



International Conference on Oil, Gas and Petrochemistry

April 3-5, 2017 Dubai, UAE

Enhanced oil recovery by Nitrogen and Carbon dioxide injection followed by low salinity water flooding for tight Carbonate reservoir: Experimental approach

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Enhanced Oil Recovery (EOR) techniques are one of the top priorities of technology development in petroleum industries nowadays due to the increase in demand for oil and gas which cannot be equalized by the primary production or secondary production methods. The main function of EOR process is to displace oil to the production wells by the injection of different fluids to supplement the natural energy present in the reservoir. Moreover, these injecting fluids can also help in the alterations of the properties of the reservoir like lowering the IFTs, wettability alteration, a change in pH value, emulsion formation, clay migration and oil viscosity reduction. The objective of this experiment is to determine the most effective EOR method in order to obtain the maximum residual oil recovery for low permeability carbonate core samples taken from Zakuum oil field in Abu Dhabi. The idea of this work is to combine both the interactions of the injected gas with the oil that results in the alternation of oil properties and the other property alteration which is caused by the low salinity water flooding as well as its sweep efficiency. This is done by a series of flooding tests on selected tight carbonate core samples by firstly using low salinity water as the base case and nitrogen & CO₂ injection followed by low salinity water flooding at reservoir conditions of pressure and temperature. The experimental results revealed that a significant improvement of the oil recovery is achieved by the nitrogen injection followed by the low salinity water flooding with a recovery factor of approximately 24% of the residual oil. Moreover, the contact angle of sea water and low salinity water were measured and the results revealed that the angle has increased with the low salinity water which indicates that the low salinity water can alter the wettability of the rock to intermediate level and hence improves the oil recovery. Therefore low salinity water was selected for this EOR method.