

ABSTRACT

Cordova, Jose Antonio. M.S.M.E., Purdue University, December, 2005. Dilute Granular Flow Around an Immersed Cylinder and Oblique Granular Shock Waves. Major Professor: Carl Wassgren.

Granular flows around objects are common in nature and industry. From snow and sand abrasion in a windblown environment, to mixers, granulators and particle segregators in industry, examples of granular flows around objects are common. Understanding these types of flows is very important because of the large number of processes in industry that involve the interaction of mechanical systems with granular materials. This thesis presents the design, construction and use of an experimental apparatus for studying dilute granular flow around objects. An air table and granular pump are used to generate the two dimensional, low friction, no gravity, dilute granular flows.

Experiments of a granular flow past a cylinder were filmed with a digital video camera and the velocities of the flow were obtained using Particle Tracking Velocimetry. An experimental method was developed to obtain indirect force measurements through video analysis. The drag coefficient acting on the cylinder and the Knudsen number of the experimental flows were calculated and compared to numerical simulation results. Bow shock and expansion fan like structures similar to what appear in supersonic gas flows were observed

Experiments and soft-particle simulations were also used to investigate the dilute granular flow past a wedge and both reveal the existence of oblique shockwaves as well as dilute, transitional and shear flow regions. The dependence of the oblique shock angle on the wedge angle and the flows solid fraction were investigated. A secondary shock having a different angle than the upstream shock was observed as the wedge angle and solid fraction were increased.