STUDIES IN PNEUMATIC CONVEYING IN HORIZONTAL PIPES

By

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CERTIFICATE

This is to certify that the thesis entitled 'STUDIES IN PNEUMATIC CONVEYING IN HORIZONTAL PIPES' being submitted by Mr. P.V. Ramachandra Iyer to Indian Institute of Technology, Delhi, for the award of Doctor of Philosophy in Chemical Engineering, is a record of bonafide research work carried out by him. Mr. P.V. Ramachandra Iyer has worked under our guidance and supervision and has fulfilled the requirements for the submission of thesis, which to our knowledge has reached the requisite standard.

The results contained in this thesis have not been submitted in part or in full to any other University or Institute for the award of any degree or diploma.

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ABSTRACT

For the design of pneumatic conveying systems for bulk transportation of solids, information is required on the saltation velocity and the pressure drop accompanying the conveying. Although a large volume of literature has appeared in the field, no single unified approach has evolved for predicting them in horizontal pneumatic conveying systems. Prediction of pressure drop will require a knowledge of particle velocity which, in turn, has been correlated by many earlier workers in terms of the excess pressure drop due to presence of solids. Moreover, particle-wall and particle-particle interaction factors, included in some of the correlations, cannot be measured accurately.

In the present study, horizontal pneumatic transport of solids, at low solids to gas ratios, is analysed in terms of the mechanisms of particle suspension and its transport and the factors responsible for energy losses during the conveying. At saltation, the upward forces due to velocity fluctuations accompanying turbulence is assumed to counterbalance the gravitational forces acting on the particles. At higher gas velocities, the already suspended particle is pushed forward by the drag exerted by the gas on it. The particle velocity can, therefore, be related to the size and shape of the particle, gas velocity and the physical properties of the gas. The excess pressure drop due to solids is analysed in terms of the drag on the particles, particle concentration and the energy required to suspend the particles.

Correlations are proposed for predicting (a) saltation velocities of large-sized single and multiparticles, (b) particle velocity and (c) pressure drop, on the lines indicate above. All the correlations are in terms of properly identifi dimensionless groups, involving easily measurable parameters. Prediction of particle velocity by the proposed correlation does not require a knowledge of the excess pressure drop.

Single particle saltation velocities of a variety of large-sized particles were measured using a horizontal glass pipe. Particle velocity and pressure drop measurements were made by pneumatic conveying of particles of different size, density and sphericity in a horizontal copper pipe.

The proposed correlations are found to agree well with the data of the present investigation as well as with those of several earlier investigators, covering a very wide range of variables.

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