ULTRASONIC STUDIES ON DI SODIUM HYDRO PHOSPHATE AND DI POTASSIUM HYDRO PHOSPHATE (Na_2HPO_4&K_2HPO_4) AQUEOUS IN POLYACRYLAMIDE SOLUTION AT DIFFERENT CONCENTRATIONS FOR BIOLOGICAL APPLICATIONS

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Ultrasonic velocity (U), Density (ρ) and viscosity (η) of binary mixtures of Na_2HPO_4/K_2HPO_4 mixed solution in Polyacrylamide solution were determined at 303k. The experimental data have been used to calculate acoustic parameters such as Adiabatic compressibility (β_{ad}), Intermolecular free length (L_f), Acoustic impedance (Z), viscosity (η) have been calculated. The non-linear variations of ultrasonic velocity were observed. The experimental data for sound velocity (C) and density (ρ) of the mixture have been used to compute these parameters. The variations of sound speed with frequency plays the key role to execute the variation in these parameters which is explained in terms of different intermolecular interactions present in the binary mixture. The result is interpreted in terms of molecular interaction such as dipole-dipole interaction through hydrogen bonding between components of mixtures. The density of a solution is found to increase with increase in concentration of sodium hydro phosphate and potassium hydro phosphate and it is found to be maximum at 90:10. This may be interpreted to the structure of the solvent due to the added solute. The molecular interactions are explained on the basis of acoustical properties in the binary mixtures. These properties are used to illustrate the nature of molecular interaction between the component molecules.

Keywords: Ultrasonic velocity, compressibility, molecular interaction, free length, viscosity.

1. Introduction

Ultrasonic technique has been widely used to study the molecular interaction in polymer solutions. Acoustic impedance, Molecular free length and Adiabatic compressibility, computed from ultrasonic velocity and density of the solution gives direct information about different interactions involved among the various polymer-solvents, complex formation, association or dissociation, structural and destructural nature of the solvents. The ultrasonic technique has been established as a powerful technique for polymer characterization. In recent

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years, several researchers have used such technique to characterize the polymer and polymer blend solutions [1-2]. Ultrasonic study of velocity, density along with acoustic parameters of polymer are essential to understand the molecular interactions between the unlike molecules to develop theoretical models and applications in industrial and some biological processes. Propagation of ultrasonic waves through polymer solution reveals many physico-chemical properties of the polymer. These polymers have a wide range of applications in various industries and technology [3-5].

The study of molecular interaction plays a vital role in the development of molecular science. Molecular interactions and structural behavior of molecules and their mixtures can be identified using ultrasonic studies. Recent studies have discovered application of ultrasonic studies in field of medicine, construction and farming.

The practical application of mixed solvents, rather than single solvent, in industrial and biological processes has been recognized all over the world, as they provide a wide choice of solvent mixtures with appropriate properties. Ultrasonic speed together with thickness and consistency information outfit abundance of data about the association between particles, dipoles, hydrogen bonding, multi-polar and dispersive forces [6-9].

Polyacrylamide (PAA) and its derivatives are widely used in subsurface applications such as Enhanced Oil Recovery. High viscosity aqueous solutions can be generated with low concentrations of polyacrylamide, and these can be injected to improve the economics of conventional water flooding. Also, it is used to prevent soil crusting as well as to increase water infiltration into soils containing clay. The main objective of this study is to give the modified polymer in a particular character. Dipotassium phosphate (K_2HPO_4) is a highly water-soluble salt is often used as a fertilizer, food additive and buffering agent. NaH_2PO_4 is used as water softening treatment. The assessment of the nature of molecular interaction present in materials can be done by ultrasonic investigation. Ultrasonic velocity measurements have been employed extensively to detect and assess the weak /strong molecular interactions in binary mixtures. Using ultrasonic velocity and density, the derived parameters such as adiabatic compressibility (β), molecular free length (L_f), acoustical impedance (Z), were determined. There is a possibility of complex formation of either stable or unstable type and also it is expected that variation of ultrasonic related parameters of mixed salt solutions with change in concentration of compounds will be affected in a manner different from those of single salt solution. Therefore, the aim of this study is to investigate the acoustical parameters of polyacrylamide with phophspate salt solution. In this study, an attempt has been made to report the experimental value of ultrasonic velocity (U), density (ρ) viscosity (η) of

various compositions of 1N solutions of mixtures Na_2HPO_4/K_2HPO_4 mixed in Polyacrylamide solution at room temperature.

