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Effects of Water Soluble Ions on Wettability Alteration and Contact Angel in Smart and Carbonated Smart Water Injection Process in Oil Reservoirs

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Abstract - As the demand for crude oil increases, the oil-producing countries try to increase production. Enhanced Oil Recovery (EOR) techniques play a significant role in improving oil production. Improved or smart water injection, among the methods, has higher performance due to its low cost. Carbonated smart water is injected to improve smart water capabilities. Dissolution of carbon dioxide in water will change chemical properties of the injected water to facilitate wettability alteration from hydrophobic to hydrophilic more effectively. Besides, it causes swelling and changes of oil density and viscosity by transferring from the aqueous phase to the oil phase. Adding CO₂ to the smart solution can have other effects, expressed as dissolution and carbonate rock weight alteration, in addition to the wettability alteration on carbonate rock. In this communication, NaCl, KCl, KI, MgCl₂, CaCl₂, Na₂SO₄, MgSO₄, and K₂SO₄ were used to produce smart water, and CO₂ gas was utilized to carbonate the water. Observational/visual and contact angle tests were then carried out to express wettability alteration of carbonate rock with smart water and carbonated smart water. These observational tests clearly indicate the wettability alteration property of injected materials. Carbonated smart water exposed to rock analysis shows that Mg²⁺ ion was higher in comparison with Ca²⁺ rate in tested carbonate rock. Therefore, we can say that the rock is a Dolomite one. Finally, by conducting tests on oil production imbibitions, we show that the smart water while utilizing the provided mechanism is capable of improving the oil production in contrast to imbibitions with normal water, such that the imbibitions with smart water increases the production 33% more in contrast to production with initial formation water.

Keywords - Wettability; Contact Angel; Smart water; Carbonated smart water; EOR; Water flooding.

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