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Determination of a Particle Size Distribution Criterion for Predicting Dense Phase Pneumatic Conveying Behaviour of Granular and Powder Materials

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Keywords: Particle Size, Size Distribution Influence, Pneumatic Conveying Characteristics, Powders

Abstract: The purpose of this study was to evaluate the effect of particle size distribution on the modes of flow that particulate materials will support in a pneumatic conveying pipeline. It has long been known that some materials can be conveyed in dense phase flow, i.e. a condition wherein the superficial gas velocity is below the saltation value, whereas some materials will block the pipeline under such conditions. It has also been known for a long time that there are two distinct forms of dense phase flow, generally linked to whether the material is fine (such as cement powder), or coarse (such as pellets), but until now there has been no successful method to assess the conveyability of a material based on size distribution alone. Six materials with different size grades were conveyed in a 25mm bore pipeline, at a range of pressures up to 3 bar and gas velocities from zero to 12 m/s. The results showed that materials below a certain size would support a fluid-like dense phase mode of flow, whereas to support a low-velocity slug flow the key was to have a very narrow size distribution. Materials that satisfied neither of these criteria would not support flow at gas velocities below the saltation value. Clear trends for how throughput changes in the transition from lean to dense phase, are also demonstrated, which have major implications for pipeline sizing. A quantitative criterion for deciding on the likely conveyability of a material, based on size distribution alone, is proposed.

Keywords: Pneumatic Conveying Characteristics; Particulate Materials; Size Influence; Modes of Flow;