Three-Way Coupling Simulation of a Gas-Liquid Stirred Tank using a Multi-Compartment Population Balance Model

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ABSTRACT

Modelling of gas-liquid stirred tanks is very challenging due to the presence of strong bubble-liquid interactions. Depending upon the needs and desired accuracy, the simulation may be performed by considering one-way, two-way, three-way or four-way coupling between the primary and secondary phase. Accuracy of the prediction on the two-phase flow generally increases as the details of phase interactions increase but at the expense of higher computational cost. This study deals with two-way and three-way coupling of gas-liquid flow in stirred tanks which were then compared with results via four-way coupling. Population balance model (PBM) based on quadrature method of moments (QMOM) was implemented in a multi-compartment model of an aerated stirred tank to predict local bubble size. The multi-compartment model is regarded as three-way coupling because the local turbulent dissipation rates and flow rates were obtained from a two-way computational fluid dynamics (CFD) simulation. The predicted two-phase flows and local bubble size showed good agreement with experimental data.

KEYWORDS: Computational fluid dynamics; multi-compartment model; three-way coupling; population balance model; gas-liquid

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