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Unsteady Reynolds-Averaged Navier-Stokes Analysis of Turbulent Flow in the Venturi Dustiness Tester PRAHIT DUBEY, URMILA GHIA, University of Cincinnati, LEONID A. TURKEVICH, National Institute for Occupational Safety and Health — Dustiness quantifies the propensity of a finely divided solid to be aerosolized by a prescribed mechanical stimulus. Dustiness is relevant wherever powders are mixed, transferred or handled, and is important in the control of hazardous exposures and the prevention of dust explosions and product loss. Limited (mg) quantities of pharmaceutical powders available for testing led to the development (at University of North Carolina) of a Venturi-driven dustiness tester. The powder is turbulently injected at high-speed (for 1.5 sec) into a glass chamber; the aerosol is then gently sampled (for 240 sec) through two filters located at the top of the chamber; the dustiness index is the ratio of sampled to injected mass of powder. Injection is activated by suction at a port at the top of the chamber; loss of powder during injection compromises the sampled dustiness. The present work analyzes the flow inside the Venturi Dustiness Tester, using an Unsteady Reynolds-Averaged Navier-Stokes formulation with the k-ω Shear Stress Transport turbulence model. The simulation considers single-phase flow, valid for small particles (Stokes number Stk $<$1). Results for velocity, turbulence kinetic energy, and path-lines during high-speed injection are presented. The results show that 24% of the injected powder escapes from the chamber during injection.

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