl sulfide; methylthiomethane; thiobismethane; 2-thiapropene; DMS; Exact-S

EINECS No. 200-846-2

RTECS No. PV 5075000

Uses Catalyst. Feeding stimulant for fish. Odourising agent for natural gas. Solvent.

Occurrence Detected in biogenic sulfur-containing gas emissions from soils (1).

Physical properties

M. Pt. -98°C **B. Pt.** 36-38°C **Flash point** -36°C **Specific gravity** 0.846 at 21°C with respect to water at 4°C

Volatility v.den. 2.14

Solubility Organic solvents: diethyl ether, ethanol

Occupational exposure

SE-LEVL 1 ppm

UN No. 1164 **HAZCHEM Code** 3YE **Conveyance classification** flammable liquid

Environmental fate

Degradation studies

Degraded by *Thiobacillus thioparus* which was isolated from peat (2).

Utilised as a sulfur source by the green alga *Chlorella fusca* (3).

Abiotic removal

Undergoes photooxidation in the atmosphere (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 535, 3700 mg kg⁻¹, respectively (5,6).

LD₅₀ intraperitoneal mouse 8000 mg kg⁻¹ (7).

Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation (5).

250 µg instilled into rabbit eye for 24 hr caused severe irritation (6).

Legislation

Maximum permissible concentration in domestic water in former USSR 0.01 mg l⁻¹ (8).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (9).

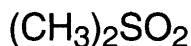
Other comments

Autoignition temperature 206°C.

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D457 dimethyl sulfone



C₂H₆O₂S

Mol. Wt. 94.13

CAS Registry No. 67-71-0

Synonyms methyl sulfone; methylsulfonylmethane; sulfonylbismethane

EINECS No. 200-665-9

Uses Catalyst. Solvent. Vulcanising agent.

Physical properties

M. Pt. 108-110°C B. Pt. 238°C Flash point 143°C Partition coefficient log P_{ow} -1.41

Solubility Water: miscible. Organic solvents: acetone, ethanol, methanol

Other effects

Any other adverse effects

IC₅₀ growth inhibition *in vitro* bovine aortic smooth muscle cells 1% and endothelial cells 1.8% (1).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (2).

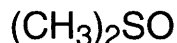
Other comments

Mammalian metabolite of dimethyl sulfoxide (1).

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D458 dimethyl sulfoxide



$\text{C}_2\text{H}_6\text{OS}$

Mol. Wt. 78.14

CAS Registry No. 67-68-5

Synonyms methyl sulfoxide; methylsulfinylmethane; sulfinylbis(methane); DMSO; Decap; Enviro-S

EINECS No. 200-664-3

RTECS No. PV 6210000

Uses Solvent. Antifreeze. Anti-inflammatory drug. Organic synthesis. Paint remover.

Physical properties

M. Pt. 18.4°C **B. Pt.** 189°C **Flash point** 95°C (open cup) **Specific gravity** 1.100 at 20°C with respect to water at 4°C **Partition coefficient** $\log P_{\text{ow}}$ -1.35 **Volatility** v.p. 0.37 mmHg at 20°C ; v.den. 2.71
Solubility Water: miscible. Organic solvents: acetone, benzene, chloroform, ethanol

Occupational exposure

SE-LEVL 50 ppm (150 mg m⁻³)

SE-STEL 150 ppm (500 mg m⁻³)

Ecotoxicity

Fish toxicity

Exposure of coho salmon to 1% v/v solution for 100 days caused no adverse effects (1).

Invertebrate toxicity

EC₅₀ (5 min) *Photobacterium phosphoreum* 103,000 ppm, Microtox test (2).

LC₅₀ (4, 12 days) embryo grass shrimps (*Palaemonetes pugio*) 22.57, 12.33 g l⁻¹, respectively (3).

Environmental fate

Degradation studies

< 20% degradation was observed in a screening test using activated sludge inoculum (4).

Transformed to methyl sulfide by anaerobic bacteria isolated from sediments (5).

Abiotic removal

Undergoes disproportionation in water to methyl sulfide and methyl sulfone (6).

Reaction with photochemically produced hydroxyl radicals in the atmosphere $t_{1/2}$ ~7 hr (7).

Adsorption and retention

Methyl sulfoxide is reported to be adsorbed chemically and physically to clay minerals (8).

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird, starling >100 mg kg⁻¹ (9).

LD₅₀ oral rat 14.5 g kg⁻¹ (10).

LD₅₀ oral mouse 7900 mg kg⁻¹ (11).

LD₅₀ subcutaneous rat 12 g kg⁻¹ (12).

LD₅₀ intraperitoneal mouse, rat 2500, 8200 mg kg⁻¹, respectively (13,14).
LD₅₀ intravenous dog, mouse, rat 2500, 3800, 5360 mg kg⁻¹, respectively (15-17).

Sub-acute and sub-chronic data

Gavage rat (45 day) 5000 mg kg⁻¹ day⁻¹ caused a slight loss in body weight, liver cell necrosis and inflammation with irritation of the portal spaces (18).

Carcinogenicity and chronic effects

Gavage rat (18 month) 20 mg kg⁻¹ day⁻¹ 5 days wk⁻¹ for 18 months caused minimal changes in body weight, in haematological parameters and in the eyes (19).

♀ CH3/He mice were administered *N*-butyl-*N*-(4-hydroxybutyl)nitrosamine in drinking water for 8 wk. After this they were given wkly intravesicular instillations of 0.1 ml methyl sulfoxide for 10 wk. After 30 wk the animals were killed and their urinary bladders were examined, 98.7% of the treated animals developed bladder carcinomas compared to 27.7% of controls (20).

In a similar study ♀ mice administered for 7 wk 0.05 ml intravesically after an initial 5 wk exposure to *N*-butyl-*N*-(4-hydroxybutyl)nitrosamine in drinking water, 25% developed bladder carcinomas compared to 0% in the controls (20).

Teratogenicity and reproductive effects

Intraperitoneal rat 10 g kg⁻¹ day⁻¹ on days 6-12 of gestation caused developmental effects to the central nervous system and musculo-skeletal system including anencephalia, malformed limbs and celosomia (18).

Intraperitoneal mouse, lowest toxic dose 8500 mg kg⁻¹ on day-10 of gestation caused foetal death (21).

Intraperitoneal mouse, lowest toxic dose 5500 mg kg⁻¹ on day-10 of gestation caused developmental effects to the musculo-skeletal system (21).

Metabolism and toxicokinetics

Readily absorbed following administration by all routes. Metabolised by oxidation to dimethyl sulfone, and by reduction to dimethyl sulfide. Dimethyl sulfoxide and the sulfone metabolite are excreted in the urine and faeces. Dimethyl sulfide is excreted via the lungs and skin and is responsible for the characteristic garlic-like odour from patients (22).

Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation, 500 mg instilled into rabbit eye for 24 hr caused mild irritation (23).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537, TA1538 with and without metabolic activation negative (24).

Escherichia coli WP2₅(λ), Microscreen assay with and without metabolic activation positive (25).

Saccharomyces cerevisiae induction of mitotic chromosome loss, ambiguous results reported (26).

Drosophila melanogaster sex-linked recessive lethal assay negative (27).

Other effects

Other adverse effects (human)

Systemic effects, which may occur after administration by any route, include gastro-intestinal disturbances, drowsiness, headache and hypersensitivity reactions (22).

Intravenous infusion induced transient haemolysis and haemoglobinuria. Infusion strengths >10% were associated with grossly discoloured urine but there was no evidence of kidney damage (28).

Two patients developed raised circulating levels of liver and muscle enzymes, mild jaundice, and evidence of haemolysis after intravenous administration for the treatment of arthritis. One patient also developed acute renal tubular necrosis, deterioration in the level of consciousness, and evidence of cerebral infarction (29).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (30).

Other comments

Isomers and homologues of diphenylmethane isocyanate dissolved in dimethyl sulfoxide with metabolic activation were mutagenic in the *Salmonella*/microsome test due to the formation of small amounts of diaminodiphenylmethane via the hydrolysis of diisocyanates by traces of water that are always present in DMSO. The authors warn that DMSO is an inappropriate solvent and should not be used with any *in vitro* study with diisocyanates and that the positive test results reported so far for DMSO solution of MDI are of limited relevance for risk evaluation (31).

Has been detected in natural and drinking waters (32,33).

Physical properties, use, toxicity and safety precautions reviewed (34-36).

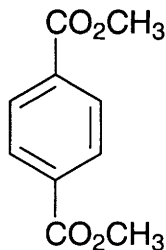
In ♀ mice retarded the development of epidermal carcinomas which were chemically induced with 9,10-dimethyl-1,2-benzanthracene and triamcinolone (37).

Autoignition temperature 215°C.

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37. Siegel, W. V. et al *Oral Surg., Oral Med., Oral Pathol.* 1969, **27**(6), 772-779

D459 dimethyl terephthalate



$C_{10}H_{10}O_4$

Mol. Wt. 194.19

CAS Registry No. 120-61-6

Synonyms dimethyl 1,4-benzenedicarboxylate; dimethyl *p*-terephthalate; methyl carbomethoxybenzoate

EINECS No. 204-411-8

RTECS No. WZ 1225000

Uses Manufacture of copolymers.

Physical properties

M. Pt. 140-142°C **B. Pt.** > 300°C (sublimes) **Flash point** 147°C **Specific gravity** 1.2 at 20°C

Partition coefficient $\log P_{ow}$ 1.35 (1) **Volatility** v.p. 16 mmHg at 100°C ; v.den. 6.7

Solubility Water: 3.3 g l⁻¹ in hot water. Organic solvents: diethyl ether, dimethyl sulfoxide, ethanol

Ecotoxicity

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* Microtox test (2).

Environmental fate

Degradation studies

86% COD removal in 48 hr from a wastewater with a COD of 80 g l⁻¹ O₂ was achieved on a laboratory scale using mixed cultures of *Pseudomonas*, *Aeromonas*, *Arthrobacter* and *Bacillus* species (3).

Complete degradation was obtained in 10 days after inoculation of contaminated soil with *Rhodococcus erythropolis* (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 4390 mg kg⁻¹ (5).

LD₅₀ intraperitoneal rat 3900 mg kg⁻¹ (6).

Carcinogenicity and chronic effects

National Toxicology Program tested in rats and mice via feed. Negative results were reported in rats and mice (7).

Irritancy

500 mg instilled into rabbit eye for 24 hr caused moderate irritation (5).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA102, TA1535, TA1537, TA1538 with and without metabolic activation negative (8).

Drosophila melanogaster sex-linked dominant lethal assay positive (9,10).

In vitro Chinese hamster ovary cells, chromosomal aberrations and sister chromatid exchanges negative (11).

In vitro mouse lymphoma L5178Y tk⁺/tk⁻ mutation assay negative (11).

In vivo mouse bone marrow micronucleus assay positive (9,10).

Other effects

Any other adverse effects

Inhalation pig, concentrations of 100-1000 × maximum permissible concentration (unspecified) induced inflammation of the lungs, a disorder of protein metabolism and decreased growth rate. Leucocyte count increased, apparently due to an immune response to antigens from the damaged organs. Oral administration produced similar effects (12).

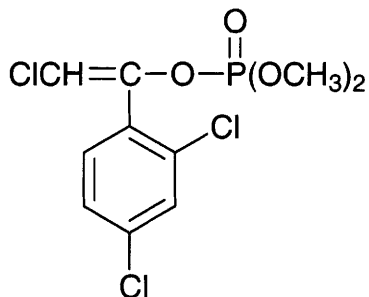
Legislation

Maximum permissible concentrations in domestic water in former USSR 1.5 mg l⁻¹ (13).

References

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5. Marhold, J. V. *Sbornik Vysledku Toxikologickeho Vysetreni Latek A Pripravku* 1972, 47, Prague, Czechoslovakia.
6. *Am. Ind. Hyg. Assoc. J.* 1973, **34**, 455.
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12. Zhuk, L. L. et al *Vesti Akad. Nauk BSSR, Ser. Sel'skogaspad. Nauk* 1986, (4), 107-112 (Beloruss.) (*Chem. Abstr.* **106**, 190512w).
13. *Russian Toxicological Data For Chemicals in Sources of Drinking Water* 1978, Tech. Note No. 20, Central Water Planning Unit, Reading, UK

D460 dimethylvinphos



C₁₀H₁₀Cl₃O₄P

Mol. Wt. 331.52

CAS Registry No. 2274-67-1

Synonyms 2-chloro-1-(2,4-dichlorophenyl)ethenyl dimethyl phosphate;
2-chloro-1-(2,4-dichlorophenyl)vinyl dimethyl phosphate; dimethyl 1-(2,4-dichlorophenyl)-2-chlorovinyl phosphate; IPO 10; OMS 712; Rangado

RTECS No. TB 8805000

Uses Insecticide. Miticide.

Physical properties

M. Pt. 69-70°C **B. Pt.** 128°C at 0.05 mmHg **Specific gravity** 1.26 at 25°C **Partition coefficient** Log P_{ow} 3.12 at 25°C

Solubility Water: 130 ppm at 20°C. Organic solvents: acetone, cyclohexanone, xylene

Ecotoxicity

Fish toxicity

LC₅₀ (24 hr) carp 2.3 ppm (1).

Invertebrate toxicity

LC₅₀ (24 hr) *Daphnia* 0.002 ppm (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 155-210, 200-220 mg kg⁻¹, respectively (1).

LD₅₀ dermal rat 1360-2300 mg kg⁻¹ (1).

LC₅₀ (4 hr) ♂, ♀ rat 970-1186, >4900 mg m⁻³, respectively (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (2).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (3).

Other comments

Comprises >95.0% (Z)-isomer and <2.0% (E)-isomer.

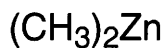
Toxicity tested at pH5-10 on *Bufo bufo japonicus* (4).

Compound is an inhibitor of cholinesterases and thus affects the central and peripheral nervous systems.

References

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4. Nishiuchi, Y. et al *Seitai Kagaku* 1988, 9(3), 19-26 (Japan.) (*Chem. Abstr.* 111, 2387r)

D461 dimethylzinc



C₂H₆Zn

Mol. Wt. 95.46

CAS Registry No. 544-97-8

EINECS No. 208-884-1

Uses Intermediate in chemical synthesis and in production of semiconductors.

Physical properties

M. Pt. -40°C **B. Pt.** 44-46°C **Specific gravity** 1.33-1.38 at 20°C **Volatility** v.p. 123-125 mmHg at 0°C

Solubility Organic solvents: diethyl ether, miscible with hydrocarbons

Occupational exposure

UN No. 1370 HAZCHEM Code 4WE Conveyance classification spontaneously combustible substance

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Zinc: guide level 100 µg l⁻¹ at outlets or 5000 µg l⁻¹ after water has been standing in pipes for 12 hr (1).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (2).

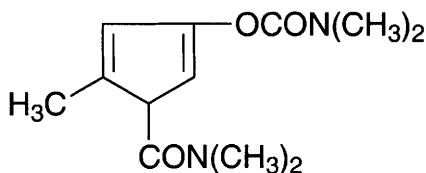
Other comments

Ignites in air.

References

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2. S. I. 1991 No. 472 The Environmental Protection (Prescribed Processes and Substances) Regulations 1991, HMSO, London, UK

D462 dimetilan



C₁₀H₁₆N₄O₃

Mol. Wt. 240.26

CAS Registry No. 644-64-4

Synonyms 1-(dimethylcarbamoyl)-5-methylpyrazol-3-yl dimethylcarbamate; dimethylcarbamic acid 1-[(dimethylamino)carbonyl]-5-methyl-1H-pyrazol-3-yl ester; 2-dimethylcarbamyl-3-methyl-5-pyrazolyl dimethylcarbamate

EINECS No. 211-420-0

RTECS No. EZ 9084000

Uses Superseded insecticide.

Physical properties

M. Pt. 68-71°C (colourless form) 55-65°C (coloured form) **B. Pt.** 200-210°C at 13 mmHg

Solubility Organic solvents: acetone, chloroform, dimethylformamide, ethanol, xylene

Occupational exposure

Supply classification toxic

Risk phrases Harmful in contact with skin – Toxic if swallowed (R21, R25)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S36/37, S45)

Mammalian & avian toxicity

Acute data

LD₅₀ oral starling 250 mg kg⁻¹ (1).

LD₅₀ oral mouse, rat, guinea-pig 12, 25, 63 mg kg⁻¹, respectively (2-4).

LD₅₀ dermal rat, rabbit 600, 2000 mg kg⁻¹, respectively (2,5).

LD₅₀ intraperitoneal mouse 12 mg kg⁻¹ (6).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (7).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (8).

Other comments

Persistence in soil reviewed (9).

Metabolism reviewed (10).

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9. Aly, O. M. et al *Water Res.* 1971, **5**, 1191.
10. Malvisi, R. et al *Acta Toxicol. Ther.* 1990, **11** (3), 277-287 (Ital.) (*Chem. Abstr.* **115**, 43882z)

D463 dimexano



C₄H₆O₂S₄

Mol. Wt. 214.35

CAS Registry No. 1468-37-7

Synonyms bis(methoxythiocarbonyl)disulfide; bis(methylxanthogen)disulfide; O,O-dimethyl dithiobis(thioformate); dimethyl dixanthogen; dimethyl thioperoxydicarbonate; dimethyl xanthic disulfide; TRI-PE

EINECS No. 215-993-8

RTECS No. LQ 8050000

Uses Reagent for oxidation of thiols to disulfides. Herbicide. Insecticide.

Physical properties

M. Pt. 22.5-23°C **B. Pt.** 122°C (decomp.) **Specific gravity** 1.3886 at 20°C with respect to water at 4°C

Solubility Water: 25 mg l⁻¹

Occupational exposure

Supply classification harmful

Risk phrases Harmful if swallowed (R22)

Safety phrases Keep out of reach of children (if sold to general public) (S2)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 240 mg kg⁻¹ (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides and related products: maximum admissible concentration 0.1 µg l⁻¹ (2).

Included in Schedule 6 (Release into Land: Prescribed Substances) of Statutory Instrument No. 472, 1991 (3).

Other comments

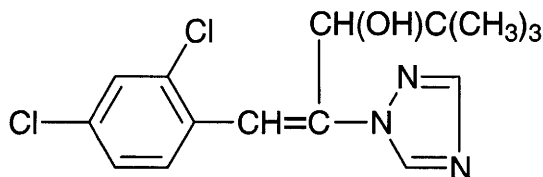
Best stored at -20°C (4).

Its use as a herbicide and insecticide has been superseded (5).

References

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5. Feekes, F. H. *Mededel. Landbouwhogesthool Opzoekingssta Staat Gent* 1962, 27(3), 1289-1307, (Ger.) (*Chem. Abstr.*, 63, 13957d)

D464 diniconazole



C₁₅H₁₇Cl₂N₃O

Mol. Wt. 326.22

CAS Registry No. 76714-88-0

Synonyms 1*H*-1,2,4-triazole-1-ethanol, β-[(2,4-dichlorophenyl)methylene]-α-(1,1-dimethylethyl)-, (*E*)-;

(*E*)-(*RS*)-1-(2,4-dichlorophenyl)-4,4-dimethyl-2-(1*H*-1,2,4-triazol-1-yl)pent-1-en-3-ol;

(*E*)-(+)-β-[(2,4-dichlorophenyl)methylene]-α-(1,1-dimethylethyl)-1*H*-1,2,4-triazole-1-ethanol; Mixor; Ortho Spotless; Sumi 8

RTECS No. XZ 4803500

Uses Control of leaf and ear diseases in cereals; powdery mildew in vines; powdery mildew, rust and black spot in roses; leaf spot in groundnuts. Also used on fruit, vegetables and other ornamentals.

Physical properties

M. Pt. 134-156°C **Specific gravity** 1.32 at 20°C with respect to water at 20°C **Partition coefficient** Log P_{ow}

4.30 at 25°C **Volatility** v.p. 2.2 × 10⁻⁵ mmHg at 20°C

Solubility Water: 4 mg l⁻¹ at 25°C. Organic solvents: acetone, methanol, xylene

Occupational exposure

Supply classification harmful, dangerous for the environment

Risk phrases Harmful if swallowed – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R22, R50/53)

Safety phrases Keep out of reach of children (if sold to the general public) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special to special instructions/safety data (S2, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout, carp, Japanese killifish 1.6, 4.0, 6.8 mg l⁻¹, respectively (1).

Invertebrate toxicity

LD₅₀ contact >20 µg bee⁻¹ (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral bobwhite quail 1490 mg kg⁻¹ (1).

LD₅₀ oral ♀, ♂ rat 474, 639 mg kg⁻¹, respectively (1).

LD₅₀ dermal rat >5000 mg kg⁻¹ (1).

Sub-acute and sub-chronic data

LC₅₀ (8 day) oral mallard duck 5075 mg kg⁻¹ in diet (1).

Metabolism and toxicokinetics

Rapidly metabolised by hydroxylation of the *tert*-butyl methyl groups following oral administration in rats. 52-87% is excreted in faeces and 13-46% in urine within 7 days (1).

Irritancy

100 mg instilled into rabbit eye caused mild irritation (duration of exposure unspecified) (3).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (4).

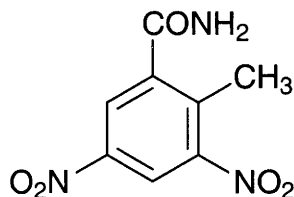
WHO Toxicity Class III (5).

EPA Toxicity Class III (formulation) (2).

References

1. *The Agrochemicals Handbook* 3rd ed., 1991, The Royal Society of Chemistry, London, UK.
2. *The Pesticide Manual* 11th ed., 1997, The British Crop Protection Council, Farnham, UK.
3. *United States Environmental Protection Agency, Office of Pesticides and Toxic Substances* 8EHQ-0485-0548, Washington, DC, USA.
4. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
5. *The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification* 1998-1999 WHO/PCS/98.21

D465 dinitolmide



$C_8H_7N_3O_5$

Mol. Wt. 225.16

CAS Registry No. 148-01-6

Synonyms 2-methyl-3,5-dinitrobenzamide; 3,5-dinitro-2-toluamide; 3,5-dinitro-2-methylbenzamide; Coccidine; Coccidot; Zoaline

EINECS No. 205-706-4

RTECS No. XS 4200000

Uses Coccidiostat in veterinary practice.

Physical properties

M. Pt. 181°C

Solubility Organic solvents: acetone, acetonitrile, dimethylformamide

Occupational exposure

FR-VME 5 mg m⁻³

US-TWA 5 mg m⁻³

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 600 mg kg⁻¹ (1).

LD₅₀ intravenous dog 75 mg kg⁻¹ (2).

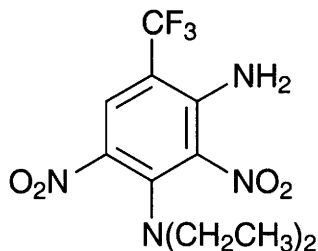
Other comments

Reviews on experimental toxicology, human health effects and workplace experience listed (3).

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1. Sunshine, I. (Ed.) *Handbook of Analytical Toxicology* 1969, 537, Chemical Rubber Company, Cleveland, OH, USA.
2. *Pesticide Chemicals Official Compendium* 1966, 1252, Association of the American Pesticide Control Officials Inc.
3. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuyse (Bte 6), B-1160 Brussels, Belgium

D466 dinitramine



C₁₁H₁₃F₃N₄O₄

Mol. Wt. 322.24

CAS Registry No. 29091-05-2

Synonyms *N*³,*N*³-diethyl-2,4-dinitro-6-(trifluoromethyl)-1,3-benzenediamine; *N*⁴,*N*⁴-diethyl- α,α,α -trifluoro-3,5-dinitrotoluene-2,4-diamine; Cobex; USB3584

EINECS No. 249-419-2

RTECS No. XS 9990000

Uses Herbicide incorporated in the soil against many annual grasses and broad-leaved weeds in beans, carrots, cotton, groundnuts, soyabeans, sunflowers, swedes, turnips, transplanted brassicas, peppers and tomatoes.

Physical properties

M. Pt. 98-99°C **Partition coefficient** Log *P*_{ow} 4.3 **Volatility** v.p. 3.5×10^{-6} mmHg at 25°C

Solubility Water: 1.1 mg l⁻¹ at 25 °C. Organic solvents: acetone, ethanol

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) catfish, rainbow trout, bluegill sunfish 3.7, 6.6, 11.0 mg l⁻¹, respectively (1).

Environmental fate

Degradation studies

Metabolised by soil microorganisms (1).

Adsorption and retention

90-120 days after application, <10% remains in most soils (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral bobwhite quail >1200 mg kg⁻¹ (1).

LD₅₀ oral mallard duck >10,000 mg kg⁻¹ (1).

LD₅₀ oral rat 3000 mg kg⁻¹ (1).

LC₅₀ inhalation rat (4 hr) >0.16 mg l⁻¹ air (1).

LD₅₀ dermal rabbit >6,800 mg kg⁻¹ (1).

LD₅₀ dermal rabbit 2000 mg kg⁻¹ (2).

Sub-acute and sub-chronic data

In 90-day feeding trials, rats and dogs receiving 2000 mg kg⁻¹ diet showed no adverse effects (1).

Carcinogenicity and chronic effects

In 2-yr carcinogenicity studies, rats receiving 300 mg kg⁻¹ diet showed no carcinogenic response (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides and related products: maximum admissible concentration $0.1\mu\text{g l}^{-1}$ (3).
WHO Toxicity Class Table 5 (4).

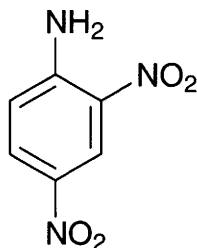
Other comments

Metabolic pathways reviewed (5).

References

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D467 2,4-dinitroaniline



$\text{C}_6\text{H}_5\text{N}_3\text{O}_4$

Mol. Wt. 183.12

CAS Registry No. 97-02-9

Synonyms 2,4-dinitrobenzenamine

EINECS No. 202-553-5

RTECS No. BX 9100000

Uses Preparation of azo dyestuffs.

Physical properties

M. Pt. 188°C Flash point 224°C (closed cup) Specific gravity 1.615 at 14°C Volatility v.den. 6.31

Occupational exposure

UN No. 1596 HAZCHEM Code 2W Conveyance classification toxic substance

Supply classification toxic

Supply classification dangerous for the environment

Risk phrases Very toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects – Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R26/27/28, R33, R51/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident

or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S28, S36/37, S45, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 14.2 mg l⁻¹ (1).

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 48.2 ppm Microtox test (2).

EC₅₀ (24, 48 hr) *Daphnia magna* 12.0, 9.6 mg l⁻¹ (3).

Environmental fate

Degradation studies

Insufficient data are available to assess the relative importance of biodegradation in water, although one study found evidence of no microbial degradation (4).

In 3-day culture tests using 100 mg l⁻¹ initial concentration, no biodegradation observed in river and seawater (4).

Abiotic removal

Degraded relatively rapidly in the vapour phase in an ambient atmosphere by reaction with photochemically produced hydroxyl radicals, (calc.) t_{1/2} 17.7 hr (5).

Adsorption and retention

When released to soil, 2,4-dinitroaniline may undergo covalent chemical bonding with humic materials. Leaching is not expected to occur (6).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 370 mg kg⁻¹ (7).

LD₅₀ oral guinea pig 1050 mg kg⁻¹ (8).

LD_{Lo} intraperitoneal mouse 400 mg kg⁻¹ (9).

Metabolism and toxicokinetics

Oral rat 0-16 mg kg⁻¹ or intravenous rat 0-1.8 mg kg⁻¹ with ¹⁴C-labelled compound. Nine metabolites were detected in rats killed between 15 minutes and 3 days after dosing. 2,4-Dinitrophenylhydroxylamine was the main metabolite. The study concluded that there is little potential for bioaccumulation in animal tissues. Amine hydroxylation and sulfation are the probable detoxification processes that occur rapidly and facilitate clearance (10).

Irritancy

Eye rabbit (24 hr) 500 mg caused mild irritation (11).

Genotoxicity

Salmonella typhimurium TA100, TA98 with and without metabolic activation positive (12).

Escherichia coli ATCC11775 without metabolic activation positive (13,14).

Drosophila melanogaster wing spot test negative (15).

Other comments

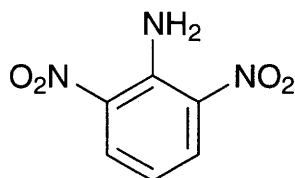
Reviews on physico-chemical properties, human health effects and experimental toxicology listed (16).

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D468 2,6-dinitroaniline



$C_6H_5N_3O_4$

Mol. Wt. 183.12

CAS Registry No. 606-22-4

Synonyms 2,6-dinitrobenzenamine

EINECS No. 210-108-1

RTECS No. BX 9200000

Uses Herbicide and preparation of azo dyes.

Physical properties

M. Pt. 139-140°C

Solubility Organic solvents: diethyl ether, hot benzene

Occupational exposure

UN No. 1596 HAZCHEM Code 2W Conveyance classification toxic substance

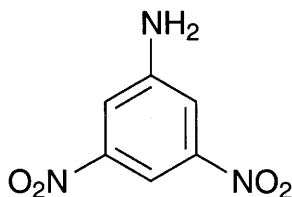
Genotoxicity

Salmonella typhimurium TA100, TA98 with and without metabolic activation positive (1).

References

1. Kawai, A. et al *Jpn. J. Ind. Health* 1987, **29**, 34-54

D469 3,5-dinitroaniline



$C_6H_5N_3O_4$

Mol. Wt. 183.12

CAS Registry No. 618-87-1

Synonyms 3,5-dinitrobenzenamine

EINECS No. 210-567-8

RTECS No. BX 9200100

Uses Preparation of azo dyestuffs.

Physical properties

M. Pt. 160-162°C Specific gravity 1.601 at 50°C

Solubility Organic solvents: diethyl ether, ethanol

Occupational exposure

UN No. 1596 HAZCHEM Code 2W Conveyance classification toxic substance

Ecotoxicity

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 19.2 ppm Microtox test (1).

Genotoxicity

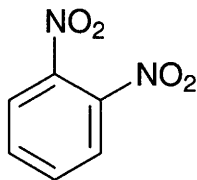
Salmonella typhimurium TA100, TA98 without metabolic activation positive (2,3).

Salmonella typhimurium TA1537, TA1538, TA98, TA100 without metabolic activation positive; *Salmonella typhimurium* TA100 NR3 with and without metabolic activation negative (3).

References

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D470 1,2-dinitrobenzene



$C_6H_4N_2O_4$

Mol. Wt. 168.11

CAS Registry No. 528-29-0

Synonyms *o*-dinitrobenzene

EINECS No. 208-431-8

RTECS No. CZ 7450000

Uses Analytical reagent. Manufacture of dyestuffs.

Physical properties

M. Pt. 117-119°C **B. Pt.** 318°C **Flash point** 150°C (closed cup) **Specific gravity** 1.565 at 17°C with respect to water at 4°C **Partition coefficient** $\log P_{ow}$ 1.58 (1) **Volatility** v.p. <1 mmHg at 20°C ; v.den. 5.79
Solubility Water: 150 mg l⁻¹ at 20°C. Organic solvents: benzene, chloroform, ethyl acetate

Occupational exposure

JP-OEL 0.15 ppm (1 mg m⁻³)

SE-LEVL 0.15 ppm (1 mg m⁻³)

SE-STEL 0.3 ppm (2 mg m⁻³)

UK-LTEL 0.15 ppm (1.0 mg m⁻³)

UK-STEL 0.5 ppm (3.5 mg m⁻³)

US-TWA 0.15 ppm (1.0 mg m⁻³)

UN No. 1597 HAZCHEM Code 2W Conveyance classification toxic substance

Supply classification very toxic, dangerous for the environment

Risk phrases Very toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R26/27/28, R33, R50/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S28, S36/37, S45, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (14 day) guppy 1.1 mg l⁻¹ (2).

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 5.32 ppm Microtox test (3).

EC₅₀ (48 hr) *Daphnia magna* 2.9 mg l⁻¹ (4).

Bioaccumulation

Calculated bioconcentration factor 0.97 (5).

Environmental fate

Degradation studies

Degradation by soil microflora >64 day (6).

Incubation with sewage sludge at 29°C resulted in 100% degradation after 14 days under anaerobic conditions, and 25% degradation after 28 days under aerobic conditions (7).

Abiotic removal

Estimated $t_{1/2}$ for reaction with photochemically produced hydroxyl radicals in the atmosphere 14-15 hr (8).

Adsorption and retention

Calculated K_{oc} 1.47 indicates that 1,2-dinitrobenzene will not adsorb strongly to soil (9).

Mammalian & avian toxicity

Acute data

Oral rat, single dose of 50 mg kg⁻¹ caused no adverse effects on the testes or spleen and did not produce cyanosis (10).

Intravenous rat, single injection 0.08 mg kg⁻¹ induced methaemoglobin concentration of 49%, and increased urinary catecholamine excretion and blood sugar concentration (11).

Metabolism and toxicokinetics

Following oral administration of ¹⁴C-labelled compound to rats, 85% of the dose was excreted primarily in the urine, within 24 hr. 8% was excreted in the faeces. The major urinary metabolites were *S*-(2-nitrophenyl)-*N*-acetyl-cysteine (42%), 2-nitroaniline-*N*-glucuronide (4%), 4-amino-3-nitrophenyl sulfate (17%), 2-amino-3-nitrophenyl sulfate (1.5%), and 2-(*N*-hydroxylamino)nitrobenzene (1.5%) (12).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537, TA1538 with and without metabolic activation negative (13).

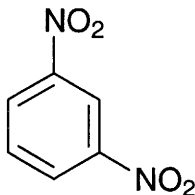
Other comments

Reviews on toxicity listed (14).

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2. Deneer, J. W. et al *Aquat. Toxicol.* 1987, **10**(2-3), 115-129.
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4. Deneer, J. W. et al *Aquat. Toxicol.* 1989, **15**(1), 83-98.
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9. Kenaga, E. E. *Ecotoxicol. Environ. Saf.* 1980, **4**, 26-38.
10. Blackburn, D. M. et al *Toxicol. Appl. Pharmacol.* 1988, **92**(1), 54-64.
11. Pankow, D. et al *Toxicology* 1978, **11**(4), 377-384.
12. Nystrom, D. D. et al *Drug Metab. Dispos.* 1987, **15**(6), 821-825.
13. Spanggord, R. J. et al *Environ. Mutagen.* 1982, **4**(2), 163-179.
14. ECETOC Technical Report No. 71 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuyse (Bte 6), B-1160 Brussels, Belgium

D471 1,3-dinitrobenzene



$C_6H_4N_2O_4$

Mol. Wt. 168.11

CAS Registry No. 99-65-0

Synonyms *m*-dinitrobenzene; 1,3-dinitrobenzol

EINECS No. 202-776-8

RTECS No. CZ 7350000

Uses Analytical reagent. Catalyst. Corrosion inhibitor.

Physical properties

M. Pt. 88-90°C B. Pt. 297°C Specific gravity 1.575 at 18°C with respect to water at 4°C

Partition coefficient $\log P_{ow}$ 1.49 (1) Volatility v.p. 9×10^{-4} mmHg

Solubility Water: 500 mg l⁻¹ at 20°C. Organic solvents: benzene, chloroform, ethanol, ethyl acetate

Occupational exposure

JP-OEL 0.15 ppm (1 mg m⁻³)

SE-LEVL 0.15 ppm (1 mg m⁻³)

SE-STEEL 0.3 ppm (2 mg m⁻³)

UK-LTEL 0.15 ppm (1.0 mg m⁻³)

UK-STEEL 0.5 ppm (3.5 mg m⁻³)

US-TWA 0.15 ppm (1.0 mg m⁻³)

UN No. 1597 HAZCHEM Code 2W Conveyance classification toxic substance

Supply classification very toxic, dangerous for the environment

Risk phrases Very toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R26/27/28, R33, R50/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S28, S36/37, S45, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) silver carp 9.9 mg l⁻¹ (2).

LC₅₀ (14 day) guppy 3.5 mg l⁻¹ (3).

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 26.6 ppm Microtox test (4).

EC₅₀ (48 hr) *Daphnia magna* 72 mg l⁻¹ (5).

Bioaccumulation

Bioconcentration factor in trout muscle 8.5 (6).

Environmental fate

Degradation studies

Degradation by soil microflora >64 days (7).

No degradation reported after 20 days, as determined by COD removal, in adapted activated sludge process at 20°C when present as sole carbon source (8).

Incubation with sewage sludge at 29°C resulted in 85% degradation under anaerobic conditions and 40% under aerobic conditions after 28 days (9).

Abiotic removal

Estimated $t_{1/2}$ for reaction with photochemically produced hydroxyl radicals in the atmosphere 14-15 hr (10).

Adsorption and retention

Calculated K_{oc} 1.39 indicates that 1,3-dinitrobenzene will not adsorb strongly to soils (11).

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird, 42 mg kg⁻¹ (12).

LD₅₀ oral rat 83 mg kg⁻¹ (13).

LD₅₀ intravenous dog 10 mg kg⁻¹ (13).

LD₅₀ intraperitoneal rat 28 mg kg⁻¹ (14).

Oral rat, single dose of 50 mg kg⁻¹ caused a reduction in testis weight, testicular lesions, Sertoli cell damage, cyanosis and splenic enlargement (15).

Oral rat (3 day) 10 mg kg⁻¹ 2 × day⁻¹ caused ataxia and methaemoglobinaemia. Acute thiamine deficiency-like lesions of the brain stems were observed; the primary cellular targets were astrocytes, oligodendrocytes and vascular elements with secondary neuronal involvement. The study found that 1,3-dinitrobenzene interfered with intracellular redox mechanisms resulting in impaired glucose oxidation (16).

Intravenous rat, single injection of 23 µg kg⁻¹ induced a methaemoglobin concentration of 60%, and increased urinary catecholamine excretion and blood sugar concentration (17).

Teratogenicity and reproductive effects

Seminiferous tubules isolated from Sprague-Dawley rats (30, 75, and 120 days old) were incubated with 100 µM for 22 hr. No differences in the formation of metabolites and tubular levels of ATP and glutathione (GSH) were found over time for the three ages. Age-related differences in testicular toxicity observed *in vivo* may be due to the shorter half-life in young animals with consequent reduced exposure of the testis (18).

Metabolism and toxicokinetics

Following oral administration of ¹⁴C-labelled compound to rats, 60% of the dose was excreted primarily in the urine, within 24 hr. 18% was excreted in the faeces. The major metabolites were 3-aminoacetanilide (22%), 4-acetamidophenyl sulfate (6%), 1,3-diacetamidobenzene (7%) and 3-nitroaniline N-glucuronide. Metabolism occurred primarily by reduction of the nitro-group and conjugation with glutathione (19).

An age-related difference in half-life has been reported (18).

Genotoxicity

Salmonella typhimurium TA100 without metabolic activation positive (20).

Other comments

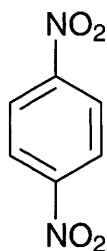
Reviews on toxicity listed (21).

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3. Deneer, J. W. et al *Aquat. Toxicol.* 1987, 10(2-3), 115-129.
4. Kaiser, K. L. E. et al *Water Pollut. Res. J. Can.* 1991, 26(3), 361-431.
5. Deneer, J. W. et al *Aquat. Toxicol.* 1989, 15(1), 83-98.
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9. Hallas, L. E. et al *Appl. Environ. Microbiol.* 1983, **45**, 1234-1241.
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D472 1,4-dinitrobenzene



$C_6H_4N_2O_4$

Mol. Wt. 168.11

CAS Registry No. 100-25-4

Synonyms *p*-dinitrobenzene

EINECS No. 202-833-7

RTECS No. CZ 7525000

Uses Corrosion inhibitor. Cross-linking agent. Chemical intermediate.

Physical properties

M. Pt. 172-174°C B. Pt. 299°C Specific gravity 1.625 at 20°C with respect to water at 4°C

Partition coefficient $\log P_{ow}$ 1.46 (1) Volatility v.p. <1 mmHg at 20°C ; v.den. 5.8

Solubility Water: 0.8 g l⁻¹ at 20°C. Organic solvents: acetone, benzene, chloroform, ethanol, ethyl acetate, toluene

Occupational exposure

JP-OEL 0.15 ppm (1 mg m⁻³)

SE-LEVL 0.15 ppm (1 mg m⁻³)

SE-STEL 0.3 ppm (2 mg m⁻³)

UK-LTEL 0.15 ppm (1.0 mg m⁻³)

UK-STEL 0.5 ppm (3.5 mg m⁻³)

US-TWA 0.15 ppm (1.0 mg m⁻³)

UN No. 1597 HAZCHEM Code 2W Conveyance classification toxic substance

Supply classification very toxic, dangerous for the environment

Risk phrases Very toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R26/27/28, R33, R50/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S28, S36/37, S45, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 0.6 mg l⁻¹ flow-through (2).

LC₅₀ (14 day) guppy 0.36 mg l⁻¹ (3).

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 0.095 ppm Microtox test (4).

EC₅₀ (48 hr) *Daphnia magna* 1.2 mg l⁻¹ (5).

Bioaccumulation

Bioconcentration factor in trout muscle 0.91 (6).

Environmental fate

Degradation studies

Degradation by soil microflora >64 day (7).

No degradation reported after 20 days, as determined by COD removal, in adapted activated sludge process at 20°C, when present as sole carbon source (8).

Abiotic removal

Estimated t_{1/2} for reaction with photochemically produced hydroxyl radicals in the atmosphere 14-15 hr (9).

Adsorption and retention

Estimated K_{oc} 1.46 indicates that 1,4-dinitrobenzene will not adsorb strongly to soils (10).

Mammalian & avian toxicity

Acute data

LD_{Lo} oral cat 29 mg kg⁻¹ (11).

Oral rat, single dose of 50 mg kg⁻¹ caused no adverse effects on the testes but induced cyanosis and splenic enlargement (12).

Intravenous rat, single injection of 23 µg kg⁻¹ induced a methaemoglobin concentration of 86%, and increased urinary catecholamine excretion and blood sugar concentration (13).

Metabolism and toxicokinetics

Following oral administration of ¹⁴C-labelled substance to rats, 75% of the dose was excreted, primarily in the urine, within 24 hr. 9% was excreted in the faeces. The major urinary metabolites were 2-amino-5-nitrophenyl sulfate (35%), S-(4-nitrophenyl)-N-acetylcysteine (13%) and 1,4-diacetamidobenzene (7%). Metabolism occurred primarily by reduction of the nitro-group and conjugation with glutathione (14).

Genotoxicity

Salmonella typhimurium TA98, TA1538 with metabolic activation (bacterial nitroreductase) positive (15).

Other comments

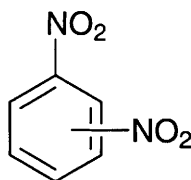
Reviews on toxicity listed (16).

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2. Holcombe, G. M. et al *Environ. Pollut.* 1984, 35(Series A), 367-381.

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D473 dinitrobenzene (mixed)



$C_6H_4N_2O_4$

Mol. Wt. 168.11

CAS Registry No. 25154-54-5

Synonyms dinitrobenzol

EINECS No. 246-673-6

RTECS No. CZ 7340000

Uses Catalyst. Analytical reagent.

Physical properties

M. Pt. 88-174°C Volatility v.p. <1 mmHg at 20°C ; v.den. 5.8

Solubility Water: miscible. Organic solvents: benzene, chloroform, ethyl acetate

Occupational exposure

FR-VME 0.15 ppm (1 mg m⁻³)

SE-LEVL 0.15 ppm (1 mg m⁻³)

UK-LTEL 0.15 ppm (1.0 mg m⁻³)

US-TWA 0.15 ppm (1.0 mg m⁻³)

SE-STEL 0.3 ppm (2 mg m⁻³)

UK-STEL 0.5 ppm (3.5 mg m⁻³)

UN No. 1597 HAZCHEM Code 2W Conveyance classification toxic substance

Supply classification very toxic, dangerous for the environment

Risk phrases Very toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R26/27/28, R33, R50/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident

or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S28, S36/37, S45, S60, S61)

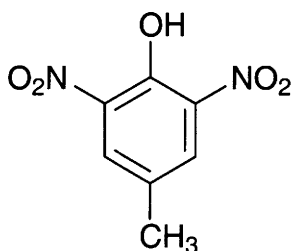
Other comments

Testicular toxicology of dinitrobenzene reviewed (1).
Reviews on toxicity listed (2).

References

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2. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuyse (Bte 6), B-1160 Brussels, Belgium

D474 2,6-dinitro-*p*-cresol



$C_7H_6N_2O_5$

Mol. Wt. 198.14

CAS Registry No. 609-93-8

Synonyms 2,6-dinitro-4-methylphenol; 4-methyl-2,6-dinitrophenol; 3,5-dinitro-4-hydroxytoluene; DNPC

EINECS No. 210-203-8

RTECS No. GO 9800000

Uses Polymerisation inhibitor. Manufacture of dyestuffs and pharmaceuticals.

Physical properties

M. Pt. 77-79°C (anhydrous) **Partition coefficient** $\log P_{ow}$ 2.47 (1)

Solubility Water: miscible. Organic solvents: benzene, diethyl ether, ethanol

Ecotoxicity

Invertebrate toxicity

EC₅₀ (48 hr) *Tetrahymena pyriformis* 3.4 mg l⁻¹ (1).

EC₅₀ (30 min) *Photobacterium phosphoreum* 9.06 ppm Microtox test (2).

Mammalian & avian toxicity

Acute data

LD₅₀ intraperitoneal mouse 25 mg kg⁻¹ (3).

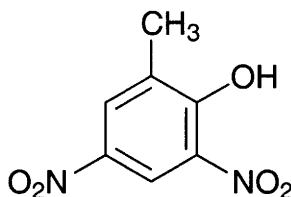
Genotoxicity

Salmonella typhimurium TA100 without metabolic activation negative (4).

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D475 4,6-dinitro-o-cresol



$C_7H_6N_2O_5$

Mol. Wt. 198.14

CAS Registry No. 534-52-1

Synonyms 2-methyl-4,6-dinitrophenol; dinitrocresol; 3,5-dinitro-2-hydroxytoluene; DNOC; Dinitrol; DNC; ENT 154

EINECS No. 208-601-1

RTECS No. GO 9625000

Uses Selective herbicide. Insecticide.

Physical properties

M. Pt. 88.2-89.9°C B. Pt. 312°C Specific gravity 1.58 at 20°C Partition coefficient $\log P_{ow}$ 0.08

Volatility v.p. 0.0001 mmHg at 25°C; v.den. 6.82

Solubility Water: 6.94 g l⁻¹ at pH 7 and 20°C. Organic solvents: acetone, chloroform, ether

Occupational exposure

FR-VME 0.2 mg m⁻³

UK-LTEL 0.2 mg m⁻³

UK-STEL 0.6 mg m⁻³

US-TWA 0.2 mg m⁻³

UN No. 1598 HAZCHEM Code 2W Conveyance classification toxic substance

Supply classification very toxic

Risk phrases Very toxic in contact with skin and if swallowed – Danger of cumulative effects – Irritating to the eyes – Possible risk of irreversible effects – Risk of explosion if heated under confinement (R27/28, R33, R36, R40, R44)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S36/37, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (duration unspecified) carp 6-13 mg l⁻¹ (1).

Invertebrate toxicity

Cell multiplication inhibition test *Pseudomonas putida* 16 mg l⁻¹, *Scenedesmus quadricauda* 13 mg l⁻¹, *Entosiphon sulcatum* 5.4 mg l⁻¹ (2).

EC₅₀ (30 min) *Photobacterium phosphoreum* 6.12 ppm Microtox test (3).
EC₅₀ (24, 48 hr) *Daphnia magna* 2.8, 2.7 mg l⁻¹, respectively (4).
EC₅₀ (21 day) *Daphnia magna* 1.3 mg l⁻¹ (5).
LD₅₀ 1.79-2.29 mg bee⁻¹; moderate to low toxicity under field conditions (1).

Bioaccumulation

Calculated bioconcentration factor 24-37 (6).

Previous studies reported that its toxicity rules out bioaccumulation, or that it was probably not important.

Results from this study indicate bioaccumulation is possible (7).

Environmental fate

Anaerobic effects

The significance of biodegradation cannot be predicted with certainty from available data (6).

Anaerobic biodegradability and toxicity to methanogenesis was evaluated using two anaerobic bioassays. Added as sole carbon source in a pre-reduced defined medium using 10% v/v inoculum of municipal digester sludge.