2. Experimental Details

AR grade of Polyacrylamide (PAA) is used in the present study with a molecular weight of 5,000,000 g/mol. 5 gm of PAA were dissolved in 500 ml of distilled water to get a PAA solution of 1%. Na_2HPO_4/K_2HPO_4 (1N) salt solution is mixed in a solution PAA in different concentration. PAA is added with phosphate solution in different concentration like 10:90, 20:80, 30:70… and ultrasonic parameters were studied. The total volume of a solution should be maintained as 100 ml. For density measurements, the liquid mixtures were taken in a 10 ml gravity bottle (Borosil). The bottle was immersed in a water bath. In order to obtain a constant temperature, the specific gravity bottle was kept inside the water bath for about 30 minutes. Finally, the densities of the pure liquids and liquid mixtures we measured using an electronic balance. The results of the densities are accurate to ± 0.5%. Ultrasonic interferometer of fixed frequency (2MHz) was used for measuring ultrasonic velocity. (F-81, Mittel Enter Prices, New Delhi). Density and ultrasonic velocity were measured for the different concentration of the mixed solution at 303K. Different acoustic parameters like adiabatic compressibility, acoustic impedance, intermolecular free length and surface tension were calculated at different concentration at 303K temperatures.

3. Results

The ultrasonic velocity and density of Di Sodium Hydro Phosphate and Di Potassium Hydro Phosphate aqueous in Polyacrylamide solution were measured for varying concentrations at 303K and it is given in Table 1 & 2. The variation of ultrasonic velocity in a solution depends on the intermolecular free length. The increase in ultrasonic velocity decreases the free length as vice-versa. Intermolecular free length is a predominant factor, as it determines the same velocity in a fluid state. Presence of the ion alters the intermolecular free length. Therefore, ultrasonic velocity of a solution will be different from that of solvent. Fig.1 shows the variation density with concentration of Di Sodium Hydro Phosphate and Di Potassium Hydro Phosphate aqueous in Polyacrylamide solution. The density of a solution is found to increase with increase in concentration of sodium hydro phosphate and potassium hydro phosphate and it is found to be maximum at 90:10. This may be interpreted to the structure of the solvent due to the added solute. In the lower region of density, the linear change of velocity indicates the miscibility of the solution. The density data shows that, the interaction between ion-solvent is maximum at 90:10.

Density increases with increase in concentration of potassium salts in Polyacrylamide solution, due to the presence of ions or particles. The variations in density with increase in concentration are shown in Tables 1-2. When an ion is added, it attracts certain solvent molecules towards itself by wrenching the molecular from bulk compressibility of a solvent is higher than that of a solution and it decreases with the increase in concentration of the solution.

Adiabatic compressibility is inversely proportional to the square of the ultrasonic velocity. The deviation in adiabatic compressibility can be explained by taking by taking into consideration of the following factor.

1. Loss of di-polar association and difference in size and shape of the component molecules which leads to decrease in velocity and increase in compressibility.

2. Dipole-dipole interaction or hydrogen bonded complex formation between unlike molecules which lead to increase in sound velocity and decrease of compressibility.

The actual deviation depends on the resultant effect. The observed decrease/increase in adiabatic compressibility, intermolecular free length, acoustic impedance and relative association with composition is an evidence of significant interaction between the component molecules in the binary mixtures.

The compressibility data indicate an ordering interaction leading to the formation of ionic complex in the mixture. The complex formation in an ionic system is due to ionic association. In this study, the adiabatic compressibility decreases with the increase in concentration. It means when the phosphate salt solution is added with polyacrylamide solution, ion-solvent interaction increases [4, 10].

