

Critical micelle concentration of surfactant, mixed –surfactant and polymer by different method at room temperature and its importance

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ABSTRACT

Critical micelle concentration (CMC) is key point for surface chemistry as well as chemist and systematic data collection and day-to-day development in this regard is very essential. Hence, we have analyzed the CMC of surfactant, mixed surfactant and polymer at room temperature (28°C). With the change in surfactant, mixed surfactant and polymer concentration CMC values were observed by different method such as surface tension and conductometric. The result of CMC values for surfactant, mixed surfactant and polymer show different characteristics and out comes. The values of CMC follow below order:

Polymer > Surfactant–Polymer > Mixed Surfactant > Surfactant

Key words: Micelle concentration, surfactants, polymer.

INTRODUCTION

The role of micellar catalysis in recent year has been no need to say its importance in different area such as pharmaceuticals, oil recovery industry, environmental¹⁻³ as well as Nano technological system⁴. The role of micellar catalysis may not be understood without its critical micelle concentration. This is the concentration when surfactant will work as micelle. Therefore, it is very interested as well as important to know this factor very correctly and accurately. Our group had done some work in this area⁵⁻⁶. Nevertheless, systematic and new out comes develop this work. The present work is an investigation of critical micelle concentration of different surfactant, polymer, and mixed micelle at room temp (28°C) and with reaction condition.

MATERIAL AND METHODS

The surfactant CTAB, CPC, CPB, SLS, TX-100, Brij-35, PEG-300 all were AR grade loba make chemicals used as such. Triple distilled water was used through out the Experiment. Solutions were prepared with weighing accuracy 0.001gm Denver make balance at room temperature. Conductomertre systronic make digital ,glass surface tension was used.

RESULTS AND DISCUSSION

Critical micelle concentration (CMC) is the concentration above which monomeric surfactant molecule abruptly aggregate to form micelle⁷⁻⁸. It is mostly determined by conduct metric and surface tension method. Using these CMC data is helpful to

find shape, structure of micelle, surface activity, solubilization, absorption, wetting phase behavior etc. In this Table 1 and 2 the CMC values for different surfactant, polymer, and polymer-Surfactant, mixed surfactant has been successfully determined by surface tension method and the values are increasing with increasing molar concentration. We can easily find out the drastic change in surface tension in all case. The points have been shown in fig 1&2.

In this table 3 and 4 the CMC values for different surfactant, polymer, polymer-Surfactant,

mixed surfactant has been successfully determined by conduct metric method and the values are increasing with increasing molar concentration. We can easily find out the drastic change in conductometry in all case. The points have been shown in Fig 3 and 4.

