Density Measurements of (Argon + Carbon Dioxide) Over the Temperature Range from (253.15 to 453.15) K at Pressures up to 20 MPa

Robin Wegge[1, S, C], Markus Richter[2] and Roland Span[3]

[1]*Green Energy Lab, Technical University of Applied Science Georg Agricola, Bochum, Germany*
[2]*Applied Thermodynamics, Chemnitz University of Technology, Chemnitz, Germany*
[3]*Thermodynamics, Ruhr-University Bochum, Bochum, Germany*
robin.wegge@thga.de

We present a completely redesigned single-sinker densimeter that is optimized to measure densities of mixtures without changes in composition during the measurement runs. This was achieved by several measures, such as heating all wetted parts to high temperatures and minimizing the amount of polymers (*i.e.*, sealants) in contact with the mixtures. We will comprehensively describe the necessary adaptations for measurements of gas mixtures and give a detailed overview of the uncertainty analysis. To verify the performance of the set-up, the density of (argon + carbon dioxide) mixtures was measured over the temperature range from (253.15 to 453.15) K with pressures up to 20 MPa. Four gravimetrically prepared mixtures with compositions of (0.50000 and 0.49975) mole fraction carbon dioxide and (0.75093 and 0.74985) mole fraction carbon dioxide were studied. The relative combined expanded uncertainty ($k = 2$) in density ranges from (0.060 to 0.150) % for the 0.50 mole fraction carbon dioxide mixtures and from (0.059 to 0.127) % for the 0.75 mole fraction carbon dioxide mixtures. Comparisons to experimental data sets obtained from literature and to different equations of states will be presented. The deviations from the current state-of-the-art multi-component mixture model for combustion-gas-like mixtures range from (-3.30 to 0.08) % for the 0.50 mole fraction carbon dioxide mixtures and from (-0.98 to 0.65) % for the 0.75 mole fraction carbon dioxide mixtures, whereby at low temperatures and high pressures, a systematic deviation compared to the equation of state was found.