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Dynamic modelling of reservoir fines retention by mesoporous silica nanofluid to improve oil recovery during low salinity water flooding of a consolidated sandstone

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ABSTRACT

Mesoporous silica (SiO_2) nanoparticles (MSNP) was used to stabilize formation fines for increased oil recovery during low salinity water flooding. Likewise, the effect of porous media length on dynamic retention of fines at high temperature reservoir condition was investigated. Breakthrough curves of reservoir fines adsorption by mesoporous SiO_2 nanofluid (MSNF) were described using Thomas and Yoon-Nelson models. Similarly, effect of concentration, flow rate, porous media length and temperature on the retention capacity of reservoir fines was modelled using Box Behnken design of experiments. Subsequently, effect of reservoir fines stabilization on oil recovery was evaluated. Formation damage remediation propensity of MSNF was investigated. Finally, the oil recovery mechanisms were determined using the sessile drop contact angle and Wilhelmy plate methods. Experimental results of the dynamic adsorption with coefficient of determination (R^2) values between 0.967 and 0.999 signifies that the reservoir fines adsorption by MSNF were well predicted by Thomas and Yoon-Nelson models. Consequently, MSNF stabilized the reservoir fines by attaching onto their surface rather than on the porous media thereby changing the wettability to water-wet, decreasing the contact angle to 16.1°, 17.1° and 20.7° for kaolinite, illite and montmorillonite, respectively. Thus, increasing oil recovery by 22–23% original oil in place.

Credit author statement

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