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Effects of Nanoparticle Types on Carbon Dioxide Foam Flooding in Enhanced Oil Recovery

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Abstract

Enhancement of foam stability has been recently evidenced with addition of nanoparticles (NPs), especially in the case of CO_2 foams. Stabilized foams via solid NPs can potentially withstand high reservoirs temperatures. Studies have been conducted to examine the effect of NPs on foam stability; however, more research is required for various types of NPs. Therefore, the authors aimed to investigate the performance of silicon dioxide (SiO_2), aluminum oxide (Al_2O_3), copper oxide (CuO), and titanium dioxide (TiO_2) of different sizes in the presence of fixed concentration of anionic surfactant (AOS) on foam stability. Nano particle concentrations of (0.1 wt%, 0.3 wt%, 0.5 wt%, and 1 wt%) were used to investigate the foam stability, displacement test were performed to determine oil recovery at the optimum concentrations for each nanoparticle. The stability of the aqueous foam was evaluated by the Ross-Miles

method using half-life measurements. All experiments were conducted at room temperature and pressure. The results revealed that all different NPs used were able to improve the stability of CO_2 foam at certain concentrations. However, aluminum oxide NPs showed better results compared to others in terms of foam stability and half-life time. In addition, 0.1 wt% of all NPs types gave the highest foam stability and half-life time. In conclusion, a low concentration of NPs is recommended regardless of type for improving form stability.

Keywords:

foam stability | nanoparticle | enhanced oil recovery | immiscible flooding | surfactant