Thermal Conductivities and Viscosities of Binary Mixtures Containing Hydrofluorocarbons and Hydrofluorolefins: Measurement and Modelling

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Hydrofluorolefins (HFOs) are a new class of more environmentally-friendly refrigerant with zero ozone depletion potential, low global warming potentials, and low flammability. In this work, transport property data for equimolar mixtures of HFOs (specifically R1234yf and R1234ze(E)) and hydrofluorocarbons (R125, R134a, R143a, and R152a) are presented. The following were measured:

- Liquid and vapor thermal conductivities of seven equimolar mixtures: R1234ze(E) + [R125, R143a, R1234yf]; R1234yf + [R125, R134a, R143a]; and R125 + R152a by the transient hot wire method at temperatures between (260 and 304) K and pressures between (870 and 14100) kPa. The standard uncertainty of the measured thermal conductivities was about 2 %.

- Liquid and vapor viscosities of five equimolar mixtures of: R1234ze(E) + [R125, R143a, R1234yf]; R1234yf + R143a; and R125 + R152a by vibrating wire viscometry at temperatures between (252 and 403) K and pressures between (910 and 4000) kPa. The standard uncertainty of the measured viscosity was about 2 %.

Our measurements were combined with the literature data available for these binary mixtures to optimize the mixture parameters in the transport property models used in NIST REPFROP 9.1 and thereby improve transport property predictions of mixtures of HFO and HFC refrigerants. Significant improvements in the predicted properties were achieved, for example, the average deviation of the viscosity model for R1234yf + R1234ze(E) from the data was reduced by a factor of 4. These measurements and modelling should allow for more accurate simulations of refrigeration processes using mixtures of these compounds.