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Development of a new surfactant material for CO2 -foam stability

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In contact with oil, CO2 lowers the oil viscosity, causes the oil to swell, overcome the high interfacial tension between oil and rock, dislodge the immobile oil and hence increase the volumetric sweep efficiency. The surfactant must possess suitable structure to successfully play these roles. In this context, a new surfactant with different functionalities has been synthesized to examine its CO2 philicity. The response surface methodology (RSM) was employed to optimize the yield and provide the shortest reaction time using less stringent reaction conditions. Final structure was validated using FT-IR and NMR technique. The surfactant was evaluated for EOR suitability by firstly examining the fluid – fluid compatibility (in different temperatures, salinity and harness tolerance). The ability for foaming is also assessed. The interfacial tension (IFT) between surfactant and CO2 gas at 90oC and upto 2700 psi showed some interesting findings. The IFT of CO2 - brine without surfactant dropped from a value of 70 mN/m to 30 mN/m when the critical pressure approached (1070 psi). It remained 30 mN/m at higher pressures. When surfactant is incorporated the minimum IFT achieved was 1.76 mN/m after the critical pressure is reached. The foam stability of the surfactants was evaluated. The MRF values reflect the same trend as IFT lowering and foam stability. Three tailed surfactant has the MRF of 3.4. AOS (commercial surfactant) MRF was 1.3. It appears that the surfactant having structure which demonstrates favorable CO2 affinity has the largest IFT reduction, highest foam stability and MRF values. This trend is also repeated in the recovery factor achieved by the surfactants when core flood are performed at 90oC and with a working pressure of 1800 psi. The three tailed surfactant provides the highest RF of 96% ROOIP. The adsorption of the surfactant was kept low at less than 0.5 mg/g.