Comparative hydrodynamic studies of dilute phase vertical pneumatic transport in a uniforms and equivalent converging risers

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Abstract

Pneumatic transport has been used in process industries for a long time, mainly for transport of particulate solids due to some technological advantages over other modes of similar transport. Better interaction of transporting particulate solids with the driving gaseous phase during transport has induced to use this mechanism to apply for drying of particulate, preheating and gas-solid reactions in many industries. The underlying gas-solid hydrodynamics is very significant in this area of applications. It has been observed that a minor convergence in the transport tube influences the hydrodynamics which in turn improve the efficiency of heat and mass transport between the suspended particulate solids and the conveying gas.

In the present work, a comparative hydrodynamic study by developing a computational model for a dilute phase vertical pneumatic conveying in uniform and converging tubes have been conducted. The developed model is used for the estimation of hydrodynamic parameters like pressure drop, gas and particle velocity, gas and particle Reynolds number and their variations with gas and particle loading, particle size and density in both uniform and equivalent converging risers. Since the pressure drop along a riser is significant, the effect of convergence on pressure drop has been also studied and observed that pressure drop was increase with increase in convergence angle. The augmentation of particle Reynolds number in case of converging risers as compared to that of uniform riser has been highlighted in the present context.