CONDUCTANCE STUDY OF ELECTROLYTES IN LIQUID MIXTURES : A REVIEW

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ABSTRACT

Modeling conductivity of electrolytes is a crucial method to determine the physical properties of liquid mixtures. It explores the nature of ion solvent and ion-ion interactions in electrolytic system. This review presents a summary of conductance behavior of liquid mixtures observed by various workers.

Key words: Conductance, Electrolytes, Liquid mixtures.

INTRODUCTION

The study of conductivity behavior of electrolytes in aqueous and non-aqueous media has received considerable importance in recent years due to its varied applications in various electrochemical investigations. Conductivity study is one of the important and simplest tools to understand the transport behavior in general and solvation behavior in specific for the ionic species involved in that electrolytic system under existing conditions[1]. The behavior of electrolytes in solution can be revealed by conductance[2] and viscosity investigations[3], which makes one to understand in detail about the nature of ion-ion and ion-solvent interactions.

Litrature survey

Three types of binary solvent mixture have been generally used in the literature for conductance measurements. Most frequently used are the mixtures of dipolar solvents with at least one protic solvent[4,5]. In order to change the dielectric constant of the medium without introducing a second solvating component, mixtures of dipolar solvents with non-polar components have also been used[6]. Mixtures of dipolar aprotic solvents, however, have rarely been used for the conductance studies of electrolytes[7] and thus need further investigations.

The effect of sucrose on the conductivity of aqueous electrolyte solutions has been reported by a number of repoters[8,9]. The conductance data have been analyzed by Kohlrausch's law or Onsagar's limiting

law. An increase in the viscosity of medium has been attributed to large aggregate of sucrose molecules having no effect on the mobility of smaller ions. However, Stokes & Stokes[10]. While analyzing the conductance data of LiCl, NaCl, KCl, etc. in 10 and 20% sucrose solutions at 25° C have opined that decrease in conductance of the electrolytes is due to the frictional charactor of the medium.

Mishra and Behera[11] reported the conductance data on NaCl, NaBr and NaI in sucrose solution at 25°C. The data obtained was analysed by Shedlovsk'y method. Solute-solvent interaction studies have been a subject of active interest among physical chemists[12] and mostly the inference regarding these interactions are drawn from conductance[13], molar volume and viscosity data. Bokhra and Verma[14] reported the conductance data for potassium acetate in water and in aqueous methyl acetate at different temperatures. The experimental data have been evaluated from Onsager's plot and with the help of Owen's method.

In recent years, structural interactions in ternary systems comprising electrolyte-solvent-non electrolyte are gaining special attention. It has been observed that non-electrolyte moiety interacts with the ions of the electrolytes in solution[15]. Several polyhydroxy compounds are known to interact with electrolytes in solution[16,17]. Definite adducts of many carbohydrates with salts and hydrated oxides of alkali and alkaline earth metals have also been reported. Measurements of conductance of electrolyte solutions in the presence of non-electrolytes have been made by several workers[18,19]. The changes in conductance of carbohydrate-electrolyte solutions[20] were attributed to the obstruction of the electrical migration of ions by the environmental, non-electrolyte entities.

Vishnu & Vidya Sagar Mishra[21] carried out conductance measurement of maltose with alkali metal halides in water & formamide solutions at different temperatures. The transitional behavior in the conductance values was explained in terms of solute-solvent interactions involved in the electrolyte-solvent-nonelectrolyte system.Conductance behavior of hydrogen halides in amphi-protic solvents and their mixtures has been extensively studied[22]. Rao[23] and Sastri[24] studied the conductance behavior of HCl and HBr in water -propylene glycol mixtures over the entire composition range at 25°C. The data has been analyzed by the Fuoss-Onsagar-Skinner three-parameter equation. The data has been evaluated interms of structural changes in the mixed solvents.

Varaprasad and Ishwara Bhat[25] reported the conductivity of N-chlorosuccinimide & N-bromosuccinimide in water & various compositions of water + dioxane at a temperature range 283 to 323K. From the conductance data free energy, enthalpy and entropy were evaluated and interpreted in terms of ion-ion & ion-solvent interactions in the present system.Extensive studies on electrical conductance[26] in various solvents have been performed in recent years to examine the nature & magnitude of ion-solvent and ion-ion interactions. Roy and Sinha[27] carried out conductance measurement for tetra methyl ammonium chloride, tetra ethyl ammonium bromide, etc. in iso amyl alcohol at 298.15 K. The conductance data have been analyzed by Fuoss equation & the results have been explained in terms of ion-solvent & ion-ion interactions.

Syal et al.[28] carried out conductance studies on the drugs Parvan Spas, Parvodex and Tramacip in ethanol-water mixtures at 25°C in absence and presence of additives viz. electrolytes –sodium chloride, sodium dodecyl sulphate, non-electrolytes – fructose and sucrose. The data obtained was evaluated interms of specific conductance, equivalent conductance and limiting molar conductance. Das and Roy[29] reported conductance measurement for selected alkali metal chlorides in the binary mixtures of methanol with carbon tetrachloride and 1,4 dioxane at 298.15 K. The data was used to evaluate limiting equivalent conductance, the association constant and the Walden product at all the mole fraction of solvent mixtures using the 1978

Fuoss conductance – concentration equation. The results have been interpreted inters of ion-solvent interactions and structural changes in the mixed solvent systems.

CONCLUSION

In this work we have just reviewed the electrical conductance of electrolytes in various solvents and the nature & magnitude of ion-solvent and ion-ion interactions by various workers. Definitely this survey will be more useful and having wide applicability in electrochemical investigations theories related with liquid mixtures.

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