Viscosity Measurements of the Methane/Ethane System over wide Density and Temperature Ranges

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The viscosity of pure methane and ethane as well as of three (methane + ethane) mixtures was measured over the temperature range from (253 to 473) K with pressures up to 2 MPa utilizing a rotating-body viscometer. Herewith, the viscosity is determined relative to helium on the basis of the decay rate of a slender cylindrical body, which is vertically levitated by a magnetic suspension coupling and which rotates inside a pressure-tight measuring cell. The same instrument was recently used in our group to accurately measure the viscosity of pure carbon dioxide, nitrogen, and their mixtures [1, 2]. The compositions of the three binary gas mixtures were approximately 0.25, 0.50, and 0.75 mole fraction ethane and were checked through highly accurate density measurements. The relative expanded combined uncertainty (k = 2) was estimated to be between (0.2 and 0.5) % for the pure fluids and slightly higher for the mixture data. The new experimental data for methane and ethane are in good agreement with current experimental literature data and recent *ab initio* calculations. For the binary mixture data, maximum deviations of 0.74 % from values calculated with an Extended Corresponding States model implemented in the NIST REFPROP 9.1 database [3] were observed in the limit of zero density. In addition to the low-pressure viscosity measurements, a combined viscometer-densimeter was modified and recommissioned. Applying a revised measurement procedure, first viscosity and density measurements for the (methane + ethane) system in the same temperature range (253 K to 473 K) but with pressures up to 20 MPa were carried out.

References:

[1] M. Schäfer, M. Richter, R. Span, J. Chem. Thermodyn. 89 (2015), 7-15.
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[3] J.C. Chichester, M.L. Huber, Documentation and Assessment of the Transport Property Model for Mixtures Implemented in NIST REFPROP (Version 8.0), NIST, Boulder, 2008