

Size Distribution Modeling in FLUENT

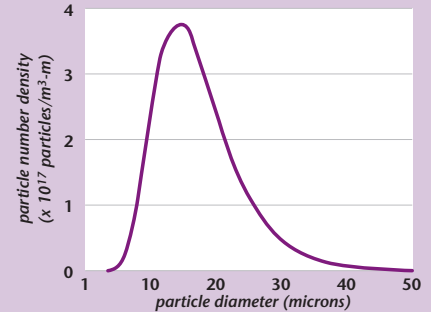
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In many industrial applications involving multiphase flow, the size distribution of particles, bubbles, or droplets can evolve in conjunction with transport and chemical reaction. The evolutionary processes can be a combination of different phenomena, such as nucleation, growth, dispersion, dissolution, aggregation, and breakage. In CFD models of these systems, a balance equation is required to describe the changes in the particle population.

Population balance can be applied to a wide range of applications such as crystallizers, bubble columns, fluidized bed reactors, sprays, soot formation, oil-water separators, and aerosols. There are several approaches to solving the population balance equations, and each is more suited to one application area than another. A discrete method divides the particle population into a finite number of size intervals or bins, and keeps track of particle transfer among the bins. A moment method solves for moments of the population balance equation, providing aver-

age and total properties of the distribution. In the classical moments approach, no assumptions are made about the size distribution and the equations are formulated in a closed form involving only functions of the moments themselves. However, this exact closure requirement poses a serious limitation as aggregation and breakage phenomena cannot be written as functions of moments. The quadrature method of moments overcomes this limitation with an approximate closure using Gaussian quadrature.

Population balance is a salient component of modeling transport phenomena and chemical reactions. Fluent has undertaken significant development efforts in this area during the last three years through a Department of Energy Office of Industrial Technologies (DOE-OIT) program. All three of the size distribution modeling approaches have been implemented, and these are currently being offered in the form of application-specific consulting services for interested clients. ■



The predicted particle size distribution of KCl in a batch crystallizer using the discrete method; the solubility curve of KCl is modeled as a linear function of temperature, and crystal nucleation and growth are modeled using a typical supersaturation power law