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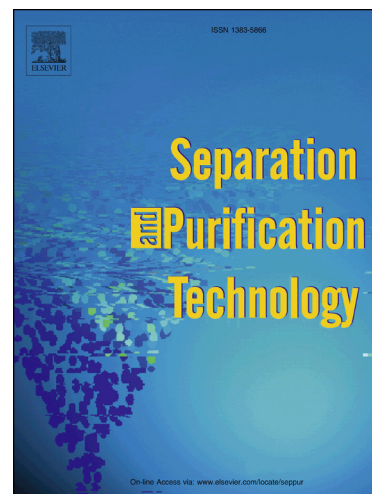
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CFD analysis of solid particles properties effect in three-phase flotation column

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Abstract

A Computational Fluid Dynamics (CFD) model of flotation column was developed and validated against published experimental data. The model is based on an Eulerian multi-fluid formulation with $k-\epsilon$ turbulence model and includes three phases: gas bubbles, liquid and solid particle suspended in the liquid. The model is developed by writing FORTRAN subroutine and incorporating then into the commercial CFD code AVL FIRE, v.2014. The gas holdup in flotation column was predicted as a function of superficial gas velocity and solids concentration. The effect of particle type, density, wettability and concentration on gas holdup and bubble hydrodynamics (i.e. bubble size distribution, and attached particle density) were studied. The rate of removal of particles from the pulp zone was obtained with kinetic equations for the three sub-processes: collision, attachment, and detachment involving number density of bubbles and particle concentrations, which were also calculated in this model. As confirmed by the comparisons with available data, the modeling methodology proposed in this work represents the physics of flotation column consistently, since the CFD model correctly predicts the experimental effects of gas flow rate and solid concentration on gas holdup within the range of $\pm 20\%$. It was found that the addition of hydrophobic particles to the air/water mixture promotes bubble coalescence and, therefore, reduces the gas holdup, while the addition of hydrophilic particles suppresses bubble coalescence and increases the gas holdup. It was also found that the increase of gas flow rate leads to an increase in the attached particle density due to the increase of the concentration number of bubbles that were available for the attachment process. Further, the increase of hydrophobic particles concentration led to an increase in the attached particle density.

Keywords: CFD, froth flotation, bubble coalescence, gas holdup, solid properties.

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