

CHAPTER-IX

CONCLUDING REMARKS

Amphiphilic molecules or amphiphiles show numerous interesting properties that are now being actively investigated in many laboratories. Most of the present day knowledge of micellar solutions has come from studies on various surfactants by means of variety of techniques like neutron scattering, quasielastic light scattering, luminescence probing, NMR, spin labeling, chemical relaxation etc. Various thermodynamic properties e.g., apparent molar volume, adiabatic compressibilities, heat capacities, surface tension etc. as well as transport properties e.g., conductance, rheology etc. give important information about micellar solutions. We have, therefore, determined some thermodynamic and transport properties of a number of selected simple amphiphiles in aqueous and non-aqueous media from the measurements of their conductance, surface tension, apparent molar volumes and adiabatic compressibilities. Attempt have also been made to determine the mixed micellar properties of some simple ionic-ionic, ionic-nonionic and nonionic-nonionic surfactant mixtures by means of conductance, surface tension and spectroscopy as these mixtures of surfactants often exhibit properties superior to those of the constituent single surfactants due to synergistic interactions between the surfactant molecules.

Thermodynamics of micellization provide a lot of information on the strength and nature of surfactant-solvent and solvent-solvent interactions. These properties can be derived from the study of surfactant aggregation as a function of temperature. Since the micellization process is most often revealed by the surfactant concentration value at which aggregation takes place *i.e.*, at the so-called critical micelle concentration (*cmc*), it is important to have appropriate procedure to obtain reliable *cmc* values in different solvent media. Different methods have been used to obtain the critical micelle concentration (*cmc*). Proper evaluation of the *cmc*, the degree of counterion dissociation (β), maximum interfacial adsorption (Γ_{\max}), minimum area per surfactant molecule (A_{\min}) and surface pressure at *cmc* (Π_{cmc}) would of great help in determining the surfactant-solvent and solvent-solvent interactions. However, the

cmc values are method dependent and though conductance slopes, light scattering and *cmc* determination as a function of counterion concentration are used as principal experimental techniques for measuring the degree of counterion dissociation, yet there is no unambiguous method of measuring this degree of freedom or of binding of counterions. Efforts should be made to find out a suitable method for the determination of *cmc* as well as the degree of counterion dissociation.

The determination of apparent molar volumes and apparent molar adiabatic compressibilities of surfactant solutions is useful as a guide to the structural properties of these solutions, particularly in the study of surfactant-solvent interactions. The concentration dependence of these properties in aqueous medium can be used to study (i) the electrostatic repulsion between the head groups of the surfactant (ii) the liberation of water molecules from around the hydrocarbon tails of the surfactant molecules (iii) the release of the water molecules from the counterions upon binding to the micelles. The relative magnitude of the limiting apparent molar volumes and the limiting apparent molar adiabatic compressibilities would enable us to provide important information about the solution behaviour of surfactants in aqueous solution.

In general, specific interactions (synergistic or antagonistic) between surfactants result in solution of surfactant mixture having micellar and phase behaviour properties which can be significantly different from those of the constituent single surfactants. Consequently, understanding specific interactions between the various surfactant species present in solution is of central importance to the surfactant technologist. In spite of their considerable practical importance, as well as the challenging theoretical issues associated with the description of these complex fluids, solutions of surfactant mixtures have not received full attention that they deserve. These aspects need consideration and further study.

However, it is necessary to remember that surfactant-solvent interactions are very complex in nature. There are strong electrical forces between the surfactant ions and between the surfactant and solvents. Nevertheless, if careful judgment is used, valid conclusion can be drawn in many cases from conductivity, surface tension, apparent molar volume and apparent molar adiabatic compressibility measurements relating to degree of structure and order of the system.

More extensive studies of the different thermodynamic and transport properties of surfactants will be of immense help in understanding the nature of surfactant-solvent interactions and role of the solvents in different micellar properties.

