

Heat Capacities of Binary Mixtures of Hydrocarbons Up to 20 MPa Using a New Flow Calorimeter

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The equation of state and the heat capacity are the basic thermodynamic data which allow other useful properties, such as changes in enthalpy, Gibbs energy or entropy, to be calculated using only thermodynamic relations. The knowledge of pVT data and heat capacities over a wide range of temperatures and pressures for a mixture allows a complete thermodynamic characterization of the mixture. An automated flow calorimeter has been developed for the accurate measurement of isobaric heat capacities for pure compounds and mixtures over the range (250 to 400) K and (0 to 20) MPa [1]. A precision isocratic pump delivers the mixture through the cell at a programmable constant flow rate. The cell is a stainless steel vessel containing a copper block where all the energy in the process is exchanged by conduction. The mixture decreases its temperature as it moves along the cell because the calorimeter works with a constant difference between the inlet and outlet temperatures of 0.5 K. To achieve this condition, a Peltier cooler removes energy at a constant rate from the cell and a control-heater compensates for this energy loss to maintain the desired temperature difference. The fluid exit temperature is measured by an NTC thermistor and the inlet temperature using a calibrated standard Pt-25 thermometer. An electrical calibration of the calorimeter is carried out by Joule effect at the same conditions as in the experimental measurements. The equipment is automatically pressurized using a variable volume driven by a stepper motor and the pressure is measured by means of a Druck DPI 145. Isobaric heat capacities of three binary mixtures: (heptane +1-hexene), (heptane + toluene) and (1-hexene + toluene) have been measured at 313.15 K for pressure range up to 20 MPa at nine different compositions per mixture. The estimated uncertainty in the isobaric heat capacity measurement is $\pm 1\%$.

[1] J.J. Segovia, D. Vega-Maza, C. R. Chamorro, M. C. Martín. J. Supercrit. Fluids.46,3, 258-264 (2008).