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COMPARISON OF VARIOUS MEASUREMENT TECHNIQUES FOR CHARACTERIZING THE HYDRODYNAMICS OF GAS-SOLID FLUIDIZED BEDS

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Abstract

There are various techniques to characterize the hydrodynamic of fluidized beds. Nowadays, sensor development is widely used to determine the hydrodynamic state of a fluidized bed to improve control and safety of the operation of such reactors. The objective of this study was to compare the advantages and disadvantages of the intrusive and novel non-intrusive techniques. The measurement techniques investigated in this work were vibration of the bed, acoustic emission and pressure. Extensive measurements were carried out at different superficial gas velocities with different particle sizes. Vibration and acoustic emissions were recorded at 25 KHz for 30 s using accelerometer and microphone, respectively. Pressure fluctuation signals were also collected at a sampling frequency of 400 Hz. These measurements were used for investigating the changes in the flow structure, specifically the flow regime transitions. The recorded signals were processed using wavelet analysis and statistical tools. It was shown that the variation of standard deviation, skewness and kurtosis of vibration signals against superficial gas velocity of the bed obey the same trend for different techniques. Results indicated that analyzing the vibration and acoustic signals can be considered as effective non-intrusive techniques to characterize the hydrodynamics of gas-solid fluidized beds and in some cases they show better prediction of the hydrodynamic parameters.

Keywords: Fluidization; Measurement techniques; Statistical analysis; Multi-phase flow

1. INTRODUCTION

Fluidized bed reactors have a number of characteristics that make them suitable for industrial applications and advantageous over other reactor types, especially fixed bed reactors, Kunii and Levenspiel (1). They have been applied to physical, chemical, metallurgical and other operations, Yang (2). In spite of their advantages, lack of reliable knowledge about the hydrodynamics of fluidized bed reactors has limited their application in large scale units. In some applications, a well defined and stable contact regime is difficult to maintain. Many investigations were used to

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