An insight into the self-assembly of cationic surfactants in a mixed water-alcohol environment

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Abstract

This work reports the self-assembly and micellization behaviour of cationic surfactant in water and mixed alcohol-water solutions was investigated using various physicochemical techniques. Here, three C_{16}-type cationic surfactant were studied in presence of ethanol (co-solvent) 1-butanol (BuOH, mediator) and 1-octanol (C_8OH, co-surfactant) respectively. The studies suggested that the micellization process of 16-2-16 becomes delay and less spontaneous in the presence of ethanol because of ethanol locate within the aqueous bulk phase. Whereas, BuOH is promotes the mixed micelle formation of CPB micelle. In addition, the incorporation of C_8OH leads to an elongation of the ellipsoidal CTAB micelles. With the further addition of C_8OH, a transition of the elongated micelles occurred to a viscoelastic fluid comprising entangled wormlike micelles due to the solubilization of C_8OH within the CTAB micelle. These results will facilitate the optimization of processes and other comparable surfactants are used as phase transfer catalysts, structure-directing agents, or stabilizers in colloidal dispersions or emulsions.

Introduction

- Surfactant-alcohol systems are important to form various solubilized systems or microemulsions.
- Usually, alcohols can act as solubilizers, co-solvents or co-surfactants and that alter micellar properties
- Co-surfactants that adsorb at or penetrate into the micelles promotes micellization.
- Co-solvents reduced the dielectric constant of the solution and that reduce the micellization of surfactant.

Experimental Section

Materials

- 16-2-16
- CPB
- CTAB
- Ethanol
- BuOH
- C_8OH

Methods

- Phase behaviour
- Rheology
- Small-angle neutron scattering

Results and Discussion

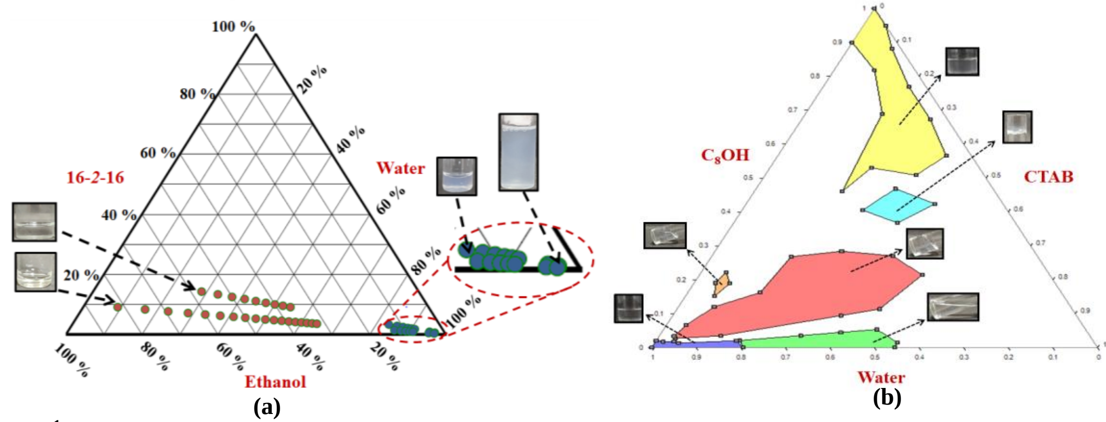

Fig. 1. Phase diagram of the (a) 16-2-16-ethanol-water and (b) CTAB-C_8OH -water ternary systems at ambient temperature.

