CHAPTER IX.

SUMMARY OF THE RESULTS OF PRESENT WORK AND CONCLUSION.

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The results and discussions of the present investigation have been described in detail in chapters III to VIII. Here a chapterwise summary of the results are given below.

Chapter III: Dielectric Properties of Some Polar Liquids at UHF Radiowaves.

The attenuation coefficient α in db/cm for four different polar liquids such as acetone, methylethyl ketone, diethyl ketone and nitrobenzene have been determined over a wide ultrahigh frequency range at different temperatures. The relation $I = I_0 \exp.(-\alpha d)$ was used for calculating the value of α. The time of relaxation τ was calculated from three different relations i.e. from maximum absorption peak, from Debye relation and from the relation $\tau = \frac{\epsilon_o - \epsilon_\infty}{2\alpha_{max} c n}$ A single relaxation time was observed for all studied temperatures. It was further observed that the absorption coefficient of two ketones, CH_3COCH_3 and $C_2H_5COC_2H_5$ increases with lowering of temperature but the reverse effect was observed for $CH_3COC_2H_5$ liquid. The effect was explained with an assumption that when two alkyl groups in the ketone molecule are identical then the permanent electric moment produced by the intermolecular field increases with lowering of temperature. The abnormality due to presence of CH_3 group in methylethyl ketone, that

is, where the alkyl group attached to the C = O bond are not identical, was assumed to be due to the fact that at a low temperature the molecules abruptly become associated to form groups and thereby produces resultant permanent moment less than that of single molecule.

Chapter IV: Dielectric Relaxation Time of Some Polar Liquids Dissolved in Non-Polar Solvents at Ultrahigh Frequency Radiowaves.

The values of attenuation coefficient α were estimated from the relation $\alpha = \frac{1}{d} \log_e \frac{I_o}{I}$. The variation of α with frequency of incident radiowaves for 2-propanone, 2-butanone and 3-pentanone dissolved at different concentrations in benzene and carbontetrachloride have been recorded. It was found that the maxima of the absorption curve shift towards higher frequency with the increase of dilution and the shift increases with dilution of the mixture. It was thought that the diminution of the height of the absorption peak may be due to self dissociation of the molecules. The lower value of α_{max} for $CH_3COC_2H_5$ compared to CH_3COCH_3 and $C_2H_5COC_2H_5$ in different solvents was further explained with the same assumption that non-identical alkyl group attached to C = O show certain abnormality. A single relaxation time was observed at all studied dilution. It was thought that the monotonous shortening of τ with dilution in non-polar solvents may be due to the un usual reduction of dipole-dipole interaction.

Chapter V: Relaxation Times and Free Energies of Activation of Some Ketone Molecules in Ultrahigh Frequency Region.

The dielectric relaxation times of some ketone molecules were determined at different temperatures. The variation of time of relaxation with temperature was utilised for determining the thermodynamical parameters of dipole orientation. The Eyring rate theory has been used for calculating the free energy of activation (ΔF_τ), the enthalpy of activation (ΔH_τ) and the entropy of activation (ΔS_τ) for dipole orientation and also for calculating activation energies ΔF_η, ΔH_η and ΔS_η for viscous flow.

It was observed that free energies of activation for all the molecules increase with rise of temperature where as the values of ΔS_τ were found negative and remain almost constant with the variation of temperature. It was suggested from the observed values of ΔF_τ and ΔS_τ that for all the ketone molecules a large molecular region is involved in the relaxation process and the decrease in the value of τ with rise of temperature may be due to the breaking of cluster of molecules with rise of temperature. The abrupt fall in the value of heat of activation energy of 2-butanone further suggestes the anomalous behaviour of methyl group attached to the ketone molecule.

The experimental results lead to the conclusion that the dependence of relaxation time τ on viscosity is represented better by the relation $\tau T = c\eta^{\gamma}$, where C is constant and γ is ratio of two activation energies $(\gamma = \frac{\Delta H_\tau}{\Delta H_\eta})$. It was proposed that the quantity η^{γ} may be regarded as a measure of the internal viscosity $\eta_{int.}$ of the liquid in question.

Chapter VI. The Effect of an Electrolyte on the Ultrahigh Frequency Absorption in Some Aliphatic Alcohols.