All concentrations were observed to undergo no significant mineralisation of added substrate and inhibited methanogenesis to varying degrees. The environmental fate can be significantly influenced by both concentration and residence time in anoxic environments (8).

Degradation studies

In soil and plants, the nitro groups are reduced to amino groups (1).

Exposure to 1-100 µg l⁻¹ on the morphology and anatomy of colonies and hyphae of *Rhizopus nigricans*, *Mucor mucedo*, *Mucor griseo-cyanus*, *Penicillium purpurogenum* and *Aspergillus niger*. 10 µg l⁻¹ caused morphological changes of vegetative hyphae (9).

The effect on soil microbial activity was determined by studying alkaline phosphatase, dehydrogenase and fluorescein diacetate hydrolysis activities, respiration and nitrification following 5- and 10-fold the normal agricultural application. Inhibited soil activities and potential nitrification in a dose-dependent manner, but stimulated nitrogen transformation (ammonification and nitrification). Nitrification effects persisted (10).

Abiotic removal

t_{1/2} for photooxidation via peroxy radicals has been estimated to be 58 days (11).

Adsorption and retention

Estimated soil adsorption coefficient of 225-290 indicates medium to low mobility in soil (6).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat, goat 16-47, 25-40, 100 mg kg⁻¹, respectively (1).

LD₅₀ dermal rat 200 mg kg⁻¹ (12).

LD₅₀ intraperitoneal mouse 19 mg kg⁻¹ (13).

LD₅₀ subcutaneous rat 25 mg kg⁻¹ (14).

Sub-acute and sub-chronic data

In 6-month feeding trials, rats and rabbits receiving >100 mg kg⁻¹ in diet showed no adverse effects (1).

Teratogenicity and reproductive effects

Intraperitoneal, oral mice (35 day) unspecified doses for five consecutive days, no induction of teratospermia observed in mice treated by both routes of administration (15).

Irritancy

Dermal rabbit (9 day) 105 mg caused mild irritation (16).

Eye rabbit (24 hr) 20 mg caused severe irritation (16).

In patch tests carried out on 652 subjects, 0.1 % in water caused no irritation or sensitisation (17).

Genotoxicity

Salmonella typhimurium TA98, TA1537, TA2637 without metabolic activation positive (18).

Salmonella typhimurium TA1535, TA100, TA92 with and without metabolic activation negative (18).

Escherichia coli ATCC 11775 without metabolic activation positive and showed a biphasic inhibition of multiplication for a concentration-dependent period of time (19).

In vitro rat bone marrow blocked mitosis (20).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (21).

WHO Toxicity Class Ib (22).

EPA Toxicity Class I (formulation) (1).

Other comments

Acts as a powerful cumulative metabolic poison in humans. Dangerous amounts can be absorbed through the skin. There is danger of chronic poisoning with repeated uptake.

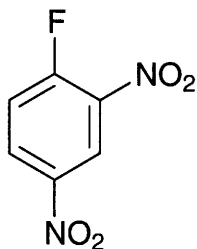
Reviews on physico-chemical properties, human health effects, experimental toxicology, epidemiology, workplace experience and exposure listed (23).

Metabolic pathways reviewed (24).

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22. *The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification* 1998-1999 WHO/PCS/98.21.
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24. Roberts, T.R. et al (Eds.) *Metabolic Pathways of Agrochemicals. Part 1: Herbicides and Plant Growth Regulators* 1998, The Royal Society of Chemistry, Cambridge, UK

D476 2,4-dinitrofluorobenzene



$C_6H_3FN_2O_4$

Mol. Wt. 186.10

CAS Registry No. 70-34-8

Synonyms 2,4-dinitrophenyl fluoride; 1,2,4-fluorodinitrobenzene; 1-fluoro-2,4-dinitrobenzene; 2,4-DNFB; FDNB; DNFB; Sanger's reagent

EINECS No. 200-734-3

RTECS No. CZ 7800000

Uses Reagent for labelling a terminal amino-acid group and in modified Wohl degradations of aldoses. Preparation of drugs and plant protective agents.

Physical properties

M. Pt. 27.5-30°C **B. Pt.** 178°C at 25 mmHg **Flash point** >110°C (closed cup) **Specific gravity** 1.482 at 20°C with respect to water at 4°C

Solubility Organic solvents: benzene, diethyl ether, propylene glycol, hot ethanol

Mammalian & avian toxicity

Acute data

LD_{Lo} oral rat 50 mg kg⁻¹ (1).

LD_{Lo} dermal mouse 100 mg kg⁻¹ (2).

LD_{Lo} subcutaneous mouse 100 mg kg⁻¹ (3).

Carcinogenicity and chronic effects

Dermal mice 5 topical doses wk⁻¹ 0.1% in acetone induced tumours after 4 wk and 70% tumour incidence after 38 wk (2).

Sensitisation

Contact hypersensitivity in mice reached a maximum after 4 days and persisted for 3 wk. Cutaneous hypersensitivity reaction peaked at 24 hr (4).

Allergic contact dermatitis is maximum 5-6 days after sensitisation and rapidly fades in succeeding days (5).

Genotoxicity

Salmonella typhimurium TA100, TA98 with and without metabolic activation positive (6,7).

Escherichia coli polA without metabolic activation positive (6).

Saccharomyces cerevisiae gene conversion positive (8).

In vitro V-79 Chinese hamster cells with and without metabolic activation, sister chromatid exchange negative, unscheduled DNA synthesis negative. The carcinogenic potential might reside in the ability of DNFB to act as a tumour promoter and not as a carcinogenic initiator (9).

Other comments

Experimental observations and clinical reports are reviewed and factors influencing human sensitisation are discussed. Recommendations are given for proper use of protective gloves and avoidance of spray inhalation (10).

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3. *Biochem. J.* 1947, **41**, 558.
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6. Kerklaam, P. R. M. et al *Mutat. Res.*, 1987, **176**(2), 171-178.
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10. Thompson, J. S. et al *Ann. Occup. Hyg.* 1980, **23**(1), 27

D477 dinitrogen pentoxide



N_2O_5

Mol. Wt. 108.01

CAS Registry No. 10102-03-1

Synonyms nitrogen oxide (N_2O_5); nitrogen pentoxide; nitric anhydride

EINECS No. 233-264-2

Uses Nitrating agent.

Occurrence Occurs naturally in earth's atmosphere. The only nitrogen oxide which is solid at normal temperatures.

Physical properties

M. Pt. 30°C **B. Pt.** 47°C **Specific gravity** 2.05 at 15°C

Solubility Organic solvents: carbon tetrachloride, chloroform

Environmental fate

Abiotic removal

Removed from flue gases of coal-fired burner with a dry absorbant comprising fly ash, lime, gypsum (for SO_x removal), high carbon ash, ash from the combustion of oil and iron oxides (1).

Increasing temperature above -10°C caused decomposition to O_2 and the $\text{NO}_2/\text{N}_2\text{O}_4$ equilibrium mixture (2).

Undergoes hydrolysis in the atmosphere to form nitric acid (3).

Other effects

Other adverse effects (human)

Occupational exposure, even at concentrations of $<5 \text{ mg m}^{-3}$, produced chronic symptoms of respiratory disease and impaired ventilation in workers of a nitrogen fertiliser plant (4).

Legislation

Oxides of nitrogen are included in Schedule 4 (Release into the Air: Prescribed Substances) Statutory Instrument No.472, 1991 (5).

Other comments

Reviews on toxicity listed (6).

At room temperature it decomposes into nitrogen dioxide and oxygen. Explodes if heated rapidly.

References

1. Samish, N. C. *Shell Oil Co.* US Patent 4,980, 138 (bl.423-239; BOIJ8/00), 25 Dec 1990.
2. *The Merck Index* 12th ed., 1996, Merck & Co., Inc., Whitehouse Station, NJ, USA.
3. McCormac, B. M. *Physics and Chemistry of the Upper Atmospheres* 1973, Reidel Publishing Co., The Netherlands.
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D478 dinitrogen tetroxide



N_2O_4

Mol. Wt. 92.01

CAS Registry No. 10544-72-6

Synonyms nitrogen oxide (N_2O_4); nitrogen tetroxide; dinitrogen dioxide

EINECS No. 234-126-4

Uses Catalyst. Nitrating agent. Nuclear reactor coolant. Oxidising agent. Propellant. Intermediate in chemical synthesis.

Physical properties

M. Pt. -11°C **B. Pt.** 21°C **Specific gravity** 2.620 at 20°C **Volatility** v.p. 400 mmHg at 8°C

Occupational exposure

UN No. 1067 **HAZCHEM Code** 2PE **Conveyance classification** toxic gas, fire intensifying hazard, corrosive
Supply classification very toxic

Risk phrases Very toxic by inhalation – Causes burns (R26, R34)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Keep container in a well ventilated place – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing, gloves and eye/face protection – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S9, S26, S28, S36/37/39, S45)

Environmental fate

Abiotic removal

In the liquid state undergoes partial dissociation to nitrogen dioxide. In the vapour complete dissociation occurs at 140°C (1).

Undergoes hydrolysis in water giving nitrous and nitric acids (1).

Mammalian & avian toxicity

Acute data

LC₅₀ (15 min) inhalation rabbit 315 ppm (2).

Dermal rat, methaemoglobin levels increased from 1.9% to 55% total blood haemoglobin 1 hr after application (dose not specified) (3).

Other effects

Other adverse effects (human)

Accidental exposure of the liquid and concentrated gas to dry skin caused corrosion; the appearance was similar to burns from contact with nitric acid (4).

Legislation

Oxides of nitrogen are included in Schedule 4 (Release into the Air: Prescribed Substances) Statutory Instrument No. 472, 1991 (5).

Other comments

Toxicity reviewed (6,7).

Toxicity and environmental fate of nitrogen oxides comprehensively reviewed (8).

References

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D479 dinitrogen trioxide



N_2O_3

Mol. Wt. 76.01

CAS Registry No. 10544-73-7

Synonyms nitrogen oxide (N_2O_3); nitrous anhydride

EINECS No. 234-128-5

Physical properties

M. Pt. -102°C B. Pt. 3.5°C

Solubility Water: miscible. Organic solvents: diethyl ether

Environmental fate

Abiotic removal

In the vapour phase dinitrogen trioxide dissociates to nitrogen dioxide and nitric oxide (1).

Legislation

Oxides of nitrogen are included in Schedule 4 (Release into the Air: Prescribed Substances) Statutory Instrument No. 472, 1991 (2).

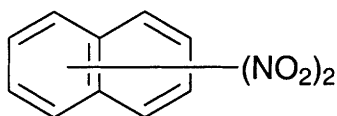
Other comments

Toxicity and environmental fate of nitrogen oxides comprehensively reviewed (3).

References

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3. Izmerov, N. F. *Scientific Reviews of Soviet Literature on Toxicity and Hazards of Chemicals 1991*, UNEP, IRPTC, CIP, Moscow, USSR

D480 dinitronaphthalene



$C_{10}H_6N_2O_4$

Mol. Wt. 218.17

CAS Registry No. 27478-34-8
(unspecified isomers).

Synonyms

EINECS No. 248-484-4

Uses Manufacture of isotropic graphite products having high intrinsic resistivity, explosives and detonators.

Mammalian & avian toxicity

Acute data

LD₅₀ intraperitoneal mouse 5600 mg kg⁻¹ (1).

Carcinogenicity and chronic effects

MAK classification category 3. Substances that cause concern that they could be carcinogenic for man but which cannot be assessed conclusively because of lack of data (2).

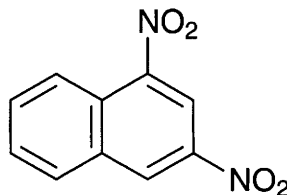
Other comments

27478-34-8 is the general registry number for dinitronaphthalene (unspecified isomers).

References

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D481 1,3-dinitronaphthalene



C₁₀H₆N₂O₄

Mol. Wt. 218.17

CAS Registry No. 606-37-1

Synonyms

EINECS No. 210-116-5

RTECS No. QJ 4550800

Uses Organic synthesis.

Physical properties

M. Pt. 146-148°C

Solubility Organic solvents: acetone, dimethyl sulfoxide

Mammalian & avian toxicity

Carcinogenicity and chronic effects

MAK classification category 3. Substances that cause concern that could be carcinogenic for man but which cannot be assessed conclusively because of lack of data (1).

Irritancy

Irritating to the mucous membranes and upper respiratory tract (species unspecified) (2).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537, TA1538 with and without metabolic activation positive (3).

Other effects

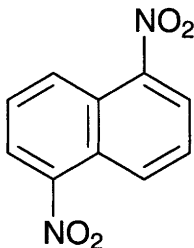
Other adverse effects (human)

Absorption into the body leads to the formation methaemoglobin which in sufficient concentrations causes cyanosis (2).

References

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2. Lenga, R. E. *The Sigma-Aldrich Library of Chemical Safety Data* 2nd ed. 1988, 1, 1438, Sigma-Aldrich, Milwaukee, WI, USA.
3. Zeiger, E. et al *Environ. Mol. Mutagen.* 1992, 19 (Suppl. 21), 2-141

D482 1,5-dinitronaphthalene



C₁₀H₆N₂O₄

Mol. Wt. 218.17

CAS Registry No. 605-71-0

Synonyms

EINECS No. 210-095-2

RTECS No. QJ 4551000

Uses Manufacture of explosives and dyestuffs.

Physical properties

M. Pt. 216-217°C

Solubility Water: <1 g l⁻¹ at 20°C. Organic solvents: acetone, benzene, ethanol, pyridine

Mammalian & avian toxicity

Carcinogenicity and chronic effects

MAK classification category 3. Substances that cause concern that could be carcinogenic for man but which cannot be assessed conclusively because of lack of data (1).

Genotoxicity

Escherichia coli PQ 37 SOS chromotest with metabolic activation positive (2).

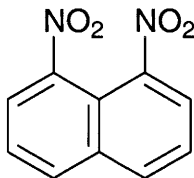
Other comments

Reviews on toxicity listed (3).

References

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3. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuyse (Bte 6), B-1160 Brussels, Belgium

D483 1,8-dinitronaphthalene



$C_{10}H_6N_2O_4$

Mol. Wt. 218.17

CAS Registry No. 602-38-0

EINECS No. 210-016-1

RTECS No. QJ 4552000

Uses Catalyst. Manufacture of dyestuffs.

Physical properties

M. Pt. 171-172°C B. Pt. 445°C (decomp.)

Solubility Water: <1 g l⁻¹ at 19°C. Organic solvents: acetone, benzene, chloroform, ethanol, pyridine

Mammalian & avian toxicity

Carcinogenicity and chronic effects

MAK classification category 3. Substances that cause concern that could be carcinogenic for man but which cannot be assessed conclusively because of lack of data (1).

Genotoxicity

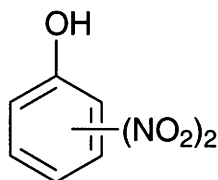
Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation, incorporating preincubation with flavin mononucleotide, positive (2).

In vitro rat, mouse hepatocytes, DNA repair test negative (3).

References

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2. Dellarco, V. L. et al *Environ. Mol. Mutagen.* 1989, **13**(2), 116-127.
3. Mori, H. et al *Mutat. Res.* 1987, **190**(2), 159-167

D484 dinitrophenol



$C_6H_4N_2O_5$

Mol. Wt. 184.11

CAS Registry No. 25550-58-7

EINECS No. 247-096-2

RTECS No. SL 2625000

Uses Manufacture of dyestuffs and explosives. Analytical reagent. Pesticide.

Physical properties

M. Pt. 63-109°C **Specific gravity** 1.68 at 20°C **Volatility** v.p. $\approx 10^{-5}$ mmHg ; v.den. 6.35
Solubility Organic solvents: acetone, benzene, chloroform, diethyl ether, ethanol

Occupational exposure

UN No. 1599 (solution); 1320 (wetted with $\geq 15\%$ water by mass) **HAZCHEM Code** 3WE (solution)
Conveyance classification toxic substance (solution) **Conveyance classification** flammable solid, toxic (wetted with $\geq 15\%$ water by mass)
Supply classification toxic
Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects (R23/24/25, R33)
Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S37, S45)

Mammalian & avian toxicity

Acute data
LD_{Lo} oral rat, dog 30 mg kg⁻¹ (1,2).
LD_{Lo} subcutaneous rabbit 30 mg kg⁻¹ (2).
Sensitisation
Reported to cause dermatitis (3).

Other effects

Any other adverse effects
Disrupts oxidative phosphorylation, causing increased metabolic rate, oxygen consumption and heat production. Chronic exposure may lead to kidney and liver damage and cataract formation (3).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (4).
Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (5).
Included in the UK List of Classified and Authorised Explosives 1994. UK Class and Division 3.2. Competent Authority Reference GB 32049 (6).

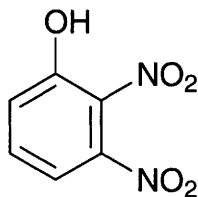
Other comments

Reviews on toxicity of dinitrophenol and its salts listed (7).
25550-58-7 is the general registry number for dinitrophenol (unspecified isomer).

References

1. *Pesticide Index* 1969, 4, 196, College Science Publications, PA, USA.
2. *J. Pharmacol. Exp. Ther.* 1933, 49, 187.
3. *Patty's Industrial Hygiene and Toxicology* 3rd ed., 1981, 24, 2457, John Wiley & Sons, New York, USA.
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5. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
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D485 2,3-dinitrophenol



$C_6H_4N_2O_5$

Mol. Wt. 184.11

CAS Registry No. 66-56-8

Synonyms 2,3-DNP

EINECS No. 200-628-7

RTECS No. SL 2700000

Uses Colorimetric analytical reagent. Manufacture of dyestuffs.

Physical properties

M. Pt. 144°C Specific gravity 1.681 at 20°C Volatility v.den. 6.35

Solubility Water: miscible. Organic solvents: benzene, diethyl ether, ethanol

Occupational exposure

UN No. 1599 (solution)

UN No. 1320 (wetted with $\geq 15\%$ water by mass) HAZCHEM Code 3WE (solution)

Conveyance classification toxic substance (solution) Conveyance classification flammable solid, toxic (wetted with $\geq 15\%$ water by mass)

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects (R23/24/25, R33)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S37, S45)

Mammalian & avian toxicity

Acute data

LD₅₀ intraperitoneal rat, mouse 20, 26 mg kg⁻¹, respectively (1,2)

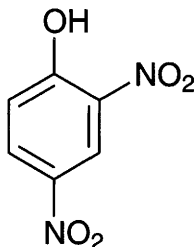
Genotoxicity

Salmonella typhimurium TA100 with metabolic activation positive (3).

References

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D486 2,4-dinitrophenol



$C_6H_4N_2O_5$

Mol. Wt. 184.11

CAS Registry No. 51-28-5

Synonyms 1-hydroxy-2,4-dinitrobenzene; 2,4-DNP; α -dinitrophenol

EINECS No. 200-087-7

RTECS No. SL 2800000

Uses Manufacture of dyestuffs. Wood preservatives and insecticide. Analytical reagent, as a pH indicator. Polymerisation inhibitor in styrene production.

Physical properties

M. Pt. 106-108°C Specific gravity 1.683 at 24°C Partition coefficient $\log P_{ow}$ 1.51 (1)

Volatility v.p. 2×10^{-5} mmHg at 25°C ; v.den. 6.35

Solubility Water: 5.6 g l⁻¹ at 18°C. Organic solvents: acetone, benzene, carbon tetrachloride, chloroform, ethanol, pyridine, toluene

Occupational exposure

UN No. 1599 (solution)

UN No. 1320 (wetted with $\geq 15\%$ water by mass) HAZCHEM Code 3WE (solution)

Conveyance classification toxic substance (solution) Conveyance classification flammable solid, toxic (wetted with $\geq 15\%$ water by mass)

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects (R23/24/25, R33)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S37, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) bluegill sunfish, fathead minnow, marine sheephead minnow 0.7-29 mg l⁻¹ (2,3).

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 6.1-10.6 ppm Microtox test (4).

IC₅₀ (24 hr) *Daphnia magna* 7.2 mg l⁻¹ (5).

Bioaccumulation

Calculated bioconcentration factor <10 (6).

Environmental fate

Nitrification inhibition

Threshold nitrification inhibition 150 mg l⁻¹ (7).

75% inhibition of ammonia oxidation by activated sludge process at 460 mg l⁻¹, ~ 50% inhibition of ammonia and nitrite oxidation at 37 mg l⁻¹ (8-10).

Anaerobic effects

IC₅₀ (50 day) methanogenic bacteria 0.01 mg l⁻¹ (11).

Degradation studies

85% COD removal in adapted activated sludge, 6 mg COD g⁻¹ dry inoculum hr⁻¹ when incorporated as sole carbon source at 20°C (12).

Metabolites produced by *Fusarium oxysporum* were 2-amino-4-nitrophenol and 4-amino-2-nitrophenol. Nitrite release has been observed after metabolism by *Nocardia alba*, *Arthrobacter* sp. and *Corynebacterium simplex* (13).

Abiotic removal

Reaction with photochemically produced hydroxyl radicals and direct photolysis in the atmosphere, t_{1/2} 14 hr (14).

Reaction with alkylperoxy radical and direct photolysis in water at wavelengths >290 nm, t_{1/2} 58 day (15).

Adsorption and retention

Soil adsorption coefficients 36 and 164, no significant adsorption to soil or sediments in water reported (16).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse, starling, redwing blackbird 13-46 mg kg⁻¹ (17,18).

LD₅₀ intraperitoneal rat, mouse 20, 26 mg kg⁻¹, respectively (19,20).

LD₅₀ intravenous rat, mouse 56, 72 mg kg⁻¹, respectively (21).

Sub-acute and sub-chronic data

Oral rat (6 month) 0, 5, 10, 25, 50 and 100 mg kg⁻¹ day⁻¹. Rats treated with 50 or 100 mg kg⁻¹ day⁻¹ suffered some fatalities, weight loss, enlarged and darkened spleens, liver and kidney damage and testicular atrophy (22).

Teratogenicity and reproductive effects

Teratogenic effects reported in mice following intraperitoneal injection of 41 mg kg⁻¹ on days 10-12 of pregnancy (23).

Metabolism and toxicokinetics

Following subcutaneous administration to rabbits, dinitrophenol glucuronide, 2-amino-4-nitrophenol and its ether sulfate were detected in the urine (24).

Irritancy

Dermal rabbit (4 wk) 300 mg day⁻¹ caused mild irritation (25).

Sensitisation

Reported to cause dermatitis (26).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537, TA1538 with and without metabolic activation negative (27).

In vitro Chinese hamster V79 cells, inhibition of DNA synthesis positive (28).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (29).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (30).

Other comments

Residues have been isolated from the atmosphere, soil, water and sediments (31).

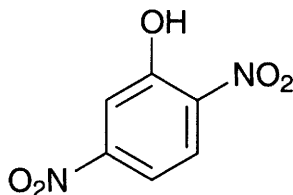
Environmental fate of 2,4-dinitrophenol reviewed (31).

Toxicity reviewed (26,32).

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D487 2,5-dinitrophenol



$C_6H_4N_2O_5$

Mol. Wt. 184.11

CAS Registry No. 329-71-5

Synonyms 1-hydroxy-2,5-dinitrobenzene; 2,5-DNP

EINECS No. 206-348-1

RTECS No. SL 2900000

Uses Bactericide. Manufacture of dyestuffs. Analytical reagent, as a pH indicator.

Physical properties

M. Pt. 106-109°C Partition coefficient $\log P_{ow}$ 1.75 (1) Volatility v.p. 1×10^{-5} mmHg at 25°C

Solubility Water: slightly soluble. Organic solvents: benzene, diethyl ether, ethanol

Occupational exposure

UN No. 1599 (solution)

UN No. 1320 (wetted with $\geq 15\%$ water by mass) HAZCHEM Code 3WE (solution)

Conveyance classification toxic substance (solution) Conveyance classification flammable solid, toxic (wetted with $\geq 15\%$ water by mass)

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects (R23/24/25, R33)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S37, S45)

Ecotoxicity

Invertebrate toxicity

EC₅₀ (24 hr) *Daphnia magna* 8.5 mg l⁻¹ (2).

Bioaccumulation

Calculated bioconcentration factor 13 (3).

Environmental fate

Degradation studies

No degradation after 20 days, determined by COD removal in adapted activated sludge when incorporated as sole carbon source at 20°C (4).

Adsorption and retention

Calculated K_{ow} 1.75 indicates no significant adsorption to soil and sediments (3).

Mammalian & avian toxicity

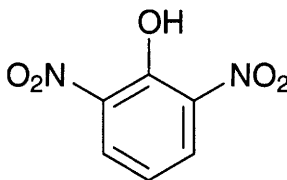
Acute data

LD₅₀ intraperitoneal rat, mouse 150, 273 mg kg⁻¹, respectively (5).

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D488 2,6-dinitrophenol



$C_6H_4N_2O_5$

Mol. Wt. 184.11

CAS Registry No. 573-56-8

Synonyms 1-hydroxy-2,6-dinitrobenzene

EINECS No. 209-357-9

RTECS No. SL 2975000

Uses Bactericide. Manufacture of dyestuffs. Analytical reagent, a pH indicator.

Physical properties

M. Pt. 63-64°C Partition coefficient $\log P_{ow}$ 1.18 (1) Volatility v.den. 6.35

Solubility Water: slightly soluble. Organic solvents: acetone, chloroform, diethyl ether, dimethylformamide, dimethyl sulfoxide, ethanol, pyridine

Occupational exposure

UN No. 1599 (solution)

UN No. 1320 (wetted with $\geq 15\%$ water by mass) HAZCHEM Code 3WE (solution)

Conveyance classification toxic substance (solution) Conveyance classification flammable solid, toxic (wetted with $\geq 15\%$ water by mass)

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects (R23/24/25, R33)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S37, S45)

Ecotoxicity

Bioaccumulation

Calculated bioconcentration factor 6 (2).

Environmental fate

Degradation studies

Completely degraded by *Pseudomonas* sp. isolated from soil (3).

No degradation after 20 days, determined by COD removal, in adapted activated sludge when incorporated as sole carbon source at 20°C (4).

Adsorption and retention

Calculated K_{oc} 133 indicates 2,6-dinitrophenol will not absorb strongly to soil or sediments (2).

Mammalian & avian toxicity

Acute data

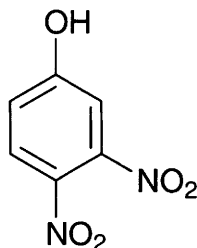
LD₅₀ intraperitoneal rat, mouse, dog 35-50 mg kg⁻¹ (5).

LD_{Lo} intramuscular pigeon 40 mg kg⁻¹ (6).

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D489 3,4-dinitrophenol



C₆H₄N₂O₅

Mol. Wt. 184.11

CAS Registry No. 577-71-9

Synonyms δ-dinitrophenol; 3,4-DNP

EINECS No. 209-415-3

RTECS No. SL 3000000

Uses Analytical reagent.

Physical properties

M. Pt. 134°C Specific gravity 1.672 at 20°C

Solubility Organic solvents: benzene, diethyl ether, ethanol

Occupational exposure

UN No. 1599 (solution)

UN No. 1320 (wetted with ≥15% water by mass) HAZCHEM Code 3WE (solution)

Conveyance classification toxic substance (solution) Conveyance classification flammable solid, toxic (wetted with ≥15% water by mass)

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects (R23/24/25, R33)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S37, S45)

Environmental fate

Degradation studies

Metabolised to 5-hydroxybenzimidazolylcobamide under anaerobic conditions by methanogenic bacteria isolated from digested sewage sludge (1).

Mammalian & avian toxicity

Acute data

LD₅₀ intraperitoneal rat, mouse 98, 112 mg kg⁻¹, respectively (2).

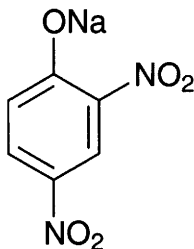
Genotoxicity

Salmonella typhimurium TA100 with and without metabolic activation negative (3).

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D490 2,4-dinitrophenolate sodium



C₆H₄N₂O₅Na

Mol. Wt. 207.10

CAS Registry No. 1011-73-0

Synonyms sodium 2,4-dinitrophenate; sodium 2,4-dinitrophenol; sodium 2,4-dinitrophenolate; sodium DNP

EINECS No. 213-786-7

RTECS No. SL 3190000

Uses Fungicide.

Occupational exposure

UN No. 5321 (wetted with ≥15% water by mass) **Conveyance classification** flammable solid, toxic (wetted with ≥15% water by mass)

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects (R23/24/25, R33)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S37, S45)

Mammalian & avian toxicity

Acute data

LD₅₀ subcutaneous mouse 50 mg kg⁻¹ (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (2).

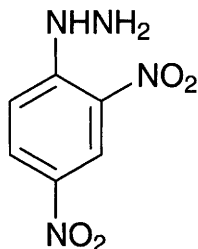
Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (3).

Included in the UK List of Classified and Authorised Explosives 1994. UK Class and Division 3.2. Competent Authority Reference GB 32171 (4).

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D491 2,4-dinitrophenylhydrazine



C₆H₆N₄O₄

Mol. Wt. 198.14

CAS Registry No. 119-26-6

Synonyms 2,4-DNPH

EINECS No. 204-309-3

RTECS No. MV 3325000

Uses Adsorbent used in air samplers. Reagent in HPLC and colorimetry. Corrosion inhibitor. Organic synthesis. Reagent for determination of aldehydes and ketones.

Physical properties

M. Pt. ~200°C

Solubility Water: slightly soluble. Organic solvents: ethanol

Ecotoxicity

Fish toxicity

Stickleback and rainbow trout exposed to 10 mg l⁻¹ died within 8-12 hr (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 650 mg kg⁻¹ (2).

LD₅₀ intraperitoneal mouse 450 mg kg⁻¹ (3).

Irritancy

500 mg instilled into rabbit eye for 24 hr caused moderate irritation (2).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537, TA1538 tested with or without metabolic activation positive (4).

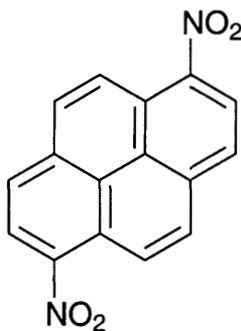
In vitro primary rat and mouse hepatocytes DNA repair test negative (5).

In vivo mouse liver and lungs DNA damage positive (3).

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D492 1,6-dinitropyrene



C₁₆H₈N₂O₄

Mol. Wt. 292.25

CAS Registry No. 42397-64-8

RTECS No. UR 2455000

Physical properties

M. Pt. >300°C

Solubility Water: insoluble. Organic solvents: toluene

Mammalian & avian toxicity

Carcinogenicity and chronic effects

Sufficient evidence for carcinogenicity to animals, possibly carcinogenic to humans, IARC classification group 2B (1).

National Toxicology Program classification: reasonably anticipated to be a human carcinogen (2).

A 100% incidence of tumour induction was seen in rats injected subcutaneously $2 \times \text{wk}^{-1}$ for 10 wk to a total of 4 mg (3).

Weanling ♀ CD rats administered $10 \mu\text{mol kg}^{-1}$ intraperitoneally or intragastrically $3 \times \text{wk}^{-1}$ for 4 wk. (The total cumulative dose averaged $16 \mu\text{mol animal}^{-1}$.) Average survival time 19 wk owing to the occurrence of life-threatening peritoneal malignant histiocytomas in nearly all of the rats (4).

Newborn ♀ CD rats dosed subcutaneously once a week for 8 wk with a total dose of $6.3 \mu\text{mol}$. Average survival period 149 days. Malignant fibrous histiocytomas were observed in 100% of the dosed rats and leukaemia in 20%. No control rats developed these tumours (5).

Intratracheal golden hamsters (26 wk) 0.5 mg wk^{-1} . Lung tumours were observed in 10/10 ♂ and 9/10 ♀ in 48 wk (3).

Metabolism and toxicokinetics

Reduced under anaerobic conditions *in vitro* by both rat liver microsomes and cytosol. The presence of oxygen decreased both amino- and nitroso-pyrene formation in microsomal incubations. In cytosolic incubations the presence of oxygen decreased the amino-derivatives but increased the nitroso-intermediates. The presence of intestinal microflora affected its *in vivo* metabolism by rats. Liver and mammary gland DNA adducts produced by 1,6-dinitropyrene were consistent with activation by nitro-reduction (6).

Genotoxicity

Induced chromosome damage in peripheral human lymphocyte cultures. Clastogenic activity peaked at $1.25 \mu\text{g ml}^{-1}$ in the presence of a rat liver cytosol fraction (7).

Dose-dependent increases in DNA repair in human and rat hepatocyte cultures, as measured by unscheduled DNA synthesis, were seen in the range $0.05\text{--}5 \mu\text{M}$ for both species (8).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Polycyclic aromatic hydrocarbons: maximum admissible concentration $0.2 \mu\text{g l}^{-1}$ (9).

Other comments

Found in some carbon blacks and in particulate emissions from kerosene heaters and gas burners. Also found at low concentrations in ambient air (1).

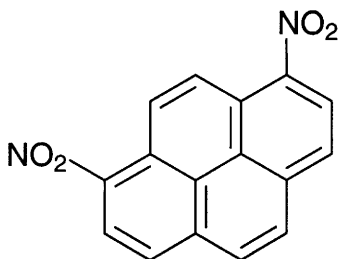
Occurs at levels of $0.81\text{--}1.2 \text{ mg kg}^{-1}$ in extracts of particles from the exhaust of diesel engines (10,11).

Carcinogenic risks to humans evaluated (2).

References

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D493 1,8-dinitropyrene



C₁₆H₈N₂O₄

Mol. Wt. 292.25

CAS Registry No. 42397-65-9

RTECS No. UR 2456000

Physical properties

M. Pt. >300°C

Environmental fate

Abiotic removal

Photodecomposition of 1,8-dinitropyrene exposed to light (≥ 310 nm) either in DMSO or coated onto silica t_{1/2} 0.7 and 5.7 days, respectively. A principal photodecomposition product was 1-nitrophenol-8-ol (1).

Mammalian & avian toxicity

Carcinogenicity and chronic effects

Sufficient evidence for carcinogenicity to animals, possibly carcinogenic to humans, IARC classification group 2B (2).

National Toxicology Program classification: reasonably anticipated to be a human carcinogen (3).

Newborn ♀ CD rats dosed subcutaneously 1 × wk⁻¹ for 8 wk with a total dose of 6.3 μmol. Average survival period 164 days. Malignant fibrous histiocytomas were observed in 100% of the dosed rats and leukaemia in 22%. No control rats developed these tumours (4).

Weanling ♀ CD rats administered 10 μmol kg⁻¹ intraperitoneally or intragastrically 3 × wk⁻¹ for 4 wk. (Total cumulative dose averaged 16 μmol animal⁻¹). Average survival time 38 wk owing to the occurrence of life-threatening peritoneal malignant fibrous histiocytomas in nearly all of the rats. A significant increase in the incidence of leukaemia and of mammary tumours was also observed (5).

Metabolism and toxicokinetics

Anaerobic bacterial suspensions derived from human faeces and the intestinal contents of rhesus monkeys and rats metabolised 1,8-dinitropyrene to 1,8-diaminopyrene and 1-amino-8-nitropyrene, both of which are less mutagenic than the parent compound (6).

Reduced under anaerobic conditions *in vitro* by both rat liver microsomes and cytosol. The presence of oxygen decreased both amino- and nitroso-pyrene formation in microsomal incubations. In cytosolic incubations the presence of oxygen decreased the amino-derivatives but increased the nitroso-intermediates. The presence of intestinal microflora affected its *in vivo* metabolism by rats. Liver and mammary gland DNA adducts produced by 1,8-dinitropyrene were consistent with activation by nitroreduction (7).

Oral ♀ mice administered 1,8-dinitro[4,5,9,10-¹⁴C]pyrene excreted 12% in the urine and 42% in the faeces within 48 hr. A linear increase in the concentration of radioactive material occurred in the blood, liver and kidneys up to 6 hr after dosing (0.27, 2.9 and 0.21% of the radioactive dose, respectively). Radioactivity present in the spleen and lungs was low and did not change significantly with time over 9 days. The authors concluded that absorption of orally administered 1,8-dinitropyrene is slow but that the compound or its metabolites persist in the body for long periods, with the liver as the major target organ (8).

Genotoxicity

Mutagenic but non-toxic for mouse lymphoma L5178Y cells when assayed for induced resistance to 6-thioguanine, methotrexate, ouabain, excess thymidine and 1-β-D-arabinofuranosylcytosine (9). Chinese hamster V79 cell assay with or without X-irradiated Syrian hamster embryo cells positive (10). 1-N-(2'-deoxyguanosin-8-yl)amino-8-nitropyrene was shown to be the DNA adduct formed by the metabolism of 1,8-dinitropyrene in *Salmonella typhimurium* TA 98NR (11).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Polycyclic aromatic hydrocarbons: maximum admissible concentration 0.2 µg l⁻¹ (12).

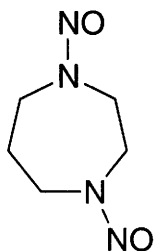
Other comments

Found at a level of 3.4 mg kg⁻¹ in extracts of particles from the exhaust of heavy-duty diesel engines (2).

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D494 dinitrosohomopiperazine



C₅H₁₀N₄O₂

Mol. Wt. 158.16

CAS Registry No. 55557-00-1

Synonyms hexahydro-1,4-dinitroso-1H-1,4-diazepine

RTECS No. HM 3950000

Physical properties

M. Pt. 91-92°C

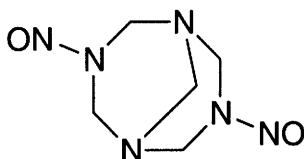
Genotoxicity

CASE structure-activity methodology, applied to a Gene-tox derived *Salmonella typhimurium* mutagenicity database of 808 chemicals, predicts dinitrosohomopiperazine is active and would therefore be expected to be mutagenic in experimental assay (1).

References

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D495 *N,N'*-dinitrosopentamethylenetetramine



$C_5H_{10}N_6O_2$

Mol. Wt. 186.17

CAS Registry No. 101-25-7

Synonyms 3,7-dinitroso-1,3,5,7-tetraazabicyclo[3.3.1]nonane; di-*N*-nitrosopentamethylenetetramine; 1,5-methylene-3,7-dinitroso-1,3,5,7-tetraazacyclooctane; DNPT

EINECS No. 202-928-3

RTECS No. XA 5250000

Uses Blowing agent. Foaming agent.

Physical properties

M. Pt. 207°C (decomp.)

Solubility Water: ~1%. Organic solvents: acetone, benzene, diethyl ether, dimethylformamide, dimethyl sulfoxide, ethanol, pyridine

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 940 mg kg⁻¹ (1).

LD₅₀ intraperitoneal mouse, rat 130, 220 mg kg⁻¹, respectively (1,2).

LD₅₀ subcutaneous mouse, rat 140, 220 mg kg⁻¹, respectively (2,3).

LD₅₀ intravenous mouse, rabbit 120, 130 mg kg⁻¹, respectively (2,3).

Carcinogenicity and chronic effects

No adequate evidence for carcinogenicity to humans, inadequate evidence for carcinogenicity to animals, IARC classification group 3 (4).

Oral rat (18 month) 0, 0.3, 1, 3 or 9 mg rat⁻¹ 4 day wk⁻¹ for 1 yr did not cause an increase in tumour incidence (5).

Intraperitoneal rat (2 yr) 25 mg wk⁻¹ of 13/24 surviving animals, 1 developed a hepatoma and 1 a pituitary tumour. One hepatoma was also observed among 24 controls (6).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1537 with and without metabolic activation negative (7).

In vitro mouse lymphoma L5178Y tk⁺/tk⁻ cells positive (7).

In vitro Chinese hamster ovary cells sister chromatid exchanges and chromosomal aberrations positive (7).

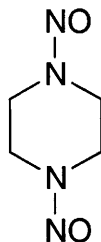
Other comments

Physical properties, use, carcinogenicity and mammalian toxicity reviewed (8).
Toxicity reviews cited (9).

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2. Ivan, J. *Acta Physiol. Acad. Sci. Hung.* 1965, **28**, 209-216.
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D496 dinitrosopiperazine



$C_4H_8N_4O_2$

Mol. Wt. 144.13

CAS Registry No. 140-79-4

Synonyms 1,4-dinitrosopiperazine; *N,N'*-dinitrosopiperazine; DNPZ; NSC339; USAF DO-36

EINECS No. 205-434-6

RTECS No. TL 6300000

Physical properties

M. Pt. 158°C Volatility v.den. 4.97

Solubility Water: miscible. Organic solvents: acetone, hot ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 160 mg kg⁻¹ (1).

LD₅₀ subcutaneous rat 160 mg kg⁻¹ (1).

LD₅₀ intraperitoneal mouse 100 mg kg⁻¹ (2).

Carcinogenicity and chronic effects

Reported to induce nasopharyngeal carcinoma and epithelial hyperplasia of the mucosa of the nasopharynx in rats (3).

Oral ♀ pregnant and lactating mice (1 yr) 15% of treated adult animals died and 57% of transmaternally exposed animals died due to acute toxic effects. The incidence of tumours was higher in transmaternally exposed animals and the latency time for the appearance of tumours in treated animals was shorter than controls. Results suggest that exposure of pregnant or lactating animals may increase the incidence of tumours in their offspring at maturity (4).

Metabolism and toxicokinetics

Following oral administration of 50 µg to rats, 7.7% of the administered dose was recovered unchanged in the urine together with *N*-mononitrosopiperazine (0.04%), *N*-nitroso-3-hydroxypyrrolidine (2.9%), *N*-nitroso-diethanolamine (6.7%) and *N*-nitroso-(2-hydroxyethyl)glycine (20.2%) in 24 hr (5).

Genotoxicity

Salmonella typhimurium TA1535, with metabolic activation positive (6).

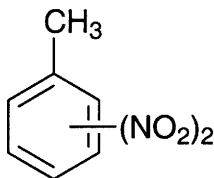
Saccharomyces cerevisiae forward mutation assay with metabolic activation positive (7).

Drosophila melanogaster sex-linked recessive lethal assay positive (8).

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D497 dinitrotoluene



$C_7H_6N_2O_4$

Mol. Wt. 182.14

CAS Registry No. 25321-14-6

Synonyms methyl dinitrobenzene; dinitrophenylmethane

EINECS No. 246-836-1

RTECS No. XT 1300000

Uses Catalyst. Manufacture of dyestuffs and explosives.

Physical properties

M. Pt. 71°C B. Pt. 300°C Specific gravity 1.3208 at 20°C

Solubility Organic solvents: acetone, benzene, diethyl ether, ethanol

Occupational exposure

SE-LEVL 0.15 mg m⁻³

SE-STEL 0.3 mg m⁻³

US-TWA 0.2 mg m⁻³

UN No. 2038 HAZCHEM Code 2W Conveyance classification toxic substance

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects (R23/24/25, R33)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with

skin, wash immediately with plenty of water – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S37, S45)

Environmental fate

Degradation studies

Reported to be readily biodegraded by microorganisms in sea water. The order of biodegradability was 2,5-dinitrotoluene > 3,4- > 2,3- > 3,5- > 2,4- > 2,6-dinitrotoluene (1).

Abiotic removal

Effluents containing dinitrotoluene were effectively treated by lignite adsorption to give residual concentration of <5 mg l⁻¹ (2).

Mammalian & avian toxicity

Acute data

LD₅₀ subcutaneous mouse 750 mg kg⁻¹ (3).

Carcinogenicity and chronic effects

Oral rat (1 yr) 35 mg kg⁻¹ day⁻¹ resulted in 47% incidence of hepatocellular tumours (4).

Teratogenicity and reproductive effects

Gavage rat (7-20 days gestation) 150 mg kg⁻¹ day⁻¹ caused 46% maternal toxicity, embryo/foetotoxicity was observed at this high dose but it was concluded that dinitrotoluene was not teratogenic (5).

Genotoxicity

In vitro Chinese hamster ovary cells induction of mutation to 6-thioguanine, with and without metabolic activation negative (6).

In vitro rat, mouse hepatocyte unscheduled DNA synthesis positive (7).

Other effects

Other adverse effects (human)

An epidemiological study was carried out on 4989 workers exposed to dinitrotoluene and 7436 unexposed workers who had worked for at least five months at a munitions factory between 1949 and 1980. An excess of hepatobiliary cancer was observed among workers exposed to dinitrotoluene in this study (8).

Any other adverse effects

In vitro rat Sertoli cells (24 hr) 2-20 mg l⁻¹ cytotoxicity was observed in a dose-dependent manner, increasing germ cell detachment, and lactate and pyruvate production (9).

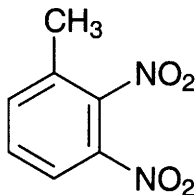
Other comments

Reviews on toxicity listed (10).

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D498 2,3-dinitrotoluene



$C_7H_6N_2O_4$

Mol. Wt. 182.14

CAS Registry No. 602-01-7

Synonyms 1-methyl-2,3-dinitrobenzene; 2,3-DNT

EINECS No. 210-013-5

RTECS No. XT 1400000

Uses In the manufacture of explosives.

Physical properties

M. Pt. 59-61°C Partition coefficient $\log P_{ow}$ 2.0 (calc.) (1)

Solubility Organic solvents: petroleum ether

Occupational exposure

US-TWA 0.15 mg m⁻³

UN No. 2038 HAZCHEM Code 2W Conveyance classification toxic substance

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects (R23/24/25, R33)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S37, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) bluegill sunfish, sheephead minnow 0.33-2.28 mg l⁻¹ (2).

Invertebrate toxicity

EC₅₀ (96 hr) *Selenastrum capricornutum* 1.37-1.62 mg l⁻¹ (2).

EC₅₀ (15 min) *Photobacterium phosphoreum* 6.03 ppm Microtox test (3).

EC₅₀ (48 hr) *Daphnia magna* 0.66 mg l⁻¹ (2).

Environmental fate

Adsorption and retention

Calculated K_{oc} 290, moderate adsorption to soil and sediments is expected (4).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 910, 1100 mg kg⁻¹, respectively (5,6).

Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation (7).

Genotoxicity

Salmonella typhimurium TA98, TA100 with and without metabolic activation positive (8).

In vitro primary rat hepatocytes DNA damage negative (9).

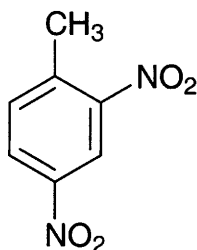
Other comments

Reviews on toxicity listed (10).

References

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D499 2,4-dinitrotoluene



$C_7H_6N_2O_4$

Mol. Wt. 182.14

CAS Registry No. 121-14-2

Synonyms 1-methyl-2,4-dinitrobenzene; 2,4-DNT

EINECS No. 204-450-0

RTECS No. XT 1575000

Uses Catalyst. Manufacture of explosives. Polymerisation inhibitor. Analytical reagent. Plasticiser.

Physical properties

M. Pt. 67-70°C B. Pt. 300°C Flash point 207°C (closed cup) Specific gravity 1.521 at 15°C

Partition coefficient $\log P_{ow}$ 2.28 (1) Volatility v.p. 1.1×10^{-4} mmHg at 20°C ; v.den. 6.3

Solubility Water: 270 mg l⁻¹ at 22°C. Organic solvents: carbon disulfide, dimethyl sulfoxide

Occupational exposure

US-TWA 0.15 mg m⁻³

UN No. 2038 HAZCHEM Code 2W Conveyance classification toxic substance

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects (R23/24/25, R33)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S37, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 31 mg l⁻¹ (2).

LC₅₀ (14 day) guppy 13 mg l⁻¹ (3).

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 20.9 ppm Microtox test (4).

EC₅₀ (48 hr) *Daphnia magna* 24 mg l⁻¹ (5).

Bioaccumulation

Bioconcentration factor for *Daphnia magna*, *Lumbriculus variegatus* and bluegill sunfish 13-78 (6).

Bioconcentration curves for carp in a semi-static system reached two peaks each followed by a steady state. The first and second steady state values were 9.15 and 4.15 (97.86 and 44.39, based on lipid content), respectively (7).

Environmental fate

Degradation studies

Did not degrade in anaerobic activated sludge in 14 days, when present as sole carbon source at concentrations of 5-25 mg l⁻¹ (8).

