Interfacial Properties of Live Fluids at Reservoir Conditions

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Carbon capture coupled with geological storage are key technologies for mitigating anthropogenic CO_2 emissions. In connection with geological storage, thermophysical properties have a strong influence on the movement and distribution of reservoir fluids in porous media. In order to understand the interfacial properties of live reservoir fluids, the interfacial tensions of binary, ternary and quaternary systems comprising decane, brine, CH_4, CO_2 and a CO_2/CH_4 (0.5:0.5) gas mixture have been studied. Experiments were conducted at (298, 348 and 393) K and at pressures up to 30 MPa. The interfacial tension was measured by utilising the pendant drop technique with axisymmetric drop shape analysis.

The results show that the addition of CH_4 or CO_2 reduces the interfacial tension (IFT) between decane-rich and aqueous phases. In particular, the influence of CH_4 was found to be less pronounced than that of CO_2. As expected, the addition of salt increases the IFTs of both gas + water and the decane + water system. The IFT results are compared with predictions based on density gradient theory (DGT) coupled with a volume-translated Peng-Robinson or CPA equation of state. For brine systems, empirical data for the brine surface tension and the Setschenow coefficient were combined with the salt-free DGT model to estimate the salt effects. These IFT results may be useful in predicting the CO_2 injection pressure into a depleted hydrocarbon reservoir, as well as the overall reservoir capillary sealing capacity.