Liquid foam flow through/around a permeable defect

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ABSTRACT

We present an experimental study of a two-dimensional liquid foam, composed of a confined monolayer of bubbles, forced to flow within an inhomogeneous open fracture. Our model porous medium consists of a Hele-Shaw cell with a single localised defect that reduces or expands locally the cell gap, and therefore, decreases or increases its permeability. Taking advantage of the possibility to directly visualise and follow the bubbles (films and vertices), we compute the average steady-state velocity and deformation fields of the flowing liquid foam, by analysing the evolution of its texture.

The local permeability variation due to the localised defect (either a constriction or an expansion) can strongly disturb the foam flow. We investigate here the influence of the geometry of the defect (height, size, and shape) on the average steady-state flow (velocity and deformation) of foams of various liquid content. In the frame of the flowing foam, we can observe a recirculation around the defect, characterised by a multi-polar velocity field. Our experiments confirm that the elastic properties of the foam (notably controlled by its liquid fraction) are at the origin of the complex structure of the velocity and deformation fields, and in particular, their strong fore-aft asymmetry.

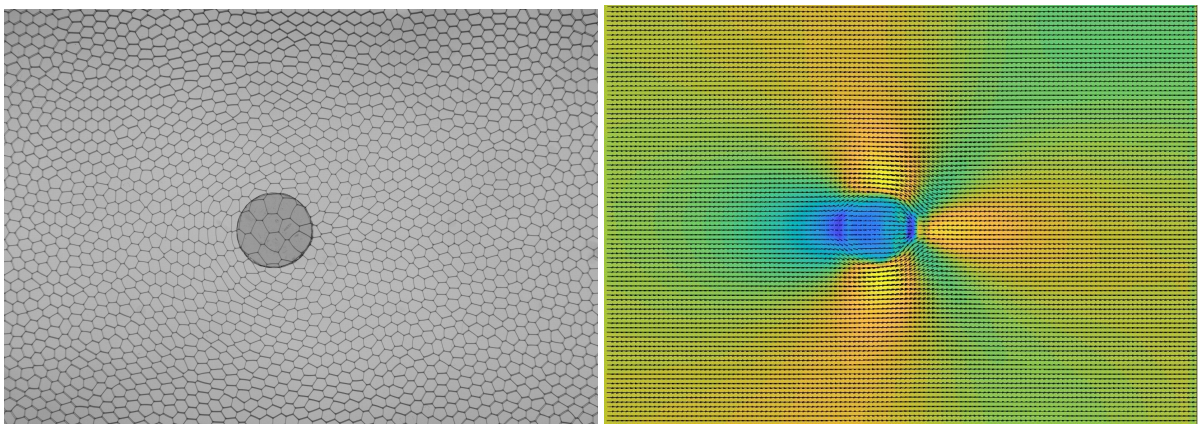

Figure 1: Example of a foam flow through a 50% gap constriction (2 cm wide) and the corresponding velocity field.