

A transient method for characterizing flow regimes in a Circulating Fluid Bed

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Abstract

In recent years, although an increase number of literature have been devoted to circulating fluidized bed, the prediction of velocities over which different fluidization regimes exist is still difficult. In this study, a transient method was applied which readily allows one to identify operational features and critical transitions. The method is based on stopping the solids flow rate into the riser when riser is operating in fully dense transport regime. The analysis of transient pressure drop data across the riser during a solids flow cut-off experiment against its time derivative demonstrate the three distinct operating regimes that exist as the gas deplete the solid out of the riser. The transient was compared to data taken under steady state operations using statistically designed experiments. Results indicated that although there were significant differences when comparing operations in dilute conditions, there were no significant differences between the two methods in the fast fluidized and dense transport regimes. The transient method was capable of reproducing the solids circulation dependence on riser solids holdup and on the axial pressure profile. This transient method offers an accurate, easy, rapid, and reproducible means of characterizing CFB operations over a wide range of flow conditions. The lack of accuracy in the dilute regime is conjectured to be due to the wide particle size distribution that resulted in segregation during the transient testing.

1. Introduction

Circulating fluidized beds (CFB) and pneumatic conveying of solids have been widely used in chemical and petroleum industries, including pressurized circulating fluidized bed combustion, catalytic cracking, and aluminum oxide calcination. Understanding of the flow regimes in CFB risers is the key to successful design and scale-up of CFB systems. Numerous studies on CFB riser's regimes are available in the literature [1-6]. Due to restricted range of operating conditions, generally these studies are carried out for the specific regimes (i.e. dilute, fast fluidized, and dense). For instance, studies on the dilute regime do not provide any information on the neighboring regimes, such as fast fluidized regime. Therefore, it is difficult to recognize the operating conditions for fast fluidized regime. There is a lot of

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