Application of Densimetry for Phase-Equilibrium Measurements on Carbon Dioxide, Propane, and their Mixtures

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Phase equilibria of fluid mixtures are important in numerous industrial applications and improved data, particularly along the dew line, are needed to improve model predictions. Near the dew line, sorption effects can distort the composition and introduce systematic errors in the measurement. In this work, we study the (carbon dioxide + propane) system. This system is important for natural gas and is well suited for studies of sorption phenomena because both components are well known and their similar molecular mass eliminates certain confounding effects. The (p, ρ , T, x) behaviour of two (carbon dioxide + propane) mixtures as well as their pure components was investigated utilizing the NIST two-sinker magnetic suspension densimeter. The measurements were carried out along isotherms (T = 253.15 K to 293.15 K) and extended from low pressures into the two-phase region. An alternative solution of the working equations allowed us to determine the adsorbed mass on the sinker surfaces. We used the sharp increase in adsorbed mass with increasing pressure and density to deduce the dew-point density. The single-phase data were fitted to a virial equation. We have previously demonstrated this measurement technique using other binary mixtures, but report here, for the first time, its application to pure fluids. Since the dew-point pressure and density of carbon dioxide and propane are accurately known, we can use the literature data to conclude that the analysis of adsorbed mass through the use of densimetry provides an accurate determination of the dew point.