

For submission to Physics of Fluids:

Cylinder aspect ratio and Reynolds number influence on segregation-Pattern Drift in Particle-Laden Rimming flow

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Abstract:

Our recent work on the dynamics of band drift in particle laden rimming flow describes the existence of a new drift phenomenon: Bands can be either stationary, or drifting along the cylinder axis; the drift motion being directed either outwards or inwards [Guyez and Thomas, Phys. Rev. Lett., 100, 074501]. Focusing on the influence of the granules properties, a Stokes number was found to be a good criterion to establish minimal required drifting conditions [Guyez and Thomas, Phys. Fluid]. Questions concerning the effects of the cylinder end-caps and the impact of fluid properties dependent parameters (Reynolds number, Alpha parameter, Capillary number) are now addressed. Modifying the cylinder length, i.e. its aspect ratio, edge-regions can be distinguished. Their length and their dynamics appear to be invariant over a wide range of aspect ratio, Reynolds numbers, and capillary number. The central part, however, is very sensitive to these parameters. As expected the increase of the Reynolds number first inhibits the edge effects (stationary bands), then induced a more complex dynamics with regular events of band merging and new bands formation. We confirm the influence of the capillary number: Modifying only the surface tension of the fluid results in reversing the drift direction (all other parameters being kept constant). Finally the alpha parameter, characterizing the balance between gravity and viscous forces, appears to be a key parameter in the control of the drift direction of the bands.