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Determination of the Critical Micelle Concentration of Some Surfactants in the Presence of 2-Hydroxy Propyl Methacrylate

Fariborz Azizinezhad[1]* and Majid Abdouss[2]

[1] Department of Chemistry, College of Science, Varamin-Pishva Branch, Islamic Azad University, Varamin, Iran
[2] Department of Chemistry, Amir Kabir University of Technology, Tehran, Iran

ABSTRACT

In this study, the critical micelle concentration (CMC) of different surfactants in the presence of 2-hydroxy propyl methacrylate (2-HPMA) as monomer has been investigated by the using of conductommetry and viscommetry methods. For this aim, sodium dodecyl sulfate (SDS) as anionic, dodecyl trimethyl ammonium bromide (DTAB) and cetyl trimethyl ammoniu bromide (CTAB) as cationic and lecithin as nonionic surfactants have been used. The main aim of this research was to introduce of a new compatible co-surfactant for different applications in industry. Finding of this research showed that, by incresing of the monomer, the CMC values showed decreasing for lecithin and SDS. The results of viscommetry confirmed that this technique can be use as a drastic and simple method for determination of the CMC.

Keywords: Critical Micelle Concentration, Conductommery, Viscommetry

Corresponding author

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INTRODUCTION

Surfactants or surface active agents or detergents have applications in various fields like biology, pharmacy and etc. Their structures are amphiphilic which consist both apolar long chain hydrocarbon and polar groups. In polar solvent like water, this comportment causes to self-associated or micellization. Depending on the surfactants structures, their micelles can be anionic, cationic, nonionic and ampholitic. CMC is the most important physical change in a solution including surfactant, when its concentration increases. Below the CMC, they are monomeric and above the CMC they are self-associated and observe as disperse form to lower their free energy.Thus, the CMC, for a surfactant in a definite solvent, is a elementry means of surfactant characterization.Various methods were used to determine the CMC in aqueous system. The most important techniques are based on conductommetry, voltammetry, calorimetry, scattering methods, surface tension, UV-Vis and fluoresence spectroscopy. [1-14] Recently, interactions of the polymers and surfactans have been attended by many researchers [15-17]. In this study, the micellization of different surfactants such as SDS, DTAB, CTAB and lecithin in the presence of 2-HPMA in aqueous medium was investigated by conductommetry and viscommetry.

MATERIALS AND METHODS

2-HPMA as monomer was purchased from Merck.co (Germany) and after distillation under reduced pressure (23mmHg , T_{bp}=372K) was used. Both of cationic surfactants (DTAB, CTAB) were purchased from Merck.co and were recrystallized from 50/50 (v%)=acetone/ethanol mixture and egg lecithin was provided from Aldrich.co(England) and prepared as 40% ethanolic solution and after evaporation of all alcohol was used. SDS was supplied by Merck.co and was used as receieved.Crison GLP 32 conductoeter and Ostwald viscometer were used to determine the CMC values at 298K. For this aim, the electic conductivity and relative viscosity versus surfactants concentration were plotted and the break points of the curves were recorded the CMC. [18]

$$\eta_r=\eta/\eta_0 = t.\rho/t_0.\rho_0$$

In this equation, η and η_0 are the solvent and the solution viscosity, respectively. t is the flow time of the solution, t_0 is the flow time of the solvent and ρ and ρ_0 are the density of the solution and the solvent, respectively .[18]

RESULTS AND DISCUSSION

As shown in Figures 1-24, in all cases the electrical conductivity and the relative viscosity in the presence of monomer were increased. However, the effect of monomer in the presence of SDS and lecithin were tangible, there were not any changing in the CMC for cationic surfactants. The CMC values for SDS and lecithin decreased from 0.008M to 0.005M and 0.01M to 0.004M, respectively. In the presence of cationic surfactants (DTAB and CTAB) the CMC values were standstill and were recorded (0.006M and 0.003M), respectively. At the CMC point, the relative viscosity showed a maximum value and after complexation of monomer-surfactant due to the formation of stable drops of micelles, the Gibbs free energy decreased. At higher concentrations (post-micellar region) due to increasing of the number of micelles in system, the electrical conductivity and the viscosity was increased. The finding research, identify, the presence of 2-HPMA had positive effect to the formation of stable micelles in 2-HPMA/SDS and 2-HPMA/lecithin systems and the compatibility of monomer and SDS or lecithin is favorable. [15-17]

