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Sensitivity studies of different scenarios of polymer injection applied to Ainsa Quarry1 outcrop

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The presented work deals with polymer injection in an oil reservoir of which the geological organization is obtained thanks to an outcrop located close to the Ainsa town in southern Pyrenees, Spain. In this study the permeability distributions are not fixed. We address the following question: what is the impact of permeability distribution on the oil recovery considering a polymer slug injection. This question makes sense because the outcrop may be an analogue of different types of reservoirs. Indeed the outcrop helps to characterize the facies distribution but has a different geological story compared to a subsurface reservoir. Three different reservoirs are thus considered to be associated to three permeability distributions, respectively corresponding to a non-altered reservoir, a fractured reservoir and an unconsolidated reservoir. The second permeability model results from an upscaling step in order to take into account the presence of fractures. The large permeability values of the third permeability model are due to unconsolidated facies. Models are respectively called “permeable”, “fractured” and “unconsolidated”.

A water injection is modeled for 4 years with a pressure constraint of 500 bar. For each simulation, after a year of water flood, a polymer injection is carried out for two years. Finally, a water post-flush is injected until the end of the simulation. Polymer performance is tested against a water flood simulation whose final cumulated oil production equals to 0.2 hm³.

- Permeable model

By injecting 0.21 hm³ of water, 0.21 hm³ of oil is produced. Due to weak facies permeabilities pressure reaches quickly the imposed limit. As a consequence, the water injection rate decreases during the water flood and, even more strongly when polymer is added to the solution. Therefore polymer injection does not help to better produce oil in the permeable model.

- Fractured model

0.28 hm³ of oil and 0.2 hm³ of water are produced by injecting 0.65 hm³ of water. The produced water volume ratio (with and without polymer) is reduced by ~70%. Polymer injection is quite appropriate in this case since enhanced oil recovery reaches 40%.

- Unconsolidated sandstone

0.23 hm³ of oil is produced after injecting 0.87 hm³ of water. The high permeability allowed the injection of larger volumes of water and polymer solution. However, the oil recovery volume is decreased in comparison to the fractured case. An earlier water breakthrough and a higher produced water volume contribute to this bad performance.

As a conclusion, the polymer impact critically depends on the permeability distributions. If the reservoir permeability is too weak it will be difficult to inject polymer without damaging the reservoir or the injection wells. If the reservoir is too permeable, an earlier water breakthrough is observed which has a negative impact on oil production.

References

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