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Monodisperse granular flows in viscous dispersions in a centrifugal acceleration field

Miguel Angel Cabrera and Wei Wu

Universität für Bodenkultur Wien, Institut für Geotechnik, Bautechnik und Naturgefahren, Wien, Austria (miguel.cabrera@boku.ac.at)

Granular flows are encountered in geophysical flows and innumerable industrial applications with particulate materials. When mixed with a fluid, a complex network of interactions between the particle- and fluid-phase develops, resulting in a compound material with a yet unclear physical behaviour. In the study of granular suspensions mixed with a viscous dispersion, the scaling of the stress-strain characteristics of the fluid phase needs to account for the level of inertia developed in experiments. However, the required model dimensions and amount of material becomes a main limitation for their study. In recent years, centrifuge modelling has been presented as an alternative for the study of particle-fluid flows in a reduced scaled model in an augmented acceleration field. By formulating simple scaling principles proportional to the equivalent acceleration Ng in the model, the resultant flows share many similarities with field events. In this work we study the scaling principles of the fluid phase and its effects on the flow of granular suspensions. We focus on the dense flow of a monodisperse granular suspension mixed with a viscous fluid phase, flowing down an inclined plane and being driven by a centrifugal acceleration field. The scaled model allows the continuous monitoring of the flow heights, velocity fields, basal pressure and mass flow rates at different Ng levels. The experiments successfully identify the effects of scaling the plastic viscosity of the fluid phase, its relation with the deposition of particles over the inclined plane, and allows formulating a discussion on the suitability of simulating particle-fluid flows in a centrifugal acceleration field.