Entropy Scaling of Viscosity IV: Application to 124 Industrially Important Fluids

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In our previous work (J. Chem. Eng. Data 2021, 66, 1385–1398 and Int. J. Thermophys. 2022, 43, 183), a residual entropy scaling (RES) approach was developed to link viscosity to residual entropy (a thermodynamic property calculated with an equation of state) using a simple polynomial equation for 124 industrially important fluids. The studied fluids contain a considerable variety from light gases (hydrogen and helium) to dense fluids (e.g., heavy hydrocarbons) and fluids with strong association (e.g., water). The 4-term polynomial equation consisting of global and fluid-specific parameters was developed by manually adapting the equation structure and global parameters and choosing the one that best fits the approximately 50000 well-evaluated experimental data points. The average of the absolute value of relative deviations (AARD) of these experimental data from the RES model prediction is approximately 3.36%, which is still higher than the 2.84% obtained with the various multi-parameter models in REFPROP 10.0. In the present work, a polynomial equation was developed by iteratively fitting the global (fluid-independent power terms) and local parameters (fluid-specific and group-specific coefficients), and screening the data. The resulting equation has the same general structure as the previous one but uses only three terms instead of four. Most notably, the AARD of the experimental data from the RES model predictions is reduced to 2.80%; this is at the same level as (or even less than) the best previous fit with the various multi-parameter models in REFPROP 10.0. A software package written in Python will be provided for users to apply our model.