CFD SIMULATION ON HYDRODYNAMICS OF TAPERED FLUIDIZED BED; A COMPARATIVE STUDY

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Abstract

The hydrodynamic characteristics of fluidization in conical or tapered beds differ from those in columnar beds due to variation of superficial velocity in the axial direction of the beds. In the former, fixed and fluidized regions coexist and hence the sharp peaking of the pressure drop will occur, thereby giving rise to a remarkable pressure drop-flow rate hysteresis loop at an incipient fluidization. To explore these unique properties, a series of experiments were carried out in gas-solid tapered fluidized bed with various tapering angles. Detailed visual observations of fluid and Particle behavior and measurements of the pressure drops resulted in identification of five flow regimes. The tapering angle of the beds has been found to dramatically affect the beds' behavior. Other hydrodynamic characteristics determined experimentally include; maximum pressure drop, minimum velocity of partial fluidization and minimum velocity of full fluidization. Models developed in literature have been used to quantify the hydrodynamic characteristics of gas-solid tapered fluidized beds. The results predicted by the models were compared favorably with simulation data. Naturally, the models are applicable to gas-solid columnar fluidized beds corresponding to the tapered beds with a tapering angle of zero.

Key words: Hydrodynamics, CFD simulation, tapered fluidized beds, gas-solid system, and mathematical models.