Interfacial Tension Measurements of Binary Mixtures of N₂ + Brine and CO₂ + Hydrocarbon Systems at Conditions Relevant for CCS and EOR

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Interfacial tension (IFT) between hydrocarbons, gases and water/brines plays an important role in the assessment of injection strategies, capillary trapping capacity, and caprock seal security in deep saline aquifer sequestration of CO₂ and enhanced oil recovery in mature reservoirs. However, CO₂ captured is not pure, containing impurities such as N₂. There is a gap understanding interfacial interactions between N₂ from CO₂ streams and brines present in geological storage sites. This challenge aligns with a quest for characterising what happens at the interface between CO₂ and different types of hydrocarbons during CO₂ storage or usage in EOR. Experimental IFT data on these systems is still scarce in the literature, under representative reservoir conditions of temperature and pressure. Therefore, in this study, the interfacial tension of N₂ + brine, and CO₂ + hydrocarbon liquid systems at injection/storage geo-conditions will be investigated, as a key thermophysical property to enable carbon capture and storage (CCS) and enhanced oil recovery (EOR) strategies.

We will report new experimental data on interfacial tension of (1) N₂ + NaCl(aq) and N₂ + CaCl₂(aq) systems, representative of monovalent and divalent salts present in the reservoirs with concentrations ranging from dilute to high salinity brines (1.0, 3.0, 5.0 mol kg⁻¹), and (2) CO₂ + cyclohexane and CO₂ + toluene systems. Measurements are made at temperatures from (298 to 423) K and pressures from (2.0 to 40.0) MPa, using the axisymmetrical drop shape analysis (ADSA) technique. The impact of temperature, pressure and salinity (molality and ion type) on the IFT was assessed using the data acquired from the measured systems.