SM15S_11150

XXI International Congress of Theoretical and Applied Mechanics
Warsaw, Poland, August 15–21, 2004

Experimental Investigation of Dense Free Surface Granular Flow

Fidelis Tibi Sabum

University of Buea, Buea, Cameroon

When the slope of a sandpile is tipped beyond a critical angle (30 degrees for dry particles) the grains of sand will begin to flow. This type of flow is important geologically (e.g. landslides and river sedimentation) and industrially (e.g. mixing pharmaceuticals and transporting grains). However, this flow is not well-understood, dense granular flow is very different from that of a conventional fluid in that granular flow is limited to a thin boundary layer. For this project boundary layer granular flow was studied in a slowly rotated drum mixer using different rotation speeds and bead sizes. A high speed digital camera was used to locate and track the particles in the top flowing layer. These trajectories show the boundary layer has a dominant ordered structure of layers of trajectories parallel to the free surface. The velocity and density profiles were calculated from the particle trajectories, and their dependence on rotation speed and bead size will be discussed. A conventional scaling model does not appear to apply, though the stratified structure of the flow appears to determine some details of the velocity fluctuations and granular temperature.

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