Rheological characterization of pickering emulsions stabilized by Hectorite and Disteardimonium Hectorite for scaling-up considerations

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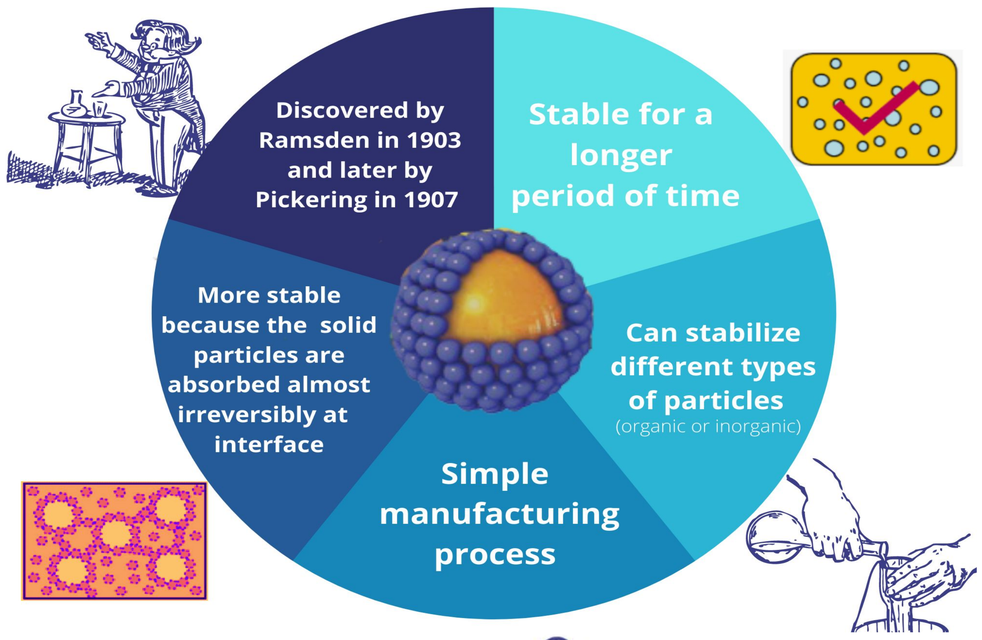
Introduction

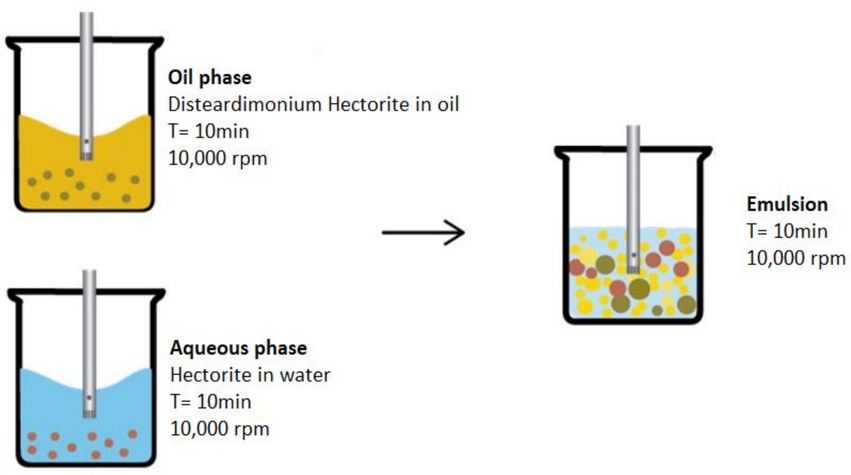
PICKERING EMULSIONS



Materials & Methods

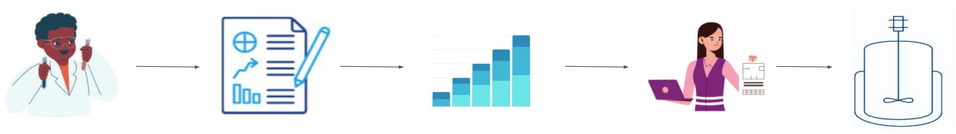
Raw Material

-Bentone® Gel ISD V (Donated by Pharmachem)
-Bentone® Hydroclay 2001 (Donated by Pharmachem)
-Mineral oil NF 55 -Demineralized water



Methods

Experimental design: The Box-Behnken design was used to determine the composition of the emulsions.
Rheological evaluation: The shear stress vs shear rate curve and viscosity and the viscosity curve in function of time were made adjusted to the Herschel-Bulkley model and the power model.

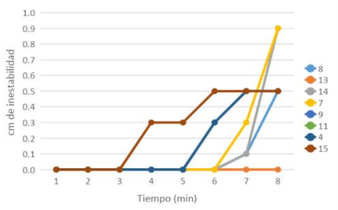


Results & Discussion

Stability:

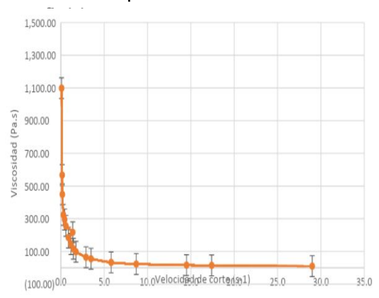
Best performance Emulsion 13 and 14, attributed to the proportion of clays.

