

Experimental Determination of Mixture Dew Points with a Two-Sinker Densimeter with Application to the (Methane + Propane) System

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We compare methods for determining the dew-point density and pressure of fluid mixtures. In this context the (p , ρ , T , x) behavior of three (methane + propane) mixtures was measured with a two-sinker magnetic suspension densimeter over the temperature range of (248.15 to 298.15) K; the data extended from low pressures into the two-phase region. The compositions of the gravimetrically prepared mixtures were (0.74977, 0.50688, and 0.26579) mole fraction methane. We analyzed isothermal data in three ways: (1) in a “traditional” analysis the dew point was given by the intersection of a virial fit of the (p vs. ρ) data in the single-phase region with a linear fit of the data in the two-phase region; (2) an analysis of the adsorbed mass on the sinkers versus pressure yielded a sharp discontinuity at the dew point; and (3) an analysis of the “coupling constant” φ (related to the force transmission error of the magnetic suspension coupling) also yielded a sharp discontinuity because of condensation onto the sinker. The “traditional” analysis suffered from an indistinct change in the slope, resulting in relatively high uncertainties. The “adsorbed mass” analysis provided a good determination of the dew-point pressure, but at the expense of an increased uncertainty in the dew-point density, because the data from one of the sinkers was required to determine the adsorbed mass. The “coupling constant” analysis yielded an accurate pressure while retaining the full density accuracy of the two-sinker technique. By comparison, a traditional isochoric experiment resulted in larger uncertainties in the dew point, due in large part, to the continuously changing temperature. We conclude that the analysis of the data determined for the coupling constant throughout an isothermal experiment provides an accurate determination of the dew point temperature, pressure, and density. However, a two-sinker instrument is required.