



Contribution ID: 730

Type: **Poster Presentation**

Water transport in n-alkane phases through diffusion and emulsion: insights into oil remobilization from a pore-scale perspective

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

Several controlling mechanisms have been proposed to explain oil remobilization due to low-salinity effects. Among them, osmosis and water-in-oil emulsification have been widely reported as two potential mechanisms. However, our knowledge of these processes is limited, and their associated time scales are not well understood. To verify their roles, we have conducted a series of experiments in oil-wet microfluidic devices. The solid surface in the micromodels have been rendered oil-wet via a silanization procedure. Sequential fluid injections with high-salinity water (HSW), pure or surfactant-added synthetic oils, and low-salinity water (LSW) are performed to obtain a fluid distribution where oil is sandwiched between disconnected HSW water and connected LSW. Such fluid distribution is assumed to be prevalent in natural reservoirs. A $2,797 \times 2,238 \mu\text{m}^2$ region is continuously observed for over 70 hours under a high-resolution microscope. We observe that the salinity contrast over oil films can cause water transport through the oil and lead to swelling of the trapped high-salinity water, resulting in the movement of oil phases within the pores. Dodecane displays higher water transport than heptane. We compare salinity contrasts of 1.7-170 g/L and 50-170 g/L. The higher salinity contrast induces higher water transport for both heptane and dodecane. The lower salinity contrast of 50-170 g/L salinity contrast gives less water flux, even reaching zero after a prolonged time. With the addition of a surfactant (SPAN 80) to alkanes, we observe spontaneous emulsification at the LSW-oil interface, while no apparent micro-emulsions were found at the HSW-oil interface. We notice an increase of almost 100 times in water flux for both n-heptane and n-dodecane. This increase is due to the enhanced formation of micro-emulsions of water-in-oil. The emulsification process weakens the influence of salinity on the transport of water molecules in the oil phases. Our experiments provide direct pore-scale observation of dynamic spontaneous emulsification at the LSW-oil interface, whereas we could not detect any micro-emulsions at the HSW-oil interface. Based on our observations, two scenarios for explaining water transport through the oil phase are proposed: water diffusion due to chemical potential gradient and water transport via reverse micelle or micro-emulsions movement. The relative influence of these two transport mechanisms is dependent on the rate of generation of emulsions at the LSW-oil interface, which we observe to be significantly altered by surfactants in the oil phase.

Participation

In-Person

References

MDPI Energies Student Poster Award

No, do not submit my presentation for the student posters award.

Country

Netherlands

Acceptance of the Terms & Conditions

[Click here to agree](#)

Energy Transition Focused Abstracts

Primary author: YAN, LIFEI

Presenter: YAN, LIFEI

Session Classification: Poster

Track Classification: (MS06-A) Physics of multiphase flow in diverse porous media