Pickering Emulsion	4	7	8	9	11	13	14	15
Stable Reference								

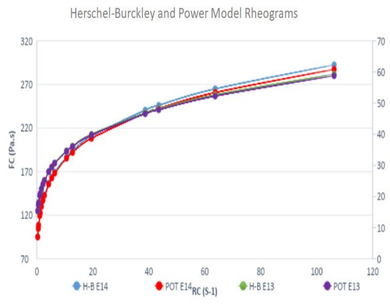


Performance:

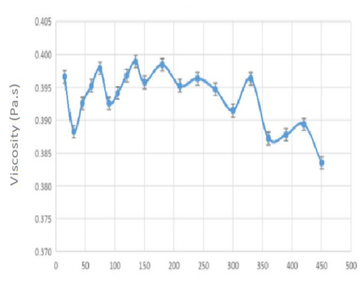
-Pseudoplastic non-Newtonian



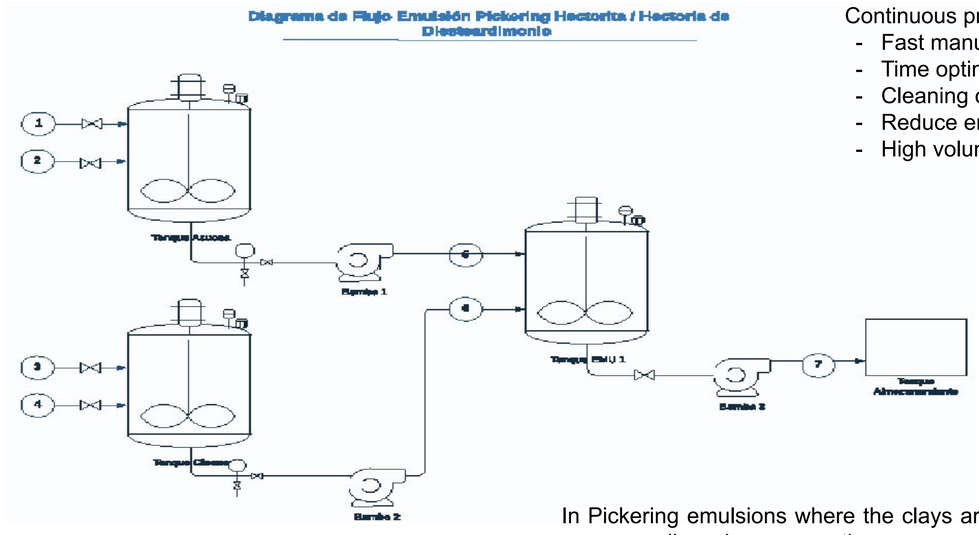
-Power Model rheological behavior



-Thixotropic fluid



Process Diagram:

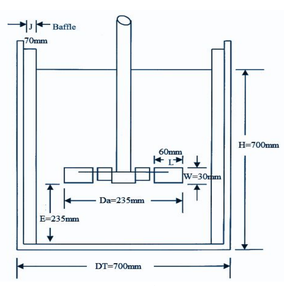


Continuous process benefits:

- Fast manufacturing
- Time optimization
- Cleaning optimization
- Reduce energy
- High volume

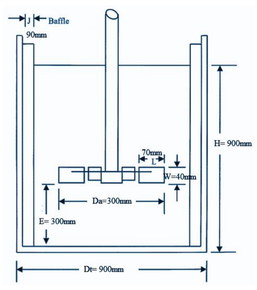
In Pickering emulsions where the clays are mixed with the corresponding phase a continuous process is considered more efficient.

Equipment Design



Mixer Tank

The mixing tanks were designed for a volume of 200 kg each one. Aqueous phase mixer need a 1 HP electric motor and the Oli phase mixer require a 8 HP electric motor.



Homogenization Tank

The homogenization tank was designed for 400 kg and need a 2.5 HP electric motor.

Conclusions

Pickering's emulsions are stabilized by solid nanoparticles, the rheological behavior of Pickering emulsion stabilized by hectorite and hectorite of disteardimonium has been characterized by rheograms in order to obtain more information for scaling-up considerations.

Knowing the rheological behavior of emulsions is a valuable tool for the chemical industry because it provides information for manufacturing, the information is used to perform calculations related to equipment design, ingredients influence, quality control and in some cases texture with sensory data.

References

[1] Spencer Umfreville Pickering, M. F. (1906). Emulsions. London: Eyre y Spottiswoode.
[2] Yang, Y., Fang, Z., Chen , X., Zhang, W., Xie, Y., Chen , Y., . . . Yuan, W. (2017). An Overview of Pickering Emulsions: Solid-Particle Materials, Classification, Morphology, and Applications. Front Pharmacol, 202-209.Tadros, T. F. (2009). Emulsion Science and Technology. Weinheim: WILEY-VCH Verlag GmbH & Co. KGaA.
[3] Cui, Y., Threlfall, M., & Van Duijneveldt, J. s. (2011). Optimizing organoclay stabilized Pickering emulsions . Elsevier, 665-671.
[4] Chevalier, Y., & Bolzinger, M.-A. (2013). Emulsions stabilized with solid nanoparticles: Pickering emulsions. Elsevier, 23-34.
[5] Tadros, T. F. (2010). Rheology of Dispersions. Weinheim: WILEY-VCH Verlag GmbH & Co. KGaA.

Acknowledgments

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