Contribution ID: **538** Type: **Poster Presentation**

Multi-Scale Assessment of Surfactant-Assisted Spontaneous Imbibition

Wednesday, 24 May 2023 16:10 (1h 30m)

Hydrocarbon-rich unconventional reservoirs are vital resources for the anticipated growth in energy demand. Spontaneous imbibition is a primary mechanism for improving shale fracturing and wettability alteration treatments in these ultralow-porosity and permeability reservoirs. Therefore, enhancing the efficiency of spontaneous imbibition is crucial to achieving higher recovery and delaying the decline in production rates. This study assesses the potential of surfactant-assisted spontaneous imbibition at multi-scale lengths, including Darcy- and pore-scales.

The proposed methodology consists of three main phases: Surfactants assessment, Darcy-scale, and pore-scale spontaneous imbibition. In this study, we selected three surfactants representing three different types of surfactants: cationic, anionic, and zwitterionic. Surface tension, interfacial tension, and contact angle are determined during the surfactant assessment. Then, we performed Amott Cell spontaneous imbibition experiments for all the surfactants in addition to the baseline on Berea sandstone rock. Finally, we assessed the performance of surfactant-assisted spontaneous imbibition at the pore-scale level using CT imaging. A micro-flow cell was used to perform the flooding while imaging with the CT scanner.

All surfactants reduced the interfacial tension and had variable contact angle results. However, the surfactants overall did not improve the spontaneous imbibition in Berea rock compared to the baseline. Cationic surfactants are comparable to the baseline results, as contact angle measurements showed that this surfactant slightly increased the rock's hydrophilicity. The other surfactants reduced the capillarity performance, leading to lower spontaneous imbibition. Segmented CT images were used to estimate the plugs' initial oil and water saturations. Wetting and nonwetting phases were labeled and quantified by voxel counts. The change in oil saturation in the matrix was then calculated over time. The constructed production curves showed variations in the performance of the surfactants in enhancing oil recovery. A thorough discussion is provided to correlate the Darcy-scale spontaneous imbibition with the pore-scale results.

New insights into the fundamental mechanisms of spontaneous imbibition with various surfactant types were obtained. The provided study demonstrated that pore-scale analysis could improve the interpretation of production curves obtained by conventional Amott cell experiments. Multi-scale assessment helps understand how different surfactants enhance or hinder the process of spontaneous imbibition, leading to more optimized recovery.

Participation

In-Person

References

MDPI Energies Student Poster Award

Yes, I would like to submit this presentation into the student poster award.

Country

Saudi Arabia

Acceptance of the Terms & Conditions

Click here to agree

Energy Transition Focused Abstracts

Primary author: ALAAMRI, Jamal (KAUST)

Co-authors: Dr CHANDRA, Viswasanthi (King Abdullah University of Science and Technology (KAUST)); HOTEIT, Hussein (King Abdullah University of Science & Tech (KAUST))

Presenter: ALAAMRI, Jamal (KAUST)

Session Classification: Poster

Track Classification: (MS06-B) Interfacial phenomena across scales