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MOLECULAR INTERACTIONIN OF SODIUM SALT IN DIFFERENT SOLVENTS AT DIFFERENT CONCENTRATIONS

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ABSTRACT:

Now a days Ultrasonic velocity plays a vital role to study molecular interaction existing in the solution. Densities, viscosities of aqueous solution of sodium salt were measured at different concentrations and in different solvents. acoustic parameters were calculated from the experimental data . Type of interaction exist in the solution was predicted from acoustic parameters.

Keywords: - Sodium, Solvent. Ultrasonic, Molecular Interaction, Acoustic.

INTRODUCTION :

Ultrasonic work on the principle that sound is reflected at different speed by tissues or substances of different densities .Ultrasonic investigation of liquid mixtures consisting of polar and non-polar component enable to understand the molecular interaction and structural behavior of molecules and their mixture. Number of researchers has studied the characteristics of inorganic salts in different solution. It has been reported that ions with low charge density are net structure breakers while ions with high charge density are net structure makers. The strength of ion dipole attraction is directly proportional to size of the ion, charge and the magnitude of the dipole but inversely proportional to the distance between the ions and the dipolar molecule.Electrolytes dissolving in solvent have been classified as structure makers or structure breakers. The values of all the acoustic parameters are important for collecting information about the structure of solvent as well as molecular interaction existing in the solution.

In present investigation Ultrasonic velocity and related acoustic parameters of NaBr with water have been calculated at different temperature 298K, 303K and 308K of different mole fraction.

MATERIAL AND METHODS :

In the present experimental work the different mole fraction of NaBr in water and NaBr in 20% ethyl alcohol solutions has been prepared. All thhe salt and solvent used are of AR Grade sample. All the solutions were prepared in deionized and distilled water. Following parameters were calculated

Velocity measurement :

The ultrasonic velocity of binary mixture for NaBr in H2O and NaBr in 20% Ethyl Alcohol The ultrasonic velocity (U) been measured using an ultrasonic interferometer (Mittal type, Model F-81) working at 2MHz frequency and at temperature 298K ,303K,308K. The accuracy of sound velocity was $\pm 0.1 \text{ms}^{-1}$. An electronically digital operated constant temperature water bath has been used to circulate water through the double walled measuring cell made up of steel containing the experimental solution at the desired temperature.

Density Measurement :

The densities was measured using a 25ml specific density bottle by measurement with an accuracy of

$\pm 0.01 Ns^{-1}m^{-2}$ relative specific gravity of 0.01Kg .The weight of the sample was measured using an electronic digital balance with an accuracy of $\pm$ 0.1 mg

Viscosity Measurement :

Ostwald Viscometer was used for measuring viscosity of flowing time with the accuracy of ± 0.1 by usingdigital stop watch.

The parameters such as adiabatic compressibility (β), inter molecular free length (Lf), and acoustic impedance (Z), are calculated by using the following

relation (1- 3).

RESULT AND DISCUSSION :

$\beta = (U^2 \rho)^{-1}$ (1)

$Lf = KT \ \beta \ a^{1/2}$ (2)

$Z = U\rho$ (3)

Table I,II and III shows the ultrasonic velocity , density ,viscosity of NaBr in water solution of different concentration at different temperature 298k,303k and 308k

The velocity increases with the increase in the concentration shows the strong solute solvent interaction. The other acoustic parameter adiabatic compressibility decreases while relaxation time (τ) decreases while intermolecular free length decreases(Lf) acoustic impendence increases. The value of all these parameter shows that there is more association between solute and solvent It is observed from table I,II,and III that as the temperature of NaBr in water solutions are increases from 298K to 303K and 308K due to the thermal agitation of component molecule the interaction between solute and solvent becomes weak. This is indicated by decrease in ultrasonic velocity values in the present investigation.

CONCLUSION :

The velocity, density, viscosity and other related parameter were calculated and conclusion drawn:

1) The net increase in velocity with increase in mole fraction indicate strong molecular interaction in the solution.

2) The other parameter values such as β, τ, z, and Lf of various concentration confirmed that there is existence of strong molecular interaction in solute –solvent.

