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The Formation of Microemulsion at Flow Conditions in Rock

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Surfactant flooding is a chemical enhanced oil recovery (cEOR) technique where a low concentration of surfactant is added to the injection water. The surfactant reduces the oil/brine interfacial tension which, in return, increases the capillary number favoring the viscous mobilization of (capillary) trapped oil. In order to reduce the residual oil saturation significantly, ultra-low interfacial tension (<10-2 mN.m-1) between crude oil and aqueous phase is required. That is achieved by employing surfactants that solubilizes the oil and form a microemulsion phase. How low interfacial tension can become depends on the phase behaviour of the surfactant/oil/water system which is often studied with equilibrium phase behaviour tests. However, oil recovery is a dynamic process, and microemulsion formation occurs in situ over different time and length scales depending on the flow and porous medium characteristic.
In this study, we investigated in-situ formation of microemulsion and mobilization production of oil by solubilization in the core samples. The aqueous solution of an EOR surfactant was injected into the core sample after the waterflood to solubilize the remaining oil. The surfactant was an internal olefin sulfonate (IOS), and had affinity to the oil phase (n-decane); in situ microemulsion formation occurred. The oil phase was doped with iodo-decane as contrast agent, which allowed visualization of the oil-and emulsion phases using X-ray computed micro-tomography technique. The resolution was sufficient to visualize pure and emulsified oil within individual pores. Image analysis of the scans showed that the emulsification during flow took place at shorter time scales than what was observed at static conditions. These results were consistent with findings of micromodel experiments.

References

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