

Accurate Phase Equilibrium Measurements for CCS Using an Analytical Method

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Studies by IEA and others have emphasized that large-scale deployment of CO₂ capture, transportation, and storage (CCS) systems is required in order to mitigate anthropogenic climate change in a cost-effective manner. SINTEF Energy Research has for more than a decade led a series of research projects on CCS, currently centered around the Norwegian CCS Research Centre (NCCS). Measurements and modeling of the behavior and properties of fluids relevant for CCS have been a vital component of this effort, which has led to development of a state of the art experimental infrastructure. Highly accurate phase equilibrium measurements of the binary mixtures CO₂ + O₂, CO₂ + N₂, CO₂ + Ar, CO₂ + CO, and CO₂ + CH₄ have been important results of this work so far. In total, more than 23 isotherms have been measured. For the most part, vapor-liquid equilibria (VLE) have been measured, but for CO₂ + Ar also phase equilibria with solid CO₂ have been investigated. These measurements of phase equilibria will continue in the years ahead within NCCS to fill remaining knowledge gaps, employing an isothermal analytical method with a variable-volume cell. Except in the critical region, the limiting factor for the accuracy of analytical phase equilibria measurements is usually the accuracy in which the composition of the fluid phases can be determined. In the preparations for the aforementioned VLE measurements, it was early realized that commercially available and common methods with regards to e.g. analysis of chromatograms, sampling, calibration, and hardware are mostly not optimal. In the symposium, a summary of the phase equilibrium measurements that have been performed at SINTEF will be provided, with a focus on the improvements in the quantitative chemical analysis which have greatly reduced the overall uncertainty of the measurements.

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