

## **CHAPTER XI**

### **CONCLUDING REMARKS**

At the present work we have tried to investigate the various interactions of some metal and tetraalkyl ammonium salts in different solvent media and some useful conclusion of then have been derived. Tetrahydrofuran and its aqueous and non aqueous mixtures are very important solvents widely used in various industries including the manufacture of pharmaceuticals and cosmetic products and modern battery technology.

Rheology is the branch of science that studies material deformation and flow and is increasingly applied to analyze the viscous behavior of many pharmaceutical products and to establish their stability and even bioavailability since it has been firmly established that viscosity influences drug absorption rate in the body.

The study of the viscous behavior of pharmaceuticals, foodstuffs, cosmetics and industrial products etc. is essential for confirming that their viscosity is appropriate for the contemplated used of the products.

Alkali metal and symmetrical tetraalkylammonium salts show numerous interesting properties that are now being actively investigated in many laboratories. Most of the present day knowledge on non-aqueous solutions have come from studies on various thermodynamics properties e.g. apparent molar volumes, adiabatic compressibilities, heat capacities etc. as well as on transport properties, e.g. conductance, viscosity and transference numbers. So, we determined the thermodynamics and transport properties of some alkali metal and tetraalkyl ammonium salts in tetrahydrofuran and water mixtures from the measurements of their viscosities, conductances apparent

molar volumes and adiabatic compressibilities. In addition to this, we also investigated the interactions between the binary mixtures tetrahydrofuran (THF) + benzene and tetrahydrofuran + n-hexane and among the ternary mixtures n-hexane + tetrahydrofuran + benzene, n-hexane + tetrahydrofuran + isopropanol and n-hexane + isopropanol + benzene at different temperatures.

The apparent molar volumes ( $V_\phi$ ) of the solutes and the apparent molal adiabatic compressibilities ( $\phi_k$ ) of the liquid solution were calculated from the following relations.

$$V_\phi = M / \rho_o - 1000(r - \rho_o)c \rho_o$$

$$\phi_k = \beta M / \rho_o + 1000 (\beta r - \beta^o \rho) / m \rho \rho_o$$

where the symbols have their usual significances.

The determination of apparent molar volumes and apparent molal adiabatic compressibilities of electrolyte solutions is useful as a guide to the structural properties of solutions, particularly in the study of ion-solvent, ion-ion and solvent-solvent interactions. The concentrations dependence of these properties can be used to study ion-ion interactions. The relative magnitude of the limiting apparent molar volumes,  $V_\phi^o$  and the limiting apparent molal adiabatic compressibilities  $V_k^o$ , would enable us to provide information about the strengths of interactions between ions and solvent molecules. Measurements of the apparent molar volumes as a function of temperature can give an indication of electrostriction or concentration of solvent molecules around an ion.

The excess thermodynamics properties of binary and ternary liquid mixtures are also very useful as a guide to the structural properties of solutions mainly in the study of complex formation between the mixing molecules due

to intermolecular interactions, dispersion forces arising out due to the dissociation of molecular complexes strong molecular interactions due to appreciable dipole-dipole and dipole induced dipole interactions etc based on the following equations

$$V^E = V - (x_1 v_1 + x_2 v_2) \quad | \quad (\text{binary liquid mixtures})$$

$$\eta^E = \eta - (x_1 \eta_1 + x_2 \eta_2)$$

$$V^E = V - (x_1 v_1 + x_2 v_2 + x_3 v_3) \quad | \quad (\text{ternary liquid mixture})$$

$$\eta^E = \eta - (x_1 \eta_1 + x_2 \eta_2 + x_3 \eta_3)$$

(symbols have their usual significance)

Another important parameters is the excess Gibbs free energy of activities of flow ( $\Delta G^{fE}$ ) which computed from the Eying equation for ternary liquid mixture.

$$\Delta G^{fE} = [RT \{ \ln \eta v - (x_1 \ln \eta_1 v_1 + x_2 \ln \eta_2 v_2 + x_3 \ln \eta_3 v_3) \}]$$

where the letters have their usual significance which may be attributed to the dominance of dispersion forces due to weak intermolecular interactions. Conductance measurement is one of the most accurate and widely used physical methods for investigation of electrolytic solutions. The measurements can be made in a variety of solvents over wide ranges of temperature and pressure and in dilute solutions where interionic interaction theories are not applicable. Recent development of experimental techniques provides an accuracy to the extent of 0.01% or even more. Conductance measurements together with transference number determinations provide an unequivocal method of obtaining single ion values.

The conductance method primarily depends on the mobility of ion so, it can be suitably utilized to determined the dissociation constant of weak acids

and association constants of electrolytes in aqueous and non-aqueous solvents. The limiting equivalent conductance ( $\Lambda^\circ$ ) and the solute-association constant ( $K_A$ ) will be evaluated using Shedlovsky equation. The results will be discussed in terms of solute-solute, solute-solvent and solvent-solvent interactions. Thermodynamics parameters will be evaluated to understand the change of the association constants with solvent composition. The conductance data can also be analyzed with Fuoss 1978 equation and Fuoss Kraus equation which is still one of widely used equations for the simultaneous evaluation of  $K_A$  and  $\Lambda^\circ$ .

Viscosity is one of the most important transport properties used for the determination of ion-solvent interactions. It is not a thermodynamics quantity, but viscosity of an electrolytic solution together with the thermodynamic property,  $\nabla_2$ , the partial molar volume gives much information and insight regarding ion-solvent interactions and the structures of the electrolytic solution. The viscosity B-coefficients give us quantitative values of the ion-solvent interactions.

The proper understanding of the ion-solvent interactions would form the basis of explaining quantitatively the influence of the solvent and the extent of interactions of the ions in solvents and have the way for the real understanding of the different phenomenon associated with the solution chemistry.

However, it is necessary to remember that ion-solvent interactions are very complex in nature. There are strong electrical forces between the ions and between the ions and solvents, and it is not really possible to separate them all. Nevertheless, if careful judgement is used, valid conclusions can be drawn in many cases from viscosity, conductivity, apparent molar volume and apparent molal adiabatic compressibility measurements relating to degree of structure and order of the system.

More extensive studies of the different thermodynamic and transport properties of the electrolytes will be of sufficient help in understanding the nature of the ion-solvent interactions and the role of solvents in different chemical processes.

