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Particle deposition and clogging over rough natural fractures with surface attachments

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Particle transport in rough natural fractures has seen diversified potentials and applications in environmental engineering and resource development engineering. Despite intensive and outstanding research on their transport phenomena, the impact of surface attachment and confined space of rough natural fractures on particle transport remains poorly understood.
In this work, we simulated the transport behavior of micro-particles using a coupled computational fluid dynamics and discrete element method (CFD–DEM) approach, accounting for irreversible surface attachment and particle-particle interactions in rough fractures with spatially varying apertures. Rough fracture geometries are generated with the geostatistical simulator SgeMS by two dimensionless roughness parameters. The influence of roughness parameters and surface attachment on the flow field and micro-particles migration are investigated. Numerical results indicate that surface attachment will intensify the particle sediment and clogging over a rough fracture especially at the fracture inlet zone. As the fracture aperture gradually decreases, and the contact area increases, resulting in a more complicated flow field and transport behavior. In addition, the particle deposition rates were increased by the mean roughness and an uneven particle distribution can be observed. Rough fracture walls will not only lead to more energy loss due to frequent particle-particle and particle-fracture contact, but also resulting in an increase in the average particle velocity. The overall findings will shed light on understanding clogging and deposition characteristics of particles in subsurface rough natural fractures.

Participation

In-Person

References

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