

Simulation Study on Effects of Surfactant Properties on Surfactant Enhanced Oil Recovery from Fractured Reservoirs

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Abstract : One objective of this work is to analyze the effects of surfactant properties (viscosity, concentration, and adsorption) on surfactant enhanced oil recovery at laboratory scale. The other objective is to obtain the functional relationships between surfactant properties and the ultimate oil recovery and oil recovery rate. A core is cut into two parts from the middle to imitate the matrix with a horizontal fracture. An injector and a producer are at the left and right sides of the fracture separately. The middle slice of the core is used as the model in this paper, whose size is 4cm x 0.1cm x 4.1cm, and the space of the fracture in the middle is 0.1 cm. The original properties of matrix, brine, oil in the base case are from Ekofisk Field. The properties of surfactant are from literature. Eclipse is used as the simulator. The results are followings: 1) The viscosity of surfactant solution has a positive linear relationship with surfactant oil recovery time. And the relationship between viscosity and oil production rate is an inverse function. The viscosity of surfactant solution has no obvious effect on ultimate oil recovery. Since most of the surfactant has no big effect on viscosity of brine, the viscosity of surfactant solution is not a key parameter of surfactant screening for surfactant flooding in fractured reservoirs. 2) The increase of surfactant concentration results a decrease of oil recovery rate and an increase of ultimate oil recovery. However, there are no functions could describe the relationships. Study on economy should be conducted because of the price of surfactant and oil. 3) In the study of surfactant adsorption, assume that the matrix wettability is changed to water-wet when the surfactant adsorption is to the maximum at all cases. And the ratio of surfactant adsorption and surfactant concentration (C_{ads}/C_{surf}) is used to estimate the functional relationship. The results show that the relationship between ultimate oil recovery and C_{ads}/C_{surf} is a logarithmic function. The oil production rate has a positive linear relationship with $\exp(C_{ads}/C_{surf})$. The work here could be used as a reference for the surfactant screening of surfactant enhanced oil recovery from fractured reservoirs. And the functional relationships between surfactant properties and the oil recovery rate and ultimate oil recovery help to improve upscaling methods.

Keywords : fractured reservoirs, surfactant adsorption, surfactant concentration, surfactant EOR, surfactant viscosity

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