Abiotic removal

Treatment of aqueous solutions with UV/hydrogen peroxide leads to hydroxylation to di- and trihydroxy derivatives followed by ring cleavage to produce lower molecular weight carboxylic acids and aldehydes. Further photooxidation yields carbon dioxide and water (9).

t_{1/2} for evaporation from water 133-248 hr (10).

Photolysis t_{1/2} by sunlight in water 2.7-9.6 hr in natural waters and 43 hr in distilled water (11).

Reaction with photochemically produced hydroxyl radicals in the atmosphere, estimated t_{1/2} 8 hr (12).

Adsorption capacity of activated carbon 146 mg g⁻¹ carbon (13).

Adsorption and retention

Estimated soil adsorption coefficient 282, and 12 for sediment, indicating slight mobility (14).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse, guinea pig 270, 790, 1300 mg kg⁻¹, respectively (15-17).

Sub-acute and sub-chronic data

Oral ♂ rat (3 wk) 0.1 or 0.2% diet. A marked change in Sertoli cell morphology was found for the high dose.

Circulating levels of follicle stimulating hormone and luteinising hormone were increased in this group. Reduced weights of the epididymis and decreased epididymal sperm reserves were observed in all treated groups. Thus testicular damage, disturbed pituitary function and toxic effects of the late stages of spermatogenesis were caused (18).

Carcinogenicity and chronic effects

Oral rat (1 yr) 27 mg kg⁻¹ day⁻¹ did not cause hepatocellular carcinomas (19).

National Toxicology Program tested rats and mice via oral administration. Negative results were reported for ♂ or ♀ mice, positive results were reported for ♂ and ♀ rats (20).

Metabolism and toxicokinetics

The major *in vitro* metabolites of rat liver microsomal and cytosol fractions were 2,4-dinitrobenzyl alcohol, 2,4-dinitrobenzaldehyde and 2,4-dinitrobenzoic acid (21).

The common biliary metabolites in rats were 2,4-dinitrobenzyl alcohol and its glucuronide, and 2,4-dinitrobenzaldehyde (22).

Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation (23).

Genotoxicity

Salmonella typhimurium TA98, TA100 with metabolic activation positive (24).

In vitro Chinese hamster ovary cells sister chromatid exchanges positive, chromosomal aberrations negative (25).

In vitro human and rat primary hepatocytes, DNA repair assay positive (26).

In vitro rat hepatocytes, unscheduled DNA synthesis positive (27).

In vitro mouse, dominant lethal assay, sperm morphology test and recessive spot test negative (28).

Other comments

Residue have been detected in natural waters and sediments (14).

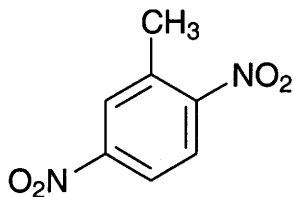
Environmental fate reviewed (14).

Toxicology reviewed (29-31).

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D500 2,5-dinitrotoluene



$C_7H_6N_2O_4$

Mol. Wt. 182.14

CAS Registry No. 619-15-8

Synonyms 2-methyl-1,4-dinitrobenzene

EINECS No. 210-581-4

RTECS No. XT 1750000

Uses In the manufacture of explosives and dyestuffs.

Physical properties

M. Pt. 52.5°C **Specific gravity** 1.282 at 111°C **Partition coefficient** $\log P_{ow}$ 2.0 (calc.) (1)

Solubility Organic solvents: benzene, carbon disulfide, ethanol

Occupational exposure

US-TWA 0.15 mg m⁻³

UN No. 2038 **HAZCHEM Code** 2W **Conveyance classification** toxic substance

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects (R23/24/25, R33)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S37, S45)

Environmental fate

Adsorption and retention

Calculated K_{oc} 290 indicates moderate adsorption to soil and sediments (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 520, 650 mg kg⁻¹, respectively (3).

Irritancy

Dermal rabbit (24 hr) 500 mg caused moderate irritation (4).

Genotoxicity

Salmonella typhimurium TA98 with metabolic activation positive (5).

In vitro primary rat hepatocytes DNA damage negative (6).

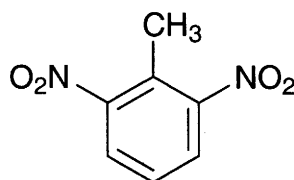
Other comments

Reviews on toxicity listed (7).

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D501 2,6-dinitrotoluene



$C_7H_6N_2O_4$

Mol. Wt. 182.14

CAS Registry No. 606-20-2

Synonyms 1-methyl-2,6-dinitrobenzene; 2-methyl-1,3-dinitrobenzene; 2,6-DNT

EINECS No. 210-106-0

RTECS No. XT 1925000

Uses Cathodic depolariser for magnesium batteries. Manufacture of dyestuffs and explosives.

Physical properties

M. Pt. 64-66°C B. Pt. 285°C Specific gravity 1.54 at 15°C with respect to water at 15°C

Partition coefficient $\log P_{ow}$ 1.72 (1) Volatility v.p. 3.5×10^{-4} mmHg at 20°C; v.den. 6.28

Solubility Organic solvents: chloroform, ethanol, ethylenediamine

Occupational exposure

US-TWA 0.15 mg m⁻³

UN No. 2038 HAZCHEM Code 2W Conveyance classification toxic substance

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects (R23/24/25, R33)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S37, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (14 day) guppy 18 mg l⁻¹ (2).

Invertebrate toxicity

EC₅₀ (15 min) *Photobacterium phosphoreum* 2.89 ppm Microtox test (3).

EC₅₀ (48 hr) *Daphnia magna* 34 mg l⁻¹ (4).

Bioaccumulation

Bioconcentration factor for algal biomass in model waste stabilisation pond 5225 (5).

Environmental fate

Nitrification inhibition

IC₅₀ (25 day) *Nitrosomonas* 180 mg l⁻¹ (6).

Anaerobic effects

IC₅₀ (50 day) methanogenic bacteria 7.9 mg l⁻¹ (6).

Abiotic removal

Reaction with photochemically produced hydroxyl radicals in the atmosphere t_{1/2} 8 hr (7).

Photolysis in water under sunlight t_{1/2} 17-24 hr (8,9).

Adsorption capacity of activated carbon 145 mg g⁻¹ carbon (10).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 180, 620 mg kg⁻¹, respectively (11,12).

Carcinogenicity and chronic effects

Oral rat (1 yr) 7 or 14 mg kg⁻¹ day⁻¹ resulted in 85 and 100% incidence of hepatocellular carcinomas, respectively (13).

Metabolism and toxicokinetics

Following oral administration to rats, unchanged 2,6-dinitrotoluene; 2-amino-6-nitrotoluene; 2,6-dinitrobenzyl alcohol; 2-amino-6-nitrobenzyl alcohol, and their conjugates were detected in the urine. These were also detected in the bile where the main metabolite was conjugated 2,6-dinitrobenzyl alcohol, accounting for 30% of the dose (14).

Intestinal microflora of ♂ Wistar rat transformed 2,6-dinitrotoluene into mutagenic 2,6-diaminotoluene after 12 hr incubation (15).

Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation (16).

Genotoxicity

Salmonella typhimurium TA98, TA100 with and without metabolic activation negative (17).

In vitro human primary hepatocytes DNA repair test positive, in rat primary hepatocytes negative (18).

In vivo rat hepatocytes, unscheduled DNA synthesis positive (19).

Other comments

Residues have been detected in natural waters and sediments (20).

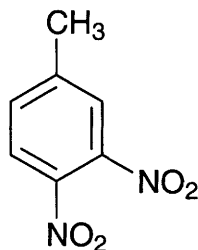
Toxicology reviewed (21,22).

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D502 3,4-dinitrotoluene



$C_7H_6N_2O_4$

Mol. Wt. 182.14

CAS Registry No. 610-39-9

Synonyms 4-methyl-1,2-dinitrobenzene; 3,4-DNT

EINECS No. 210-222-1

RTECS No. XT 2100000

Uses Manufacture of dyestuffs and explosives.

Physical properties

M. Pt. 54-57°C Flash point >110°C Specific gravity 1.26 at 111°C

Partition coefficient $\log P_{ow}$ 2.0 (calc.) (1)

Solubility Organic solvents: carbon disulfide, chloroform, ethanol, ethylenediamine

Occupational exposure

US-TWA 0.15 mg m⁻³

UN No. 2038 HAZCHEM Code 2W Conveyance classification toxic substance

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects (R23/24/25, R33)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S37, S45)

Ecotoxicity

Invertebrate toxicity

EC₅₀ (15 min) *Photobacterium phosphoreum* 6.92 ppm Microtox test (2).

EC₅₀ (96 hr) *Chlorella pyrenoidosa* 0.75 mg l⁻¹ (3).

EC₅₀ (48 hr) *Daphnia magna* 5.6 mg l⁻¹ (3).

Environmental fate

Abiotic removal

Reaction with photochemically produced hydroxyl radicals in the atmosphere, estimated t_{1/2} 8 hr (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 180, 750 mg kg⁻¹, respectively (4,5).

Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation (6).

Genotoxicity

Salmonella typhimurium TA98, TA100 with and without metabolic activation negative (7).

In vitro primary rat hepatocytes, DNA damage negative (8).

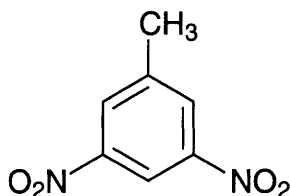
Other comments

Reviews on toxicity listed (9).

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D503 3,5-dinitrotoluene



C₇H₅N₂O₄

Mol. Wt. 182.14

CAS Registry No. 618-85-9

Synonyms 1-methyl-3,5-dinitrobenzene; 3,5-DNT

EINECS No. 210-566-2

RTECS No. XT 2150000

Uses Cathodic depolariser for magnesium batteries. Chemical intermediate.

Physical properties

M. Pt. 93°C **Specific gravity** 1.2772 at 111°C **Partition coefficient** $\log P_{ow}$ 2.28 (calc.) (1)
Solubility Organic solvents: benzene, carbon disulfide, chloroform, diethyl ether, ethanol

Occupational exposure

US-TWA 0.15 mg m⁻³

UN No. 2038 **HAZCHEM Code** 2W **Conveyance classification** toxic substance

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects (R23/24/25, R33)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S37, S45)

Environmental fate

Abiotic removal

Reaction with photochemically produced hydroxyl radicals in the atmosphere, estimated $t_{1/2}$ 87 days (2).

Adsorption and retention

Estimated K_{oc} 414 indicates that 3,5-dinitrotoluene is moderately adsorbed to soil and sediments (3).

Mammalian & avian toxicity

Acute data

LD_{50} oral rat, mouse 215, 610 mg kg⁻¹, respectively (4).

Genotoxicity

Salmonella typhimurium TA98, TA1538 without metabolic activation positive (5).

In vitro primary rat hepatocytes, DNA damage negative (6).

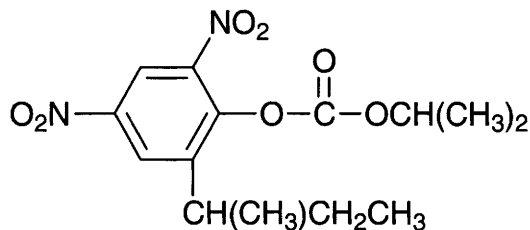
Other comments

Reviews on toxicity listed (7).

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D504 dinobuton



C₁₄H₁₈N₂O₇

Mol. Wt. 326.31

CAS Registry No. 973-21-7

Synonyms 2-sec-butyl-4,6-dinitrophenyl isopropyl carbonate; 1-methylethyl 2-(1-methylpropyl)-4,6-dinitrophenyl carbonate; 2-(1-methyl-2-propyl)-4,6-dinitrophenyl isopropyl carbonate; 2,4-dinitro-6-sec-butylphenyl isopropyl carbonate; Acamichem; Acarelte

EINECS No. 213-546-1

RTECS No. FF 9100000

Uses Acaricide. Fungicide. Wood preservative.

Physical properties

M. Pt. 56-61°C **B. Pt.** 103.4°C **Flash point** 12°C

Solubility Water: 1 mg l⁻¹ at 20°C. Organic solvents: acetone, xylene, aromatic and aliphatic hydrocarbons, ethanol, benzene, *n*-hexane, toluene

Occupational exposure

Supply classification toxic

Risk phrases Toxic if swallowed (R25)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S37, S45)

Ecotoxicity

Invertebrate toxicity

Toxic to bees (1).

Environmental fate

Degradation studies

Utilised as sole carbon source by *Pseudomonas* isolated from soil. Decomposed less rapidly by *Aspergillus* sp. (2).

Abiotic removal

Undergoes hydrolysis in aqueous solutions. Rate increases with temperature, pH and moisture content (3).

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird 650 µg kg⁻¹ (4).

LD₅₀ oral chicken 150 mg kg⁻¹ (5).

LD₅₀ oral rat, mouse, chicken 60-170 mg kg⁻¹ (6-5) .

LC_{Lo} inhalation rat (4 hr) 4850 µg m⁻³ (8).

LD₅₀ dermal rabbit 3200 mg kg⁻¹ (1).

LD_{Lo} dermal rat 1500 mg kg⁻¹ (6).

LD₅₀ intraperitoneal mouse 125 mg kg⁻¹ (9).

Metabolism and toxicokinetics

In mice and rats metabolism involves rapid hydrolysis to form 2-*sec*-butyl-4,6-dinitrophenol which then undergoes oxidation followed by conjugation. The esterases most active for dinobuton hydrolysis are present in the liver and blood (10).

Dinobuton is metabolised in sheep ruminal fluid to 2-amino-6-*sec*-butyl-4-nitrophenol, 68 mg kg⁻¹ dinobuton was incubated with ruminant fluid and 80% was decomposed within 30 min (11).

Oral rat, mouse (dose unspecified) rapidly hydrolysed, 100% eliminated via urine in rats and 74% eliminated via urine in mice within 72 hr (12).

Sensitisation

Prolonged or repeated exposure may result in contact sensitisation dermatitis (13).

Genotoxicity

Salmonella typhimurium TA1535, TA1537, TA1538 with and without metabolic activation negative (14).

Oral mouse 25 mg kg⁻¹ cytogenic analysis positive; a significant increase in the frequency of aberrant metaphases was induced (15).

In vitro bone marrow cells chromosomal aberrations positive (15).

Other effects

Other adverse effects (human)

Shows reversible binding with human protein albumin (16).

Any other adverse effects

Poisoning may increase the metabolic rate and affect the nervous system, liver and kidneys. In rats, yellow staining of sclerae and urine indicates absorption of potentially toxic amounts. Cataracts can form (13).

Induced dose-dependent muscular weakness, convulsions, disorders of the digestive tract and nervous system (17).

Gavage rat single dose 70 mg kg⁻¹ caused liver damage, indicated by increases in serum concentrations of total proteins, lipids, cholesterol, glycerides and alanine amino transferase (18).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (19).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (20). WHO Toxicity Class II (21).

Other comments

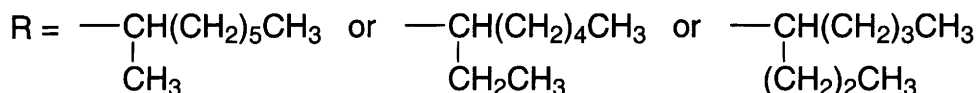
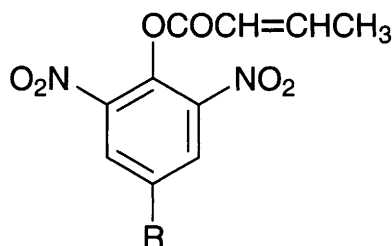
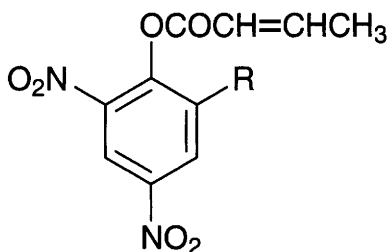
Dust air mixtures may ignite or explode. Incompatible with alkaline materials.

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21. *The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification* 1998-1999 WHO/PCS/98.21

D505 dinocap



C₁₈H₂₄N₂O₆

Mol. Wt. 364.40

CAS Registry No. 39300-45-3

Synonyms 2(or 4)-isooctyl-4,6(or 2,6)-dinitrophenyl 2-butenate; capryldinitrophenyl crotonate; Afrodane; Agrenocap; Aplotin; Cekucap; Dinobas; Ethane; Fenocap

EINECS No. 254-408-0

RTECS No. GQ 5775000

Uses Acaricide. Fungicide. Wood preservative.

Physical properties

B. Pt. 138-140°C at 0.05 mmHg **Specific gravity** 1.10 at 20°C **Partition coefficient** log P_{ow} 4.537 (1)

Volatility v.p. 4×10^{-8} mmHg at 20°C

Solubility Water: <0.1 mg l⁻¹. Organic solvents: acetone, heptane, methanol

Occupational exposure

Supply classification harmful, irritant

Risk phrases Harmful if swallowed – Irritating to the skin (R22, R38)

Safety phrases Keep out of reach of children (if sold to general public) – Wear suitable gloves (S2, S37)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout, bluegill sunfish 15-20 µg l⁻¹, temperature range 13-18°C (2).

Environmental fate

Degradation studies

In soil, the principal metabolite from microbial degradation is 4,6-dinitro-2-(2-octyl)phenol. $t_{1/2}$ in silt loam and fine sandy loam 4.5-6 days (3,4).

Degradation of labelled compound in three soils was investigated using 9 mg kg⁻¹ soil at 15 and 25°C.

Degradation rate in parabraunerde soil was one order of magnitude higher than two standard soils (3.3 and 5.1%, respectively) during 100 days (3).

Abiotic removal

>99% removal from wastewaters effected by filtration through medium of organic media composed of peat, moss and manure (5).

Effectively removed from water by ozonation (6).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat ♂ ♀ 980, 1190 mg kg⁻¹, respectively (4).

LD₅₀ oral mouse, dog 50, 100 mg kg⁻¹, respectively (7,8).

LC₅₀ (4 hr) inhalation rat 360 mg m⁻³ (1).

LD₅₀ dermal rabbit 9400 mg kg⁻¹ (9).

LD₅₀ intravenous rat 23 mg kg⁻¹ (10).

LD₅₀ intraperitoneal ♂, ♀ rat 48-51 mg kg⁻¹ (11).

Sub-acute and sub-chronic data

Oral rat (90 day) 150 mg kg⁻¹ caused degenerative and necrotic alterations in liver, kidneys and stomach which were more intense after 2-3 months. Changes in composition of blood and urine also occurred. Lower dose 30 mg kg⁻¹ caused slight effects (12).

Carcinogenicity and chronic effects

Oral rat, dog (2 yr) no-adverse-effect level for rats 6-8 mg kg⁻¹ day⁻¹ and for dogs 0.4 mg kg⁻¹ day⁻¹ (1).

Teratogenicity and reproductive effects

Gavage mouse 0, 5, 10, 20, 40, 80 or 120 mg kg⁻¹ day⁻¹ on days 7-16 of gestation. The highest dose killed 80% of dams and the 80 mg kg⁻¹ dose killed 29% of dams during the test period. Maternal weight gain was also affected in the 80 and 120 mg kg⁻¹ groups. There were no live foetuses in the high-dose groups. The number of live foetuses per litter decreased and the number of resorptions increased at 80 mg kg⁻¹. There was a dose-related decrease in gravid uterus weight and foetal weight, and increase in cleft palate in all treated groups (13).

EPA has determined that dinocap is teratogenic in laboratory animals (14).

Dietary administration to ♂ and ♀ rats (4 generations) 105-126 mg kg⁻¹ day⁻¹ gradually decreased weight and food intake. Offspring survival was decreased in the second generation (15).

Metabolism and toxicokinetics

Following oral administration to rats, dinocap is rapidly and almost entirely eliminated in the urine and faeces. In dairy cows, dinocap and its metabolites are excreted almost entirely in the faeces, with only a small amount in the urine. The nitro-groups are enzymatically reduced to amino-groups, and ester hydrolysis also takes place (1).

Genotoxicity

Salmonella typhimurium TA98, TA1537, TA1538 with metabolic activation positive (16).

Nicotiana tabacum variant *xanthi* somatic mutation assay negative (17).

Other effects

Other adverse effects (human)

♀ greenhouse workers had liver function abnormalities of varying degrees depending on duration of occupational contact (18).

Any other adverse effects

Dermal ♀ rabbit, rhesus monkeys (6 hr) 25 mg kg⁻¹ day⁻¹ for 13 days. 4-9% was absorbed. It was concluded that there is no unreasonable developmental risk to man (19).

Legislation

EEC maximum residue limit for fruit and vegetables 0.1 ppm (1).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (20).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (19).

WHO Toxicity Class III (21).

EPA Toxicity Class III (1).

Other comments

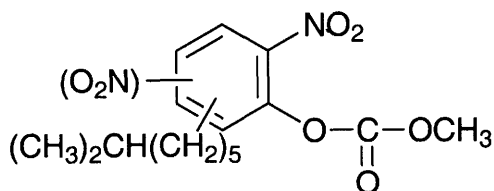
Occurs as a mixture of isomers: 2,6-dinitro-4-octylphenyl crotonates and 2,4-dinitro-6-octylphenyl crotonates in which "octyl" is a mixture of 1-methylheptyl, 1-ethylhexyl and 1-propylpentyl groups.

The commercial material consists of 2.0-2.5 parts of the 2,4-dinitro-6-acetylphenyl crotonates to 1.0 part of the 2,6-dinitro-4-octylphenyl crotonates. The former are more effective as acaricides and the latter as fungicides (1). Reviews on toxicity listed (22).

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D506 dinocton



$C_{16}H_{22}N_2O_7$

Mol. Wt. 354.36

CAS Registry No. 104078-12-8

Synonyms carbonic acid, 2(or 4)-isooctyl-4,6 (or 2,6)-dinitrophenyl methyl ester

RTECS No. FG 1788800

Occupational exposure

Supply classification harmful

Risk phrases Harmful if swallowed (R22)

Safety phrases Keep out of reach of children (if sold to general public) (S2)

Mammalian & avian toxicity

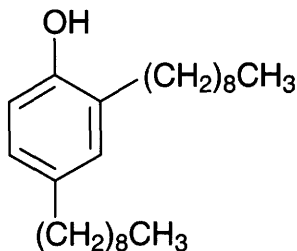
Acute data

LD₅₀ oral rat 1700 mg kg⁻¹ (1).

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D507 2,4-dinonylphenol



$C_{24}H_{42}O$

Mol. Wt. 346.60

CAS Registry No. 137-99-5

Synonyms

EINECS No. 205-310-1

Uses Solvent.

Physical properties

B. Pt. 207-225°C at 10 mmHg

Solubility Organic solvents: acetone, ethanol

Mammalian & avian toxicity

Sensitisation

Reported to cause skin sensitisation (1).

Legislation

Organic solvents are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (2).

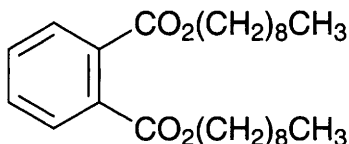
Other comments

Reviews on toxicity listed (3).

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D508 dinonyl phthalate



$C_{26}H_{42}O_4$

Mol. Wt. 418.62

CAS Registry No. 84-76-4

Synonyms dinonyl 1,2-benzenedicarboxylate; di-*n*-nonyl phthalate; Bisoflex 91

EINECS No. 201-560-0

RTECS No. TI 1800000

Uses Plasticiser. Solvent.

Physical properties

B. Pt. 413°C Flash point 141°C Specific gravity 0.972 at 20°C with respect to water at 20°C

Volatility v.p. 1 mmHg at 205°C

Occupational exposure

SE-LEVL 3 mg m⁻³

SE-STEL 5 mg m⁻³

UK-LTEL 5 mg m⁻³

Environmental fate

Degradation studies

Degraded by *Nocardia erythropolis* inoculated into activated sludge, undergoing hydrolysis of the ester (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 2000 mg kg⁻¹ (2).

LD₅₀ intraperitoneal mouse >10 g kg⁻¹ (3).

Sub-acute and sub-chronic data

Inhalation rat (12 day) exposure to saturated vapour for 6 hr day⁻¹ caused no adverse effects (2).

Legislation

Organic solvents are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

Other comments

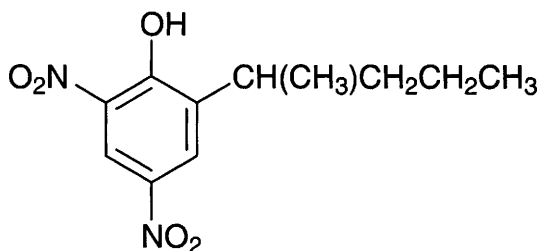
Toxicity of phthalate esters reviewed (5).

Reviews on toxicity listed (6).

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D509 dinosam



C₁₁H₁₄N₂O₅

Mol. Wt. 254.24

CAS Registry No. 4097-36-3

Synonyms 2-sec-amyl-4,6-dinitrophenol; 2-(1-methylbutyl)-4,6-dinitrophenol; 4,6-dinitro-*o*-sec-amylphenol; DNAP; **RTECS No.** SL 9275000

Uses Superseded herbicide.

Physical properties

B. Pt. 145°C at 0.05 mmHg

Occupational exposure

Supply classification toxic

Risk phrases Toxic by inhalation, in contact with skin and if swallowed (R23/24/25)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Keep away from food, drink and animal feeding stuffs – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S13, S45)

Mammalian & avian toxicity

Acute data

LD_{Lo} intraperitoneal mouse 3.8 mg kg⁻¹ (1).

Legislation

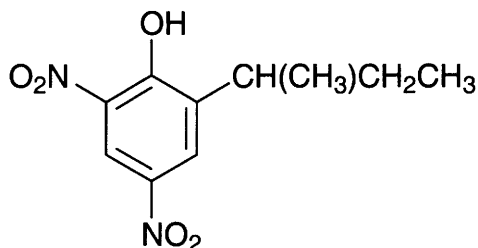
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (2).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (3).

References

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3. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D510 dinoseb



C₁₀H₁₂N₂O₅

Mol. Wt. 240.22

CAS Registry No. 88-85-7

Synonyms phenol, 2-(1-methylpropyl)-4,6-dinitro-; 2-sec-butyl-4,6-dinitrophenol; dinitrobutylphenol; 4,6-dinitro-2-(1-methyl-*n*-propyl)phenol; 2-(1-methylpropyl)-4,6-dinitrophenol; DNBP; Caldon; Dinopec; Gebutox; Liromort; Ovatox

EINECS No. 201-861-7

RTECS No. SJ 9800000

Uses Superseded herbicide and insecticide. Desiccant. Dormant fruit spray.

Physical properties

M. Pt. 38-42°C **Flash point** 177°C **Specific gravity** 1.2647 at 45 °C **Partition coefficient** log P_{ow} 3.69 (1)

Volatility v.p. 1 mmHg at 151°C ; v.den. 7.73

Solubility Water: 52 mg l⁻¹ at 25°C. Organic solvents: acetone, diethyl ether, ethanol, *n*-heptane, petroleum oils

Occupational exposure

Supply classification toxic, dangerous for the environment

Supply classification toxic

Risk phrases May cause harm to the unborn child – Possible risk of impaired fertility – Toxic in contact with skin and if swallowed – Irritating to the eyes – Risk of explosion if heated under confinement – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R61, R62, R24/25, R36, R44, R50/53)

Safety phrases Restricted to professional users – Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S53, S45, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) channel catfish 118 µg l⁻¹ (2).

LC₅₀ (96 hr) cutthroat trout 41-1350 µg l⁻¹ static bioassay at 10°C (3).

LC₅₀ (96 hr) lake trout 32-1400 µg l⁻¹ (3).

Invertebrate toxicity

Cell multiplication inhibition test *Pseudomonas putida* >40 mg l⁻¹, *Microcystis aeruginosa* 5.7 mg l⁻¹ (4).

Lethal threshold *Homarus americanus* 300 µg l⁻¹ (5).

LC₅₀ (96 hr) freshwater shrimp 1800 µg l⁻¹ (6).

Toxic to bees (7).

Environmental fate

Degradation studies

At a high soil application rate of 11 tons ha⁻¹ no biodegradation was observed. The pesticide was found to inhibit soil microorganisms at this level of application (8).

Incubations of 5 ppm in soil at 25°C for 60 days resulted in evolution of 36% of the applied ¹⁴C as ¹⁴CO₂ (9).

Pseudomonas aeruginosa and *Pseudomonas putida* grew readily with dinoseb as the sole carbon source (10).

Abiotic removal

Subject to photolytic degradation. t_{1/2} in sandy loam soil 14 hr. In water with natural sunlight dinoseb has t_{1/2} of 14-18 days, in artificial light this increased to 42-58 days (11).

>80% removal from dialysis water effected by reverse osmosis. Removal efficiency was not dependent on concentration (12).

t_{1/2} for reaction with photochemically produced hydroxyl radicals in the atmosphere 4.1 days (13).

t_{1/2} for evaporation from a soil surface 26 days (14).

99.98% removal from water at concentrations >0.1 mg l⁻¹. Langmuirian equilibrium constant (Q) 444 mg dinoseb g⁻¹ carbon (15,16).

Adsorption and retention

K_d <5 for four loam soils with organic matter of 0.8-3% (17).

Mammalian & avian toxicity

Acute data

LD₅₀ oral chicken 40 mg kg⁻¹ (18).

LD₅₀ oral redwing blackbird, starling, mallard duck 7-9 mg kg⁻¹ (19-21).

LD₅₀ oral mouse, rat 16, 25 mg kg⁻¹, respectively (22,23).

LD₅₀ dermal rat, rabbit 80 mg kg⁻¹ (24,25).

LD_{Lo} dermal guinea pig 500 mg kg⁻¹ (26).

LD₅₀ subcutaneous rat 20 mg kg⁻¹ (27).

Sub-acute and sub-chronic data

LC₅₀ (5 day) oral Japanese quail, ring-necked pheasant 409-515 mg kg⁻¹ (19).

Oral rat (153 day) 2.5-25 mg kg⁻¹ day⁻¹. Mortality was observed at ≥15 mg kg⁻¹, and growth was depressed in all treated animals (28).

Carcinogenicity and chronic effects

TD_{Lo} oral mouse (78 wk intermittent) 764 mg kg⁻¹ equivocal tumorigenic effects (29).

Oral rat (2 yr) 0, 1, 3 or 10 mg kg⁻¹ day⁻¹ caused a dose-related decrease in mean thyroid weight in ♂ rats. No other treatment related changes were observed in histopathology, haematology or blood chemistry (30).

Teratogenicity and reproductive effects

Oral ♂ rat (11 wk) 0, 3.8, 9.1, 15.6 or 22.2 mg kg⁻¹ day⁻¹. The fertility index was reduced to zero at 22.2 mg kg⁻¹ and to 10% at 15.6 mg kg⁻¹. Other effects were also observed for the ≥9.1 mg kg⁻¹, including decreased weight of the seminal vesicles, decreased sperm count and increased incidence of abnormal sperm (31).

Teratogenic when administered to rats in diet causing specific malformations but not embryolethality; gavage doses >5 mg kg⁻¹ caused maternal toxicity and embryotoxicity (32).

TD_{Lo} oral mouse (day-8 gestation) 26 mg kg⁻¹ musculoskeletal system developmental abnormalities (33).

TD_{Lo} oral ♂ rat (77 day) 1201 mg kg⁻¹, fertility effects reported (31).

Oral gravid CD-1 mice (8-12 days) 15 mg kg⁻¹ (maximum tolerated dose) in corn oil, no adverse effects reported (34).

Dermal rabbit, day 7-16 of gestation, no-adverse-effect level, teratogenic effects 1 mg kg⁻¹. Maternal toxicity was evident at this dose level (35).

Oral rat 0, 1, 3 or 10 mg kg⁻¹ day⁻¹ on day 6-15 of gestation. Slight depression of foetal body weight, increased incidence of absence of skeletal ossification for a number of sites and an increase in the number of supernumerary ribs were observed in the high-dose groups (36).

Metabolism and toxicokinetics

Metabolites include butanoic acid; 2-sec-butyl-4-nitro-6-aminophenol; 2-sec-butyl-4-acetamido-6-nitrophenol and 2-(3,5-dinitro-2-hydroxyphenyl)-2-methylpropanoic acid (37-39).

Following oral administration to rats, ≈25% of the dose appeared in faeces; in mice 20% was excreted in urine and 30% in faeces. However, following intraperitoneal administration in the mouse ≈40% appeared in the faeces, suggesting that dinoseb is initially completely absorbed following oral administration with subsequent secretion into the gut. No appreciable accumulation occurred in the blood, liver or kidneys (40).

Partially absorbed through the skin of adult and young rats. Fractional penetration was observed throughout the dose range of 5-650 µg m⁻² (41).

Irritancy

Dermal rabbit 200 mg applied five times did not cause irritation (25).

Administration of 50 µg for 24 hr to rabbit eye caused severe irritation (42).

Genotoxicity

Escherichia coli WP2 *uvrA* with and without metabolic activation negative (43).

Drosophila melanogaster sex-linked recessive lethal assay negative (44).

In vitro human lung fibroblasts WI-38, unscheduled DNA synthesis negative (42).

Non-mutagenic in a number of organisms including: *Salmonella typhimurium*, *Escherichia coli*, *Saccharomyces cerevisiae*, *Drosophila melanogaster* and *Bacillus subtilis* (44-46).

Other effects

Other adverse effects (human)

One death has been attributed to accidental exposure of a farm worker to sprayed dinoseb and dinitro-*o*-cresol (47).

Any other adverse effects

Readily absorbed through skin in lethal amounts in rabbits and guinea pigs. Health problems associated from skin contact, inhalation or ingestion are discussed (26).

Affects the metabolic rate, central nervous system, liver and kidney of rats. Yellow staining of sclerae and urine indicates absorption of potentially toxic amounts (48).

Inhibits respiratory electron transport, and uncouples oxidative phosphorylation in humans and experimental animals (19).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration $0.1 \mu\text{g l}^{-1}$ (49).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (50).

Log P_{ow} exceeds EC limit.

WHO Toxicity Class Ib (51).

Other comments

Residues have been detected in surface and groundwater (17,52).

Toxicity reviewed (53,54).

Physical properties, occurrence, environmental fate, metabolism, mammalian toxicology, mutagenicity, carcinogenicity, health advisories, analysis and treatment reviewed (17,52).

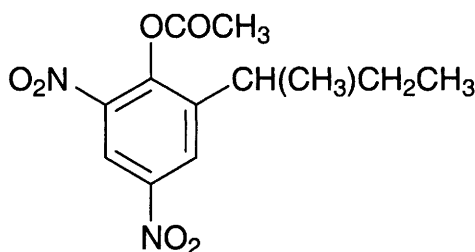
Metabolic pathways reviewed (55).

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D511 dinoseb acetate



$C_{12}H_{14}N_2O_6$

Mol. Wt. 282.25

CAS Registry No. 2813-95-8

Synonyms 2,4-dinitro-6-sec-butylphenyl acetate; 2-(1-methylpropyl)-4,6-dinitrophenyl acetate; 2-sec-butyl-4,6-dinitrophenyl acetate; 4,6-dinitro-2-sec-butylphenyl acetate; Kabre; Kabrol; Nitrofan N; Superfanox

EINECS No. 220-560-1

RTECS No. AF 7140000

Uses Superseded herbicide. Wood preservative.

Physical properties

M. Pt. 26-27°C **B. Pt.** 170°C at 4 mmHg **Volatility** v.p. 2.1×10^{-4} mmHg at 43°C

Solubility Water: 2.2 g l⁻¹ at 20°C. Organic solvents: benzene, phenol, toluene

Occupational exposure

Supply classification toxic

Risk phrases May cause harm to the unborn child – Possible risk of impaired fertility – Toxic in contact with skin and if swallowed – Irritating to the eyes – Risk of explosion if heated under confinement (R61, R62, R24/25, R36, R44)

Safety phrases Restricted to professional users – Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S53, S45)

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 55-65 mg kg⁻¹ (1).

LC₅₀ (4 hr) inhalation rat 1.3 g l⁻¹ (air) (1).

Carcinogenicity and chronic effects

Oral rat, dog (2 yr), no-adverse-effect level for rats 100 mg kg⁻¹ diet and for dogs 8 mg kg⁻¹ diet (1).

Metabolism and toxicokinetics

In mammals metabolised by oxidation of the *sec*-butyl side-chain, conjugation, and in rats (but not in mice) reduction of one of the nitro-group s and acylation of the amino-group formed (1).

Other effects

Any other adverse effects

Toxicity in mammals is caused by uncoupling of oxidative phosphorylation (1).

Gavage rat, single dose 25 mg kg⁻¹ caused changes in diurnal rhythm of haemoglobin concentration and erythrocyte count (2).

Legislation

EEC maximum residue limit for fruit and vegetables 0.05 ppm (1).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (3).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

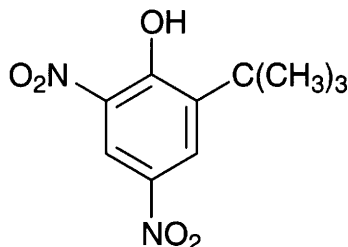
Other comments

Residues have been isolated from drinking water (5).

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D512 dinoterb



$C_{10}H_{12}N_2O_5$

Mol. Wt. 240.22

CAS Registry No. 1420-07-1

Synonyms 2-*tert*-butyl-4,6-dinitrophenol; 2-(1,1-dimethylethyl)-4,6-dinitrophenol; *o*-*tert*-butyl-4,6-dinitrophenol; 2,4-dinitro-6-*tert*-butylphenol; DNTBP; Herbogil; Extar Forte; Stirpan

EINECS No. 215-813-8

RTECS No. SK 0160000

Uses Herbicide. Oxidative phosphorylation uncoupler.

Physical properties

M. Pt. 125.5-126.5°C **Volatility** v.p. 1.504 mmHg at 20°C

Solubility Water: 4.5 mg l⁻¹ at 25°C, pH 5.0. Organic solvents: aliphatic hydrocarbons, cyclohexanone, dimethyl sulfoxide, ethanol, ethyl acetate, glycols

Occupational exposure

Supply classification toxic

Risk phrases May cause harm to the unborn child – Toxic in contact with skin and if swallowed – Irritating to the eyes – Risk of explosion if heated under confinement (R61, R24/25, R36, R44)

Safety phrases Restricted to professional users – Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S53, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout 3.4 µg l⁻¹ (1).

Invertebrate toxicity

Toxic to bees (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rabbit, rat 25, 28, 62 mg kg⁻¹, respectively (2-4).

LD₅₀ dermal guinea pig 150 mg kg⁻¹ (3).

Carcinogenicity and chronic effects

In 2-yr feeding trials no-effect level for rats was 375 µg kg⁻¹ diet (4).

Metabolism and toxicokinetics

In rats, following oral administration 98% excreted in the faeces and urine within 7 days (4).

Sensitisation

Allergic sensitisation can occur (5).

Other effects

Other adverse effects (human)

Moderate direct toxicity was observed with *in vitro* human granulomonocytic progenitor-cells, suggesting myelosuppressive activity (6).

Systemic effects include fatigue, weakness, fever, thirst, nausea, vomiting, headaches, excessive perspiration, tachycardia, tachypnoea, and dyspnoea. Cerebral, circulatory, respiratory injury and damage to heart, kidney and liver can occur (5).

Legislation

WHO Toxicity Class Ib (7).

Other comments

Toxicity and physiochemical data of dinoterb reviewed (8).

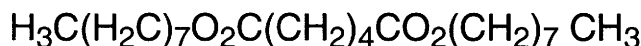
From 1977 to 1979, 274 samples of game animals found dead in fields of France were analysed for pesticide residues. Dinoterb was found in 21.5% of animals analysed (9).

Incompatible with metals. Decomposes above 220°C. Corrosive.

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D513 di-*n*-octyl adipate



C₂₂H₄₂O₄

Mol. Wt. 370.57

CAS Registry No. 123-79-5

Synonyms hexanedioic acid, dioctyl ester; octyl adipate; adipic acid, dioctyl ester; Good-rite GP-223; Jayflex DOA; Kodaflex DOA; Uniflex DOA

EINECS No. 204-652-9

Uses Plasticiser.

Physical properties

M. Pt. -70°C **B. Pt.** 360°C **Flash point** 206°C (open cup) **Specific gravity** 0.927 at 20°C with respect to water at 20°C

Mammalian & avian toxicity

Sub-acute and sub-chronic data

Oral guinea pig (21 day) 5 mg kg⁻¹ day⁻¹ was not fatal, while 100 mg kg⁻¹ day⁻¹ caused 100% fatality (1).

Oral rat (6 month) 0.4, 1.0 or 2.0 g kg⁻¹ day⁻¹ caused no enzyme changes, specifically of catalase, but increased the sulphhydryl compounds in the rat blood (2).

Oral rat (10 month) 100 mg kg⁻¹ day⁻¹ decreased central nervous excitability after 6 month (2).

Other comments

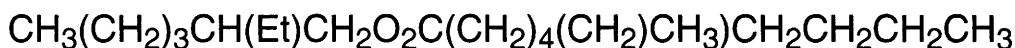
Reviews on toxicity listed (3).

Autoignition temperature 377°C.

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D514 di-sec-octyl adipate



C₂₂H₄₂O₄

Mol. Wt. 370.57

CAS Registry No. 103-23-1

Synonyms di-2-ethylhexyl adipate; bis(2-ethylhexyl) adipate; hexanedioic acid, bis(2-ethylhexyl) ester; Morflex 310; Palatinol DOA; Crodamol DOA; Corflex DOA; Bisoflex DOA

EINECS No. 203-090-1

RTECS No. AU 9700000

Uses Solvent. Aircraft lubricants. Plasticiser. Has been used as a plasticiser or solvent in bath oils, eye shadow, cologne, foundations, rouge, blusher, nail polish remover, moisturisers and indoor tanning preparations. Food packaging in Europe.

Occurrence

In bulbs of *Lilium lancifolium* (1).

Physical properties

M. Pt. -67.8°C B. Pt. 417°C Flash point 110°C Specific gravity 0.990

Volatility v.p. 26 mmHg at 200°C; v.den. 12.8

Solubility Water: <1 g l⁻¹ at 28°C. Organic solvents: dimethyl sulfoxide, ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 9, 15 g kg⁻¹, respectively (2,3).

LD₅₀ dermal rabbit 8410 mg kg⁻¹ (4).

LD₅₀ intravenous rabbit, rat 540, 900 mg kg⁻¹, respectively (4).

Carcinogenicity and chronic effects

No adequate evidence of carcinogenicity to humans, limited evidence to animals, IARC classification group 3 (5).

TD_{Lo} oral mouse (2 yr continuous) 1038 g kg⁻¹ (total dose) induced liver carcinomas (6).

Teratogenicity and reproductive effects

Adult ♀ Sprague-Dawley rats were treated with 1, 5 or 10 ml kg⁻¹ (undiluted) by intraperitoneal injection on days 5, 10, 15 of gestation. Resorptions, foetal death, gross, skeletal and visceral abnormalities were observed in animals treated with 5 and 10 ml kg⁻¹ (7).

Metabolism and toxicokinetics

Administration at 2% level for 2 wk in rats caused an increase in hepatic phospholipids and a decrease in the ratio of phosphatidylcholine to phosphatidylethanolamine (8).

Radioactively labelled bis(2-ethylhexyl) adipate was administered intravenously or intragastrically to ♂ rats and mice. During the first 24 hr high levels of radioactivity was observed in the body fat, liver and kidneys (9).

Irritancy

Instillation of 500 mg to rabbit eye, (24 hr) caused mild irritation (10).

Dermal rabbit 500 mg (duration unspecified) caused mild irritation (11).

Genotoxicity

400 µg ml⁻¹ hamster ovary cell lines without metabolic activation chromosomal aberrations positive (12,13).

Administration oral rat 378 µg kg⁻¹ (140 mg kg⁻¹) unscheduled liver DNA synthesis positive (14).

Intraperitoneal mouse 10 ml kg⁻¹ dominant lethal mutations positive in both post-meiotic and pre-meiotic stages of spermatogenesis (15).

Other effects

Any other adverse effects

Found to be a peroxisome proliferator in the liver of rodents (16).

14-day administration of bis(2-ethylhexyl) adipate to ♂ F344 rats and ♀ B6C3F₁ mice induced hepatic peroxisome proliferation (17,18).

Other comments

Has been detected in concentration ranges 0.02-30 µg l⁻¹ in rivers in the US (19-21).

Experimental toxicology and human health effects reviewed (22).

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D515 di-sec-octylamine



C₁₆H₃₅N

Mol. Wt. 241.46

CAS Registry No. 106-20-7

Synonyms bis(2-ethylhexyl)amine; 2,2'-diethyldihexylamine; 2-ethyl-N-(2-ethylhexyl)-1-hexanamine; dioctylamine; Amine 8 D

EINECS No. 203-372-4

RTECS No. IH 6825000

Uses Synthesis of dyestuffs. Insecticide. Emulsifying agents.

Physical properties

B. Pt. 281°C

Solubility Water: <1 mg ml⁻¹ at 21°C. Organic solvents: acetone, dimethyl sulfoxide, ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1640 mg kg⁻¹ (1).

LD₅₀ dermal rabbit 1190 mg kg⁻¹ (2).

LD₅₀ intraperitoneal mouse 800 mg kg⁻¹ (3).

Irritancy

Skin, eyes and mucous membranes irritant (rat) (4).

Dermal rabbit (24 hr) produced severe irritation and 50 µg instilled into rabbit eye for 24 hr produced severe irritation (5).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (6).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (7).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (8).

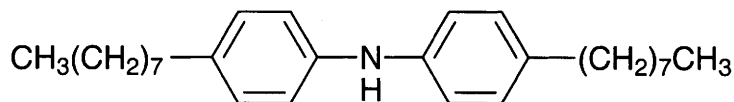
Other comments

Lachrymator.

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D516 4,4'-dioctyldiphenylamine



C₂₈H₄₃N

Mol. Wt. 393.66

CAS Registry No. 101-67-7

Synonyms 4-octyl-N-(4-octylphenyl)benzeneamine; Vanox 12; Vanox ODP

EINECS No. 202-965-5

Uses Antioxidant for petroleum products.

Physical properties

M. Pt. 80-90°C **Specific gravity** 0.99 at 20°C

Solubility Organic solvents: acetone, benzene, ethanol, ethylene dichloride, gasoline

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 8000 mg kg⁻¹ (1).

Genotoxicity

In vitro Chinese hamster ovary cells and lung cells, chromosomal aberrations negative (2).

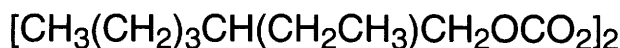
Other comments

Reviews on toxicity listed (3).

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D517 di-sec-octyl peroxydicarbonate



C₁₈H₃₄O₆

Mol. Wt. 346.46

CAS Registry No. 16111-62-9

Synonyms bis(2-ethylhexyl) peroxydicarbonate; bis(ethylhexyl) peroxydicarbonate; Trigonox EHP

EINECS No. 240-282-4

RTECS No. SD 9700000

Uses Catalyst for polymerisation.

Physical properties

Flash point 63°C

Occupational exposure

UN No. 2123

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1020 mg kg⁻¹ (1).

Other comments

Reviews on experimental toxicology and human health effects listed (2).

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D518 di-sec-octyl phosphate



C₁₆H₃₅O₄P

Mol. Wt. 322.43

CAS Registry No. 298-07-7

Synonyms bis(2-ethylhexyl) phosphate; bis(2-ethylhexyl) hydrogen phosphate; bis(2-ethylhexyl)orthophosphoric acid; di(2-ethylhexyl)phosphate; 2-ethyl-1-hexanol hydrogen phosphate

EINECS No. 206-056-4

RTECS No. TB 7875000

Uses Cation extracting agent. Heavy metal extraction.

Physical properties

M. Pt. -60°C **Flash point** 171°C (open cup) **Specific gravity** 0.965 at 20°C with respect to water at 4°C

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 4940 mg kg⁻¹ (1).

LD₅₀ dermal rabbit 1250 mg kg⁻¹ (1).

LD₅₀ intraperitoneal rat 50 mg kg⁻¹ (2).

LD_{Lo} intraperitoneal mouse 63 mg kg⁻¹ (3).

Sub-acute and sub-chronic data

Exposure of rats to 1% or 3% bis(2-ethylhexyl)phosphate in the diet for 5 days results in 2-3 fold induction of liver cytosolic epoxide hydrolase activity and microsomal cytochrome P450 content (4).

