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Experimental study on the motion of solids around an isolated bubble rising in a vertically vibrated fluidized bed

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Abstract

The motion of solids around isolated bubbles rising in a vertically vibrated pseudo-2D bed is experimentally studied in this work by combining Digital Image Analysis (DIA) and Particle Image Velocimetry (PIV). The bed material is Geldart B spherical particles. Different vibration amplitudes and frequencies are applied to the bed vessel while the bed is fluidized with air at minimum fludization conditions and isolated bubbles are sequentially injected in the bed. An averaging of bubbles method is presented and used to statistically characterize the average motion of solids around the bubbles. The results show that the presence of a bubble in the system perturbs the cyclic compression and expansion behavior of the bed bulk and, in particular, influences the velocity of the expansion wave front traveling upwards the bed. Analogously, the motion of solids around the bubble and, specially, in the bubble wake region, are strongly affected by the cyclic compression and expansion of the bed bulk. However, direct comparisons of the experimental results with the Davidson & Harrison potential flow model reveal that this model is still applicable for the prediction of the solids velocity around the bubble in a vertically vibrated fluidized bed.

Keywords: Fluidized bed, Vibration, Pseudo-2D, Bubble, PIV

1. Introduction

Vibration of a gas fluidized bed tends to break gas channeling and agglomeration, facilitate fluidization and enhance mixing or segregation depending on the vibration strength and the superficial gas velocity. Vibration is also a way of stabilizing the system and gain some control on the bed dynamics [1–5]. Despite its advantages, vibration introduces complexities in the dynamics of the bed that are far from being fully understood. Knowledge of these complex physical phenomena arising from vibration of a fluidized bed may be used to improve design and control of the existing Vibrated Fluidized Beds (VFBs) and to increase their range of operation to new applications.

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