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Numerical simulation of bioleaching pond reactors coupling CFD and heat balance modelling

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Summary

A new technology of bioreactor was recently developed for bioleaching applications. It consists in ponds where pulp suspension and gas-liquid mass transfer are achieved with floating agitators[1,2]. Bioleaching reactions are significantly exothermic with high oxygen requirements and thus need temperature regulation to maintain biological activity. Contrary to conventional stirred tank reactors, the temperature in ponds may be difficult to regulate through heat exchangers. A numerical strategy was developed to design an industrial demonstration of the concept and to select suitable operating parameters. Firstly, Computational Fluid Dynamics was used to model the system's hydrodynamics and to define the volume of influence of one single agitator, the number of floating agitators and the mechanical power dissipated into the fluid. Then, a heat balance model was developed to characterize the impact of each heat transfer contribution (operating and environmental conditions) on temperature regulation. Various location (equatorial and sub-arctic climates) and geometries (stirred tank, pond) were simulated for the model development. These simulations showed that, for low sulfide concentrations, by controlling aeration (flow rate and oxygen partial pressure) and the fresh pulp inlet conditions (flow rate, temperature), the temperature can be maintained in a suitable range (40 to 50°C).

Keywords: Bioleaching, pond, floating agitator, CFD, heat balance, triphasic reactor.

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