Irritancy

Dermal rabbit (24 hr) 5 mg caused mild irritation (5).

250 mg instilled into eye rabbit for 24 hr caused severe irritation (5).

Other comments

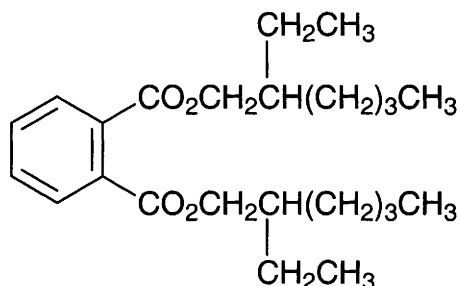
Reviews on human health effects and experimental toxicology listed (6).

Ingredient in barrier cream for protecting hands from sensitising metals (7).

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D519 dioctyl phthalate



C₂₄H₃₈O₄

Mol. Wt. 390.56

CAS Registry No. 117-81-7

Synonyms 2-ethylhexyl phthalate; di-sec-octyl phthalate; bis(2-ethylhexyl) phthalate; 1,2-benzenedicarboxylic acid, dioctyl ester; DOP; DEHP; Morflex 210; Kodalfex DOP; Palatinol DOP; PX-138; Vestinol AH

EINECS No. 204-211-0

RTECS No. TI 0350000

Uses Plasticiser. Pump fluid.

Physical properties

M. Pt. -50°C **B. Pt.** 384°C **Flash point** 207°C **Specific gravity** 0.977 at 20°C with respect to water at 4°C

Partition coefficient log P_{ow} 5.11 (1) **Volatility** v.p. 6.45 × 10⁻⁶ mmHg at 25°C

Solubility Water: 0.003 mg l⁻¹ at 25°C (2). Organic solvents: acetone, dimethyl sulfoxide, ethanol

Occupational exposure

DE-MAK 10 mg m⁻³

FR-VME 5 mg m⁻³

JP-OEL 5 mg m⁻³

SE-LEVEL 3 mg m⁻³

UK-LTEL 5 mg m⁻³

US-TWA 5 mg m⁻³

SE-STEL 5 mg m⁻³

UK-STEL 10 mg m⁻³

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr, flow-through) bluegill, fathead minnow, sheepshead minnow, medaka >100, >0.67, >0.17, >0.67, respectively (3-5).

Invertebrate toxicity

No significant increase in mortality of larvae *Palaemonetes pugio-holthius* after 26 days exposure to 1 mg l⁻¹ (6).

Bioaccumulation

Oedogonium sp. exposed to 0.34 µg l⁻¹ for 33 days in water, bioconcentration factor 53,890. *Physa* sp. exposed to 0.34 µg l⁻¹ for 33 days in water, bioconcentration factor 21,500. *Daphnia magna* exposed to 0.1 mg l⁻¹ for 48 hr in water, bioconcentration factor 183. *Physa* sp. exposed to 0.1 mg l⁻¹ for 48 hr in water, bioconcentration factor 858. *Elodea canadensis* exposed to 0.1 mg l⁻¹ for 48 hr in water, bioconcentration factor 232 (7).

Environmental fate

Degradation studies

Aerobic degradation in freshwater hydrosol: 50% after 14 days incubation (8).

Anaerobic degradation in freshwater hydrosol: 0% after 30 days incubation (9).

Phthalate esters undergo ≥ 50% ultimate degradation within 28 days in standardised aerobic biodegradation tests with sewage sludge inocula. Biodegradation is expected to be the dominant loss mechanism in surface water, soils and sediments (10).

Biodegradation aquatic model ecosystem, t_{1/2} 5 days, by the route: diester → monoester → diacid (11).

Abiotic removal

Photolysis (estimated) t_{1/2} 143 days (12).

Evaporation rate relative to *n*-butyl acetate which has been assigned a value of 1 at 25°C is 2.17 (13).

Adsorption and retention

Strongly adsorbed by aquatic sediments (14).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 30, 33 g kg⁻¹, respectively (15,16).

LD₅₀ dermal rabbit 25 g kg⁻¹ (17).

LD₅₀ intraperitoneal rat, mouse 30, 38 g kg⁻¹, respectively (15,18).

Sub-acute and sub-chronic data

Lethal effect appears to be cumulative, since the sub-acute LD₅₀ of intraperitoneal administration to mice 5 × wkly for 10 wk was 1.36 g kg⁻¹ (18).

LC₅₀ (8 day) mallard duck, ring-necked pheasant >5000 mg kg⁻¹ (diet) (19).

Oral marmosets (13 wk) 100, 500, or 2500 mg kg⁻¹ day⁻¹. Clofibrate was administered at 250 mg kg⁻¹ as a reference drug. The increases in liver mass, hepatic hypertrophy and peroxisome proliferation seen in rodents were not found in marmosets, neither were atrophic change in the testis or proliferative change in the pancreatic acinar cells. There were no changes in blood chemistry or pathological changes in other organs (20).

Carcinogenicity and chronic effects

Tumours found in liver in ♀ rats and ♂ and ♀ mice. Liver carcinomas and adenomas found in ♂ rats (21).

Site-specific tumour analysis showed carcinogenicity in mice and rats (22).

Teratogenicity and reproductive effects

Teratogenicity of this compound and its metabolite mono(2-ethylhexyl) phthalate has been demonstrated in rats and mice (23).

Serum oestradiol levels were suppressed in adult ♀ rats by the administration of dioctyl phthalate daily for a maximum of 12 days. Hypoestrogenic anovulatory oestrus cycles and the development of polycystic ovaries followed (24).

Has been shown by several studies to cause testicular damage in rats (22).

♂ Rats administered dioctyl phthalate 10 or 20 g kg⁻¹ in diet suffered pituitary changes and dose-dependent atrophy of the testes after approximately 2 wk of feeding. Subsequent investigations showed that reduction in testicular and prostate zinc levels and concomitant increased urinary excretion of zinc also occurred (25,26).

Metabolism and toxicokinetics

Following oral administration, metabolised by intestinal cells and gut contents to mono(2-ethylhexyl) phthalate and 2-ethylhexanol (27).

There is little tissue accumulation, highest concentration being found in the liver. Estimated $t_{1/2}$, including metabolites, 3-5 days in fat, 1-2 days in other tissues. Metabolites in rats include: 5-keto-2-ethylhexyl phthalate, 5-carboxy-2-ethyl phthalate, 5-hydroxy-2-ethyl phthalate, and 2-(carboxymethyl)butyl phthalate after initial hydrolysis to mono(2-ethylhexyl) phthalate. The major routes of elimination are urinary and biliary excretion (28). In contrast, African green monkeys and ferrets excrete glucuronide derivatives of mono(2-ethylhexyl) phthalate in urine (29,30).

The response of enlarged livers, deficient in glycogen and triglycerides with excessive amounts of phospholipids, is indicative of a transformation from glycolysis to lipolysis as an energy source. It was concluded that gluconeogenesis is inhibited by preventing the conversion of 3-phosphoglycerate into fructose-1,6-diphosphate (31).

In humans, excreted in urine as derivatives of the glucuronide. Following intravenous administration to humans, it is cleared rapidly from the serum; the majority is excreted in the urine within 24 hr (32).

Irritancy

Dermal rabbit (24 hr) 500 mg produced mild irritation and 500 mg instilled into rabbit eye for 24 hr produced mild irritation (33).

Sensitisation

Only slightly or non-sensitising when applied to human skin (15).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1538, TA97, TA1537 with and without metabolic activation negative (21).

Caused dominant lethal mutations in mice after systemic but not topical administration (23).

Other effects

Other adverse effects (human)

A human subject who swallowed 10 g experienced gastritis and purgation, while there were no such effects in another who swallowed 5 g (15).

Any other adverse effects

Adverse effects in mice and rats included an increase in liver and kidney weight, formation of renal cysts and reduction in weight gain (22).

Peroxisome proliferator in the rat (34).

Other comments

Has been detected in blood stored in polyvinyl chloride bags at levels ≤ 250 mg l⁻¹ and in various body tissues in subjects who received haemodialysis or blood transfusions (23).

Toxicity and hazards reviewed (35).

Aquatic toxicity of eighteen phthalate compounds reviewed (2).

The environmental fate of eighteen phthalate esters reviewed (10).

Environmental health criteria reported (36).

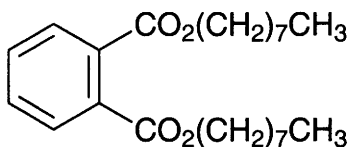
Residues have been detected in air and water. Has also been detected in sediments from manufacturing processes, and as leachate from plastic products wastes (37).

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D520 di-*n*-octyl phthalate



C₂₄H₃₈O₄

Mol. Wt. 390.56

CAS Registry No. 117-84-0

Synonyms dioctyl phthalate; di-*n*-octyl *o*-phthalate; 1,2-benzenedicarboxylic acid, dioctyl ester; Dinopol NOP

EINECS No. 204-214-7

RTECS No. TI 1925000

Uses Lubricating oil additive. Plasticiser. Solvent.

Physical properties

M. Pt. -50°C B. Pt. 384°C Flash point 210°C Specific gravity 0.978 at 20°C with respect to water at 20°C
Volatility v.p. 1.2 mmHg at 200°C ; v.den. 13.45
Solubility Water: 0.0005 mg l⁻¹ (1). Organic solvents: acetone, benzene, dimethyl sulfoxide, ethanol

Occupational exposure

SE-LEVL 3 mg m⁻³

SE-STEL 5 mg m⁻³

Ecotoxicity

Fish toxicity

Not acutely toxic to fathead minnow (96 hr) at concentrations exceeding water solubility (2).
LC₅₀ (7 day) channel catfish, red ear sunfish 0.7, 6.0 mg l⁻¹, respectively (3).

Invertebrate toxicity

NOEC (24 hr, growth inhibition) *Tetrahymena pyriformis* 100 mg l⁻¹ (4).
LC₅₀ (48 hr, static renewal) *Daphnia magna* > 10.0 mg l⁻¹ (5).

Bioaccumulation

Bioconcentration factor in mosquito fish in model ecosystem was 130 at concentrations of 0.34 µg l⁻¹ for 33 days (6).

Environmental fate

Degradation studies

Phthalate esters undergo ≥ 50% ultimate degradation within 28 days in standardised aerobic biodegradation tests with sewage sludge inocula. Biodegradation is expected to be the dominant loss mechanism in surface water, soils and sediments (7).

Persisted in sewage sludge under anaerobic conditions at concentrations of 0.5-10 mg l⁻¹ (8).
>98% removal from wastewater by activated sludge inoculated with *Nocardia erythropolis* after 1 day incubation (9).

Abiotic removal

Reaction with photochemically produced hydroxyl radicals in the atmosphere t_{1/2} 13.8 hr (10).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 53.7 g kg⁻¹ (11).
LD₅₀ dermal guinea pig >5 g kg⁻¹ (12).
LD₅₀ intraperitoneal mouse 65 g kg⁻¹ (13).

Sub-acute and sub-chronic data

LC₅₀ (5 day) oral ringnecked pheasant, mallard duck >5000 mg kg⁻¹ diet (14).
Oral rat (5 day) 2.5, 5.0 or 10 mg kg⁻¹ caused a dose-dependent alteration to the immune system, impairing the rejection of *Nippostrongylus brasiliensis* and increasing susceptibility to endotoxin toxicity. Also, phagocytosis of erythrocytes by peritoneal exudate cells were reduced (11).
Intraperitoneal rat (90 day) 13, 40 or 80 mg kg⁻¹ 5 day wk⁻¹ caused irreversible kidney damage (15).

Teratogenicity and reproductive effects

Oral mouse 0, 1.25, 2.5 in 5.0% in diet following a continuous breeding protocol for 105 days caused no adverse reproductive effects in relation to number of litters, live pups per litter and pup weight (16).

Metabolism and toxicokinetics

Following oral administration to rats hydrolysed to the mono-ester in the gastro-intestinal tract (17).

Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation, and 500 mg instilled into rabbit eye for 24 hr caused mild irritation (18).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (19).
Escherichia coli W3100 (pol A+) and P3478 (pol A-) with and without metabolic activation negative (20).

Legislation

Organic solvents are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (21).

Other comments

Toxicity reviewed (22,23).
Autoignition temperature 390°C.
Isolated from the ashes of municipal waste incinerators (24).
Aquatic toxicity of eighteen phthalate esters reviewed (1).
The environmental fate of eighteen phthalate esters reviewed (7).

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21. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
22. *Toxicity Review 14: Review of the Toxicity of the Esters of o-Phthalic acid (Phthalate Esters)* 1986, 14, Health and Safety Executive, HMSO, London, UK.
23. *ECETOC Technical Report No. 71* 1996, European Chemical Industry Ecotoxicology and Toxicology of Chemicals, 4 E. Van Nieuwenhuyse (Bte 6), B-1160 Brussels, Belgium.
24. Wolbach, C. D. et al *Nucl. Chem. Waste Manage.* 1987, 7(1), 43-52

D521 dioctyltin bis(2-ethylhexyl thioglycolate)



$\text{C}_{36}\text{H}_{72}\text{O}_4\text{S}_2\text{Sn}$

Mol. Wt. 751.81

CAS Registry No. 15571-58-1

Synonyms di-*n*-octyltin bis(2-ethylhexyl) mercaptoacetate; 10-ethyl-4,4-dioctyl-7-oxo-8-oxa-3,5-dithia-4-stannatetradecanoic acid, 2-ethylhexyl ester

EINECS No. 239-622-4

RTECS No. RO 0955000

Uses Catalyst. Heat stabiliser for polymers.

Occupational exposure

DE-MAK 0.1 mg m⁻³ (as Sn) (inhalable fraction of aerosol)

SE-LEVL 0.1 mg m⁻³ (as Sn)

SE-STEL 0.2 mg m⁻³ (as Sn)

UK-LTEL 0.1 mg m⁻³ (as Sn)

UK-STEL 0.2 mg m⁻³ (as Sn)

US-TWA 0.1 mg m⁻³ (as Sn)

US-STEL 0.2 mg m⁻³ (as Sn)

UN No. 2788 (liquid)

UN No. 3146 (solid) HAZCHEM Code 2X (solid) Conveyance classification toxic substance

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 2010, 2100 mg kg⁻¹, respectively (1,2).

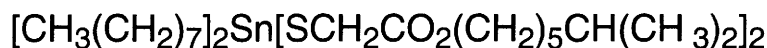
Legislation

Organometallics included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (3).

References

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D522 dioctyltin bis(isooctyl thioglycolate)



$\text{C}_{36}\text{H}_{72}\text{O}_4\text{S}_2\text{Sn}$

Mol. Wt. 751.81

CAS Registry No. 26401-97-8

Synonyms di(*n*-octyl)tin-*S,S'*-bis(isooctyl mercaptoacetate); 2,2'-[bis(dioctylstannylene)bis(thio)]bis[acetic acid], diisooctyl ester; bis(isooctyloxycarbonylmethylthio) dioctyl stannate; diisooctylbis(dioctylstannylene)diethio diacetate

EINECS No. 247-666-0

RTECS No. WH 6723000

Uses Heat stabiliser for PVC. Catalyst.

Physical properties

Flash point >93.3°C Specific gravity 1.082 at 17°C Volatility v.p. 10.2 mmHg at 25°C
Solubility Water: <1 g l⁻¹ at 18°C. Organic solvents: acetone, ethanol

Occupational exposure

DE-MAK 0.1 mg m⁻³ (as Sn) (inhalable fraction of aerosol)
SE-LEVL 0.1 mg m⁻³ (as Sn) SE-STEL 0.2 mg m⁻³ (as Sn)
UK-LTEL 0.1 mg m⁻³ (as Sn) UK-STEL 0.2 mg m⁻³ (as Sn)
US-TWA 0.1 mg m⁻³ (as Sn) US-STEL 0.2 mg m⁻³ (as Sn)
UN No. 2788 (liquid)
UN No. 3146 (solid) HAZCHEM Code 2X (solid) Conveyance classification toxic substance

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1280 mg kg⁻¹ (1).
LD₅₀ dermal rat 2250 mg kg⁻¹ (1).

Teratogenicity and reproductive effects

Oral rat, 1-21 days of gestation, lowest toxic dose, teratogenic effects 420 mg kg⁻¹ (2).

Genotoxicity

Salmonella typhimurium TA100 without metabolic activation positive (3).

Legislation

Organometallic compounds are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

Other comments

May migrate into foods from PVC packaging (5).

References

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2. *Toxicol. Appl. Pharmacol.* 1973, **26**, 253.
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5. Till, D. et al *CRC Crit. Rev. Toxicol.* 1987, **18**(3), 215-243

D523 dioctyltin dichloride



C₁₆H₃₄Cl₂Sn

Mol. Wt. 416.06

CAS Registry No. 3542-36-7

Synonyms dioctyldichlorotin; dioctylstannyl dichloride; dichlorodioctyltin; dichlorodioctylstannane

EINECS No. 222-583-2

RTECS No. WH 7247000

Uses Heat stabiliser for polymers.

Physical properties

M. Pt. 45-49°C

Occupational exposure

DE-MAK 0.1 mg m⁻³ (as Sn) (inhalable fraction of aerosol)

SE-LEVL 0.1 mg m⁻³ (as Sn)

SE-STEL 0.2 mg m⁻³ (as Sn)

UK-LTEL 0.1 mg m⁻³ (as Sn)

UK-STEL 0.2 mg m⁻³ (as Sn)

US-TWA 0.1 mg m⁻³ (as Sn)

US-STEL 0.2 mg m⁻³ (as Sn)

UN No. 2788 (liquid)

UN No. 3146 (solid) HAZCHEM Code 2X (solid) Conveyance classification toxic substance

Ecotoxicity

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 0.0015 ppm Microtox test (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 5500 mg kg⁻¹ (2).

LD₅₀ intravenous mouse 18 mg kg⁻¹ (3).

Sub-acute and sub-chronic data

Oral rat, on days 10-20 of gestation, on days 11-20 of gestation and postnatal days 2-11 of age, or postnatal 2-13 days of age, 20-50 mg kg⁻¹ day⁻¹ to dams, 5-15 mg kg⁻¹ day⁻¹ to pups, did not cause any alteration to the immune function of the offspring. However, dosing of the pups with 5-15 mg kg⁻¹ beginning at day-3 and then 3 × wk⁻¹ up to day-24 of age resulted in significant suppression of lymphoproliferative response of splenocytes to a T-cell mitogen at 10 wk of age (4).

Oral rat (3 wk) 75 mg kg⁻¹ diet caused severe thymic atrophy. Differences in the vacuolation of reticulo-epithelial cells were observed in pregnant and non-pregnant rats, indicating the oestrogens present during pregnancy may predispose these cells to the toxic effect of dioctyltin dichloride (5).

Oral rats (8 wk) 75 ppm via feed developed overt thymic atrophy after 2-wk exposure. After 8 wk the thymic remnant consisted of almost entirely brown fat. Thymic sections from treated rats revealed a marked depletion of cortical thymocytes. The spleen, liver, prostate and seminal vesicles showed no abnormal histological features or pathological lesions, indicating selective thymic toxicity (6).

Metabolism and toxicokinetics

Following oral administration of 6.3 mg or intravenous administration of 1.2 mg ¹⁴C-labelled substance to rats, the highest radioactivity was found in the liver and kidney, and to a lesser extent in the adrenal, pituitary and thyroid glands. The lowest activity was observed in the blood and brain. Most of the radioactivity was excreted in the faeces within 24 hr. ≈20% of the dosages were reported to have been absorbed (7).

Genotoxicity

In vitro Chinese hamster V-79 cells and calf thymus cells, with and without metabolic activation, DNA binding negative (8).

In vivo rat liver and thymus, DNA binding negative (8).

Other effects

Any other adverse effects

In vitro rabbit articular and growth-plate chondrocytes, 10 mg l⁻¹ inhibited DNA synthesis but did not affect sulfate incorporation into proteoglycans (9).

Demonstrated to reduce the number of leukaemic colony forming units in the spleen by >50% following intraperitoneal administration to mice (10).

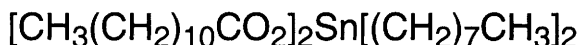
Legislation

Organometallics included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (11).

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D524 dioctyltin dilaurate



$\text{C}_{40}\text{H}_{80}\text{O}_4\text{Sn}$

Mol. Wt. 743.78

CAS Registry No. 3648-18-8

Synonyms dioctylbis[(1-oxododecyl)oxy]stannane; bis(lauroyloxy)dioctylstannane; bis(lauroyloxy)dioctyltin; di-*n*-octyltin dilaurate; dioctyltin didodecanoate; dioctylidi(lauryloxy)stannane; ADK STAB OT-1

EINECS No. 222-883-3

RTECS No. WH 7562000

Uses Cross-linking catalyst.

Physical properties

M. Pt. 20°C

Occupational exposure

DE-MAK 0.1 mg m⁻³ (as Sn) (total dust)

SE-LEVL 0.1 mg m⁻³ (as Sn)

SE-STEL 0.2 mg m⁻³ (as Sn)

UK-LETL 0.1 mg m⁻³ (as Sn)

UK-STEL 0.2 mg m⁻³ (as Sn)

US-TWA 0.1 mg m⁻³ (as Sn)

US-STEL 0.2 mg m⁻³ (as Sn)

UN No. 2788 (liquid) 3146 (solid) HAZCHEM Code 2X (solid) Conveyance classification toxic substance

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 6450 mg kg⁻¹ (1).

LD₅₀ intraperitoneal rat 95 mg kg⁻¹ (1).

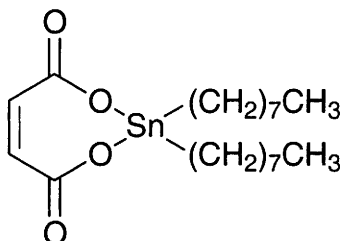
Legislation

Organometallics included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (2).

References

1. *Arzneim.-Forsch.* 1969, **19**, 934.
2. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D525 dioctyltin maleate



$C_{20}H_{36}O_4Sn$

Mol. Wt. 459.21

CAS Registry No. 16091-18-2

Synonyms di-*n*-octyltin maleate; dioctylstannylene maleate; 2,2-dioctyl-1,3,2-dioxastannepin-4,7-dione

EINECS No. 240-253-6

RTECS No. JH 4745000

Uses Cross-linking catalyst. PVC stabiliser.

Physical properties

Solubility Water: <1 g l⁻¹ at 22°C. Organic solvents: dimethyl sulfoxide

Occupational exposure

DE-MAK 0.1 mg m⁻³ (as Sn) (inhalable fraction of aerosol)

SE-LEVL 0.1 mg m⁻³ (as Sn)

SE-STEL 0.2 mg m⁻³ (as Sn)

UK-LTEL 0.1 mg m⁻³ (as Sn)

UK-STEL 0.2 mg m⁻³ (as Sn)

US-TWA 0.1 mg m⁻³ (as Sn)

US-STEL 0.2 mg m⁻³ (as Sn)

UN No. 2788 (liquid)

UN No. 3146 (solid) **HAZCHEM Code** 2X (solid) **Conveyance classification** toxic substance

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 4500 mg kg⁻¹ (1).

LD₅₀ oral mouse 775 mg kg⁻¹ (2).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535 with and without metabolic activation negative (3).

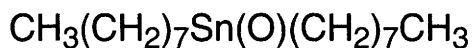
Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

References

1. *Arzneim.-Forsch.* 1969, **19**, 934.
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4. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D526 dioctyltin oxide



$\text{C}_{16}\text{H}_{34}\text{OSn}$

Mol. Wt. 361.16

CAS Registry No. 870-08-6

Synonyms di-*n*-octyltin oxide; dioctyloxotin; dioctyloxostannane

EINECS No. 212-791-1

RTECS No. WH 7620000

Uses Catalyst.

Occupational exposure

DE-MAK 0.1 mg m⁻³ (as Sn) (inhalable fraction of aerosol)

SE-LEVEL 0.1 mg m⁻³ (as Sn)

SE-STEEL 0.2 mg m⁻³ (as Sn)

UK-LTEL 0.1 mg m⁻³ (as Sn)

UK-STEEL 0.2 mg m⁻³ (as Sn)

US-TWA 0.1 mg m⁻³ (as Sn)

US-STEEL 0.2 mg m⁻³ (as Sn)

UN No. 2788 (liquid)

UN No. 3146 (solid) HAZCHEM Code 2X (solid) Conveyance classification toxic substance

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 2500 mg kg⁻¹ (1).

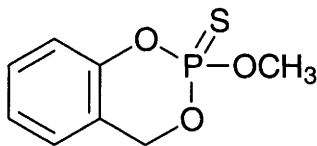
Legislation

Organometallics included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (2).

References

1. *Arzneim.-Forsch.* 1969, **19**, 934.
2. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D527 dioxabenzofos



$C_8H_9O_3PS$

Mol. Wt. 216.20

CAS Registry No. 3811-49-2

Synonyms 2-methoxy-4H-1,3,2-benzodioxaphosphorin, 2-sulfide; phosphorothioic acid, cyclic *O,O*-(methylene-*o*-phenylene) *O*-methyl ester; phosphorothioic acid, *O*-methyl ester, cyclic *O,O*-ester with *o*-hydroxybenzyl alcohol; Fenfosphorin; Salithion

EINECS No. 223-292-3

RTECS No. DF 4375000

Uses Superseded miticide and insecticide.

Physical properties

M. Pt. 52.5-54°C **Volatility** v.p. 3.2×10^{-3} mmHg at 20°C

Solubility Water: 43 mg l⁻¹ 20°C. Organic solvents: acetonitrile, cyclohexanone, xylene

Ecotoxicity

Fish toxicity

LC₅₀ (48 hr) carp 7.8 mg l⁻¹ (1).

Environmental fate

Degradation studies

In a study of aerobic upland soils at 25°C, extractable compound disappeared from the soil, *t*_{1/2} 36-72 hr. P-O linkages were destroyed and the compound demethylated. In sterilised soils, disappearance was slower. Binding of the compound to soil components is thought to account for some apparent disappearance (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral chicken 110 mg kg⁻¹ (3).

LD₅₀ oral ♂, ♀ rat, ♂ mouse 125, 180, 125 mg kg⁻¹, respectively (1).

LD₅₀ dermal rat 125-180 mg kg⁻¹ (4).

LD₅₀ dermal mouse >1250 mg kg⁻¹ (4).

LD₅₀ subcutaneous mouse 82 mg kg⁻¹ (5).

Metabolism and toxicokinetics

Compound is rapidly absorbed and rapidly excreted, along with its metabolites (6).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537, TA1538 with and without metabolic activation positive (7).

Other effects

Any other adverse effects

Compound is an inhibitor of cholinesterase and thus affects the central and peripheral nervous system of many species (8).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration $0.1 \mu\text{g l}^{-1}$ (9).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (10).
WHO Toxicity Class II (11).

Other comments

Food contaminant. Water pollutant.

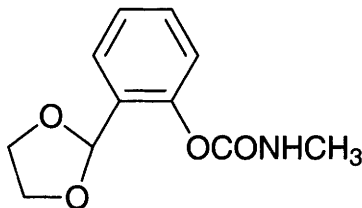
In insects, the compound combines with glutathione to produce 5-(2-hydroxybenzyl)glutathione which then inhibits glutathione transferase (12,13).

House flies that demonstrate resistance to the pesticide show markedly reduced inhibition of acetylcholinesterase, when exposed to the compound (8).

References

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2. Itoh, K. *Nippon Noyaku Gakkaishi* 1990 **15**(4), 561-566.
3. Itoh, K. *Nippon Noyaku Gakkaishi* 1991, **16**(1), 97-100 (*Chem. Abstr.* **115**, 24332d).
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6. Huang, J. *Huanjing Huaxue* 1989, **8**(3), 33-38 (Ch.) (*Chem. Abstr.* **11**, 110680q).
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9. EC Directive Relating to the Quality of Water Intended for Human Consumption 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
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D528 dioxacarb



$\text{C}_{11}\text{H}_{13}\text{NO}_4$

Mol. Wt. 223.23

CAS Registry No. 6988-21-2

Synonyms 2-(1,3-dioxolan-2-yl)phenyl methylcarbamate; *o*-(1,3-dioxolan-2-yl)phenyl methylcarbamate

EINECS No. 230-253-4

RTECS No. FC 1925000

Uses Superseded insecticide.

Physical properties

M. Pt. 114-115°C **Volatility** v.p. 3×10^{-7} mmHg at 20°C

Solubility Water: 6 g l^{-1} at 20°C. Organic solvents: acetone, cyclohexanone, dichloromethane, dimethylformamide, ethanol, hexane, xylene

Occupational exposure

Supply classification toxic

Risk phrases Toxic if swallowed (R25)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Wear suitable gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S37, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout, carp 29-32 mg l⁻¹ (1).

Environmental fate

Abiotic removal

In aqueous media t_{1/2} for hydrolysis 40 min at pH 3, 3 days at pH 5, 60 days at pH 7, 20 hr at pH 9 and 2 hr at pH 10 (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 48, 72 mg kg⁻¹, respectively (1-3).

LD₅₀ dermal mouse, rabbit, rat 1660, 1950, 3000 mg kg⁻¹, respectively (2,4).

Sub-acute and sub-chronic data

Oral rat, dog (90 day) no-adverse-effect level for rats was 10 mg kg⁻¹ day⁻¹ and for dogs 2 mg kg⁻¹ day⁻¹ (1).

Metabolism and toxicokinetics

Following oral administration to mammals, dioxacarb is rapidly absorbed and hydrolysed to the corresponding phenol and *N*-methylol. Both breakdown products are eliminated as conjugates, 80-90% elimination occurring within 24 hr (1).

Other effects

Any other adverse effects

Cholinesterase inhibitor (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (5).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (6).

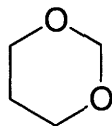
WHO Toxicity Class II (7).

EPA Toxicity Class II (1).

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7. *The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification* 1998-1999 WHO/PCS/98.21

D529 1,3-dioxane



C₄H₈O₂

Mol. Wt. 88.11

CAS Registry No. 505-22-6

Synonyms *m*-dioxane; trimethylene glycol methylene ether; trimethylene methylene dioxide

EINECS No. 208-005-1

RTECS No. JG 8224000

Uses Solvent. Monomer for acetyl resins.

Physical properties

M. Pt. -45°C **B. Pt.** 105-106°C **Flash point** 15°C **Specific gravity** 1.0342 at 20°C with respect to water at 4°C **Partition coefficient** log *P*_{ow} -0.419 (calc.) (1) **Volatility** v.p. 39 mmHg at 25°C
Solubility Water: miscible. Organic solvents: acetone, benzene, ethanol

Occupational exposure

UN No. 1165 **HAZCHEM Code** 2YE **Conveyance classification** flammable liquid

Environmental fate

Abiotic removal

Reacts with photochemically produced hydroxyl radicals in the atmosphere, *t*_{1/2} ~ 2 days (2).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537, TA1538 with and without metabolic activation negative (3).
In vitro Chinese hamster ovary cells, chromosomal aberrations and sister chromatid exchanges positive (4).

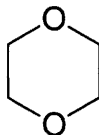
Legislation

Organic solvents are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (5).

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D530 1,4-dioxane



C₄H₈O₂

Mol. Wt. 88.11

CAS Registry No. 123-91-1

Synonyms *p*-dioxane; diethylene dioxide; 1,4-diethylene dioxide; diethylene ether; 1,4-dioxacyclohexane; dioxetylene ether

EINECS No. 204-661-8

RTECS No. JG 8225000

Uses Solvent. Stabiliser in chlorinated solvents. Organic synthesis.

Physical properties

M. Pt. 11.8°C **B. Pt.** 100-102°C **Flash point** 12°C **Specific gravity** 1.0329 at 20°C with respect to water at 4°C **Partition coefficient** log *P*_{ow} -0.35 (1) **Volatility** v.p. 37 mmHg at 25°C ; v.den. 3.0

Solubility Water: miscible. Organic solvents: acetone, benzene, carbon tetrachloride, diethyl ether, ethanol, toluene

Occupational exposure

DE-MAK 20 ppm (73 mg m⁻³)

FR-VME 10 ppm (35 mg m⁻³)

FR-VLE 40 ppm (140 mg m⁻³)

JP-OEL 10 ppm (36 mg m⁻³)

SE-LEVL 10 ppm (35 mg m⁻³)

SE-STEEL 25 ppm (90 mg m⁻³)

UK-LTEL 25 ppm (91 mg m⁻³) (technical grade)

UK-STEEL 100 ppm (366 mg m⁻³) (technical grade)

US-TWA 20 ppm

UN No. 1165 **HAZCHEM Code** 2YE **Conveyance classification** flammable liquid

Supply classification highly flammable, harmful

Risk phrases Highly flammable – May form explosive peroxides – Irritating to eyes and respiratory system –

Possible risk of irreversible effects (R11, R19, R36/37, R40)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from sources of ignition – No smoking – Wear suitable protective clothing and gloves (S2, S16, S36/37)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) bluegill sunfish >10 g l⁻¹ (2).

LC₅₀ (96 hr) inland silverside 6700 mg l⁻¹ (2).

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 733 ppm Microtox test (3).

Environmental fate

Nitrification inhibition

Limiting concentration for inhibition of nitrification (agar test) 825 mg l⁻¹ (4).

Carbonaceous inhibition

Pseudomonas putida threshold for cell multiplication inhibition 2700 mg l⁻¹ (5).

Abiotic removal

Reacts with photochemically produced hydroxyl radicals in the atmosphere, t_{1/2} 6.7 hr (6).

Mammalian & avian toxicity

Acute data

LD₅₀ oral cat, rabbit, guinea pig, mouse 2000, 2000, 3150, 5700 mg kg⁻¹, respectively (7).

LC₅₀ (2 hr) inhalation rat 46 g m⁻³ (8).

LD₅₀ dermal rabbit 7600 mg kg⁻¹ (9).

LD₅₀ intraperitoneal rat 5600 mg kg⁻¹ (10).

Sub-acute and sub-chronic data

Inhalation rat, mouse, guinea pig and rabbit, repeated exposure to 3600 mg m⁻³ for periods of 1.3 hr (total exposure 78-203 hr) caused vascular congestion of the liver and degenerative changes in the renal cortex (11).

Carcinogenicity and chronic effects

Inadequate evidence of carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2B (12).

Oral rat (2 yr) 0, 0.01, 0.1 and 1% in drinking water for up to 716 days. The mean survival time for the highest dose group was 16 months compared to 22 for other groups. There was a dose-related increase in the incidence of hepatocellular carcinomas, cholangiomas and squamous cell carcinomas of the nasal cavity (13).

Inhalation rat (2 yr) 400 mg m⁻³ 7 hr day⁻¹ 5 day wk⁻¹. There was no statistically significant increase in the incidence of tumours compared with controls (14).

Dermal mouse (14 month) 0.2 ml of an unspecified concentration in acetone 3 × wk⁻¹ caused 1/60 skin sarcoma and 1/60 malignant lymphoma. The increased incidence was not statistically significant. In a similar group pretreated with 50 µg of 7,12-dimethylbenzanthracene there was a significant increase in skin tumours, malignant lymphomas, lung tumours and other tumours (15).

National Toxicology Program tested rats and mice 0.5-1.0% (v/v) drinking water. Animals were killed 110-117 wk (rats) and 90-93 wk (mice). The incidence of squamous-cell carcinomas of the nasal turbinates was significant in both ♂, ♀ rats and the incidence hepatocellular adenomas was significant in ♀ rats. In ♂, ♀ mice induced hepatocellular carcinomas (16).

Teratogenicity and reproductive effects

0.1 ml injected into chick embryos caused 100% mortality (17).

Oral rat, 6-15 days of gestation, lowest toxic dose, teratogenic effects 10 g kg⁻¹ (18).

Metabolism and toxicokinetics

Following oral administration of 10, 100 or 1000 mg kg⁻¹ [¹⁴C]-1,4-dioxane, excretion of the unchanged 1,4-dioxane in expired air was 0.43% for the lowest dose and 25% for the highest dose (19).

Irritancy

Inhalation human (15 min) 1080 mg m⁻³ caused irritation of the eyes, nose and throat (20).

Sensitisation

Direct contact with the skin has been reported to cause dermatitis in humans (21).

Genotoxicity

Salmonella typhimurium TA98, TA100 with and without metabolic activation negative (22).

Drosophila melanogaster sex-linked recessive lethal assay negative (23).

In vitro primary rat hepatocytes, DNA repair assay negative (24).

In vitro mouse lymphoma 25178Y tk⁺/tk⁻ forward mutation assay negative (25).

In vitro Chinese hamster ovary cells, chromosomal aberrations negative, sister chromatid exchanges positive (26).

In vivo rat, hepatic DNA damage positive (27).

Other effects

Other adverse effects (human)

In a mortality study of 165 workers who had been exposed to low concentrations of 1,4-dioxane since 1954, seven deaths had occurred by 1975, two of which were from cancer (28).

Five acute deaths due to 1,4-dioxane exposure have been reported. Haemorrhagic nephritis and liver necrosis were recorded at autopsy (29).
Death of a worker was attributed to exposure to 1800 mg m⁻³ for 1 wk. Skin absorption was also a possibility as the solvent was used to remove glue from hands. Autopsy revealed damage to the kidneys, liver and brain (30).

Legislation

Organic solvents are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (31).

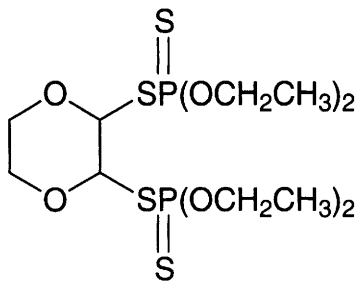
Other comments

Residues detected in the atmosphere and water.
Environmental fate reviewed (32).
Physical properties, use analysis, carcinogenicity and mammalian toxicity reviewed (33-35).
Autoignition temperature 180°C.

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D531 dioxathion



$C_{12}H_{26}O_6P_2S_4$

Mol. Wt. 456.55

CAS Registry No. 78-34-2

Synonyms 2,3-*p*-dioxanedithiol *S,S*-bis[*O,O*-diethyl phosphorodithioate]; Delnav; Hercules AC528; Navadel; *S,S'*-1,4-dioxane-2,3-diyl *O,O,O,O'*-tetraethylphosphorodithioate; 1,4-dioxan-2,3-diyl-bis[*O,O*-diethylphosphorothiolothioate]

EINECS No. 201-107-7

RTECS No. TE 3350000

Uses Superseded and pesticide and insecticide. Animal ectoparasiticide. Acaricide.

Physical properties

M. Pt. -20°C **Specific gravity** 1.257 at 26°C with respect to water at 4°C

Partition coefficient $\log P_{ow}$ 0.95 (1)

Solubility Organic solvents: acetone, benzene, ethanol

Occupational exposure

FR-VME 0.2 mg m^{-3}

UK-LTEL 0.2 mg m^{-3}

US-TWA 0.2 mg m^{-3}

Supply classification very toxic

Risk phrases Toxic in contact with skin – Very toxic by inhalation and if swallowed (R24, R26/28)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S36/37, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 9.3 mg l^{-1} (2).

LC₅₀ (96 hr) bluegill sunfish, green sunfish, largemouth bass $34\text{--}61 \text{ }\mu\text{g l}^{-1}$ (2).

Invertebrate toxicity

LC₅₀ (96 hr) *Gammarus lacustris* $270 \text{ }\mu\text{g l}^{-1}$ (3).

LC₅₀ (96 hr) *Gammarus fasciatus* $8.6 \text{ }\mu\text{g l}^{-1}$ (4).

Relatively harmless to bees (5).

Mammalian & avian toxicity

Acute data

LD₅₀ oral chicken 170 mg kg^{-1} (6).

LD₅₀ oral rat, dog, mouse 20, 176, 180 mg kg^{-1} , respectively (7-10).

LC₅₀ (1 hr) inhalation mouse, rat 340, 1400 mg m^{-3} , respectively (10).

LD₅₀ dermal rat, rabbit 60-105 mg kg⁻¹ (10,11,12).
LD₅₀ intraperitoneal rat, mouse 30, 33 mg kg⁻¹, respectively (10,13).

Sub-acute and sub-chronic data

LD₅₀ (5 day) oral Japanese quail, ring-necked pheasant, mallard duck 3600-6640 mg kg⁻¹ diet (14).

Carcinogenicity and chronic effects

National Toxicology Program tested rats and mice via oral administration. Negative results were reported for ♂ and ♀ rats and mice (15).

Teratogenicity and reproductive effects

In a multigeneration study in rats a no-effect level of 10 ppm determined (16).

Metabolism and toxicokinetics

In mammals, following oral administration, hydrolysis of the phosphorodithionate groups, oxidative dealkylation, hydroxylation of the dioxane ring, and ring cleavage occurred (17).

Irritancy

Caused mild transient conjunctivitis but no transient or permanent corneal damage when 0.1 ml was instilled into rabbit eyes (8).

Genotoxicity

Salmonella typhimurium TA100 with metabolic activation positive (18).

In vitro Chinese hamster ovary cells, sister chromatid exchanges positive (19).

Other effects

Any other adverse effects

Inhibits cholinesterase (20).

No effect level rats (inhibition of brain erythrocyte and plasma cholinesterase activities studied) at 3 ppm (~0.22 mg kg⁻¹ day⁻¹); dogs 0.075-0.25 mg kg⁻¹ day⁻¹. Human volunteers no effects to plasma or erythrocyte cholinesterase at 0.075 mg kg⁻¹ day⁻¹; but at 0.150 mg kg⁻¹ day⁻¹ showed a significant slight depression of plasma cholinesterase but not erythrocyte activity (8).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (21).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (22).

Tolerable daily intake (TDI) humans set by World Health Organisation at 1.5 µg kg⁻¹ day⁻¹ (23).

WHO Toxicity Class Ib (24).

Other comments

Dioxathion is a mixture of the *cis* and *trans* ratio 1:1.5-2.0 (17).

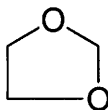
cis isomers ≈ 4 × the toxicity (acute) of *trans* isomers (8).

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D532 1,3-dioxolane



$C_3H_6O_2$

Mol. Wt. 74.08

CAS Registry No. 646-06-0

Synonyms 1,3-dioxacyclopentane; glycol methylene ether

EINECS No. 211-463-5

RTECS No. JH 6760000

Uses Electrolyte. Solvent. Acetal resin co-monomer.

Physical properties

M. Pt. -95°C **B. Pt.** 74-75°C **Flash point** 1°C **Specific gravity** 1.066 at 15°C with respect to water at 4°C

Volatility v.den. 2.6

Solubility Water: miscible. Organic solvents: acetone, diethyl ether, ethanol

Occupational exposure

UN No. 1166 **HAZCHEM Code** 2WE **Conveyance classification** flammable liquid

Supply classification highly flammable

Risk phrases Highly flammable (R11)

Safety phrases Keep out of reach of children (if sold to general public) – Keep away from sources of ignition – No smoking (S2, S16)

Mammalian & avian toxicity

Acute data

LC₅₀ oral rat 5800 mg kg⁻¹ (1).

LC₅₀ (4 hr) inhalation rat, rabbit, guinea pig 87-118 g m⁻³ (1).

LD₅₀ dermal rabbit 1500 mg kg⁻¹ (1).

Metabolism and toxicokinetics

Following inhalation exposure of dogs to 500 ppm for 10 min, net nasal uptake was 66.6%. Lung absorption was 2.1% (2).

Irritancy

Eye irritant (1).

Sensitisation

No dermatitis was observed in acute toxicity studies (species unspecified) (1).

Genotoxicity

Salmonella typhimurium TA1535/pSK1002 *umu* test system, with and without metabolic activation negative (3).

Legislation

Organic solvents are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

Other comments

Toxicity of 1,3-dioxolane reviewed (5).

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D533 dipentylamine

C₁₀H₂₃N

Mol. Wt. 157.30

CAS Registry No. 2050-92-2

Synonyms di-*n*-amylamine; *N*-pentyl-1-pentanamine; diamylamine; di-*n*-pentylamine

EINECS No. 218-108-3

RTECS No. RZ 9100000

Uses Catalyst. Hair wave setting compound. Templating agent. Rubber accelerator. Solvent for oils, resins and cellulose esters.

Physical properties

M. Pt. -44°C **B. Pt.** 202-203°C (97% purity) **Flash point** 51°C **Specific gravity** 0.7771 at 20°C with respect to water at 4°C **Volatility** v.p. 0.3 mmHg at 20°C ; v.den. 5.42

Solubility Water: <1 mg ml⁻¹ at 20°C. Organic solvents: diethyl ether, dimethyl sulfoxide, ethanol

Occupational exposure

UN No. 2841 **HAZCHEM Code** 3W **Conveyance classification** flammable liquid, toxic

Ecotoxicity

Fish toxicity

LC₅₀ (24 hr) creek chub 5-20 mg l⁻¹ (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 270 mg kg⁻¹ (2).

LC_{Lo} (4 hr) inhalation rat 63 ppm (3).

LD₅₀ dermal rabbit 350 mg kg⁻¹ (3).

Irritancy

Dermal rabbit (duration unspecified) 500 mg caused severe irritation (2).

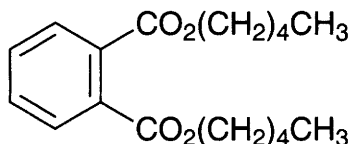
Legislation

Organic solvents are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

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D534 dipentyl phthalate



C₁₈H₂₆O₄

Mol. Wt. 306.40

CAS Registry No. 131-18-0

Synonyms amyl phthalate; diamyl phthalate; dipentyl 1,2-benzenedicarboxylate; di-*n*-pentyl phthalate

EINECS No. 205-017-9

RTECS No. TI 1930000

Uses Polymersation catalyst. Solvent. Plasticiser.

Physical properties

M. Pt. -55°C B. Pt. 342°C Partition coefficient log P_{ow} 4.85 (1)

Solubility Water: 0.8 mg l⁻¹ at 25°C (2). Organic solvents: carbon disulfide, chloroform, vegetable oils

Occupational exposure

SE-LEVL 3 mg m⁻³

SE-STEL 5 mg m⁻³

Ecotoxicity

Bioaccumulation

Based on the water solubility of diamyl phthalate (0.8 mg l^{-1} at 25°C), a bioconcentration factor 700 was calculated, suggesting moderate bioaccumulation in fish and aquatic organisms (2).

Mammalian & avian toxicity

Teratogenicity and reproductive effects

Oral rat, single dose of 0.25, 1.0 or 2.0 g kg^{-1} . Treatment did not produce any significant effect on body, liver, kidney, prostate or seminal/vesicle weights. Elevated serum levels of androgen-binding protein indicated damage to the Sertoli cells (3).

Oral mouse 0, 0.5, 1.25, or 2.5% diet following a continuous breeding protocol for 105 days. Complete inhibition of fertility in both sexes was induced in the 1.25 and 2.5% dosage groups. Reduced fertility, number of litters and pups per litter were observed for the 0.5% group. Treatment was associated with decreased body weight, increased liver weight, decreased testes and epididymis weights, decreased epididymal sperm concentration and increased seminiferous tubule atrophy (4).

Legislation

Organic solvents are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (5).

$\text{Log } P_{\text{ow}}$ exceeds EC limit.

Other comments

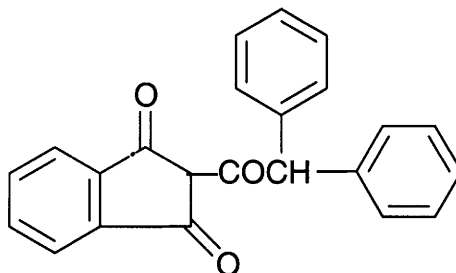
Toxicity of phthalate esters reviewed (1,6).

Phthalate esters partition strongly into the lipids of both plants and animals. Degradation by microbiota and metabolism by fish and animals does occur (7).

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D535 diphacinone



C₂₃H₁₆O₃

Mol. Wt. 340.38

CAS Registry No. 82-66-6

Synonyms 2-(diphenylacetyl)-1H-indene-1,3(2H)-dione; 2-diphenylacetyl-1,3-diketohydrindene; diphenadione; 2-(diphenylacetyl)indan-1,3-dione; 2-(diphenylacetyl)-1,3-indandione; Di-Blox; Diphacin; Ditrac; Final Pellets; Ramik; Rodent Cake

EINECS No. 201-434-5

RTECS No. NK 5600000

Uses Anticoagulant. Rodenticide.

