Modelling Cavitation in a High Intensity Agitation Flotation Cell

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Abstract

The presence of small scale air bubbles has been observed to enhance both fine and coarse particle flotation in a flotation cell. In a high intensity agitation (HIA) cell, these bubbles can be induced by cavitation. In this work, the cavitation in a HIA cell, used in our laboratory, is computationally studied. CFD modeling has been used in the past to study flow pattern in flotation cells and the predicted velocity was in agreement with measured values [1].

Several different types of impellers (2-vane and 4-vane flat blade, 4-vane pitched blade, and 6-vane radial disk turbine) are studied to obtain flow patterns of velocity, pressure and turbulent dissipation rate in a two-baffled HIA cell. The simulation predicts that 4-vane flat blade turbine dissipates more power than other turbines in the given HIA cell. Different turbulence models are attempted and the Realizable k-ε model predicted the highest power number.

A cavitation model is used in conjunction with a multiphase mixture model to predict the vapor generation in the HIA cell. Cavitating flow is simulated at different RPM, different dissolved air concentration, and at different operating temperatures to understand the dependency of hydrodynamic cavitation on these operating parameters. Predicted volume fraction of vapor showed a strong dependency on fluid operating conditions like temperature and dissolved gas content, as expected. For comparative study, cavitation in a pressure driven flow through a constriction is also modeled.

A population balance model is used to obtain the bubble size distribution of the generated cavities. Since there was no in-built coupling between Cavitation model and Population Balance Model in the software used (Fluent), a User Defined Function is used to couple cavitation with Population Balance model. The vaporization rate term is successfully incorporated using UDF.

Keywords: High intensity agitation, flotation cell, impeller, CFD, Multiphase, hydrodynamic cavitation, bubble size distribution, population balance model, mixture model, turbulent dissipation rate

Reference: 1) P. T. L. Koh, M. P. Schwarz, Y. Zhu, P. Bourke, R. Peaker, and J. P. Franzidis, Development of CFD models of mineral flotation cells, *Third International Conference on CFD in the Minerals and Process Industries*, CSIRO, Melbourne, Australia, 10-12 December, 2003.

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