CFD-Based Multiscale Modelling of Bubble-Particle Collision Rates and Efficiencies in a Flotation Cell

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Abstract

Prediction of flotation kinetics has not been possible because of the complexity of the particle bubble interactions in the turbulent three-phase process. Typical industrial scale flotation cells contain many millions of bubbles and particles, so a direct 3D numerical modelling approach resolving bubble and particle scales would require far more computational power than will be available for many years. CFD models have therefore been developed using time-averaged RANS and multi-fluid techniques. These models require the inputs on bubble-particle collisions in turbulent flows. Research has been carried out to investigate bubble-particle collisions, but has been restricted to the two limiting cases that can be treated theoretically: Stokes flow and potential flow. More realistic situations have not been considered. To address this problem, a multi-scale modelling approach is proposed in this paper, whereby CFD modelling is carried out at both the macro (cell) scale and micro (bubble) scale with closure relations for the macro-scale models determined through analysis of the micro-scale models. A methodology is developed to investigate the elementary characteristics of bubble-particle collisions in turbulent flows using CFD modelling, and the use of these characteristics, primarily collision frequency and efficiency, in a macroscale model of a flotation cell.