Particle Image Validation of a Classifier Hydrodynamic Model

Damien Boudeville[1], André Leclerc[2], Romain Chesnaux[3], Guy Simard[4] and Alain Boivin[5]
1. Graduate Student,
2. Professor,
3. Professor,
4. Professor,
Université du Québec à Chicoutimi, Chicoutimi, Québec, Canada
5. Senior Research Scientist,
Arvida Research and Development Centre, Rio Tinto, Jonquière, Québec, Canada
Corresponding author: aleclerc@uqac.ca

Abstract

The aim of the project documented here is to study the hydrodynamic behaviours observed in an alumina hydrate classifier. The flow pattern in a classifier influences the sedimentation: large particles (~ 100 μm) fall towards the underflow under the effect of gravity, while fine particles (~ 10 μm) are transported by upward flows and are evacuated at the overflow. An efficient classifier allows for an appropriate particle segregation based on targeted sizes at the overflow and underflow. In this project the flow pattern is described by a mathematical model of turbulence with a free surface that is calculated by finite elements using the ANSYS FLUENT software. The free surface represents the air / water interface of the overflow through the two-phase model VOF (volume of fluid). Many turbulence models may be found in the literature. To select the most appropriate one, an experimental validation is conducted by particle image velocimetry (PIV), where a thin slice of the classifier tank is illuminated (laser tomography) and the velocity field is measured with a high-resolution digital camera. This study is carried out in a 48.3 cm diameter pilot classifier and maps of the fluid velocity field by measuring the velocity of fine tracer particles representative of the fluid flow. The velocity field favors the k-epsilon turbulence model which provides, along with the free surface, an accurate representation of the velocity field in the classifier.

Keywords: Classifier hydrodynamic modeling; turbulence models; alumina hydrate classifier; Particle-size distribution (PSD); ANSYS FLUENT.