Table-1

Experimental values of ultrasonic velocity, density, compressibility, acoustic impedance, intermolecular free length, surface tension of Na_2HPO_4 mixed solution in PAA

Concentration NAHP:PAA	Velocity (U) m/s	Density (ρ) m/s^2	Viscosity (η) N/m^2	Adiabatic compressibility (β_{ad})	Free length (L) $x10^{-10}m$	Acoustic Impedance (Z) $x10^6m$
100:0	1580.40	1066.44	1.1408	3.7543	0.3875	1.6854
90:10	1572.11	1062.04	1.4325	3.8097	0.3903	1.6696
80:20	1569.74	1057.63	1.8201	3.8371	0.3917	1.6602
70:30	1563.92	1051.02	2.4931	3.8901	0.3944	1.6436
60:40	1560.71	1044.05	3.4963	3.9322	0.3965	1.6294
50:50	1545.88	1038.54	4.2990	4.0292	0.4014	1.6054
40:60	1543.66	1031.20	6.1392	4.0696	0.4034	1.5918
30:70	1538.75	1026.43	9.5959	4.1146	0.4056	1.5794
20:80	1522.18	1020.58	11.463	4.1728	0.4078	1.5541
10:90	1514.13	1015.23	13.587	4.2369	0.4122	1.5356
0:100	1508.37	1007.34	16.258	4.3632	0.4177	1.5194

Table-2

Experimental values of ultrasonic velocity, density, compressibility, acoustic impedance, intermolecular free length, surface tension of K_2HPO_4 mixed solution in PAA

Concentration KHP:PAA	Velocity (U) m/s	Density (ρ) m/s^2	Viscosity (η) N/m^2	Adiabatic compressibility (β_{ad})	Free length (L) $x10^{-10}m$	Acoustic Impedance (Z) $x10^6m$
10:90	1522.53	1877.01	0.1650	2.2982	0.3031	2.8578
20:80	1531.76	1885.46	0.0510	2.2604	0.3006	2.8880
30:70	1545.15	1891.70	0.0293	2.2141	0.2975	2.9229
40:60	1546.91	1898.31	0.0197	2.2014	0.2967	2.9364
50:50	1549.43	1903.45	0.0138	2.1884	0.2958	2.9492
60:40	1564.87	1909.32	0.0087	2.1387	0.2924	2.9878
70:30	1567.25	1912.99	0.0002	2.1281	0.2917	3.0073
80:20	1577.78	1918.86	0.0040	2.0934	0.2893	3.0275
90:10	1582.82	1928.41	0.0029	2.0698	0.2877	3.0522
100:0	1588.12	1934.65	2.2490	2.0494	0.2863	3.0724

