

Experimental Study on the Interfacial Tension and Density of Water + Branched Hydrocarbon Systems as a Function of Temperature

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Experimental data on the interfacial tension of binary systems composed of water and branched hydrocarbons were obtained using the pendant drop method. In this study, structural isomers of hydrocarbons with molecular formulas C_6H_{14} , C_7H_{16} , and C_8H_{18} (2-methylpentane, 3-methylpentane, 2,3-dimethylpentane, 2,2,4-trimethylpentane and 2,3,4-trimethylpentane) were used. The temperatures at which the experiments were carried out were the following: 303.15, 313.15, 323.15, 333.15, and 343.15 K. The uncertainty in the experimental interfacial tension data is $\pm 0.1 \text{ mN}\cdot\text{m}^{-1}$. As for the measurement of the interfacial tension by the pendant drop method, values for the density of both saturated liquid phases are needed, and therefore an experimental apparatus for reaching the liquid-liquid equilibrium and also for sampling was developed. This apparatus allowed the on-line sampling and analysis of both liquid phases to measure the corresponding density values with an uncertainty of $\pm 0.005 \text{ kg}\cdot\text{m}^{-3}$.

The behaviors shown by the two different properties included in this work are in complete agreement to what is expected, i.e., the interfacial tension as well as the density decrease with increasing temperature. Considering that density values were obtained for both saturated liquid phases, the behavior observed for this property for the water rich liquid phase was almost the same in the temperature range studied for the different systems included in this work. For the hydrocarbon rich liquid phase, the density values increase with increasing number of carbon atoms in the molecule: for the isomers with six carbon atoms, density values show an average difference of $11.62 \text{ kg}\cdot\text{m}^{-3}$ with an standard deviation of $0.3 \text{ kg}\cdot\text{m}^{-3}$ between 2-methylpentane and 3-methylpentane, where the density was greater for the isomer with the methyl group on carbon number 3; for the isomers with 8 carbon atoms, the average density difference was $27.9 \text{ kg}\cdot\text{m}^{-3}$ with a standard deviation of $1.2 \text{ kg}\cdot\text{m}^{-3}$. Again, the density along the temperature range covered is greater for the isomer with a methyl groups on carbon number 3. In contrast, interfacial tension differences were 0.09 and $1.69 \text{ mN}\cdot\text{m}^{-1}$, with standard deviations of 0.08 and 0.42 , respectively, for the same C_6 and C_8 isomer pairs.