World Academy of Science, Engineering and Technology
International Journal of Energy and Power Engineering
Vol:17, No:07, 2023

Enhancing Heavy Oil Recovery: Experimental Insights into Low Salinity Polymer in Sandstone Reservoirs

Authors : Intisar, Khalifa, Salim, Al Busaidi

Abstract : Recently, the synergic combination of low salinity water flooding with polymer flooding has been a subject of paramount interest for the oil industry. Numerous studies have investigated the efficiency of enhanced oil recovery using low salinity polymer flooding (LSPF). However, there is no clear conclusion that can explain the incremental oil recovery, determine the main factors controlling the oil recovery process, and define the relative contribution of rock/fluids or fluid/fluid interactions to extra oil recovery. Therefore, this study aims to perform a systematic investigation of the interactions between oil, polymer, low salinity and sandstone rock surface from pore to core scale during LSPF. Partially hydrolyzed polyacrylamide (HPAM) polymer, Boise outcrop, a crude oil sample and reservoir cores from an Omani oil field, and brine at two different salinities were used in the study. Several experimental measurements including static bulk measurements of polymer solutions prepared with brines of high and low salinities, single phase displacement experiments, along with rheological, total organic carbon and ion chromatography measurements to analyze ion exchange reactions, polymer adsorption, and viscosity loss were used. In addition, two-phase experiments were performed to demonstrate the oil recovery efficiency of LSPF. The results revealed that the incremental oil recovery from LSPF was attributed to the combination of the reduction in the water-oil mobility ratio, an increase in the repulsion forces between crude oil/brine/rock interfaces and an increase in pH of the aqueous solution. In addition, lowering the salinity of the make-up brine resulted in a larger conformation (expansion) of the polymer molecules, which in turn resulted in less adsorption and a greater in-situ viscosity without any negative impact on injectivity. This plays a positive role in the oil displacement process. Moreover, the loss of viscosity in the effluent of polymer solutions was lower in low-salinity than in high-salinity brine, indicating that an increase in cations concentration (mainly driven by Ca2+ ions) has stronger effect on the viscosity of high-salinity polymer solution compared with low-salinity polymer.

Keywords : polymer, heavy oil, low salinity, COBR interactions
Conference Title : ICAOGCT 2023 : International Conference on Advances in Oil, Gas and Coal Technology
Conference Location : Vienna, Austria
Conference Dates : July 24-25, 2023