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Implementing a VES-Polymer Flood in Heavy-Oil Carbonate Reservoir – Laboratory Study

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Several large heavy-oil reserves in the Middle East, both in sandstone and limestone, require new management and production strategies in order to meet the global market demand for oil. Therefore, for many oil producers, the need to optimize oil production from these resources through advanced Enhanced Oil Recovery (EOR) technology is a main strategy to address reservoir management challenges.

In this paper, we describe the laboratory work performed to design a VES (Visco-Elastic-Surfactant)-Polymer formulation in a carbonate reservoir. The reservoir has a permeability of around 100 mD, a temperature of 45 °C, a salinity of 45 g/L TDS and oil viscosity of 800 mPa.s. At the start of the project, we have made an exhaustive selection of polymers and VES that can be applicable in the reservoir. As make-up water, there was a possibility to optimize the formulation on the salinity, having seawater and fresh water available in large quantities. The methodology consisted of starting with the tests with polymers, then performing the tests with VES, using the previously qualified polymers. The laboratory tests for each type of product consisted first of bulk tests, followed by core flood tests with the qualified products. The bulk tests consisted of rheology, filtration, stability and static adsorption experiments. Core flood tests consisted of experiments in reservoir cores at $S_w=100$, followed by experiments at residual oil saturation, followed by oil displacement experiments for the most appropriate VES-Polymer formulation. The experimental procedure aims at qualifying Polymer and VES-Polymer formulation and delivering core flood data set, which can be used as input data set for the reservoir simulations.

Results show that polyacrylamide of medium molecular weight and betaine is a viable option for this reservoir. The make-up water was fresh water coming from an abundant source. In addition, the optimal concentrations range from 500-750 ppm for the polymer and around 5000 ppm for the VES. The mobility reduction and permeability reduction were around 30 and 10, respectively. It should be noted that there is a clear synergy between polymer and VES, as VES adsorption is considerably reduced by the presence of polymer. Displacement efficiency of the VES-Polymer blend was high, reaching 60% of oil in place. This study shows that VES-Polymer Flood can be an EOR option for heavy-oil carbonate reservoir. The data set issued from the laboratory study has been used for the reservoir simulation study, which will be the subject of a subsequent paper.

Biography

German Omonte is working as Reservoir Engineer at POWELTEC, France. He is also a Vice Technical Manager at SUTEC import & Trading S.R.L