RELATIONSHIP BETWEEN RHEOLOGICAL BEHAVIOUR AND THE TYPE OF FORMED MESOPHASE WHEN PREPARING NANOEMULSIONS

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Formulation influences both drop break-up and the coalescence

Two opposite effects → there is a minimum
For instance Salinity scan

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Two opposite effects → there is a minimum on each side of optimum formulation

Salinity
S^*
S*
Minimum
O/W
W/O
MEH

Hence drop size depends on dilution that results in formulation changes

Emulsification by dilution = Mass transfer + formulation change

Nanoemulsification strategy (low energy)

If original formulation is adequate (slightly hydrophilic surfactant)
Dilution by water of oil solution produces a formulation scan through 3 phases because of the partitioning
Close to optimum formulation: low γ = minimum drop size
High coalescence if mesophase is emulsion > not stable
Protection against coalescence if mesophase is LC > stable

Inversion + mass transfer change in formulation and composition

SPONTANEOUS EMULSIFICATION

Original oil surfactant (microemulsion or LC)

Dilution Path

O/W
2 phases

LqLLC breaks

nanodroplets

But Optimum Formulation (γ min) depends on surfactant concentration

Hence drop size versus Formulation experimental data

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With liquid crystal at optimum instead of microemulsion drops do not coalesce, hence small at optimum

Microemulsion at optimum

Liquid crystal at optimum

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**SPONTANEOUS EMULSIFICATION**

Original oil+surfactant forms LC that takes water in

LaLLC swells

2 phases

LaLLC breaks

nanodroplets

**Conductivity vs. Water content**

4 mesophase cases

- Conductivity increases
- Possible phase transitions

**Droplet Size and Rheology Relationship**

Changes in the composition and formulation of the original solution

Tween 80-Span 20 (HLB=12)/Water/Paraffin Oil system at a S/O relationship of 25/75, 0.06% NaCl and T=30ºC

**Conclusions**

Phase Inversion Emulsification by dilution shows a relationship between

- Rheological behavior,
- Type of mesophase formed,
- Droplet size of final emulsion

Viscoelasticity measurements allow to distinguish the phase transition between the O+LC and O+LC+Wm cases

This is important because nanoemulsions are only attained with O+LC mesophase slowly produced, then quickly diluted.

**Thank you for your attention**