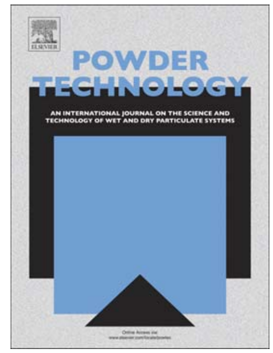
Accepted Manuscript



Experimental pressure drop analysis for horizontal dilute phase particle-fluid flows

Ron Naveh, Naveen Mani Tripathi, Haim Kalman

PII: S0032-5910(17)30669-1
DOI: doi:10.1016/j.powtec.2017.08.029
Reference: PTEC 12768

To appear in: *Powder Technology*

Received date: 7 March 2017
Revised date: 31 July 2017
Accepted date: 6 August 2017

Experimental pressure drop analysis for horizontal dilute phase particle-fluid flows

Ron Naveh[1], Naveen Mani Tripathi[1], Haim Kalman[1,2]

1. The Laboratory for Conveying and Handling of Particulate Solids, Department of Mechanical Engineering, Ben-Gurion University of the Negev, Beer-Sheva 84105, Israel
2. Aaron Fish Chair in Mechanical Engineering – Fracture Mechanics

Abstract

Prediction of horizontal pressure drop in dilute phase pneumatic conveying or slurry transport is among the fundamental issues of designing these systems. In this work a thorough literature survey demonstrates that there is no consensus on an integrative solution for conveying pressure drop, therefore a large data base of conveying systems' operating points at dilute phase is established and analyzed. It includes measurements taken at our 52 mm bore laboratory pneumatic conveying line, as well as thousands of data points collected from the literature. Two modelling approaches are attempted – the first is frictional representation based on dimensional analysis, which presents linear dependency between the pressure drop and the superficial fluid velocity normalized by the minimum pressure velocity of the transport curve. It had also been found that the pressure drop increase rate has a strong dependency on the Archimedes number. The second approach is an energy balance between the power of the drag force applied to the particles and the additional power required to drive the fluid due to particle presence. Unlike the common expressions, a modification to the drag coefficient is suggested, which takes into account pipe turbulence and particle acceleration. The two presented models do not require pilot plant calibration, and an applicability of one of them to slurry transport is demonstrated. Some future research routes are offered.

Keywords

pneumatic conveying; slurry transport; dilute phase; pressure drop; drag coefficient

1. Introduction

Pneumatic conveying is a common technology for bulk materials transport in process manufacturing, where a two-phase mixture of gas and solid particles travel along a pipeline. Theoretically, any material may be pneumatically conveyed, given a large enough gas velocity and pressure drop. For system design purposes, one of the key aspects is fluid pressure drop per unit length of a pipeline, as it dictates energy consumption and characteristics of all components (e.g. blower, fittings and feeder). The problem of pressure drop along a dilute phase horizontal conveying line, that is, transport of particles in suspension with no significant concentration gradient, has been studied extensively in the

---

Corresponding Author: Tel: +972 54 6681283, Fax: +972 8 6472811, E-mail address: ronnave@post.bgu.ac.il (R. Naveh).