Effect of Impurities on the Interfacial Tension and Density of CO_2-Rich/Water Systems at HP/HT Conditions

Luís Pereira [C, S], Mahmoud Nazeri, Rod Burgass, Antonin Chapoy and Bahman Tohidi
Institute of Petroleum Engineering, Heriot Watt University, Edinburgh, Scotland, United Kingdom
luis.pereira@pet.hw.ac.uk

Interfacial properties in partially miscible phases play a major role in several chemical and reservoir engineering applications. Liquid–vapour and liquid–liquid interfacial tensions in CO2-rich/water systems are, among others properties, of great importance when describing multiphase reservoir flows associated with enhanced oil recovery (EOR) and carbon capture and storage (CCS) as this property can greatly affect several rock properties. In general, CO2 streams used in EOR and/or CCS operations come from capturing processes and can contain impurities such as methane, nitrogen, hydrogen and oxygen, among others. Despite its key role in water-alternating-gas (WAG) processes and direct influence on the CO2 storing capacity of a potential reservoir, experimental data on the effect of impurities on the interfacial tension (IFT) of carbon dioxide / water systems are still limited. In this communication, our Pendant Drop facility was used to measure IFT values of water and three CO2-rich multicomponent mixtures containing different species and content in impurities (up to 10% mol/mol). The phase densities, required to determine pertinent and accurate IFT values, were determined by measuring the oscillation period of the equilibrated phases with an Anton Paar densitometer at the experimental conditions of interest. The results showed a high pressure dependency of IFT values below the saturation point of CO2 whereas a slight decrease on the interfacial tension was observed for higher pressures. The increase of content in light components resulted in generally higher gas-water IFT values comparing to that of pure CO2 and in a reduction of the density of the CO2-rich mixtures in particular at the CO2 saturation conditions. Altogether, novel IFT and density measurements in CO2-rich/water systems were performed for temperatures ranging from 25 to 150 ˚C and pressures up to 70 MPa.