Prediction of Thermodynamic Properties of Refrigerant Mixtures from Extended Corresponding States and Speed of Sound Measurements

P.H. Stanley, J.P.M. Trusler and W.A. Wakeham
Department of Chemical Engineering and Chemical Technology
Imperial College of Science Technology and Medicine
Prince Consort Road
London, SW7 2BY United Kingdom

The speed of sound has been measured by means of a spherical acoustic resonator in the refrigerants R134a (1,1,1,2-Tetrafluoroethane), R32 (Difluoromethane) and R125 (Pentafluoroethane) and their binary mixtures. The measurements were made in the gas phase over the temperature range 240 K to 400 K and at densities up to the lower of 80 per cent of the saturated-vapor density and one quarter of the critical density. The speed of sound data will be compared with experimental results from other workers and the equations of state of Tillner-Roth and Baehr (R134a and R32) and Outcalt and McLinden (R32 and R125).

The experimental results have been used to investigate the feasibility of determining binary interaction parameters in a mixture model from speed-of-sound data. In this work, an extended corresponding states model incorporating van der Waals one-fluid mixing rules was employed. R134a was the reference fluid and its properties were calculated from the equation of state of Tillner-Roth and Baehr. Molecular shape factors for R32 and R125 were deduced from the speed of sound and other experimental data for the pure fluid. For the mixtures, binary interaction parameters were fitted to the experimental mixture speeds of sound by means of a non-linear regression analysis. The model gives a good representation of the experimental speeds of sound on which it is based and its predictive capability has been tested by means of a comparison between calculated and experimental VLE data. The results of this comparison will be presented.

This work is supported by EPSRC and ICI Chemicals and Polymers Ltd.; the latter also supplied the refrigerant samples.