Thermophysical Properties and Phase Behaviour of Fluids for Application in Geological Carbon Storage

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Deep saline aquifers and depleted oil & gas fields have been identified as promising sinks for the storage of large amounts of anthropogenic carbon dioxide. In order to design safe, effective and economic geological carbon storage projects, it is necessary to have a thorough understanding of the physical and chemical properties of mixtures of CO_2 and reservoir fluids, both brines and hydrocarbons, at reservoir conditions. This requires a combination of empirical data and well-founded models that can be applied in reservoir simulations.

In this work, a programme of experimental and modelling work has been undertaken with the objective of obtaining improved quantitative understanding the phase behaviour, interfacial properties and single-phase properties of systems containing carbon dioxide, water, salts, hydrocarbons and diluent gases. An overview of the outputs from this research will be presented. Examples include experimental measurements of the solubility of CO_2 in water and brines or various compositions, and measurements of the density, viscosity, *p*H and diffusion coefficients of the resulting solutions. Additionally, measurements have also been made of interfacial tension in CO_2-brine systems, both with and without diluent gases such as nitrogen or hydrogen that might be present in the CO_2 stream.

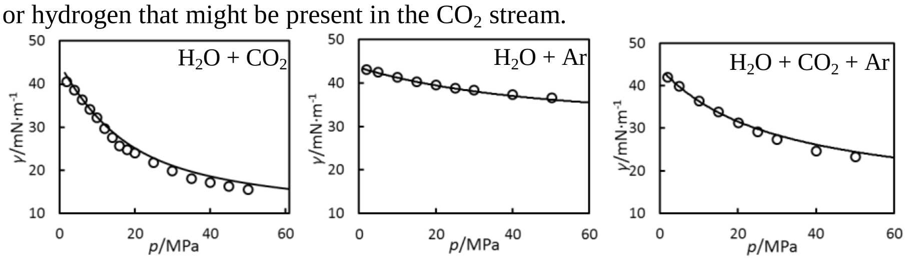

Fig. 1. Interfacial tension in binary and ternary mixtures of H_2O, CO_2 and Ar as a function of pressure at 448 K: O, experiment; ———, SAFT-VR Mie + Square-Gradient Theory

The results of the experimental programme will be compared with both established and recently-developed modelling approaches. For phase behaviour, these include traditional γ-φ approaches and also the SAFT approach. The latter has been successfully coupled with square-gradient theory to model interfacial tension (see Fig. 1). Conclusions will be presented concerning the current state of knowledge of phase behaviour, interfacial properties and single-phase properties of systems containing CO_2 with brine and/or hydrocarbon, with or without diluent gases, under conditions representative of geological carbon storage.