Viscosity and Density Measurements of Squalane with Dissolved Methane [$x CH_4 + (1-x) C_{30}H_{62}$] at HTHP Conditions

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In order to fully understand and model the flow of hydrocarbons in important oil and gas processes such as enhanced oil recovery and carbon capture and storage, reliable transport properties data of asymmetric fluid mixtures at high-temperature and high-pressure (HTHP) reservoir conditions are required. In this research, we have measured simultaneously the viscosity and density of the asymmetric binary mixtures of squalane with dissolve methane at different compositions under HTHP conditions. The measurements were conducted using a bespoke vibrating-wire viscometer-densimeter (VWVD) and have an estimated expanded uncertainty of 2% in viscosity and 0.2% in density. The measurements were made at a wide range of temperatures, (323.15 to 448.15) K, and at pressures up to 200 MPa. The VWVD device was operated in an absolute manner in relation to the determination of viscosities. To facilitate this mode of operations, the radius of the centreless-ground tungsten wire was measured accurately with a laser micrometer. In relation to the density measurements, a single point calibration was required and this was carried out in n-nonane at T = 298.15 K and p = 0.1 MPa. The density results have been correlated with a modified Tait [1] equation, whereas the viscosity results are compared with the predictions of the hard sphere model of Dymond and Assael [2, 3] within its range of validity. Once again the results show clearly that dissolution of methane in squalane leads to both a dramatic reduction in the viscosity and a small increase in the density of the latter.

References

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[3] Assael, M.J., et al., *Correlation and prediction of dense fluid transport coefficients. III. n-alkane mixtures.* International Journal of Thermophysics, 1992. 13(4): p. 659-669.