A New Single-Sinker Densimeter for Accurate (*p, ρ, T, x*) Measurements of Liquefied Natural Gas (LNG) in the Temperature Range from 90 K to 290 K at Pressures up to 12 MPa

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For accurate (*p, ρ, T, x*) measurements of liquefied natural gas (LNG), a special densimeter has been developed. This new densimeter covers the density range from 10 kg×m^{-3} to 1000 kg×m^{-3}, thus enabling density measurements in the homogeneous liquid region, along the saturated liquid line (incl. vapor pressures), in the supercritical region and in the homogeneous gas region. The apparatus is designed for measurements in a temperature range from 90 K to 290 K at pressures up to 12 MPa. The densimeter is based on the Archimedes (buoyancy) principle and is a single-sinker system incorporating a magnetic suspension coupling. The density is obtained directly without the need for calibration fluids. The expanded uncertainty (k = 2) for density measurements in the homogeneous liquid is estimated to be 0.02 %. This value does not include the uncertainty associated with the gas analysis, which is to be added. The influence on density corresponds to approximately a few 0.01 %. Further uncertainties resulting from a change in composition of the mixture can be avoided by the special design of the new densimeter. In this way, the composition in the measuring cell does not deviate from the composition of the original sample. The presented work will describe the new densimeter and the validation of the functionality based on measurements of pure methane. First results of accurate (*p, ρ, T, x*) measurements of a typical Liquified Natural Gas (LNG) will be reported as well. The LNG mixture has been prepared gravimetrically according to metrological standards, and the composition was additionally analysed utilizing a multi-level calibrated gas chromatograph. As the uncertainty of the mixture analysis has a significant impact on the overall measurement uncertainty in density, this aspect will be discussed in more detail.