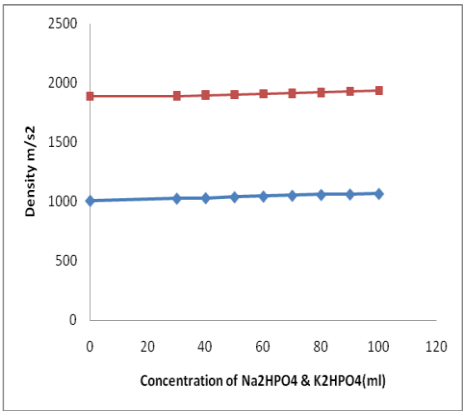

Fig.1. Variation of density of Na_2HPO_4 & K_2HPO_4 in PAA solution

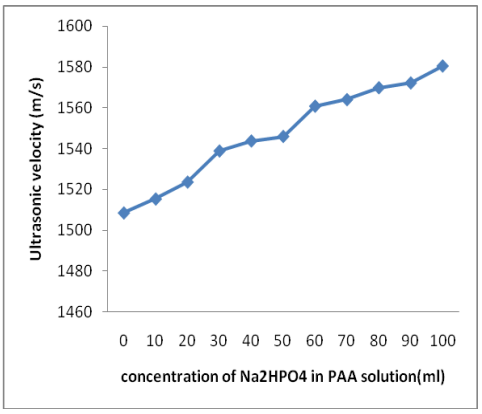

Fig.2 Variation of ultrasonic velocity of Na_2HPO_4 in PAA solution

Ultrasonic velocity varies in accordance with molecular interactions in solutions. Fig. 2 & Fig. 3 shows the variation of velocity with concentration of Di Sodium Hydro Phasphate and Di Potassium Hydro Phosphate aqueous in Polyacrylamide solution. As the free length decreases due to increase in concentration, the velocity has to increase and vice versa. Ultrasonic velocity varies linearly with composition of a binary mixture in compatible blends, it is shown in graph as straight line, but the ultrasonic velocity of incompatible systems is of type ‘‘S’’; and the plotted ultrasonic velocity of semi compatible systems falls between a straight line and S-curve. It is seen that the ultrasonic velocity increases with the increase in the concentration of sodium hydro phosphate and potassium hydro phosphate salts solution in polyacrylamide solution.

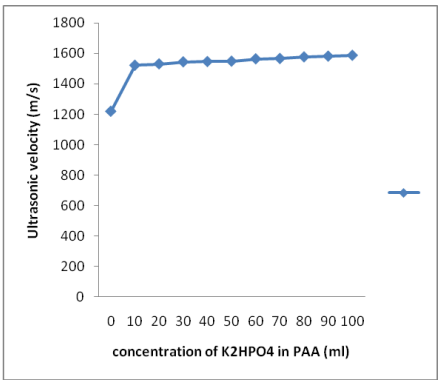

Fig.3. Variation of ultrasonic velocity of K_2HPO_4 in PAA solution.

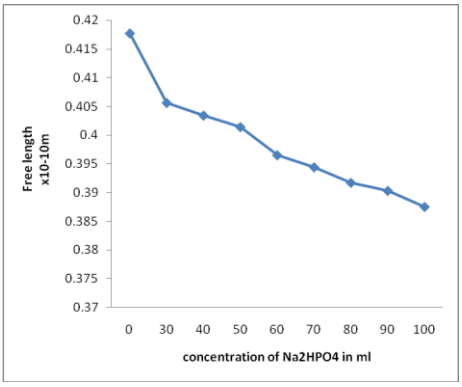

Fig.4 Variation of free length of Na_2HPO_4 in PAA solution

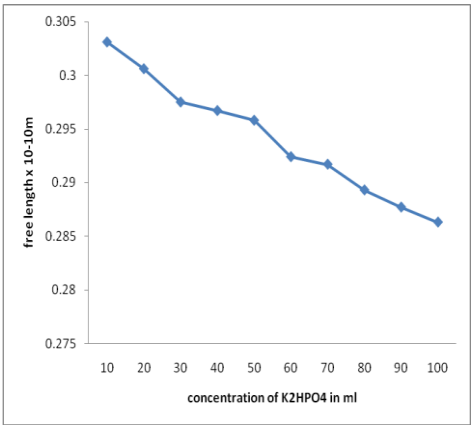

Fig.5 Variation of free-length of K_2HPO_4 in PAA solution solution

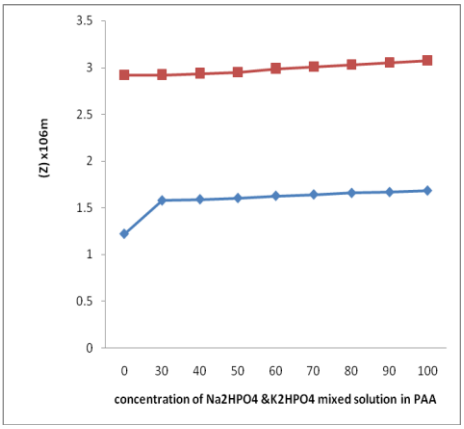

Fig.6 Variation of acoustic impedance of Na2HPO4 & K_2HPO_4 in PAA

The increase in velocity with concentrations suggests the increase in cohesive forces due to polymer-solvent interactions. In this present system, the velocity increases with the increase in concentration, while at 50:50 concentration, the changes of velocity is very less in both the system. The abrupt variation of velocity indicates the formation of complex. Increase in concentration leads to decrease in gap between two species and it is referred as intermolecular free length. It is inverse behavior to the velocity. The variations in velocity/free length were due to the structural changes. Variation in ultrasonic velocity in any solution generally indicates molecular association in it. This is due to the interaction between solute solvent molecules. Interaction is weaker at minimum velocity [11-13].

