Modelling Brines Consistent to Helmholtz Multi-Fluid Mixture Models for CCS Applications- from Seawater to High Concentrated Brine Mixtures in Saline Aquifers

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Reaching the aims of the Paris Agreement – including limiting long-term global warming to 2 °C above pre-industrial levels – is widely thought to require significant reduction of carbon dioxide in the atmosphere compared to its current concentration. The widespread application of key technologies such as carbon capture and storage (CCS) will be important to achieve this goal. One of the main storage mechanisms for carbon dioxide is within geological structures including saline aquifers. Although the capture and transport sections of a CCS-chain can be described with highly accurate equations of state (e.g. EOS-CG), the modelling of processes in the aquifer are more challenging due to the presence of salts at high concentration and wide ranges of temperature and pressure. Existing models for describing the interaction of brines with CCS-fluids only use cubic equations for the pure components at storage conditions or have rather narrow ranges for storage applications. Considering that applying multiple thermodynamic models to the different sections in the CCS-chain would result in inconsistencies and imbalances in mass and/or energy calculations, the ability of process designers to optimize the whole CCS-chain is severely limited in the current scenario.

In a previous work [1], the IAPWS seawater model [2] was combined with Helmholtz multi-fluid models to overcome these inconsistencies in process design. Nevertheless, the seawater model used for the description of the brine exhibits shortcomings at elevated pressures and higher salt concentrations. To overcome these limitations a more capable brine model, based on Pitzer's equations [3,4] and consistent with accurate equations of state suitable for describing carbon capture and transport, will be presented in this work.

References:

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