

A Novel Method to Investigate the Dew Line and Sorption Effects of Binary Mixtures Using a Modified Two-Sinker Densimeter

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We present a new technique for accurately determining the dew line of binary mixtures and for investigating sorption effects when approaching the dew line. To realize the new technique, we modified the NIST two-sinker densimeter by incorporating a new pair of sinkers. In contrast to the original sinkers, the new ones were of the same material (titanium), same mass, and same volume, but they had different surface characteristics, which allowed for a quantitative determination of the mass of sample adsorbed onto the sinker. Measurements of the (p , ρ , T , x) behavior were carried out on binary mixtures of (methane + propane) and (argon + carbon dioxide) in the temperature range from (248.15 to 298.15) K starting at low pressures and extending into the two-phase region. With the new sinkers, sorption effects on the order of 10 μg could be measured; hence, the idea of using special sinkers has been proven successful. As the pressure was increased towards the dew point along an isotherm, three distinct regions were observed: Far away from the dew point, the adsorbed mass was on the order of a few ten's of μg ; within approximately 98 % of the dew point pressure, the adsorbed mass increased sharply (up to a few hundred μg); finally, a further, sharper increase in adsorbed mass (up to a few mg) occurred. We speculate that the second region corresponds to capillary condensation (also called pre-condensation), and that the transition from the second to the third region corresponds to bulk condensation onto the sinkers, thus being the true dew point. Further work will be required, however, to confirm this hypothesis and to model it.