Adiabatic compressibility (β_{ad}) of the solution was calculated using the formula:

$$(\beta_{ad})=1/(U^2\rho)- \quad (1)$$

Where U is the ultrasonic velocity and ρ is the density of the solution. The variation of adiabatic compressibility with the concentration for the two systems is shown in Table 1-2. From the data, it is observed that adiabatic compressibility varies linearly with the concentration of solution. The variation of adiabatic compressibility of Di Sodium Hydro Phasphate and Di Potassium Hydro Phosphate with polyacrylamide solution is shown in Table1- 2. In this present study, adiabatic compressibility is decreases with increase in concentration of the salts which may be due to departure of solvent molecules around the ions. The compressibility data indicates an ordering of interaction leading to the formation of ionic complex. The complex formation in an ionic system is due to ionic association in the solution. In this case, the minimum compressibility indicates the enhancement of bond strength and maximum compressibility indicates the poor bond strength of the molecule. This data indicates an interaction leading to the formation of complexes [14-15].

Viscosity of a solution is a measure of cohesiveness or rigidity present in between the ions or ion-solvent or solvent-solvent molecules present in a solution. Viscosity measurements ideally would yield information on the association and conformation of the complex formation of mixtures. Density and viscosity of any solution is directly related to each other. Viscosity is calculated by using the formula and it is related to normal forces in the liquids.

Viscosity $(\eta) = \eta_w \rho t/\rho_w t_w$ N S m^{-2} ---------- (2)

Where η_w, ρ_w and t_w are respectively the viscosity, density and time of water and ρ

and t is respectively the density and time of flow of mixture. Viscosity is measured for a mixed salt solution at different concentration. It is generally assumed that the value of viscosity can be used as an experimental criterion of the solvent power [16]. The great viscosity implies that the polymer–solvent interaction, though strong, should decrease naturally with the intensifying of the polymer–solvent interaction. The linear variation is observed in the mixed solution of Na_2HPO_4- - PAA solution and nonlinear variations are observed in K_2HPO_4 –PAA solution and It shows a minimum at a concentration of 70:30, indicates the weakening of intermolecular interaction between the component molecules [17].

Intermolecular free length

$$(L_f) = k\,(\beta_{ad})^{1/2}\ \text{m} \quad (3)$$

Where K is the Jocobson's constant. The intermolecular free length depends upon the adiabatic compressibility and shows a similar to that of compressibility and inverse to the velocity of mixtures. The behavior of intermolecular free length of a molecule is an inverse behavior of sound propagation. Variation of free length of mixed solution is shown in Fig.4 and

Fig.5. An increase in intermolecular free length produces a decrease in ultrasonic velocity. Here, on increasing the concentration of Na_2HPO_4 & $KHPO_4$ mixed solution in PAA, the free length value decreases with increase in velocity. It indicates the interaction between the solute and solvent molecules due to which the structural arrangement is considerably changed. The decrease of molecular free length with concentration indicates that the structural readjustment in the liquid mixture and it suggests the presence of strong solute-solvent interactions with a less compressible phase or closer packing molecules. The free length increases due to expansion, which indicates the looser packing of the molecule. Decrease in free length is due to compression of liquid which indicates that the molecules are coming closer to each other and hence a strong molecular association occurs in the mixtures [18-20]. The reaction between the solvent with polyacrylamide is further supported by a decrease in intermolecular length that varied with concentration. This can be explained in terms of polymer electrostative effects on its surrounding molecules of solvent.

