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Increasing Recoverable Oil in Northern Afghanistan Kashkari Oil Field by Low-Salinity Water Flooding

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Abstract : Afghanistan is located in a tectonically complex and dynamic area, surrounded by rocks that originated on the mother continent of Gondwanaland. The northern Afghanistan basin, which runs along the country's northern border, has the potential for petroleum generation and accumulation. The Amu Darya basin has the largest petroleum potential in the region. Sedimentation occurred in the Amu Darya basin from the Jurassic to the Eocene epochs. Kashkari oil field is located in northern Afghanistan's Amu Darya basin. The field structure consists of a narrow northeast-southwest (NE-SW) anticline with two structural highs, the northwest limb being mild and the southeast limb being steep. The first oil production well in the Kashkari oil field was drilled in 1976, and a total of ten wells were drilled in the area between 1976 and 1979. The amount of original oil in place (OOIP) in the Kashkari oil field, based on the results of surveys and calculations conducted by research institutions, is estimated to be around 140 MMbbls. The objective of this study is to increase recoverable oil reserves in the Kashkari oil field through the implementation of low-salinity water flooding (LSWF) enhanced oil recovery (EOR) technique. The LSWF involved conducting a core flooding laboratory test consisting of four sequential steps with varying salinities. The test commenced with the use of formation water (FW) as the initial salinity, which was subsequently reduced to a salinity level of 0.1%. Afterward, the numerical simulation model of core scale oil recovery by LSWF was designed by Computer Modelling Group’s General Equation Modeler (CMG-GEM) software to evaluate the applicability of the technology to the field scale. Next, the Kahskari oil field simulation model was designed, and the LSWF method was applied to it. To obtain reasonable results, laboratory settings (temperature, pressure, rock, and oil characteristics) are designed as far as possible based on the condition of the Kashkari oil field, and several injection and production patterns are investigated. The relative permeability of oil and water in this study was obtained using Corey’s equation. In the Kashkari oilfield simulation model, three models: 1. Base model (with no water injection), 2. FW injection model, and 3. The LSW injection model was considered for the evaluation of the LSWF effect on oil recovery. Based on the results of the LSWF laboratory experiment and computer simulation analysis, the oil recovery increased rapidly after the FW was injected into the core. Subsequently, by injecting 1% salinity water, a gradual increase of 4% oil can be observed. About 6.4% of the field is produced by the application of the LSWF technique. The results of LSWF (salinity 0.1%) on the Kashkari oil field suggest that this technology can be a successful method for developing Kashkari oil production.

Keywords : low-salinity water flooding, immiscible displacement, Kashkari oil field, two-phase flow, numerical reservoir simulation model
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