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The Performance of VES-Polymer Flood in Heavy-Oil Carbonate Reservoir – Simulation Study

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Large heavy-oil reserves are located in the Middle East, both in sandstone and limestone reservoirs. The exploitation of these reserves requires advanced EOR technology. This paper describes the reservoir simulation work performed to evaluate different flooding scenarios in a typical Middle Eastern carbonate reservoir. The reservoir has an average permeability of 100 mD, a temperature of 45 °C, a reservoir pressure of 1275 psia at a reference depth of 2487 ft. Oil viscosity at reservoir pressure is 620 mPa.s. The simulation study used the data set obtained by a laboratory study presented in another paper.

The reservoir model is divided in five layers, two main productive zones and three impermeable layers. Heavy oil reserves are located in the upper part of the reservoir. After evaluation of the performance and conditions of vertical and horizontal wells present in this reservoir, it was decided to continue the study with a pattern composed of three parallel horizontal wells; one central injector and two lateral producers. Sensitivity analysis was carried to determine the impact of well length, well spacing, injection rate and injected pore volumes for different recovery methods, namely water flood, polymer flood and VES (viscoelastic surfactant)-polymer flood. Data sets to simulate polymer and VES-Polymer blend were obtained from lab core flood study (IPV, adsorption, Mobility Reduction, Permeability Reduction and desaturation). The simulations exercises were performed for a period of 30 years.

The main results can be listed as follows:

1. Well's horizontal length has an important effect on production. Horizontal wells 2000 meters long were used during the study.
2. A well spacing of 100 meters was found to be the best configuration for a flooding recovery process.
3. Oil incremental recovery by water flood was improved. Mobility Ratio is highly unfavorable and channeling occurs very early.
4. Polymer flood shows better results compared to water flood in terms of incremental oil production. Mobility Ratio is improved, displacement front is better controlled and sweep efficiency increased.
5. VES-Polymer blend flood further increases the oil production compared to polymer flood. The effect of IFT reduction and increase of mobility reduction induced by the blend solution improves the sweep efficiency and mobilizes additional oil reserves.

Based on these outcomes, both polymer flood and VES-Polymer flood can be considered as valuable EOR options in Tayarat-heavy-oil reservoir. Results prove the feasibility of chemical EOR techniques in reservoir conditions which have not been considered so far. The injection designs can be used for a field pilot implementation.

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