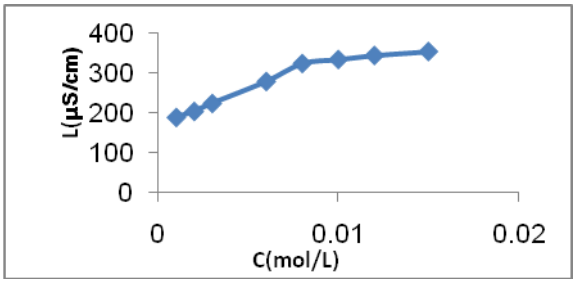

Figure 1: SDS elecrical conducivity in the absence of monomer at 298K

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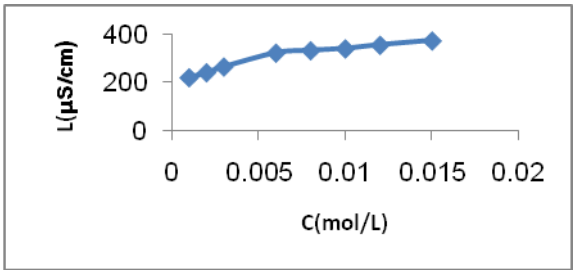

Figure 2: SDS elecrical conducivity in the presence of 0:5mL monomer at 298K

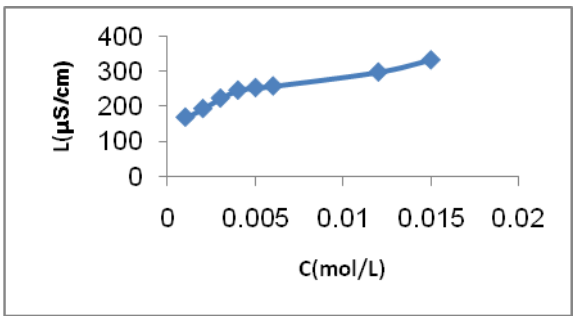

Figure 3: SDS elecrical conducivity in the presence of 1:0mL monomer at 298K

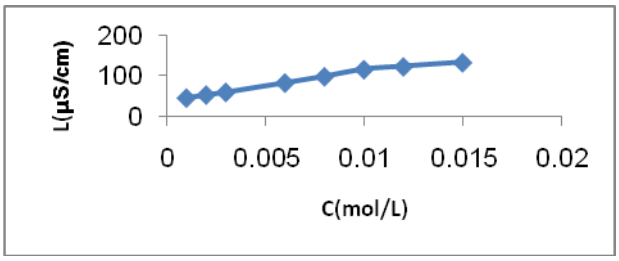

Figure 4: lecithin elecrical conducivity in the absence of monomer at 298K

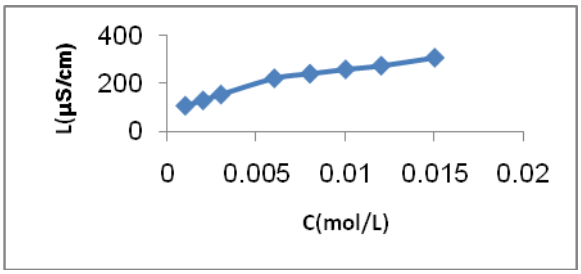

Figure 5: lecithin elecrical conducivity in the presence of 0:5mL monomer at 298K

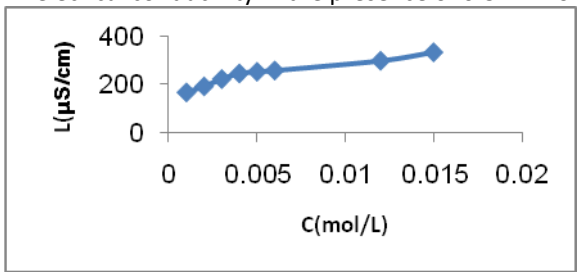

Figure 6: lecithin elecrical conducivity in the presence of 1:0mL monomer at 298K

