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Experimental Study and Numerical Simulation of Baffled Bubbling Fluidized Beds with Geldart A Particles in Three Dimensions

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Abstract: In this study, a new method was developed to simulate the flow characteristics of Geldart A particles in the bubbling fluidized beds with perforated plates by the modified structure-based drag model. In this approach, the baffle was considered as a gas distributor and the baffled bubbling fluidized bed was divided into several sections which were treated as a series of freely bubbling fluidized beds. These freely bubbling fluidized beds were simulated by the structure-based drag model. Due to the structure difference between the baffle and the distributor, the empirical correlation of the initial bubble diameter in the structure-based drag model was modified to adapt the simulation of these freely bubbling fluidized beds. By this modification, the bubbling fluidization behavior and the bed expansion in a bubbling fluidized bed with perforated plates can be correctly predicted. The simulation results showed good agreements with the experimental data of the radial and axial solid volume fraction distributions and the axial pressure distribution. The phenomenon that baffles restrained back-mixing of particles was captured in the solid circulation pattern as well.

Key words: Fluidization; Baffles; Hydrodynamics; Simulation; Bubbling fluidized beds

1. Introduction

As most classical fluidization technologies, bubbling fluidized beds are widely used in chemical and physical operations. However, bubbles in bubbling fluidized beds cause poor contacting of gas and solids, back-mixing of particles and solids entrainment. Researches show that internal baffles can suppress and break bubbles, as well as reduce back-mixing of particles and gas [1, 2]. Therefore, adding baffles into fluidized beds is often used as a relatively low-cost measure to