Experimental Investigation of the Influence of Nanoparticles Adsorption on Wettability Alteration for Berea Sandstone

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Abstract

Nanoparticle, as part of nanotechnology has already drawn attentions for its promising potential of increasing oil recovery. In the last few years some publications have addressed this topic, but the basic enhanced oil recovery (EOR) mechanisms have not been released very clearly. Wettability alteration was proposed as an important EOR mechanism for nanoparticles fluid. In order to better understand nanoparticles adsorption behavior inside core and its effect on wettability alteration, a series of wettability index measurement experiments for oil wet, neutral wet and water wet Berea sandstone were conducted. The wettability index of core plugs without nanoparticles treatment and core plugs with nanoparticles treatment was measured by using Amott method. Both hydrophilic silica nano-structure particles (NSP) and hydrophilic silica colloidal nanoparticles (CNP) were utilized in above experiments.

The results of wettability alteration experiments indicated that hydrophilic nanoparticles have ability of changing wettability of Berea sandstone to be more water wet, and basically the higher concentration the more water wet will be. And different type of nanoparticles has different effect on the wettability alteration process. At the same concentration CNP can make oil wet core more water wet than NSP for oil wet core. While in neutral wet condition, lower concentration NSP can alter wettability to be more water wet than CNP, but at higher concentration core treated by CNP has higher wettability index than NSP. The initial wettability of core plug also can affect adsorption of nanoparticles inside core. Nanoparticles adsorption inside neutral wet and water wet core is stronger and more than their adsorption in oil wet core. Based on observation of wettability alteration experiments, the mechanism of nanoparticles adsorption alter wettability was proposed.
Wettability alteration mechanism of oil wet core

![Diagram showing wettability alteration before and after treatment by nanoparticle.]

Wettability index for oil wet cores treated by NSP

![Bar chart showing wettability index for different treatments.]

- Without treatment
- Treatment by NSP nanofluid (0.05 wt. %)
- Treatment by NSP nanofluid (0.2 wt. %)
- Treatment by NSP nanofluid (0.5 wt. %)