A Numerical Approach to Simulate and Design VAPEX Experiments

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Abstract

The Vapor Extraction (VAPEX) process is a promising technique directed towards heavy oil reservoirs that are typically thin and underlain with water, and cannot be exploited economically or technically by conventional thermal recovery methods. The VAPEX technique was developed by Butler and Mokrys in the 1990s as an alternative to Steam-Assisted Gravity Drainage.

This process is mechanistically complex and some questions regarding its expected performance are still pending. A numerical model can play a critical role in addressing important questions about the process. Specifically, a numerical model can predict the performance of the process, especially the occurrence and effect of asphaltenes precipitation during the â   upgradingâ   process.

This work proposes an alternative approach to simulate numerically the asphaltene precipitation effect of the VAPEX process. The model was constructed using a commercial thermal reservoir simulator. It was then validated using published experimental data. The effect of relative permeability curves, reaction frequency factor, selection of reactant, apparent dispersion coefficient, and operating parameters on performance were investigated. In addition, the model was used to design a physical experiment. The operating conditions of the experiment were optimized to represent the main mechanisms of the VAPEX process.

The results of the study indicate that the numerical model can reproduce the process with acceptable accuracy. Moreover, despite the significant viscosity reduction, it was found that there was no significant evidence to demonstrate blockage of fluid flow through the porous medium due to asphaltene precipitation. Further experiments would be required to confirm these findings.

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