Simulation of bubble-particle attachment using smoothed particle hydrodynamics

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ABSTRACT

Adhesion of mineral particles to the bubble surface is a fundamental and important step in froth flotation. Balance among van der Waals force, capillary force, and hydrophobic force determines the key feature of the bubble-particle attachment, and especially hydrophobic force plays a critical role in the process. Several theoretical models for hydrophobic force are available. The limitation of those models is that they are based on the assumption that the effect of bubble deformation on the process is negligible, which is not the case in reality [1].

In this work, we introduce a novel approach to describe the bubble-particle attachment using smoothed particle hydrodynamics (SPH), a Lagrangian computational fluid dynamics (CFD) model. Surface tension models from literature and a novel repulsion-based-model were implemented on the framework of SPH, and tested to see if the models can capture the various surface-tension-related phenomena such as contact angle formation and bubble oscillation. The result agreed well with theory. Then the attachment process was described in the context of kinetic time. In this model, the induction time, the amount of time required for film thinning, film rupture, and three-phase contact line expansion, is compared to the sliding time of particle over the bubble surface to determine whether the particle attaches on the bubble or not [2].

Simulation was conducted under various conditions of material-specific surface property, and then compared with other experimental results and theory. The result shows that our SPH model can successfully simulate the dynamic process of bubble-particle attachment. The result of this work will be used in multi-scale modelling of froth flotation process.

REFERENCES

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