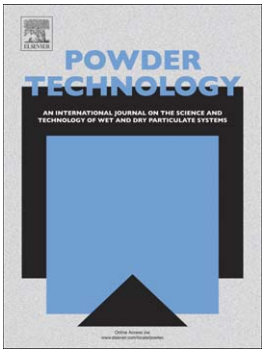

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Simulation of Gas–Solid Flow Characteristics in a Circulating Fluidized Bed Based on a Computational Particle Fluid Dynamics Model

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Abstract

A computational particle fluid dynamics model of a pilot scale circulating fluidized bed (CFB) was used to numerically simulate its gas–solid flow characteristics. The bed pressure drop characteristics of the CFB were obtained for different bed material heights. The accuracy of the model was confirmed by comparing the simulation results with experimental data. The minimum fluidization velocity was found by simulation, and the pressure distribution, gas–solid velocity, and particle concentration were further analyzed. The simulation results provide a reference for further understanding of the flow characteristics in CFBs.

Keywords: CPFD; Flow characteristic; Modeling; CFB

1. Introduction

As a core part of clean coal-combustion technology, CFB has received continuous attention in recent years. Compared with pulverized coal-fired boilers, CFB boilers have significant advantages in fuel adaptability and environmental performance. In relation to the operational characteristics of a CFB, the material concentration is high, and the gas–solid flow and heat exchange are very important for maintaining low-temperature operation. Some studies have been made of the gas–solid flow characteristics of CFB by using a cold experimental scale. In addition, some test results on industrial boilers have been published. Kim et al. [12, 13] studied the effect of the particle properties on the solid circulation law and proposed a pressure equilibrium model to determine the flow dynamics throughout the CFB cycle. Lim et al. [14] studied the solid cyclic behavior in a CFB model and developed operational diagrams to distinguish between different fluidization states. Yang et al. [41] studied the performance of several operating parameters, such as the fluidized air velocity and total bed inventory, of external loops in CFB systems with annular seals and risers. In the work of Yao et al. [43], the flow state of the transient packed bed in the riser and its effect on the hydrodynamic performance of the CFB were proved. Hu et al. [44]