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Simulation of Bubble-Aggregate Attachment in Froth Flotation Using Computational Fluid Dynamics and Discrete Element Method (CFD-DEM) Coupling

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ABSTRACT

In Froth flotation particles smaller than 20 microns are difficult to recover because of low bubble particle collision and attachment. One of the ways to recover particles that are smaller than 20 microns is by aggregation. Fine valuable mineral particles can be selectivly aggregated to create floccs of optmum size for recovery in froth flotation. However, the bubble-aggregate attachment occurs in a milisecond time frame and micrometre-length scale, which limits the observation of the process experimentally. We developed a bubble-particle attachment model using Computational Fluid Dynamics (Volume of Fluid)-Discrete Element Method (CFD (VOF)-DEM) three-phase coupling to simulate bubble-particle interaction at a micro-length scale and milisecond time frame. The model shows that the particle recovery increases as the contact angle (20º to 90º) and particle size (15 to 71 microns) increase, in agreement with particle recovery experiments. The model is also extended to capture the attachment of 40 to 70 µm fractal-like aggregates (composed of 10-µm-primary particles) to air bubbles. The aggregate recovery is higher than that of fine 10-micron spherical particles. The effect of the critical contact angle and aggregate structure on recovery is also investigated.

KEY WORDS

Froth Flotation; Bubble-Aggregate Interaction; Bubble-Particle-Interaction; CFD-DEM; CFD-(VOF)DEM

BIOGRAPHY

Tareq is a PhD student in the Chemical Engineering Department at the University of Melbourne. His current research focuses on understanding bubble-particle and bubble-aggregate interaction

at the microscale using CFD-DEM simulations to improve recovery of fine particles in froth flotation.

Previously, Tareq used CFD to simulate the release of a trapped oil blob in a constricted capillary tube under external excitation for enhanced oil recovery purposes. He also investigated the in-situ stresses orientation change resulting from gas production in shale gas reservoirs by coupling fluid flow in porous media with geomechanics using FEM simulations.

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