Real time monitoring of emulsions stability thanks to microrheology

Application

Emulsions

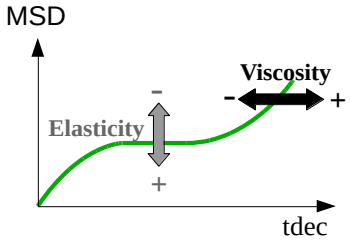
Objective

Monitor the real time stability to adjust the final formulation.

Device

Rheolaser® LAB6

Reminder about Mean Square Displacement



MSD curves are the signature of the product's microrheology. It reflects the viscoelastic behaviour of a sample.

By acquiring MSD curves at different ageing times for a same sample, it is therefore possible to identify the evolution of both viscosity, elasticity, and microstructural properties of a given product.

Introduction

Emulsions are commonly used in food and cosmetic industries. Their shelf life is very important for the supplier and also for the customer. For many years, soluble polymers have been routinely added to emulsions and suspensions in order to improve their stability. These polymers enhance the stability by providing a gel like behaviour, leading to precise viscoelastic properties. These properties drive several end use properties such as physical stability or efficiency during use.
There are many interests in using an optical technique such as microrheology and Rheolaser® LAB6 to monitor viscoelastic properties with the aim of characterizing the stability: working without shear on weak gels, monitoring the rheology versus ageing time on the very same sample, thus simulating the behaviour of the emulsion in the packaging, and determining its stability completely at rest.

In this example, the purpose is to monitor the emulsions rheological properties and the effect of various polymer concentrations on the emulsion stability time. Four emulsions (20% v/v) with different xanthan concentrations (0.12 to 0.4%) are analysed in order to rank them depending on their stability.

Basics on the emulsion stabilization

Xanthan, considered such as a non-absorbing polymer, plays the role of a depletion flocculent and create a transient gel with the emulsion, a percolation network forms. The integrity of the gel persists for a given period of time, and local fractures appear, the structure collapses suddenly, then a denser creamed phase forms. This phenomenon is called delayed creaming.

Raw data: Particles Mean Square Displacement (MSD)

In microrheology, droplets probe the viscoelastic behaviour of an emulsion. Thus, particle Mean Square Displacement curve is the signature of the product rheology.
The evolution of the MSD curves versus ageing time is then characteristic of the viscoelastic properties variations (Microrheology concept).
Rheolaser® LAB enables to monitor rheology on a very same sample during ageing time.

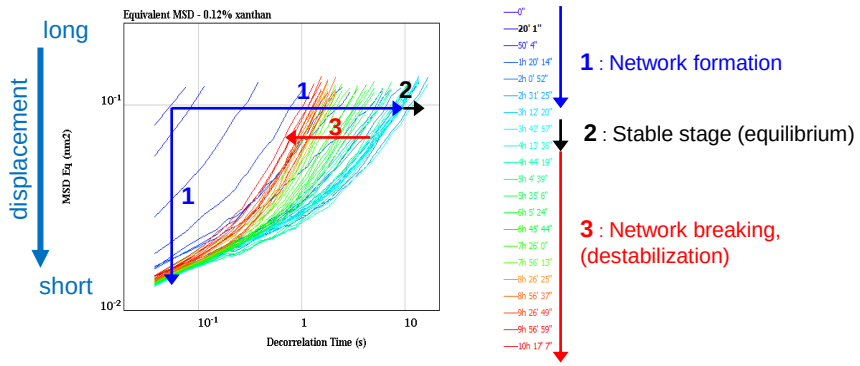


Figure 1. Mean Square Displacement evolution of the emulsion (20% v/v) with 0.12% xanthan polymer