Physical properties

M. Pt. 146-147°C **Specific gravity** 1.281 **Volatility** v.p. 1.03×10^{-7} mmHg at 25°C

Solubility Water: 0.3 mg l⁻¹. Organic solvents: acetone, acetic acid, chloroform, toluene, xylene

Occupational exposure

Supply classification very toxic

Risk phrases Very toxic if swallowed – Toxic: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed (R28, R48/23/24/25)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S36/37, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) channel catfish, rainbow trout, bluegill sunfish, 2.1, 2.8, 7.6 mg l⁻¹, respectively (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mallard duck 3158 mg kg⁻¹ (1).

LD₅₀ oral rat, dog, cat, rabbit 2.3, 3-7.5, 14.7, 35 mg kg⁻¹, respectively (1).

LD₅₀ oral pig, mouse 150, 340 mg kg⁻¹, respectively (1).

LC₅₀ (4 hr) inhalation rat <2 mg l⁻¹ (dust) (1).

LD₅₀ dermal rat <200 mg kg⁻¹ (1).

Sub-acute and sub-chronic data

Oral rat (3 day) 1.5 mg kg⁻¹ and (28 day) 0.15 mg kg⁻¹ induced increased glutamic-oxalacetic transaminase and GPT activities in brains and kidneys but liver exhibited reductions in activity. Alkaline phosphatase showed increased activity in brains and livers but the opposite effects occurred in kidneys (2).

Subcutaneous dog (3 day) 2.5 mg kg⁻¹ day⁻¹ were treated with vitamin K₁ 2.5 or 5 mg kg⁻¹ day⁻¹ subcutaneously for 21 days. Serum concentration of vitamin K₁ increased significantly within 1-4 hr on day-4 (3).

Oral rat (28 day) 1.5 mg kg⁻¹ induced increases in bleeding, coagulation and prothrombin times. Decreases were recorded in red blood cell count, white blood cell count, Hb content and haematocrit value (4).

Dermal rabbit (21 day) 0.1 mg kg⁻¹ day⁻¹ was recorded as the no-observable-effect level (5).

Oral sparrow hawk (56 day) in bait 50 mg kg⁻¹ revealed no hazard under conditions likely to be encountered in nature (5).

Oral rat (28 day) 1.5 mg kg⁻¹ decreased total content of lipids in brains, livers and kidneys. Reduction in cholesterol and phospholipids levels but lipid metabolism in brains and livers recovered after 28 days (6).

Metabolism and toxicokinetics

Not extensively metabolised in the rat but any metabolism mainly involves hydroxylation and conjugation (1).

Irritancy

Non-irritating to skin and eyes (1).

Sensitisation

Non-sensitising to skin of guinea pig (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (7).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (8).

WHO Toxicity Class Ia (9).

EPA Toxicity Class I (formulation) (1).

Other comments

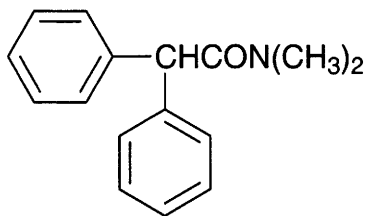
Reported to be non-mutagenic in the Ames *Salmonella typhimurium* assay (5).

Inhibits the vitamin K-dependent steps in the synthesis of coagulation factors (5).

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8. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
9. *The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification* 1998-1999 WHO/PCS/98.21

D536 diphenamid



$C_{16}H_{17}NO$

Mol. Wt. 239.32

CAS Registry No. 957-51-7

Synonyms *N,N*-dimethyldiphenylacetamide; *N,N*-dimethyl- α -phenylbenzeneacetamide; *N,N*-dimethyl-2,2-diphenylacetamide; *N,N*-dimethyl- α,α -diphenylacetamide; 2,2-diphenyl-*N,N*-dimethylacetamide; Difen; Dymid; Enide; Fenam; Kasser; Marrel P; Selemide

EINECS No. 213-482-4

RTECS No. AB 8050000

Uses Selective systemic herbicide for pre-emergence control of annual grasses and some broad-leaved weeds.

Physical properties

M. Pt. 134.5-135.5°C **Specific gravity** 1.17 at 23.3°C

Solubility Water: 260 mg l⁻¹ at 25°C. Organic solvents: acetone, dimethylformamide, phenyl cellosolve, xylene

Occupational exposure

Supply classification harmful

Risk phrases Harmful if swallowed (R22)

Safety phrases Keep out of reach of children (if sold to general public) (S2)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) guppy 25.76 mg l⁻¹ (1).

Invertebrate toxicity

EC₅₀ (48 hr) *Daphnia magna* 56 mg l⁻¹ (2).

LC₅₀ (48 hr) *Cryptodopsis vidua* 50 mg l⁻¹ (2).

LC₅₀ (48 hr) *Palaemonetes kadiakensis* 58 mg l⁻¹ (2).

EC₅₀ (96 hr) *Selenastrum capricornutum*, *Scenedesmus quadricauda* and *Oocystis parva* 16.7, 10.1 and 6.3 mg l⁻¹, respectively (3).

Environmental fate

Degradation studies

Microbial degradation in soil. Persistence in warm, damp conditions 3-6 months. Relatively resistant to degradation by UV light; moderately stable to heat (4).

Accelerated degradation in soil involves a population shift and/or change in activity of microbial degraders in favour of bacteria. Accelerated degradation occurs via oxidation involving demethylation. Degradation suppressed by fungicides thiram and fentin acetate, and the antibiotic chloramphenicol in mixed bacterial cultures. Rapidly degraded by *Fusarium* in cultures (5).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 700-1050 mg kg⁻¹ (6,4).

LD₅₀ oral dog, rabbit 1000, 1500 mg kg⁻¹, respectively (7).

LD₅₀ subcutaneous mouse 800 mg kg⁻¹ (8).

LD₅₀ intraperitoneal mouse 500 mg kg⁻¹ (8).

Teratogenicity and reproductive effects

No adverse effects on fertility of rats and dogs fed 2000 mg kg⁻¹ in diet for 2 yr (4).

Metabolism and toxicokinetics

N-Demethylated in mammals after oral exposure; excreted as the O-glucuronide. *p*-Hydroxylation is a minor metabolic route (9).

Irritancy

Non-irritating to rabbits' skin and eyes (4).

Sensitisation

Non-sensitising to guinea pig skin (4).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (10).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (11).

WHO Toxicity Class III (12).

Other comments

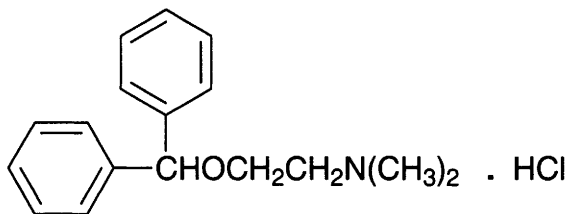
Reviews on human health effects, experimental toxicology and physicochemical effects listed (13).

Health hazards and safety reviewed (14).

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D537 diphenhydramine



$C_{17}H_{21}NO$

Mol. Wt. 255.36

CAS Registry No. 58-73-1

Synonyms 2-(diphenylmethoxy)-*N,N*-dimethylethanamine; 2-(benzhydryloxy)-*N,N*-dimethylethylamine; Allerdryl; Allergan; Benadryl; Benylin; Dermistine; Restamine

EINECS No. 200-396-7

RTECS No. KR 6825000

Uses Antihistamine drug.

Physical properties

B. Pt. 150-165°C at 2 mmHg

Solubility Organic solvents: vegetable oils

Environmental fate

Abiotic removal

Undergoes photolysis in water, involving rearrangement and side chain fission (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 160, 390 mg kg⁻¹, respectively (2,3).

LD₅₀ intravenous mouse 29 mg kg⁻¹ (2).

LD₅₀ intraperitoneal mouse, rat 56, 280 mg kg⁻¹, respectively (4,5).

LD₅₀ subcutaneous mouse 50 mg kg⁻¹ (6).

Teratogenicity and reproductive effects

Subcutaneous rat, day 1-22 of gestation lowest toxic dose, teratogenic effects 440 mg kg⁻¹ day⁻¹ (7).

Metabolism and toxicokinetics

Four hours after oral administration of 40 or 100 mg kg⁻¹ to lactating rats, concentration in the milk averaged 0.30 and 2.2 µg ml⁻¹ and the milk/plasma ratio ranged from 4.4-7.5. No adverse effects on lactation were observed (8).

Following oral administration to humans, peak plasma concentrations are achieved in 1-4 hr. Widely distributed throughout the body including the central nervous system. Excretion is almost complete within 24 hr (9).

Other effects

Other adverse effects (human)

In humans, adverse effects include impaired consciousness and, additionally, psychosis, seizures, antimuscarinic symptoms such as mydriasis, tachycardia, tachyarrhythmias and respiratory failure (9).

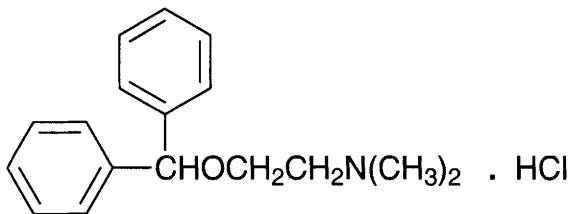
Other comments

Used in the control of nausea, vomiting and vertigo. Normally administered as the citrate salt (oral), hydrochloride (oral, topical), methiodide, polistirex, tannate (orally), methylbromide (rectally) or methylsulfate (topical) (9).

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D538 diphenhydramine hydrochloride



$C_{17}H_{22}ClNO$

Mol. Wt. 291.82

CAS Registry No. 147-24-0

Synonyms 2-(diphenylmethoxy)-*N,N*-dimethylethanamine hydrochloride; Benadryl hydrochloride; BAX; Benocten; Dolestan; Felben; Sedopretten

EINECS No. 205-687-2

RTECS No. KR 7000000

Uses Antihistamine. Used in the manufacture of cosmetic products.

Physical properties

M. Pt. 168-169°C

Solubility Water: 50%. Organic solvents: acetone, chloroform, diethyl ether, ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse, rat 114, 500 mg kg⁻¹, respectively (1,2).

LD₅₀ intraperitoneal mouse, rat 56, 82 mg kg⁻¹, respectively (3,4).

LD₅₀ subcutaneous rat 362 mg kg⁻¹ (5).

LD₅₀ intravenous mouse, rat 20, 35 mg kg⁻¹, respectively (6,7).

Carcinogenicity and chronic effects

Oral rat, mouse (2 yr) 0, 156, 313 or 625 ppm diet. There was equivocal evidence of carcinogenicity for ♂ rats, based on marginally increased incidences of uncommon brain neoplasms and alveolar/bronchiolar neoplasms. There was equivocal evidence of carcinogenicity for ♀ rats, based on a marginal increase in the incidence of pituitary adenomas. There was no evidence of carcinogenicity in mice (8).

Teratogenicity and reproductive effects

Oral rat, days 6-15 of gestation, lowest toxic dose, teratogenic effects 1000 mg kg⁻¹ (9).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (10).
In vitro Chinese hamster ovary cells, sister chromatid exchanges and chromosomal aberrations positive (11).

Other effects

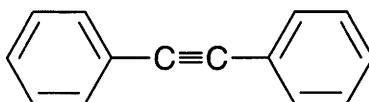
Other adverse effects (human)

Dystonic extrapyramidal reactions have been reported when used therapeutically (12).

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D539 diphenylacetylene



C₁₄H₁₀

Mol. Wt. 178.23

CAS Registry No. 501-65-5

Synonyms 1,2-diphenylethyne; 1,1'-(1,2-ethynediyl)bisbenzene

EINECS No. 207-926-6

Uses Catalyst. Organic synthesis.

Physical properties

M. Pt. 60-61°C B. Pt. 300°C

Solubility Organic solvents: diethyl ether, ethanol

Ecotoxicity

Fish toxicity

Not toxic to stickleback or rainbow trout at 10 mg l⁻¹ for 24 hr (1).

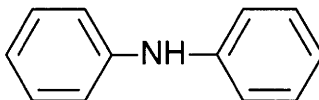
Invertebrate toxicity

Predicted EC₅₀ (24 hr) *Daphnia magna* 20 µg l⁻¹ (based on test data for a minimum number of monosubstituted benzenes) (2).

References

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D540 diphenylamine



C₁₂H₁₁N

Mol. Wt. 169.23

CAS Registry No. 122-39-4

Synonyms *N*-phenylbenzenamine; *N*-phenylaniline; anilinobenzene; DPA; Coraza; Fruitguard DPA; Fruttistore; No Scald; Xedamine

EINECS No. 204-539-4

RTECS No. JJ 7800000

Uses Manufacture of dyestuffs. Stabilising nitrocellulose explosives and plastics. Post harvest protection of pome fruit from fungal attack. Insecticide. Rubber antioxidant and accelerator. Solid rocket propellant. Pharmaceuticals. Analytical reagent.

Physical properties

M. Pt. 52.5-54°C **B. Pt.** 302°C **Flash point** 152°C **Specific gravity** 1.16 at 20°C **Partition coefficient** log

P_{ow} 3.50 **Volatility** v.p. 1 mm Hg at 108.3°C ; v.den. 5.8

Solubility Organic solvents: benzene, carbon disulfide, diethyl ether, glacial acetic acid

Occupational exposure

FR-VME 10 mg m⁻³

SE-LEVL 4 mg m⁻³

SE-STEL 12 mg m⁻³

UK-LTEL 10 mg m⁻³

UK-STEL 20 mg m⁻³

US-TWA 10 mg m⁻³

Supply classification toxic

Supply classification dangerous for the environment

Risk phrases Toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R23/24/25, R33, R50/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S28, S36/37, S45, S60, S61)

Ecotoxicity

Invertebrate toxicity

EC₅₀ (5, 15, 30 min) *Photobacterium phosphoreum* 4.77 ppm Microtox test (1).

Environmental fate

Nitrification inhibition

Nitrosomonas sp. 100 mg l⁻¹ no inhibition of ammonia oxidation (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 2000 mg kg⁻¹ (3).

LD₅₀ oral guinea pig 300 mg kg⁻¹ (4).

Sub-acute and sub-chronic data

Oral ♂ hamster 400, 600, 800 mg kg⁻¹ day⁻¹ for 3 days caused total renal papillary necrosis. Oral ♂ rat 800 mg kg⁻¹ day⁻¹ caused apex-limited necrosis of the medullary interstitial cells and vasa recta and degeneration of the renal interstitial matrix. Intraperitoneal ♂ hamsters 400 mg kg⁻¹ day⁻¹ induced degeneration and necrosis of the pars recta. No renal lesions were observed in gerbils given similar doses (5).

Oral ♂, ♀ rat (28 day) 111, 333 or 1000 mg kg⁻¹ day⁻¹ caused inhibition of body weight gain, and increases in liver, spleen and kidney weights. Anaemia was observed at the highest dose. Histopathology showed mucosal hyperplasia in the stomach, dilation, degeneration or necrosis of the renal tubules and hyperplasia in the bone marrow. Slight degeneration occurred with 333 mg kg⁻¹ day⁻¹ with repair of lesions after 14 days. No effects were observed at 111 mg kg⁻¹ day⁻¹ (6).

Carcinogenicity and chronic effects

Selected for general toxicology study by National Toxicology Program (7).

Teratogenicity and reproductive effects

Oral rat (17-22 day gestation) 7500 mg kg⁻¹ caused teratogenic effects (8).

Irritancy

Human skin, eye and mucous membrane irritant (9).

Sensitisation

Human skin sensitiser (9).

Genotoxicity

Escherichia coli PQ37 with and without metabolic activation negative (10).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (11).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (12).

FAO/WHO tolerable daily intake (TDI) humans 0.02 mg kg⁻¹ (13).

Other comments

Residues found in [¹⁴C]diphenylamine-treated apples after storage at reduced temperature for 40 wk consisted mainly of unmetabolised diphenylamine which was confined largely to the skin. The pulp contained 2-, 3-, and 4-hydroxylated diphenylamine and dihydroxydiphenylamine and their glycosyl conjugates (14).

Toxicology reviewed (15).

Reviews on human health effects, experimental toxicology, physico-chemical properties, environmental health effects, ecotoxicity and workplace experience listed (16).

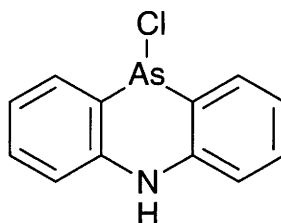
Studies of methods for calculating bioconcentration of organic chemicals are reported (17-22).

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D541 diphenylamine chloroarsine



$C_{12}H_9AsClN$

Mol. Wt. 277.58

CAS Registry No. 578-94-9

Synonyms 10-chloro-5,10-dihydrophenarsazine; 5-aza-10-arsenaanthracene chloride; 10-chloro-5,10-dihydroarsacridine; phenazarsine chloride

EINECS No. 209-433-1

RTECS No. SG 0680000

Uses Formulation of wood-treating solutions against marine borers and similar pests. For riot control in combination with tear gas (chloroacetophenone).

Physical properties

M. Pt. 186°C **B. Pt.** 410°C **Specific gravity** 1.648 at 20°C **Volatility** v.den. 9.6

Solubility Organic solvents: benzene, carbon tetrachloride, xylene

Occupational exposure

UK-LTEL MEL 0.1 mg m⁻³ (as As)

UN No. 1698 HAZCHEM Code 2XE **Conveyance classification** toxic substance

Mammalian & avian toxicity

Acute data

LD₅₀ intravenous mouse 35 mg kg⁻¹ (1).

LD₅₀ intravenous rabbit 6 mg kg⁻¹ (2).

LC_{Lo} (30 min) inhalation human 54 ppm (3).

LD₅₀ intravenous mouse 35 mg kg⁻¹ (1).

LD₅₀ intravenous rabbit 6 mg kg⁻¹ (2).

Irritancy

In humans irritating to skin and respiratory tract. Causes profuse watery nasal discharge, severe pain in nose, sinuses, chest with sneezing and coughing. Sensory disturbances may occur later (4).

Legislation

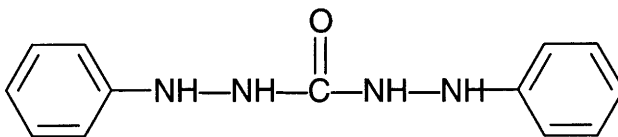
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (5).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (6).

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5. *EC Directive Relating to the Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
6. *S. I.* 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D542 1,5-diphenylcarbazine



C₁₃H₁₄N₄O

Mol. Wt. 242.28

CAS Registry No. 140-22-7

Synonyms 2,2'-diphenylcarbonylhydrazide; 2,2'-diphenylcarbazine; 1,5-diphenylcarbonylhydrazide; *sym*-diphenylcarbazine; *N,N'*-diphenylcarbazine; DPC

EINECS No. 205-403-7

RTECS No. FF 2750000

Uses Chelating agent. Analytical reagent used in colorimetric determination of chromium and other metal ions. Indicator in iron titration.

Physical properties

M. Pt. 173-176°C (99% purity)

Solubility Organic solvents: acetone, ethanol, glacial acetic acid

Environmental fate

Nitrification inhibition

No inhibition of ammonia oxidation by *Nitrosomonas* at 100 mg l⁻¹ (1).

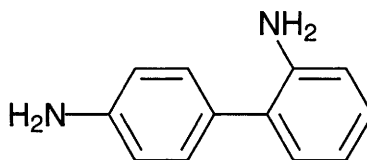
Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (2).
Escherichia coli WP2, WP67, CM871, DNA repair test with and without metabolic activation positive (2).

References

1. Hockenbury, M. R. et al *J. Water Pollut. Control Fed.* 1977, **49**(5), 768-777.
2. DeFlora, S. et al *Mutat. Res.* 1984, **133**, 161-198

D543 2,4'-diphenyldiamine



$C_{12}H_{12}N_2$

Mol. Wt. 184.24

CAS Registry No. 492-17-1

Synonyms 2,4'-biphenyldiamine; diphenylene; *o,p'*-dianiline; *o,p'*-bianiline; 2,4'-diaminodiphenyl; (1,1'-biphenyl)-2,4-diamine; difenylin

RTECS No. DV 2100000

Uses In the past as an analytical reagent for the detection of tungsten and in the manufacture of azo dyes.

Physical properties

M. Pt. 45°C (needles from dilute alcohol) **B. Pt.** 363°C

Solubility Water: insoluble. Organic solvents: ethanol, ether

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 311 mg kg⁻¹ (1).

Carcinogenicity and chronic effects

No adequate data for carcinogenicity to humans, inadequate evidence for carcinogenicity to animals, IARC classification group 3 (2).

Oral dog (5 yr intermittent administration) TD_{Lo} 7020 mg kg⁻¹ equivocal tumorigenic agent (1).

Genotoxicity

Salmonella typhimurium microsomal mutagenicity assay 100 µg plate⁻¹. Strain TA98 without metabolic activation negative, with metabolic activation positive. Strain TA100 with and without metabolic activation negative (3).

Other comments

Reviews on human health effects, experimental toxicology, physico-chemical properties, epidemiology, workplace experience, ecotoxicity, environmental effects and exposure levels listed (4).

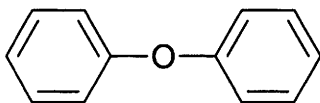
Most technical grades of benzidine contain about 1% 2,4'-diphenyldiamine as an impurity, inferior grades up to 4%. (Benzidine production has been prohibited in Japan, Ireland, UK and the former USSR, and it is not known to be manufactured commercially, except as an unisolated intermediate, in the US) (5).

References

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3. Nohara, A. et al *Mutat. Res.* 1985, **149**, 9-15.

4. ECETOC Technical Report No. 71 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuyse (Bte 6), B-1160 Brussels, Belgium.
5. Montesano, R. et al *Cancer Res.* 1977, **37**, 310-316

D544 diphenyl ether



C₁₂H₁₀O

Mol. Wt. 170.21

CAS Registry No. 101-84-8

Synonyms diphenyl oxide; phenoxybenzene; geranium crystals; 1,1'-oxybisbenzene; phenyl ether; biphenyl oxide

EINECS No. 202-981-2

RTECS No. KN 8970000

Uses Perfumery especially soaps. Heat transfer medium. Chemical intermediate. Catalyst. Solvent.

Physical properties

M. Pt. 26-30°C **B. Pt.** 259°C **Flash point** 110°C (99+% purity) **Specific gravity** 1.073 at 20°C

Partition coefficient log *P*_{ow} 4.21 **Volatility** v.p. 0.02 mmHg at 25°C ; v.den. 5.9

Solubility Water: 21 mg l⁻¹ at 25°C. Organic solvents: benzene, diethyl ether, ethanol, glacial acetic acid

Occupational exposure

DE-MAK 1 ppm (7.1 mg m⁻³)

FR-VME 1 ppm (7 mg m⁻³)

UK-LTEL 1 ppm (7.1 mg m⁻³) (vapour)

US-TWA 1 ppm (7 mg m⁻³)

US-STEL 2 ppm (14 mg m⁻³)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 4 mg l⁻¹ (1).

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 3.64 ppm Microtox test (2).

Bioaccumulation

Bioconcentration factor for rainbow trout 195 (3).

Found in fatty tissue of fish sampled in Nova Scotia 0.3-4.0 µg g⁻¹ (lipid) (4).

Environmental fate

Degradation studies

Degraded by *Pseudomonas cepacia* isolated from soil when utilised as sole carbon source. Metabolites included 2,3-dihydroxydiphenyl ether and 2-pyrone-6-carboxylic acid (5).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 3370 mg kg⁻¹ (6).

LD₅₀ oral guinea pig 1.0-4.0 g kg⁻¹ (6).

Sub-acute and sub-chronic data

Inhalation rats, rabbits, dogs 4.9 or 10.0 ppm 7 hr day⁻¹, 5 days wk⁻¹ for 20 exposures and rats at 20 ppm for similar exposures. No signs of toxicity or irritation observed in rabbits and dogs at 4.9 ppm. Eye and nasal irritation were observed in rats and rabbits (but not dogs) exposed at 10 ppm and rats exposed to 20 ppm (7).

Metabolism and toxicokinetics

Injection rabbit (dose unspecified) excreted in the urine as a 2-hydroxyphenyl phenyl ether and di-(*p*-hydroxyphenyl) ether (6).

In the rabbit the major urinary metabolite was 4-hydroxyphenyl phenyl ether, 15% unconjugated, 63% conjugated with glucuronic acid and conjugated with sulfuric acid 12%. Di-(*p*-hydroxyphenyl) ether was also isolated (8).

Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation (9).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1537, TA1538, TA1978 with and without metabolic activation negative (10).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (11).
Log P_{ow} exceeds EC limit.

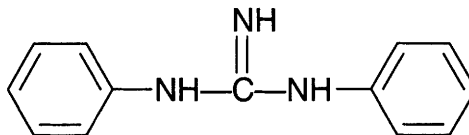
Other comments

Pollutant in water samples (12).
Reviews on toxicity listed (13).
Autoignition temperature 610°C.

References

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2. Kaiser, K. L. E. et al *Water Pollut. Res. J. Can.* 1991, **26**(3), 361-431.
3. Korte, F. *Percolatiewaterafvalstortplaatsen Bevat Gevaarlijke Chemicalien* Nov 1974, Orientatiedag OGEM-MPC Milieutechniek.
4. Neely, W. et al *Environ. Sci. Technol.* 1974, **8**.
5. Pfeifer, F. et al *Arch. Microbiol.* 1989, **152**(6), 515-519.
6. Opdyke, D. L. J. *Food Cosmet. Toxicol.* 1974, **12**, 303.
7. Hefner, R. E. J. et al *Toxicol. Appl. Pharmacol.* 1975, **33**, 78.
8. *Patty's Industrial Hygiene and Toxicology* 3rd ed., 1981, **2a**, 2542, John Wiley & Sons, New York, USA.
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10. Westinghouse, R & D Center: *Potential Carcinogenicity Testing of PCB Replacements Using the Ames Test* 1977, EPA Document No. 878214672.
11. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
12. Grob, K. et al *J. Chromatogr.* 1974, **90**, 303.
13. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuyse (Bte 6), B-1160 Brussels, Belgium

D545 1,3-diphenylguanidine



$C_{13}H_{13}N_3$

Mol. Wt. 211.27

CAS Registry No. 102-06-7

Synonyms *N,N'*-diphenylguanidine; diphenylguanidine; *sym*-diphenylguanidine; Akrochem DPG; Perkacit DPG; Vanax DPG; Rhenogran DPG-80

EINECS No. 203-002-1

RTECS No. MF 0875000

Uses Catalyst. Vulcanisation accelerator. Cross-linking agent. In thermal recording paper. Primary material for standardising acids.

Physical properties

M. Pt. 150°C **B. Pt.** 170°C (decomp.) **Specific gravity** 1.13 at 20°C with respect to water at 4°C

Solubility Organic solvents: benzene, chloroform, ethanol, toluene

Environmental fate

Nitrification inhibition

Ammonia oxidation by activated sludge is not inhibited by 50 mg l⁻¹ (the highest concentration tested) (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird, house sparrow >100 mg kg⁻¹ (2).

LD₅₀ oral mouse 290 mg kg⁻¹ (3).

LD₅₀ oral rat 507 mg kg⁻¹ (4).

LD₅₀ intraperitoneal rat 75 mg kg⁻¹ (4).

LD₅₀ intraperitoneal mouse 25 mg kg⁻¹ (5).

LD₅₀ subcutaneous guinea pig 200 mg kg⁻¹ (6).

LD₅₀ intravenous dog 25 mg kg⁻¹ (6).

When fed to adult rats as a 1% emulsion with an aqueous starch suspension, produced unsteady walk, flabbiness, spasmodic jerking of limbs and tensing of body muscles. Death occurred on the first or second day (7).

Teratogenicity and reproductive effects

Oral mouse 0.25, 1.0, 4.0 or 10 mg kg⁻¹ day⁻¹ throughout pregnancy. No teratogenic effects were observed.

Disturbances in implantation were seen in the mothers (7).

Sensitisation

Occupational allergic dermatosis was observed in rubber workers, caused by rubber additives including diphenylguanidine (8).

Genotoxicity

Salmonella typhimurium TA98, TA100 with and without metabolic activation negative (9).

Salmonella typhimurium TA1535, TA1537, TA1538 with and without metabolic activation positive (10).

Other effects

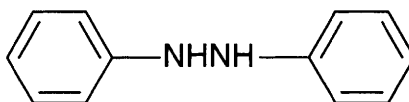
Any other adverse effects

Toxic effects include increased levels of triglycerides and cholesterol esters in the liver (11).

References

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2. Schafer, E. W. et al *Arch. Environ. Contam. Toxicol.* 1983, **12**, 355-382.
3. *Hyg. Sanit. (USSR)* 1964, **29**, 37.
4. *Med. Pr.* 1965, **16**, 35.
5. *NTIS Report AD 277-689*, Natl. Tech. Inf. Ser., Springfield, VA, USA.
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8. Somov, B. A. et al *Vestn. Dermatol. Venerol.* 1976, **5**, 68.
9. Yamaguchi, T. et al *Eisei Kagaku* 1991, **37**(1), 6-13 (Japan.) (*Chem. Abstr.* **115**, 2940y).
10. Benspong, M. A. et al *J. Environ. Pathol., Toxicol. Oncol.* 1985, **6**(2), 293-301.
11. Pitsin, D. G. et al *Farmakol. Toksikol. (Moscow)* 1972, **35**(3), 360

D546 1,2-diphenylhydrazine



$C_{12}H_{12}N_2$

Mol. Wt. 184.24

CAS Registry No. 122-66-7

Synonyms hydrazobenzene; *sym*-diphenylhydrazine; *N,N'*-bianiline

EINECS No. 204-563-5

RTECS No. MW 2625000

Uses Fuel additive. Manufacture of dyestuffs and benzidine.

Physical properties

M. Pt. 123-126°C Specific gravity 1.158 at 16°C with respect to water at 4°C

Partition coefficient $\log P_{ow}$ 3.00 (1)

Solubility Organic solvents: benzene, ethanol, vegetable oils

Occupational exposure

Supply classification toxic

Risk phrases May cause cancer – Harmful if swallowed (R45, R22)

Safety phrases Restricted to professional users – Avoid exposure – obtain special instruction before use – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S53, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) bluegill sunfish 0.27 mg l⁻¹ (2).

Invertebrate toxicity

EC₅₀ (24 hr) *Daphnia magna* 8.1 mg l⁻¹ (2).

EC₅₀ (30 min) *Photobacterium phosphoreum* 0.989 ppm Microtox test (3).

Bioaccumulation

Exists in rapid equilibrium with azobenzene, which would predominate in aerobic waters. The P_{ow} 3.82 (NTP value 3.0; see ref. 2) of azobenzene predicts bioconcentration would occur in aquatic organisms (4,5).

Environmental fate

Degradation studies

17% was degraded in 2 wk and 100% after 4 wk in activated sewage sludge (6).

Mammalian & avian toxicity

Carcinogenicity and chronic effects

National Toxicology Program tested rats and mice via oral administration. Negative results were reported for ♂ mice. Induced hepatocellular carcinoma and Zymbal gland squamous cell neoplasms in ♂ rats and neoplastic liver nodules and mammary adenocarcinomas in ♀ rats. Induced hepatocellular carcinomas in ♀ mice (7).

Metabolism and toxicokinetics

Following intraperitoneal administration of 200 mg kg⁻¹ to rats, 1,2-diphenylhydrazine; aniline; benzidine; 4-aminophenol and 2-aminophenol were identified in the urine (2).

Genotoxicity

Salmonella typhimurium TA100 with metabolic activation positive (8).

In vitro Chinese hamster ovary cells, sister chromatid exchanges and chromosomal aberrations positive (9).

Other comments

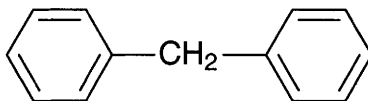
Has been detected in the tissues of fish collected from several freshwater sources in the Great Lakes of north America (10).

Toxicity and assessment of adverse health effects of 1,2-diphenylhydrazine reviewed (11,12).

References

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D547 diphenylmethane



C₁₃H₁₂

Mol. Wt. 168.24

CAS Registry No. 101-81-5

Synonyms 1,1'-methylenebis(benzene); biphenylmethane; benzylbenzene

EINECS No. 202-978-6

Physical properties

M. Pt. 22-24°C B. Pt. 264°C Flash point 110°C Specific gravity 1.006

Solubility Water: 3.0 mg l⁻¹ at 24°C. Organic solvents: benzene, chloroform, diethyl ether, ethanol, hexane

Ecotoxicity

Invertebrate toxicity

Cell multiplication inhibition test, *Uronema parduczi* 2.2 mg l⁻¹ (1).

Bioaccumulation

Calculated bioconcentration factor 825 (2).

Environmental fate

Degradation studies

Degraded by microorganisms isolated from sewage, water and soil (3).

Extensively degraded in 40 days when seeded with a soil inoculum, following a 30-day lag (4).

Abiotic removal

Diphenylmethane has an absorption band extending beyond 290 nm, hence direct photolysis likely. Irradiation as a thin film with simulated sunlight causes photooxidation to diphenylmethyl hydroperoxide, diphenylmethanol and benzophenone (5).

Mammalian & avian toxicity

Acute data

LD_{Lo} oral rat 5000 mg kg⁻¹ (6).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Substances extractable in chloroform: guide level 0.1 mg l⁻¹ dry residue (7).

Other comments

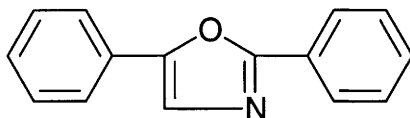
Three microbial metabolic pathways identified to 1,1,1',1'-tetraphenyldimethyl ether, phenylacetic acid and benzhydrol (3).

Wastewater from 4000 industrial and publicly owned treatment works surveyed. Diphenylmethane was identified in discharges from the timber, paint and ink, printing and publishing, coal mining, organics and plastics, synthetics, rubber processing, pesticide manufacturing, pharmaceuticals, explosives, electronics, oil and gas, and organic chemicals industries. Also identified in publicly owned treatment plants. Highest levels of 29,554 ppm were from the paint and ink industry (8).

References

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D548 2,5-diphenyloxazole



$C_{15}H_{11}NO$

Mol. Wt. 221.26

CAS Registry No. 92-71-7

EINECS No. 202-181-3

RTECS No. RP 2685000

Uses Corrosion inhibitor. In compositions for radioactivity scintillation counters.

Physical properties

M. Pt. 72-74°C B. Pt. 360°C

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird 96.2 mg kg⁻¹ (1).

LD₅₀ intraperitoneal mouse 750 mg kg⁻¹ (2).

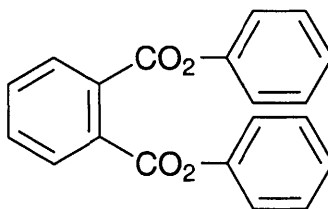
Metabolism and toxicokinetics

Metabolism catalysed by 3-methylcholanthrene-induced rat liver microsomes and inhibited by α -naphthoflavone, indicating cytochrome P₄₄₈ or ₄₅₀ involvement; studies with human lymphocytes have indicated metabolism was mediated by aryl hydrocarbon hydroxylase activity (3).

References

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2. *NTIS Report AD 277-689*, Natl. Tech. Inf. Ser., Springfield, VA, USA.
3. Ahokas, J. T. et al *Pharmacol. Toxicol. (Copenhagen)* 1987, **61**(3), 184-190

D549 diphenyl phthalate



$C_{20}H_{14}O_4$

Mol. Wt. 318.33

CAS Registry No. 84-62-8

Synonyms diphenyl 1,2-benzenedicarboxylate; phenyl phthalate

EINECS No. 201-546-4

RTECS No. TI 1935000

Uses Plasticiser. Solvent.

Physical properties

M. Pt. 74-76°C B. Pt. 405°C Flash point 224°C Specific gravity 1.3 at 20°C

Solubility Organic solvents: acetone, chloroform, dichloromethane, diethyl ether, ethanol

Occupational exposure

SE-LEVL 3 mg m⁻³

SE-STEL 5 mg m⁻³

Environmental fate

Degradation studies

Degraded by *Nocardia erythropolis* inoculated into activated sludge. Degradation occurs via hydrolysis of the esters of the free phthalic acid (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 8000 mg kg⁻¹ (2).

Metabolism and toxicokinetics

Following oral administration to dogs, poorly absorbed from the gastro-intestinal tract with ~90% excreted in the faeces (3).

Legislation

Organic solvents are included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

Other comments

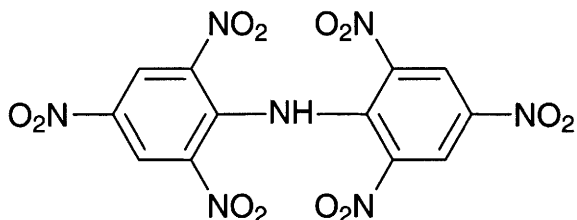
Toxicity of phthalate esters reviewed (5,6).

References

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2. *Environ. Health Perspect.* 1973, 3, 131.
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5. *Toxicity Review 14: Review of the Toxicity of the Esters of o-Phthalic Acid (Phthalate Esters)* 1986, **14**, HSE, Broadlane, Sheffield, UK.
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D550 dipicrylamine



$C_{12}H_5N_7O_{12}$

Mol. Wt. 439.21

CAS Registry No. 131-73-7

Synonyms bis(2,4,6-trinitrophenyl)amine; 2,4,6,2',4',6'-hexanitrodiphenylamine; hexyl; 2,4,6-trinitro-*N*-(2,4,6-trinitrophenyl)benzenamine; benzenamine, 2,4,6-trinitro-*N*-2,4,6-trinitrophenyl; C.I. 10360; Aurantia

EINECS No. 205-037-8

RTECS No. JJ 9275000

Uses A booster explosive. Analysis of potassium.

Physical properties

M. Pt. 238°C (decomp.)

Occupational exposure

Supply classification explosive, very toxic, dangerous for the environment

Risk phrases Risk of explosion by shock, friction, fire or other sources of ignition – Very toxic by inhalation, in contact with skin and if swallowed – Danger of cumulative effects – Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R2, R26/27/28, R33, R51/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – This material and its container must be disposed of in a safe way – Wear suitable protective clothing – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S35, S36, S45, S61)

Ecotoxicity

Invertebrate toxicity

EC₅₀ (30, 60, 90 min) *Vibrio fischeri* NRRL-B-11177 6.32, 6.31 and 6.26 mg l⁻¹, respectively (1).

Genotoxicity

Salmonella typhimurium TA100, TA98, TA1537 and TA1538 without metabolic activation positive (2).

Other comments

The effects of dipicrylamine on the lipid membrane transport of ionised drugs was studied. Highly lipophilic counterions accumulate in the lipid membrane and act as a carrier for ionised drugs (3).

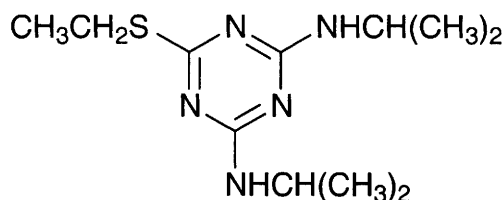
A powerful and violent explosive superior to TNT. Soluble in alkali and warm acetic or nitric acid. Explodes on shock or exposure to heat.

Reviews on human health effects and experimental toxicology listed (4).

References

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D551 dipropetryn



C₁₁H₂₁N₅S

Mol. Wt. 255.39

CAS Registry No. 4147-51-7

Synonyms 6-(ethylthio)-N,N'-bis(1-methylethyl)-1,3,5-triazine-2,4-diamine; 2-(ethylthio)-4,6-bis(isopropylamino)-s-triazine; 2,4-bis(isopropylamino)-6-ethylthio-s-triazine

EINECS No. 223-973-5

RTECS No. XY 4100000

Uses Superseded herbicide.

Physical properties

M. Pt. 104-106°C **Specific gravity** 1.120 at 20°C **Volatility** v.p. 7.3×10^{-7} mmHg at 20°C

Solubility Water: 16 mg l⁻¹ at 20°C. Organic solvents: acetone, dichloromethane, hexane, methanol, *n*-octanol, toluene

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) bluegill sunfish, rainbow trout 1.6, 2.7 mg l⁻¹, respectively (1).

Invertebrate toxicity

Practically non-toxic to bees (1,2).

Environmental fate

Degradation studies

Degradation involves dealkylation of the side-chain, splitting of the ring and evolution of carbon dioxide (1).

Degraded in soils, t_{1/2} ~100 days (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 3900-4200 mg kg⁻¹ (1).

LD₅₀ dermal rabbit >10,000 mg kg⁻¹ (1).

Sub-acute and sub-chronic data

Oral rat, dog (98 day) 400 mg kg⁻¹ in diet, no adverse effects reported (1).

Irritancy

Mild irritant to skin but not to eyes of rabbits (2).

Other effects

Any other adverse effects

Practically non-toxic to birds (2).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (3).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

References

1. *The Agrochemicals Handbook* 3rd ed., 1991, The Royal Society of Chemistry, London, UK.
2. *The Pesticide Manual* 9th ed., 1991, British Crop Protection Council, Farnham, UK.
3. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
4. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D552 dipropionyl peroxide



C₆H₁₀O₄

Mol. Wt. 146.14

CAS Registry No. 3248-28-0

Synonyms bis(1-oxopropyl)peroxide; propionyl peroxide

EINECS No. 221-828-0

RTECS No. UG 7109900

Uses Initiator in polymerisation reactions. Used in high pressure polymerisation of ethylene.

Physical properties

M. Pt. -40 to -20°C Flash point 51.5°C

Mammalian & avian toxicity

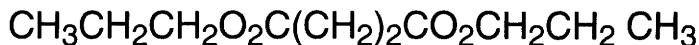
Acute data

LC_{Lo} (duration unspecified) inhalation rat 100 ppm (1).

References

1. *Br. J. Ind. Med.* 1970, 27, 1

D553 dipropyl adipate



$\text{C}_{12}\text{H}_{22}\text{O}_4$

Mol. Wt. 230.30

CAS Registry No. 106-19-4

Synonyms di-*n*-propyl adipate; dipropyl hexanedioate

EINECS No. 203-371-9

RTECS No. AV 1740000

Uses Catalyst for polymerisation of olefins. Cosmetic ingredient.

Physical properties

M. Pt. -15.7°C B. Pt. 151°C at 11 mmHg Specific gravity 0.9790 at 20°C with respect to water at 4°C

Mammalian & avian toxicity

Acute data

LD_{50} intraperitoneal rat 3790 mg kg^{-1} (1).

Teratogenicity and reproductive effects

Intraperitoneal rat (5-15 day gestation) 757 mg kg^{-1} caused teratogenic effects and 1262 mg kg^{-1} reproductive effects (1).

In a CASE study of developmental toxicity using animal toxicity studies and their application to human teratogenic and embryotoxic effects, dipropyl adipate was predicted to be negative in humans (2).

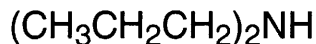
Other comments

Reviews on human health effects, experimental toxicology and environmental effects listed (3,4).

References

1. *J. Pharm. Sci.* 1973, **62**, 1596.
2. Jelovsek, F. R et al *Obstet. Gynecol. (N.Y.)* 1989, **74**(4), 624-636.
3. Schardein, J. L. et al *Environ. Health Persps.* 1985, **61**, 55-67.
4. ECETOC Technical Report No. 71 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuyse (Bte 6), B-1160 Brussels, Belgium

D554 dipropylamine



$\text{C}_6\text{H}_{15}\text{N}$

Mol. Wt. 101.19

CAS Registry No. 142-84-7

Synonyms *N*-propyl-1-propanamine; di-*n*-propylamine

EINECS No. 205-565-9

RTECS No. JL 9200000

Uses Catalyst. Intermediate in organic synthesis. Templating agent in molecular sieve manufacture. Corrosion inhibitor.

Occurrence Present in various plants including tobacco.

Physical properties

M. Pt. -63°C **B. Pt.** 105-110°C **Flash point** 3°C (99+% purity) **Specific gravity** 0.738 at 20°C with respect to water at 4°C **Partition coefficient** $\log P_{ow}$ 1.67 **Volatility** v.p. 30mmHg at 25°C ; v.den. 3.5
Solubility Water: miscible. Organic solvents: acetone, benzene, diethyl ether, ethanol

Occupational exposure

UN No. 2383 **HAZCHEM Code** 2WE **Conveyance classification** flammable liquid, corrosive
Supply classification highly flammable
Supply classification corrosive
Risk phrases Highly flammable – Harmful by inhalation, in contact with skin and if swallowed – Causes severe burns (R11, R20/21/22, R35)
Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Keep away from sources of ignition – No smoking – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – Wear suitable protective clothing, gloves and eye/face protection – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S16, S26, S36/37/39, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (24 hr) creek chub 20-60 mg l⁻¹ (1).

Bioaccumulation

The calculated bioconcentration factor of 1.04 indicates that environmental accumulation is unlikely (2).

Environmental fate

Degradation studies

Aerobacter sp. 200 mg l⁻¹ at 30°C, 100% degradation by parent in 26 hr; by mutant strains within 12 hr (3).

Abiotic removal

t_{1/2} for volatilisation from water 0.83 days in 1 m deep model and 9.5 days in environmental pond (2).

In the atmosphere reacts with photochemically produced hydroxyl radicals with an estimated t_{1/2} of 4.6 hr (4).

Evaporation rate relative to *n*-butyl acetate, which has been assigned a value of 1 at 25°C, is 1.99 (5).

Adsorption capacity of activated carbon 174 mg g⁻¹ (6).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 930 mg kg⁻¹ (7).

LC₅₀ (4 hr) inhalation rat 4400 mg m⁻³ (8).

LD₅₀ dermal rabbit 1250 mg kg⁻¹ (9).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (10).

Other effects

Any other adverse effects

Intraperitoneal rat (dose unspecified) moderately inhibited liver monoamine oxidase activity (11).

Other comments

Present in some industrial effluents.

Threshold odour concentration 0.02-0.10 ppm (12).

Hazards reviewed (13).

A Romanian toxicological study suggests that the maximum allowable concentrations of dipropylamine for air in workplace and for surface water should be set at 2 mg m⁻³ and 0.4 mg l⁻¹, respectively (14).
Reviews on human health effects, experimental toxicology and physico-chemical properties listed (15).

References

1. McKee, J. E. et al *Water Quality Criteria* 1963, The Resources Agency of California, State Water Quality Control Board.
2. Flick, E. W. *Industrial Solvents Handbook* 3rd ed., 1985, 526.
3. Wonne, H. E. "The Activity of Mutant Microorganisms in the Treatment of Industrial Wastes" *Tijdschrift van het BECEWA* Liege, Belgium.
4. Eisenreich, J. J. et al *Environ. Sci. Technol.* 1981, **15**, 30-38.
5. *Texaco Chemical UK* 1992, 195 Knightsbridge, London, UK.
6. Guisti, D. M. et al *J. Water Pollut. Control Fed.* 1974, **46**(5), 947-965.
7. Smyth, H. F. et al *Am. Ind. Hyg. Assoc. J.* 1962, **23**, 95.
8. Izmerov, N. F. et al *Toxicometric Parameters of Industrial Toxic Chemicals under Single Exposure* 1982, CIP, Moscow, USSR.
9. Lenga, R. E. *The Sigma-Aldrich Library of Chemical Safety Data* 1988, **1**, 1470, Sigma-Aldrich, Milwaukee, USA.
10. Zeiger, E. et al *Environ. Mutagen.* 1987, **9**(Suppl.9), 1-110.
11. Valier, A. G. *Vopr. Biokhim. Immunol. Chel. Zhivotn.* 1974, **33**.
12. Hellmann, T. M. et al *Chem. Eng. Prog.* 1973, **69**, 9.
13. *Dangerous Prop. Ind. Mater. Rep.* 1987, **7**(2), 54-58.
14. Colosi-Esca, D. et al *Rev. Chim. (Bucharest)* 1988, **39**(2), 179-184 (Rom.) (*Chem. Abstr.* **108**, 226185z).
15. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuysse (Bte 6), B-1160 Brussels, Belgium

D555 dipropylene glycol



C₆H₁₄O₃

Mol. Wt. 134.18

CAS Registry No. 25265-71-8

Synonyms 1,1'-oxydi-2-propanol; β,β-dihydroxydi-*n*-propyl ether; 2,2'-dihydroxydipropyl ether; 2,2'-dihydroxyisopropyl ether

EINECS No. 246-770-3

RTECS No. UB 8785000

Physical properties

M. Pt. supercools **B. Pt.** 229-232°C **Flash point** 118-121°C (open cup) **Specific gravity** 1.023 at 20°C with respect to water at 4°C **Volatility** v.p. <0.01 at 20°C ; v.den. 4.63

Environmental fate

Abiotic removal

Activated carbon 33 g kg⁻¹, 16.5% reduction, influent 1000 mg l⁻¹, effluent 835 mg l⁻¹ (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 14,800 mg kg⁻¹ (2).

