JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

STUDIES OF SOME ACOUSTIC PARAMETERS OF Cu $(NO_3)_2$ IN WATER-DIOXANE MIXTURE AT 298.15^{0}K BY PHYSICO -CHEMICAL METHOD

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ABSTRACT

Isentropic compressibility (φ_S),intermolecular free length (L_f),apparent molar volume (φ_v), apparent molar compressibility (φ_k), molar compressibility (w),molar sound velocity (R),acoustic impedance (z) of $Cu(NO_3)_2$ in dioxane -water at 298.15^0 K have been determined from ultrasonic velocity (V),density($\boldsymbol{\rho}$) and relative viscosity (η_r) of the solution. These ultrasonic parameters are related with the molar concentration of the solution, which manifest the conformation of the structure of the solvent when the solute is added to it.

Key Words: Interferometer, Cu $(NO_3)_2$, Dioxane-Water.

INTRODUCTION

A literature survey shows that studies on the acoustic parameters such as ultrasonic energy is used in medicine, engineering, agriculture, defence and industry. In chemical industries ultrasonic energy is found useful in studying the chemical processes and in synthesis of chemical substances. The study of molecular interactions in the liquid mixtures is very much important to study the structural properties of molecules. In solution of ionic solute the attraction between the solute and solvent is of ion-dipole type. When electrolyte is dissolved in solvent it causes volume contraction due to interactions between ions and solvent molecules and therefore other acoustical parameters may be affected. Ultrasonic velocity measurements are helpful to study the ion-solvent interactions in aqueous and non-aqueous solutions that are why ion-salvation is the back bone of solution chemistry [1-3]. Ultrasonic study provide useful information regarding transports properties of electrolytes in aqueous solution and the behavior of the electrolyte and non-electrolyte solutions in aqueous [4-5] and non-aqueous solvent mixtures [6-7].A number of coworkers have studied the acoustical behavior of electrolyte solution containing metal ion [8-9]. In the present investigation, an attempt is made to study the ion-ion, ion-solvent and solvent-solvent interaction of Cu $(NO3)_2$ solution in 20%, 40%, 70% and dioxane –water mixture by using ultrasonic parameters.

EXPERIMENTAL SECTION

Analytical reagent (AR) grade with minimum assay of 99.5% were obtained from Sd Fine chemicals, India which is used as such without further purification. Water used in the experiment was demonized, distilled and degassed prior to making solutions. The required quantity of Cupper Nitrate for a given morality was dissolved in binary mixture of dioxane-water and similar procedure has been adopted for different molarities. All the solutions were prepared by weight method. A ultrasonic interferometer MX-3 model (Mittal Enterprises, Delhi) having frequency 2MHz and accuracy ±0.05% was used for the measurement of ultrasonic velocity in solutions.

RESULTS AND DISCUSSION

Table -1, highlights the experimental data of density (ρ), Relative viscosity ($\boldsymbol{\eta}_r$) and apparent molar volume (Φ) for the solute in different concentration of the solvent at 298.15 Kelvin.From the Jones-Dole equation [10] A and B the viscosity coefficients were calculated.

$$\boldsymbol{\eta}_r = 1 + A\sqrt{c} + Bc$$

Where A is determined by the ionic attraction theory of Falkenhagen-Vernon and called as Falkenhagen coefficient, B or Jones-Dole coefficient is an empirical constant determined by ion-solvent interactions. $\boldsymbol{\eta}_r = (\boldsymbol{\eta}_s/\boldsymbol{\eta}_o)$, and $\sqrt{c}$ are the viscosities of the solution and solvent respectively and c is the molal concentration of the solute.

The Values of A and B are given in Table 2. Result interpreted the relative viscosity ($\boldsymbol{\eta}_r$) increases with the increase in volume percentage of dioxane-water, the increase in concentration of the solute the relative viscosity increases [11] the above data have been agree with the Masson's equation [12] as the plot of Φ vs $\sqrt{c}$ is linear.

$$\Phi = \Phi_0 + S_v c^{1/2}$$

Where Φ0 is the values of the limiting apparent molar volume .The limiting slope S_v is a constant dependent on charge and salt type and can be related ion–ion interaction. The values of $\Phi_0$and S_v are shown in Table 2. The limiting slope (S_v) is positive suggesting ion-ion interaction. The increase in Φ_0 with increase in dioxane –water.The apparent molar volume (Φ) was determined from the equations which are given in table 1.

$$\Phi = \frac{M}{\rho 0} - \frac{(r - r_0)10^3}{\rho 0 \times c}$$

Where M is the molecular wt. of the solute, ρ0 is the density of the solvent, ρis the density of the solution; c is the molar concentration of the solution.

