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# Comparative Study of Cationic and Non-ionic Surfactants using Tensiometry

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**A B S T R A C T**

*In this work we report the critical micelle concentration (CMC) of cationic and non-ionic surfactants using tensiometry in aqueous medium . The CMC of non-ionic surfactants is much less than cationic surfactants of comparable chain length. The less CMC of non-ionic surfactants indicate their desire to form micelles wth easevery. The higher CMC of cationic surfactants shows their resistance from micelle formation. Surfactants with low CMC can be utilised to carry chemical reactions instantaneously within the micelles by decreasing activation energy of chemical reactions. The surfactants of higher CMC are no more less important as they can be utilised in many drug formulations. The surfactants of high CMC easily break in dilute solutions and can release drugs present in their micelle core .Solubility concepts can be utilised to understand differences in the CMC's of cationic and non-ionic surfactant besides taking distortion of medium under consideration. The results of the present study can be used to modify solubility of drugs in micelles and accordingly be used in many drug formulations.*

## I. INTRODUCTION

A surfactant is a substance that, when present at low concentration in a system, has the property of adsorbing onto the surface or interfaces and altering interfacial free energies of theose surfaces or interfaces.

Surfactants are among the most versatile products of the chemical industry, appearing in such diverse products as the motor oils we use in our automobiles, the pharmaceuticals we take when we are ill, the detergents we use in cleaning our laundry and our homes, the drilling muds used in prospecting for petroleum, and the flotation agents used in beneficiations of ores. Mixed micelles are generally used in technical, pharmaceutical and biological fields, since they work better than pure micelles [1,2]. The role of mixed micelles in pharmaceutical and other industrial preparation is paramount.

## II. MATERIALS AND METHOD

The cationic surfactant used in the experimental work was a cetyltrimethylammonium bromide CTAB and non ionic amphiphile used was polyoxyethylene(10)cetyl ether (Brij-56) .Stock solutions of Brij-56 and CTAB were prepared at concentrations of 15mM and 25mM respectively. The stock solutions were utilized to prepare the samples solutions of desired concentration. All solutions were prepared in triple distilled water

## III. DETERMINATION OF CMC

The CMC values of surfactant solution were determined from the plot of surface tension (γ) vs. logarithm of surfactant concentration (log Ct) as shown in Fig 3.1. Surface tension measurements were made by the ring detachment method using a Kruss-9 (Germany) tensiometer equipped with a thermostable vessel holder that holds the vessel containing the experimental solution. Water at constant temperature from a thermostatic circulatory bath is circulated through the double walled vessel holder to maintain the experimental solution at constant temperature.

### 3.1 CMC Of Brij56 and CTAB

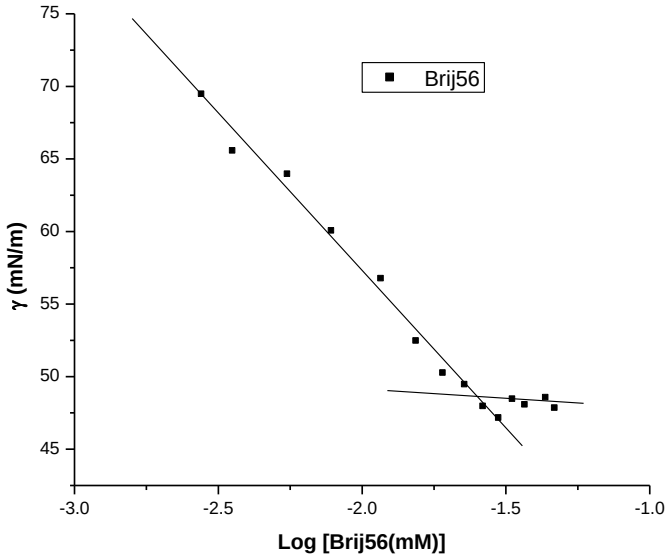
The Tables 3.1 shows experimental values of surface tension of Brij56 and CTAB in aqueous solutions at 25 $^{o}$C. The CMC values of Brij56 and CTAB were determined by plotting graphs between the surface tension (γ) and logarithm of the corresponding surfactant concentration.

**Table 3.1:** ***Experimental CMC ($CMC^{Exp}$) of CTAB and Brij56.***

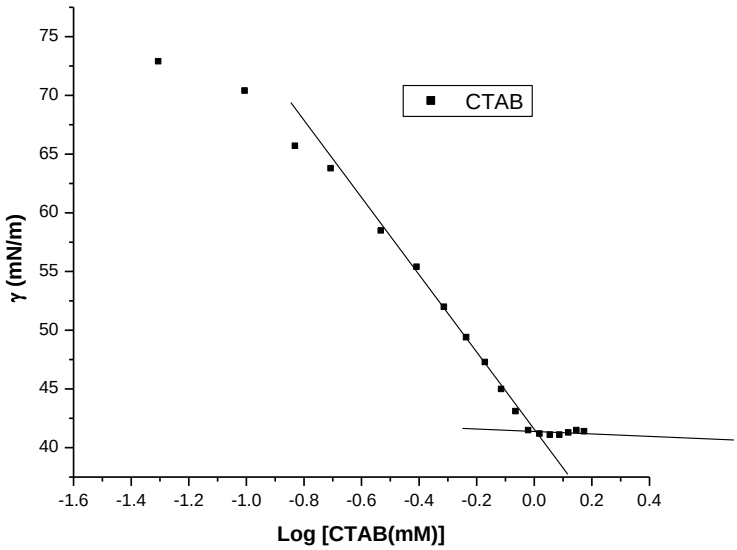
| S. No. | Surfactant | $CMC^{Exp}$ (mM) |
|---|---|---|
| 1 | CTAB | 1.03 (0.815)[a] |
| 2 | Brij56 | 0.026 (0.036)[b] |

[a]Ref[4], [b]Ref[5]

Fig. 3.1 represents the experimental plots for Brij56 & CTAB respectively. Initially the surface tension decreases with surfactant concentration till it reaches almost a constant value. The concentration after which surface tension remains practically constant, as determined by the point of intersection of the two lines drawn through the data points, was taken as corresponding to the critical micelle concentration (CMC). The CMC values for pure surfactants so obtained along with the literature values are given in Table 3.1. The experimental values closely resemble the literature values. The low CMC value of the non-ionic surfactant indicates its better propensity for micelle formation [3]. In the case of non-ionic surfactants, the molecules aggregate easily to form micelles, probably because for aggregation they need not to overcome any repulsion, as is the case with charged surfactants.




*(a)*




*(b)*

**Figure 3.1: Plot of Surface tension versus logarithm of: (a) Brij56, (b) CTAB concentration.**

Further, low CMC of Brij56 can be also explained on the basis of entropy concept. Brij56 being more hydrophobic than CTAB, hence its addition to water may cause distortion in the structure of water to much extent i.e. addition of Brij56 decreases the entropy of the system more strongly. Therefore, system opposes this decrease in entropy by allowing Brij56 molecules to get aggregate. Hence CMC of Brij56 is much less than CTAB.

## IV. CONCLUSION

Brij56 has low CMC than CTAB indicating Brij56 molecules have more tendency to form micelles than CTAB molecules.

Higher CMC of CTAB might be due to the fact that for the formation of micelles CTAB molecules have to oppose electrostatic repulsions.

Attractive interactions of CTAB molecules with water are more than Brij56 molecules show with water, hence phase separation with Brij56 occurs easily.

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