FOAM DRAINAGE - part 3

gas effect : coupling coarsening and drainage (1)

 C_2F_6 :almost « insoluble » , so no coarsening N₂ : much more soluble, significantly faster coarsening

Free-drainage, liquid fraction at a given position :



Free-drainage, height of drained liquid :



strong effect of the gas on the drainage speed !



gas effect : coupling coarsening and drainage (3)



Drainage time for different liquid fractions :

Note that one can already reduce coarsening with only traces of an insoluble gas added to a soluble one...

Height effect :

 $\tau_c/\tau_d \approx \frac{\varepsilon R_0^4}{\mu H D f(\varepsilon)}$

Container shape effect

the sample cross-section A is not always constant :

conservation equation :
$$\frac{\partial \varepsilon}{\partial t} + \frac{\partial (u\varepsilon)}{\partial z} + \frac{\partial (u\varepsilon)}{A\partial z} = 0$$

a special case : drainage in an Eiffel Tower...

liquid fraction profiles :



Bulk viscosity effect: Newtonian and Non-Newtonian fluids







Non-gravitational drainage (3)



Thin film drainage

Reynolds equation for thin film drainage speed (large thickness, without disjoining forces) :

$$V = \frac{2h^3 \Delta p}{3\mu R^2}$$

Almost never work !



small film diameter : no dimples, no circulation, flat thin film

Flow in a single PB

O. Pitois, C. Fritz, M. Adler, MLV

(O. Pitois, C. Fritz, M. Adler, Coll. Surf. A, 2005)



Flow in PBs between glass plates





$$M=\frac{\mu r}{\mu s}$$

With this setup : mostly high values of M



« If you were a bubble, in a draining foam... »

During drainage : the bubble move upward...





...and assuming mass conservation, one can recovers the liquid fraction evolution ϵ (z, t).

important results to remember...

(ask me for complete references on these results)

- take care of the effect of coarsening during drainage !

- First steps of drainage of a thin film towards its equilibrium value is quite complex (dimples, marginal regeneration, ...). Many dynamic effects, which also depends on the film size.

- Experiments on isolated structures (like single PB, 2 PBs, single thin film) are usually consistent with macroscopic measurements in foams, and are quite useful.

- Experiments in microgravity : a lot of fun !