Formulation of direct emulsions

Done in collaboration with ademtech

Application
Cosmetics

Objective
Optimization of a mixture of surfactants to formulate a direct emulsion

Device
TURBISCAN® LAB

INTRODUCTION

Mixtures of surfactants are commonly used in the industry, as industrial surfactants are usually mixtures very difficult to purify. Moreover, a synergy between surfactants is very often observed, enabling to get an even better stability. Therefore, the formulator has to test a large range of surfactant mixtures. In order to make his choice quickly and in the best possible way, he needs an analytical tool to evaluate the stability of his formulations.

METHOD

We produced a control O/W emulsion using an oil (caprylic/capric triglyceride) and a high HLB surfactant (Tween 80, HLB=15). The sample is emulsified through agitation for 10 seconds using a vortex.

We observed that the emulsion is coarse and creams quickly. The Turbiscan LAB highlights a low average of backscattering intensity in the core of the emulsion (about 20 %) as well as migration of the drops to the top of the tube after a few minutes (Figure 1). This migration leads to the appearance of a subnatant phase that is nearly transparent (Figure1, top graph).

We study the influence of addition of a low HLB surfactant (Span 80, HLB=4.3). It is prepared in an oil solution of varying concentrations. The emulsions are prepared in the same way as the control part (Table 1), then analyzed with the Turbiscan LAB.

	0	1	2	3
Tween (%)	1	1	0.1	1
Span (%)	0	10	10	20

Table 1. Composition of the emulsions

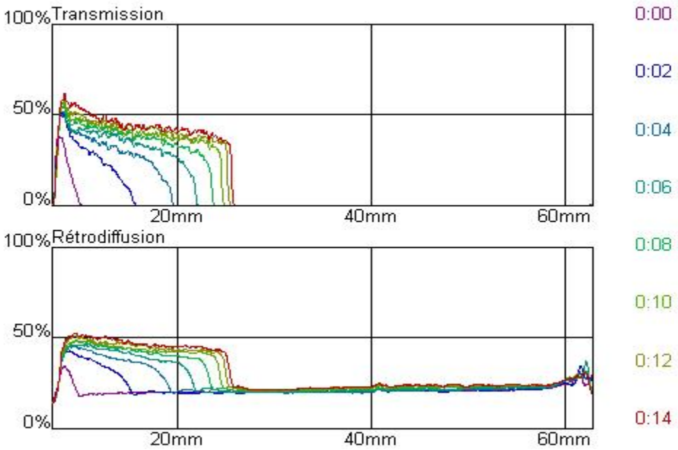


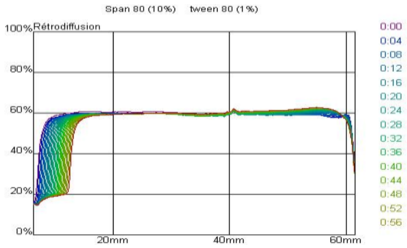
Figure 1. Transmission and backscattering profiles of the control emulsion

RESULTS

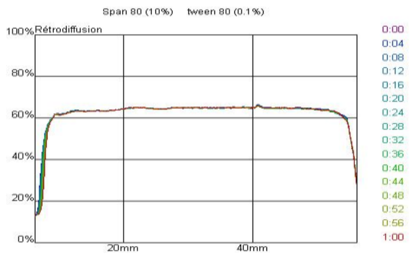
1. <u>Analysis of the Backscattering</u>

The presence of Span 80 considerably modifies results obtained with the control emulsion. Macroscopically, the difference is also noticeable because the samples are more turbid than the control part and because no creaming is visible to the naked eye (Figure 3).

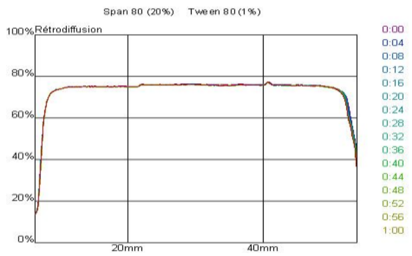
A finer analysis with the Turbiscan LAB enables a deeper investigation. The backscattering levels obtained in the presence of Span 80 are much higher (60, 65 and 75% respectively for emulsions 1, 2 and 3). These variations correspond to a decrease of the average size of the drops in the emulsion. We also observe that the phenomenon of migration is considerably reduced (on longer time scales), hence a reduction of the average size.



n°1



n°2



n°3

Figure 2. Backscattering profiles for emulsions 1 to 3.

With the Turbiscan LAB, it is possible to select the best formula, which turns out to be emulsion 3 (1% Tween, 20% Span), stable on a scale of one hour. The Turbiscan LAB offers a compromise solution (emulsion 2), which consists in using less surfactant (0.1% Tween, 10% Span). This second solution is less satisfactory regarding creaming (it is noticeable in less than one hour) but may suit to the formulator if he can use a thickener. The last alternative presented here consists in adding 1% of Span 80 to the control formula. It results in a substantial decrease in the average size drops. It will be necessary to add an additional component, such as a thickener, to prevent the creaming.

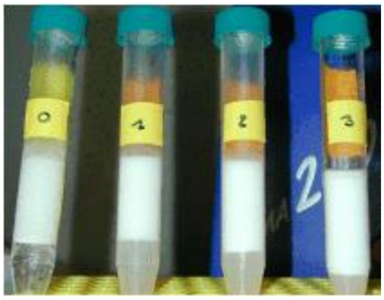


Figure 3. Pictures of the different samples

2. <u>Calculation of the diameter</u>

Moreover, the Turbiscan LAB^{expert} allows a calculation of the mean diameter from the backscattering intensity. To perform this calculation, one needs the refractive indices of the continuous and dispersed phases and the phase volume. This result could be used as a characterization parameter to optimize the formulation and as a control to check the quality of the product.

SUMMARY

We have shown how the Turbiscan LAB enables to optimize the formulation of an emulsion. The method presented applies, whatever the type of emulsion: direct, inverse or even multiple. With the Turbiscan LAB, it is then possible to highlight any instabilities (coalescence, flocculation, etc.), to pre-select the worthwhile formulations and to compare them to one another (backscattering level) in order to produce the best possible conditions. The Turbiscan LAB^{expert} gives also the mean diameter that can be used later on for quality control in industrial processes.