Development of Generalized Expressions to Describe the Liquid Viscosity of *n*-Alcohols and *n*-Alkanes from a Cubic Equation of State and Different Viscosity Theories

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In this work, some viscosity models available in the literature are coupled with a cubic equation of the state (EoS) to develop simple and generalized models that can describe the viscosity of alkanes and alcohols. The viscosity models selected are those proposed by Derevich, Liu et al. and the free volume theory. For the cubic EoS, a modified Peng-Robinson EoS proposed recently by the authors is selected. The present study is performed in the pressure range between 0.1 to 70 MPa for the liquid phase. In the first place, the capability of the cubic EoS to describe the thermodynamic properties that appear in the different viscosity models is evaluated. The properties are the compressibility factor, density, enthalpy, and residual molar Helmholtz free energy. In general, results are adequate; the average deviations calculated correspond to 1.29 % for the density, 0.48 % for the residual molar Helmholtz free energy, and 0.88 % for the residual enthalpy. In second place, for a fixed viscosity model, the parameters of the model are generalized in terms of the normal boiling point. The generalized expressions are estimated by fitting the experimental data for a group of alkanes or alcohols. Substances between methane and decane are selected for alkanes; also alcohols between methanol and decanol are used. In summary, the results obtained with the equations of Derevich, Liu et al. and the free volume theory are 3.13 %, 6.39 %, and 4.42 % for alkanes and 11.55 %, 6.90 %, and 13.80 % for alcohols. On the other hand, to validate the generalized expressions, some predictive calculations are performed for alkanes between dodecane and octadecane. Calculations, also include dodecanol, tetradecanol, and hexadecanol. In total 2325 viscosities are predicted with the models applied in this research. The average deviations obtained with the equations of Derevich, Liu et al. and the free volume theory are 4.89 %, 3.96 %, and 5.07 %. for alkanes and 13.50 %, 12.62 %, and 10.34 % in the alcohol case. Finally, to compare all the models, a one-way analysis at 95.0 % of confidence level is performed. The results show that there is not a statistical difference between the models of Derevich, Liu et al. and the free volume theory. In conclusion, the viscosity model recommended in this research is the free volume theory; this model has a low viscosity deviation and only three adjustable parameters that can be generalized, and it only requires a single thermodynamic property.