Contribution ID: **158**

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Impact of osmosis and emulsification on oil remobilization in pore-scale experiments

Tuesday, 1 June 2021 19:00 (1 hour)

Numerous experimental observations and field applications have confirmed that low-salinity water flooding is an effective technique for enhanced oil recovery. Given the complex physical and chemical processes, several controlling mechanisms have been proposed to explain the oil remobilization due to low-salinity effects. Osmosis and water-in-oil emulsification are among these mechanisms. However, our knowledge of these processes is limited and their associated time scales are not well understood.

To verify their roles, we conducted a series of microfluidic experiments by sequentially injecting high-salinity water, pure or surfactant-added synthetic oil, low-salinity water into the hydrophobized glass-based microchips. Several selected specific areas were continuously observed for over 48 hours, with systems of trapped high-salinity water along the solid grains, low-salinity water in bulk, and sandwiched oil. The systems mimicked the contact status of these three fluids in the natural reservoir. In the experiments using pure oil, we found that the trapped high-salinity water gradually squeezed the sandwiched oil phases out of the pores due to the osmosis induced expansion. The volume of high-salinity water increased by 22.73% with an average rate of 141.88 μm2/hr, which was difficult to rely solely on the diffusion of water in the oil. Therefore, we proposed a hyperthesis and developed a coupled water transport model to explain the high-salinity water expansion with a water flux in the oil phase. In the experiments with adding surfactant (SPAN 80) in oil, we observed that the expansion rate of high-salinity water was 2.72 times higher than it without surfactant, meaning that the emulsification contributed to accelerating water transport in the oil phase.

On the other hand, a corresponding series of experiments were carried out using Zetasizer to capture the size trend in water-in-oil emulsion around the oil/salinity-water interface under different salinity conditions. In the case of 1,700 ppm salinity, we found that the water-SPAN80-dodecane emulsions kept a primary size of around 50 nm for the first 4 hours, then generated a second primary size of 2 nm during 4-20 hrs. Finally, the small emulsions progressively dominated the size distribution around the interface, and relative big emulsions, e.g., 4,800 nm, occurred with the coalescence until the emulsification process reached equilibrium. This tendency matched well with the observation on the emulsion transformation in the microfluidic experiments and helped explain the process of high-salinity water expansion.

Time Block Preference

Time Block B (14:00-17:00 CET)

References

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