



IFPRI Project Abstract

CAPCAP: Controlling Adhesion between Particles for a better understanding of Compaction, Aeration and flow of Powders.

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Project Objective:

The main objective of the project is to understand the rheology of powders to predict their flow properties in various configurations. The project is based on the development of model cohesive materials, on the development of innovative tools to characterize their rheology and infer their constitutive laws, and ultimately study flows in configuration of interest for applications, including taking into account coupling with air

Approach:

The approach is mainly experimental. The first step is to develop protocols to synthesize and characterize model cohesive granular materials. The aim is to synthesize particles with tailored properties (stiffness and adhesion) using two techniques (micro-polymer particles, or polymer coated silica particles). The second step is to develop a pressure-imposed shear cell adapted to small particle sizes. The third step will be to study different flow configurations. The last step concerns the coupling with air.

Recent Results:

- To characterize the adhesion of our tailored adhesive particles, we have developed a new experimental setup, similar to a macro-scale AFM, that enables statistical measurements.
 - Despite numerous experimental challenges, we have obtained the first reliable rheological results under low confinement using our coated particles. These results reveal a new phenomenology. Scaling with the cohesion number has been tested, and strong hysteresis effects have been observed.
 - We have begun analyzing the role of air in powder flow by reviewing literature on soil liquefaction and geophysical flows. In parallel, we have started to characterize the range of accessible volume fractions for different sample preparation methods.
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Next Steps:

- A systematic analysis of the rheological properties of various particle types will be conducted. A similar experimental setup should be developed for Type C particles.
 - Efforts will be made to establish links between shear cell measurements and results obtained from other rheometers, including rotating drums and the FT4 powder rheometer.
 - The role of air during the collapse of a powder column will be investigated by monitoring both the dynamics of the collapse and the evolution of pore pressure.
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