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Advances in Mathematical Modeling of Hydraulic Stimulation of the Hot Dry Rock Geothermal Reservoir

Sergei A. Fomin, Toshiyuki Hashida

Fracture Research Institute, School of Engineering, Tohoku University, Sendai, Japan

Hydraulic stimulation is an effective method of enhancing hot dry rock geothermal system productivity. The 3D structure of the fractured rock is approximated by the network model of “fractal geometry”, which is generated by distributing fractures randomly in space and assuming the fractal power-law equation for correlating the number of fractures and fracture length. This procedure makes it possible to characterize the geothermal reservoirs using parameters measured from field data. The proposed mathematical model accounts for normal and shear stresses in the rocks, fluid pressure variation and fracture dilation caused by fracture shear offset. Along with the fractal-type distribution of the fracture lengths, the fracture surfaces are also assumed to follow fractal geometry. Taken together, these tools permit the approximate engineering resolution of the multi-parametric, highly complex mechanical problem. The reliability of the developed model was validated by comparisons with the experimentally determined data for the Hijiori Deep Reservoir, Japan.

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