Simultaneous Measurements of Viscosity and Density of Isobutane Covering Wide Ranges of Temperature and Pressure and the Near Critical Region Using a Vibrating-Wire Viscometer and a Single-Sinker Densimeter

Sebastian Herrmann [C, S], Daniel Buttig and Eckhard Vogel
Institute of Chemistry, University of Rostock, Rostock, Germany

Egon Hassel
Department of Technical Thermodynamics, University of Rostock, Rostock, Germany

The exact knowledge of thermophysical properties of fluids of industrial importance is needed for a more accurate basic design of compressors, gas turbines, and gas pipelines. In contrast to the thermodynamic properties, the transport properties of isobutane, particularly in the region near to the critical point, are not sufficiently precisely known. Hence new accurate experiments are needed for the improvement of the current viscosity surface correlation. Further, density values obtained simultaneously with the viscosity measurements could be used for the test and a possible refinement of the best available equation of state of isobutane which is characterized by uncertainties of ±0.5 % in pressure in the near critical region. The experimental equipment combining a vibrating-wire viscometer and a single-sinker densimeter enables simultaneous high-precision measurements of viscosity and density of gases in large ranges of temperature and pressure. Isothermal series of measurements have been performed in the temperature range between 298 K and 473 K and at pressures either up to 90 % of the saturation pressure in the case of a subcritical isotherm or up to 30 MPa. In general, the viscosity measurements are characterized by an uncertainty of ±0.25 % to ±0.4 %. The uncertainty of the density measurements is estimated to be less than ±0.1 %, except for the near critical region as well as for the low-density range due to the single-sinker method. The reproducibility of the measurements amounts to ±0.05 %, for viscosity and density. The new experimental density values are compared with the equation of state by Bücker and Wagner (2006) and with other experimental data from the literature. Analogously the new viscosity data are assessed in comparison with the viscosity surface correlation by Vogel *et al.* (2000) and with the best experimental viscosity values available in the literature.