3) The increase in temperature due to thermal agitation resulting in weak interaction existing in the solution.

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Table I: Measured values of ultrasonic velocity (U), Density(ρ),Viscosity(η), Adiabatic compressibility(β), Relaxation time(τ) Acoustic Impendence(z), Mean Free length(Lf) of NaBr in Water at 298K

srno	mole fraction	velociyt(m/s)	Density(ρ) (kg/m3)	Viscosity(CP)	βa*10⁻¹⁰	τ*10⁻¹²	z*10⁶	Lf*10⁻¹⁰
1	0.01	1518.40	1188.4	0.9983	3.64977	4.86	1.804467	0.407
2	0.02	1528.00	1212.8	1.01254	3.53154	4.77	1.853158	0.4
3	0.03	1532.00	1252.0	1.01254	3.40313	4.59	1.918264	0.393
4	0.04	1551.00	1293.6	1.02679	3.21349	4.4	2.006374	0.382
5	0.05	1562.00	1332.0	1.04105	3.07704	4.27	2.080584	0.374
6	0.06	1574.00	1369.6	1.06958	2.94711	4.2	2.15575	0.366
7	0.07	1619.30	1397.6	1.0981	2.72874	4	2.263134	0.352
8	0.08	1662.20	1418.0	1.0981	2.55245	3.74	2.357	0.34
9	0.09	1695.60	1434.8	1.12662	2.42416	3.64	2.432847	0.332

Table II: Measured values of ultrasonic velocity (U), Density(ρ),Viscosity(η), Adiabatic compressibility(β),Relaxation time(τ) Acoustic Impendence(z), Mean Free length(Lf) of NaBr in Water at303K

srno	mole fraction	velociyt(m/s)	density(kg/m3)	Viscosity(CP)	βa*10⁻¹⁰	τ*10⁻¹²	z*10⁶	Lf*10⁻¹⁰
1	0.01	1473.28	1184.4	0.94123	3.88983	4.88	1.744953	0.42
2	0.02	1517.42	1204.4	0.95549	3.60593	4.59	1.827581	0.405
3	0.03	1529.16	1250.0	0.95549	3.42124	4.36	1.91145	0.394
4	0.04	1539.32	1291.6	0.9697	3.26749	4.22	1.988186	0.385
5	0.05	1546.05	1323.6	0.984	3.16079	4.15	2.046352	0.379
6	0.06	1547.90	1361.2	0.99801	3.06614	4.08	2.107001	0.373
7	0.07	1605.42	1384.4	1.01254	2.8026	3.78	2.222543	0.357
8	0.08	1621.22	1410.0	1.0267	2.69834	3.69	2.28592	0.35
9	0.09	1633.23	1425.2	1.041058	2.63045	3.65	2.327679	0.346

Table III: Measured values of ultrasonic velocity (U), Density(ρ),Viscosity(η), Adiabatic compressibility(β),Relaxation time(τ) Acoustic Impendence(z), Mean Free length(Lf) of NaBr in Water at 308K

srno	mole fraction	velocity(m/s)	density(kg/m3)	Viscosity(CP)	βa*10⁻¹⁰	τ*10⁻¹²	z*10⁶	Lf*10⁻¹⁰
1	0.01	1468.20	1180.0	0.9127	3.9314	4.78	1.732476	0.423
2	0.02	1488.20	1202.8	0.9269	3.75391	4.64	1.790007	0.413
3	0.03	1499.00	1244.4	0.95549	3.57632	4.56	1.865356	0.403
4	0.04	1509.00	1288.4	0.96975	3.40856	4.41	1.944196	0.393
5	0.05	1512.23	1319.6	0.9784	3.31377	4.32	1.995539	0.388
6	0.06	1524.60	1358.0	0.984	3.16802	4.16	2.070407	0.379
7	0.07	1587.80	1376.4	0.99801	2.8818	3.83	2.185448	0.362
8	0.08	1601.40	1397.2	0.99801	2.79088	3.71	2.237476	0.356
9	0.09	1606.40	1416.4	1.01254	2.73594	3.69	2.275305	0.358