Light Backscattering

A complementary tool to monitor the Phase Inversion of Emulsions

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Phase Inversion of Emulsions

Thermodynamically Unstable

Surfactant

Droplets size: 0.1 to 100 µm

Transitional

• % Salt
• Temperature
• ACN
• % Alcohol

Catastrophic

Water Oil Ratio

How can we track the Phase Inversion of Emulsions?

**In situ real time Conductimetry**

Bruggeman’s law: \( \kappa_e = \kappa_w \left(1 - \phi\right)^{3/2} \)

\( \kappa_w (T, \text{Salt Concentration}) \)

**Salt** is required...

**No information** when the Oil is the continuous phase

Compatible with all emulsification processes

Shinoda et al., Journal of Physical Chemistry 1964, 68, 3485-3490
How can we track the Phase Inversion of Emulsions?

**In situ real time Viscosimetry**

\[ \eta_e ( \eta_0, \eta_w, \phi, D, \text{Polydispersity} ) \]

**Signal** whatever the continuous phase

Allouche et al., Langmuir 2004, 20, 2134-2140

**Non versatile** emulsification conditions (geometrical factors)

**Useful practical parameters**
How can we track the Phase Inversion of Emulsions?

In situ real time Optical Technique (microscopy)

The Inversion Point can not be determined

Blind if Droplets Size $< \pm 10 \, \mu m$

Real time Droplet size determination

Alban et al., Chemical Engineering Research and Design 2004, 82(A8), 1054-1060
Sajjadi et al., Colloids and Surfaces A 2004, 240, 149-155
How can we track the Emulsions Phase Inversion?

**On line Optical Light Backscattering**

%BS \( I_0, \lambda, n_o, n_w, \phi, \theta, D \)

5% Brij 30 / Decane / 10^{-2}M NaCl
aqueous \( f_w = 0,6 \)

Adaptable to any formulations and emulsification processes

Gives a Signal whatever the continuous phase

Pizzino et al., Langmuir 2007, 27, 5286-5288

TURBISCAN On Line, FORMULACTION, Toulouse - F.
Determination of the PIT from the Backscattering Signal

Where should we place the Phase Inversion Point?

5% Brij 30 / Decane / $10^{-2}$ M NaCl fw = 0.6
Trying to understand the Light Backscattering signal…

\[ \%BS \ (I_0, \lambda, n_o, n_w, \phi, \theta, D) \]

Mastersizer Granulometer

5% Brij 30 / Decane / \(10^{-2}\) M NaCl \(fw = 0.6\)
Validation of the Light Backscattering Technique

5% Brij 30 / Decane / 10^{-2} M NaCl

Conductimetry

Backscattering

 Forgiarini et al., Langmuir 2001, 17, 2076-2083
CONCLUSION

Light Backscattering is:

A complementary technique to track the Phase Inversion

Easy to use, non-invasive and adaptable to any emulsification process

Sheding light on the transitory phenomena occuring in the W/O region blind to other techniques

Perspectives

Scale down the system?
Morphology of the transitory state (L.C.?)
Thanks For Your Attention