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Short Communication

The Study of ion-solvent Interaction of Eusol in Some Polar Solvent like Diethyl ether and Acetaldehyde

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Abstract

Ion solvent interaction measurements of Eusol in diethylether and acetaldehyde have been carried out for the study of solute-solvent interaction. Various acoustic parameters (intermolecular free length, isentropic compressibility, specific acoustic impedence, molar sound velocity, apparent molal adiabatic compressibility, relative association and solvation number) have been evaluated using ultrasound velocity data. The results were discussed in the light of solute-solvent interaction between the molecules.

Keywords:

Introduction

Several techniques such as IR, Raman spectroscopy and Ultrasonics have been used for the determination of molecular and ion-solvent interaction[1-6]. Verma and Coworker has been studies the interactionin higher alcohols with thiophene, benzene, toluene, carbon tetra chloride[7-9]. The present work deals with the study of solute-solvent interaction in the solution of Eusol in diethylether and acetaldehyde using ultrasonic velocity data. The values of ultrasonic velocity, specific acoustic impdence, apparent molal adiabatic compresibility, relative association and solvation number increases while the isentropic compressibility, intermolecular free length and molar sound velocity decrease with increasing Eusol concentration.

Material and Methods

All the chemicals used in present study are of AR/BDH grade. A known amount of Eusol is dissolved in diethlether and acetaldehyde so as to obtain various concentration solutions. The ultrasonic velocity in these solutions was measured using a multifrequency ultasonic interferometer (F-81 Mittal Enterprises, New Delhi) at a fixed frequency of 2 MHz and a constant temperature (30ºC ± 0.005ºC½\). The densities of the solvent and solutions are measured using a specific gravity bottle.

The various acoustic parameters viz. isentropic compressibility (β_2), apparent molal adiabatic compressibility (ϕ_K), specific acoustic impedance (z)[10], molar sound velocity (R)[11], relative association (R_A)[12] salvation number (S_n)[13], viscosity(η), intermolecular free length (L_f)[14], and shear's relaxation time(τ)[15] have been evaluated by using the following empirical formula

$$\beta_s = \frac{1}{v^2 \rho}$$

$$L_f = K(\beta_s)^{1/2}$$

$$Z = v \times \rho \times 10^{-15}$$

$$R = \frac{\overline{M}}{\rho} \times v^{1/3}$$

Where $[M = n_1m_1 + n_2m_2 / n_1 + n_2]$

$$R_A = (\rho / \rho_0)(v_0 / v)^{1/3}$$

$$S_n = \frac{n_1}{n_2}\left(1 - \frac{\beta_s}{\beta_{s0}}\right)$$

$$\phi_k = \frac{1000}{C \times \rho_0}\left(\rho_0 \beta_s - \beta_{s0}\rho\right) + \beta_{s0} \times \frac{M}{\rho_0}$$

$$\tau = \frac{4}{3}\eta \times \beta_s$$

v_0, v; ρ_0, ρ; β_{So}, β_s are the ultrasonic velocity density and isentropic compressibility of the solvent and solution respectively, n_1, n_2 and m_1, m_2 are the number of moles and molecular weight of the solvent and solute respectively and K and C are the temperature dependent Jacobson's constant and concentration respectively.

Result and Discussion

Ultrasonic velocity (v) in the solution of Eusol in diethyl-ether and acetaldehyde increases with increasing concentration of Eusol. The variation of velocity with concentration (c) can be expressed by the following relationship.

$$dv/dc = -\frac{v}{2}\left[\frac{1}{\rho\,(d\rho/dc)} + \frac{1}{\beta_s\,(d\beta_s/dc)}\right]$$

In general results show that while the density increase, the isentropic compressibility decreases with increasing concentration of solute and the quantity ($d\beta_s/dc$) is positive while ($d\rho/dc$) is negative. Since the values of $[1/\beta_s(d\beta_s/dc)]$ are larger than the values of $[1/\rho(d\rho/dc)]$ for Eusol in diethyl-ether and acetaldehyde, the concentration derivative of velocity, (dv/dc) is positive i.e. the ultrasonic velocity increase with increasing the concentration of solute[16-18].

