Acta Scientific Applied Physics

Volume 3 Issue 5 May 2023

Research Article

A Volumetric and Acoustical Study to Explore Interaction between Acetamide and Electrolyte solution

Chaitalee R Dange*, Urvashi P Manik and Paritosh L Mishra

PGT, Department of Physics, Sardar Patel Mahavidyalaya, Maharashtra, India

***Corresponding Author:** Chaitalee R Dange, PGT, Department of Physics, Sardar Patel Mahavidyalaya, Maharashtra, India.

Received: April 13, 2023

Published: April 29, 2023

Abstract

The ultrasonic velocity(U) and density (ρ) of ternary mixture of Acetamide and water in electrolyte sodium chloride at frequency 2MHz have been calculated at temperature (283.15K, 288.15K, 293.15K and 298.15K). In additionally, the present paper also consists of a discussion on numerous thermodynamic parameters which have been figure out using theoretical equations to study the strength and nature of intermolecular interaction in the liquid mixture compound. From conclusion it is observed, in this ultrasonic measurement corresponds with molecular interaction in a liquid mixture, the examination of inseminate of ultrasonic waves producing in liquids and liquid mixtures in highly convenient for investigating the nature of molecular interactions in a structure of chemical systems. The non-linear difference is observed in acoustic parameters of electrolyte sodium chloride solutions specifying the constitution of complex ions.

Keywords: Ultrasonic Velocity; Density; Acetamide; Sodium Chloride; Molecular Interaction; Liquid Mixture; Temperature

Introduction

The volumetric and acoustical analysis of liquid have an important role in recognizing the nature and strength of molecule interaction, and describe numerous properties of liquids and solution [1]. The calculation of ultrasonic velocity in pure liquids and mixture is a main implement to study the physicochemical properties [2]. This technique has also been used in agriculture, medicine and industrial process to pharmaceutical inquiry. Research of the ultrasonic wave in pure and liquid mixtures is helpful to study the nature of intermolecular interaction showed in these liquids. In a recent development in science and technology, the thermodynamic studies of binary liquid mixtures have impacted much attention of scientists [3].

The examination of acetamide is essential because of its implementation in industry and medicine. Acetamide is one type of drug, it is deeply dissolved in mixture of polar and non-polar liquids therefore, it is easily acceptable to explore solvent-solvent interactions [1]. It is utilized as a solvent in the production of lacquers, plasticizers, pharmaceuticals, antibiotics and polymeric product. Human body needs a lots of minerals knowns as essential minerals (like Na, K, Fe…) sodium chloride is finest called as table salt and, used commonly in food production for flavoring and preservation and exceedingly large sodium chloride are used in many industrial operation. NaCl maintain the blood pressure and balance the fluids it's also use in skin, hair and body treatment.

In order to understanding the molecular interaction among component molecules of an experiment has been done to investigation the ultrasonic behavior of acetamide and electrolyte solution at various temperatures. In the recent paper, we have computed ultrasonic velocity and other parameters of pure liquids and its mixture at 2MHz frequency at different concentration and temperature.

Material and Method

The chemical Acetamide used in the work were analytical reagent (AR) with 99% purity (CAS No 60 -35 -5) (molecular weight.

59.07 g/mol) used as a solvent and water with (molecular weight. 18.01528 g/mol) and electrolyte sodium chloride solution (CAS No. 7647 -14 -5) (molecular weight. 58.44 g/mol).

The mixture of different concentration in distilled water were prepared, and the weight of substance were measured by operating digital weighing machine The ultrasonic velocity is measured using an analog ultrasonic interferometer (Mittal Enterprises, New Delhi) operating at frequency 2 MHz with a high degree of accuracy. It is consisting of ultrasonic cell is a double walled brass cell including chromium plated surface having capacity of 10ml and frequency is produced by a quartz crystal that held at bottom of the cell.

The ultrasonic velocity and density of the liquid and their mixture were measured at the temperature (283.15K, 288.15K, 293.15K and 298.15K) is keep constant through digital thermostat. The electrically controlled constant temperature water bath is used to circulate flow of water thorough the measuring cell which is double walled made up of steel containing the experimental liquid mixture. The density of solution was properly determined with the help of 10 ml gravity density bottle.

