Study of particle-wall interaction in pneumatic conveying in a vertical pipe

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Dilute turbulent solid-gas flows in wall-bounded systems are widely used in the food, chemical and pharmaceutical industries. One aspect of pneumatic conveyance warranting further study is the particle-wall collisions; they strongly influence the particle motion and energy dissipation. A better understanding of particle-wall interactions is essential for modelling and optimizing the performance of these systems.

There are two approaches to modelling two-phase flow: 1) Eulerian-Eulerian (two-fluid model, TFM[1]), which considers both the air and particles as continuous phases, i.e., the disperse phase is treated as a pseudo-fluid; and 2) Eulerian-Lagrangian, (discrete element method, DEM) which treats the solid phase as discrete particles and the air as a continuum. For the latter, the particles are tracked using Newton's equation of motion, while the fluid motion is calculated from the Navier-Stokes equations. Both methods can provide insight into the interaction of the particles with each other and the wall. Some preliminary results are presented below for solid-gas flow in a vertical tube[2]. As shown in figure 1, the DEM model gives results that are closer to the experimental data for the particle velocity profile.

This study will model a solid-gas flow by coupling ANSYS FLUENT and the DEM software ROCKY in an Eulerian-Lagrangian framework, and compare the predictions with the TFM and the experimental data. Of special interest is a comparison of the particle-wall interactions in the two modelling approaches.

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[1] Bolio et al., *AIChE Journal* **41**, 1375 (1995).

[2] Tsuji and Morikawa, *J. Fluid Mech.* **139**, 417 (1984).

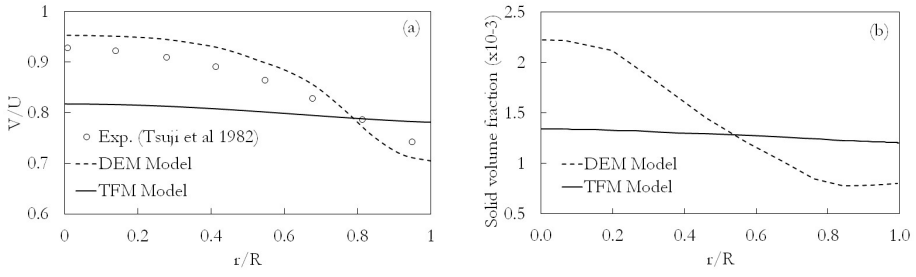

Figure 1: (a) Normalized particle velocity profile. V and U represent the particle and centerline air velocity, respectively (b) Radial variation of solid volume fraction