Centrifuge modelling of granular suspensions in a viscous fluid: impact forces and scaling principles

Miguel A. Cabrera* and Wei Wu†

* † Institut für Geotechnik (IGT)
Universität für Bodenkultur Wien (BOKU)
Feistmantelstraße 4, 1180 Vienna, Austria
e-mail: miguel.cabrera@boku.ac.at

ABSTRACT

Free-surface flows involving a combined action of particles and a viscous fluid are common of natural hazards occurring in mountainous regions. The complex interactions developed between the particles and the surrounding fluid, have encouraged in the last three decades experimental and numerical research in different fields of the scientific community. While the development and understanding of dry granular flows in experimental conditions is well underway [1], the case of granular flows immersed in fluid remains limited by the scaling considerations of the system. Furthermore, the stress-dependent nature of the granular material [2] imposes further challenges for the scaling of granular flows.

In this work, experiments over an arrangement of monodisperce particles immersed in a viscous fluid are performed in a geotechnical centrifuge. The experimental set-up allows the simulation of free-surface granular flows immersed in a viscous fluid under elevating gravity conditions. Flow heights and velocity, basal fluid and total pressure, and impact forces are measured for a range of channel inclinations, particle sizes, fluid densities and fluid viscosities.

The test results are presented and the scaling principles related to free-surface granular flows in a geotechnical centrifuge, are discussed. The centrifuge model presents an interesting new alternative for the study of granular flows. The novel experimental scheme offers a cost-effective and low time-consuming alternative for the simulation of multiphase flows keeping a close control of the stress-dependent nature of the granular material.

REFERENCES

[1] G.D.R. MiDi, “On dense granular flows”, *The European Physical Journal E*, **4**, 341-365 (2004).
[2] P. Jop, Y. Forterre and O. Pouliquen, “A constitutive law for dense granular flows”, *Nature*, **441**(7094), 727-730 (2006).