

Influence of Impurities on the Liquid Viscosity and Interfacial Tension of Fischer-Tropsch Model Systems by Surface Light Scattering

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At present, the Fischer-Tropsch process receives revitalized interest for the synthesis of high-value fuels. For product design and modeling, reliable data for the viscosity and interfacial tension of representative fluid systems involved in the process are required. Besides the production of n-alkane systems of different chain lengths, a large variety of impurities can be formed in side-reactions. Thus, information on the impact of process-relevant impurities on the thermophysical properties is needed but scarcely available in the literature. The present contribution aims to study the influence of different impurities with varying chain length, branching, or degree of oxygenation on liquid viscosity and interfacial tension of binary and ternary mixtures based on the solvent n-octacosane. Here, the isomers n-dodecane, 2-methylnonane, and 4-methylnonane were used to study the effect of branching for alkanes with the same molecular weight. The n-alcohols ethanol and 1-dodecanol as well as the acids formic acid and acetic acid were selected to investigate the impact of the alkyl chain length and degree of oxygenation. Based on surface light scattering analyzing microscopic surface fluctuations at macroscopic thermodynamic equilibrium, the viscosity and interfacial tension of the binary and ternary mixtures could be accessed close to saturation conditions at temperatures between (393 and 473) K and total mole fractions of the impurities between (0.025 and 0.8) with typical expanded measurement uncertainties of 2 %. Except for systems containing the two branched alkanes showing a distinct decrease in the interfacial tension even at low mole fractions of 0.025, viscosity and interfacial tension are not significantly affected with increasing concentration of the impurity compared to the values for the pure n-octacosane. Simple mixing rules for liquid viscosity and interfacial tension of the binary and ternary mixtures using the corresponding properties of the pure components are discussed.