Acoustic impedance (Z) was calculated using the formula:

$$(Z) = (U\rho) \tag{4}$$

The variation of acoustic impedance with concentration is shown in Fig.6. Acoustic impedance is almost reciprocal of adiabatic compressibility. In this present study, it is observed that these acoustic impedance (Z) value increase with increase in concentration of Na_2HPO_4 & $KHPO_4$ in polyacrylamide solution. The linear variation of acoustic impedance with concentration confirms the presence of molecular association between the solute-solvent molecules. Such in increasing trends of acoustic impedance further support the possibility of molecular interaction between the solute-solvent molecules [21-22].

4. Discussion

Ultrasonic measurement was used to indicate the compatibility of both solid and dissolved blends. This method was applied in a number of solid and dissolved polymer blends having molecular weights ranging from high to low. Ultrasonic velocity varies linearly with composition in compatible blends. From the results, it concluded that, Na_2HPO_4 & K_2HPO_4 mixed solution in polyacrylamide solution is compatible mixtures.

The linear changes in viscosity of the mixture with polyacrylamide solutions are found by structural changes in polymer solution due to the Polymer chain entanglements. Polymer chain entanglement affects the viscosity of the solution. Linear variations of adiabatic compressibility with concentration indicating the solute-solvent interactions & no abrupt change occurred at any concentrations. The increase in velocity and decrease in compressibility with concentration indicates the changes in intermolecular forces around the solute and

solvent molecules, which is affecting its structural arrangement. In this investigation, it was observed that the intermolecular free length decreases with increase in concentration due to the formation of hydrogen bonds between solute and solvent molecules. It shows a strong interaction between the solute and the solvents. It may be due to penetration of K^+ (or) PO_4 (or) Na ion in polymer matrix. Also, it may be due to dipole-dipole interactions/O-H bonding/ C=O bonding. The changes in molecular free length is also support this effect. This effect is expressed in terms of electrostative effects of polymer solution on its surrounding molecules of solvent. As a result, a strong interaction between polymers and solvent molecules may exist. Acoustic impedance is also evident for solute–solvent interactions.

5. Computation of Ultrasonic Velocity-Theoretical Equation

5.1. Nomoto's Relation [23]

Nomoto established an empirical formula for ultrasonic velocity in binary liquid mixtures as

$$U_{No} = \Sigma x_i R_i / \Sigma x_i V_m \tag{5}$$

where R is the molar sound velocity and V_m is molar volume.

5.2 . Free Length Theory (U_{FLT}) [24]

Jacobson introduced the concept of détermination of ultrasonic velocity in pure liquids and liquid mixtures known as free length theory (FLT). Further, He relate the ultrasonic velocity in pure liquid mixtures to the free length (L_f) by the relation,

$$\mathrm{UFLT} = \frac{K_T}{L_{fmix}\ \rho^{1/2}}\ \mathrm{m/s} \tag{6}$$

5.3 Impedance Dependent Relation (U_{IDR}) [25]

The impedance offered by a liquid to the propagation of ultrasonic wave is given by $Z_i = \rho_i U_i$. For a liquid mixture, the following empirical relation is

$$U = \Sigma x_i Z_i / \Sigma x_i \rho_i \ m/s \tag{7}$$

Theoretical data on ultrasonic velocity of Di Sodium Hydro Phosphate and Di Potassium Hydro Phosphate in polyacrylamide solution are shown in Table 3-4 at 303K. The variations of ultrasonic velocity were found increased with concentration. This is due to the interaction between solute solvent molecules. Interaction is weaker at minimum velocity. The predictive abilities of various ultrasonic theories depend upon the strength of interaction prevailing in a system.

