Study of the release of an encapsulated active in a double emulsion

Done in collaboration with Advanced Emulsion Technologies ademtech

Application
Cosmetics

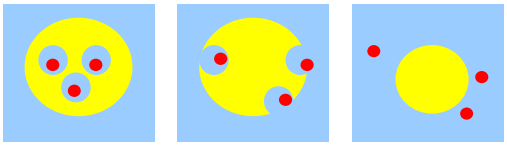
Objective
Characterization of the coalescence responsible of the release of an active in a double emulsion

Device
TURBISCAN® LAB

INTRODUCTION

Double emulsions are colloidal systems of great interest for the cosmetics industry as they enable to encapsulate both hydrophilic and lipophilic molecules. However, their formulation is very delicate and requires an important know-how. Their characterisation is also quite limited with classical techniques that, for most of them require dilution (particle size), or are not quantitative (microscopy). The Turbiscan LAB enables such characterization (see application note "Pre-formulation of a double emulsion"). The study of the kinetics of release of the active encapsulated in the internal emulsion is also very interesting for the formulator. However, here again, very few techniques are available.

The coalescence of the internal droplets of a double emulsion on the wall of the globules leads to the release of the encapsulated active ingredient. The emulsion that was initially double is transformed into a simple emulsion. This instability is critical, both for the emulsion storage and the release of the active ingredient during application (Figure 1).



Close-up of a droplet in proximity to the wall of the globule. The active ingredient is represented by a red dot.

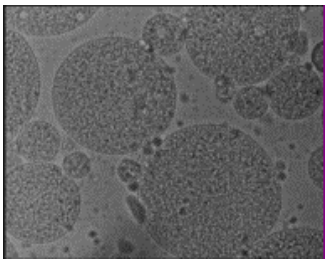
Close-up of the oil film that separates the droplet and the external aqueous phase. The high HLB surfactant helps the formation of a hole in the film.

Following the formation of a hole in the film: the active ingredient is released into the external aqueous phase.

Figure 1. Coalescence of the internal droplets

The interfacial curvature of the internal droplets is tensed due to the small size of the droplets. The addition of hydrophilic surfactant in the external phase will help the formation of a hole in the external film when the internal drops are close to the surface. This enables a decrease of the tension of the curvature, that becomes more positive, and is therefore entropically favorable.

In this regards, the addition of a surfactant of high HLB in the external phase leads to the coalescence of internal droplets, hence the release of the encapsulated active.



Microscopic observation of a double emulsion

METHOD

We analyzed a water-hexadecane-water double emulsion, encapsulating salt in the internal droplets. We studied the effect of an excess of surfactant (SDS) incorporated at t_0 in the external aqueous phase.