Viscosity measurements on gaseous ethane

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The viscosity coefficient of gaseous ethane which belongs to the main constituents of natural gas was measured with a vibrating-wire viscometer of very high precision. The measurements were performed along two subcritical isotherms at (290 and 300) K and along six supercritical isotherms at (310, 320, 340, 370, 400, and 430) K. The subcritical isotherms were restricted up to 88 % of the saturated vapor pressure. The maximum pressure for the supercritical isotherms was 30 MPa. The gas densities needed for the evaluation of the measuring values were calculated using an equation of state by Span and Wagner [1]. In general, the measurements are characterized by a reproducibility of ± (0.05 to 0.1) %, whereas the total uncertainty is estimated to be ± (0.25 to 0.4) %. However, close to the critical point, the uncertainty is increased, mainly due to the uncertainty of the density. This concerns the 310 K isotherm, next to the critical temperature $T_c = 305.322$ K, in the reduced density range $0.7 \leq \delta \leq 1.3$ ($\delta = \rho/\rho_c$ with the critical density $\rho_c = 6.8569$ mol·l^{-1}).
The viscosity values of the isotherms were correlated as a function of the reduced density using a power series representation restricted to the sixth or a lower power depending on the density range considered. The new data are very accurate and appropriate to test the viscosity surface correlations available for ethane in the literature. The correlations by Friend et al. [2] and by Hendl et al. [3] are essentially based on the same experimental data. The comparison with both correlations shows deviations up to about -5 % with a maximum at $\rho \approx 4$ mol·l^{-1} for the lower isotherms, whereas the differences decrease with increasing temperature up to about -2 %. In addition to the test of the correlations themselves, the new values are compared with direct experimental data used for the generation of the surface correlations [3, 4]. We believe that the new experimental data are most suitable for the improvement of the viscosity surface correlation of ethane which is of importance for the further development of the calculation procedures for the viscosity of natural gas.

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