Numerical Analysis of Solvent Mass Transfer in Oil Recovery

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Abstract

Generally, heavy oils and bitumen are most commonly extracted from the ground by shooting steam underground. The issue with this process is that most of that water is not reusable in the sense that it cannot be easily reintroduced to the environment. Unfortunately, this method of extracting oil from the ground requires large amounts of steam (water). One potential solution to minimizing the amount of water used is to add a solvent, much like paint thinner to paint, in with the steam -or even alone- in hopes of making the process more efficient. This process is referred to as VAPEX (Vapor Extraction) [1]. The research conducted was, simply put, a mathematical analysis of the movement of a solvent through an oil reservoir, in order to gain a better general idea of the processes occurring and the rate at which they occur. This process was modeled using a finite difference method in MATLAB to present us with a mathematical model of the physical system. The main aim of this summer's work was to evaluate the mathematical model under the assumptions that the speed of the solvent, and how it moves through the reservoir, both vary over time. In theory, this is a more realistic representation of what happens in the physical system. Research in this area is of interest to many different parties because processes such as VAPEX are aimed at combining the sustainability of the environment along with economic benefits; Two things that are not often mentioned in the same sentence. This research was primarily conducted to obtain a better understanding of the movement of solvents through an oil reservoir, and hopefully contribute towards a more widespread understanding of processes such as VAPEX, ultimately leading to a wider implementation of said processes.

[1] Lorimer, S., Boehnke, R., Brigida, M. 2015. Mass Transfer Behaviour in Hybrid Solvent Oil Recovery Processes.

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