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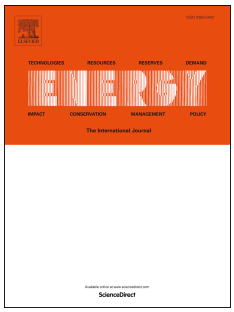

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Semi-analytical model for a geothermal system considering the effect of areal flow between dipole wells on heat extraction

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Abstract

Optimization of well placement in a geothermal system is an important topic for maximizing the heat economically extracted from a conductive geothermal reservoir. In order to understand the role of well placement, this paper presents a semi-analytical model in which fluid circulates in a single, horizontally planar geothermal reservoir with a constant hydraulic aperture via dipole wells in the presence of a 2D areal or regional flow field. By using a new coordinate system based on the velocity potential and the streamline function, analytical solutions in the Laplace space for the temperature field are found, which are then numerically inverted to obtain time-domain results. The effects of some factors such as well separation, areal flow direction, flow rate, and the velocity of the areal flow on heat recovery are investigated. It is found that the dimensionless areal flow velocity, $U_0=v_0\omega\pi L/Q$, and the angle of the areal flow, β, play an important role in maximizing the output temperature and the lifetime of dipole wells. When $U_0\leq 0.5$, the angle for minimizing interflow between wells should be $\beta=0$; when $0.5<U_0<0.7854$, the angle for minimizing the interflow should be $\beta=\arccos(0.5U_0)$; when $U_0>0.7854$, the injection well should not be placed upstream.

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Keywords: Geothermal system; Closed-loop; Dipole well; Recharge and discharge; Analytical solutions; Efficient and accurate