

Modelling and simulation of froth flotation process based on smoothed particle hydrodynamics

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ABSTRACT

Froth flotation is a major unit operation in the field of mineral processing. Numerical modelling of a froth flotation process is very challenging owing to the intrinsic complexity of the process. The interactions among the three phases involved in froth flotation, i.e., bubble, water, and powder (we refer to them collectively as dust), take place in a very complicated manner, and the kinetics of flotation is related to numerous sub-processes that take place over wide ranges of length and time scales. Also, the poly-dispersed nature of the bubble phase can influence the flotation rate significantly.

We introduce a novel numerical framework based on smoothed particle hydrodynamics (SPH) to numerically describe the froth flotation process. The model assumes that the interspacing between dusts or bubbles is sufficiently smaller than the typical length scale of the flow, and therefore, both dust and bubble phases can be treated as a continuum. Therefore, all the three phases are represented by SPH particles with different properties. Both the bubble and dust phases interact with the water phase in terms of pressure and drag.

The attachment and detachment of dust particles on bubble surface is represented by mass transfer between SPH dust particles and SPH bubble particles. Mass transfer coefficients which are closely related to the flotation kinetics can be determined by correlating to the conventional probability model of bubble-particle attachment. Contribution of mass change of the SPH particles owing to the mass transfer were taken into account in all the governing equations including smoothing length calculation and continuity equation.

The results of this work show that the new algorithm is capable of describing the froth flotation process while conserving mass and momentum. The mass transfer rate of dust between pulp and bubble should be related to the surface property of particles and solution chemistry in a future work. Ongoing work includes the correlation of bubble-particle interaction force and mass transfer rate coefficients.