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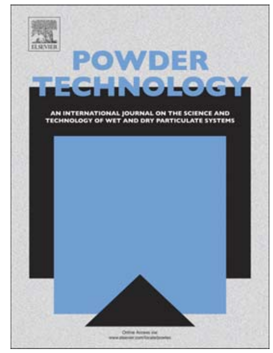

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The crucial role of frictional stress models for simulation of bubbling fluidized beds

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Abstract

In this paper we combine Eulerian-Lagrangian and Eulerian-Eulerian frameworks to simulate the behavior of a limited number of fuel particles in a bulk of inert particles in a bubbling gas-solid fluidized bed. The gas and the inert phase are treated as interpenetrating continua and resolved within the Eulerian-Eulerian framework, whereas the fuel particles are regarded as a discrete phase. The forces acting on a fuel particle are calculated by using the velocity and pressure fields of the inert solid and gas phases. We assume that the hydrodynamics of the bed are predominantly governed by the motion of the inert solid and gas phases. Therefore, emphasis in this work is on a correct description of the stress tensor of the inert particulate phase and, in particular, on the modeling of frictional stresses, which is of primary importance for continuum simulations of bubbling fluidized beds. Performance of two of the traditionally used frictional stress theories (Schaeffer [12] and Srivastava and Sundaresan [13]) and of the one more recently proposed (Jop et al. [18]) is investigated and the corresponding results are compared with experimental findings in the form of position and velocity of the fuel particles. In addition, preferential positions, the dispersion coefficient, and the average cycle time of the fuel particles motion are obtained by the simulations and compared with experiments. It is observed that the results of the visco-plastic model proposed by Jop et al. [18] are in good agreement with the experiments for prediction of the bed hydrodynamics and the movement of the fuel particles. The other two models underestimate the frictional stresses in the inert solid

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