Table:-3

Comparison of Experimental and Theoretical Velocities of Di Sodium Hydro Phosphate in polyacrylamide solution at 303K

Concentration of Na_2HPO_4 in PAA,	**Experimental Ultrasonic Velocity (U) (m/s)**	**Theoretical values of Ultrasonic velocity (U) (m/s)**		
		Nomoto's relation	**Impedance Relation**	**Free length Theory**
0:100	1508.37	1508.32	1508.12	1508.22
10:90	1514.13	1514.09	1513.85	1514.19
20:80	1522.18	1521.12	1522.02	1522.23
30:70	1538.75	1537.33	1537.21	1537.22
40:60	1543.66	1543.66	1543.24	1543.58
50:50	1545.88	1545.72	1545.18	1545.66
60:40	1560.71	1560.71	1560.22	1560.31
70:30	1563.92	1563.88	1563.56	1563.41
80:20	1569.74	1569.69	1569.58	1569.62
90:10	1572.11	1572.11	1572.02	1572.14
100:0	1580.40	1580.12	1580.62	1580.33

Table:-4

Comparison of Experimental and Theoretical Velocities of Di Potassium Hydro Phosphate with polyacrylamide solution at 303K

Concentration of K_2HPO_4 in PAA,	**Experimental Ultrasonic Velocity (U) (m/s)**	**Theoretical values of Ultrasonic velocity (U) (m/s)**		
		Nomoto's relation	**Impedance Relation**	**Free length Theory**
10:90	1522.53	1522.43	1521.85	1522.51
20:80	1531.76	1531.66	1532.36	1531.72
30:70	1545.15	1545.11	1545.77	1545.15
40:60	1546.91	1546.79	1546.79	1546.93
50:50	1549.43	1549.41	1549.21	1549.41
60:40	1564.87	1564.66	1564.87	1564.87
70:30	1567.25	1567.22	1567.22	1567.25
80:20	1577.78	1577.78	1577.69	1577.76
90:10	1582.82	1582.81	1582.82	1582.80
100:0	1588.12	1588.11	1588.12	1588.10

Theoretical data on ultrasonic velocity of Di Sodium Hydro Phosphate & Di Potassium Hydro Phosphate in polyacrylamide solution were calculated using the Nomoto's Relation, Free length Theory and Impedance Dependent Relation (U_{IDR}) at 303K and it is given in Tables-3 and 4. The variations of ultrasonic

velocity were found increased with concentration as experimental values. When two liquids are mixed together, the interaction between the molecules of the two liquids takes place because of the presence of various forces like dispersive force, charge transfer, hydrogen bonding dipole-dipole and dipole-induced dipole interactions. Hence the observed variations show that the molecular interaction is taking place between the molecules in the liquid mixture. Similar kinds of results were obtained by earlier workers. This suggests the existence of strong tendency for the association between component molecules [26-29].

6. Nonlinearity parameter (B/A) of Di Potassium Hydro Phosphate with polyacrylamide mixed solution calculated by Hartmann and Ballou relation solution at 303K

In the last few years [30], a number of theoretical methods have been proposed for estimating the non-linearity parameter (B/A) for pure liquids and liquid mixtures. This parameter has been further correlated with other thermo acoustical parameters. Due to the increasing importance of B/A during recent years, an attempt has been made to evaluate B/A of binary mixtures using Hartmann relation and Ballou empirical relation. Calculated density and ultrasonic velocity data are used to evaluate non-linearity parameter for the different binary systems. A comparative study of B/A values obtained from these relations has also been made in order to review the above-mentioned approaches. Furthermore, the results are discussed in terms of the existence of correlation of molecular orientations between the molecules in binary mixtures.

General formulation for non-linearity parameter in terms of the acoustical parameters of liquids has been made using the experiment for the sound velocity (U) and introducing the contribution due to acoustic parameters (K) and isothermal acoustic parameter (K"). The expression for B/A has been expressed as,

$$B/A = 2K+2\gamma K"$$

Computations of K and K" require only the knowledge of thermal expansion coefficient, α. Detailed method of calculation is given.

