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Title of Thesis - Study of Dye-Surfactant and Dye-Amino Acid Interactions in Aqueous Medium

ABSTRACT

The research work deals with the study of interaction between dye and surfactant and dye and amino acid in aqueous medium. The scope and objective of the proposed work was discussed along with the experimental methods and chemicals used. The interaction of cresol red with dodecyltrimethylammonium bromide and cetyltrimethylammonium bromide in aqueous solution was studied through thermodynamic and spectroscopic methods. The equilibrium model has been used to calculate the standard free energy (ΔG_m°), enthalpy (ΔH_m°), and entropy (ΔS_m°) of micelle formation. A marked decrease in the cmc is observed as the number of carbon atoms in the hydrophobic group increases from DTAB to CTAB. UV-Visible spectra suggest interaction between dye and surfactant monomers forming ion-pair complex in the pre-micellar region whereas above the cmc solubilization of dye in the micelle dominates over ion-pair formation. In next chapter, measurement of densities (ρ), ultrasonic velocities (u) and conductivities (κ) of different concentrations of tetrabutylammonium bromide in water and in 0.01 m aqueous tartrazine was done. Density data showed that TBAB acts as structure-breaker in water and structure- maker in aqueous tartrazine. From ultrasonic and conductivity studies it was observed that the value of compressibility is maximum for mixed solvent and it decreases as the concentration of TBAB increases. Decrease in equivalent conductance of TBAB in water and in aqueous tartrazine with increasing concentration of electrolyte confirm obeying Debye-Hückel-Onsager law. The interactions between tartrazine and dodecyltrimethylammonium bromide and cetyltrimethylammonium bromide have been studied by conductometric, spectrophotometric and

tensiometric techniques in next chapter. The results showed that the presence of tartrazine, as well as increasing the length of the carbon chain, both decrease the cmc. From the specific conductivity data and surface tension data different parameters have been calculated. Spectroscopic studies reveal that the binding of dye to micelles brings a bathochromic shift in dye absorption spectra that indicate dye–surfactant interaction. The interaction of cresol red with cetylpyridinium bromide, sodium dodecyl sulphate, and Triton X-100 respectively were studied in aqueous solutions employing conductometric, tensiometric, and spectroscopic methods. The micelle formation becomes more favorable in the presence of dye CR than in its absence. UV-Visible spectra suggest the formation of ion-pair complex between the dye CR and CPB in the pre-micellar region, while dye is solubilized in the post micellar region. The absorption spectra in the case of SDS indicate weak interaction between CR and SDS molecules, formation of H-bonding, short range dispersive forces, and hydrophobic interactions between CR and TX-100 molecules in the solution. The spectroscopic study for the interaction of lysine (Lys), arginine (Arg) and histidine (His) with aqueous cresol red (CR) dye at four different pH (4.0, 6.0, 8.0, 10.0) was performed. The presence of a charged amino acid is believed to affect some of the changes in the peak height and wavelength of oppositely charged dye spectra. As pH is increased from 4.0 to 10.0, the anionic form (DH^-) (λ_{max} 434) of dye converts into dianionic form (D^{2-}) (λ_{max} 572). Variation in the ratio of absorbance of D^{2-} to DH^- bands with concentration of Lys, Arg and His at different pH reveals that an increase in concentration of amino acids results in increased formation of D^{2-} form due to increase in basicity of the medium. The values of pK_a' confirm the facilitated formation of D^{2-} form as the concentration of amino acids increases. The Gibbs free energy of ionization shows the favorable interaction between ionized form of CR and amino acids.