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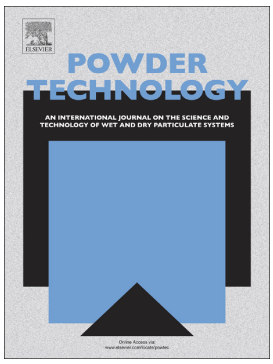

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A CFD-sectional algorithm for population balance equation coupled with multi-dimensional flow dynamics

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ABSTRACT

A novel CFD-sectional algorithm is developed to address the challenges in the existing sectional simulations coupled with multi-dimensional fluid dynamics, including solution of complex sectional coefficients, serious computational burden for lots of coupled partial differential equations, and nonlinear source terms. The sectional coefficients are specified by a numerical quadrature with adaptive integration limits, which proves to be computationally efficient and accurate. The inter-equation coupling is treated by hybrid-segregated procedures and the source term is linearized by the operator splitting method. The CFD-sectional algorithm is validated against a self-preserving solution of particles undergoing Brownian coagulation. The acoustic agglomeration in a standing wave is simulated as a representative case. It has been demonstrated that the predictions regarding the particle size distribution and agglomeration process agree well with the experimental data, which verifies the capability of the developed CFD-sectional algorithm in simulating the spatially inhomogeneous population balance equation coupled with multi-dimensional flows.

Keywords: population balance modeling; sectional method; computational fluid dynamics (CFD); coalescence/agglomeration; acoustic agglomeration

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