Rheology of a granular film

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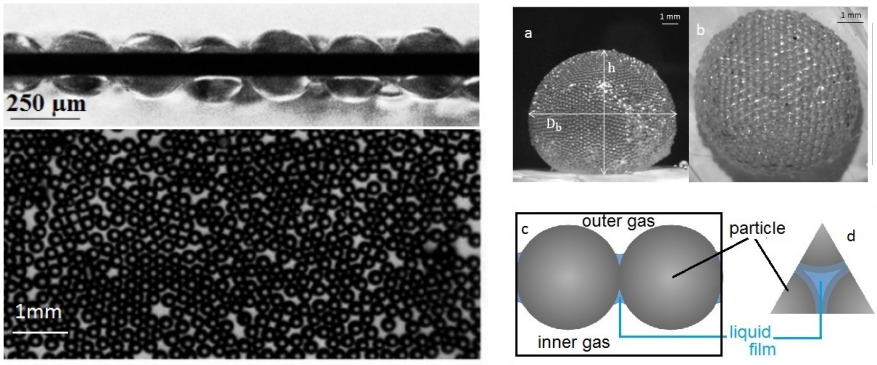
Research in line with the pioneer work of Pickering succeeded recently to produce new objects which can be described as gas pockets in air and are named gas marbles[1]. They are made of gas surrounded by a layer of grains constrained by thin liquid film in gas environment. The exceptional mechanical strength of their granular shell promise them to many applications [2]. Among these, we note here that using gas marbles can be relevant for the generation of materials with hierarchical porosity. Moreover, these new hollow marbles offer a promising route to new vibration dampers.
However, before using gas marbles, this new meta-material needs to be characterized and its behavior understood. This peculiar material belongs to the global class of granular suspension which rheology still is under development.

During this internship, the goal is to study the granular film response to a shear solicitation and to compare it to classical granular suspension. In addition to Strain-Stress measurement, the particle motions will be studied through visualization of the particle laden. In a further step, the influence of the liquid film thickness will be studied. Finally, the results will be confronted to the now used μ(I) rheological law[3].



During the PhD the shear rheology study will be extended with the use of different fluids and beads to vary the capillary forces and thus the confinement pressure. In order to test the soundness of this rheological law a bi-axial test will be performed. Finally, to complete the mechanical study of particle laden films, indentation experiments will be realized on a gas marble.

[1] Y. Timounay, O. Pitois, F. Rouyer, Gas Marbles: Much Stronger than Liquid Marbles, Phys. Rev. Lett. (2017). doi:10.1103/PhysRevLett.118.228001.
[2] "Gas Marbles" Store Air in Strong Spheres, June 2, 2017• *Focus Physics* 10, 62. "Fortified gas marbles are 10 times stronger than regular bubbles", Daily news, News Scientist, 8 June 2017. "Gas marbles are tough when squeezed", Physics Today, 5 Jul 2017 in Research & Technology.
[3] F. Boyer, É. Guazzelli, O. Pouliquen, Unifying suspension and granular rheology, Phys. Rev. Lett. (2011). doi:10.1103/PhysRevLett.107.188301.