THEORETICAL ASPECT OF STRUCTURE MODIFICATION IN SOFT GLASSY MATERIAL FLOW

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Soft glassy materials (concentrated emulsion, foams, concentrated polymer solutions…) present rheological properties between solids and liquids. Under small stress they stay elastic but at stress higher than a yield stress they begin to flow as a liquid. Those fluids present great interest for industrial application but also for theoretical questions: the elastic – viscous transition could be an example of a phase transition in a non-equilibrium problem. Furthermore it has been shown that the viscosity does not depend only on the local stress but a non-local relation links them.
The Kinetic Elasto Plastic (KEP) model has succeeded to describe those behaviours using a Boltzmann like approach. It is general enough to described lot of soft glassy fluids. This model take account 3 main effects: the elastic deformation at small stress, the relaxation of high stress due to rearrangement of the microscopic structure and finally the impact of rearrangements on the neighbourhood. According to this model, we are able to calculate a yield stress. We predict also non-local effects
Nevertheless the model fails to describe fluids which present shear-banding flow. It has been suggested that microscopic structure is coupled to the flow. In this work we have extended the KEP model to consider this hypothesis. We suppose that the parameters depend on the number of rearrangements. If the coupling is high enough, we calculate a flow curve with a part where the stress decreases with the shear rate. That is a signature of shear banding: this part is known to be instable and the flow should split in bands of different shear rate. The nature of the yield stress transition is characterized by the magnitude of the coupling parameter. Low values of the parameter promote a first order transition, while high values induce phase separation. Furthermore it exists also non-local effects. We are able to consider it to calculate inhomogeneous flow.