Ultrahigh frequency absorption of electrolytic solution (KI dissolved in methyl alcohol and in ethyl alcohol) have been studied within the frequency band 285 to 470 MHz. at different temperatures. The observed increase in the values of α with decreasing temperature, and the shift of the absorption peak with rise of temperature at a fixed concentration was interpreted as due to the approximately exponential temperature dependence of relaxation time. ~~Kh~~ To explain the sharp increase of α for a particular electrolytic solution with lowering of temperature and frequency, it was thought that the conduction loss, the dielectric loss and the permanent electric moment produced by intermolecular field increases with lowering of temperature and frequency.

The average dipole relaxation time τ was calculated from the relation $\omega\tau = 1$ and also from Debye - Falkenhagen relation $\tau = \frac{8.85 \times 10^{-11} \epsilon_s}{\Delta_\infty \cdot \gamma}$. The values of relaxation time obtained from both the relations were large compared

to the expected values of the pure solvent. Unlike aqueous electrolytic solution certain discrepancies were observed in non-aqueous electrolytic solution where solvent's dielectric constant is sufficiently lower than that of water. The temperature dependence of time of relaxation was used for calculating activation energies such as ΔH_τ, ΔF_τ and ΔS_τ for dipole orientation and it was found that free energy of activation ΔF_τ increases with increase in temperature but ΔF_τ & ΔS_τ decrease with increase in concentration.

Chapter VII. Ionic Mobility of Binary Solution of Polar Liquids at Critical Solution Temperature.

The conductivity and ionic mobility of five different binary liquid mixtures have been determined at the critical opalescent temperature (T_c) and 1°C above critical temperature (T_c + 1°C). The viscosity of the binary liquid mixture at a temperature 1°C above the critical opalescent temperature was calculated from the well known relation

$$\log \eta_{12} = n_1 \log \eta_1 + n_2 \log \eta_2$$

The temporal variation of current for various low values of electrode potentials at T_c and (T_c + 1°C) were recorded with a potentiometer chart recorder. Analysing the current time curve, the d.c. conductivity and ionic mobility of the binary liquid mixtures were obtained at various applied field. The sharp decrease of mobility of ions of binary liquid mixture

at critical temperature (T_c) further supported Fixman's hypothesis on viscosity rise in binary mixture in the critical temperature region. A reasonable value of frictional coefficient β was obtained from Fixman's relation as well as from the relation $\beta = \frac{e}{\mu m_2}$. The experimental results lead to conclude that there is intense density fluctuation in the critical stage which distort the velocity gradient and to return to the uniform composition through diffusion dissipate energy which appears as excess viscosity of the binary liquid mixture.

Chapter VIII. Influence of Magnetic Field on Radio Frequency Conductivity of Nitrobenzene.

The radio frequency conductivity of pure nitrobenzene in presence of transverse magnetic field (K_H') and also in absence of magnetic field (K') were measured. It was observed that the magnetic field has practically no effect on r.f. conductivity below a certain magnetic field (H_c) . A significant positive effect was noticed above the critical field (H_c) .The decrease of r f conductivity of nitrobenzene was assumed to be due to decrease of ionic mobility or increase of local viscosity of liquid in transverse magnetic field.

APPENDIX

LIST OF PUBLICATIONS

1. Dielectric properties of Aliphatic ketone at U.H.F. Radio waves - R. Ghosh and R.K.Datta, Jour. Phys. Soc. Japan, 50, 1981, pp. 525-530.
2. Relaxation Times and Free Energies of Activation of some ketone Molecules in the ultrahigh frequency Region - R. Ghosh and R. K. Datta, Jour. Phys. Soc. Japan, 51 (1982), pp. 1449-1452.
3. Ionic mobility of binary solution of polar liquids at critical solution temperature - R.Ghosh and R.K. Datta, Proc. 52nd. Annual Session of National Academy of Science, India, 1982. Index No. A/54
4. Influence of Magnetic field on R.F.Conductivity of Nitrobenzene - R. Ghosh & R.K. Datta, North Bengal University Review (Science & Technology), Vol. 3, No.2, 1982 (~~Press~~) pp. 49 - 52
5. The effect of an electrolyte on the ultrahigh frequency absorption in some aliphatic alcohols - R. Ghosh and R. K. Datta, Proc. 70th.Session of Indian Science Cong., India, 1983.

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