

Accurate (p, ρ, T, x) Measurements on Different Liquefied Natural Gas (LNG) Mixtures in the Temperature Range from (105 to 135) K at Pressures up to 9 MPa

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The (p, ρ, T, x) behavior of different synthetic liquefied natural gas (LNG) mixtures was measured in the temperature range from (105 to 135) K at pressures up to 9 MPa utilizing a single-sinker magnetic suspension densimeter for cryogenic liquid mixtures. Due to the supercritical liquefaction procedure and the integration of a special VLE-cell it was possible to measure (p, ρ, T, x) data in the homogeneous liquid phase of LNG without changing the composition. The mixtures were prepared gravimetrically and then analyzed by gas chromatography at the Dutch metrology institute. The relative combined expanded uncertainty ($k = 2$) in density considering all effects, including the uncertainty in composition, was approximately 0.05 % for all measurements. Comparisons of our experimental data to the GERG-2008 equation of state for natural gas mixtures revealed clear and systematic deviations up to 0.15 %; in general these deviations increase with decreasing pressures. Anyhow, the reported uncertainty for the GERG-2008 equation is (0.1 to 0.5) % for the conditions considered in the present work, and all measured densities are represented well within this uncertainty range. We also present comparisons to density calculation methods often used in LNG industry such as the Revised Klosek and McKinley Method as well as the COSTALD correlation. These comparisons yield the conclusion that the performance of widely used density calculation methods clearly depends on the pressure range and on the composition of the investigated LNG mixture. This conclusion will be discussed in detail.