# Thermophysical Property Model of Lubricant Oils and Their Mixtures with Refrigerants

Xiaoxian Yang[1, S] and Markus Richter[1, C]

[1]*Applied Thermodynamics, Chemnitz University of Technology, Chemnitz, Germany*
*m.richter@mb.tu-chemnitz.de*

In our previous work (Ind. Eng. Chem. Res. 2023, 62, 18736-18749), a modeling approach was developed to calculate all the essential thermophysical properties, including density, phase behavior, heat capacity, entropy, enthalpy, viscosity, and thermal conductivity, of lubricant oil. This approach treats oil as a quasi-pure fluid, sets up a simple set of equations for the essential properties, and develops a parameter-fitting procedure using a minimal set of experimental data (fewer than 20 and at least 12 data points). This approach can be easily extended for mixture (e.g., oil + refrigerant) property prediction. Calculations using this approach generally agree with experimental data within the same level of uncertainty, but deviations reach up to 3% of quasi-pure oil density, 5% of the mixture density, and several hundred percent of the mixture viscosity. The comprehensive experimental thermophysical property data of quasi-pure oils and oil + refrigerant mixtures were collected from published literature to improve this approach. Then, a new cubic equation of state recently developed by Yang and Richter was adopted to replace the originally used Patel-Teja-Valderrama (PTV) EoS. As a result, for density, relative deviations were down to approximately 1% for quasi-pure oil and generally 3% for mixtures. A van der Waals (vdW) type mixing rule containing one adjustable parameter, which could be fitted to experimental data, is applied to the mixture's viscosity prediction using the residual entropy scaling approach. The relative deviations could be significantly reduced; however, they are still at the level of a few tens up to a hundred percent. Careful evaluations of the mixtures' viscosity data revealed that the experimental uncertainty might be higher than expected, and there is an apparent lack of high-quality viscosity data of oil + refrigerant mixtures.