

CHAPTER- XII

Concluding remarks and future perspectives

In my research work described in this thesis, I have tried to investigate the solution properties of some solutes in some aqueous and non-aqueous industrially important liquid systems in terms of various interactions such as solute-solute, solute-solvent and solvent-solvent of some compounds in various solvent systems. Molecular interactions have been examined with the help of thermodynamic and transport properties of solutions. Systematic study made on these properties has great importance in gaining a better knowledge of these interactions. Such study will find importance in chemical engineering areas especially to understand the mixing behaviour of different components in the mixture.

In chapter IV after a through study of the behaviour of alkoxyethanols and isoamyl alcohol, we get a clear idea about the molecular interaction between the components and it was found that the interactions between the solvent molecules increases with the increase in chain length of alkoxyethanols.

Chapter V dealt with the study of ternary mixture of diethyl ether, amyl alcohol and 1, 3 dioxolane and their corresponding binaries. It was observed that the binary mixtures intermolecular interaction occurs and the interaction follows the order D.E.E + A.L > D.O + D.E.E > D.O + A.L. In case of ternary mixtures the extent of intermolecular interaction decreases as concentration of amyl alcohol increases

The study in chapter VI demonstrates molar conductance of some alkali metal acetates, viz., lithium acetate, sodium acetate and potassium acetate in aqueous 2-butanol solutions with an alcohol mass fraction of 0.70, 0.80 and 0.90 at 298.15, 303.15 and 308.15 K. The conductance data were analyzed with the Fuoss conductance-concentration equation. It was observed that the electrolytes under study behave like weak electrolytes and large values of $K_{A,c}$ for them indicate strong ionic association in aqueous 2-butanol solutions, i.e., the systems

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are characterized by strong ion-ion interactions but weak ion-solvent interactions.

In chapter VII the effect of addition of menthol in binary mixture of methyl salicylate and isopropyl alcohol at different concentrations and temperature was studied. The values of apparent molar volume (ϕ_v^0), viscosity B - coefficients and isoentropic compressibility (ϕ_k^0) indicate the presence of strong solute-solvent interactions and these interactions are strengthened at higher temperature and weakened with increasing mass percent of methyl salicylate in the binary solution.

Chapter VIII quantifies the precise measurements on electrical conductance of tetraalkylammonium iodides. From the experimental data it is evident that the tetra alkyl ammonium salts exists as ion-pairs upto 60 mass% of solvent mixture but as the dielectric constant of the solvent mixture decreases in 80 mass%, there is a tendency for triple ion pair formation.

In chapter IX we examined the solvent-solvent interactions in ternary mixtures of 2-methoxy ethanol, diethylether, dichloromethane and their corresponding binary mixtures. It was concluded that the specific intermolecular interactions are more prominent in binary liquid mixtures than in the pure species and that of ternary mixtures are more operative as compared to the binary mixtures.

From chapter X it can be concluded that both sodium molybdate and sodium tungstate shows similar trend of ion-solvent and ion-ion interactions, which can be ascribed to the similar structure of tungstate and molybdate ion. From the values of apparent molar volume (ϕ_v^0) and viscosity B - coefficients it may be concluded that ion-solvent interaction increases with increasing temperature and decreases with increasing amount of ethane-1,2-diol in the aqueous mixture. Also the structure breaking tendencies of the two electrolytes were found to be similar.

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The study made in chapter XI is ion-solvent and ion-ion interactions of phosphomolybdic acid in aqueous solution of catechol at different temperature. The values of apparent molar volume (ϕ_v^0) and viscosity B -coefficients for phosphomolybdic acid indicates the presence of strong solute-solvent interactions and these interactions are further strengthened at higher temperature and higher molarity of catechol in the ternary solutions.

Studies on viscosities, densities, ultrasonic velocities, refractive indices and conductance of solutions containing ions assist in characterizing the structure and properties of the components. Various types of interactions exist between the ions in solutions, and of these, ion-ion and ion-solvent interactions are of current interest in all branches of chemistry. These interactions help in better understanding the nature of solute and solvent, that is, whether the solute modifies or distorts the structure of the solvent.

The volumetric behaviour of solutes has been proven to be very useful in elucidating the various interactions occurring in aqueous and nonaqueous solutions. Studies on the apparent and partial molar volumes of electrolytes and the dependence of viscosity on concentration of solutes and temperature of solutions have been employed as a function of studying ion-ion and ion-solvent interactions. It has been found that the addition of electrolyte could either break or make the structure of a liquid. Because a liquid's viscosity depends on the intermolecular forces, the structural aspects of the liquid can be inferred from the viscosity of solutions at different concentrations and temperatures.

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.

Excess and bulk properties are fundamentally important in understanding the intermolecular interactions between dissimilar molecules and in developing the thermodynamic models. Moreover, knowledge of excess properties lets us develop an understanding of the interactions that determine the physical

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properties, making it easier to search for an optimal ionic liquid for a determined application.

Furthermore, thermodynamic properties of solvent mixtures, containing components capable of undergoing specific interactions, exhibit significant deviation from ideality arising not only from difference in molecular size and shape but also due to structural changes.

Mixed solvents enable the variation of properties such as use dielectric constant or viscosity, and therefore the ion-ion and ion-solvent interactions can be better studied. Moreover, different quantities strongly influenced by solvent properties can be derived from concentration dependence of the electrolyte conductivity. Consequently, a number of conductometric and related studies of different electrolytes in nonaqueous solvents, especially mixed organic solvents, have been made for their optimal use in high-energy batteries and for understanding organic reaction mechanisms. Ionic association of electrolytes in solution depends upon the mode of solvation of its ions, which in turn depends on the nature of the solvent or solvent mixtures. Such solvent properties as viscosity and the relative permittivity have been taken into consideration as these properties help in determining the extent of ion association and the solvent-solvent interactions. Thus, extensive studies on electrical conductance in mixed organic solvents have been performed to examine the nature and magnitude of ion-ion and ion-solvent interactions.

Thus excess thermodynamic properties, deviations of properties and transport properties for mixtures of liquids have both practical and theoretical interest. They have to be known to design industrial processes properly. They can be used to develop models that allow us to predict other properties.

To conclude it may be stated that extensive studies of the different physico-chemical, biological or pharmaceutical activity between different components of a given mixture will be immense help in understanding the nature of different interactions prevailing in mixed systems. The proper understanding of the ion-ion and ion-solvent interactions may form the basis of

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explaining quantitatively the influence of the solvents and ions in solution and thus pave the way for real understanding of different phenomena associated with solution chemistry. However, it is necessary to remember that molecular interactions are very complex in nature. There are strong forces existing in the molecule and it is not really possible to separate them all. Nevertheless, if careful judgement is used, valid conclusions can be drawn in many cases relating to degree of structure and order of the system.

In the near future we endeavour to extend our research work with ionic liquids and bioactive molecules which I hope will certainly compliment our present findings.

