

A New Viscosity-Surface Correlation for Propane

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The exact knowledge of thermophysical properties of fluids with industrial importance is needed for a more accurate basic design of compressors, gas turbines, and gas pipelines. In contrast to thermodynamic properties, transport properties of propane, particularly in the region near to the critical point, are not sufficiently well known. The current NIST standard data base REFPROP 9.1 of Lemmon et al. (2013) recommends the viscosity correlation of Vogel et al. (1998), which is characterized by uncertainties of $\pm(2.5-4)\%$ in their range of validity. This viscosity-surface correlation was based on an outdated equation of state of Younglove and Ely from 1987, whereas REFPROP 9.1 recommends the reference equation of state of Lemmon et al. (2009) for thermodynamic properties of propane.

Recently, new very accurate viscosity measurements were performed by Seibt et al. (2011) using a vibrating-wire viscometer combined with a single-sinker densimeter. The uncertainty of these data was conservatively estimated to be $\pm(0.25-0.4)\%$, increasing with temperature. Consequently, they are considered to be primary data. In addition, viscosity measurements by Wilhelm et al. (2001) were re-evaluated (2011) and have to be considered as primary data, too.

Based on the new reference equation of state and on the improved data situation in the dense-gas region, a new viscosity-surface correlation for propane was generated using the structure-optimisation method by Setzmann and Wagner (1989). The bank of terms comprises expressions for different regions: the limit of zero density, the higher-density fluid region, and the near-critical range. Calculated values using the new viscosity-surface correlation were compared with the primary data sets, which were used in the development of the correlation. In addition, the correlated values were compared with values resulting from the earlier viscosity-surface correlations of Vogel et al. (1998) and of Scalabrin et al. (2006).