STATIC MULTIPLE LIGHT SCATTERING TO PREDICT LONG TERM STABILITY OF EMULSIONS WITH POLYMERS

INTRODUCTION AND MICROSCOPICAL APPROACH

Polymers are widely used in the industry to control viscosity, provide end use properties and enhance the shelf life. At high concentration, the polymer stabilizes the emulsion forming a percolated network, which can persist for a very long period of time (months), but ended always to collapse and giving two separated phases. This kind of emulsions is very problematic for industry as no method exists to predict the breaking of the emulsions, samples can be qualified stables in QC-tests and break after during commercialization.

Teece & al. show from confocal microscopy measurements that for O/W emulsions with xanthan, droplets form a network with strands of thickness l_s and mesh size ξ depending on polymer concentration (see figure hereunder). They correlate these size properties with visual observation of destabilization. The smaller the cages and the thinner the strands, the longest the delayed collapse. This method with confocal microscopy detection is powerful but is not "ready-to-use" for industry, as it requires to add a fluorescent agent, and to have experience for fixing parameters, to obtain good quality images.

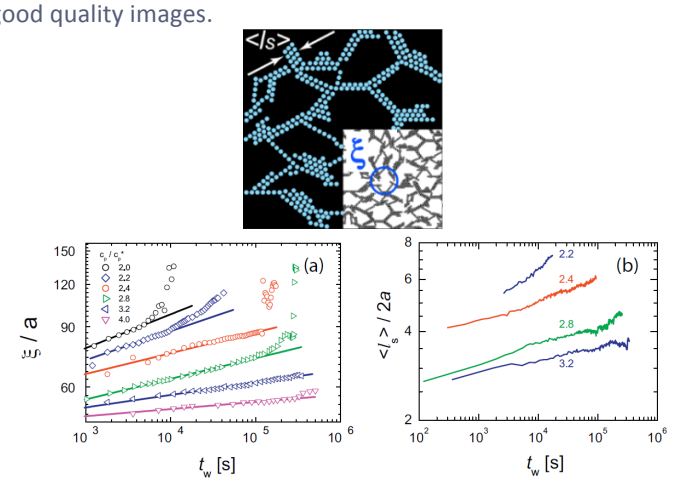

Figure 1: top = schematic of an emulsion gel with droplets forming a network of strands l_s with cages with mesh size ξ
bottom = ξ and l_s evolution for different xanthan concentrations
(ref : Teece & al., Colloids and Surfaces A: Physiochem. Eng. Aspects 458, 2014, 126-133)

In this note we propose to use Turbiscan technology with Static Multiple Light Scattering method to predict stability time of O/W emulsion + different polymer by in correlating the initial size variation with the destabilization time (both are measured at early stage with the Turbiscan) which is directly related to the shelf life. The results will be compared with data extracted from the Teece publication.

SAMPLES DESCRIPTION

O/W systems analyzed in this note are similar to the ones studied in the publication but closer to the industrial systems in terms of components and droplet size as given in the table below.

	In this note	Teece & al.
Oil	Sunflower	PDMS
Continuous phase	Water + tween20 + NaCl	Water + 1,2-ethane diol
Volume fraction	0.05	0.21
Droplet size (µm)	2.0	0.3
rg/a	0.04	0.62
Polymer nature[1]	Xanthan (HEC, Carrageenan)	Xanthan
Polymer c/c* range	3.5 to 10	2.4 to 4.8

[1]Note: NaCl is added to polymer during preparation.

PHENOMENON & RESULTS

S-MLS analysis with Turbiscan Technology

Analyses on the emulsions have been performed at ambient temperature with the Turbiscan®. The typical evolution for such emulsions is presented on the figure below.

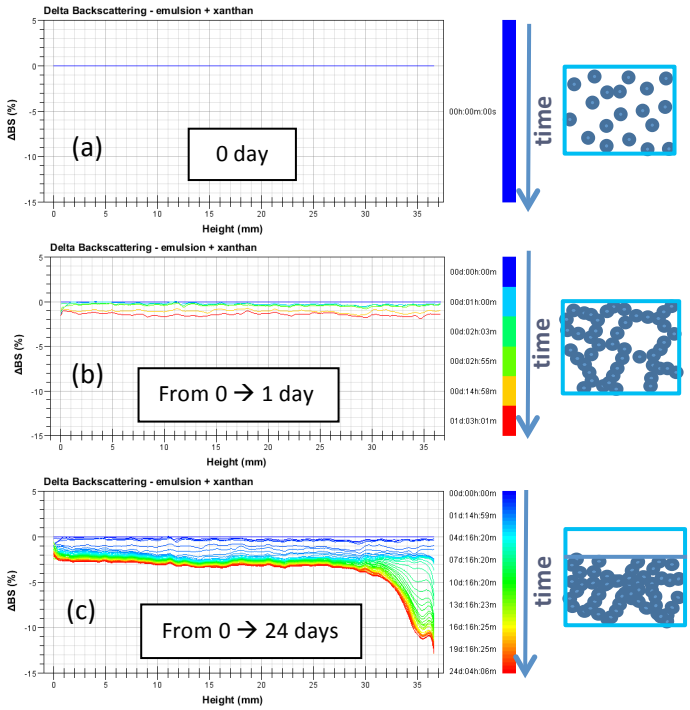

Figure 2: Delta-Backscattering for a formulation with xanthan at 25°C and schematic representation of the emulsions droplets.