Computational Study of Fluid and Heat Transport in Fractured Porous Media for Geothermal Energy Extraction

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Abstract

This study focuses on simulating heat transport processes in fractured porous media for the purpose of evaluating both saturated geothermal reservoirs and hot dry rock reservoirs. Downhole heat exchanger is employed and placed in a long lateral wellbore in a confined geothermal reservoir. Natural convection patterns in saturated porous media that are induced due to the heat extraction process influence the overall amount of heat extracted. Verification and validation studies, involving both flat [(Costa, 2006), (Sathiyamoorthy et al., 2007)] and dipping systems (Baez and Nicolas, 2007), are presented to evaluate the predictive capability of the thermal reservoir simulator.

Discrete Fracture Network (DFN) is used to model flow and heat transport in hot dry rock reservoirs, where the matrix is subject to a low permeability and fracture network takes most of responsibility to conduct fluid. Finite volume method is used to discretize equations. The results produced by continuum method, based on the calculation presented by Svensson (2001), are included as references. Calculations of both fracture connectivity and orientations are verified separately with the work done by Karimi-Fard (2003, 2004). An example case is covered to demonstrate the heat pattern induced by a given fracture network.