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Effects of Matrix Properties on Surfactant Enhanced Oil Recovery in Fractured Reservoirs

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Abstract : The properties of rocks have effects on efficiency of surfactant. One objective of this study is to analyze the effects of rock properties (permeability, porosity, initial water saturation) on surfactant spontaneous imbibition at laboratory scale. The other objective is to evaluate existing upscaling methods and establish a modified upscaling method. A core is put in a container that is full of surfactant solution. Assume there is no space between the bottom of the core and the container. The core is modelled as a cuboid matrix with a length of 3.5 cm, a width of 3.5 cm, and a height of 5 cm. The initial matrix, brine and oil properties are set as the properties of Ekofisk Field. The simulation results of matrix permeability show that the oil recovery rate has a strong positive linear relationship with matrix permeability. Higher oil recovery is obtained from the matrix with higher permeability. One existing upscaling method is verified by this model. The study on matrix porosity shows that the relationship between oil recovery rate and matrix porosity is a negative power function. However, the relationship between ultimate oil recovery and matrix porosity is a positive power function. The initial water saturation of matrix has negative linear relationships with ultimate oil recovery and enhanced oil recovery. However, the relationship between oil recovery and initial water saturation is more complicated with the imbibition time because of the transition of dominating force from capillary force to gravity force. Modified upscaling methods are established. The work here could be used as a reference for the surfactant application in fractured reservoirs. And the description of the relationships between properties of matrix and the oil recovery rate and ultimate oil recovery helps to improve upscaling methods.

Keywords : initial water saturation, permeability, porosity, surfactant EOR
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