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Improving Enhanced Oil Recovery by Using Alkaline-Surfactant-Polymer Injection and Nanotechnology

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Abstract : The continuously declining oil reservoirs and reservoirs aging have created a huge demand for utilization of Enhanced Oil Recovery (EOR) methods recently. Primary and secondary oil recovery methods have various limitations and are not practical for all reservoirs. Therefore, it is necessary to use chemical methods to improve oil recovery efficiency by reducing oil and water surface tension, increasing sweeping efficiency, and reducing displacer phase viscosity. One of the well-known methods of oil recovery is Alkaline-Surfactant-Polymer (ASP) flooding that shown to have significant impact on enhancing oil recovery. As some of the biggest oil reservoirs including those of Iran's are fractional reservoirs with substantial amount of trapped oil in their fractures, the use of Alkaline-Surfactant-Polymer (ASP) flooding method is increasingly growing, the method in which the impact of several parameters including type and concentration of the Alkaline, Surfactant, and polymer are particularly important. This study investigated the use of Nano particles to improve Enhanced Oil Recovery (EOR). The study methodology included performing several laboratory tests on drill cores extracted from Karanj Oil field Asmary Formation in Khuzestan, Iran. In the experiments performed, Sodium dodecyl benzenesulfonate (SDBS) and 1-dodecyl-3-methylimidazolium chloride ([C12mim] [Cl])) were used as surfactant, hydrolyzed polyacrylamide (HPAM) and guar gum were used as polymer, Sodium hydroxide (NaOH) as alkaline, and Silicon dioxide (SiO2) and Magnesium oxide (MgO) were used as Nano particles. The experiment findings suggest that water viscosity increased from 1 centipoise to 5 centipoise when hydrolyzed polyacrylamide (HPAM) and guar gum were used as polymer. The surface tension between oil and water was initially measured as 25.808 (mN/m). The optimum surfactant concentration was found to be 500 p, at which the oil and water tension surface was measured to be 2.90 (mN/m) when [C12mim] [Cl] was used, and 3.28 (mN/m) when SDBS was used. The Nano particles concentration ranged from 100 ppm to 1500 ppm in this study. The optimum Nano particle concentration was found to be 1000 ppm for MgO and 500 ppm for SiO2.

Keywords : alkaline-surfactant-polymer, ionic liquids, relative permeability, reduced surface tension, tertiary enhanced oil recovery, wettability change
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