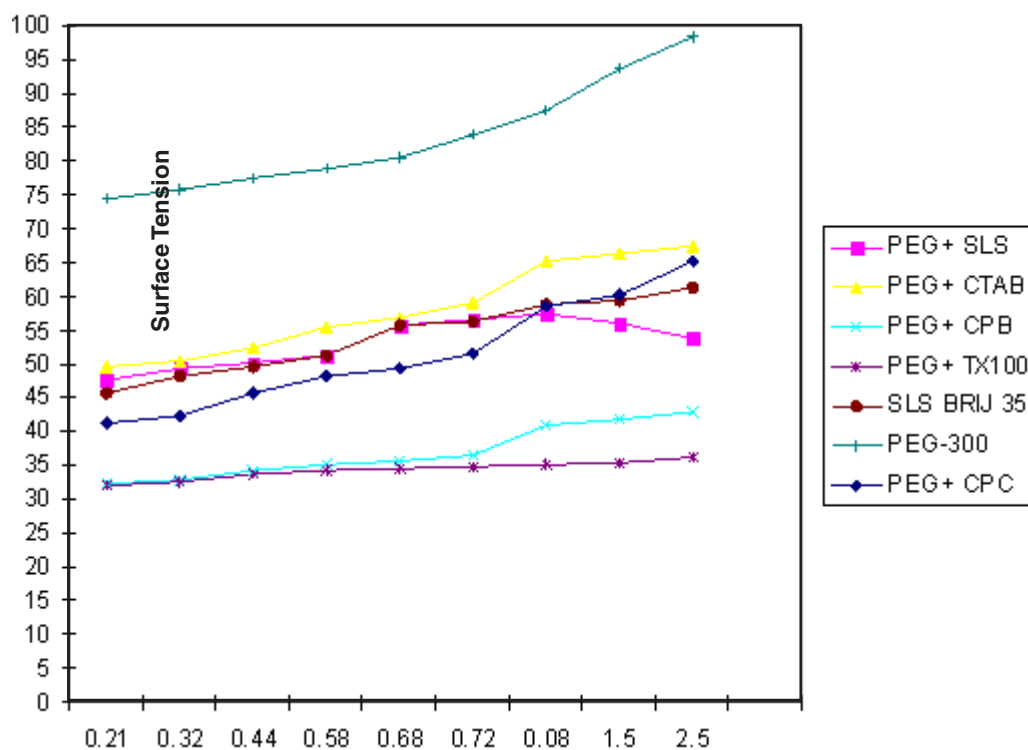
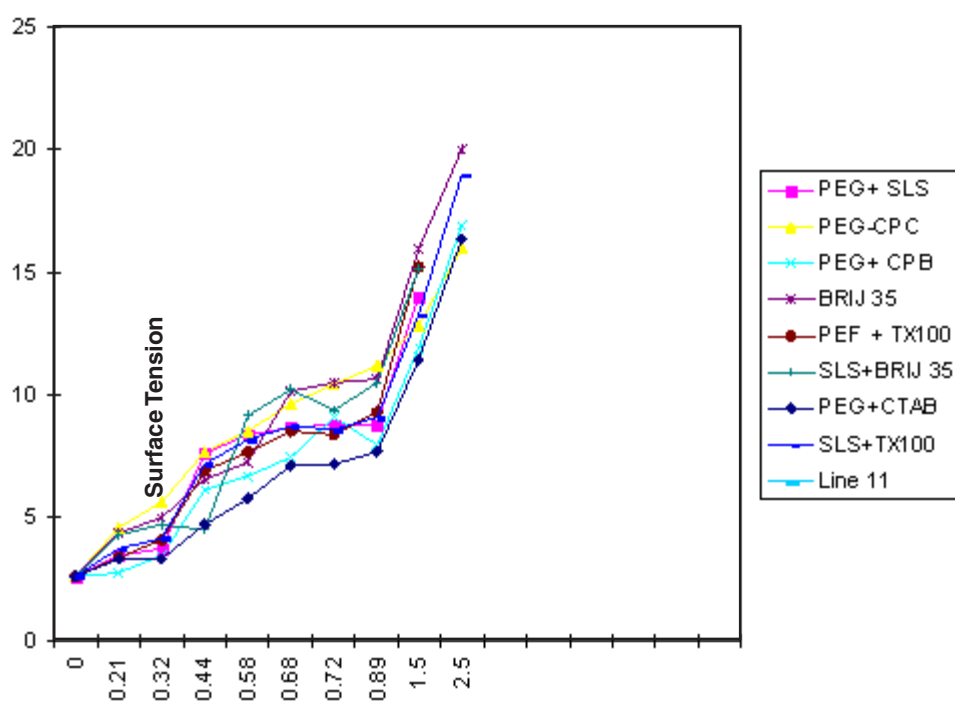
The value of CMC decrease with increase in the hydrophobic chain length of the molecule⁹. Hydrophobic interaction opposed by electrostatic repulsion among the ionic head groups derives the process of micellization .A list of CMC data of some

