Experimental study of low Reynolds number suspensions behavior in an extensional flow

Laboratory:
FAST Laboratory, Bât 502, Campus Universitaire, 91405 Orsay
http:// www.fast.u-psud.fr
G. Gauthier : georges.gauthier@u-psud.fr
A. Seguin: antoine.seguin@u-psud.fr

Macroscopic dispersions (solid particles, large enough to neglect Brownian effect, immersed in a fluid, large enough to neglect inertial effects) are encountered in many natural phenomena (settling or mixing of solid particles in estuary), industrial processes (purification of water, vitrification of nuclear waste, drilling, concrete, reinforced structure, mixing, vegetal protein paste…) or sanitary (blood tests, bacteria).
Natural flows and industrial processes much often deal with dense suspensions and imply a mixed of sheared and extensional flows. However, in extensional flows elements separate exponentially during time but linearly for sheared flow. Thus, strains that are due to the extensional part of the flow, prevail in a large number of situations. During the past decade, it has been shown that the main contribution to the suspension behaviour (Sheared induced migration, Normal stresses differences, and the main part of the viscosity) is due to the solid contacts between particles. But, until now rheological properties of macroscopic dispersion have been obtained from sheared rheometry.

Preliminary experimental study performed at FAST lab, reported a suspension viscosity really lower than the one obtained from sheared measurement, suggesting a different behaviour law.

The goal of the Internship/PhD Thesis is to rely the structure of the dispersion (spatial organisation of the particle) to the stress of the suspension in an extensional flow.
This will be done by measuring precisely the stress in each phase (fluid and solid) of the suspension and to correlate these measurements to optical measurements of the particle positions and displacement field obtained by visualization, made possible using index matching technics.

The first period of the Internship will be devoted to the measurement of the phase stresses and then the extensional viscosity as a function of the particles volume fraction while in the second period the student will focus on the development of the optical measurement.