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Nanoparticles Influence on Wetting Behaviour of Fractured Limestone Formation

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ABSTRACT

Nanoparticles have gained considerable interest in recent times for oil recovery purposes owing to significant capabilities in wettability alteration of reservoir rocks. Wettability is a key factor controlling displacement efficiency and ultimate recovery of oil. The present study investigates the influence of zirconium (IV) oxide (ZrO₂) and nickel (II) oxide (NiO) nanoparticles on the wetting preference of fractured (oil-wet) limestone formations. Wettability was assessed through SEM, AFM and contact angle. The potentials of the nanoparticles to alter oil-wet calcite substrates water wet, was experimentally tested at low nanoparticle concentrations (0.004-0.05 wt. %). Quite similar behaviour was observed for both nanoparticles at the same particle concentration; while ZrO₂ demonstrated a better efficiency by altering strongly oil-wet (water contact angle $\theta = 152^\circ$) calcite substrates into a strongly water-wet ($\theta = 44^\circ$) state, NiO changed wettability to an intermediate-wet condition ($\theta = 86^\circ$) at 0.05 wt. % nanoparticle concentration. We conclude that ZrO₂ is very efficient in terms of inducing strong water-wettability; and ZrO₂ based nanofluids have a high potential as EOR agents.

Keywords

Nanoparticles, Wettability, Zirconium oxide, Nickel oxide.

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