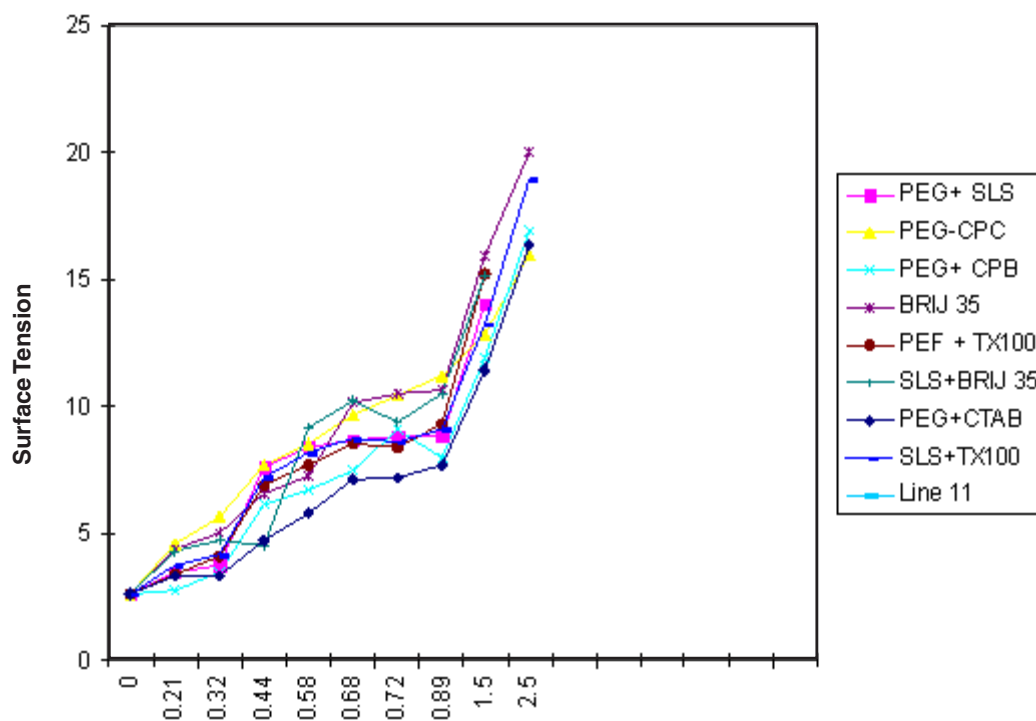
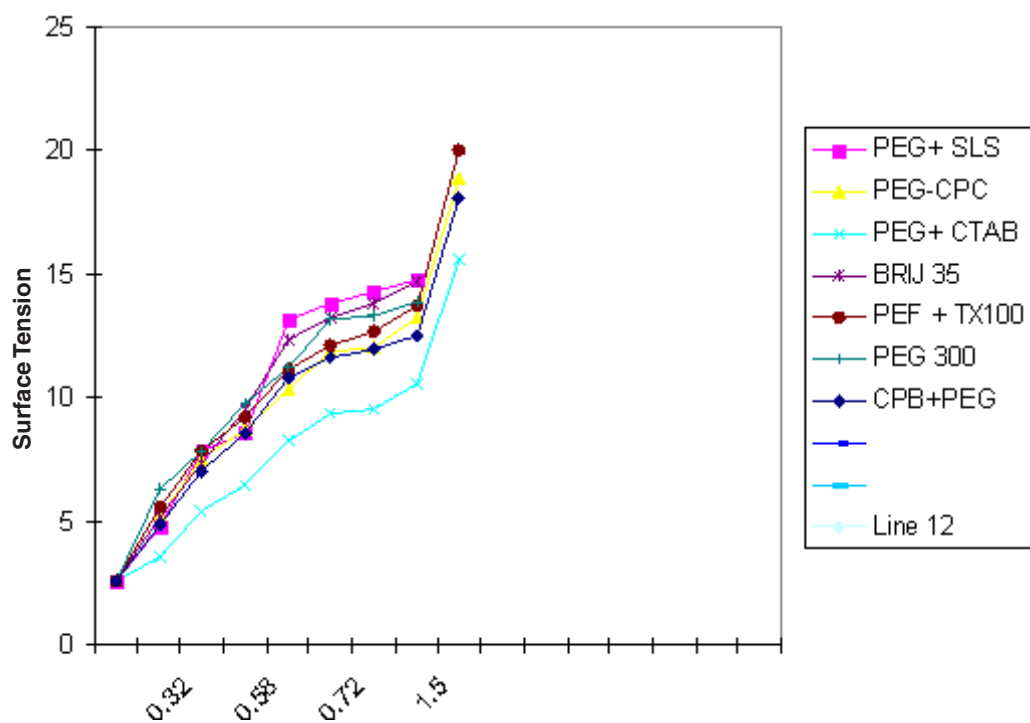
Table 1: Determination of CMC (Polymer /Surfactant) by Surface tension

S. no.	Molar conc. 10 ⁻³ M	Surface Tension						
		PEG+ S.L.S	PEG+ CPC	PEG+ CTAB	PEG+ CPB	PEG+ TX-100	S.L.S.+ Brij-35	PEG-30
1.	0.02	32.7	20.6	18.6	31.3	29.7	39.3	74.5
2.	0.32	37.6	21.4	19.5	33.5	33.5	40.6	75.9
3.	0.44	41.0	23.5	20.6	34.1	34.4	42.0	77.4
4.	0.58	42.3	24.8	25.6	34.6	35.0	42.4	78.9
5.	0.68	43.8	25.8	26.9	39.5	36.6	42.9	80.5
6.	0.72	44.9	27.4	28.9	40.3	37.3	43.4	83.8
7.	0.80	50.8	29.6	36.2	41.2	38.0	43.4	87.5
8.	1.50	52.1	31.9	38.5	42.0	40.8	44.3	93.7
9.	2.50	58.1	33.5	40.5	43.4	43.9	45.4	98.3

Table 2: Determination of CMC (Surfactant) by Surface tension

S. no.	Molar conc	Surface Tension						
		SLS	CPC	CTAB	CPB	TX-100	BRIJ35	PEG-300
1.	0.21	47.5	41.2	49.6	32.2	31.9	45.6	74.5
2.	0.32	49.2	42.3	50.3	33.0	32.5	48.3	75.9
3.	0.44	50.2	45.6	52.3	34.2	33.6	49.6	77.4
4.	0.58	51.2	48.2	55.3	35.2	34.2	51.2	78.9
5.	0.68	55.6	49.2	56.8	35.6	34.5	55.6	80.5
6.	0.72	56.5	51.6	59.0	36.6	34.8	56.3	83.8
7.	0.8	57.5	58.6	65.2	41.0	35.1	58.9	87.5
8.	1.5	55.9	60.3	66.3	41.9	35.4	59.3	93.7
9.	2.5	53.7	65.2	67.5	42.9	36.1	61.2	98.3