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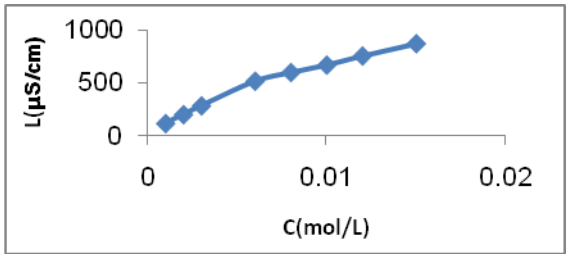

Figure 7: DTAB elecrical conducivity in the absence of monomer at 298K

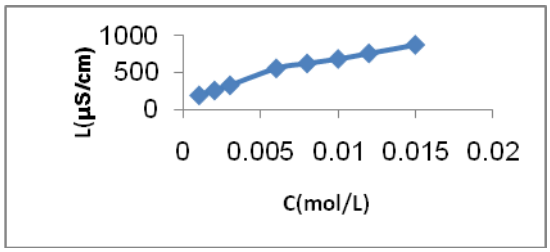

Figure 8: DTAB elecrical conducivity in the presence of 0:5mL monomer at 298K

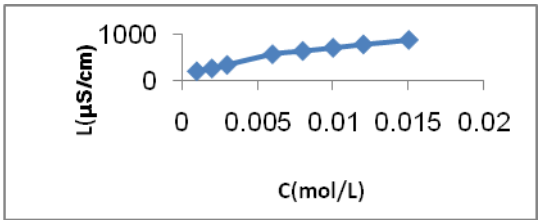

Figure 9: DTAB elecrical conducivity in the presence of 1:0mL monomer at 298K

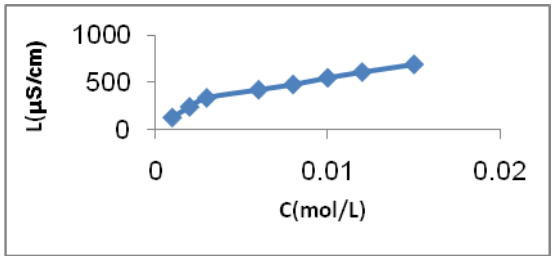

Figure10: CTAB elecrical conducivity in the absence of monomer at 298K

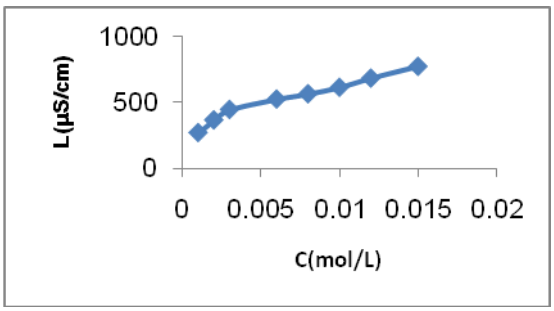

Figure 11: CTAB elecrical conducivity in the presence of 0:5mL monomer at 298K

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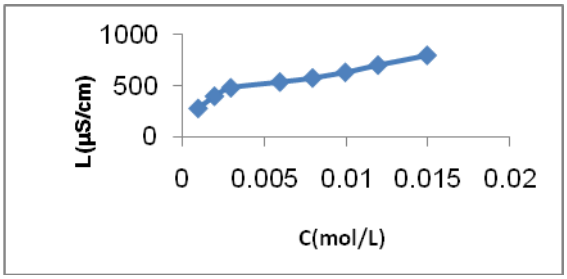

