Patching Hele-Shaw cell to model fracture networks

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Abstract

Over time, the extraction and reinjection of geothermal fluid to generate electricity results in a decrease in the overall pressure of a geothermal reservoir. This results in the precipitation of minerals that causes blockages in power station equipment and the rock fractures in the reservoir; as well as a lower flow rate available for electricity generation. A better understanding of the fluid flow in a fracture network is required to better predict the performance of the reservoir over time. Modelling the flow in a fracture networks is however very challenging because of the disparity of length scales involved: a fracture aperture can be on the order of millimetres but fractures can span kilometres. Earlier models have either used very simplistic approximation of single fractures to be able to explore large fracture networks using the electrical networks analogy or a very detailed model of single fractures using the full Navier-Stokes equation but were limited to small fracture networks due to the computational cost. The Hele-Shaw approximation has been shown to be a useful model to represent the flow through a single fracture with potentially complex shape. This work investigates how multiple intersecting fractures forming a network can be modelled by patching together Hele-Shaw cells, opening the door to more accurate modelling of complex, realistic fracture networks.

Keywords: Fracture network, Hele, Shaw approximation

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