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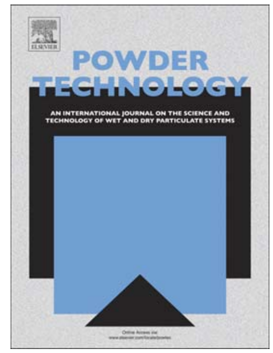

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PII: S0032-5910(14)00515-4
DOI: doi: 10.1016/j.powtec.2014.05.048
Reference: PTEC 10303

To appear in: *Powder Technology*

Received date: 8 July 2013
Revised date: 21 April 2014
Accepted date: 31 May 2014

Please cite this article as: Pandaba Patro, Sukanta K. Dash, Two-fluid modeling of turbulent particle-gas suspensions in vertical pipes, *Powder Technology* (2014), doi: 10.1016/j.powtec.2014.05.048

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Two-fluid modeling of turbulent particle-gas suspensions in vertical pipes

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Abstract

Numerical simulations of dilute, turbulent gas-solid flows in vertical pipes are performed using a two-fluid model or Euler-Euler model incorporating kinetic theory for granular flows (KTGF) and accounting for four-way coupling (i.e. consideration of particle-particle collisions along with gas-particle interactions). Comparison of the model predictions with experimental data reveals good agreement. The paper mainly focuses on the investigation of fully developed velocity profiles, turbulent intensity and pressure drop over a wide range of operating conditions and particle properties. The significant contribution of the present study is the development of a correlation for pressure drop in vertical gas-solid flows using non-linear regression analysis from the data obtained from CFD predictions, which gives an accuracy of ± 15%. This correlation can be used for the prediction of pressure drop in pneumatic conveying of fly ash, cement, pulverized coal etc.

Keywords: Gas-solid flow, pressure drop, two-fluid modeling, kinetic theory, particulate loading

1 Introduction

Turbulent gas-solid flows are most common in the oil, pharmaceutical and power industries for applications like pneumatic conveying, combustion of pulverized coal, spray drying and cooling, particulate pollution control, fluidized bed mixing and many more. Numerical simulations of particle-laden flows are complicated due to the presence of solid particles in the gas flow. The interaction terms like the drag force, lift force, inter-particle collisions and particle-wall collisions need to be modeled. The Eulerian or two-fluid model treats both phases as a continuum in which mean equations for

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