Hartmann and Balizer obtained the following relation for B/A;

$$B/A = 2+\frac{0.98\times10^4}{U} \quad \textit{Where U is in } ms^{-1} \tag{8}$$

Empirical relation proposed by Ballou is given [31] by

$$B/A = -0.5+\frac{1.2\times10^4}{U} \tag{9}$$

Table:-5

Computation of non-linearity (B/A) parameter of Di Sodium Hydro Phosphate aqueous in Polyacrylamide solution at 303K

Concentration of Na_2HPO_4 in PAA	Experimental velocity (U) (m/s)	(B/A) Non linear parameter calculated by Hartmann and Balizer method	(B/A) Non linear parameter calculated by Ballou Empirical relation
0:100	1508.37	8.4970	7.4556
10:90	1514.13	8.4723	7.4253
20:80	1522.18	8.4381	7.3834
30:70	1538.75	8.3688	7.2985
40:60	1543.66	8.3485	7.2737
50:50	1545.88	8.3394	7.2625
60:40	1560.71	8.2792	7.1888
70:30	1563.92	8.2663	7.1730
80:20	1569.74	8.2431	7.1445
90:10	1572.11	8.2336	7.1331
100:0	1580.40	8.2009	7.0930

Table:-6

Computation of non-linearity (B/A) parameter of Di Pottasium Hydro Phosphate aqueous in Polyacrylamide solution at 303K

Concentration of K_2HPO_4 in PAA	From experimental velocity (U) (m/s)	(B/A) Non linear parameter calculated by Hartmann and Balizer method	(B/A) Non linear parameter calculated by Ballou Empirical relation
10:90	1522.53	8.4366	7.3816
20:80	1531.76	8.3979	7.3341
30:70	1545.15	8.3424	7.2662
40:60	1546.91	8.3352	7.2574
50:50	1549.43	8.3249	7.2447
60:40	1564.87	8.2625	7.1684
70:30	1567.25	8.2529	7.1567
80:20	1577.78	8.2112	7.1056
90:10	1582.82	8.1915	7.0814
100:0	1588.12	8.1708	7.0561
10:90	1522.53	8.4366	7.3816

Table 5 & 6 shows the variations of the B/A values calculated from Hartmann and Balizer method and Ballou empirical relation and it shows decreased trend with increase in concentration. This data of velocity and densities were taken for computing the various quantities employed in the equation for B/A. The B/A values for the liquids/liquid mixtures have been interpreted as the quantity representing the magnitude of the hardness of liquids. A close examination of data presented in Tables 5-6 reveals that the values of B/A

calculated using (8) and (9) shows a decreasing trend with concentration of Na_2HPO_4 & K_2 HPO_4 salt in Polyacrylamide solution. It is evident from eq.(4) and (5), that Ballous and Hartmann relations depend mainly on the ultrasonic velocity. The interaction between the components of the binary mixtures is stronger at higher concentration, while it is weaker at lower concentration of a mixtures and the accuracy of both the methods limits the usefulness of direct application of these methods to liquid mixture investigation [32-34].

7. Conclusion

In this study, the measurement of ultrasonic velocity and other acoustical parameters of Di Sodium Hydro Phosphate & Di Pottasium Hydro Phosphate salt solution in polyacrylamide solution were studied in different concentrations at 303K. The experimental ultrasonic velocity data and other acoustical parameters contain valuable information regarding the solute-solvent interactions in the aqueous solution. It can be concluded that the concentration of the phosphate affects the dipole interaction, viscosity and other acoustical parameters of the solution. The concentration & nature of solvent, solute and substituent of a solution plays an important role in determining the interactions. Also, it concluded that, Ultrasonic velocities predicted using NOM, IMP and FLT were compared with experimentally measured velocity values at 303K. It may be concluded that both the relation is best suited and also confirmed the interactions between the solute and solvent molecules by experimental values. Further study may give more details about complex ion formation. On the basis of the measurement of non linear parameter, it can be concluded that the variation of computed values of B/A will depends on the ultrasonic sound wave in a given medium which helps in the interpretation of the magnitude of the hardness of the liquid in terms of the non-linearity parameter.

Acknowledgment

Author is grateful to the DST- FIST Lab, Sathyabama Institute of Science and Technology, Chennai, India, for providing the facilities. (Ref: No.SR/FST/PSI-193/2014 dated 23-07-2014.

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