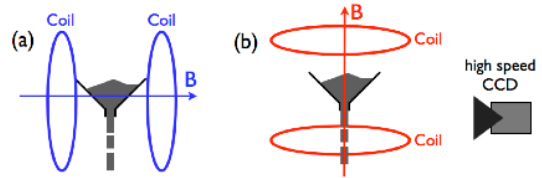


Flow properties and heap shape of magnetic powders

Abstract

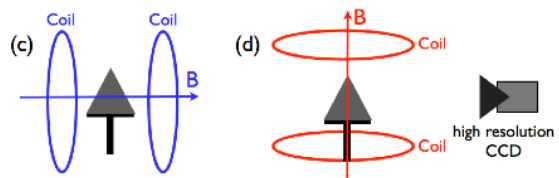
We have experimentally investigated a “smart powder” for which the interparticle interaction can be tuned by an external magnetic field. The magnetic field induces an interaction between the grains characterized by the Bond number Bo which is the ratio between the cohesive magnetic force and the grain weight. Through our experimental results, we show that the rheological and the static properties of such a system can be controlled. (i) Different dynamical flowing regimes have been observed through the output of funnel like a “dry liquid state” forming conic droplets as well as a “layered soft state”. (ii) The morphology of a cohesive heap have been also analyzed. The increase of the heap height h with the applied magnetic field strength has been measured for different orientations of the field. Moreover, a strong anisotropy of the heap shape is observed when the magnetic field is oriented perpendicularly to the gravity.

Flow of a magnetized powder through a funnel



The powder flow through the funnel output is perpendicular or parallel to the magnetic field.

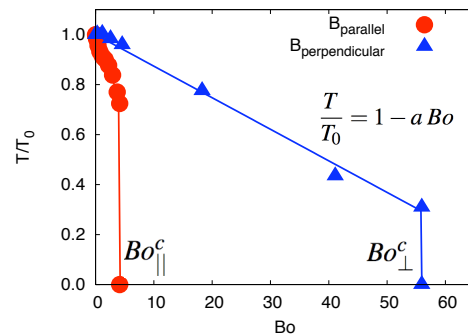
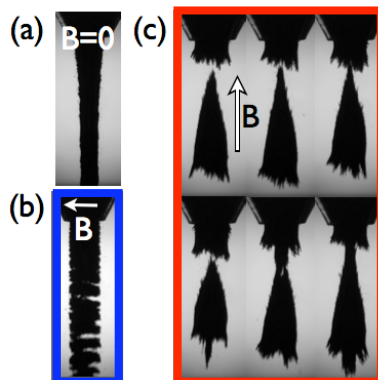
Shape of a magnetized powder heap



A heap is initialized with the magnetic field oriented perpendicularly or parallel to the gravity.

Flow of a magnetized powder through a funnel

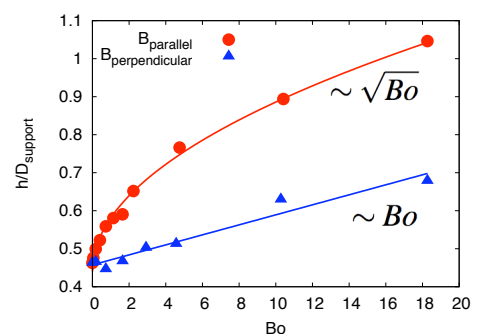
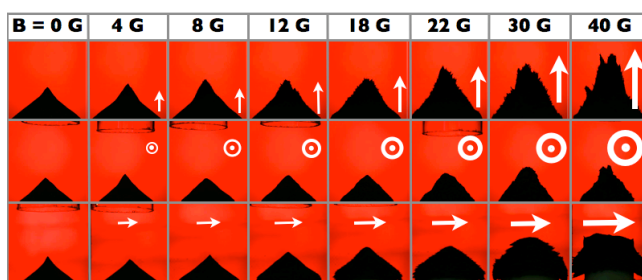
Pictures of the granular flow for different situations. (a) The cohesive-less case ($Bo=0$). (b) The magnetic field is perpendicular to the gravity. (c) The magnetic field is parallel to gravity.



The normalized flow rate T/T_0 as a function of the Bond number Bo .

G. Lumay and N. Vandewalle, Phys. Rev. E **78**, 061302 (2008)

Shape of a magnetized powder heap



Ratio between the height of the heap h and the diameter of the support D_{support} as a function of the Bond number Bo .