Fig. 1: Molar conc. $10^{-3}M$ Fig. 2: Molar conc. $10^{-3}M$

Fig. 3: Molar conc. $10^{-3}M$ Fig. 4: Molar conc. $10^{-3}M$

surfactant, mixed surfactant, polymer, surfactant polymer determined by surface tension and conduct metric method shown in table 5. The values of CMC for surfactant & mixed surfactant are all most same with surface tension & conduct metric. It proves the authenticity of result. However, the CMC values of surfactant are low as compared to mixed surfactant due to long hydrophobic group¹⁰.

Similarly, we have find CMC values for

polymer & mixed polymer. They are all most different. In surface tension CMC values are almost half than conductivity with maximum cases here we find that simple polymer CMC values is higher than or almost equal to the values of mixed in both case surface tension and conductivity. This variation in values are also due to hydrophobicity Hence the finally CMC values are increases as follows

Surfactant < Mixed –surfactant < Polymer < Surfactant –Polymer

Table 3: Determination of CMC (Surfactant/Mixed surfactant) by Conductivity.
In this table 3 and 4 the CMC values for different surfactant, polymer

S. no.	Molar Conc.10 ⁻³	Conductivity							
		S.L.S	C.T.A.B.	C.P.C.	C.P.B.	Brij-35	TX-100	S.L.S.+ Brij-35	S.L.S.+ TX-100
1.	0.0	2.59	2.59	2.59	2.59	2.59	2.59	2.59	2.59
2.	0.21	3.48	3.29	4.60	2.74	4.36	3.38	4.32	3.75
3.	0.32	3.76	3.34	5.61	3.46	5.00	4.10	4.74	4.13
4.	0.44	7.64	4.75	7.71	6.16	6.55	6.90	4.53	7.20
5.	0.58	8.41	5.79	8.55	6.70	7.25	7.70	9.13	8.14
6.	0.68	8.66	7.10	9.67	7.46	10.17	8.55	10.20	8.75
7.	0.72	8.79	7.20	10.40	9.07	10.52	8.36	9.40	8.61
8.	0.89	8.82	7.70	11.20	7.97	10.63	9.33	10.52	9.07
9.	1.5	14.02	11.40	12.80	11.88	15.93	15.18	15.13	13.23
10.	2.5	-	16.36	16.00	16.89	19.99	-	-	18.97

Table 4: Determination of CMC (Polymer /Surfactant) by conductivity

S. no.	Molar Conc.10 ⁻³	Conductivity						
		SLS+ PEG	CPB+ PEG	CPC+ PEG	CTAB+ PEG	BRIJ-35+ PEG	TX-100+ PEG	PEG-300
1.	0.0	2.59	2.59	2.59	2.59	2.59	2.59	2.59
2.	0.21	4.75	4.81	5.20	3.58	5.18	5.53	6.29
3.	0.32	7.86	7.02	7.52	5.40	7.30	7.79	7.83
4.	0.44	8.53	8.56	8.73	6.45	9.55	9.20	9.74
5.	0.58	13.12	10.82	10.30	8.22	12.33	11.12	11.17
6.	0.68	13.78	11.62	11.82	9.35	13.19	12.08	13.18
7.	0.72	14.25	11.91	12.04	9.53	13.78	12.64	13.34
8.	0.89	14.73	12.53	13.19	10.54	14.67	13.70	13.89
9.	1.50	-	18.09	18.91	15.56	-	19.97	-

Table 5: Observed CMC Values of surfactant, mixed surfactant, polymer and surfactant –polymer by surface tension and conductivity

Molar Concentration	10^{-3}				
	Surface tension	Conductivity	Polymer /Surfactant polymer mixed	Surface tension	Conductivity
Surfactant /Mixed surfactant					
SLS	0.44	0.44	SLS+PEG	0.72	0.51
CTAB	0.99	0.99	CPB+PEG	0.59	1.10
CPC	0.44	0.44	CPC+PEG	0.44	1.00
CPB	0.99	0.99	CTAB+PEG	0.44	1.00
SLS+Brij-35	0.58	0.58	Brij-35+PEG	0.68	1.00
SLS+TX-100	0.44	0.44	TX-100+PEG	0.32	0.99
Brij-35	0.99	1.50	PEG-300	0.78	0.81
TX-100	0.44	0.44			

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