Figure 12: CTAB elecrical conducivity in the presence of 1:0mL monomer at 298K

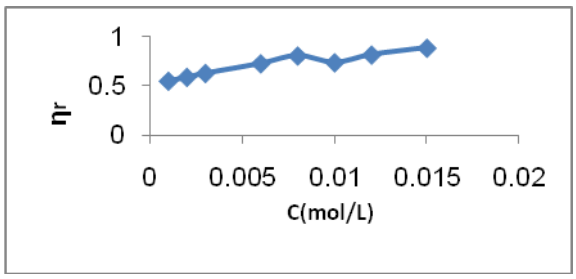

Figure 13: SDS relative viscosity in the absence of monomer at 298K

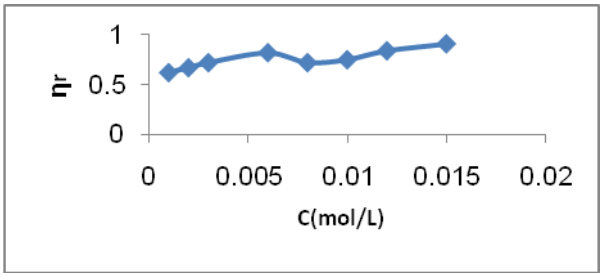

Figure 14: SDS relative viscosity in the presence of 0:5mL monomer at 298K

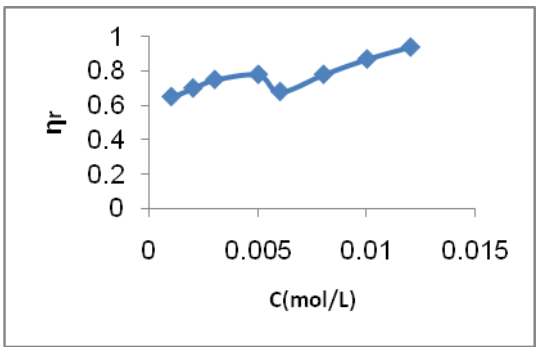

Figure 15: SDS relative viscosity in the presence of 1:0mL monomer at 298K

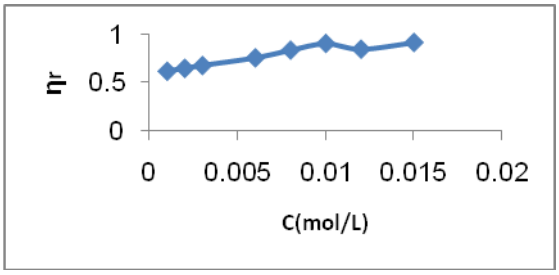

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Figure 16: lecithin relative viscosity in the absence of monomer at 298K

