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Influence of triethanolamine on the ideality of mixed micelles of Quaternary surfactants at Different temperatures: Conductometric investigation

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INTRODUCTION

- Mixture of self assembly molecules (surfactants) display enhanced performance than the single ones especially if the interaction between them is synergistic in nature. Mixed micelles have also been found to enhance bioaccumulation of various drugs through increased absorption, following low doses.
- A wide range of industrial processes that are surfactant based (detergency, drug solubilization) takes place in solvents other than water, hence co-solvents as well as temperature play major roles in the aggregation behaviour of micellar surfactants , shape, degree of micelle ionization (for ionic surfactant)
- Ethanolamines (TEAs) are important class of compounds with enormous applications in chemical research. They are widely used in the manufacturing of household detergents, agricultural herbicides, pharmaceutical ointments and as anticorrosion reagents
- They are also known to be an effective soil anti-redisposition agent as they help to keep soil in the laundry bath from re-depositing onto the fabric during the cleaning process. In addition,the presence of the organic moiety in the structure is also of value as it can give surge to hydrophobic interactions.

MATERIALS AND METHODS

The cationic surfactants, tetradecyltrimethylammonium bromide (TTAB), and cetyltrimethylammonium bromide (CTAB) were purchased from Aldrich (USA) and Sigma chemicals. Analytical grade triethanolamine (TEA) was also purchased from Sigma Aldrich and was also used without further purification. The water used in this work was double distilled, with specific conductivity of between 1 and 4 μscm^{-1} at room temperature. The surfactants were mixed by using simple mole fraction ratio Clint;s model), and the experiments were performed at temperatures between 298.1K and 313.1K in steps of 5 K using Janway (model 4510) conductivity meter. The meter was calibrated prior to use by measuring the conductivity of 0.01N KCl. Conductometric titration was carried out using a dip-type probe of 1.0 cm^{-1} cell constant. 10 cm^3 of the reference solution (water) or an appropriate amount of the TEA in water was taken in the conductance cell, and a 200 μl of a known concentration of TTAB-CTAB made with the reference solution was added, and allowed to equilibrate at a specific temperature before the onset of the experiment .The conductivity values were recorded when the solutions attained equilibrium. The conductivity of the increasing concentration of TTAB-CTAB in water containing 0.2 and 0.4 v/v% triethanolamine were measures at 298.1, 303.1, 308.1, and 313.1 K. The experimental error was ± 0.5%.

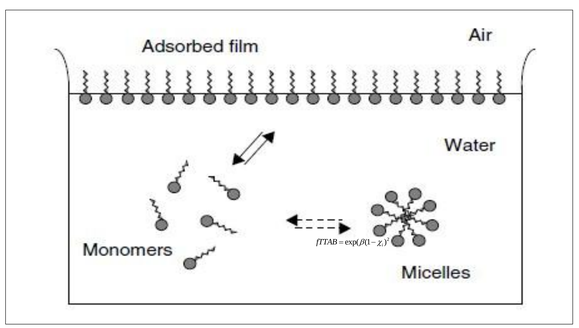

Fig. 1: Schematic diagrams of the three environments in which surfactant molecules exist in water

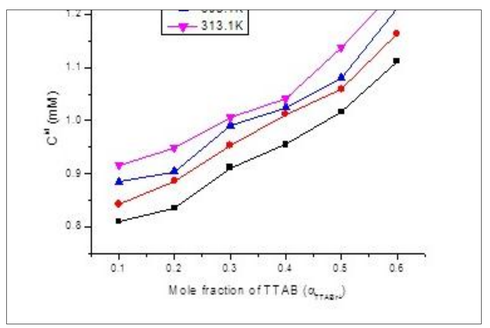

Fig. 2: Plot of Cnd versus mole fraction in AQ-TEA (0.2%) at diierent temperature

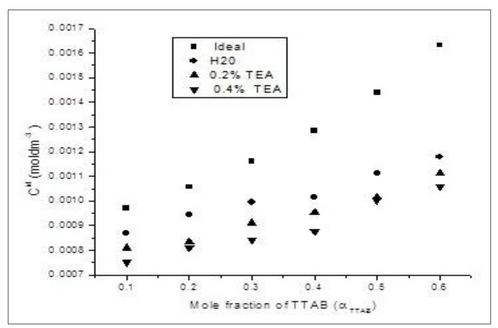

Fig. 3: Comparison of extent of non ideality

Equations used for the analyses of the experimental data (Rubingh model

$$fTTAB = \exp(\beta(1-\chi_i)^2 \qquad fCTAB = \exp(\beta\chi_i^2) \qquad \beta_{12} = \frac{\ln\left(cmc_{12}\alpha_1/cmc_1\chi_1\right)}{(1-\chi_1)^2}$$

RESULT AND DISCUSSION

The values of the experimental critical mixed micelle concentration ($\boldsymbol{C^{nd}}$) for TTAB-CTAB in 0.0 v/v% were slightly lower than the values obtained from ideal mixing. The non-ideality in the mixed-micelle was due to molecular interactions between the surfactant monomers. The decrease in the values of $\boldsymbol{C^{nd}}$ as compared with the ideal solution was quite pronounced upon the addition of 0.2 v/v% TEA., and further deviation from ideality was recorded at 0.4 v/v% addition of TEA.. In addition to monomeric interactions in AQ medium, the substantial decrease in the $\boldsymbol{C^{nd}}$ values when co-solvent was involved could be ascribed to (i) reinforcement of the 3-D structure of water by TEA, and its ability to intercalate [25] the mixed-micellar surface by increasing through replacement of some water molecules [27] the distance between the polar head group, and consequently reduced the electrostatic repulsive forces among the head groups. Figure 2 showed that the C^{nd} increased when the temperature was increasing. Figure 3clearly showed that the mixed micelles were non ideal and the extent of nonidealty was more pronounced when the system was further accentuated with 0.4 v/v% of TEA.

CONCLUSION: The resulting mixed micelles TEA based can serve as adjuvant in industry especially in the formulation of detergent