Another parameters like ultrasonic velocity (U) [13], isentropic compressibility (Bs), Molar compressibility (w),

Molar sound velocity (R), Acoustic impedance(Z)[14], inter molecular free length (L_f) [15]and Apparent molar compressibility (Φ_k) [16] of $Cu(NO_3)_2$ solution in 20%,40%,70% and dioxane -water at 298.15k are showed in the Table 3. The values of U, W, R, Φ_k increases and $\boldsymbol{\eta}_s$, Z, L_f decreases in the solvent, suggest the great interaction between dioxane and water. The increase in value of U, Z, Φ_k and decrease in values of $\boldsymbol{\eta}$s, w, R, L_f with the increase in concentration of the solute suggests the breaking nature of the solute. The formation of new bonding between solute and solvent molecules takes placed. [17-18].

Table 1.Physical properties of Cu $(NO_3)_2$ of different concentration in 20%, 40% and 70% Dioxane-water at 298.15K

Parameters	**20% Dioxane-water**								
Conc^n.	0.1000	0.0750	0.0500	0.0250	0.0200	0.0175	0.0150	0.0125	0.0000
η_r	1.01116	1.00945	1.00756	1.00517	1.00319	1.00273	1.00220	1.00155	…..
Pgm ml^{-1}	1.0493241	1.0328407	1.0163424	0.9998257	0.9899037	0.9882489	0.9865935	0.9849376	0.9832808
Φcm^3mol^{-1}	110.9828	110.60998	110.16774	109.59140	109.08000	108.96210	108.8225	108.64000	108.2000
40% Dioxane-water									
Conc^n.	0.1000	0.0750	0.0500	0.0250	0.0200	0.0175	0.0150	0.0125	0.0000
η_r	1.01135	1.00961	1.00767	1.00527	1.00320	1.00275	1.00222	1.00156	….
Pgm ml^{-1}	1.0371550	1.0207070	1.0042442	0.9877629	0.9778624	0.9762108	0.9745590	0.9729066	0.9712534
Φcm^3mol^{-1}	113.81443	113.43736	112.99010	112.40721	111.89000	111.77076	111.62932	111.44500	111.00000
70% Dioxane-water									
Conc^n.	0.1000	0.0750	0.0500	0.0250	0.0200	0.0175	0.0150	0.0125	0.0000
η_r	1.01170	1.00997	1.00789	1.00536	1.00326	1.00281	1.00226	1.00158	…..
Pgm ml^{-1}	1.0232244	1.0068121	0.9903849	0.9739393	0.9640601	0.9624124	0.9607641	0.9591153	0.9574657
Φcm^3mol^{-1}	126.94605	126.56475	126.11246	125.52302	125.00000	124.87942	124.73640	124.55000	124.10000

Table 2. Limiting apparent molar volume (φv), limiting slope (S_v), for $Cu(NO_3)_2$ in 20%, 40% and 70% Dioxane-water at 298.15K

Parameter	**20% Dioxane-water**	**40% Dioxane-water**	**70% Dioxane-water**
Φcm^3mol^{-1}	108.200	111.000	124.100
S_v ($cm^{9/2}$ $mol^{-3/2}$)	8.8	8.9	9.0
A X 10^{-2} ($mol^{1/2}lt^{1/2}$)	3.01	3.02	3.05
B (mol^{-1} lt)	0.41	0.45	0.53

Table 3. Variation of U, Bs, W, R, Z, L and φk with concentration of Cu $(NO_3)_2$ in 20%, 40% and 70% Dioxane-water at 298.15K

Parameters	**20% Dioxane-water**								
Conc^n.	0.1000	0.0750	0.0500	0.0250	0.0200	0.0175	0.0150	0.0125	0.0000
U	1650	1642	1637	1630	1627	1623	1619	1608	1605
Bs×10^{-2}	39.5646	40.1020	40.6432	40.8910	41.2067	41.4350	42.4657	43.7990	44.7890
W x 10^5	11.6596	11.7132	11.7340	11.8134	11.8601	11.8950	11.9100	11.9512	11.9907
R	62.8525	63.4213	65.0050	65.8910	66.1234	68.2340	68.9715	69.0125	69.1560
Z	1525.06	1523.10	1520.34	1517.43	1515.27	1512.67	1510.91	1508.90	1506.86
L_f	0.00625	0.00629	0.00631	0.00634	0.00639	0.00643	0.00651	0.00665	0.00690

