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CFD modeling the hydrodynamics of binary particle mixture in pseudo-2D bubbling fluidized bed: Effect of model parameters

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Abstract:

The hydrodynamics of binary coal-sand mixture in a pseudo-2D rectangular bubbling fluidized bed (0.385 m × 0.005 m × 0.128 m) was simulated using the multi-fluid Eulerian model incorporating the kinetic theory of granular flow. Parametric studies of the boundary wall condition, particle-particle restitution coefficient, friction packing limit, as well as transport equation for granular temperature were performed to investigate their influences on the predicted mixing/segregation behavior. The CFD simulation results demonstrated that the predicted mixing behavior was closely related to the expression for granular temperature transport equation and specularity coefficient. When the full transport equation for granular temperature was adopted, the predicted mixing degree decreased with the increase of specularity coefficient. And the best agreement between simulation results and experimental data was achieved when specularity coefficient was equal to 1.0. Nevertheless, when the algebraic transport equation for granular temperature was adopted, the system was always predicted in well-mixing rather than segregation state. Under the full transport equation for granular temperature and the no slip boundary wall condition, the predicted mixing degree decreased with the increase of the particle-particle restitution coefficient and frictional packing limit. The supplementary simulations indicated that for the considered gas-solid system there exist a critical bed thickness larger than which the system was in well-mixing state and the simulation results were independent from the investigated parameters. The hydrodynamic analysis indicated that the reduction of bubble size and the solid axial movement could be the mechanism responsible for the occurrence of axial segregation.

Key words: Bubbling fluidized bed; mixing; restitution coefficient; solid shear viscosity;