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Full Length Article

# Oil recovery aspects of $ZnO/SiO_2$ nano-clay in carbonate reservoir

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## Highlights

- The validity of $ZnO_2/SiO_2$ nano-clay in green way synthesis was confirmed.
- Nanofluids were prepared with high stability.
- The synthesized NCs was more effective with distilled water in reducing the IFT and CA.
- The synthesized NCs was highly enabled improving oil recovery during tertiary phase.

## Abstract

Several chemical solutions have been used to improve oil recovery as enhanced oil recovery (EOR) effective agents. However, the conventional chemical EOR solutions face some difficulties and challenges in the mobilizing and displacing the crude oil in the porous media. Nowadays, nanofluids (a mixture of nanoparticles and fluid) are used for EOR applications. In this study, a composite containing zinc and silica nanoparticles and bentonite, as a natural clay, is prepared using a simple, economic and green way from the extract of the *Cordyline fruticosa* plant. The validity of the synthesized nanocomposites (NCs) is analyzed using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR) and scanning electron microscopy (SEM). Since the salinity has an influence on the performance of the injected fluids in the porous media, we decided to evaluate the impact of the prepared NCs dispersed within water at different salinity levels, such as distilled water (DW), seawater (SW, HiSal), 10-times seawater dilution (MoSal) and 20-times seawater dilution (LoSal). The prepared nanofluids with 250, 500, 1000 and 2000 ppm NCs passed through several experimental tests, such as pH, viscosity, density, conductivity, interfacial tension (IFT), contact angle (CA) and core flooding under different temperature conditions. The obtained results show that the prepared nanofluids have a good stability, and the IFT and contact angle are decreased with increasing the NCs concentration, but they have an inverse relationship with the water salinity. The minimum IFT is achieved for the oil/nanofluid system prepared from mixing 2000 ppm NCs within the distilled water, meanwhile, the same nanofluid showed the best performance in reducing the contact angle, which is 65.5°. Nanofluids prepared from 2000 ppm NCs and water at its four different levels of salinity are injected into core plugs as secondary and tertiary recovery phases. DW-based nanofluid enabled to extract 62.14 % original oil in place (OOIP) during the secondary recovery, however, it is improved the oil recovery from 44 to 65.41 %OOIP when it is used as the tertiary recovery process.

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