

## CHAPTER- X

### CONCLUDING REMARKS

In my thesis, I have tried to investigate the various interactions of some vital compounds like ionic liquids, vitamins and amino acids in some aqueous and non-aqueous industrially important liquid systems. The observed properties have been explained by solute-solute/ion-ion, solute-solvent/ion-solvent and solvent-solvent interactions. 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.

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, viscometric, interferometric, conductometric and refractive index studies helped us to evaluate the extent of molecular interaction in a particular solution quantitatively whereas the FT-IR and spectroscopic measurements gave an insight into the type of molecular interaction occurring in any given systems.

In Chapter IV, after a thorough investigation of conductivity study of [emim]CH<sub>3</sub>SO<sub>3</sub> in n-propanol, n-butanol and n-pentanol shows that the conductance for the electrolyte is highest in case of n-propanol and lowest in case of n-pentanol. The molar refraction values also support the above fact that the highest ion-solvent interaction is seen in case of [emim]CH<sub>3</sub>SO<sub>3</sub> and n-pentanol. The diffusion coefficient ( $D_{\pm}$ ) and the ionic mobility ( $i_{\pm}$ ) decrease from n-propanol to n-pentanol for ions [emim]<sup>+</sup>, {CH<sub>3</sub>SO<sub>3</sub><sup>-</sup>} showing greater ion-solvent interaction in n-pentanol than the other studied solvents. The derived parameters obtained by analyzing various equations

supplemented with experimental data sustain the same finale as discussed and explained in this manuscript demanding the uniqueness of the work.

In Chapter V, the extensive study of thermophysical and thermodynamic properties of simple amino acids in aqueous 1-ethylpyridinium tetrafluoroborate [EPyBF<sub>4</sub>] solution at 298.15 K was done. It is evident that of the investigated amino acids L-Valine shows stronger association with the solvent molecules than L-Alanine, which, in turn, shows stronger association than Glycine. The derived properties obtained from the studies of thermophysical properties suggest that the solute-solvent interaction is dominant over the solute-solute interaction in solutions. Above all, this study demands a novelty of some amino acids prevailing in the aqueous solutions of 1-ethylpyridinium tetrafluoroborate [EPyBF<sub>4</sub>].

Extensive study of thermophysical and thermodynamic properties of simple vitamins in aqueous IL binary mixture were reported in chapter VI. In this chapter it is specified from the values of the limiting apparent molar volume ( $\phi_V^0$ ), viscosity *B*-coefficients, molar Refraction ( $R_M$ ) and limiting partial isentropic compressibility ( $\phi_K^0$ ), the presence of strong solute-solvent interactions which increases with the increase of interacting centres (groups) of vitamins and mass fraction of IL in the aqueous mixture. The refractive index and the molar refraction values imply that ascorbic acid molecules are more tightly packed in the solution leading to higher solute-solvent interaction than the other vitamin. Above all this study demands a novelty of some vitamins prevailing in the aqueous solutions of IL mixture.

In chapter VII, the methodical conductivity analysis of [EMIm]NO<sub>3</sub>, [EMIm]CH<sub>3</sub>SO<sub>3</sub> and [EMIm]OTs in DMF, DMA and DMSO explains that the conductance for all the electrolytes are highest in case of DMF and lowest in case of DMSO. Among the three electrolytes [EMIm]OTs is associated most with the studied solvents and the highest association is observed between [EMIm]OTs and DMSO. The ionic conductivity values suggest the fact that the anions conduct more than the cation except in case of [EMIm]OTs in DMF. The diffusion coefficient and the ionic mobility also shows that in studied ionic liquids the anions diffuse more due to high ionic mobility compared to the

cation in all the solvents except for the above mentioned case. The molar refraction values also support the above fact that the highest ion-solvent interaction is seen in case of [EMIm]OTs and DMSO. In all the solvents the electrolyte forms ion-dipole interactions as evident from the FT- IR studies.

Chapter VIII quantifies the investigated diverse properties such as Physico-chemical and thermodynamic properties of simple amino acids in aqueous Nicotinic acid binary mixture were performed. We found that the association of the studied amino acids, the Phenyl alanine is greater than Histidine. All the parameters of the studied properties suggest that the solute-solvent interaction is dominant over the solute-solute interaction in solutions and these interactions are further reinforced at higher temperatures for higher content of vitamin in the ternaries. Thus this study demands a uniqueness of solvation behavior of some amino acids prevailing in the aqueous solutions of nicotinic acid.

Chapter IX dealt with the exceptional inclusion behaviour of  $\beta$ -CD and studied IL in aqueous solution has been studied by surface tension and conductance measurements. The results point out that  $\beta$ -CD and IL finally form stable inclusion complexes (ICs) with a 1:1 stoichiometry. They both are promoting to each other due to hydrophilic and hydrophobic interactions among them. The experimental values obtained from the volumetric, viscometric and refractometric studies also support the data and results observed from surface tension and conductance measurements.

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

In conclusion it is to be stated that assorted interactions studies of vital compounds of a given mixture will be of immense help in understanding the nature of the different interactions and to throw more light on molecular interactions prevailing in mixed solution systems.