Reference Correlation for the Viscosity of CO_2

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A re-correlation of the viscosity of carbon dioxide CO_2 had become necessary for several reasons. First and most importantly, because new experimental data for the highly compressed liquid had been published which are not represented by the most recent formulation of Fenghour *et al*. [1]. Second, new results were published for the viscosity in the limit of zero density and for the dilute to moderately dense gas region down to near the triple point temperature. Third, Vogel reanalyzed the measurements his group had carried out in 1986 and 1993 based on recent reference viscosities. Finally, the last two correlations of Fenghour *et al*. and of Vesovic *et al*. [2] did not include the measurement results of Berg and Moldover [3] for the critical enhancement of the viscosity of CO_2. An as complete as possible compilation of the available data for the viscosity of CO_2 was attempted in this work. CO_2 is one of the most often measured fluids and the first viscosity measurements were carried out in 1846. While several of the legacy data sets are burdened with systematic uncertainties, many of them were obtained with extreme care and are in remarkable agreement with more recent measurements. A new set of data considered most reliable was assembled taking into account the theoretical advances of van den Berg and colleagues in the early 1990s regarding compressible laminar flow in capillary viscometers. The correlation was developed in two ways, both assisted by symbolic regression. The more conventional approach led to a formulation that represents the selected data with fewer adjustable parameters over a wider range of temperature and pressure and extrapolates in a physically meaningful manner. The more interaction-oriented approach uses the Frenkel-line for the transition between gas-like and liquid-like viscosity behavior. Both formulations have the potential to be models for future wide-ranging viscosity correlations for other fluids.

References

[1] A. Fenghour *et al*., J. Phys. Chem. Ref. Data **27**(1998)1, 31-44.
[2] V. Vesovic *et al*., J. Phys. Chem. Ref. Data **19**(1990)3, 763-808.
[3] R. F. Berg, M. R. Moldover, J. Chem. Phys. **93**(1990)3, 1926-1936.