Particle Swarms in Fractures with Uniform, Converging or Diverging Apertures

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ABSTRACT:

The transport of micro-scale particles through rock fractures commonly occurs as a dispersion or emulsion. However, the seepage of small liquid drops containing thousands to millions of particles is another potential method of transport. These particle swarms are a collection of discrete particles and, as such, exhibit group behavior, leading to interesting evolution and transport. Several types of artificial fracture were investigated to determine the effect of confinement on particle swarm behavior. The behavior of a swarm depends strongly on both fracture type and fracture aperture.

A fundamental feature of particle swarms is that the group travels faster than an individual particle would on its own. This difference can be quite significant. Experimental results indicate that for certain particle types the group velocity can be 1000X greater than the Stokes' Law single particle settling velocity. Due to their nature, swarms are inherently unstable in the long term. In most cases this leads to an eventual loss of cohesion and bifurcation into two smaller swarms. This loss of cohesion is strongly influenced by the fracture and is governed by competing drag and confinement forces.

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