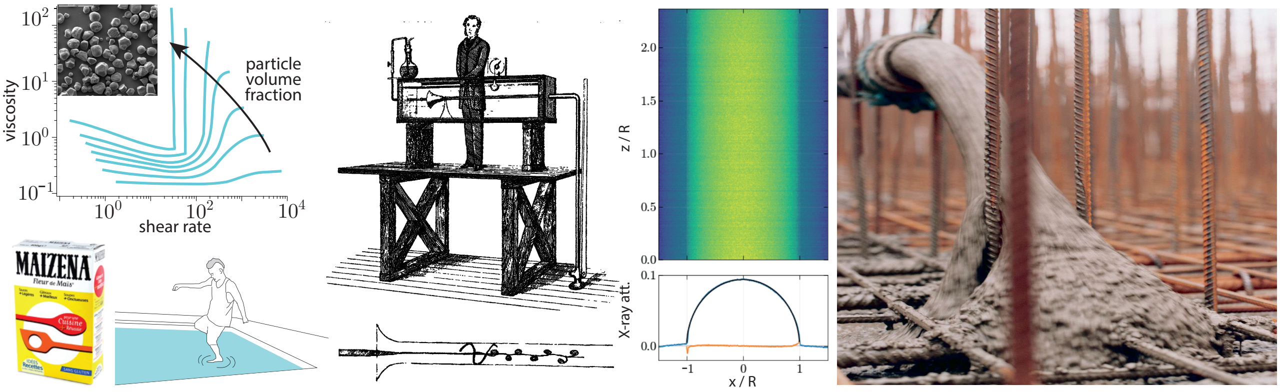
Post-doctoral position available

Shear thickening Pipe Flow

IUSTI, Aix-Marseille Univ. - Chryso



Adding a sufficient quantity of small repulsive particles (e.g. cornstarch, CaCO3 + additives) to a Newtonian liquid triggers spectacular behaviors: the suspension flows under low shear stresses and jams, i.e. solidifies, at larger stresses. Recently, this sharp transition has been shown to result from the sudden establishment of frictional contacts between the particles as the repulsive stress is overcome[1,2], and to trigger a new type of waves ('Oobleck' waves)[3]. However, its consequences on such a simple and ubiquitous flow as the flow in a straight pipe is still an open question.

The post-doc will precisely tackle this, apparently, simple question: *How does a shear-thickening suspension flow inside a pipe?* Using experiments with model shear-thickening suspensions, the goal is to address how the resistance and structure of the flow depend on the level of stress and pipe dimensions. The sliding of the particles at the wall and their migration across the pipe will be considered. In the footprints of Reynolds[4], addressing the transition to the shear-jamming of the suspension will also demand to probe the stability of the flow – both in terms of steadiness and laminarity.

This research will be performed in partnership with Chryso, a company developing additives (superplasticisers) for high performance, high-flowability concretes. The results, first obtained with model shear thickening suspensions, will then be compared to the behavior of calcium carbonate + superplasticizers suspensions, with the aim to improve fluidizing additive characteristics and concrete pumping conditions.

Context: The work will be mostly experimental involving advanced pressure-imposed rheological characterizations, pressure measurements and X-Ray imaging technics. It will be performed at IUSTI under the supervision of H. Lhuissier, P. Boustingorry, B. Metzger and Y. Forterre. This PostDoc is part of the ANR project *ScienceFriction* which also comprises theoretical and numerical approaches in collaboration with M. Wyart at EPFL, Switzerland, and with R. Mari at LiPhy, Grenoble. One other post-doc and two other PhDs will simultaneously work on other aspects of the project. We thus expect synergetic interactions and constructive collaborations between the partners and the students of this project.

Candidates having a background in Physics, Fluid Mechanics, Soft Matter, Physical chemistry and with a strong taste for both experiments and theoretical analysis are invited to apply (CV+Letter of support).

Place IUSTI, Aix-Marseille Univ, Marseille Étoile campus

Dates 1 year (possibilities of extensions), starting before Jan. 2022

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[1] Wyart & Cates. *Phys. Rev. Lett.* **112**, 098302 (2014)
[2] Clavaud, Bérut, Metzger & Forterre. *Proc. Natl. Acad. Sci.* **114**, 5147 (2017)
[3] Darbois-Texier, Lhuissier, Forterre & Metzger. *Nature Commun. Phys.* **3**, 232 (2020)
[4] Reynolds. *Phys. Trans. Roy. Soc.* **174** (1883)