

Chapter 16

SOLUBILITY IN WATER CONTAINING SALT

Carl L. Yaws
Lamar University, Beaumont, Texas

ABSTRACT

Results for variation of water solubility with salt concentration are presented for 217 hydrocarbons. The results for solubility in salt water are applicable for the complete range of salt concentrations including water without salt ($X=0$) to water saturated with salt ($X=358,700$ ppm(wt)). Correlation and experimental results are in favorable agreement. The results are provided in an easy-to-use table that is especially applicable for rapid engineering usage with the personal computer or hand calculator.

INTRODUCTION

Physical and thermodynamic property data are required for the design and operation of industrial processes. In particular, the water solubility of substances is becoming increasingly important because of more and more stringent regulations regarding health, safety and environment.

In this article, results are presented for water solubility of hydrocarbons. The results are applicable for the complete range of salt concentrations including water without salt to water saturated with salt. The results are intended for use in initial engineering and environmental applications. As an example of such usage, solubility values issuing from the correlation are useful in determining the distribution of a hydrocarbon spill upon its contact with seawater. Solubility values at other salt concentrations may also be ascertained.

SALT WATER SOLUBILITY CORRELATION

The correlation for solubility of hydrocarbons in water containing salt is based on a series expansion in salt concentration:

$$\log_{10} S = A + B X + C X^2 \quad (16-1)$$

where S = solubility in salt water at 25 C, parts per million by weight, ppm(wt)
 X = concentration of salt (NaCl) in water, parts per million by weight, ppm(wt)
 A, B and C = correlation constants

The correlation constants (A, B and C) are given in Table 16-1. The correlation constants in the table were determined from regression of data for water solubility. Both experimental values for the property under consideration and parameter values for estimation of the property are included in the source publications (1-193). The presented values are applicable to a wide variety of hydrocarbons (alkanes, naphthenes and aromatics with no, single and multiple substitutions). The tabulation is arranged by carbon number (C_5, C_6, C_7, \dots) for ease of use in quickly locating data using the chemical formula.

The tabulated values for solubility of hydrocarbons in water apply to conditions of saturation in which the hydrocarbon is in equilibrium with water. For saturation, the system pressure is approximately equal to the sum of vapor pressures of hydrocarbon and water.

A comparison of correlation and actual experimental data values for water solubility is shown in Figures 16-1, 16-2 and 16-3 for representative hydrocarbons (pentane, methylcyclopentane and benzene). In the figures, solubility values are plotted at salt concentrations ranging from water without salt to water saturated with salt. The graphs disclose favorable agreement of correlation and experimental data.

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REFERENCES – ORGANIC COMPOUNDS

- 1-190. See **REFERENCES – WATER SOLUBILITY - ORGANIC COMPOUNDS** in **Chapter 15 SOLUBILITY IN WATER AND OCTANOL-WATER PARTITION COEFFICIENT**
191. Yaws, C. L., Pollution Engineering, 14, 46 (Sept. 15, 1992).
192. Yaws, C. L. and X. Lin, Pollution Engineering, 26, 70 (January, 1994).
193. Yaws, C. L. and X. Lin, Pollution Engineering, 27, 78 (June, 1995).