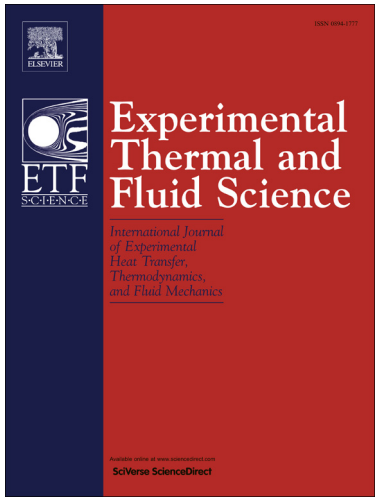

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Experimental study on flow patterns of high-pressure gas-solid flow and Hilbert-Huang transform based analysis

Lu Peng[1*], Han Dong[1], Jiang Ruixue[1], Chen Xiaoping[2], Zhao Changsui[2], Zhang Guichen[3]

[1]*College of Energy and Power Engineering, Nanjing University of Aeronautics and Astronautics, Nanjing* 210016*, China*

[2] *Key Laboratory of Energy Thermal Conversion and Control of Ministry of Education, School of Energy and Environment, Southeast University, Nanjing* 210096*, China*

[3]*College of Shipbuilding Engineering, Harbin Engineering University, Harbin* 150001*, China*

ABSTRACT: Pressurized pneumatic conveying is a key technology in the field of large-scale entrained bed coal gasification. The flow pattern plays an important role in gas-solid flow because it affects the flow behavior, safety operation and the reliability of practical processes. Few references and experiences regarding the flow patterns of pressurized pneumatic conveying are available. Because of the strong adhesion and electrostatic attraction of pulverized coal with the average particle size of less than 100μm to the pipe wall, it is very difficult to recognize the flow patterns in the conveying pipe by direct optical visualization. Thus in the present study quartz powder and pulverized coal with the larger average particle size of 300μm were selected as the substitute. High-speed digital video camera was employed to photograph the flow patterns. Experiments were conducted on a pilot scale experimental setup at the pressure up to 3.6MPa. With the decrease in superficial gas velocity, three distinguishable flow patterns were observed for quartz powder: stratified flow, dune flow and plug flow, compared to suspended flow, stratified flow and dune flow for 300μm pulverized coal. The pressure fluctuation signals acquired by high frequency response pressure transmitter were then processed by Hilbert-Huang transform (HHT). Hilbert spectrum presented a quantitative analysis of variations of energy and frequency with time, and an energy distribution index *e* was proposed to be an indicator of the flow pattern of pressurized gas-solid flow. The present work will lead to better understanding of the underlying characteristics of gas-solid flow at high pressure.

KEYWORDS: high-pressure; gas-solid flow; flow patterns; Hilbert-Huang transform (HHT); signal analysis

1. Introduction

Pneumatic conveying is widely used in the fields of energy, chemical engineering, metallurgy, and food industry. In the apparatus of the entrained-flow pressurized coal gasification, pulverized coal is conveyed to gasifier by high-pressure inert gas, and the output coal gas inevitably contains the inert gas. As a result, to improve the quality of coal gas, it is necessary to understand the flow characteristics of gas-solid flow at high pressure [1-3]. Flow pattern is one of the most important

* Corresponding author. Tel./ fax: +86 25 84892201-2614

E-mail address: plu@nuaa.edu.cn (L. Peng).