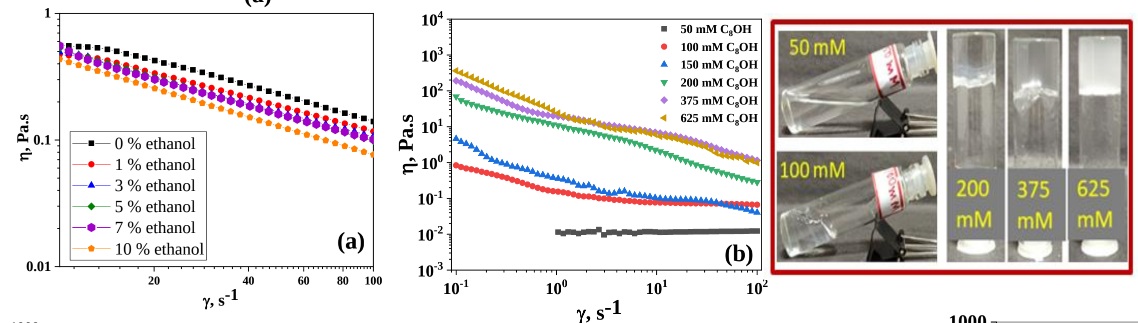

Fig. 2. Steady shear viscosity (η) of (a) 10 mM 16-2-16 in presence of varying [ethanol] and (b)150 mM CTAB in the presence of different [C_8OH] as a function of shear rate (γ) at 303.15 K.. Snapshots of aqueous 150 mM CTAB samples solution in the presence of different [C_8OH] at 30 °C.

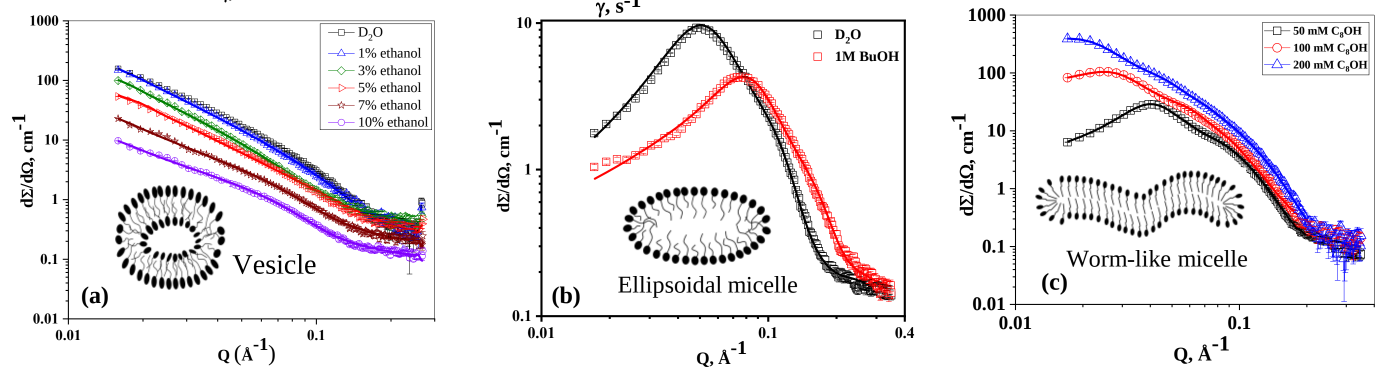

Fig. 3. Scattering profile for (a) 10 mM 16-2-16 in presence of varying [ethanol], (b) 100 mM CPB in D_2O, and 1M BuOH and (c) 150 mM CTAB in varying [C_8OH] at 303.15 K.

Conclusions

- Our studies elucidate the change occurrences in the micellization and aggregation behaviour of cationic surfactants in the presence of alcohols.
- The unilamellar vesicles of GS in the presence of ethanol which changed vesicles to micelle.
- In contrast, it was observed that micellar size and N_{agg} decreases more in the presence of BuOH.
- The C_8OH effectively enhanced micelle growth like the ellipsoidal to rod-like to worm-like transition in CTAB micellar solution.

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References

1. Kumar, V.; Patel, D.; Pal, H.; Kuperkar, K., *Physical Chemistry Chemical Physics* **2019**, *21* (28), 15584-15594.
2. Fontell, K.; Khan, A.; Lindström, B.; Maciejewska, D.; Puang-Ngern, S., *Colloid and Polymer Science* **1991,** *269* (7), 727-742.