

Rheology and Stability of Gigantic Micelles

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Abstract

Gigantic micelles are structures which are formed by an amphiphilic substance in an aqueous system combined with the presence of a co-solute. The co-solute has the important action of reduce the electrostatic repulsion between the amphiphilic molecules, making possible the formation of a long structure with differential characteristics. The influence of the molecular structure of surfactant and co-solute in the rheology of the gigantic micelles was the subject of this project.

Key words: Rheology, Micelle, Surfactant.

Introduction

Surfactants are amphiphilic molecules which at a given critic concentration, the CMC (*Critical Micelle Concentration*), self-organize in a micelle structure. When in the presence of a co-solute, the columbic repulsion between the heads of the surfactant may be minimized and the structures can gain micrometric dimensions, forming the worm-like micelles (or gigantic micelles)¹. The micelle may gain some characteristics which are similar to polymers' due to their dimensions, as the formation of viscoelastic solutions and gels and being able to reduce the hydrodynamic friction².

Results and Discussion

During this project the focus was study the effects of cationic surfactants (Cetyltrimethylammonium Chloride and Cetylpyridinium Chloride) in neutral aromatic co-solutes (tymol, 4-ethylphenol and 4-tercbutylphenol). In the systems analyzed it was possible to observe the co-solute minimize the electrostatic interaction between the surfactant's head, however maintaining a positive charge at the micelle's surface. In this manner, due to the electrostatic repulsion between the surfactants' cationic heads, long macrostructures were formed. These structures have a long relaxation time. Some systems had their rheology analyzed in the proportion of 3:2 (Surfactant:Co-Solute), as showed below.

Image 1: Variation of the elastic and viscous modules in function with frequency. Samples of CTAC with tymol, 4-ethylphenol and 4-tercbutylphenol.

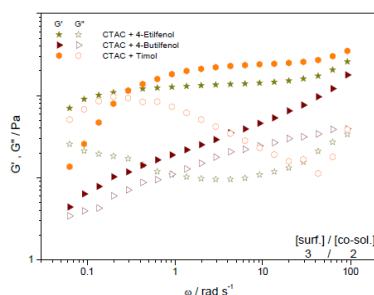


Image 2: Photographs of flasks containing different concentrations of Cetylpyridinium Chloride and Tymol (concentration in mmol L⁻¹). Some showed two-phase systems.



Conclusions

During this project was possible to verify the proportions in which the worm-like micelles form one or two phases, analyze the rheology of the homogeneous systems and yet confirm the formation of macrostructures with gigantic micelles characteristics.

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¹ May, S.; Ben-Shaul, A. Molecular packing in cylindrical micelles. In *Giant Micelles: Properties and Applications*; Zana, R.; Kaler E. W., Ed.; CRC Press, Boca Raton, 2007, Chapter 2.

² Rodrigues, R. K.; da Silva, M. A., Sabadini, E. Worm-like micelles of CTAB and sodium salicylate under turbulent flow. *Langmuir* 2008, 24, 13875-13879.