Thermophysical Properties of a Refrigerant Mixture of R365mfc (1,1,1,3,3-Pentafluorobutane) and Galden HT 55 (Perfluoropolyether)

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This work presents an experimental study on various thermophysical properties of a new refrigerant mixture of 65 mass % R365mfc (1,1,1,3,3-pentafluorobutane) and 35 mass % Galden HT 55 (Perfluoropolyether), whose azeotropic character was confirmed in the present investigations. Its use as possible working fluid in various cycle processes with phase change at elevated temperatures, e.g., in high-temperature heat-pump systems is being considered. Neither equilibrium data nor transport properties could be found in the literature for this mixture. The aim of this work was to contribute to a reliable data base for this system.

Experimental data are presented over a wide temperature range from about 253 to 523 K using light scattering techniques. Light scattering from bulk fluids has been applied for measuring both the thermal diffusivity and the speed of sound in the liquid and vapor phases under saturation conditions from 293 K and up to the liquid-vapor critical point at 450.7 K. Furthermore, the speed of sound has been measured for the superheated vapor phase along nine isotherms between 393 and 523 K up to a maximum pressure of about 2.5 MPa. For temperatures between 253 and 413 K, light scattering by surface waves on a horizontal liquid-vapor interface has been used for the simultaneous determination of surface tension and kinematic viscosity of the liquid phase. With the light scattering techniques, uncertainties of less than 2.0 %, 0.5 %, 1.5 %, and 1.5 % have been achieved for the thermal diffusivity, sound velocity, kinematic viscosity, and surface tension, respectively.

Beside vapor pressure measurements from 304 to 448 K, thermal conductivity and density have been determined by conventional techniques. The thermal conductivity was measured in the liquid phase near saturation conditions at temperatures between 258 and 328 K using a parallel plate instrument with an inaccuracy of less than 5 %. The density was measured between 273 and 443 K using a vibrating tube method. Here, measurements have been performed in the liquid phase under saturation conditions as well as for the superheated vapor up to a maximum pressure of about 3 MPa with an uncertainty of less than 0.1 %. The critical data was derived by combining the data obtained by different techniques. The results of this work represent, to the best of our knowledge, the first data sets published for the azeotropic mixture of R365mfc and Galden HT 55.