Floculation of a dense mineral suspension

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Cement is the second most widely used material in the world, preceded only by water, with an annual production of $4 \cdot 10^9$ tons. Its production involves the heating of clay and limestone, during which limestone decarbonates, leading to lime and subsequently to the clinker. The heating process, and in particular the unavoidable limestone decarbonation leads to CO_2 emission. The overall consumption of cement is estimated to amount for 8 % of the total human CO_2 emission, mostly due to limestone decarbonation.
The main strategy developed to reduce the environmental cost of cement for the last twenty years [1] has consisted in partly replacing cement by other mineral powders, being by-products of other industries (such as fly ash or slag) or manufactured ones, such as calcinated clays, but one is faced with the problem of the availability of these resources, given the enormous quantity of cement produced. The partial replacement of cement with calcinated clay and limestone has thus led to the development of the so-called Limestone Calcined Clay Cement, LC^3 [2, 3].

In this PhD work, we wish to optimize the packing of cement and sand powders in order to optimize their flowability at extremely high volume fractions while reducing the amount of clinker used.
We will study the flow and setting properties of mixtures of cement and limestone particles in order to determine the quantity of cement required to generate a cohesive material.

- The first objective of this PhD will be to study the flow, and in particular the rheo-thickening, of highly concentrated suspensions and wide granular distributions,
- the second objective will be to study the compressive modulus E and the stress at rupture of the cement suspensions developed, after they have set.

Candidate: The PhD candidate should have a background in physics or mechanics. She/he should also have some experience in scientific programming and a taste for experimental physics.

[1] UN Environment, *et al.* *Cem. Conc. Res.*, 114:2-26, 2018.
[2] K.Scrivener, *et al.* *Cem. Conc. Res.*, 114:49–56, 2018.
[3] K.L.Scrivener, *et al.* *Cem. Conc. Res.*, 114:2–26, 2018.