Simulation of 1-D Heat Distribution in Heavy Oil Reservoirs During Steam Injection Process

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Abstract

Enhanced oil recovery (EOR) is expanding worldwide to produce more oil from the existing reservoirs to fulfil the demand of the global consumption, which increases on yearly basis. Thermal methods like steam injection and its variations are the most famous methods applied in heavy oil reservoirs and bitumen to produce as much as possible oil. Understanding heat distribution during this process is the keystone to optimize the process and reduce the cost of oil barrel.

Literature is still poor with research related to heat distribution in oil reservoirs during various thermal EOR processes. In this paper, a solution of 1-D energy equation during steam flooding process will be demonstrated in dimensionless form and the effect of conduction and convection terms on temperature propagation and the parameters that controls these effects will be explained as well. Solving this problem is conducted using the Mathematics interface in COMSOL Multiphysics® environment since there is no tackling to this problem using this software.

The results show that at low Darcy's velocity, conduction plays the most significant role during hot fluid injection in cold formations while convection has much less effect on heat propagation in the formation. On the other hand, when the Darcy's velocity increases, the effect of the convective term grows and this can be attributed to the significant role of in situ fluids to increase thermal dispersion within the reservoir. The results also illustrate that the steam injection rate has not always a positive effect on heating up the porous medium.