Thermophysical Properties of a Quaternary Refrigerant Mixture: Comparison of Dynamic Light Scattering Measurements with a Simple Prediction Method

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Over the past years we have presented the determination of thermal diffusivity, sound speed, viscosity, and surface tension of the refrigerant mixtures R507, R404A, R410A, and R407C using dynamic light scattering (DLS) [1,2]. We also focused our investigations on binary mixtures of R125 and R143a with different compositions [3]. Beside a test of the applicability of the DLS-technique to binary and ternary mixtures and an improvement of the data situation for refrigerant mixtures of technical importance, our interest was directed to the comparison of experimental results with simple prediction methods. These results have suggested that the mixture data can be best represented and predicted by the mass weighted sum of the pure component data expressed as functions of the reduced temperature. In contrast to other prediction schemes, the proposed allows the calculation of thermophysical properties without adjustable parameters up to the critical point even if the critical temperature of one of the pure components is exceeded.

The motivation for further experimental investigations of a quaternary refrigerant mixture of 20 mass % R125, 30 mass % R143a, 25 mass % R134a, and 25 mass % R32 by DLS was based on the question whether this simple approach can also be used for the prediction of multi-component mixtures with different types of components. Furthermore, it should be shown if a simplification of the prediction procedure is possible by introducing the concept that also binary or ternary mixtures can form the components of a multi-component mixture. For the quaternary mixture, thermal diffusivity, sound speed, viscosity, and surface tension have been investigated for the liquid phase under saturation conditions over a wide temperature range from 243 K and up to the liquid-vapor critical point, and the results are compared to the preferred prediction method. Once again, but this time only for the properties sound speed, liquid viscosity, and surface tension, the best agreement with the simple prediction method was obtained by a mass weighted sum of the pure component data expressed as functions of the reduced temperature. For the thermal diffusivity, however, better results could be obtained by weighting with both mass fraction and molar mass. A simplification of the prediction method regarding the substitution of single mixture components by binary or ternary mixtures could be confirmed.

[1] A.P. Fröba, S. Will, and A. Leipertz, *Int. J. Thermophys.* **22**, 1349 (2001).
[2] A.P. Fröba and A. Leipertz, *Int. J. Thermophys.* **24**, 1185 (2003).
[3] A.P. Fröba, H. Kremer, and A. Leipertz, *Int. J. Thermophys.* **25**, 1115 (2004).