LD₅₀ intravenous dog 11,500 mg kg⁻¹ (3).

LD₅₀ intraperitoneal rat 10,000 mg kg⁻¹ (3).

Sub-acute and sub-chronic data

Oral rat (77 day) 5% in drinking water caused no effect (2).

Irritancy

Dermal rabbit (24 hr) 500 mg caused mild irritation and 510 mg instilled into rabbit eye caused irritation (4).

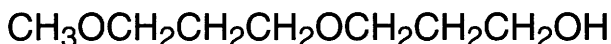
Other comments

Reviews on human health effects, experimental toxicology, environmental effects, ecotoxicology, exposure levels (limited), exposure conditions and all safety test data listed (5).

References

1. Guisti, D. M. et al J. *Water Pollut. Control Fed.* 1974, **46**(5), 947-965.
2. Patty, F. A. *Industrial Hygiene and Toxicology* 1967, Vol. 2, Interscience Publishers, New York, USA.
3. *Food Cosmet. Toxicol.* 1963-1981, **16**, 637, Pergamon Press, Elmsford, New York, USA.
4. Lenga, R. E. *The Sigma-Aldrich Library of Chemical Safety Data* 2nd ed., 1988, Sigma Aldrich, Milwaukee, WI, USA.
5. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuysse (Bte 6), B-1160 Brussels, Belgium

D556 dipropylene glycol methyl ether



$\text{C}_7\text{H}_{16}\text{O}_3$

Mol. Wt. 148.20

CAS Registry No. 34590-94-8

Synonyms dipropylene glycol monomethyl ether; (2-methoxymethylethoxy)propanol;
1,4-dimethyl-3,6-dioxo-1-heptanol; Arcosolv DPM; Dowanol PPM; Poly-Solv PPM

EINECS No. 252-104-2

RTECS No. JM 1575000

Uses Air fresheners. Cleaning solvent for agricultural sprayers, ovens, floors, etc. Hair waving agent. Solvent for jet printing ink.

Physical properties

M. Pt. -80°C **B. Pt.** 190°C **Flash point** 74°C **Specific gravity** 0.938 at 20°C with respect to water at 4°C
Volatility v.den. 5.1

Occupational exposure

DE-MAK 50 ppm (310 mg m^{-3})

FR-VME 100 ppm (600 mg m^{-3})

SE-LEVL 50 ppm (300 mg m^{-3})

SE-STEL 75 ppm (450 mg m^{-3})

US-TWA 100 ppm (606 mg m^{-3})

US-STEL 150 ppm (909 mg m^{-3})

Ecotoxicity

Fish toxicity

No adverse effect on brown trout, bluegill sunfish and goldfish fingerlings within 24 hr at a concentration of 5 ppm. Test conditions: pH7, dissolved oxygen content 7.5 ppm, total hardness (soap method) 300 ppm, methyl orange alkalinity 310 ppm, free carbon dioxide 5 ppm and temperature 12.8°C (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, dog 5600, 7500 mg kg⁻¹, respectively (2,3).

LD₅₀ dermal 9500 mg kg⁻¹ (4).

Sub-acute and sub-chronic data

Dermal ♂ rat (28 day) unspecified concentration dosed on 5 consecutive days wk⁻¹ caused no significant changes in clinical chemistry, haematology or pathology (5).

Inhalation rat, rabbit (13 wk) unspecified concentration for 6 hr day⁻¹, 5 days wk⁻¹ produced no toxic effects (6).

Oral rat (35 day) 1 g kg⁻¹ day⁻¹ produced no indications of toxicity (7).

Dermal rabbit (90 day) 5 ml kg⁻¹ day⁻¹, 5 × wk⁻¹ caused no toxic effects (8).

Intraperitoneal rat (14 day) 1000 mg kg, 5 × wk⁻¹ did not increase the urinary excretion of albumin, β₂-microglobulin or β-N-acetylglucosaminidase (9).

Metabolism and toxicokinetics

Dipropylene glycol methyl ether is metabolised to propylene glycol which is relatively non-toxic (5).

Irritancy

Dermal rabbit 500 mg (open) caused mild irritation (10).

238 mg instilled into rabbit eye caused mild irritation (11).

Sensitisation

Described as a mild allergen (12).

Other effects

Any other adverse effects

Inhalation rat (7 hr) 500 ppm produced mild narcosis with rapid recovery (13).

Inhalation monkey (7 hr) 300-400 ppm produced mild narcosis and changes in liver and lungs (13).

Other comments

Reviews on human health effects, experimental toxicology, environmental effects, ecotoxicology, exposure levels (limited), hazard assessment (specific), epidemiology and workplace experience listed (14).

References

1. Wood, E. M. *The Toxicity of 3400 Chemicals to Fish* 1987, EPA560/6-87-002 PB 87-200-275, Office of Toxic Substances, Washington, DC, USA.
2. *Am. Ind. Hyg. Assoc. J.* 1962, **23**, 95.
3. *J. Pharmacol. Exp. Ther.* 1951, **102**, 79.
4. *Doc. Threshold Limit Values for Substances in Workroom Air* 1986, Am. Conf. Govt. Ind. Hyg. Inc., Cincinnati, OH, USA.
5. Fairhurst, S. et al *Toxicology* 1989, **57**(2), 209-215.
6. Laudry, T. D. et al *Fundam. Appl. Toxicol.* 1984, **4**, 612.
7. Browning, E. *Toxicity and Metabolism of Industrial Solvents* 1965, Elsevier, Amsterdam, Netherlands.
8. Rowe, V. K. et al *Arch. Ind. Hyg.* 1954, **9**, 509.
9. Bernard, A. M. et al *Toxicol. Lett.* 1989, **45**, 271-280.
10. *Union Carbide Data Sheet* 1971, Union Carbide Corp., New York, USA.
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12. Sax, N. I. et al *Dangerous Properties of Industrial Materials* 8th ed., 1992, Van Nostrand Reinhold, New York, USA.
13. Gosselin, R. E. et al *Clinical Toxicology of Commercial Products* 5th ed., 1984, Williams & Wilkins, Baltimore, MD, USA.
14. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuysse (Bte 6), B-1160 Brussels, Belgium

D557 dipropyl ether



$\text{C}_6\text{H}_{14}\text{O}$

Mol. Wt. 102.18

CAS Registry No. 111-43-3

Synonyms propyl ether; 1,1'-oxybispropane; dipropyl oxide

EINECS No. 203-869-6

RTECS No. UJ 5125000

Uses Pharmaceuticals. Polymerisation catalyst in the manufacture of olefins.

Physical properties

M. Pt. -122°C B. Pt. $89-91^\circ\text{C}$ Flash point 4°C (99+% purity) Specific gravity 0.7360 at 20°C with respect to water at 4°C Partition coefficient $\log P_{\text{ow}}$ 2.03 Volatility v.den. 3.5

Solubility Organic solvents: diethyl ether, ethanol

Occupational exposure

UN No. 2384 HAZCHEM Code 3/E Conveyance classification flammable liquid

Supply classification highly flammable

Risk phrases Highly flammable – May form explosive peroxides (R11, R19)

Safety phrases Keep out of reach of children (if sold to general public) – Keep container in a well ventilated place – Keep away from sources of ignition – No smoking – Take precautionary measures against static discharges (S2, S9, S16, S33)

Ecotoxicity

Bioaccumulation

Based on the reported $\log P_{\text{ow}}$ 2.03 a bioconcentration factor of 21 has been estimated using a recommended regression equation. Based upon the estimated bioconcentration factor of 21, no significant bioconcentration in aquatic organisms can be expected (1,2).

Mammalian & avian toxicity

Acute data

LD_{50} intravenous mouse 204 mg kg^{-1} (3).

Metabolism and toxicokinetics

Lung uptake by beagle dogs was 47% of the inhaled vapour that passed through the nose (4).

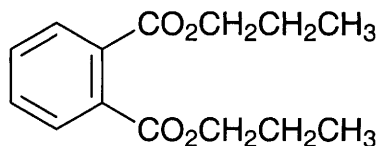
Other comments

Reviews on human health effects, experimental toxicology and physico-chemical properties listed (5).

References

1. Hansch, C. et al *Medchem. Project Issue No. 26* 1985, Pomona College, Claremont, CA, USA.
2. Lyman, W. J. et al *Handbook of Chemical Property Estimation Methods. Environmental Behaviour of Organic Compounds* 1982, 5, McGraw-Hill, New York, USA.
3. *J. Pharm. Sci* 1978, 67, 566.
4. Dahl, A. R. *Toxicol. Appl. Pharmacol.* 1991, 109, 263-275.
5. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuysse (Bte 6); B-1160 Brussels, Belgium

D558 dipropyl phthalate



C₁₄H₁₈O₄

Mol. Wt. 250.29

CAS Registry No. 131-16-8

Synonyms dipropyl 1,2-benzenedicarboxylate; di-*n*-propyl phthalate; DPP

EINECS No. 205-015-8

RTECS No. TI 1940000

Uses Catalysts for polymerisation of olefins. Used in the manufacture of fuel cells, plasticisers.

Physical properties

B. Pt. 317.5°C **Flash point** >110°C **Specific gravity** 1.078 at 20°C with respect to water at 4°C

Solubility Water: 108 mg l⁻¹ (1)

Occupational exposure

SE-LEVL 3 mg m⁻³

SE-STEL 5 mg m⁻³

Ecotoxicity

Invertebrate toxicity

EC₅₀ (96 hr) *Gymnodinium breve* 33 ppm, 50% growth reduction observed (2).

NOEC (24 hr, growth inhibition) *Tetrahymena pyriformis* 10 mg l⁻¹; LOEC (24 hr, growth inhibition) 25 mg l⁻¹ (3).

Environmental fate

Degradation studies

Based on oxygen uptake data, dipropyl phthalate is biodegradable in activated sludge >80% within 40 days (4).

Phthalate esters undergo ≥ 50% ultimate degradation within 28 days in standardised aerobic biodegradation tests with sewage sludge inocula. Biodegradation is expected to be the dominant loss mechanism in surface water, soils and sediments (5).

Mammalian & avian toxicity

Acute data

TD_{Lo} oral mouse 1260 mg kg⁻¹ (6).

Teratogenicity and reproductive effects

Oral mouse (♂ 15 wk prior to mating) 1260 mg kg⁻¹ caused reproductive effects (6).

Oral mice (♂, ♀ 7 day prior to and during 98 day cohabitation period) 0, 1.25, 2.5, 5.0% in diet. Toxic effects were observed by complete inhibition of fertility at highest dose, being more toxic to ♀ than ♂ reproductive system.

Decreased body weight increased liver weight, decreased testes and epididymis weights, decreased epididymal sperm concentration and elevated seminiferous tubule atrophy were noted (6).

Other comments

Reviews on human health effects and experimental toxicology listed (7).

Aquatic toxicity of eighteen phthalate esters reviewed (1).

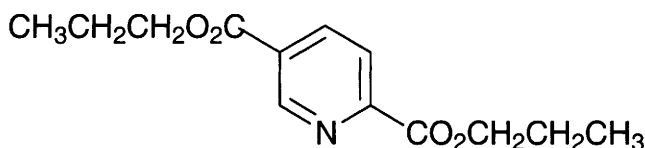
The environmental fate of eighteen phthalate esters reviewed (5).

Analysis of drinking water samples monthly detected maximum concentration of 0.036 µg l⁻¹ (8).

References

1. Staples, C. A. *Environ. Toxicol. Chem.* 1997, **16**(5), 875-891.
2. Wilson, W. B. et al *Bull. Environ. Contam. Toxicol.* 1978, **20**, 149-154.
3. Yoshizawa, T. et al *Kagawa Daigaku Nogakubu Bakuajutsu Hokuky* 1977, **28**, 149-155.
4. Desai, S. et al *ACS Sym. Ser.* 1989, **422**, 142-156.
5. Staples, C. A. *Chemosphere* 1997, **35**(4), 667-749.
6. Heindel, J. J. et al *Fundam. Appl. Toxicol.* 1989, **12**(3), 508-518.
7. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuysse (Bte 6), B-1160 Brussels, Belgium.
8. Onodera, S. *J. Chromatog.* 1991, **557**, 413-427

D559 dipropyl 2,5-pyridinedicarboxylate



$C_{13}H_{17}NO_4$

Mol. Wt. 251.28

CAS Registry No. 136-45-8

Synonyms dipropyl pyridine-2,5-dicarboxylate; dipropyl isocinchomeronate

EINECS No. 205-245-9

RTECS No. US 8000000

Uses Insect repellent.

Physical properties

B. Pt. 150°C at 1 mmHg **Specific gravity** 1.082 at 20°C **Partition coefficient** Log P_{ow} 3.57

Solubility Organic solvents: miscible with ethanol, kerosene, methanol, propan-2-ol

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) rainbow trout, bluegill sunfish 1.6-1.8 mg l⁻¹ (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 5230-7230 mg kg⁻¹ (1).

LD₅₀ dermal rat 9400 mg kg⁻¹ (1).

LD₅₀ intravenous rat 2500 mg kg⁻¹ (2).

Sub-acute and sub-chronic data

LC₅₀ (8 day) oral mallard duck, bobwhite quail > 5000 mg kg⁻¹ diet (1).

Oral rat (90 day) ≤ 20,000 mg kg⁻¹ in diet. No adverse effects reported (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (3).

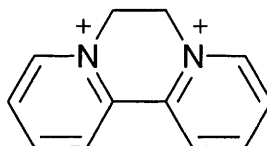
Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).

WHO Toxicity Class Table 5 (5).

References

1. *The Pesticide Manual* 9th ed., 1991, British Crop Protection Council, Farnham, UK.
2. Gosselin, R. E. et al *Clinical Toxicology of Commercial Products* 1984, 5th ed., William & Wilkins, Baltimore, MD, USA.
3. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
4. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
5. *The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification* 1998-1999 WHO/PCS/98.21

D560 diquat



$C_{12}H_{12}N_2^+$

Mol. Wt. 184.24

CAS Registry No. 2764-72-9

Synonyms 6,7-dihydrodipyrido[1,2-a:2',1'-c]pyrazinedium; 9,10-dihydro-8a,10a-diazoniaphenanthrene; 1,1'-ethylene-2,2'-bipyridylium; 6,7-dihydropyrido [1,2-a:2',1'-c]pyrazine-5,8-dium; Katalon; Aquacide; Barclay Desiquat; Brenox; Gramox; Midstream; Regazol

EINECS No. 220-433-0

RTECS No. JM 5685000

Uses Herbicide. Seed desiccant. Aquatic weed control agent.

Physical properties

Partition coefficient $\log P_{ow}$ -3.05 (1) **Volatility** v.p. 4×10^{-5} mmHg at 20°C

Solubility Water: 700 g l⁻¹ at 20°C. Organic solvents: slightly soluble in alcohols and hydroxylic solvents

Occupational exposure

US-TWA 0.5 mg m⁻³ (inhalable fraction); 0.1 mg m⁻³ (respirable fraction)

Supply classification toxic

Risk phrases Toxic in contact with skin and if swallowed – Irritating to eyes, respiratory system and skin (R24/25, R36/37/38)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Do not breathe dust – Wear suitable protective clothing, gloves and eye/face protection – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S22, S36/37/39, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow, bluegill sunfish 14-35 mg l⁻¹ (2,3).

LC₅₀ (48 hr) northern pike, rainbow trout 11.2-16 mg l⁻¹ (3).

Invertebrate toxicity

Chlorococcum sp. $>0.5 \times 10^6$ ppb caused 50% decrease in oxygen evaluation, 2×10^5 ppb 50% decrease in growth.

Isochrysis galbana, *Phaeodactylum tricornutum* $>5 \times 10^6$ ppb caused 50% decrease in oxygen evolution, 1.4×10^4 ppb caused 50% decrease in growth (4).

LC₅₀ (96 hr) *Hyalella azteca* 48 µg l⁻¹ (5).

LC₅₀ (96 hr) *Limnephilus* 33 mg l⁻¹ (5).

LC₅₀ (96 hr) *Callibaetes* sp. 16.4 mg l⁻¹ (5).

LC₅₀ (96 hr) *Tendipedidae*, *Euallagma* 10 mg l⁻¹ (5).

EC₅₀ growth inhibition, green algae (two species) 0.6 mg l⁻¹, cyanobacteria (five species) 0.074 mg l⁻¹, diatoms (two species) 0.079 mg l⁻¹ (6).

Toxicity to other species

Rana pipiens eggs were resistant to diquat. At early gastrula stage, 5 and 10 mg l⁻¹ caused mortalities. 10 and 0.5 mg l⁻¹ caused higher mortalities when administered at early gastrula than at 15 days of age (7).

LC₅₀ tadpole >100 ppm (8).

Bioaccumulation

No residues were detected in organs or tissues of channel catfish collected from pools 5 months after a single application or 2 months after a second treatment of 1 ppm (9).

Environmental fate

Degradation studies

After 65 days, 0.88% of diquat was converted into CO₂ under anaerobic conditions using water and sediment from a eutrophic lake and 0.21% from an oligotrophic lake (10).

Diquat is unlikely to be removed during biological sewage treatment even after prolonged exposure to microorganisms (11).

Adsorbed on montmorillonite clay in aqueous soil-nutrient solution, diquat is not degraded by microorganisms over a 1 yr period (12).

Abiotic removal

Photolysis (t_{1/2} 48 hr) and gravitational settling occur during spraying operations (1).

Decomposition of >50% (48 hr) and 75% (96 hr) to volatile products was observed when exposed to sunlight (9).

5 ppm diquat solution exposed to sunlight was 70% degraded in 3 wk, picolinic acid and 1,2,3, 4-tetrahydro-1-oxopyridol[1,2-*a*]-5-pyrazinium salt were major photo-degradation products (13).

Diquat is stable in neutral or acid solutions but hydrolyses in the presence of alkaline materials or waters (14).

Adsorption and retention

Tightly adsorbed to the interlayer spacings of montmorillonite at pH 4.1 and 8.2 (9,15).

With high solubility in water and very low vapour pressure, it will not volatilise appreciably from water or soil (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 400-440 mg kg⁻¹ (16).

LD₅₀ oral rabbit 187 mg kg⁻¹ (16).

LD₅₀ oral dog >192 mg kg⁻¹ (16).

LD₅₀ oral cow 37 mg kg⁻¹ (17).

LD₅₀ dermal rabbit >750 mg kg⁻¹ (16).

Sub-acute and sub-chronic data

Dermal rabbit (20 day) 20 mg kg⁻¹ day⁻¹ caused skin erythema, thickening and scabbing but no systemic effects were noticed. At 40 mg kg⁻¹ day⁻¹ 4 of 6 rabbits died after 8-20 days. Weight loss, unsteadiness and muscular weakness was also observed (17).

Inhalation rat (5 month) 1.9 mg m⁻³ at 6 day wk⁻¹, 4 hr day⁻¹ induced inflammatory changes in the peribronchial and perivascular connective tissues of the lung. Dystrophic changes were observed in the kidneys and heart (18).

Teratogenicity and reproductive effects

Oral rat from day-35 of age 0, 125, 500 ppm in diet. At higher dose body weight and food intake were reduced. At lower dose, weights were normal. Treatment did not effect fertility, litter size, number of stillborn or sex distribution and no differences in behaviour, congenital abnormalities or gross and microscopic pathology were observed (19).

Metabolism and toxicokinetics

Diquat accumulates in the kidney and is excreted unmetabolised or as polar metabolites in urine or faeces. It does not accumulate in the lung or cause lung damage (20).

Sensitisation

Patch tests applied to 50 agricultural workers and 150 other subjects produced negative reaction (21).

Genotoxicity

Salmonella typhimurium TA98, TA100 with and without metabolic activation positive (22).

In vitro Chinese hamster lung cells sister chromatid exchanges positive, chromosomal aberrations negative at low diquat concentrations that stimulated cell cycle rate. At higher concentrations found to inhibit cell cycle rate, chromosomal aberrations positive. The authors concluded that the genotoxic effects occur not only at high concentrations but also at concentrations low enough to stimulate cell cycle rate (23).

Legislation

Maximum contaminant level in drinking water proposed 0.02 mg l⁻¹ in US under Federal Safe Drinking Water Act (24).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (25).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (26).

WHO Toxicity Class II (27).

ADI 0.002 mg kg⁻¹ body weight as diquat ion (28).

Other comments

EC₅₀ growth inhibition duckweed 0.004 mg l⁻¹ (6).

Trifolium subterraneum (0-20 mg l⁻¹) caused severe decrease in nodulation. *Rhizobium trifolii* TA1 growth significantly retarded (29).

LD₅₀ wild barley *Hordeum leporinum* 160 g ha⁻¹ (30).

The lethal concentration in *Hydrilla verticillata* was estimated to be 81 µg g⁻¹ plant dry weight when exposed to diquat at 0.25 mg l⁻¹ for 2 days (31).

An oxidative mechanism of cytotoxicity was proposed by the authors for diquat by the establishment of both a concentration- and time-dependent increase in lipid peroxidation, complete oxidation of NADPH and NADH and glucose oxidation at subtoxic levels (32).

The mechanisms of toxicity of diquat in relation to the formation of active oxygen species reviewed (33).

Absorbed by foliage with some translocation in the xylem. Superoxide is generated during photosynthesis which damages cell membranes and cytoplasm (34).

Hazardous properties are reviewed (35).

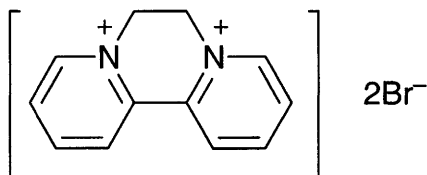
Metabolic pathways reviewed (36).

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D561 diquat dibromide



$C_{12}H_{12}Br_2N_2$

Mol. Wt. 344.05

CAS Registry No. 85-00-7

Synonyms 6,7-dihydrodipyrido[1,2-*a*:2',1'-*c*]pyrazinediium, dibromide; Reglone; Reglex

EINECS No. 201-579-4

RTECS No. JM 5690000

Uses Contact herbicide. Desiccant and defoliant.

Physical properties

M. Pt. 335-340°C **Specific gravity** 1.22-1.27 at 20°C with respect to water at 4°C

Partition coefficient -4.602 at 20°C

Solubility Water: 700 g l⁻¹ at 20°C. Organic solvents: ethanol

Occupational exposure

FR-VME 0.5 mg m⁻³

UK-LTEL 0.5 mg m⁻³

UK-STEL 1 mg m⁻³

Supply classification toxic

Risk phrases Toxic in contact with skin and if swallowed – Irritating to eyes, respiratory system and skin (R24/25, R36/37/38)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Do not breathe dust – Wear suitable protective clothing, gloves and eye/face protection – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S22, S36/37/39, S45)

Ecotoxicity**Fish toxicity**

LC₅₀ (96 hr) rainbow trout 21 mg l⁻¹ (1).

LC₅₀ (96 hr) mirror carp 67 mg l⁻¹ (1).

Invertebrate toxicity

EC₅₀ *Selenastrum capricornutum* 5-34 µg l⁻¹ (2).

Non-toxic to bees (1).

Environmental fate**Degradation studies**

No algistatic or algicidal activity demonstrated on soil algae of yellow green, blue green or green types or on diatoms (3).

Completely inactivated on contact with soil. Adsorption capacity 0.1-50 mg kg⁻¹ (4).

Mammalian & avian toxicity**Acute data**

LD₅₀ oral hen, partridge 200-400, 295 mg kg⁻¹, respectively (1).

LD₅₀ oral mouse, rabbit, rat 125, 187, 231 mg kg⁻¹, respectively (5).

Teratogenicity and reproductive effects

Oral rat (6-15 day gestation) (concentration unspecified) exhibited weight loss, however, no embryotoxicity observed (6).

Metabolism and toxicokinetics

Compound exerted a non-competitive inhibition of xenobiotic metabolism by mixed function oxidases in rat lung, liver and kidney. Stimulated NADPH oxidation in the same tissues (7).

Administration of ¹⁴C-labelled compound indicated wide distribution to tissues, in the rat. Increased biliary excretion of glutathione. Cell deaths were attributed to reactive oxygen species (8).

Transport across human skin is poor, although it is better across rat skin (9).

Genotoxicity

Escherichia coli WP2, WP2uvrA⁻ without metabolic activation positive (10).

In vitro primary rat hepatocytes unscheduled DNA synthesis negative (10).

Other effects**Any other adverse effects**

Compound is a weak inhibitor of acetylcholinesterase and pseudo-cholinesterase activities exhibiting little specificity, but inhibition of a reversible, competitive type (11,12).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (13).

Included in Schedule 6 (Release Into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (14).

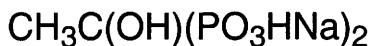
Other comments

The diquat cation is the active principle responsible for herbicidal action (15).
Environmental fate reviewed (16).
Compound decomposes at high temperatures.

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D562 disodium etidronate



$\text{C}_2\text{H}_4\text{Na}_2\text{O}_7\text{P}_2$

Mol. Wt. 247.98

CAS Registry No. 7414-83-7

Synonyms disodium dihydrogen (1-hydroxyethylidene)diphosphonate; disodium ethanol-1,1-diphosphonate; sodium ethidronate; Didronel

EINECS No. 231-025-7

Uses Calcium regulator that inhibits bone resorption, used principally in treatment of Paget's disease and hypercalcaemia of malignancy.

Physical properties

Solubility Water: 69% at 20°C

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 1340, 2050 mg kg⁻¹, respectively (1,2).

LD₅₀ intravenous mouse 200 mg kg⁻¹ (3).

Teratogenicity and reproductive effects

Teratogenic effects reported in rabbits after oral administration of a total dose of 1500 µg kg⁻¹ from day-2 of pregnancy to day-16 after birth. Reproductive effects reported in rats after oral administration of a total dose of 2500 mg kg⁻¹ from day 6-15 of pregnancy (4).

Metabolism and toxicokinetics

1-6% of an oral dose is absorbed in humans. Rapidly cleared from blood, with plasma $t_{1/2}$ 6 hr. 50% excreted in urine within 24 hr, the remainder being chemically adsorbed on bone and slowly eliminated. $t_{1/2}$ in bone >90 days. The unabsorbed is excreted in faeces (5).

Other effects

Other adverse effects (human)

Gastro-intestinal disturbances reported after oral administration. Impaired bone mineralisation and transient loss or alteration of taste reported (5).

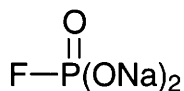
Other comments

Pharmacology reviewed (6).

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D563 disodium fluorophosphate



$\text{Na}_2\text{FO}_3\text{P}$

Mol. Wt. 143.95

CAS Registry No. 10163-15-2

Synonyms disodium monofluorophosphate; disodium phosphorofluoridate; sodium fluorophosphate; sodium monofluorophosphate; phosphorofluoridic acid, disodium salt; MFP sodium

EINECS No. 233-433-0

RTECS No. TE 6130000

Uses Used in toothpaste to prevent dental caries; given orally to treat osteoporosis.

Physical properties

Solubility Water: soluble

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 570, 710 mg kg⁻¹ respectively (1,2).

LD₅₀ intraperitoneal rat 220 mg kg⁻¹ (1).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans or animals, IARC classification group 3 (3).

Only studies on water fluoridation and cancer were reviewed, none of which provided evidence that increased fluoride in water was associated with increased cancer mortality (4).

Metabolism and toxicokinetics

Rapidly and extensively absorbed from the gut in rats; the fluoride ion is transported free in the blood, accumulates in bone and teeth, and is excreted via urine (4).

Genotoxicity

Did not induce dominant lethal mutations in sperm or oocytes of *Drosophila melanogaster* (5).

Did not induce micronuclei after single or multiple intravenous injection to mice *in vivo* (6).

Other effects

Other adverse effects (human)

Toxic doses of soluble inorganic fluorides cause vomiting, abdominal pain, diarrhoea, convulsions, ventricular fibrillation and in fatal cases death is due to respiratory paralysis (4).

Chronic exposure can lead to osteosclerosis, fluorosis, and kidney and thyroid changes (4).

Legislation

Total fluoride in oral hygiene products limited in UK to 0.15% by Cosmetic Products Regulations (7).

Included in Schedule 4 (Release into the Air: Prescribed Substances) Statutory Instrument No. 472, 1991 (8).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Phosphorous: guide level 400 µg l⁻¹; maximum admissible concentration 5000 µg l⁻¹ (as P₂O₅). Fluoride: maximum admissible concentration 1500 µg l⁻¹ at 8-12°C, 700 µg l⁻¹ at 25-30°C (9).

Other comments

Reviews on human health effects, experimental toxicology, physico-chemical properties listed (10).

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D564 disuccinoyl peroxide



C₈H₁₀O₈

Mol. Wt. 234.16

CAS Registry No. 123-23-9

Synonyms succinyl peroxide; 4,4'-dioxylbis[4-oxobutanoic acid]; bis(3-carboxypropionyl) peroxide; succinic acid peroxide

EINECS No. 204-611-5

Uses Germicide. Antiseptic. Polymerisation catalysts.

Physical properties

M. Pt. 127°C (decomp.)

Solubility Organic solvents: acetone, ethanol

Ecotoxicity

Toxicity to other species

Nicotiana tabacum 2×10^{-15} – 2×10^{-2} g l⁻¹ inhibited callus growth at higher concentrations (1).

Mammalian & avian toxicity

Acute data

LD₅₀ intraperitoneal mouse 16 mg kg⁻¹ (2).

Other comments

Reviews on human health effects, epidemiology, workplace experience and experimental toxicology listed (3).

Exhibits explosive properties with a self-accelerating decomposition temperature 25°C (4).

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D565 disulfiram



C₁₀H₂₀N₂S₄

Mol. Wt. 296.55

CAS Registry No. 97-77-8

Synonyms tetraethylthiuram disulfide; tetraethylthioperoxydicarbonic diamide; 1,1'-dithiobis(*N,N*-diethylthioformamide); bis(diethylthiocarbamoyl)disulfide; Antabuse; Abstensil; Noxal; Ethyl Tuads; Ethyl Tuex; Akrochem TETD; Perkacit TETD; Rhenogran TETD-75

EINECS No. 202-607-8

RTECS No. JO 1225000

Uses Fungicide. Bactericide. Rubber vulcanisation accelerator. Drug for treatment of chronic alcoholism.

Physical properties

M. Pt. 70°C Specific gravity 1.30 at 25°C with respect to water at 4°C Partition coefficient log P_{ow} 4.0 (1)

Solubility Water: 0.2 g l⁻¹. Organic solvents: acetone, benzene, chloroform, carbon disulfide, diethyl ether, ethanol

Occupational exposure

DE-MAK 2 mg m⁻³ (inhalable fraction of aerosol)

FR-VME 2 mg m⁻³

SE-LEVL 1 mg m⁻³

SE-STEL 2 mg m⁻³

US-TWA 2 mg m⁻³

Supply classification harmful, dangerous for the environment

Risk phrases Harmful if swallowed – May cause sensitisation by skin contact – Harmful: danger of serious

damage to health by prolonged exposure if swallowed – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R22, R43, R48/22, R50.53)

Safety phrases Keep out of the reach of children (if sold to general public) – Avoid contact with skin – Wear suitable gloves – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S2, S24, S37, S60, S61)

Ecotoxicity

Fish toxicity

Disulfiram is teratogenic in rainbow trout (2).

LC₅₀ (96 hr) guppy 0.32 mg l⁻¹ (3).

Invertebrate toxicity

Survival, reproduction and growth of *Daphnia magna* are reduced at concentrations at the ppb level (2).

EC₅₀ (15 min) *Photobacterium phosphoreum* 1.21 ppm Microtox test (4).

EC₅₀ (48 hr) *Daphnia magna* 0.12 mg l⁻¹ (3).

EC₅₀ (96 hr) *Chlorella pyrenoidosa* 1.8 mg l⁻¹ (3).

Environmental fate

Nitrification inhibition

MIC (3 hr) *Nitrosomonas*, *Nitrobacter* >320 mg l⁻¹ (3).

Mammalian & avian toxicity

Acute data

LD₅₀ oral redwing blackbird, house sparrow >111-244 mg kg⁻¹ (5).

LD₅₀ oral rat 8600 mg kg⁻¹ (6).

LD₅₀ oral mouse 1980 mg kg⁻¹ (7).

LD₅₀ intraperitoneal mouse 75 mg kg⁻¹ (8).

Sub-acute and sub-chronic data

Chronic dosing of rats with 1000-2000 mg kg⁻¹ in diet for up to 90 days retards growth and decreases reproductive capacity and longevity (9).

Carcinogenicity and chronic effects

No adequate evidence for carcinogenicity to humans, inadequate evidence for carcinogenicity to animals, IARC classification group 3 (10).

Oral rat, mouse (103 wk) negative for carcinogenicity (11).

National Toxicology Program tested rats and mice via feed. No evidence for carcinogenicity in ♂, ♀ rats and mice (12).

Oral ♂, ♀ mice (78 wk) 100 mg kg⁻¹ via gavage on days 7-28 subsequent dose 323 mg kg⁻¹ in diet. An excess number of pulmonary adenomas, hepatomas and subcutaneous fibrosarcomas were found in ♂ mice. The occurrence of subcutaneous sarcomas is extremely unusual following oral administration and this observation raises doubts to the significance of this finding (13).

Subcutaneous ♂, ♀ mice (78 wk) 1000 mg kg⁻¹ showed an increased incidence of reticulum-cell sarcomas (14).

Teratogenicity and reproductive effects

Oral rat (36 day) 10, 30 and 100 mg kg⁻¹ on day 6 to 36 gestation had 52, 61 and 89% reductions in spermatids and also decreased the number of spermatocytes (15).

Oral ♀ mouse (6-13 day gestation) 4900 mg kg⁻¹. No maternal or neonatal adverse effects were observed (16).

Metabolism and toxicokinetics

The principal metabolite of disulfiram is diethylthiocarbamic acid, found either as the free acid or as the S-glucuronide conjugate (1).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1530, TA1535, TA1537 with and without metabolic activation negative (17,18).

In vitro cultured lymphocyte cells 2.7 µg-27 mg, chromosomal aberrations negative (19).

Other effects

Other adverse effects (human)

Drowsiness and fatigue are common during initial treatment with disulfiram. Side-effects include garlic-like or metallic taste, body odour, headache and allergic contact dermatitis. Peripheral and optic neuropathies, psychotic reaction and hepatotoxicity may occur (20).

Ingestion of ethanol following disulfiram administration causes intense vasodilation of face and neck, tachycardia and tachypnoea followed by nausea, vomiting, pallor and hypertension (21).

90 mg kg⁻¹ administered intermittently over 18 days to a woman induced liver damage (22).

150 mg kg⁻¹ administered intermittently over 6 wk to a man induced musculo-skeletal effects including muscular degeneration (23).

Peripheral neuropathy and optic neuritis have been observed in alcoholics treated with 125-150 mg day⁻¹ (24).

Can react with nitrite under mildly acid conditions, simulating those in the human stomach, to form *N*-nitroso-diethylamine, which has been shown to be carcinogenic in ten animal species (17).

Any other adverse effects

Oral rat (72 hr) caused very rapid decrease of *N*-nitrosodimethylamine demethylase activity with loss of cytochrome P₄₅₀IIE1 protein after 18 hr, but markedly induced P₄₅₀IIB1 between 15-72 hr (25).

Oral rat 500 mg kg⁻¹ 3 ×, induced the activity of cytosolic glutathione-S-transferase, UDP-glucuronosyltransferase but decreased the activity of sulfotransferase (26).

Disulfiram interferes with various enzyme systems, including those involved in the oxidation of alcohol by the liver to acetaldehyde, acetic acid and finally carbon dioxide and water. Administration increases the blood acetaldehyde level significantly (24).

Disulfiram inhibits the activity of aldehyde dehydrogenase, dopamine β-hydroxylase, hexosekinase, glyceraldehyde 3-phosphate dehydrogenase, xanthine oxidase and D-amino-acid oxidase and depresses cytochrome P₄₅₀ levels (27).

Legislation

Not approved for pesticide use in the US (17).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum permissible concentration 0.1 µg l⁻¹ (28).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (29).

Other comments

Therapy should not commence for >12 hr after ingestion of alcohol (6).

The mechanisms of disulfiram liver toxicity and their differences for alcoholism-induced liver damage are reviewed (30).

Based on consideration of its chemical structure, disulfiram was classed as a non-genotoxic compound. The negative findings in short-term genotoxic tests confirm this conclusion (31-33).

Reviews on human health effects, epidemiology, workplace experience and experimental toxicology listed (34).

The chemistry and toxicology of dithiocarbamates, including disulfiram have been reviewed (1).

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D566 disulfoton



$\text{C}_8\text{H}_{19}\text{O}_2\text{PS}_3$

Mol. Wt. 274.41

CAS Registry No. 298-04-4

Synonyms *O,O*-diethyl S-[2-(ethylthio)ethyl] phosphorodithioate; *O,O*-diethyl S-ethylmercaptoethyl phosphorodithioate; thiodemeton; ethylthiodemeton; Acaphid; Altomix; Di-Syston; Ekatin TD; Frumin AL; Solvirex

EINECS No. 206-054-3

RTECS No. TD 9275000

Uses Insecticide. Acaricide.

Occurrence Residues have been isolated from water, air samples, and in food (1).

Physical properties

M. Pt. <-25°C **B. Pt.** 132-133°C at 1.5 mmHg **Specific gravity** 1.144 at 20°C with respect to water at 4°C

Partition coefficient log P_{ow} 4.02 (1) **Volatility** v.p. 1.8×10^{-4} mmHg at 20°C

Solubility Water: 12 mg l⁻¹ at 22°C. Organic solvents: readily miscible with most organic solvents

Occupational exposure

FR-VME 0.1 mg m⁻³

UK-LTEL 0.1 mg m⁻³

UK-STEL 0.3 mg m⁻³

US-TWA 0.1 mg m⁻³

Supply classification very toxic, dangerous for the environment

Risk phrases Very toxic in contact with skin and if swallowed – Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R27/28, R50/53)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S1/2, S28, S36/37, S45, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) bluegill sunfish, guppy, rainbow trout, goldfish 0.039-6.5 mg l⁻¹ (2).

LC₅₀ (96 hr) carp 3.4 mg l⁻¹ (3).

Invertebrate toxicity

LC₅₀ (96 hr) *Gammarus fasciatus* 21-52 µg l⁻¹ (4,5).

LC₅₀ (96 hr) *Palaemonetes kadiakensis* 38 µg l⁻¹ (5).

LC₅₀ (48 hr) *Crassostrea virginica* eggs 5860 ppb (6).

LC₅₀ (14 day) *Crassostrea virginica* larvae 3670 ppb (6).

LD₅₀ (48 hr) *Mercenaria mercenaria* eggs 55,280 ppb (6).

LC₅₀ (12 day) *Mercenaria mercenaria* larvae 1390 ppb (6).

EC₅₀ (24 hr) *Daphnia magna* 18 µg l⁻¹ (7).

LC₅₀ (72 hr) *Rhizoglyphus eschinopus* 799 ppm (8).

LC₅₀ (48 hr) *Tetranychus urticae* >1000 ppm (9).

LC₅₀ (96 hr) *Pteronarcys californica* 5-24 µg l⁻¹ (10).

LC₅₀ (96 hr) *Acroneuria pacifica* 8.2 µg l⁻¹ (11).

LC₅₀ (30 day) *Pteronarcys californica* 1.9 µg l⁻¹ (11).

LC₅₀ (30 day) *Acroneuria pacifica* 1.4 µg l⁻¹ (11).

Toxic to bees (2).

Bioaccumulation

The bioconcentration factor of 450 in carp has been measured (12).

Calculated bioconcentration factors of 101 and 670 based on water solubility and octanol-water partition coefficient have been calculated (13).

Environmental fate

Nitrification inhibition

Did not affect ammonification, nitrification, microbial population and legume nodulation after 7 days when applied to soil at the recommended rate of 1.07 mg l⁻¹ for field application (14,15).

Degradation studies

Disulfoton is metabolised in soil and plants to the sulfoxide and sulfone, to the corresponding phosphorothioate analogues, and finally to derivatives of *O,O'*-diethyl hydrogen phosphate and 2-(ethylthio)ethyl mercaptan (2).

In soil t_{1/2} 19 days and 13-35 days are reported (14,16).

Degradation 96.2% of decay after 91 days (17).

Abiotic removal

t_{1/2} for photosensitised oxidation to midday sunlight in water reported as 4-12 hr, depending on time of year (18).

t_{1/2} for volatilisation from a pond is estimated as 8 days (19).

$t_{1/2}$ for the vapour phase reaction of disulfoton with photochemically produced hydroxyl radicals estimated at 3 hr in an atmosphere containing 5×10^5 hydroxyl radicals m^{-3} at 25°C (20).

In aqueous solution, the reported $t_{1/2}$ for hydrolysis at pH 3, 5, 7, 9 at 70°C are 62, 60, 27.6, and 7.2 hr (21).

Adsorption and retention

Disulfoton has a high leaching potential (17).

Estimated soil adsorption coefficients of 642, 1104, 1770, 5217 indicate low to immobile mobility in soil and disulfoton should adsorb strongly to suspended soils and sediments in soil (1).

Due to its strong adsorption to soil, disulfoton is not expected to volatilise significantly from dry or moist soil surfaces (22).

Mammalian & avian toxicity

Acute data

LD₅₀ oral bobwhite quail 28 mg kg^{-1} (2).

LD₅₀ oral common grackle, redwing blackbird, starling 3.16 mg kg^{-1} (23).

LD₅₀ oral ♀ rat 2.3 mg kg^{-1} , ♂ rat 6.8 mg kg^{-1} (24).

LC₅₀ (4 hr) inhalation rat 0.3 mg l^{-1} (2).

LD₅₀ dermal ♀ rat 6 mg kg^{-1} , ♂ rat 15 mg kg^{-1} (20).

LD₅₀ intraperitoneal rat, mouse 2, 5.5 mg kg^{-1} , respectively (25).

Sub-acute and sub-chronic data

LC₅₀ (5 day) oral mallard duck 962 mg kg^{-1} diet, bobwhite quail 544 mg kg^{-1} diet (2).

Blue jays after 6-7 hr exposure from disulfoton-treated pecan groves had moderate to severe brain cholinesterase depression of 32-72% (26).

Carcinogenicity and chronic effects

Oral rat (2 yr) 1 mg kg^{-1} in diet showed no ill-effect (2).

Oral mouse (23 month) 0, 0.15, 0.6 or 2.4 mg kg^{-1} day⁻¹. A statistically significant increase in kidney weight was noted in high-dose ♀ mice, which may have been associated with a non-significant increase in malignant lymphomas of kidneys in this group. Plasma, red blood cell and brain cholinesterase activity was significantly reduced in both sexes, although this was only monitored in the high-dose group and in controls (27).

Teratogenicity and reproductive effects

Gavage rat 0, 0.1, 0.3 or 1 mg kg^{-1} day⁻¹ on days 6-15 gestation. Plasma and red blood cell cholinesterase activity was decreased significantly in dams receiving 0.3 and 1 mg kg^{-1} . There were no increases in the incidence of soft tissue, external or skeletal abnormality. However, at the high-dose level increased incidences of incompletely ossified parietal bones and sternebrae were observed (8).

Metabolism and toxicokinetics

In rats following oral administration, disulfoton is rapidly absorbed, metabolised and excreted in the urine (2).

In rats given 0.2-1.2 mg kg^{-1} ¹⁴C-disulfoton by gavage, after 10 days 82% of radioactivity was removed in the urine, 7% in the faeces and 9% in expired air. ♂ rats excreted 50 % in the urine within 4-6 hr while ♀ rats required 30-32 hr. 48 hr after administration 4% and 16% were detected in the livers of ♂ and ♀, respectively and 0.4% and 1.2% in the kidneys of ♂ and ♀, respectively. Major urinary metabolites were diethyl phosphate and diethylphosphorothioate (28).

Genotoxicity

Saccharomyces cerevisiae gene conversion and mitotic recombination positive (29).

Salmonella typhimurium TA1535 with and without metabolic activation positive, TA98, TA100, TA1537, TA1538, TA98, TA100 with and without metabolic activation negative (30).

Escherichia coli WP2 with and without metabolic activation negative (30).

In vitro human lung fibroblast unscheduled DNA synthesis positive, mouse lymphoma forward mutation assay L5T positive (29).

Other effects

Other adverse effects (human)

Oral human (30 day) 0.75 mg day⁻¹ caused no significant effect on cholinesterase activity (31).

Any other adverse effects

Toxic effects due to cholinesterase inhibition (32).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum advisable concentration 0.1 µg l⁻¹ (33).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (34).

WHO Toxicity Class Ia (35).

EPA Toxicity Class 1 (formulation) (36).

ADI 0.0003 mg kg⁻¹ body weight (36).

Other comments

Hazardous properties reviewed (37).

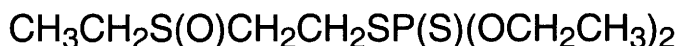
Physical properties, environmental fate, metabolism, mammalian toxicity, carcinogenicity, mutagenicity, teratogenicity and health effects reviewed (1,37,38).

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D567 disulfoton sulfoxide



$\text{C}_8\text{H}_{19}\text{O}_3\text{PS}_3$

Mol. Wt. 290.41

CAS Registry No. 2497-07-6

Synonyms phosphorodithioic acid, *O,O*-diethyl *S*-[2-ethylsulfinyl]ethyl ester; ethylthiometon sulfoxide; oxydisulfoton

EINECS No. 219-679-1

RTECS No. TD 8600000

Uses Insecticide, no longer in widespread use.

Occupational exposure

Supply classification very toxic

Risk phrases Toxic in contact with skin – Very toxic if swallowed (R24, R28)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – After contact with skin, wash immediately with plenty of water – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S28, S36/37, S45)

Ecotoxicity

Invertebrate toxicity

The compound is an inhibitor of cholinesterase activity in the house fly and the nematode *Aphelenchus avenae*. Concentrations of ≤ 500 ppm cause $\leq 100\%$ mortality of the nematode (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 3.5 mg kg⁻¹ (2).

LD₅₀ oral mouse 12 mg kg⁻¹ (3).

The compound is an inhibitor of cholinesterase activity in many species, thus adversely influencing function in the central and peripheral nervous systems (2).

Metabolism and toxicokinetics

In a human subject who had ingested the compound, phosphorodithioate and phosphorothioate sulfoxides and sulfones were isolated as metabolites (4).

Legislation

Limited under EEC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentrations 0.1 µg l⁻¹ (5).

Included in Schedule 4 (Release into Air) and Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (6).

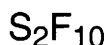
Other comments

Metabolite of disulfoton. Water pollutant. Food contaminant.

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D568 disulfur decafluoride



F_{10}S_2

Mol. Wt. 254.12

CAS Registry No. 5714-22-7

Synonyms sulfur fluoride

EINECS No. 227-204-4

RTECS No. WS 4480000

Uses No commercial uses for this compound have been developed.

Physical properties

M. Pt. -92°C B. Pt. 29°C Specific gravity 2.08 at 0°C with respect to water at 4°C

Occupational exposure

DE-MAK 0.025 ppm (0.26 mg m^{-3})

SE-LEVL 2 mg m^{-3} (as F)

UK-LTEL 0.025 ppm (0.26 mg m^{-3})

UK-STEL 0.075 ppm (0.79 mg m^{-3})

US-STEL ceiling limit 0.01 ppm (0.10 mg m^{-3})

Mammalian & avian toxicity

Acute data

LC₅₀ (10 min) inhalation mouse 96 ppm (1).

LC₅₀ (10 min) inhalation rat 193 ppm (1).

LC₅₀ (10 min) inhalation dog 4000 mg m^{-3} (2).

LC₅₀ (10 min) inhalation monkey 9000 mg m^{-3} (2).

LD_{Lo} intravenous dog, rabbit 1-5 mg kg^{-1} (3).

