Interaction of foams with a porous support [Abstract]

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Foam drainage: experimental study and numerical simulations

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Foams are widely used in food, cosmetics, pharmacy etc [1]. Traditionally foams are stabilised by surfactants, but during the last decade polymers (polyelectrolytes) become a frequently used additives to foaming solutions [2]. We explored the possibility of using commercially available polymers Aculyn™ 22 and Aculyn™ 33 (broadly used in cosmetic industry) as foaming agents [3]. Here we present the results of experimental study and numerical simulations on drainage of foams produced from solutions of those polymers and interaction of foams with porous media, which is important for a number of applications. In particular the influence of bulk and the surface rheology of foaming solutions on the drainage kinetics is addressed.

To identify the methods to control the kinetics of liquid release in this case we performed direct numerical simulations of foam drainage on the porous substrate. The mathematical model developed combines the foam drainage equation with the equation describing the penetration of liquid in the porous substrate of prescribed structure coupled with appropriate boundary conditions at foam/substrate interface [3]. The performed numerical simulations have shown that depending on the liquid viscosity, bubble size, foam height, substrate porosity and wetting conditions there are three possible scenarios for the interaction of foam with a porous substrate: (i) a rapid imbibition, the liquid volume fraction at the bottom of the foam is a decreasing function of time. In this regime the imbibition into the porous substrate dominates and it is faster as compared with the foam drainage; (ii) an intermediate imbibition, the liquid volume fraction at the interface experiences a peak point and imbibition into the porous substrate is slower for some time as compared with the foam drainage; (iii) a slow imbibition, the liquid volume fraction at foam/substrate interface increases to a maximum limiting value and free liquid layer is formed over the porous substrate.

Literature: