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Mathematical modeling of the geothermal reservoir with multi-borehole circulating system

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Abstract

A three-dimensional model (FRACSIM-3D) developed in Tohoku University for numerical simulation of heat and fluid flow within the fractured media is used in the analysis of geothermal reservoir performance. The model effectively simulates two main stages of the geothermal reservoir exploitation, namely, (i) hydraulic stimulation of the existing natural fractures within the Hot Dry Rock (HDR) reservoir and (ii) forced convection through the fractured media when the filtrating fluid extracts the heat from the hot rock and delivers it to the production well. Since the heat accumulated by the fluid within the system of injection boreholes can constitute a substantial fraction of the total thermal output of the geothermal power plant, the model of heat and mass transfer in the fractured media at the heat extraction stage should be coupled with the equations which describe the heat transport in the system of injection and production wells. Mathematical modeling of heat flow within the multi-borehole circulating system is proposed in this study. On the basis of this model the major parameters that affect the thermal productivity of the geothermal power plant are analyzed. The effective regimes of the fluid circulation and optimal geometry of the multi-borehole system are proposed.

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