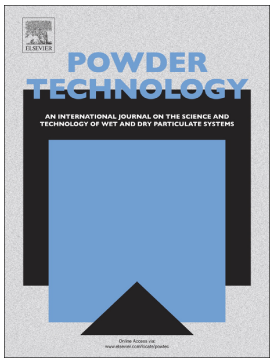

Mesh sensitivity analysis on hydrodynamics behavior of a fluidized bed containing silver oxide nanoparticle agglomerates: Transition from bubbling to slugging and turbulent flow regimes

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Mesh Sensitivity Analysis on Hydrodynamics Behavior of a Fluidized Bed Containing Silver Oxide Nanoparticle Agglomerates: Transition from Bubbling to Slugging and Turbulent Flow Regimes

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Abstract

The fluidization characteristics of silver oxide nanoparticles (NPs) were studied in a bench-scale fluidized bed in this research. Hydrophobic NPs adhere to each other and form nano-agglomerates because of inter-particle forces, leading to bed channeling. The hydrodynamic behavior of the two-phase flow was investigated to gain insights into the transition from bubbling to slugging and from slugging to turbulent flow regimes. To check the mesh configuration, simulations of the triangular and tetrahedral grid cells were performed using the two-fluid model (TFM). The simulation results revealed that the first transition occurs over a range of velocities rather than at a specific velocity, while the second transition occurs due to the upward-movement of bubbles along the bed's length. The simulation outputs showed that the increasing gas velocity reduces the bed's solid volume fraction mainly because it enhances the area occupied by the slugs in the slugging regime, which were identified by optical fiber experiments. The simulation results of fine mesh with the tetrahedral grid cell and near-wall mesh refinement showed a reasonably good agreement with the experimental data, but the results deviated when the mesh structure was triangular without the near-wall mesh strategy. The validation of the simulation results was discussed based on experimental observations, optical technique, and pressure measurements.

Keywords: Mesh sensitivity analysis, fluidized bed, hydrodynamic characteristics, bubbling regime, turbulent fluidization, nanoparticle agglomerates.

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