

流体力学与传递现象

循环流化床提升管内压力脉动特性

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摘要

在大型循环流化床装置上, 以 $\phi 200\text{ mm}\times 12500\text{ mm}$ 提升管为对象, 使用FCC催化剂颗粒粉料, 实验测量了提升管内气固两相流的动态压力, 分析了提升管内气固两相流的压力脉动特性和产生的机理。实验结果表明, 提升管内气固两相流的压力脉动由两种不同成分的脉动叠加构成, 一种为低频高幅值脉动, 是由提升管的不稳定进料引起的; 另一种为高频低幅值脉动, 是颗粒簇运动、气固相互作用、气体速度脉动等多种因素耦合作用的结果。压力脉动的标准偏差分析和功率谱分析表明, 压力脉动的强度随颗粒质量流率的增加而增大, 但沿提升管轴向有一定程度衰减。压力脉动的量纲1和功率谱分析表明, 低频高幅值的脉动在提升管轴向具有一定的相似性。

关键词

[提升管](#) [压力脉动](#) [标准偏差](#) [功率谱密度](#) [相似性](#)

分类号

Characteristics of pressure fluctuations in CFB riser

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Abstract

The characteristics and mechanism of pressure fluctuations in a CFB riser were investigated with the measurement on dynamic pressure of a gas-solid two-phase flow in a $\phi 200\text{ mm}\times 12500\text{ mm}$ riser using FCC catalyst. The mass flux of solids in the riser was varied in the range $0\text{ to }250\text{ kg}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ and the superficial gas velocity was $5.6\text{ m}\cdot\text{s}^{-1}$. Pressure transducers were employed to evaluate the axial pressure profile, especially the dynamics pressure along the riser. The experimental results show two types of pressure fluctuations in the riser. One is at low frequency and high amplitude, which is resulted from unstable feeding to the riser, and the other is at high frequency and low amplitude, which is the resultant of a variety of factors, such as cluster movement, gas-solid interaction and gas velocity fluctuation. The dynamic behavior of the pressure fluctuation is characterized by Fourier spectral analysis. The standard deviation and power spectral density of pressure fluctuations indicate that the intensity of pressure fluctuations increases with solid mass flux, but it attenuates in some degree along the axial direction of the riser. The dimensionless power spectral density shows that the fluctuations at low frequency and high amplitude are similar along the axial direction of the riser.

Key words

[riser](#) [pressure fluctuations](#) [standard deviation](#) [power spectral density](#) [similarity](#)

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