The isentropic compressibility (β_s) of Eusol solutions decreases with increase in the molar concentration of solute. The complimentary use of isentropic compressibility data can provide interesting information on solute interaction. The results of isentropic compressibility have been explained in terms of Bachem's equation.[19]

$$\beta_s = \beta_{So} + AC + BC^{3/2}$$

The variation of intermolecular free length with molar concentration of Eusol in diethylether and acetaldehyde is shown in figure-1 at 30ºC. It decreases with increasing molar concentration and the slope of lines is found to be negative. Linear decreases of L_f has also been reported for oxalic acid dehydrate in tetra hydro furan by Ravi chandran et.al[20].

The variation of specific viscosity increases with increasing molar concentration of Eusol in diethyl-ether and acetadehyde is shown in figure-2 at 30ºC it increase with increasing molar concentration and the solope of lines is found to be negative. The result of η_{sp} indicates that there is significant interaction between the solute and solvent molecules[21-22].

It is found that molal adiabatic compressibility has been negative increase with increasing molar concentration while molal adiabatic compressibility negative on increasing molar concentration shown in table 1 and 2.

Table–1
Eusol + Diethyl ether at Temp. 30^{0}C

Molar Concentration	density	Ultrasound Velocity	Isentropic Compressibility	Lowering Compressibility	Viscosity	Specific Viscosity	Reduce Viscosity	Shear's Relaxation Time	Specific Acoustic Impedence	Molar Sound Velocity	Relative Association	Solvation Number	Intermolecular Free Length	Specific Lowering Compressibility	Apparent Molal Compressibility
0.0210	0.7196	991	141.50	1.86	0.2266	0.0094	0.4454	42.7524	0.7131	471.93	1.0012	0.0209	0.7506	-88.4924	-9.7983
0.0420	0.7217	996	139.68	3.69	0.2308	0.0281	0.6682	42.9832	0.7188	474.11	1.0059	0.0415	0.7457	-87.6926	-9.7183
0.0630	0.7238	1001	137.88	5.48	0.2371	0.0561	0.8909	43.5897	0.7245	476.28	1.0105	0.0617	0.7409	-86.9237	-9.6414
0.0840	0.7259	1006	136.12	7.24	0.2455	0.0935	1.1136	44.5572	0.7303	478.46	1.0151	0.0816	0.7362	-86.1707	-9.5661
0.1050	0.7280	1011	134.39	8.97	0.2560	0.1403	1.3363	45.8717	0.7360	480.63	1.0197	0.1011	0.7315	-85.4305	-9.4921
0.1260	0.7301	1016	132.64	10.72	0.2600	0.1581	1.2550	45.9803	0.7419	482.85	1.0244	0.1209	0.7267	-85.1163	-9.4607
0.1470	0.7322	1021	131.01	12.35	0.2720	0.2116	1.4393	47.5145	0.7476	485.00	1.0290	0.1392	0.7223	-83.9842	-9.3475
0.1680	0.7343	1026	129.37	13.99	0.2780	0.2383	1.4185	47.9529	0.7534	487.18	1.0336	0.1577	0.7177	-83.2771	-9.2768
0.1890	0.7364	1031	127.75	15.61	0.2860	0.2739	1.4494	48.7162	0.7592	489.36	1.0382	0.1759	0.7132	-82.5802	-9.2071
0.2100	0.7385	1035	126.38	16.98	0.2920	0.3007	1.4318	49.2047	0.7644	491.41	1.0426	0.1914	0.7094	-80.8481	-9.0339

