

Calorimetric Measurement of Melting Temperatures and Isobaric Heat Capacities in Hydrocarbon Mixtures

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Thermophysical property data for hydrocarbon mixtures that emulate natural gas are essential in both the design and operation of gas gathering, treating, and processing equipment. However, there is a lack of data at relevant compositions and operating pressures, which could lead to over-design and increased costs of gas plant facilities. Additionally, poor understanding of hydrocarbon solid-fluid equilibria (SFE) can cause freeze-out of heavy hydrocarbons (C6+) within liquefied natural gas production facilities resulting in shutdown of the plant. Two differential scanning calorimeters (DSC) were utilised to measure the melting temperatures, T_{melt} , and isobaric heat capacities, c_p , of high pressure hydrocarbon mixtures: 1) a Setaram BT 2.15 DSC to measure T_{melt} and c_p at cryogenic temperatures, and 2) a Setaram C80 DSC to measure c_p at high temperatures. The c_p measurements are reported at (200, 255, 311, 366 and 422) K and pressures between (10 and 32) MPa for four supercritical mixtures of methane (1) + propane (3) + heptane (7) at $x_7 \approx 0, 0.05, 0.10$ and 0.15 . Comparison of the data against EOS model predictions reveals the inability of the models to represent the c_p of hydrocarbon mixtures containing heavy components, especially at conditions near the critical point of the mixtures. The T_{melt} measurements were obtained for the above mixtures over a temperature range from (138 to 198) K between (11 and 32) MPa. Additionally, T_{melt} for methane (1) + heptane (7) binary mixtures at $x_7 \approx 0.1$ and 0.25 from (158 to 188) K at 30 MPa were obtained to study the impact that the addition of intermediate components such as propane has on the SFE phase behaviour. The results are compared against current state-of-the-art models for SFE prediction and show a need to improve model performance for predicting SFE in hydrocarbon mixtures.