



Characterization of an emulsion

Quick and simple fingerprint of emulsions

Application

Cosmetics

Objective

Characterization of emulsions and of their creaming

Device

TURBISCAN® LAB

INTRODUCTION

Emulsions are colloidal systems commonly used in the cosmetics industry. There are inherently unstable but can be considered as kinetically stable if their destabilisation is slower than their expected shelf life. Moreover, in order to sell these products, it is necessary to characterise them and control their quality. The advantage of the Turbiscan LAB is that it does not require any dilution and therefore gives information on the actual product.

METHOD

We analysed three direct emulsions of canola seed oil in water with different volume fractions of oil (10%, 20 % and 40 %) using the Turbiscan LAB. These emulsions are stabilised with SDS and Span 80. The destabilisation analyses were performed by doing one scan every 3 minutes during almost 2 hours.

RESULTS

1. Raw emulsion characterization

The analyses of the three emulsions done with the Turbiscan LAB give the following results (Figure 1):

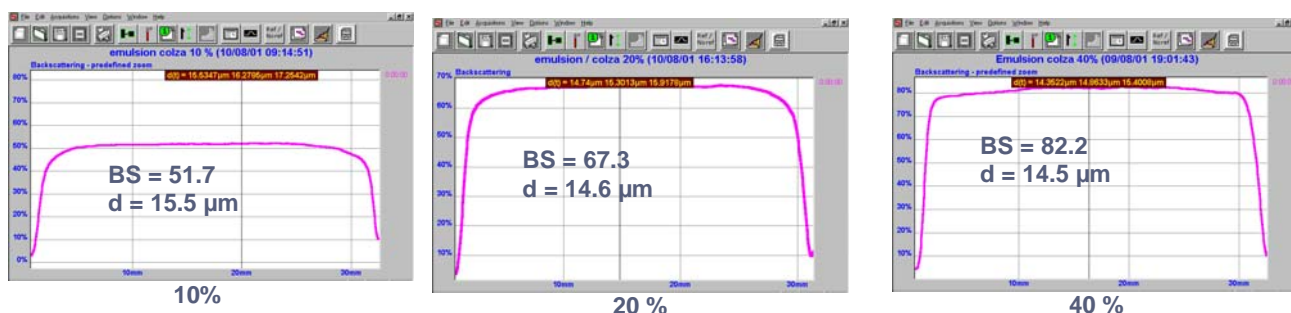


Figure 1. Backscattering versus sample height for various phase volume

From these graphs one can see that the initial levels of backscattering are representative of the three different emulsion concentrations while the mean droplet diameters are equal in the three cases. These calculations are performed, with the Turbiscan LAB^{expert}, in one point from the first backscattering profile with using the following parameters:

- Refractive index of the dispersed phase $n_p = 1.471$
- Refractive index of the continuous phase $n_f = 1.33$ (water)
- Volume fraction of the dispersed phase $\phi = 10, 20$ and 40%

Study of the creaming emulsions

On the other hand we see on *Figure 2*:

- a backscattering decrease with time at the bottom of the sample due to a clarification of the product
- a backscattering increase with time at the top of the sample due to a cream layer formation
- no backscattering evolution in the heart of the sample: no droplet size variation phenomenon (isobestic point).

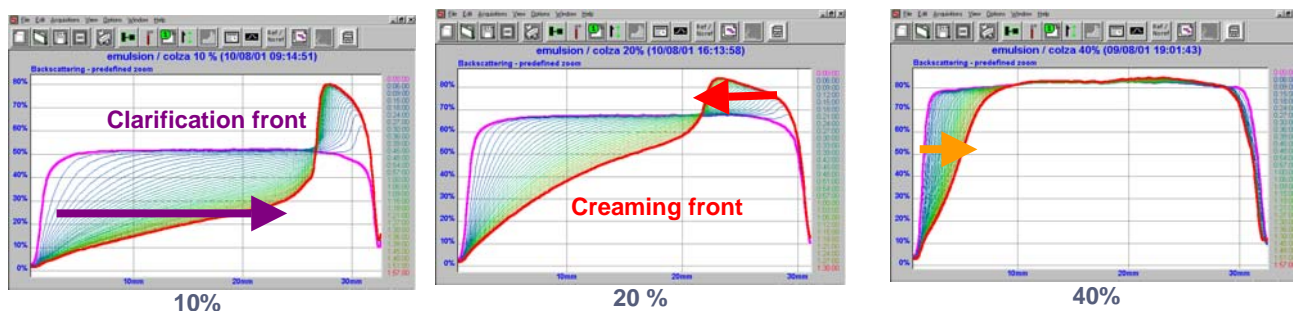


Figure 2. Study of the creaming of the emulsion

2.

From backscattering measurements, the Turbiscan LAB calculates the migration velocity versus time by tracking the migration front (*Table 1*). Once the migration velocity is stable (flat curve versus time), we can calculate the “hydrodynamic” mean diameter of the droplets using the “general law of sedimentation” (Stokes Einstein law extended to concentrated dispersions). The values to enter in the software are:

- Continuous phase density = 1 (water)
- Continuous phase dynamic viscosity = 1 mPa.s (water)
- Dispersed phase density = 0.91 (canola seed oil)
- Dispersed phase volume fraction ϕ = 10, 20 or 40 %

Volume fraction (%)	Migration velocity ($\mu\text{m}/\text{min}$)	Hydrodynamic diameter (μm)
10	168.4	10.2
20	93.0	10.5
40	24.7	11.5

Table 1. Migration speed in function of time for different emulsions

We can see from these results that the hydrodynamic diameters are also similar for the three formulations. However, we observe that the creaming velocity is more important when the phase volume is low. This can be explained by an increase in viscosity of the emulsions when the phase volume is high, that will slow down the phase separation.

SUMMARY

The Turbiscan LAB enables the characterization of concentrated emulsions by calculating a mean diameter together with a hydrodynamic diameter. It is also a good tool for following the kinetics of destabilisation of the system.