Influence of Inertial and Centrifugal Forces on Flow Rate and Patterns of Flow in Natural Fracture Networks

Fluid injection or withdrawal are common in subsurface engineering applications, inducing peak velocities of $\geq$ meters per second in wide-aperture fractures. Although inertia effects are well documented for channel flow, discrete fracture flow models often treat fracture flow as laminar creeping flow or try to account for inertia effects via constitutive relationships. Centrifugal forces acting on the fluid passing through fracture intersections are largely ignored.

This numeric simulation study investigates how flow patterns and spatial variations of flow velocity vary with the total fluid flux through a fracture network. After verification with a fracture intersection model, a Reynolds-averaged Navier Stokes solver is applied to an outcrop-based discrete fracture model, in this sensitivity analysis. Our results show how fluid inertia affects the flow velocity spectra and the partitioning of flow among fractures already at velocities greater than ~1-cm/sec. The significant effects seen, highlight the need for an improved model of fracture flow.

Participation

Online

References

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