Other effects

Any other adverse effects

Disulfur decafluoride is an extremely toxic, volatile liquid (4).

In vitro Chinese hamster ovary cells (1.4 hr) 50-5000 ppm, cell survival at 1 hr was 30% at 400 ppm and 100% at 100 ppm. With Chinese hamster lung cells V79, survival was 60% and 100%, respectively (5).

In vitro Chinese hamster ovary cells (1 hr) 100-500 ppm, cytotoxicity increased from 0-100%. Chinese hamster lung cells V79 showed the same dose response (6).

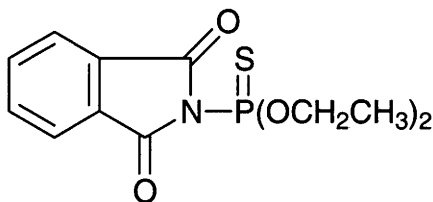
Other comments

Thermal, photochemical or electrical breakdown of sulfur hexafluoride SF₆.

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D569 ditalimfos



C₁₂H₁₄N₄P₂S

Mol. Wt. 277.31

CAS Registry No. 5131-24-8

Synonyms phosphonothioic acid, (1,3-dihydro-1,3-dioxo-2H-isoindol-2-yl)-, O,O-diethyl ester; phosphonothioic acid, phthalimido-, O,O-diethyl ester; Dowco 199; M2452; Plondrel

EINECS No. 225-875-8

RTECS No. TB 2050000

Uses Superseded fungicide.

Occupational exposure

Supply classification irritant

Risk phrases Irritating to the skin – May cause sensitisation by skin contact (R38, R43)

Safety phrases Keep out of reach of children (if sold to general public) – Wear suitable protective clothing and gloves (S2, S36/37)

Mammalian & avian toxicity

Teratogenicity and reproductive effects

Oral administration to pregnant rats, 0.5 g kg⁻¹ on day 13 or 0.5-5 mg kg⁻¹ throughout pregnancy caused a dose-dependent increase in foetal mortality. Nicotinamide adenine dinucleotides in liver of dams and foetuses were reduced. Compound was judged to cause both teratological and embryotoxic damage (1).

Other effects

Any other adverse effects

In rodents, the compound has been shown to cause changes in lipid peroxidation and to the monooxygenase system in a dose- and duration-dependent manner (2).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration $0.1 \mu\text{g l}^{-1}$ (3).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (4).
WHO Toxicity Class Table 5 (5).

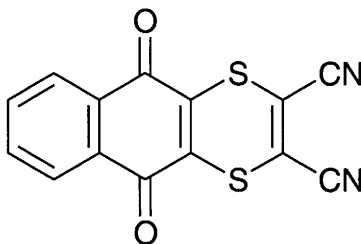
Other comments

Food contaminant. Water pollutant.

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D570 dithianon



$\text{C}_{14}\text{H}_4\text{N}_2\text{O}_2\text{S}_2$

Mol. Wt. 296.33

CAS Registry No. 3347-22-6

Synonyms 2,3-dicyano-1,4-dithiaanthraquinone; 5,10-dihydro-5,10-dioxonaphtho[2,3-*b*]-1,4-dithiin-2,3-dicarbonitrile; Cadol; Delan

EINECS No. 222-098-6

RTECS No. DL 0700000

Uses Fungicide. Insecticide.

Physical properties

M. Pt. 225°C **Specific gravity** 1576 kg m^{-3} at 20°C **Partition coefficient** $\log P_{\text{ow}}$ 3.2 (1)

Volatility v.p. $5 \times 10^{-7} \text{ mmHg}$ at 25°C

Solubility Water: 0.14 mg l^{-1} at pH 7 and 20°C . Organic solvents: acetone, benzene, chloroform, dichloromethane, dioxane, methanol

Occupational exposure

Supply classification harmful

Risk phrases Harmful if swallowed (R22)

Safety phrases Keep out of reach of children (if sold to general public) – Avoid contact with the skin (S2, S24)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) goldfish, fathead minnow, channel catfish 130-165 µg l⁻¹ (2).

Invertebrate toxicity

LD₅₀ contact bee >0.1 mg kg⁻¹ (1).

Environmental fate

Degradation studies

Following application at the recommended maximum rate to grape vines growing in a strongly alkaline calcareous sandy loam with low organic content, rapid degradation occurred in the soil (63-100% degradation in 10 days) (3).

Abiotic removal

At concentrations of between 26-1820 mg l⁻¹ in wastewater, average normal efficiency was >99% in a filter unit of peat and moss (4).

Adsorption and retention

No leaching occurred from strongly alkaline calcareous sandy loam with low organic content (1-2%) following application at the maximum recommended rates to grape vines. It was immobilised in the top 2 cm of soil and concentrations were low (0-37% applied dose) (3).

Mammalian & avian toxicity

Acute data

LD₅₀ oral quail, ♂ 280 ♀ 430 mg kg⁻¹ (1).

LD₅₀ oral guinea pig, rat 115, 640 mg kg⁻¹, respectively (1).

LC₅₀ (4 hr) inhalation rat ~3 g m⁻³ (1).

LD₅₀ dermal rat >2000 mg kg⁻¹ (1).

Carcinogenicity and chronic effects

Oral dog, rat (2 yr) no-adverse-effect level 20 mg kg⁻¹ diet for rats and 40 mg kg⁻¹ diet for dogs (1).

Genotoxicity

In vitro Friend leukaemia cells, DNA damage, positive (5).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (6).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (7).

WHO Toxicity Class III (8).

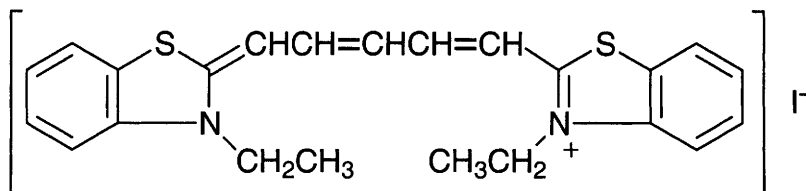
EPA Toxicology Class III formulation (1).

ADI 0.01 mg kg⁻¹ body weight (1).

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D571 dithiazanine iodide



$C_{23}H_{23}IN_2S_2$

Mol. Wt. 518.49

CAS Registry No. 514-73-8

Synonyms 3-ethyl-2-[5-(3-ethyl-2-(3*H*)-benzothiazolylidene-1,3-pentadienyl]benzothiazolium iodide; 3,3'-diethylthiadicyanocyanine iodide; 3,3'-diethylpentamethineethiacyanine iodide

EINECS No. 208-186-7

Uses Anthelmintic. Sensitiser for photographic emulsions. Constituent of laser dyes.

Physical properties

M. Pt. 251-253°C

Solubility Organic solvents: polyvinylpyrrolidone

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 20 mg kg⁻¹ (1).

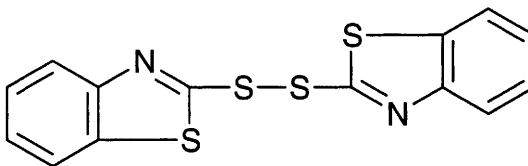
LD₅₀ intraperitoneal mouse 3 mg kg⁻¹ (2).

LD₅₀ intravenous mouse 1 mg kg⁻¹ (3).

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D572 2,2'-dithiobis(benzothiazole)



$C_{14}H_8N_2S_4$

Mol. Wt. 332.50

CAS Registry No. 120-78-5

Synonyms mercaptobenzothiazole disulfide; benzothiazole disulfide; dibenzothiazyl disulfide; mercaptobenzthiazyl ether

EINECS No. 204-424-9

RTECS No. DL 4550000

Uses Accelerator in the rubber industry.

Physical properties

M. Pt. 175°C Specific gravity 1.5

Solubility Water: slightly soluble. Organic solvents: ethanol, methanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 7 g kg⁻¹ (1).

LD₅₀ intraperitoneal mouse, rat 100, 2600 mg kg⁻¹, respectively (1,2).

LD₅₀ intravenous mouse 180 mg kg⁻¹ (3).

Carcinogenicity and chronic effects

Equivocal tumorigenic effects reported in rats after oral administration of a total of 172 g kg⁻¹ intermittently over 78 wk (4).

Teratogenicity and reproductive effects

200 mg kg⁻¹ injected into the stomach of ♀ rats either on day 1 and 3 of oestrus (before pregnancy) or on day 4 and 11 of pregnancy, and to ♂ rats twice with a 3-day interval resulted in a lengthened oestrus cycle, 30-46% reduced fertility and post-implantation embryomortality (5).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537, TA1538 with and without metabolic activation negative (6).

Escherichia coli WP₂ uvrA⁻ with or without metabolic activation equivocal(6).

Mouse lymphoma L5178Y cell assay with or without metabolic activation negative (6).

BALB/3T3 mouse cell transformation assay with or without metabolic activation negative(6).

Did not induce chromosomal aberrations in Chinese hamster ovary cells with or without metabolic activation (6).

Other comments

Reviews on human health effects, experimental toxicity and environmental effects listed (7).

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D573 2,5-dithiobiurea



$\text{C}_2\text{H}_6\text{N}_4\text{S}_2$

Mol. Wt. 150.23

CAS Registry No. 142-46-1

Synonyms bis(thiourea); 1,2-hydrazinedicarbonylthioamide; hydrazine-*N,N'*-bisthiocarbonamide; hydrazidodicarbonylthioamide; dithiocarbamidohydrazine; bisthiocarbonylhydrazine

EINECS No. 205-537-6

RTECS No. EC 1460000

Uses Bleaching promoter in photography.

Physical properties

M. Pt. 214°C (decomp.)

Mammalian & avian toxicity

Acute data

LD₅₀ intraperitoneal mouse 100 mg kg⁻¹ (1).

Carcinogenicity and chronic effects

Oral rat (78 wk) 1.2 mg kg⁻¹. Dose-related decrease in tumour incidence was observed (2).

Oral mouse (78 wk) 2 mg kg⁻¹ also showed a decrease in mouse liver tumours (2).

National Toxicology Program tested rats and mice via feed ♂ and ♀ rats, ♂ mice negative, equivocal evidence of carcinogenic activity (marginal increase of neoplasms that may be chemically related) in ♀ mice (3).

Genotoxicity

In vitro Chinese hamster ovary cells chromosomal aberrations negative, sister chromatid exchanges positive (4).

Other comments

There is no basis for the prediction of mutagenicity from structural determinants of 2,5-dithiobiurea (5,6).

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D574 2,4-dithiobiuret



$\text{C}_2\text{H}_5\text{N}_3\text{S}_2$

Mol. Wt. 135.21

CAS Registry No. 541-53-7

Synonyms thioamidodicarbonic diamide; 2-thio-1-(thiocarbamoyl)urea

EINECS No. 208-784-8

RTECS No. EC 1575000

Uses Used in the manufacture of insecticides and rodenticides. Plasticiser. Rubber accelerator and intermediate in resin manufacture.

Physical properties

M. Pt. 181°C (decomp.) Specific gravity 1.522 at 30°C

Solubility Water: 2.7 g l⁻¹ at 27°C. Organic solvents: acetone, cellosolve, ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 5 mg kg⁻¹ (1).

LD₅₀ intraperitoneal rat 29 mg kg⁻¹ (2).

LD_{Lo} intraperitoneal mouse 50 mg kg⁻¹ (3).

Sub-acute and sub-chronic data

Intraperitoneal rat (6-7 day) 1 mg kg⁻¹ day⁻¹ induced paralysis which was associated with alterations of spontaneous and evoked release of acetylcholine during induced neuromuscular weakness (4).

Intraperitoneal rat (7-8 day) 1 mg kg⁻¹ day⁻¹ reduced the safety factor for neuromuscular transmission and abnormal quantal secretion preceding neuromuscular weakness (5).

Intraperitoneal rat (4 day) 1 mg kg⁻¹ day⁻¹ caused lesion in the preterminal axons and motor endplates in the lumbrical muscle (6).

Intraperitoneal rat (6 day) 1 mg kg⁻¹ day⁻¹ caused diminished treadmill performance after 4 days with complete failure after 5-6 days. Body weight loss, dehydration, hypothermia and depression in serum concentrations of thyroid hormones appeared by day-6. Oxygen content of blood was not reduced, nor were serum concentrations of glucose, Na, K, Ca, chloride and P (7).

Other effects

Any other adverse effects

Intraperitoneal rat 25 mg kg⁻¹ initially induced neuromuscular effects after 1 hr, but these were reversed within 24 hr following exposure (8).

Limited animal experiments suggest high toxicity due to respiratory paralysis (9).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (10).

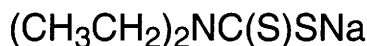
Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (11).

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D575 dithiocarb



$\text{C}_5\text{H}_{10}\text{NNaS}_2$

Mol. Wt. 171.26

CAS Registry No. 148-18-5

Synonyms sodium diethyldithiocarbamate; sodium diethylaminocarbodithioate; Ethyl Namate; Octopol SDE-25; Thiostop E

EINECS No. 205-710-6

RTECS No. EZ 6475000

Uses Colorimetric detection of copper and for its separation from other metals. Immunomodulator. Chelating agent in Wilson's disease. Antidote for nickel and cadmium poisoning.

Physical properties

M. Pt. 94-102°C **Partition coefficient** $\log P_{\text{ow}}$ 0.9744 (1)

Solubility Water: freely soluble. Organic solvents: acetone, ethanol, methanol

Occupational exposure

DE-MAK 2 mg m⁻³ (inhalable fraction of aerosol)

Ecotoxicity

Invertebrate toxicity

EC₅₀ (15 min) *Photobacterium phosphoreum* 1.21 ppm Microtox test (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 1500 mg kg⁻¹ (3).

LD₅₀ intraperitoneal rat, mouse 1250, 1302 mg kg⁻¹, respectively (3).

LD₅₀ subcutaneous rabbit 500 mg kg⁻¹ (4).

Sub-acute and sub-chronic data

Mice subcutaneously injected with 50 mg kg⁻¹ day⁻¹ for 6 wk showed the compound had marked anti-thyroid activity (5).

Carcinogenicity and chronic effects

No adequate evidence for carcinogenicity to humans, insufficient evidence for carcinogenicity to animals, IARC classification group 3 (6).

National Toxicology Program investigated administration in feed. Designated non-carcinogen in rat and mouse (7).

♂, ♀ (C57Bl/6xC3H/Anf)F₁ and (C57BL/6xAKR)F₁ mice received 215 mg kg⁻¹ body weight from day-7 to wk-4 of age, then 692 mg kg⁻¹ diet until wk-78 of age. 3/17 and 5/18 ♂ of each strain, respectively, had pulmonary

adenomas compared with 5/79 and 9/90 controls. Hepatomas developed in 7/17 ♂ of the first strain compared with 8/79 controls but no increased incidence was seen in ♂ of the other strain or in ♀ (8,9).
♂, ♀ (C57BL/6xC3H/Anf)F₁ and (C57BL/6xAkr)F₁ mice received 464 mg kg⁻¹ body weight subcutaneously on day-28 of life. No increased incidence of tumours was observed by wk-78 of age compared with controls (9).

Teratogenicity and reproductive effects

Pregnant rabbits injected intravenously with 0.5 g day⁻¹, 5 day wk⁻¹ throughout pregnancy had reduced blood copper concentrations and failed to deliver litters (10).

Metabolism and toxicokinetics

Metabolised in rats to diethyldithiocarbamate, diethyldithiocarbamate-S-glucuronide and inorganic sulfate and carbon disulfide (11).

Genotoxicity

In vitro Chinese hamster ovary cells with and without metabolic activation sister chromatid exchange, chromosomal aberrations negative (12).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Sodium: guide level 20 mg l⁻¹ (13).
Included in Schedule 4 (Release into the Air: Prescribed Substances) Statutory Instrument No. 472, 1991 (14).

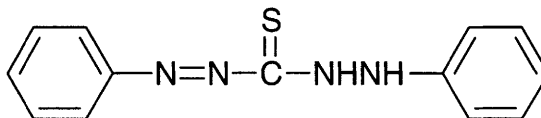
Other comments

Reviews on human health effects and experimental toxicology listed (15).

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D576 dithizone



$C_{13}H_{12}N_4S$

Mol. Wt. 256.33

CAS Registry No. 60-10-6

Synonyms diphenylthiocarbazone; dithigon; phenyldiazene-carbothioic acid 2-phenylhydrazide; (phenylazo)thioformic acid 2-phenylhydrazide; USAF EK-3092

EINECS No. 200-454-1

RTECS No. LQ 9450000

Uses Analytical-reagent used in colorimetric analysis of lead and other metal ions.

Physical properties

M. Pt. 168°C (decomp.)

Solubility Organic solvents: carbon tetrachloride, chloroform, ethanol

Ecotoxicity

Fish toxicity

Not toxic to brown trout, bluegill sunfish, yellow perch and goldfish at 5 mg l⁻¹ for 24 hr (1).

Mammalian & avian toxicity

Acute data

LD₅₀ intraperitoneal mouse 200 mg kg⁻¹ (2).

LD₅₀ intravenous mouse 56 mg kg⁻¹ (3).

Irritancy

Irritating to skin. Vapour or mist is irritating to the eyes, mucous membranes and upper respiratory tract (4).

Other effects

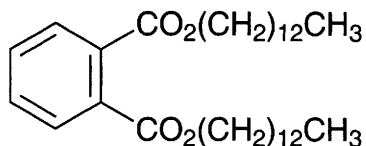
Any other adverse effects

Intraperitoneal mouse, single injection of 100 mg kg⁻¹ virtually abolished Timm staining in the CA3 region of the hippocampus. Only the mossy fibre system in the hilus of the dentate gyrus retained staining at 10 minutes after administration. Spontaneous EEG activity was extinguished for 5 min, starting at 5 min after administration (5).

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D577 ditridecyl phthalate



C₃₄H₃₈O₄

Mol. Wt. 510.67

CAS Registry No. 119-06-2

Synonyms ditridecyl 1,2-benzenedicarboxylate; 1-tridecanol phthalate; Jayflex DTD; DTDP; PX-126

EINECS No. 204-294-3

RTECS No. TI 1950000

Uses Plasticiser. Lubricating oil additive.

Physical properties

M. Pt. -37°C **B. Pt.** >285°C at 5 mmHg **Flash point** 244°C (open cup) **Specific gravity** 0.951 at 20°C with respect to water at 20°C

Solubility Water: < 0.0001 mg l⁻¹ (1). Organic solvents: dimethyl sulfoxide

Occupational exposure

SE-LEVL 3 mg m⁻³

SE-STEL 5 mg m⁻³

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr, flow-through) rainbow trout, fathead minnow, sheepshead minnow >0.15, >0.26, >0.65 mg l⁻¹, respectively; NOEC 0.15, 0.26, 0.65 mg l⁻¹, respectively (2-5).

Invertebrate toxicity

NOEC (24 hr, growth inhibition) *Tetrahymena pyriformis* 200 mg l⁻¹ (6).

LC₅₀ (48 hr, static) *Daphnia magna* >0.05 mg l⁻¹; NOEC 0.05 mg l⁻¹ (2,7).

LC₅₀ (96 hr, static) *Mysidopsis bahia* >0.80 mg l⁻¹; NOEC 0.8 mg l⁻¹ (2,8).

Bioaccumulation

Calculated bioconcentration factor 1140 indicated that environmental accumulation in fish and aquatic organisms will occur (9).

Environmental fate

Degradation studies

Metabolised by *Nocardia erythropolis* inoculated into activated sludge, undergoing hydrolysis of the ester to phthalic acid, which is then metabolised by cleavage (10).

Metabolised by pure cultures of *Pseudomonas acidovorans* under aerobic conditions (11).

t_{1/2} in semicontinuous activated sludge process 12 hr (12).

Using an inocula obtained from soil and sewage sludge, >50% primary biodegradation occurred under aerobic conditions in 28 days, 37% mineralisation to carbon dioxide also occurred within 28 days (13).

Phthalate esters undergo ≥ 50% ultimate degradation within 28 days in standardised aerobic biodegradation tests with sewage sludge inocula. Biodegradation is expected to be the dominant loss mechanism in surface water, soils and sediments (14).

Abiotic removal

Phthalate esters can slowly volatilise from plastics into air at high temperatures. They have been detected in air and surface of the windows of automobile interiors in hot climates due to volatilisation from vinyl furnishings (15).

Volatilisation from model river water, $t_{1/2}$ (estimated) 16 hr although adsorption to sediment and suspended matter may attenuate the rate of volatilisation considerably, (estimated) $t_{1/2}$ from a model pond which takes into account adsorption processes is 204 days (16,17).

In the atmosphere, the predicted low vapour pressure suggested that adsorption to particulates in the atmosphere will occur. Destruction may occur by the vapour-phase reaction with photochemically produced hydroxyl radicals, $t_{1/2}$ 11 hr (18,19).

Adsorption and retention

Calculated soil adsorption coefficient 7900 indicates strong adsorption to soil and sediments (20).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat >64 mg kg⁻¹ (21).

LD₅₀ dermal rabbit >20 mg kg⁻¹ (21).

Irritancy

Dermal rabbit (24 hr) 10 mg caused mild irritation (21).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (22).

Other comments

Toxicity reviewed (23,24).

Aquatic toxicity of eighteen phthalate esters reviewed (1).

The environmental fate of eighteen phthalate esters reviewed (14).

Phthalates will slowly leach or volatilise from plastics whether in normal use or in landfills. Higher temperatures and the presence of organics in water can appreciably increase the rate of leaching. Surfactants, fulvic acid, dispersed fats or oils and other hydrophobic substances are likely to solubilise phthalates in the environment (25). Most probable route of exposure for workers involved in the production and formulation is through dermal contact. For the general public, dermal exposure may occur by the use of commercial products containing dinitridecyl phthalate (25).

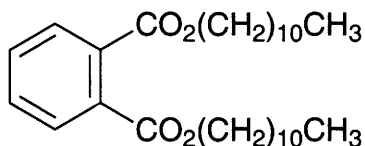
Information on quantities and rates of phthalate ester loss to the environment from production and processing activities is based on estimates supplied by industry. $\approx 0.7\text{--}1.6 \times 10^6$ kg of phthalate esters were lost to the environment in 1973, during production and processing. No surveillance or monitoring was carried out to validate these estimates (25).

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D578 diundecyl phthalate



$C_{30}H_{50}O_2$

Mol. Wt. 442.73

CAS Registry No. 3648-20-2

Synonyms diundecyl 1,2-benzenedicarboxylic acid; PX-111

EINECS No. 222-884-9

RTECS No. TI 1980000

Uses Plasticiser.

Physical properties

B. Pt. 265-267°C at 3 mmHg Flash point 21°C Specific gravity 0.9405 at 30°C

Solubility Water: <0.0001 mg l⁻¹ (1). Organic solvents: dimethyl sulfoxide, ethanol

Occupational exposure

SE-LEVL 3 mg m⁻³

SE-STEL 5 mg m⁻³

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr, flow-through) rainbow trout, fathead minnow, sheepshead minnow >1.4, >1.3, >0.22 mg l⁻¹, respectively (2-5).

Invertebrate toxicity

LC₅₀ (48 hr, static) *Daphnia magna* >0.02 mg l⁻¹; NOEC 0.02 mg l⁻¹ (2,6).

LC₅₀ (96 hr, static) *Mysidopsis bahia* >0.29 mg l⁻¹; NOEC 0.29 mg l⁻¹ (2,7).

Environmental fate

Degradation studies

Phthalate esters undergo $\geq 50\%$ ultimate degradation within 28 days in standardised aerobic biodegradation tests with sewage sludge inocula. Biodegradation is expected to be the dominant loss mechanism in surface water, soils and sediments (8).

37% degradation in continuous activated sludge process, and 10% degradation occurred in river water after 1 wk (9).

Abiotic removal

Reaction with photochemically produced hydroxyl radicals in the atmosphere, $t_{1/2}$ (estimated) 10.2 hr (10).

Mammalian & avian toxicity

Sub-acute and sub-chronic data

Oral rat (21 day) 0.3-2.5% diet produced peroxisome proliferation in liver (11).

Irritancy

100 mg instilled into rabbit eye caused mild irritation (unspecified duration) (12).

Genotoxicity

In vitro mouse lymphoma L5178Y cells with metabolic activation positive (13).

In vitro mouse Balb/C-3T3 cells morphological transformation negative (14).

Other comments

Acute short-term and chronic toxicity of phthalic esters, commonly used as plasticisers in biomedical devices reviewed (15).

Toxicity reviewed (16,17).

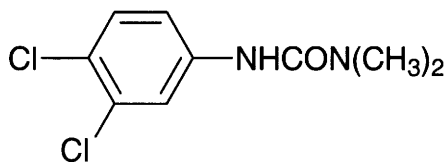
Aquatic toxicity of eighteen phthalate esters reviewed (1).

The environmental fate of eighteen phthalate esters reviewed (8).

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D579 diuron



$C_9H_{10}Cl_2N_2O$

Mol. Wt. 233.10

CAS Registry No. 330-54-1

Synonyms 3-(3,4-dichlorophenyl)-1,1-dimethylurea; *N'*-(3,4-dichlorophenyl)-*N,N*-dimethylurea; DCMU; DMU; Diuron; Direx; Diurex; Karmex; Toterbane; Unidron

INECS No. 206-354-4

RTECS No. YS 8925000

Uses Cross-linking catalyst. Herbicide.

Physical properties

M. Pt. 158-159°C **Partition coefficient** $\log P_{ow}$ 2.75 (1) **Volatility** v.p. 3.1×10^{-6} mmHg at 50°C

Solubility Water: 42 mg l⁻¹ at 25°C. Organic solvents: acetone, benzene, butyl stearate, vegetable oil

Occupational exposure

FR-VME 10 mg m⁻³

UK-LTEL 10 mg m⁻³

US-TWA 10 mg m⁻³

Supply classification harmful

Risk phrases Harmful: danger of serious damage to health by prolonged exposure if swallowed (R48/22)

Safety phrases Keep out of reach of children (if sold to general public) – Do not breathe dust – Wear suitable gloves (S2, S22, S37)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow, rainbow trout, bluegill sunfish, guppy, lake trout, channel catfish 2-27 mg l⁻¹ (1,2).

LC₅₀ (48 hr) coho salmon 16 mg l⁻¹ (3).

Invertebrate toxicity

LC₅₀ (5 min) *Photobacterium phosphoreum* 16.5 ppm Microtox test (4).

EC₅₀ (48 hr) *Daphnia pulex* 1.4 mg l⁻¹ (5).

LC₅₀ (96 hr) *Gammarus fasciatus* 0.7 mg l⁻¹ (6).

Toxicity to other species

LC₅₀ (14 days) frog tadpoles *Rana aurora*, *Pseudacris regilla*, and *Xenopus laevis* 22.2, 15.2, and 11.3 mg l⁻¹, respectively. LC₅₀ (21 days) *Rana catesbeiana* 12.7 mg l⁻¹. The lowest NOAELs calculated for the tadpoles were (in mg l⁻¹) *P. regilla* 14.5 (14 days), *R. catesbeiana* 7.6 (21 days), *R. aurora* 7.6 (14 days), *X. laevis* 29.1 (14 days) (7).

Bioaccumulation

Bioconcentration factor for fathead minnow 2.0 (2).

Environmental fate

Nitrification inhibition

Not inhibitory to nitrification in soil at 5.0 ppm. Inhibitory at 100 ppm for 3-4 day (8).

Degradation studies

In soil, microbial demethylation of the nitrogen atom and hydroxylation at position-2 of the benzene ring occurs. Duration of activity in the soil is ~4-8 hr, depending on soil type and humidity (2).

Anaerobic degradation in a pond sediment reduced diuron by 85% in ~18 days. The only metabolite identified was 3-chlorophenyl-1,1-dimethylurea, demonstrating that dehalogenation occurred at the *p*-position (9). 67-99% degradation occurred in 10 wk under aerobic conditions by mixed cultures isolated from water and sediment.

The major metabolite was 3,4-dichloroaniline. 3-(3,4-dichlorophenyl)-1-methylurea and 3,4-dichlorophenylurea were also identified (10).

Abiotic removal

100% removal of 23 mg l⁻¹ diuron was reported in 30 min at pH 9.2 by ozonation (11).

Adsorption by powdered activated carbon: 73.7 mg g⁻¹ carbon at a concentration of 100 µg l⁻¹ (12).

Adsorption and retention

Mean value open K_{oc} in various soils 383 (13).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 1020-3400 mg kg⁻¹ (14,15).

LD₅₀ dermal rabbit >2500 mg kg⁻¹ (16).

Sub-acute and sub-chronic data

LD₅₀ (8 day) oral bobwhite quail 1730 mg kg⁻¹ (17).

LD₅₀ (8 day) oral Japanese quail, mallard duck, ring-necked pheasant > 5000 mg kg⁻¹ (17).

Oral rat (30 day) 35 or 70 mg kg⁻¹ diet caused a significant increase in γ-glutamyl transpeptidase activity in serum and liver. The activity of glutamic-oxalacetic transaminase and glutamic-pyruvic transaminase showed a decrease in the liver, while the activity of these enzymes was elevated significantly in the serum, indicating hepatotoxicity (18).

Oral rat (90 day) 0, 2.5, 25, or 250 mg kg⁻¹ day⁻¹. The highest dose caused a body weight reduction, spleen enlargement and evidence of chronic methaemoglobinaemia (19).

Carcinogenicity and chronic effects

Dermal mouse 250 mg kg⁻¹ 3 × wk⁻¹ for 3 wk followed by repeated application of 5 µg of known skin tumour promoter 12-O-tetradecanoylphorbol-13-acetate 3 × wk⁻¹ led to the development of benign skin tumours (total period of exposure not specified) (20).

Oral rat and dog (2 yr) no-adverse-effect level for rats 150 mg kg⁻¹ diet, for dogs 125 mg kg⁻¹ (16).

Teratogenicity and reproductive effects

Oral rat, 125 or 250 mg kg⁻¹ day⁻¹ on days 6-15 of gestation. The high dose caused an increase in the incidence of wavy ribs in foetuses (21).

Metabolism and toxicokinetics

In humans, the plasma and urinary metabolites, 3,4-dichlorophenylurea and *N*-(3,4-dichlorophenyl)-*N'*-methylurea and dichloroaniline were identified following ingestion in a suicide attempt (22).

Irritancy

Dermal rabbit (24 hr) 1000-2500 caused a slight erythema (17).

10 mg of fine dry powder instilled into conjunctival sac of rabbit eye caused irritation within 72 hr (23).

Genotoxicity

Salmonella typhimurium TA1535 with metabolic activation positive (24).

Escherichia coli spot test for back-mutation negative (25).

Saccharomyces cerevisiae mitotic gene conversion negative (25).

Chlamydomonas reinhardtii mutagenicity assay extremely mildly positive (no further details given) (26).

In vitro Chinese hamster ovary cells forward gene mutation assay negative (27).

Inhibited testicular DNA synthesis (DSI) test in orally dosed mice (24).

Mouse bone marrow polychromatic erythrocyte micronucleus test negative (24).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration $0.1 \mu\text{g l}^{-1}$ (28).
Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (29).
WHO Toxicity Class Table 5 (30).
EPA Toxicity Class III (formulation) (15).
ADI 0.002 mg kg^{-1} body weight (31).

Other comments

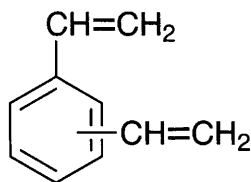
Residues have been isolated from soil, water and sediment (32).
Physical properties, and environmental fate of diuron reviewed (32).
Physical properties, environmental and mammalian toxicity reviewed (5,33).
In plants, diuron undergoes dimethylation of the nitrogen atom and hydroxylation at position 2 of the benzene ring (16).
Metabolic pathways reviewed (34).

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34. Roberts, T.R. et al (Eds.) *Metabolic Pathways of Agrochemicals. Part 1: Herbicides and Plant Growth Regulators* 1998, The Royal Society of Chemistry, Cambridge, UK

D580 divinylbenzene



$C_{10}H_{10}$

Mol. Wt. 130.19

CAS Registry No. 1321-74-0

Synonyms diethenylbenzene; vinylstyrene; Bio-Beads

EINECS No. 215-325-5

RTECS No. CZ 9370000

Uses Manufacture of ion exchange resins.

Physical properties

M. Pt. -45°C B. Pt. 195°C Flash point 61°C Specific gravity 0.912 Partition coefficient $\log P_{ow}$ 3.59 (calc.) (1) Volatility v.p. 6.6×10^{-1} mmHg at 20°C ; v.den. 4.5

Solubility Water: 50 mg l^{-1} . Organic solvents: acetone, benzene, carbon, diethyl ether, methanol, olive oil

Occupational exposure

FR-VME 10 ppm (50 mg m^{-3})

UK-LTEL 10 ppm (54 mg m^{-3})

US-TWA 10 ppm (53 mg m^{-3})

Environmental fate

Abiotic removal

Volatilisation from model river water, $t_{1/2}$ (est.) 4 hr (1).

Reaction with photochemically produced hydroxyl radicals in the atmosphere, $t_{1/2}$ (calc.) ~ 7 hr and with ozone 6.5 hr (2,3).

Adsorption and retention

Calculated K_{oc} 510-215 indicated a low to slight mobility in soils (4).

Mammalian & avian toxicity

Acute data

LD_{Lo} oral rat 4640 mg kg^{-1} (5).

Sub-acute and sub-chronic data

Inhalation σ and η B6CF1 mice 0, 25, 50, or 75 ppm 6 hr day^{-1} , 5 days wk^{-1} for up to 2 wk. The most severe effects occurred in the nasal cavity and liver. Acute necrosis and inflammation of the nasal cavity olfactory epithelium occurred after a few exposures. Olfactory epithelial changes were concentration-dependent with peripheral sparing at 25 ppm and extensive involvement at 75 ppm. Necrosis and regeneration of olfactory-associated Bowman's glands and the lateral nasal (Steno's) glands also occurred. Hepatic GSH levels were decreased in a

dose-dependent manner. Hepatocellular centrilobular necrosis was seen only in the 75 ppm dose group. Transient tubular damage was seen in some ♂ mice exposed to 75 ppm (6).

Irritancy

Mild irritation has been observed in workers acutely exposed by inhalation and from skin and eye contact (dose and duration unspecified) (7).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (8).

Legislation

The log P_{ow} value exceeds the European Community recommended level 3.0 (6th and 7th amendments) (9).

Other comments

Reviews on toxicity listed (10).

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10. *ECETOC Technical Report No. 71* 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuyse (Bte 6), B-1160 Brussels, Belgium

D581 divinyl ether



C₄H₆O

Mol. Wt. 70.09

CAS Registry No. 109-93-3

Synonyms 1,1'-oxybisethene; vinyl ether; vinethene; divinyl oxide; ethenyloxyethene

EINECS No. 203-720-5

RTECS No. YZ 6700000

Uses Anaesthetic.

Physical properties

B. Pt. 29°C **Flash point** < -30°C **Specific gravity** 0.774 at 20°C with respect to water at 20°C

Volatility v.p. 430 mmHg at 20°C ; v.den. 2.41

Solubility Water: 5.3 g l⁻¹ at 37°C. Organic solvents: diethyl ether, ethanol

Occupational exposure

UN No. 1167 (inhibited) HAZCHEM Code 3YE (inhibited) Conveyance classification flammable liquid (inhibited)

Environmental fate

Abiotic removal

On exposure to air decomposed to formaldehyde and formic acid (1).

Mammalian & avian toxicity

Acute data

LC_{Lo} (15 min) inhalation mouse 329 mg m⁻³ (2).

Genotoxicity

Salmonella typhimurium TA100, TA1535 with metabolic activation positive (3).

In vitro Chinese hamster ovary cells, sister chromatid exchanges with metabolic activation positive (4).

Other comments

Has ~4 × the anaesthetic potency of diethyl ether (1).

Physical properties and toxicity reviewed (5).

Autoignition temperature 360°C.

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D582 dixan



C₆H₁₀O₂S₄

Mol. Wt. 242.41

CAS Registry No. 502-55-6

Synonyms bisethylxanthogen sulfide; diethyl thioperoxydicarbonate; diethyl dithiobis[thioformate]; bisethylxanthogen; O,O-diethyl dithiobis[thioformate]; diethyl dixanthogenate; dixanthogen

EINECS No. 207-944-4

RTECS No. LQ 7700000

Uses Polymerisation catalyst. Flotation agent for separation of chalcopryite ores. Lubricant additive. Insecticide. Herbicide.

Physical properties

M. Pt. 28-32°C

Solubility Organic solvents: benzene, diethyl ether, ethanol, petroleum ether

Occupational exposure

Supply classification harmful

Risk phrases Harmful if swallowed (R22)

Safety phrases Keep out of reach of children (if sold to general public) – Avoid contact with the skin (S2, S24)

Mammalian & avian toxicity

Acute data

LD₅₀ oral guinea pig, rat, mouse 400, 480, 1200 mg kg⁻¹, respectively (1-3).

LD_{Lo} dermal rat 2100 mg kg⁻¹ (3).

LD₅₀ intraperitoneal rabbit 320 mg kg⁻¹ (4).

Legislation

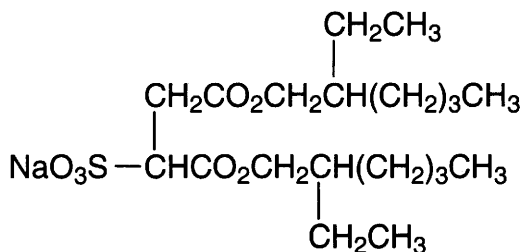
Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (5).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (6).

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6. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK

D583 docusate sodium



C₂₀H₃₈O₇SNa

Mol. Wt. 445.57

CAS Registry No. 577-11-7

Synonyms dioctyl sodium sulfosuccinate; bis(2-ethylhexyl) sulfosuccinate; 1,4-bis(2-ethylhexyl) sulfobutanedioate; di(2-ethylhexyl) sodium sulfosuccinate; Aerosol OT-70 PG; Complemix; Discol DFW; Doxinate; Regutol; Octowet 40

EINECS No. 209-406-4

RTECS No. WN 0525000

Uses Anionic surfactant. Component of antistatic agents. Emulsifying and dispersing agent. Used as an ingredient of laxatives, and for softening the wax in ears.

Physical properties

M. Pt. 173-179°C

Solubility Water: 15 g l⁻¹ at 25°C. Organic solvents: acetone, carbon tetrachloride, dibutyl phthalate, ethanol, naphtha, glycerol, petroleum ether, vegetable oils

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 1900, 2640 mg kg⁻¹, respectively (1,2).

LD₅₀ intraperitoneal rat 590 mg kg⁻¹ (3).

LD₅₀ intravenous mouse 60 mg kg⁻¹ (4).

Teratogenicity and reproductive effects

Oral rat (three-generation study) 0, 0.1, 0.5, or 1.0%. Reproductive function was not affected in any generation.

Body weight gain was reduced in a dose-dependent manner in each generation. Pup weights were significantly lower than controls only for the high-dose group during the 3rd generation. No teratogenic effects were observed (5).

Metabolism and toxicokinetics

In humans, absorbed from the gastro-intestinal tract and excreted in bile (6).

Irritancy

Dermal rabbit (24 hr) 10 mg caused moderate irritation (7).

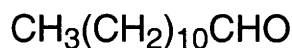
Other comments

Reviews on toxicity listed (8).

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D584 dodecanal



C₁₂H₂₄O

Mol. Wt. 184.32

CAS Registry No. 112-54-9

Synonyms 1-dodecyl aldehyde; lauryl aldehyde; lauraldehyde

EINECS No. 203-983-6

RTECS No. JR 1910000

Uses Food flavouring agent. Deodorant. Intermediate in chemical synthesis.

Occurrence In plant oils. Identified in aroma of cooked meats.

Physical properties

M. Pt. 44.5°C **B. Pt.** 185°C at 100 mmHg **Flash point** 101°C **Specific gravity** 0.835 at 15°C with respect to water at 4°C

Solubility Water: miscible. Organic solvents: glycerin, propylene glycol, fixed oils

Environmental fate

Degradation studies

Degradation in wastewater by activated sludge as determined by reduction of ThOD, 8% after 6hr, 14.6% after 12 hr, 19.9% after 24 hr (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat >20 g kg⁻¹ (2).

Irritancy

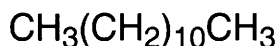
Dermal rabbit (24 hr) 500 mg caused moderate irritation (2).

Dermal human, (48 hr) 5 mg caused mild irritation (2).

References

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D585 dodecane



C₁₂H₂₆

Mol. Wt. 170.34

CAS Registry No. 112-40-3

Synonyms *n*-dodecane; duodecane; dihexyl

EINECS No. 203-967-9

RTECS No. JR 2125000

Uses Solvent. Lubricant oil additive.

Occurrence Identified in aroma of cooked meats. In plant oils.

Physical properties

M. Pt. -12°C **B. Pt.** 216.2°C **Flash point** 71°C (closed cup) (99+% purity) **Specific gravity** 0.750

Partition coefficient log P_{ow} 6.80 **Volatility** v.p. 0.3 mmHg at 20°C ; v.den. 5.9

Solubility Water: 3.7 µg l⁻¹ at 25°C. Organic solvents: acetone, carbon tetrachloride, chloroform, diethyl ether, ethanol

Ecotoxicity

Bioaccumulation

Bioconcentration factor for golden orfe 52, and for green algae 6300 (1).

Environmental fate

Anaerobic effects

IC₅₀ (50 day) methanogenic bacteria 0.23 mg l⁻¹ (2).

Degradation studies

Practically completely removed from wastewater at concentrations of 400-450 mg l⁻¹ in a two-stage activated sludge process (3).

Degraded by *Rhodococcus rhodochrous* and fungal flora isolated from soil and sediments and by *Pseudomonas putida*, *Pseudomonas alcaligenes*, *Pseudomonas aeruginosa* and *Pseudomonas fluorescens* (4-6).

Abiotic removal

Volatilisation from the water of a Netherlands river, t_{1/2} 12 hr (7).

Reaction with photochemically produced hydroxyl radicals in the atmosphere, t_{1/2} 17 hr in clean air, 4 hr in moderately polluted air (8).

Mammalian & avian toxicity

Acute data

LD_{Lo} intravenous mouse 2670 mg kg⁻¹ (9).

Sub-acute and sub-chronic data

Inhalation rat (8 hr) 142 ppm caused no observable toxic effect (10).

Other effects

Any other adverse effects

In vitro rabbit heart mitochondria 10-160 µg resulted in uncoupling of oxidative phosphorylation. Slight inhibition of NADH was also noted (11).

Reported to act as a promoter of carcinogenesis of polycyclic aromatic hydrocarbons for mouse skin (12).

Legislation

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (13).

The log P_{ow} value exceeds the European Community recommended level 3.0 (6th and 7th amendments) (14).

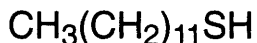
Other comments

Autoignition temperature 200-205°C.

References

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2. Blum, D. J. W. et al *J. Water Pollut. Control Fed.* 1991, **63**(3), 198-207.
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4. Sorkhoh, N. A. et al *Environ. Pollut.* 1990, **65**(1), 1-17.
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7. Zoetemann, B. C. J. et al *Chemosphere* 1980 **9**, 231-249.
8. Hendry, D. G. et al *Atmospheric Reactions of Organic Compounds* 1979, USEPA-560/12-79-001.
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10. Nilsen, O. D. et al *Pharmacol. Toxicol. (Copenhagen)* 1988, **62**(5), 259-266.
11. Borgatti, A. R. et al *Boll. - Soc. Ital. Biol. Sper.* 1981, **57**(15), 1583-1589.
12. Slaga, T. J. et al (Ed.) *Mechanisms of Tumor Promotion and Carcinogens* 1978, Raven Press, New York, USA.
13. S. I. 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
14. 1967 Directive on Classification, Packaging and Labelling of Dangerous Substances 67/548/EEC; 6th Amendment EEC Directive 79/831/EEC; 7th Amendment EEC Directive 91/32/EEC 1991, HMSO, London, UK

D586 1-dodecanethiol



$\text{C}_{12}\text{H}_{26}\text{S}$

Mol. Wt. 202.40

CAS Registry No. 112-55-0

Synonyms lauryl mercaptan; dodecyl mercaptan; *n*-dodecyl mercaptan; 1-mercaptododecane

EINECS No. 203-984-1

RTECS No. JR 3155000

Uses Catalyst. Chain-transfer agent. Intermediate in chemical synthesis.

Physical properties

M. Pt. -7°C B. Pt. $266\text{--}283^{\circ}\text{C}$ Flash point 87°C Specific gravity 0.849 at 15.5°C with respect to water at 15.5°C Volatility v.den. 7.0

Solubility Water: $<1\text{ g l}^{-1}$ at 22°C . Organic solvents: acetone, benzene, diethyl ether, ethanol, ethyl acetate

Mammalian & avian toxicity

Teratogenicity and reproductive effects

Inhalation mouse 0-7.4 ppm for 6 hr day $^{-1}$ on day 6-16 of gestation. Maternal mortality, resorptions were reported in treated animals. No evaluation of teratogenic effects could be made in this study because of the premature fetuses obtained as a result of maternal mortality (1).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (2).

Other effects

Other adverse effects (human)

Workers exposed to a mixture of 1-dodecanethiol with polychloroprene latexes showed a significant increase in the frequency of chromosomal aberrations in the peripheral blood (3).

Residues in an adhesive (containing 1-dodecanethiol) used in the shoe industry were reported to be responsible for the occurrence of shoe dermatitis (4).

Other comments

In mineral oils. Residues have been found in polychloropropene-based adhesives (4).

References

1. International Research and Development Corp. *Inhalation Teratology Study of n-Dodecyl Mercaptan in Rats and Mice* 1983, EPA Doc. No. FYI-OTS-1085-0234.
2. Zeiger, E. et al *Environ. Mutagen.* 1987, 9(Suppl. 9), 1-109.
3. *Patty's Industrial Hygiene and Toxicology* 3rd ed., 1982, 2, 2079, Clayton, G. D. et al (Eds.), Interscience Publishers, New York, USA.
4. Grimalt, F. et al *Contact Dermatitis* 1975, 1, 169-174

D587 *tert*-dodecanethiol



$\text{C}_{12}\text{H}_{26}\text{S}$

Mol. Wt. 202.40

CAS Registry No. 25103-58-6

Synonyms *tert*-dodecyl mercaptan; *tert*-dodecylthiol

EINECS No. 246-619-1

RTECS No. JR 3150000

Uses Catalyst. Chain-transfer agent.

Physical properties

M. Pt. -7.5°C B. Pt. $227\text{--}248^\circ\text{C}$ Flash point 96°C (open cup) Specific gravity 0.859 at 25°C with respect to water at 25°C Volatility v.den. 6.98

Mammalian & avian toxicity

Acute data

LD_{50} oral rat 310 mg kg^{-1} (1).

LD_{50} intraperitoneal rat 1830 mg kg^{-1} (2).

Irritancy

Dermal rabbit (24 hr) 500 mg caused moderate irritation and 500 mg instilled into rabbit eye for 24 hr caused mild irritation (1).

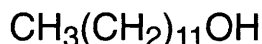
Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537, TA1538 with and without metabolic activation negative (3).

References

1. Marhold, J. V. *Sbornik Vysledku Toxikologickeho Vysetreni Latek A Pripravku* 1972, 169, Prague, Czechoslovakia.
2. Izmerov, N. F. et al *Toxicometric Parameters of Industrial Toxic Chemicals under Single Exposure* 1982, 64, CIP, Moscow, USSR.
3. Zeiger, E. et al *Environ. Mol. Mutagen.* 1992, 19(Suppl. 21), 2-141

D588 1-dodecanol



$\text{C}_{12}\text{H}_{26}\text{O}$

Mol. Wt. 186.34

CAS Registry No. 112-53-8

Synonyms lauryl alcohol; dodecyl alcohol; *n*-dodecanol; duodecyl alcohol

EINECS No. 203-982-0

RTECS No. JR 5775000

Uses Antistatic agent. Catalyst. Intermediate in chemical synthesis. Lubricating oil additive. Manufacture of cosmetics and topical pharmaceuticals. Surfactant.

Occurrence In plant oils. ♂ Insect pheromone. Has been detected in river and marine sediments.

