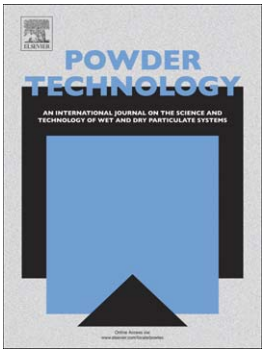

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Numerical simulation of the interactions between a vortex ring and solid particles suspended above a horizontal wall

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Abstract

The interactions between a vortex ring and solid particles near a horizontal wall in the air are explored in this study using numerical simulations. The vortex ring is moved toward the particles initially arranged in layers above the wall. The Reynolds number of the vortex ring is 1146. When the Stokes number St is 0.1, the particles initially arranged around the central axis of the vortex ring are driven toward the wall while moving in the radial direction. They distribute circularly along the outer edge of the particle cluster on the wall. The particles near the layer's edge are whirled up. Three-dimensional vortex structures, including secondary and tertiary vortex rings, are produced around the particles. When St=1, vortical flows induced around the particles appear in the broader region. They reduce rapidly owing to the motion of particles relative to the wall (collision and rebound). The drag force acting on the particles lowers the strength of the vortex ring and also suppresses the approach of the vortex ring toward the wall.

Keywords; Particle-laden gas flow, Vortex ring, Resuspension, Stokes number, Vortical structure

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