Geophysical Research Abstracts
Vol. 21, EGU2019-6151, 2019
EGU General Assembly 2019

Experimental and numerical investigation on water seepage through transparent synthetic rough- walled fractures

Ali Ranjbar (1,2), Alexander Scheuermann (2), Claudia Cherubini (3,2), Ling Li (4,2)

(1) Department of Civil and Environmental Engineering, K. N. Toosi University of Technology, Iran, (2) School of Civil Engineering, The University of Queensland, Australia, (3) Department of Physics and Earth Sciences, University of Ferrara, Italy, (4) School of Engineering, Westlake University, China

The analysis of single phase flow through fractured media is of importance for groundwater management and oil recovery. Although a natural rough fracture might have a complex geometry, the fracture aperture networks can be defined by a statistical distribution. This study involves infiltration experiments on transparent synthetic fractures to visualize the inhomogeneous flow distribution and quantify the flow field under different fracture geometries. Many fracture surfaces based on different fractal dimensions, standard deviation and mismatch wavelengths were designed using the SynFrac model and were generated by the 3D printing technology. The fracture surfaces were moulded using transparent epoxy resin to trace and quantify the preferential flow path and saturation distribution using digital image analysis. An experimental apparatus was designed by attaching a small constant head along the flow path and two no-flow boundaries in other sides. The experimental apparatus was set up so as the inclination of the fracture samples can be varied to study the interplay between the gravity and capillary forces and to detect zones of preferential flow.

The three-dimensional Lattice Boltzmann method (LBM) was employed to simulate the transient flow behaviour between two fractures. To assess the proposed conceptual models, the observed experimental velocity vectors and flow rates were compared with LBM model's simulated values. Results also showed a high correlation between the observed and simulated values, confirming the capability of the LBM model to simulate slow flow conditions in fractured media.

Keywords: Single phase fluid flow; Fractured media; Preferential paths; LBM model.