TURBISCAN DNS

Pickering emulsions studies
Dispersibility, emulsification, and stability

INTRODUCTION

The cosmetic, pharmaceutical, and food sectors are facing a growing demand for more natural and less toxic products. Usual surfactants do not respond to this need: most of them are synthetic and non-biodegradable, and some are also allergenic or irritating.
Pickering emulsions seem to be a good alternative. These emulsions, stabilized by solid particles, allow to have very stable, more natural, and more health-friendly products.
To make these emulsions, it is essential to control the dispersion phase to avoid aggregates and therefore enhance final product stability.
This paper shows TURBISCAN DNS capabilities to characterize particle dispersion and size, as well as emulsion stability in a single experiment without sampling or dilution.

Pickering **Size** **Stability**

DEFINITION: PICKERING EMULSION

Pickering emulsions are emulsions where conventional emulsifiers such as surfactants are replaced by solid particles like powders or polymers. In addition to being healthier than conventional emulsions, Pickering emulsions are much more stable. Indeed, the high adsorption energy of solid particles at the liquid-liquid interface constitutes a rigid barrier against destabilization phenomena.

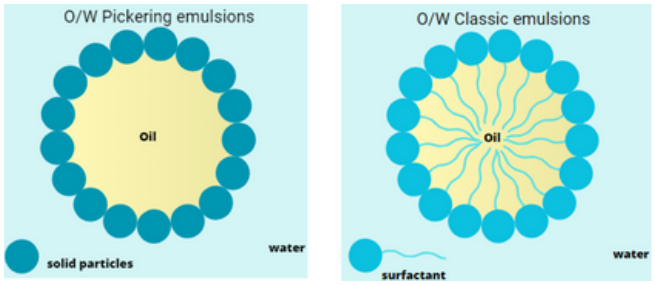


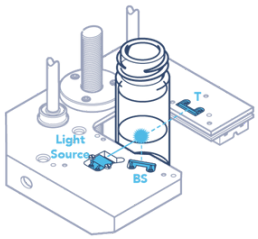
Figure 1: Illustration of classic emulsion and Pickering emulsion

However, gravitational destabilization phenomena such as creaming, or sedimentation still take place within these emulsions. To minimize them, the dispersion step of solid particles is crucial. Indeed, a good dispersion of solid particles with a smaller size leads to an emulsion with a smallest droplet size. Therefore, the final stability is enhanced. Nevertheless, there are other parameters that influence stability such as the nature of the particles, the nature of the oil, or the oil/water ratio.

Most of the time, stability measurements of these emulsions are done visually. Droplet and particle size are measured by an optical microscope or a particle size analyzer. These methods are time-consuming and do not allow live kinetics tracking.
With the Turbiscan DNS, in a single experiment, the whole process can be followed: the dispersion of particles, the online particle size, and the final emulsion stability.

TURBISCAN®: HOW IT WORKS

Turbiscan® technology, based on Static Multiple light scattering (SMLS), consists of illuminating a sample with an infrared light source and acquiring Backscattered (BS) and Transmitted (T) signals.



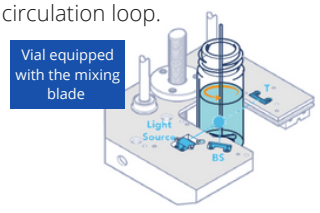
BS and T = f(φ, d, np, nf)

φ: particle concentration
d: particle diameter
np: dispersed phase refractive index
nf: continuous phase refracrive index

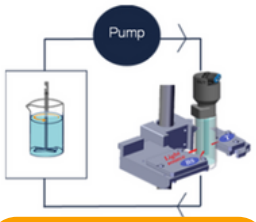
The signal is directly linked to particle's concentration (***φ***) and size (***d***) according to the Mie Theory, with (***nf***) and (***np***) being fixed parameters. Measurement of BS and T can be performed either on scanning mode, to provide homogeneity and stability measurement, or with very high frequency for high-frequency resolution and online measurement. Measurements are performed without any dilution & on native sample up to 95% V/V and from 10nm up to 1mm.

The **Turbiscan® DNS** for **Dispersibility** and **Stability** is composed of 2 modules:

- **T-MIX** for automated fast formulation screening, particle dispersibility studies with a stirring bar directly adapted inside the measurement cell.
- **T-LOOP** for online measurements and scale-up/ process optimizations with an integrated peristatic pump. The formulation is pumped from the reactor in and out the measurement cell, creating a circulation loop.



T-MIX module



T-LOOP module