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Particle Swarm Transport in Porous Media

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ABSTRACT

In recent years, interest in particulate transport in the subsurface has increased with the increased use of micro-particulates in consumer products. In this research, we study particulate swarm transport through porous media that depends on the complexity of the flow paths, on the size and shape of the particles and on the physical interactions among the particles, fluids, and matrix. Specifically, we investigate the effect of pore geometry and grain wettability on swarm evolution under gravity. Swarms were composed of 3 micron polystyrene beads in either water or water with KCL (%). Two types of grains are used to simulate a porous medium: (1) hydrogel spheres that are hydrophyllic and (2) 3D printed PMMA spheres that are hydrophobic. We found that a hydrophillic matrix resulted in a wider transport path and caused an increase in bifurcations when compared with the hydrophobic PMMA. We also observed that as the swarms increased in volume the number of bifurcations increased. Bifurcations occurred around the beads creating a more widespread dispersed transport path. The potential spread of particulate contaminants by swarms will depend on the hydrophobicity or hydrophilicity the grains, yielding either increased dispersion or more highly localized concentrations.

KEYWORDS

Porous Media, Micro-particle Transport, Fluorescent Imaging