Heat Transfer Modeling for Thermal Stimulation of Near Wellbore Using COMSOL Multiphysics®

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Abstract

The performance of the oil reservoir is decisively determined by the hydraulic permeability of the rock and the possible flow paths. During the production phase, the petrophysical properties of the rock may deteriorate due to highly viscous oil deposits, especially in the near of the borehole. Therefore, it is a challenge to restore the permeability in this area. In order to remove the deposits again and improve the productivity, thermal energy is supplied to underground. The generation of the heat underground using a chemical reaction (Thermit method) represents a new approach for the cleaning of the near borehole area.
A numerical simulation was carried out with the simulation software COMSOL Multiphysics® to support the laboratory tests. Two physics interfaces were used to describe the problem; a Nonisothermal Flow physics interface to present the fluid flow and the heat transfer in water inside the wellbore and the Heat Transfer in Porous Media physics interface to present the temperature distribution in the saturated sand near the wellbore.
Based on the comparison between calculated and measured temperatures the model was modified and then the simulation results showed a good match in comparison to the actual temperatures.
A sensitivity analysis was carried out with COMSOL Multiphysics® to show the important influencing parameters on the calculation result and the results were presented in a tornado and spinning diagram.

Figures used in the abstract

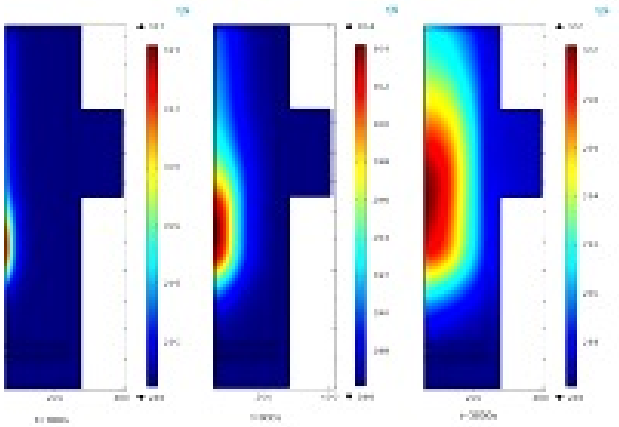

Figure 1: Temperature distribution in water-saturated sand at certain times.