Formulation of Pickering Emulsions : The feasibility of cosmetic formulations and their environmental impacts

Poster ID 393

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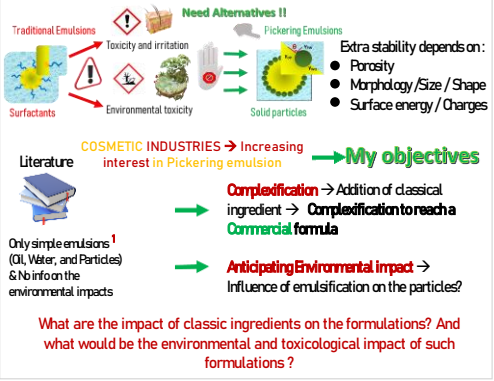
Introduction:



Materials & Methods:

Materials

Commercial Particles – Cosmetic grade

- Modified **TiO_2 Particles –** coated (16% silica & 6% cetyl (C_{16}) phosphate)
- Native **Bentonite**

Components for complexification

- Humectant : **Glycerin (G)**
- Thickening & Suspensive agent –
- **Xanthan (X) Xanthan & Glycerin (XG)**

Oils

Oil	Dynamic Viscosity (mPa.s) 25°C	Interfacial tension (vs water) mN.m^{-1} at 20°C
OO	42,9 ± 0,6	18,0 ± 0,34
CCT	16,3 ± 0,3	25,8 ± 0,08
PS	22,8 ± 0,3	54,01 ± 0,51

OO = Olive oil
CCT = Caprilic Capric Triglycerides
PS = Phytosqualane

Methods

Emulsion properties

Droplets size and microstructure

- Optical Microscopy **(OM)**
- Static Light Scattering **(SLS)**

Particles properties

Structure properties

- Scanning Electron Microscopy **(SEM)**

Physico- Chemical properties

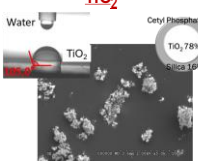
- Contact angle **(CA)**
- Infrared spectroscopy **(IR)**

Complexification steps

Results & Discussion:

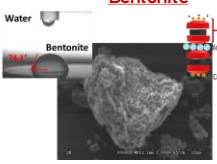
Native particles Characterisation & simple formula → Complexification to reach a commercial formula

TiO_2 [2]



- **Nanosized** isolated particles, 20nm – aggregates 100-200nm **(SLS and SEM)**
- **Oval or spherical** form **(SEM)**
- Non-polar behavior and, minor basic and acidic monopolar contributions **(CA)**

Bentonite

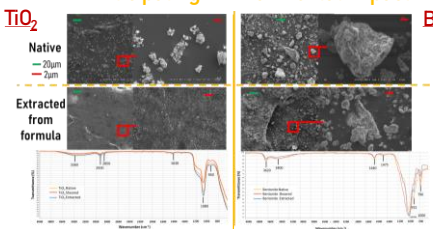


- Aggregates **1-50nm (SLS and SEM)**
- **Platelets** form **(SEM)**
- Non-polar behavior, minor acidic contribution, and a non-negligible basic contribution **(CA)**

→ All the simple formula
- **Stable**
- **Fully emulsified**

→ **Fully Cosmetics grade**

Anticipating Environmental Impact

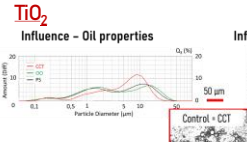


→ **No impact** on the structure **(SEM)**
→ **No impact** on physicochemical properties **(AC and IR)**

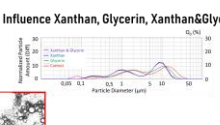
→ Impact on the structure of the particle **(SEM)**
→ Impact on the physicochemical properties ? **(CA)**

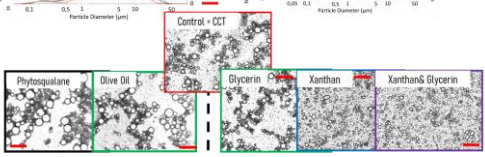
TiO_2

Influence – Oil properties



Influence Xanthan, Glycerin, Xanthan&Glycerin





Oil Influence

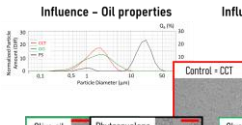
→ No significant changes **(OM, SLS)**
→ **Surface modification of TiO_2 = Stabilization independent of oil proprieties**

Xanthan gum and Glycerin Influence

→ **Glycerin**: No impact **(OM, SLS)**
→ **Xanthan**: better size distribution **(OM, SLS)**
Changes the emulsion microstructure and decreases the aggregation phenomena [3]

Bentonite

Influence – Oil properties



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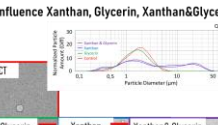

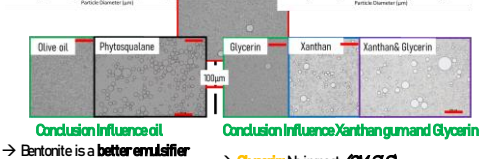

Conclusion Influence oil

→ Bentonite is a **better emulsifier for polar oil** (best affinity Water/oil and Particle/oil) **(OM, SLS)**
→ **Oil phase viscosity determines emulsion viscosity**

Conclusion Influence Xanthan gum and Glycerin

→ **Glycerin**: No impact **(OM, SLS)**
→ **Xanthan**: Increases the droplet size **(OM, SLS)**
→ **slow kinetics, and increases the energy for the anchoring at the interface of the particle.** [4]

Conclusions:

Oil properties

Surface modification = Stabilization of emulsion independently of the nature of the oil
Particle properties = Better stabilization of polar oil

Other components

Glycerin = No impact
Xanthan = Limits the aggregation phenomena

Glycerin = No impact
Xanthan = Decreases the anchoring of particles at the interface

Particles modification

Extraction

→ **No modification**
→ **Structure modification**

Perspectives !!

In vitro environmental impact ?

In vitro toxicological impact ?

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References:

1 B. P. Binks and T. S. Horozov, Eds., Colloidal Particles at Liquid Interfaces, Cambridge University Press, Cambridge, 2006.
2 D. Terescenco, N. Hucher, C. Picard and G. Savary, International journal of cosmetic science, 2020, 42, 198–207.4 S. B.
3 C. Albert, M. Beladjine, N. Tsapis, E. Fattal, F. Agnely and N. Huang, Journal of Controlled Release, 2019, 309, 302–332.
4 F. Wu, J. Deng, L. Hu, Z. Zhang, H. Jiang, Y. Li, Z. Yi and T. Ngai, Colloids and Surfaces A: Physicochemical and Engineering Aspects, 2020, 602, 125082.