Stability of foams

INTRODUCTION

A lot of industrial applications require the control of the foamability of the surfactants used in the formulations to increase it (shampoo, detergent, *etc.*) or to prevent it (pulps, paper industry). Moreover the determination of the stability of the foam created is of great interest for the formulator in order to get the right use property depending on the application. Various techniques are already available in the industry but they usually require complex and specific equipments.
The Turbiscan LAB enables to measure the drainage of a foam and the coalescence of the air bubbles. Moreover the possibility of working in "scan" or "fixed" mode enables to study both stable and very unstable foams.

Application
Surfactant

Objective
Determination of the stability of a surfactant foam

Device
TURBISCAN® LAB

METHOD

Several surfactants have been tested after dissolution in demineralised water at various concentrations. 10 mL of these solutions were put in the measurement cells. The foam is created *in-situ* with a rotor-stator homogeniser (Ultraturrax®) for 5 minutes. The analysis is performed with the Turbiscan LAB immediately after.
The determination of the stability of the foam is done by using the scan mode of the apparatus to follow the coalescence of the air bubbles over 30 minutes and the drainage of the liquid.

A parallel study was also done to measure the foamability of the surfactant. It is reported in a separate application note "Foamability of surfactants").

Experimental Set up

RESULTS

The stability of the foams is very easily visualised by looking at the raw data in transmission and backscattering (*Figure 1*). On the backscattering profile, we can observe that the shape of the curve is characteristic of a foam. Near the air-liquid interface the air bubbles are smaller (high backscattering level) than at the top of the foam (foam-air interface).
The Turbiscan LAB enables to see the evolution of the liquid front when the foam breaks. We can therefore follow the drainage of the foam by studying the transmission profile. The drainage is calculated by following the thickness of the peak in transmission (increase of the quantity of liquid) and by normalising to the initial foam height (*Figure 2*).

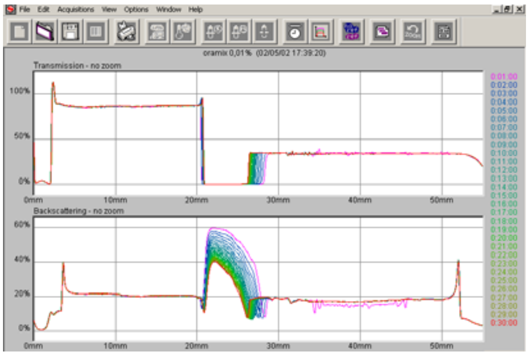

Figure 1. Profile of transmission and backscattering of a foam

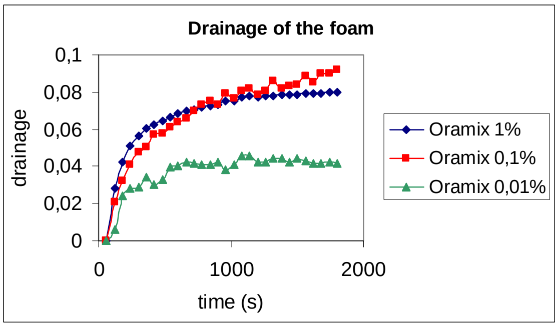

Figure 2. Drainage

We can see that for small surfactant quantities the curve is flatter, which means that the drainage is less important. This can be explained by the fact that when there is more surfactant, more foam is formed so the drainage is more important due to the height of the foam. However, we can see that the drainage is similar for 0.1 and 1% of surfactant although there is about twice as much foam for 1%. So we can conclude that the drainage depends on both the height of foam formed and the capacity of the surfactant to stabilize it.
To follow the coalescence of the air bubbles, we calculate the kinetics of the mean value of backscattering (*Figure 3*). The backscattering intensity at t=0 gives the density of the foam. This one is more important when the concentration of surfactant is the highest. If we follow the evolution of the signal in reference mode (Reference to t=1 min), it is possible to compare the coalescence of the air bubbles in each case (*Figure 4*). For 0.01% of surfactant the coalescence is the slowest, which corresponds to the case where the drainage is the less important (*Figure 2*). The two other foams are similar in stability, which again follow the results of the drainage. We can conclude that both the drainage and the coalescence of the air bubbles are directly linked.

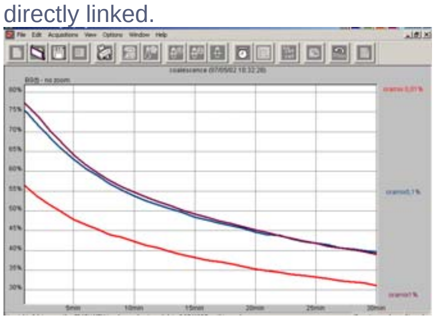

Figure 3. Coalescence of air bubbles

Figure 4. Comparison of the stability of foams.

SUMMARY

The Turbiscan LAB enables to follow the stability of the foam formed by a surfactant. It is therefore possible to compare different products depending on the application.