Table–2
Eusol + Acetaldehyde ether at Temp. 30^{0}C

0.0210	0.774	1032	121.31	3.14	0.2407	0.0088	0.4191	38.9327	0.7988	361.40	0.9695	0.0737	0.6950	-149.4833	-8.8693
0.0420	0.7779	1036	119.82	4.63	0.2449	0.0264	0.6287	39.1238	0.8056	363.56	0.9753	0.1088	0.6907	-110.3448	-6.9844
0.0630	0.7794	1039	118.86	5.59	0.2512	0.0528	0.8382	39.8087	0.8098	364.73	0.9784	0.1313	0.6879	-88.3690	-5.5886
0.0840	0.7811	1043	117.68	6.77	0.2600	0.0897	1.0677	40.7957	0.8147	366.02	0.9819	0.1589	0.6845	-80.5957	-5.0186
0.1050	0.7829	1047	116.52	7.93	0.2720	0.1400	1.3332	42.2579	0.8197	367.32	0.9854	0.1862	0.6811	-75.5241	-4.6828
0.1260	0.7847	1051	115.38	9.07	0.2860	0.1987	1.5767	43.9965	0.8247	368.61	0.9888	0.2130	0.6778	-72.0210	-4.4542
0.1470	0.7864	1055	114.25	10.20	0.2974	0.2464	1.6764	45.3023	0.8297	369.91	0.9923	0.2396	0.6744	-69.4158	-4.2869
0.1680	0.7882	1059	113.13	11.32	0.3080	0.2909	1.7313	46.4592	0.8347	371.20	0.9958	0.2657	0.6712	-67.3734	-4.1579
0.1890	0.7899	1063	112.03	12.42	0.3200	0.3412	1.8051	47.8000	0.8397	372.50	0.9993	0.2915	0.6679	-65.7074	-4.0546
0.2100	0.7917	1066	111.15	13.30	0.3270	0.3705	1.7643	48.4631	0.8440	373.68	1.0024	0.3121	0.6653	-63.3145	-3.9087

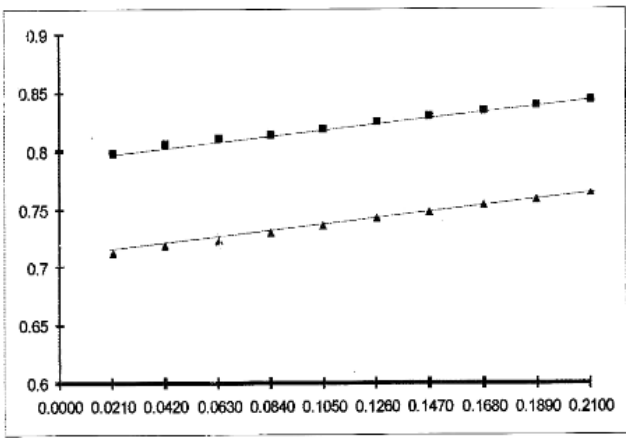

Figure-1
Specific Viscosity Vs Mole Conecentration

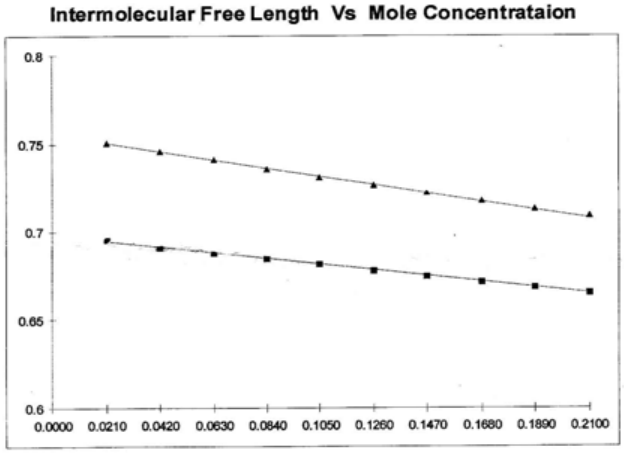

Figure-2
Intermolecular Free Length Vs Mole Concentration

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