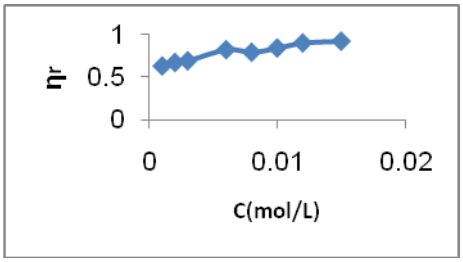

Figure 17: lecithin relative viscosity in the presence of 0:5mL monomer at 298K

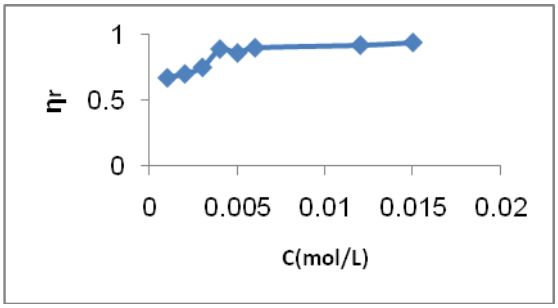

Figure 18: lecithin relative viscosity in the presence of 1:0mL monomer at 298K

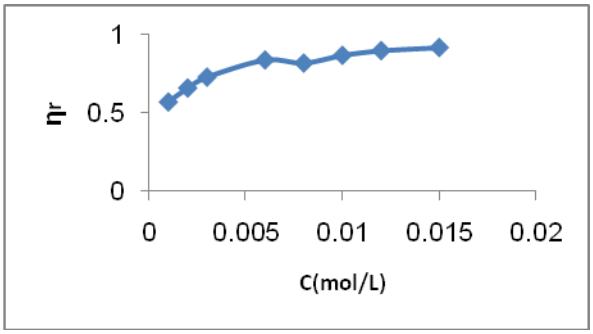

Figure 19: DTAB relative viscosity in the absence of monomer at 298K

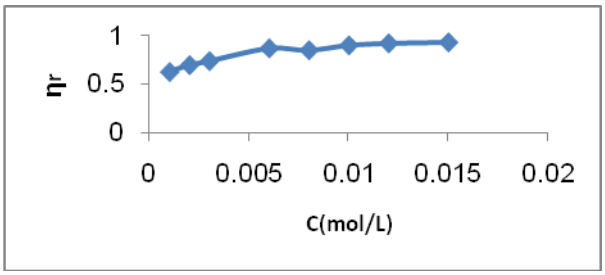

Figure 20: DTAB relative viscosity in the presence of 0:5mL monomer at 298K

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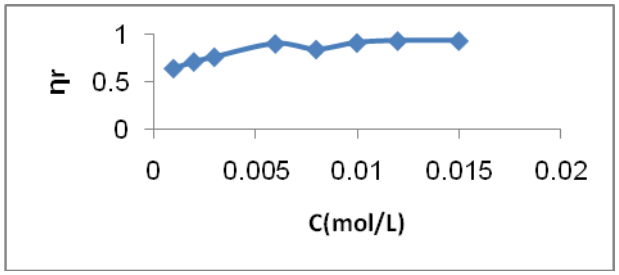

Figure 21: DTAB relative viscosity in the presence of 1:0mL monomer at 298K

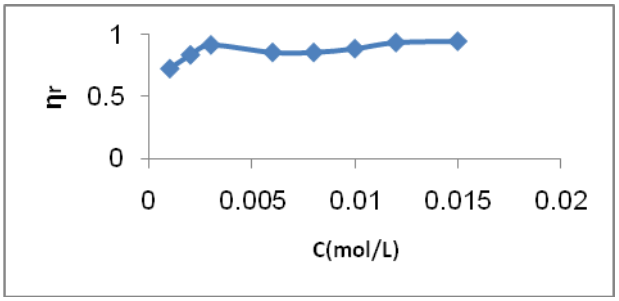

Figure 22: CTAB relative viscosity in the absence of monomer at 298K

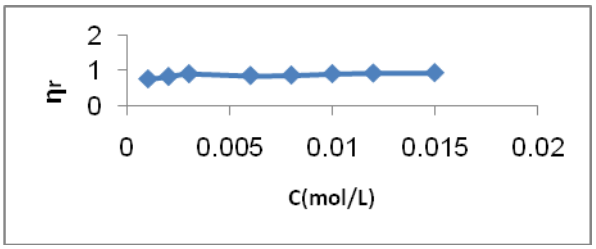

Figure 23: CTAB relative viscosity in the presence of 0:5mL monomer at 298K

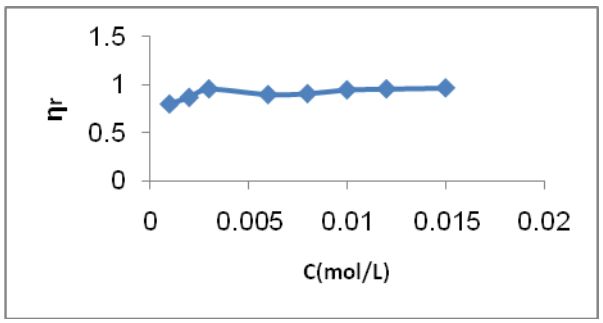

Figure 24: CTAB relative viscosity in the presence of 1:0mL monomer at 298K

CONCLUSION

A comparison of the effect of 2-HPMA in the presence of lecithin and SDS in aqueous system was recorded a synergistic effect to decreasing of the CMC. Besides of other known methods, the viscommetry was introduced as an optimum and simple method to determination of the CMC.

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