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# Investigation of Synergy between Nanoparticle and Surfactant in Stabilizing Oil-in-Water Emulsions for Improved Heavy Oil Recovery

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**Abstract:** This study presents an experimental study, including phase behavior tests, rheology studies, core flooding and microscopic visualization tests for investigating the synergistic effect of nanoparticles and surfactants in stabilizing oil-in-water (O/W) emulsions for improved heavy oil recovery. The emulsion stability and rheology studies show that the addition of nanoparticles can not only improve the stability of the emulsion, but also greatly increase the bulk viscosity of emulsion. The core flooding conducted with the nanoparticle-surfactant stabilized emulsion show a marked improvement in oil recovery over the surfactant-stabilized emulsions. The tertiary oil recovery can reach over 40% of the initial oil in place (IOIP) for crude oil with the viscosity of 350 mPa·s at 50 °C. The micromodel tests indicate that the nanoparticles can thicken the emulsion to the desirable mobility, which can damp the viscous fingering phenomena to dramatically improve sweep efficiency. In addition, the heavy oil can be emulsified into the water phase to form oil-in-water emulsions with the aid of the surfactant. These results demonstrate that the nanoparticle-surfactant stabilized emulsion has a great potential for enhanced oil recovery in waterflooded heavy oil reservoirs.

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