Φ_k	-0.00030	-0.00028	-0.00025	-0.00021	-0.00019	-0.00018	-0.00016	-0.00014	……..
40% Dioxane-water									
Conc^n.	0.1000	0.0750	0.0500	0.0250	0.0200	0.0175	0.0150	0.0125	0.0000
U	1658	1652	1645	1636	1630	1628	1622	1615	1610
Bs×10^{-2}	39.5675	40.1075	40.6450	40.8995	41.2560	41.4650	42.4997	43.7995	44.8895
W x 10^5	11.7590	11.8131	11.8348	11.9132	11.9501	11.9250	11.9401	11.9517	11.9980
R	63.5520	63.7215	64.0051	65.8915	66.6234	68.9345	68.9790	69.1135	69.9970
Z	1525.06	1523.10	1520.34	1516.45	1514.29	1511.69	1510.94	1508.97	1507.80
L_f	0.00625	0.00629	0.00631	0.00632	0.00637	0.00640	0.00650	0.00660	0.00695
Φ_k	-0.00031	-0.00029	-0.00027	-0.00024	-0.00020	-0.00018	-0.00021	-0.00017	…….
70% Dioxane-water									
Conc^n.	0.1000	0.0750	0.0500	0.0250	0.0200	0.0175	0.0150	0.0125	0.0000
U	1678	1675	1665	1658	1650	1649	1645	1637	1638
Bs×10^{-2}	39.3674	40.0079	40.4450	40.6993	41.0560	41.2650	42.2992	43.5990	44.6890
W x 10^5	12.7595	12.8136	12.8350	12.9137	12.9505	12.9255	12.9406	12.9522	12.9985
R	66.5520	66.7215	66.0054	67.8910	67.6210	68.9340	69.9795	70.1135	70.9975
Z	1515.06	1513.10	1510.34	1506.45	1504.29	1501.69	1400.94	1408.97	1407.80
L_f	0.00625	0.00629	0.00631	0.00630	0.00636	0.00645	0.00650	0.00669	0.00695
Φ_k	-0.00028	-0.00021	-0.00020	-0.00018	-0.00017	-0.00016	-0.00015	-0.00012	……..

REFERENCES:

[1] J.I. Bhat, M.N. Manjunatha and N.S.S. Varaprasad, *Ind. J.Pure and Appl. Phys*, ***48***, *875,* **(2010)**.

[2] S.R. Kanhekar, P. Pawar and G.K. Bichile, *Ind. J.Pure and Appl. Phys*, **48**, 95, **(2010).**

[3] A.N. Kannappan and P. Palani, *Ind. J. Pure and Appl.Phys, **45**, 573,* **(2007).**

[4] J.D. Pandey, K. Misra and V. Misra , *Acoust Lett*, **15**, 231**,(1992)**.

[5] R.P. Verma and A. Singh, *Ind. J. Pure and Appl.Phys,* **26**,606 **(1998).**

[**6]** J.D. Pandey, K. Misra and N. Hasan, *Acoust Lett*, **14**, 105**,(1991)**.

[7] V.K. Syal, G. Lal and S. Chauhan, *J. Mol. Liq*, **63**, 317**(1995).**

[8] S. Harvath Z. Geza, Nagymiklos, H. Harald and M. Yahollah, *J. Disp. Sci. and Tech*, **24**, 43, **(2003).**

[9] S.D. Raviprakash, H.V. Ramakrishna, S.K. Rai and A.Varadharajuly , *J. App. Polym. Sci.*, **90**, 33 **(2003)**

[10]Jones,G.and Dole,M,*J.Am.Chem.Soc*,51,2950**(1929)**

[11]. G. Widedemann, *ibid,* p. 1241

[12] D.O. Masson, *Philis. Mag.*, **(7)8**.218,**(1929).**

[13]Narwade M.L and Ramteke A,*Arch of Appl.Sci.Res.***4(1)**,254-261**(2012)**

[**14]**Deosarkar S.D,*Russian J.Phy.Chem.(A),***86(10),**1507-1511**(2012)**

[15]khobragade.B.G.,MeshramU.P,*Der.Pharm.Chemica,***3 (2)**,376-382**(2012)**

[16] Ramteke J.N,*Adv.In appl.Sci.Res,***3(3),**1832-1835**(2012)**

[17]E.G. Panenda, P. Guardado, A. Maestre,*J. Solution Chem. 33,* 1277 **(2004)**.

[18]. P.S. Nikam, R.P. Shewale, A.B. Sawani,M. Hasan, *J. Chem. Engg. Data*. **50**, 487**(2005)**.