Physical properties

M. Pt. 21-26°C **B. Pt.** 260-262°C **Flash point** 110°C **Specific gravity** 0.8309 at 24°C with respect to water at 4°C **Partition coefficient** $\log P_{ow}$ 5.13 **Volatility** v.p. 1 mmHg at 91°C ; v.den. 6.43
Solubility Organic solvents: diethyl ether, ethanol, fixed oils, propylene glycol,

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) fathead minnow 1 mg l⁻¹, flow-through bioassay, water hardness 45.5 mg l⁻¹ CaCO₃, temperature 25°C, pH 7.5 and dissolved oxygen content >60% saturation (1).

Invertebrate toxicity

EC₅₀ (30 min) *Photobacterium phosphoreum* 0.06-0.34 ppm Microtox test (2).

IC₅₀ (48 hr) *Tetrahymena pyriformis* 1.0 mg l⁻¹ (3).

EC₅₀ rotifer *Brachionus calyciflorus* 0.81 mg l⁻¹ (4).

Environmental fate

Nitrification inhibition

IC₅₀ (25 day) *Nitrosomonas* 140 mg l⁻¹ (5).

Carbonaceous inhibition

IC₅₀ (5 day) aerobic heterotrophic bacteria isolated from activated sludge 210 mg l⁻¹ (5).

Anaerobic effects

IC₅₀ (50 day) methanogenic bacteria 22 mg l⁻¹ (5).

Degradation studies

Degradation in waste water by activated sludge, as determined by reduction of ThOD, 4.5% after 6 hr, 10.1% after 12 hr, 13.4% after 24 hr (6).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 12,800 mg kg⁻¹ (7).

LD₅₀ intraperitoneal rat 800-1600 mg kg⁻¹ (8).

Carcinogenicity and chronic effects

Dermal mouse (60 wk) application of unspecified dose 3 × wk⁻¹ induced papillomas in 2/30 mice previously given an initiating dose of dimethylbenzanthracene. Severe cutaneous irritation was also reported (9).

Irritancy

Dermal human (3 day) 75 mg caused severe irritation (10).

Genotoxicity

Salmonella typhimurium TA98 with and without metabolic activation negative (11).

Legislation

The $\log P_{ow}$ value exceeds the European Community recommended level 3.0 (6th and 7th amendments) (12).

Other comments

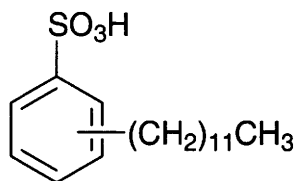
Reviews on toxicity listed (13).

Autoignition temperature 364°C.

References

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2. Kaiser, K. L. E. et al *Water Pollut. Res. J. Can.* 1991, **26**(3), 361-431.
3. Schultz, T. W. et al *Bull. Environ. Contam. Toxicol.* 1990, **44**(1), 67-72.
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5. Blum, D. J. W. et al *J. Water Pollut. Control. Fed.* 1991, **63**(3), 198-207.
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11. Shimizu, H. et al *Sangyo Igaku* 1985, **27**(6), 400-419.
12. 1967 Directive on Classification, Packaging and Labelling of Dangerous Substances 67/548/EEC; 6th Amendment EC Directive 78/831/EEC; 7th Amendment EC Directive 91/32/EEC 1991, HMSO, London, UK.
13. ECETOC Technical Report No. 71 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuysse (Bte 6), B-1160 Brussels, Belgium

D589 dodecylbenzenesulfonic acid



$\text{C}_{18}\text{H}_{30}\text{O}_3\text{S}$

Mol. Wt. 326.50

CAS Registry No. 27176-87-0

Synonyms laurylbenzenesulfonic acid; *n*-dodecylbenzenesulfonic acid; sulframin acid 1298; DBA; Emka DDBSA; Lumosaure A; Naxel AAS-98S; Sulfonax

EINECS No. 248-289-4

RTECS No. DB 6600000

Uses Disinfectant. Surfactant. Catalyst. Lubricant additive.

Physical properties

B. Pt. $>204^\circ\text{C}$ at 1 mmHg

Ecotoxicity

Invertebrate toxicity

EC_{50} (48 hr) *Daphnia magna* 11-23 mg l^{-1} (1).

Environmental fate

Degradation studies

Degradation by soil bacteria >7 day (2).

Abiotic removal

Removal from water effected by treatment with ozone in conjunction with UV irradiation at 225 nm for 3 hr at pH 7.0. Removal by treatment with UV irradiation alone was negligible (3).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 650 mg kg⁻¹ (4).

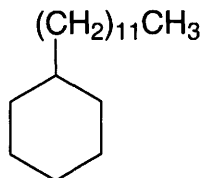
Other comments

Reviews on toxicity listed (5).

References

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2. Singh, M. et al *Environ. Pollut.* 1989, **58**(2-3), 109-113.
3. Matsumoto, H. et al *Eisei Kagaku* 1989, **35**(6), 408-413.
4. *Arch. Toxicol.* 1974, **32**, 245.
5. ECETOC Technical Report No. 71 1996, European Centre for Ecotoxicology and Toxicology of Chemicals, 4 Avenue E. Van Nieuwenhuysse (Bte 6), B-1160 Brussels, Belgium

D590 dodecylcyclohexane



C₁₈H₃₆

Mol. Wt. 252.48

CAS Registry No. 1795-17-1

Synonyms 1-cyclohexyldodecane; *n*-dodecylcyclohexane

EINECS No. 217-273-9

Physical properties

M. Pt. 12.5°C B. Pt. 331°C Specific gravity 0.8223 at 20°C

Environmental fate

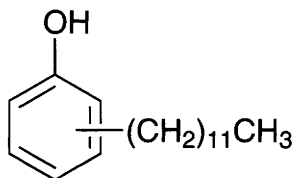
Degradation studies

Metabolised by a *Micrococcus* sp., isolated from soil, after a lag time of several days (1).

References

1. Yoshizenko, F. et al *Hakko Kogaku Kaishi* 1988, **66**(1), 25-30 (Japan.) (*Chem. Abstr.* 108, 183427k)

D591 dodecylphenol



$C_{18}H_{30}O$

Mol. Wt. 262.44

CAS Registry No. 27193-86-8

Synonyms ADX 100

EINECS No. 248-312-8

RTECS No. SL 3675000

Uses Antioxidant. Antifoaming agent.

Physical properties

B. Pt. 314-334°C **Flash point** 163°C (open cup) **Specific gravity** 0.93 at 20°C with respect to water at 20°C

Volatility v.p. 6.93×10^{-5} mmHg at 25°C ; v.den. 9.04

Solubility Water: miscible. Organic solvents: acetone, diethyl ether, ethanol

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) cutthroat trout 0.14 mg l⁻¹ (1).

Bioaccumulation

Calculated bioconcentration factor 59,000 indicated that environmental accumulation is likely (2).

Environmental fate

Abiotic removal

Volatilisation from river and pond water, calculated t_{1/2} ~ 2 and 20 days, respectively (2).

Reaction with photochemically produced hydroxyl radicals in the atmosphere, t_{1/2} 3.7-6.7 hr (3).

Adsorption and retention

Estimated K_{oc} of 90,000 indicates strong potential for adsorption to soil and sediments (2).

Mammalian & avian toxicity

Acute data

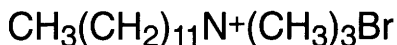
LD₅₀ oral rat 2140 mg kg⁻¹ (4).

LD₅₀ dermal rabbit 5000 mg kg⁻¹ (4).

References

1. McLeese, D. W. et al *Chemosphere* 1981, **10**, 723.
2. Lyman, W. J. et al *Handbook of Chemical Property Estimation Methods: Environmental Behaviour of Organic Compounds* 1982, McGraw-Hill, New York, USA.
3. Atkinson, R. *Int. J. Chem. Kinet.* 1987, **21**, 1123-1126.
4. *Am. Ind. Hyg. Assoc. J.* 1962, **23**, 95

D592 dodecyltrimethylammonium bromide



$\text{C}_{15}\text{H}_{34}\text{BrN}$

Mol. Wt. 308.35

CAS Registry No. 1119-94-4

Synonyms lauryl trimethylammonium bromide; *n*-dodecyltrimethylammonium bromide

EINECS No. 214-290-3

RTECS No. BQ 3195000

Uses Catalyst. Surfactant. Component of the disinfectant cetrimide.

Physical properties

M. Pt. 246°C (decomp.)

Mammalian & avian toxicity

Acute data

LD₅₀ intravenous rat, mouse 5.2-6.8 mg kg⁻¹ (1).

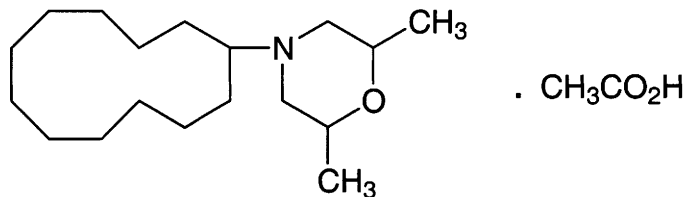
Irritancy

Irritating to the eyes, skin, mucous membranes and upper respiratory tract (species unspecified) (2).

References

1. *Acta Pharmacol. Toxicol.* 1980, **47**, 17.
2. Lenga, R. E. (Ed.) *Sigma-Aldrich Library of Chemical Safety Data* 2nd ed., 1988, 1, 1496, Milwaukee, WI, USA

D593 dodemorph acetate



$\text{C}_{20}\text{H}_{39}\text{NO}_3$

Mol. Wt. 341.53

CAS Registry No. 31717-87-0

Synonyms cyclododecane morpholine derivative; 4-cyclododecyl-2,6-dimethylmorpholine acetate; Aaroson; Compo Rosenspray; F238; Mehлтаumittel; Meltatox

EINECS No. 250-778-2

RTECS No. QE 0610000

Uses Fungicide.

Physical properties

M. Pt. 63-64°C B. Pt. 315°C at 101.3 kPa Specific gravity 0.93 Partition coefficient log P_{ow} 2.52 at pH 5, 4.23 at pH 9 (1) Volatility v.p. 1.9×10^{-5} mmHg at 20°C

Solubility Water: 1.1 mg kg⁻¹ at 20°C. Organic solvents: benzene, chloroform, ethanol

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) guppy ~40 mg l⁻¹ (1).

Invertebrate toxicity

LC₅₀ (48 hr) *Daphnia* 3.34 mg l⁻¹ (1).

Non-toxic to bees (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, ♂ 3944, ♀ 2465 mg kg⁻¹, respectively (1,2).

LC₅₀ (4 hr) inhalation rat 5000 mg m⁻³ (1).

LD₅₀ dermal rat >4000 mg kg⁻¹ (1).

LD₅₀ intraperitoneal mouse 320 mg kg⁻¹ (3).

Irritancy

Severe eye and skin irritant to rabbits (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (4).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (5).

WHO Toxicity Class Table 5 (free base) (6).

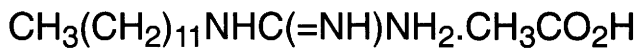
Other comments

Contains ~60% of the *cis*-2,6-dimethylmorpholine and 40% of the *trans*-2,6-dimethylmorpholine moieties (7).

References

1. *The Pesticide Manual* 11th ed., 1997, The British Crop Protection Council, Farnham, UK.
2. *Farm Chemicals Handbook* 1980, D115, Meister Publishing Co., Willoughby, OH, USA.
3. *Guide to Chemicals Used in Crop Protection* 1973, 6, 244, Information Canada, Ottawa, Canada.
4. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
5. *S. I. 1991 No. 472 The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
6. *The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification* 1998-1999 WHO/PCS/98.21.
7. *The Pesticide Manual* 9th ed., 1991, British Crop Protection Council, Farnham, UK

D594 dodine



C₁₅H₃₃N₃O₂

Mol. Wt. 287.45

CAS Registry No. 2439-10-3

Synonyms N-dodecylguanidine acetate; 1-dodecylguanidium acetate; dodine acetate; laurylguanidine acetate; dodecylguanidine monoacetate; Adine; Barlay Dodex; Carpen; Dodene; Efuzin; Fungilon D; Guanidol

EINECS No. 219-459-5

RTECS No. MF 1750000

Uses Fungicide.

Physical properties

M. Pt. 136°C **Partition coefficient** $\log P_{ow}$ 1.08-1.18 (1) **Volatility** v.p. 9.7×10^{-5} mmHg at 20°C
Solubility Water: 630 mg l⁻¹ at 25°C. Organic solvents: butanol, cyclohexanol, ethanol, propanol, tetrahydrofurfuryl alcohol

Occupational exposure

Supply classification harmful, dangerous for the environment

Risk phrases Harmful if swallowed – Irritating to eyes and skin– Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R22, R36/38, R50/53)

Safety phrases Keep out of reach of children (if sold to general public) – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice – This material and/or its container must be disposed of as hazardous waste – Avoid release to the environment. Refer to special instructions/safety data sheet (S2, S26, S60, S61)

Ecotoxicity

Fish toxicity

LC₅₀ (48 hr) harlequin 0.53 mg l⁻¹ (2).

Invertebrate toxicity

LD₅₀ topical honey bee >0.011 mg bee⁻¹ (3).

Environmental fate

Degradation studies

In plants converted into creatine by the action of methyltransferases and simultaneous oxidative cleavage of the dodecyl moiety (3).

Abiotic removal

>99% removal from wastewater effected by organic filtration medium composed of peat, moss and manure (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral Japanese quail, mallard duck 790, 1140 mg kg⁻¹, respectively (3).

LD₅₀ oral guinea pig, rabbit, rat, mouse 176, 535, 566, 1200 mg kg⁻¹, respectively (4-6).

LD₅₀ dermal rabbit 1500 mg kg⁻¹ (7).

LD_{Lo} dermal guinea pig 2000 mg kg⁻¹ (6).

Carcinogenicity and chronic effects

Oral rat (2 yr) 800 mg kg⁻¹ diet caused only a slight retardation of growth (3).

Irritancy

100 mg instilled into rabbit eye caused severe irritation (duration unspecified) (8).

Genotoxicity

Saccharomyces cerevisiae gene reversion assay negative (1).

Other effects

Any other adverse effects

A single administration of 1000 mg docrine kg⁻¹ to ♂ Wistar rats caused a significant decrease in body weight accompanied by diarrhoea. Morphological alterations to the jejunum were observed, including a significant decrease in crypt height and in villus length and depth. Protein content and sucrase activity of the jejunum were also significantly reduced (9).

Legislation

EEC maximum residue level for pome and stone fruit 1 ppm; other fruit and vegetables 0.2 ppm (3).

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration $0.1 \mu\text{g l}^{-1}$ (10).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (11).

WHO Toxicity Class III (12).

EPA Toxicity Class 1 (3).

Tolerable daily intake (human) 0.01 mg kg^{-1} (3).

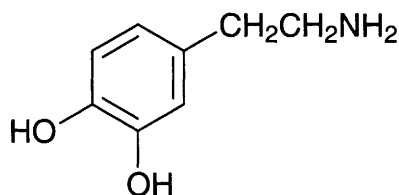
Other comments

Toxicity reviewed (1).

References

1. *Dangerous Prop. Ind. Mater. Rep.* 1990, **10**(6), 20-26.
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3. *The Agrochemicals Handbook* 3rd ed., 1991, The Royal Society of Chemistry, London, UK.
4. *World Rev. Pest Control* 1968, **7**, 135.
5. *Toxicol. Appl. Pharmacol.* 1961, **3**, 127.
6. Izmerov, N. F. et al *Toxicometric Parameters of Industrial Toxic Chemicals under Single Exposure* 1982, **64**, CIP, Moscow, USSR.
7. *Pesticide Index* 1976, **5**, 88, College Science Publications, State College, PA, USA.
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9. Mitjans, M. et al *J. Toxicol. Environ. Health* 1997, **52**(6), 545-556.
10. *EC Directive Relating to the Quality of Water Intended for Human Consumption* 1982, 80/778/EEC, Office for Official Publications of the European Communities, 2 rue Mercier, L-2985 Luxembourg.
11. *S. I.* 1991 No. 472 *The Environmental Protection (Prescribed Processes and Substances) Regulations* 1991, HMSO, London, UK.
12. *The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification* 1998-1999 WHO/PCS/98.21

D595 dopamine



$\text{C}_8\text{H}_{11}\text{NO}_2$

Mol. Wt. 153.18

CAS Registry No. 51-61-6

Synonyms 3-hydroxytyramine; 4-(2-aminoethyl)pyrocatechol; 4-(2-aminoethyl)-1,2-benzenediol; 3,4-dihydroxyphenethylamine

EINECS No. 200-110-0

RTECS No. UX 1088000

Uses Catecholamine with direct and indirect sympathomimetic effects. Used as the hydrochloride to correct haemodynamic imbalances associated with heart or kidney failure, trauma and septicaemia.

Occurrence Isolated from *Hermidium alipes*.

Mammalian & avian toxicity

Acute data

LD₅₀ intraperitoneal rat 163 mg kg⁻¹ (1).

LD₅₀ intravenous, intraperitoneal mouse 59, 950 mg kg⁻¹, respectively (2).

LD₅₀ intravenous dog 79 mg kg⁻¹ (3).

Teratogenicity and reproductive effects

Subcutaneous rat 10 mg kg⁻¹ day⁻¹ from day 10-14 or 15-19 of pregnancy. Teratogenic effects included cataracts, polydactyly and suppurative eye inflammation (4).

Subcutaneous ♀ rat 10 mg kg⁻¹ day⁻¹ for 30 days prolonged metoestrus. Histological changes were reported in the pituitary and adrenal glands, ovaries and uterus (4).

Teratogenic to chick embryo (5).

Metabolism and toxicokinetics

Metabolic precursor of noradrenaline. A proportion is excreted as metabolites of noradrenaline. Most is directly metabolised into dopamine-related metabolites (6).

Genotoxicity

Salmonella typhimurium TA98, TA100, TA1535, TA1537, TA1538 with and without metabolic activation negative (7).

In vitro mouse lymphoma L5178Y cells tk⁺/tk⁻ without metabolic activation positive (8).

Other comments

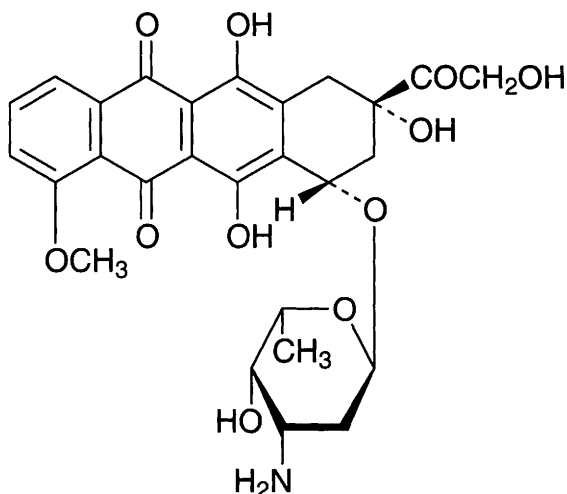
Inactive when given orally, being rapidly inactivated, with t_{1/2} of 2 min. Vasoconstrictor properties preclude subcutaneous or intramuscular injection. To avoid tissue necrosis it is usually administered into a large vein high up in a limb, preferably arm (6).

Brain dopamine research, pharmacology, renal effects, metabolism and role in male sexual disorder aetiology and therapy reviewed (9-13).

References

1. *Toxicol. Appl. Pharmacol.* 1987, **88**, 433.
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D596 doxorubicin



$C_{27}H_{29}NO_{11}$

Mol. Wt. 543.53

CAS Registry No. 23214-92-8

Synonyms (8*S*-*cis*)-10-[(3-amino-2,3,6-trideoxy- α -L-*lyxo*-hexopyranosyl)oxy]-7,8,9,10-tetrahydro-6,8,11-trihydroxy-8-(hydroxyacetyl)-1-methoxy-5,12-naphthacenedione; 14-hydroxydaunomycin; adriamycin (former generic name); Adriablastina

EINECS No. 245-495-6

Uses Antineoplastic agent, forms stable complex with DNA.

Occurrence Isolated from *Streptomyces peucetius* var. *caesius*.

Physical properties

M. Pt. 229-231°C

Solubility Organic solvents: methanol

Mammalian & avian toxicity

Acute data

LD_{Lo} intravenous human 15 mg kg⁻¹ (1).

A single dose 9 mg kg⁻¹ (route unspecified) caused 67% mortality in rats, whereas three repeat doses of 3 mg kg⁻¹ administered every third day caused 7% mortality (2).

Sub-acute and sub-chronic data

LD_{Lo} (31 wk) intravenous human 380 mg kg⁻¹ (1).

Intravenous dog 0.5 mg kg⁻¹ day⁻¹ was lethal after 5-10 doses, while 0.125-0.25 mg kg⁻¹ day⁻¹ was toxic to rats and dogs but not lethal. Inhibition of haemopoiesis was observed which persisted 2-3 days after discontinuation of treatment (3).

Intravenous Wistar ♂ rats 1 mg kg⁻¹ day⁻¹ (7 day), increased lipid peroxidation observed concomitant with a decrease in antioxidant enzymes superoxide dismutase, catalase and glutathione peroxidase. The glutathione status was also altered. The authors propose that these factors in combination may be responsible for the cardiotoxicity of doxorubicin through enhanced peroxidation of cellular membranes (4).

Carcinogenicity and chronic effects

Inadequate evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2A (5).

Single intravenous injection of 5 or 10 mg adriamycin to rats produced mammary tumours and single or repeat subcutaneous injection produced local sarcomas and mammary tumours (6).

Intravesicular instillation of doxorubicin in rats resulted in a low incidence of bladder papillomas (5).

Teratogenicity and reproductive effects

Embryonic chicks (4-5 day) $2.5\text{--}10\text{ }\mu\text{g g}^{-1}$ egg (route unspecified). High doses increased the mortality rate and frequencies of ventricular septal defect, dextroposition of the aorta and aortic arch anomalies (7).

♂ Wistar rats (1-4 wk) $1\text{ mg kg}^{-1}\text{ }3\times\text{wk}^{-1}$ (route unspecified) produced persistent dose-related reductions in testis, epididymis and seminal vesicle weight but did not alter ventral prostate weight. Serum luteinising hormone was increased after treatment, while binding of iodinated hCG to testicular luteinising hormone was reduced. Adriamycin produces significant and persistent damage to the endocrine and spermatogenic compartments of the testis (8).

Induces an increase in apoptosis at specific stages of the rat seminiferous epithelial cycle. The most sensitive cell types are type A3-4 spermatogonia, preleptotene, zygotene, and early pachytene spermatocytes (9).

Metabolism and toxicokinetics

In humans, following intravenous injection, it is rapidly cleared from blood, and distributed into lungs, liver, heart, spleen and kidneys. It undergoes rapid metabolism in the liver to the metabolite doxorubicinol (10).

In rats, doxorubicin was excreted in urine at 5.7% of initial intravenous injection after 5 days. After initial decrease, plasma levels remained constant for at least 7 days (11).

Intravenous mice 5 mg kg^{-1} , doxorubicin was readily bound to tissues and after 30 min tissue concentrations were $10\times$ greater than in blood, 50% of dose was excreted within 32 hr. Intravenous rabbit 5 mg kg^{-1} 17% of dose excreted intact in bile and 2% in urine in 8 hr (12).

A pharmacokinetic study showed anthracycline drugs are rapidly transferred to the tissues and then slowly released. Doxorubicin showed highest levels in liver and kidney (13).

Genotoxicity

Salmonella typhimurium TA1535, pSK1002 without metabolic activation positive (14).

Urine samples from cancer patients tested for mutagenicity over a 14-day period in *Salmonella typhimurium* TA98, TA100, UTH 8413, UTH 8414 without metabolic activation positive (15).

In vitro mouse lymphoma L5178 tk+/tk- without metabolic activation, induced chromosome aberrations; mutagenic and clastogenic at a dose of 5 ng ml^{-1} (16).

In vitro HeLa S3 cells $0.01\text{ }\mu\text{g ml}^{-1}$ retarded cell cycle and DNA formation, $0.1\text{ }\mu\text{g ml}^{-1}$ cells accumulated in G2 phase, $1.0\text{ }\mu\text{g ml}^{-1}$ DNA formation slow and cells accumulated in S phase (17).

Human lymphocytes $\leq 100\text{ ng ml}^{-1}$ induced chromosome aberrations and micronuclei (18).

In mice treated with $2\text{--}6\text{ mg kg}^{-1}$ 0.6% spermatocytes had chromosomal translocations. No increase in dominant lethality was observed with doses up to 6 mg kg^{-1} (19).

Drosophila melanogaster Cross N and Cross S, positive induction of mosaic light spots and twin spots, but the increase of twin spots was only significant after treatment of 46-hr larvae (20).

Drosophila melanogaster white-ivory reversion test positive (21).

Other effects

Other adverse effects (human)

In a study of 9170 patients, 2-yr (or longer) survivors of childhood cancer. The influence of therapy on subsequent leukaemic risk was detected by a case control study conducted on 25 cases and 90 matched controls. Doxorubicin was identified as a possible risk factor although treatment with alkylating agents was identified as the primary cause (22).

In vitro chemosensitivity was evaluated in 28 patients with head and neck squamous cell carcinomas (including 12 pharyngeal cancers, 7 oral cavity cancers, 4 laryngeal cancers, 4 maxillary sinus cancers, 1 oesophageal cancer and 19 thyroid cancers. Tumour fragments obtained at biopsy or surgery were exposed to anticancer drugs and assayed for succinate dehydrogenase activity. The average of succinate dehydrogenase activity in squamous cell carcinomas was 41% and for thyroid cancer 38.3% (23).

Any other adverse effects

Intraperitoneal ♀ Sprague-Dawley rats 2-8 mg kg⁻¹ decreased levels of α_c -actin mRNA, β -actin mRNA, glyceraldehyde-3-phosphate dehydrogenase mRNA in the heart and α_{sk} -actin mRNA, glyceraldehyde-3-phosphate dehydrogenase mRNA in gastrocnemius muscle correlating with induced muscle disease (24). Caused pronounced bone-marrow depression with leucopenia 10-15 days after administration (25).

Other comments

Pharmacokinetics reviewed (26).

Incompatible with heparin sodium and possibly with aluminium salts, aminophylline, cephalothin sodium, methasone, fluorouracil and hydrocortisone (27).

Effects of cardiomyopathy, tumour radiotherapy and doxorubicin reviewed (28,29).

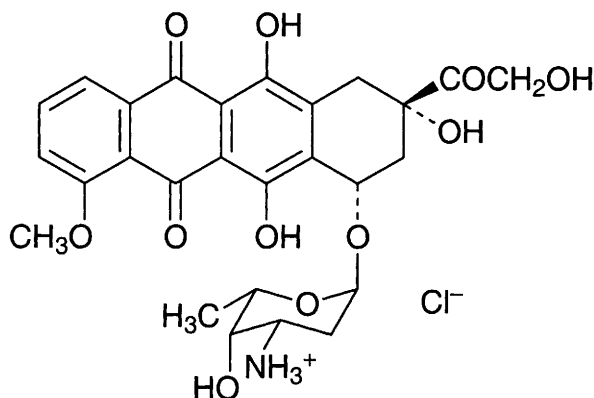
In vitro and *in vivo* experimental results on the effects of doxorubicin on interleukin-2 formation reviewed (30).

Antimitotic efficiency and resistance in chronic lymphocytic leukaemia reviewed (31,32).

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D597 doxorubicin hydrochloride



C₂₇H₃₀ClNO₁₁

Mol. Wt. 579.99

CAS Registry No. 25316-40-9

Synonyms 10-[(3-amino-2,3,6-trideoxy-α-L-lyxo-hexapyranosyl)oxy]-7,8,9,10-tetrahydro-6,8,11-trihydroxy-8-(hydroxyacetyl)-1-methoxy-5,12-naphthacenedione hydrochloride; 14-hydroxydaunomycin hydrochloride; Adriamycin hydrochloride; Adriablastina; Adriacin

EINECS No. 246-818-3

RTECS No. QI 9295900

Uses Antibiotic and antineoplastic agent.

Occurrence Isolated from *Streptomyces peucetius* var. *caesius*.

Physical properties

M. Pt. 204-205°C (decomp.)

Solubility Water: 2%. Organic solvents: ethanol, methanol

Environmental fate

Abiotic removal

Removal from clinical wastes was achieved by adsorption onto activated carbon. Adsorption increased with temperature (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse 700 mg kg⁻¹ (2).

LD₅₀ subcutaneous mouse, rat 8, 22 mg kg⁻¹, respectively (2,3).

LD₅₀ intraperitoneal mouse 11 mg kg⁻¹ (3).

LD₅₀ intraperitoneal rat 16 mg kg⁻¹ (4).

LD₅₀ intravenous rat, mouse, rabbit 6-21 mg kg⁻¹ (5,6).

Sub-acute and sub-chronic data

Injection rabbit 0.75 mg kg⁻¹ 3 × wk⁻¹ for 11 wk induced cardiomyopathy characterised by a 40-55% decrease in basal adenylyl cyclase activity in the ventricles (7).

Intraperitoneal mouse 15 mg kg⁻¹ inhibited the synthesis of DNA, RNA and protein in the heart, liver and kidney. Inhibiting effects were most marked in the heart and correlated with a decrease in the activities of lipid peroxidation preventing enzymes (8).

Intraperitoneal rat (30 day) 0.60-0.75 mg kg⁻¹ produced a considerable arrest of hair growth, with evidence of hair thinning after 30 days (9).

Carcinogenicity and chronic effects

Limited evidence for carcinogenicity to humans, sufficient evidence for carcinogenicity to animals, IARC classification group 2A (10).

Intravenous rat (1 yr) single injection of 8 mg kg⁻¹. 18/25 animals died within 1 yr and one developed a mammary cancer. Of the 7 survivors killed after 1 yr, 6 had mammary tumours (1 adenocarcinoma and 6 fibroadenomas). The mean induction time was 223 days. No tumours developed in 25 controls (11).

Teratogenicity and reproductive effects

Administration of 2.5-10 µg to 4.5 and 5 day embryonic chicks produced a dose-related increase in mortality rate and cardiovascular abnormalities (12).

Intraperitoneal rat 0, 1.0, 1.25 or 1.5 mg kg⁻¹ on days 10-12 of gestation induced alterations in the development of the renal papilla and growth retardation (13).

Metabolism and toxicokinetics

In mice, ³H-doxorubicin was rapidly bound to tissues following intravenous injection of 5 mg kg⁻¹. After 30 min tissue concentrations were 10 × greater than those in blood. 50% was excreted in 32 hr. Most of the radioactivity was excreted in the bile (14).

In rabbits, 17% of an intravenous dose of 5 mg kg⁻¹ was excreted in the bile and 2% in the urine within 8 hr. The principal metabolite was adriamycinol. There were also several conjugates. Some glycosidic cleavage was also reported to take place, particularly in the liver. Liver and kidney cytoplasmic enzymes reduce doxorubicin *in vitro* to adriamycinol in an NADPH-dependent reaction (15).

Genotoxicity

Salmonella typhimurium TA1538 without metabolic activation positive (16).

In vitro Chinese hamster V79 lung cells, gene mutation positive (17).

In vitro frog spermatocytes, induction of micronuclei positive (18).

In vitro human lymphocytes, sister chromatid exchanges and chromosomal aberrations positive (19).

In vivo rat, micronucleus test positive (20).

Other effects

Other adverse effects (human)

Clinical treatment impairs wound healing in patients (21).

In a large systematic follow up of patients with Hodgkin's disease treated with adriamycin and other chemotherapeutic agents (but no alkylating agent), results preliminary suggested no evidence of acute non-lymphocytic leukaemia in the first decade after therapy (22).

Can cause immunosuppressive activity (23,24).

Any other adverse effects

Intravesical instillation ♀ rats (4 wk) induced an increase in DNA synthesis associated with bladder epithelial hyperplasia characterised by elevated nuclear cytoplasmic ratios, cytomegaly and pleomorphism. These results indicated that the chemotherapy could itself play a possible role in the promotion of bladder carcinogenesis (25).

Other comments

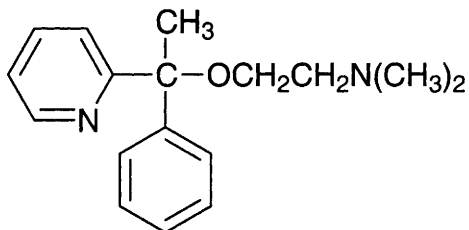
Physical properties, use, analysis, carcinogenicity and mammalian toxicity reviewed (26).

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D598 doxylamine



$C_{17}H_{22}N_2O$

Mol. Wt. 270.37

CAS Registry No. 469-21-6

Synonyms *N,N*-dimethyl-2-[1-phenyl-1-(2-pyridinyl)ethoxy] ethanamine; 2-[α -(dimethylamino)ethoxy]- α -methylbenzylpyridine; 2-dimethylaminoethoxyphenylmethyl-2-picoline; phenyl-(2-pyridyl methyl)- β -(*N,N*-dimethylamino)ethyl ether

EINECS No. 207-414-2

RTECS No. US 9250000

Uses Organic synthesis. Antihistamine and hypnotic drug.

Physical properties

B. Pt. 137-141°C at 0.5 mmHg

Mammalian & avian toxicity

Acute data

LD₅₀ oral rabbit, mouse 250, 470 mg kg⁻¹, respectively (1).

LD₅₀ subcutaneous rat, mouse 440, 460 mg kg⁻¹, respectively (1).

LD₅₀ intravenous rabbit, mouse 49, 62 mg kg⁻¹, respectively (1).

Sub-acute and sub-chronic data

Oral rat (38 day) 5, 15 or 45 mg kg⁻¹ 2 × day⁻¹ had no effect on food consumption, weight gain and haematological parameters, and caused no pathological changes in the tissues (1).

Teratogenicity and reproductive effects

Oral rabbit, rat 10, 30 or 100 mg kg⁻¹ day⁻¹ on day 9-16 of gestation. No teratogenic effects were observed in rats. Fused sternebrae and fused ribs were observed in treated rabbits, and the high-dose rabbits had reduced number of live foetuses per litter and increased foetal wastage (2).

Irritancy

4% solution instilled into rabbit eye no evidence of irritation or tissue damage (1).

Other effects

Other adverse effects (human)

In an evaluation of 109 cases of intoxication, no correlation was found between the amount ingested or plasma concentration and the frequency or extent of symptoms. The most common symptom was impaired consciousness. Psychotic behaviour, seizures and anti-muscarinic symptoms such as tachycardia and mydriasis were also observed. Rhabdomyolysis occurred in one patient and was accompanied by transient impairment of renal function (3).

Teratogenesis in humans has been attributed to therapeutic use of an antinauseant containing doxylamine (4).

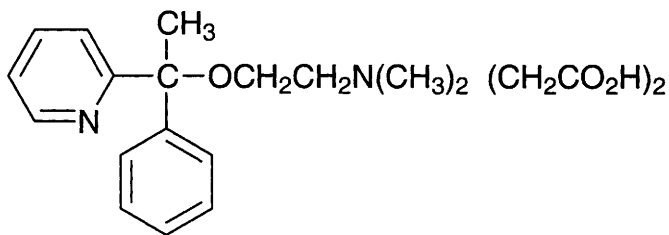
Other comments

Toxicity reviewed (4).

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D599 doxylamine succinate



C₂₁H₂₈N₂O₅

Mol. Wt. 388.46

CAS Registry No. 562-10-7

Synonyms butanedioic acid, compound with *N,N*-dimethyl-2-[1-phenyl-1-(2-pyridinyl)ethoxy]ethanamine (1:1); 2-[α -(2-dimethylaminoethoxy)- α -methylbenzyl] pyridine succinate; 2-dimethylaminoethoxyphenylmethyl-2-picoline succinate; Decapryn succinate; Unisom

EINECS No. 209-228-7

RTECS No. US 9275000

Uses Antihistamine.

Physical properties

M. Pt. 100-104°C

Solubility Organic solvents: benzene, chloroform, diethyl ether, ethanol

Mammalian & avian toxicity

Acute data

LD₅₀ oral rabbit, mouse 250, 470 mg kg⁻¹, respectively (1).

LD₅₀ intravenous rabbit, mouse 42-69 mg kg⁻¹ (1).

LD₅₀ subcutaneous rat, mouse 440-460 mg kg⁻¹ (1).

Sub-acute and sub-chronic data

Oral mouse for 14 days 0, 100, 250, 500, 1000 or 2000 mg kg⁻¹ diet, and 0, 80, 162, 325, 750 or 1500 mg kg⁻¹ diet for 90 days. In the 14-day study body weight was reduced in the high-dose group by 4% in ♂ and 7.3% in ♀ mice. In the 90-day study histologically the liver was the only organ affected. Hepatic cell cytomegaly and/or karyomegaly and a possible dose-related hepatic necrosis were reported (2).

Teratogenicity and reproductive effects

Oral rabbit 10 mg kg⁻¹ on days 8-15 of gestation induced a reduction in acetylcholine levels in the foetus and choline levels in the placenta (3).

Intramuscular marmoset 225-300 mg kg⁻¹ on days 1-7 of gestation resulted in abortion in four treated animals. A fifth animal which received 114 mg kg⁻¹ day⁻¹ on days 20-35 of gestation delivered one normal and two severely malformed foetuses (4).

Metabolism and toxicokinetics

Following oral administration to rats of 13.3 mg kg⁻¹ the cumulative urinary and faecal elimination of conjugated metabolites was 44.4 and 47.3% in ♂ and ♀ rats, respectively. For a dose of 133 mg kg⁻¹ recoveries were 55.2 and 47.9% in ♂ and ♀ rats, respectively. The conjugates identified were doxylamine O-glucuronide, N-desmethyldoxylamine O-glucuronide, and N,N-didesmethyldoxylamine O-glucuronide (5).

Genotoxicity

Salmonella typhimurium TA97, TA98, TA100, TA1535, TA1537 with and without metabolic activation negative (6).

In vitro primary rat hepatocytes, unscheduled DNA synthesis positive (7).

In vitro human lymphocytes, sister chromatid exchanges negative (8).

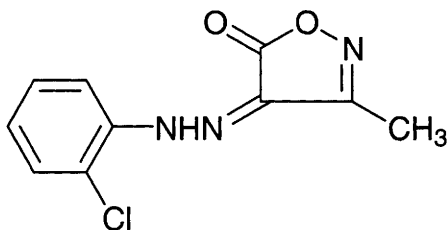
In vivo Chinese hamster bone marrow, induction of micronuclei negative (8).

In vivo mouse, transplacental exposure, induced a small dose-dependent induction of chromosome aberrations in embryos on day-11 of gestation, but no sister chromatid exchanges were induced (8).

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D600 drazoxolon



$C_{10}H_8ClN_3O_2$

Mol. Wt. 237.65

CAS Registry No. 5707-69-7

Synonyms 3-methyl-4,5-isoxazolidione, 4-(2-chlorophenyl)hydrazone; 3-methyl-4,5-isoxazolidione 4-[(*o*-chlorophenyl) hydrazone]; 4-(2-chlorophenylhydrazono)-3-methyl-1,2-oxazol-5-(4*H*)-one; Mil-Col
EINECS No. 227-197-8 **RTECS No.** NY 2800000

Uses Superseded insecticide and fungicide.

Physical properties

M. Pt. 167°C **Partition coefficient** $\log P_{ow}$ 2.6 (1) **Volatility** v.p. 4×10^{-6} mmHg at 30°C
Solubility Organic solvents: acetone, benzene, chloroform, ethanol, toluene

Occupational exposure

Supply classification toxic

Risk phrases Toxic if swallowed (R25)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – Do not breathe dust – Avoid contact with the skin – Wear suitable protective clothing and gloves – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S22, S24, S36/37, S45)

Ecotoxicity

Fish toxicity

LC₅₀ (96 hr) brown trout 0.55 mg l⁻¹ (1).

Mammalian & avian toxicity

Acute data

LD₅₀ oral chicken 100 mg kg⁻¹ (1).

LD₅₀ oral guinea pig, dog, rabbit, rat, mouse 12.5-25, 17, 100-200, 126, 129 mg kg⁻¹, respectively (2).

LD₅₀ intraperitoneal rat 20 mg kg⁻¹ (3).

LD₅₀ subcutaneous cat 50 mg kg⁻¹ (3).

LD₅₀ intravenous rabbit 20 mg kg⁻¹ (3).

Sub-acute and sub-chronic data

Oral rat (90 day) 30 mg kg⁻¹ diet caused no ill-effects (1).

Inhalation rat (15 day) 4 mg m⁻³ 6 hr day⁻¹ caused no observable toxic effect (2).

Sensitisation

May cause skin sensitisation (species unspecified) (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (4).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (5).
WHO Toxicity Class II (6).

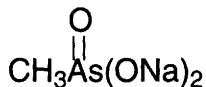
Other comments

Reviews on toxicity listed (7).

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D601 DSMA



$\text{CH}_3\text{AsNa}_2\text{O}_3$

Mol. Wt. 183.93

CAS Registry No. 144-21-8

Synonyms disodium methylarsonate; disodium monomethylarsonate; sodium methylarsonate; methanearsonic acid disodium salt; DSMA

EINECS No. 205-620-7

RTECS No. PA 2275000

Uses Herbicide.

Physical properties

M. Pt. 132-139°C B. Pt. 165°C Specific gravity 1.15

Solubility Water: 279 g l⁻¹ (anhydrous salt). Organic solvents: methanol, practically insoluble in most organic solvents

Occupational exposure

UK-LTEL MEL 0.1 mg m⁻³ (as As)

Supply classification toxic

Risk phrases Toxic by inhalation and if swallowed (R23/25)

Safety phrases Keep locked up and out of the reach of children (if sold to general public) – When using do not eat, drink or smoke – After contact with skin, wash immediately with plenty of water – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible) (S1/2, S20/21, S28, S45)

Ecotoxicity

Invertebrate toxicity

LD₅₀ (48 hr) *Daphnia* 77.5 mg l⁻¹ (1).

LD₅₀ oral bee, topical NOEL bee 68, 86 µg bee⁻¹, respectively (1).

Environmental fate

Degradation studies

MeAsO₃²⁻ applied to flooded rice field soils had a half-life of 11-28 days. In non-flooded rice field soils disodium methylarsonate was degraded more rapidly than ferric methanearsonate (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 2800 mg kg⁻¹ (technical grade) (3).

LD₅₀ oral rat 821 mg kg⁻¹ (4).

LD₅₀ dermal rabbit 10 g kg⁻¹ (5).

LD₅₀ intraperitoneal mouse ♂ 600 mg kg⁻¹, ♀ 681 mg kg⁻¹ (6,7).

LD₅₀ intraperitoneal ♂, ♀ rat 561 mg kg⁻¹ (6,7).

Teratogenicity and reproductive effects

TD_{Lo} intraperitoneal pregnant ♀ hamster (day 12 of gestation). Caused teratogenic effects (8).

Irritancy

Mild irritant to skin and eyes (rabbits) (1).

Genotoxicity

Gave negative results in DNA repair tests in *E. coli* and *B. subtilis*, in the *Salmonella*/microsome test, and in a *Saccharomyces cerevisiae* mitotic recombination assay (7,9).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (10).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (11).

US Food and Drug Administration tolerance for disodium methylarsonate residues on citrus fruit, 0.35 mg kg⁻¹ as As₂O₃ (12).

WHO Toxicity Class III (13).

EPA Toxicity Class III (formulation) (1).

Other comments

DSMA forms a hexahydrate.

A review of arsenic and arsenic compounds appears in the IARC Monograph Volume 23 (7).

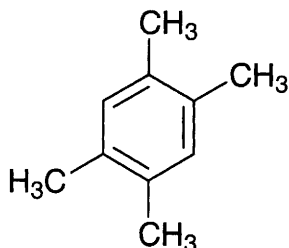
When heated to decomposition emits toxic fumes of NO_x and Na₂O.

Decomposed by strong oxidising and reducing agents.

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D602 durene



$C_{10}H_{14}$

Mol. Wt. 134.22

CAS Registry No. 95-93-2

Synonyms 1,2,4,5-tetramethylbenzene; Durol

EINECS No. 202-465-7

RTECS No. DC 0500000

Uses Chemical intermediate, particularly for plastics and polymers.

Occurrence In aromas of some foods, in crude oil.

Physical properties

M. Pt. 80°C B. Pt. 191-193°C Flash point 73°C Specific gravity 0.84 at 81°C with respect to water at 4°C

Partition coefficient $\log P_{ow}$ 4.10

Solubility Organic solvents: benzene, diethyl ether, ethanol

Ecotoxicity

Fish toxicity

Can cause narcosis in fathead minnows and guppies (1).

Invertebrate toxicity

The water soluble fraction of Algerian crude oil that contains the compound is toxic to *Phaeodactylum tricornutum* and in turn modifies the behaviour of *Trigriopus brevicornis* which feeds upon the algae (2).

Environmental fate

Adsorption and retention

No adsorption to smectite clay particles was observed at a concentration of 10 $\mu\text{g l}^{-1}$ under experimental conditions (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat 6.98 g kg^{-1} (3).

LD₅₀ intravenous mouse 180 mg kg^{-1} (4).

Legislation

The $\log P_{ow}$ value exceeds the European Community recommended level 3.0 (6th and 7th amendments) (5).

Other comments

As a pollutant in lake water (6), landfill sites (7), urban air (8), and tobacco smoke (9).

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D603 dymron



$C_{17}H_{20}N_2O$

Mol. Wt. 268.36

CAS Registry No. 42609-52-9

Synonyms *N*-(4-methylphenyl)-*N'*-(1-methyl-1-phenylethyl)urea; 1-(α,α -dimethylbenzyl)-3-(4-methylphenyl)urea; 1-(1-methyl-1-phenylethyl)-3-*p*-tolylurea; 1-(α,α -dimethylbenzyl)-3-*p*-tolylurea; daimuron; **RTECS No.** YT 8602500

Uses Herbicide.

Physical properties

M. Pt. 203.4°C **Specific gravity** 1.108 at 20°C **Partition coefficient** $\log P_{ow}$ 2.7 (1) **Volatility** v.p. 3.41×10^{-9} mmHg at 25°C

Solubility Water: 1.7 mg l⁻¹ at 20°C. Organic solvents: acetone, benzene, hexane, methanol

Ecotoxicity

Fish toxicity

LC₅₀ (48 hr) carp >300 mg l⁻¹ (1).

Environmental fate

Degradation studies

In paddy field soil, $t_{1/2} \approx 50$ days (2).

Abiotic removal

Stable to heat and light at pH 4-9 (2).

Mammalian & avian toxicity

Acute data

LD₅₀ oral rat, mouse 6130-6830 mg kg⁻¹ (3).

LC₅₀ (4 hr) inhalation rat 3250 mg m⁻³ (2).

LD₅₀ dermal rat, mouse >3500 mg kg⁻¹ (4).

LD₅₀ subcutaneous rat, mouse 7600-7810 mg kg⁻¹ (3).

Sub-acute and sub-chronic data

Oral rat, mouse (90 day) no-adverse-effect level established as 3550 mg kg⁻¹ day⁻¹ for ♂ rats, 3950 mg kg⁻¹ day⁻¹ for ♀ rats and 6300 mg kg⁻¹ day⁻¹ for mice (1).

Teratogenicity and reproductive effects

Oral rat, three-generation study, non-teratogenic at 10 g kg⁻¹ diet (1).

Legislation

Limited under EC Directive on Drinking Water Quality 80/778/EEC. Pesticides: maximum admissible concentration 0.1 µg l⁻¹ (5).

Included in Schedule 6 (Release into Land: Prescribed Substances) Statutory Instrument No. 472, 1991 (6).

WHO Toxicity Class Table 5 (7).

ADI 0.3 mg kg⁻¹ body weight (2).

Other comments

Metabolic pathways reviewed (8).

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D604 dysprosium

Dy

Dy

Mol. Wt. 162.50

CAS Registry No. 7429-91-6

EINECS No. 231-073-9

Uses Marking and imaging agent. Oxide is used in control rods of some nuclear reactors.

Occurrence Rare earth metal, yttrium group. Abundance in earth's crust 4.5-7.5 ppm.

Exists as the chloride, oxide or sulfide. Occurs as a trace element in phosphate rock and fertilisers (1).

Physical properties

M. Pt. 1407°C B. Pt. 2567°C Specific gravity 8.559

Mammalian & avian toxicity

Acute data

LD₅₀ oral mouse: nitrate 3100 mg kg⁻¹; chloride 7650 mg kg⁻¹ (2,3).

LD₅₀ intraperitoneal mouse: nitrate 300 mg kg⁻¹; chloride 590 mg kg⁻¹ (2,3).

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