Defining relation

Internal Pressure (πi): Internal Pressure is depending on temperature, concentration and external pressure in case of the solution, and it is important parameter to examine nature of molecular interaction in liquid [4]

$$\pi_i = \left\{\frac{T*\alpha}{K_T}\right\}$$

Relative association (RA): Relative association has two important factor that is: break down of the associated solvent molecule on adding up of solute molecule [5]

$$RA = \left\{\left(\frac{\rho}{\rho_0}\right)\left(\frac{U}{U_0}\right)^{\frac{1}{3}}\right\}$$

Adiabatic Compressibility (Adiabatic compressibility (β) is consequence by the ultrasonic velocity and the density (ρ), and it is determining the frictional change in volume with respect to increase of pressure [6]

$$\beta = \left\{\frac{1}{U^2\rho}\right\}$$

Change in Adiabatic Compressibility (: following equation determine the change in adiabatic compressibility [7]

$$\Delta\beta = \beta - \beta_0$$

Isothermal Compressibility (K_T): The isothermal compressibility can be calculated by using MeGowan's expression [8]

$$K_T == \left\{1.33 * 10^{-8}/(6.4 * 10^{-4}U^{1/3}\rho)^{3/2}\right\}$$

Specific Heat Ratio (ɣ): The specific heat ratio is the specified relation between Isothermal compressibility and Adiabatic compressibility is determine by following method [5]

$$\gamma = \left\{\frac{17.1}{T^{\frac{4}{9}} * \rho^{1/3}}\right\}$$

Acoustic Impedance (Z): This indicates that how much sound pressure is produced by the vibration of molecules of a specific acoustic medium at a given frequency and it is a term useful in discussing the relation between density and velocity [9]

$$Z = \{U\rho\}$$

Relaxation strength(r): Relaxation strength is straightly connected with adiabatic compressibility the relation is as follow [10],

$$(r) = \left\{1 - \left(\frac{U}{U_\infty}\right)^2\right\}$$

Available volume (V_a): Available volume is the straight measurement of compactness and strength of binding the molecule of liquid mixture, and it can be calculated through ultrasonic velocity is [11]

$$Va = \left\{Vm\left[1 - \frac{U}{U_\infty}\right]\right\}$$

Surface tension (σ): Surface tension is established as interfacial tension it's a major property of liquid and it is the force appearing at the surface of a liquid, tending to minimize the surface area [12]

$$\sigma = \left\{(6.3 * 10^{-4})\rho U^{\frac{3}{2}}\right\}$$

Result and Discussion

The experimental data of velocity U, density at temperature (283.15K, 288.15K, 293.15K and 298.15K) presented in table 1. Calculated value of Internal Pressure (πi), Relative association (RA), Adiabatic Compressibility (, Change in adiabatic compressibility Isothermal Compressibility K_T, Specific Heat Ratio ɣ, Acoustic Impedance Z, Relaxation strength r, Available volume V_a and Surface tension σ are recorded in Table 1-4. The variation of all of this parameter with concentration of distilled water and NaCl with the acetamide which is shown in figure 1-12.

In the present work, we can see the variation in ultrasonic velocity and density in the acetamide in distilled water and in electrolyte sodium chloride and distilled water at different temperature and concentration. Figure 1 Shows that the velocity is increase with the increase in concentration and temperature, and however the ultrasonic velocity is higher in acetamide with NaCl + distilled water solution than in distilled water. The ultrasonic velocity increases in any solution usually indicates an association is greater in the molecules, greater association may be causses by circumstance like hydrogen bonding or ionic-hydration of the solutes [2]. The density of mixture of acetamide in solution of water and electrolyte Nacl increases with increase in concentration and decreases with increase of temperature which is shown in figure 2. while the temperature increases the mobility of ions increases therefore density decreases [13].

It is observed from figure 3 that the internal pressure is increase with the increase in the temperature and concentration, this is due to the association through hydrogen-bonding at molarity of concentration. Internal pressure of acetamide in sodium chloride is consciousness the nature of interaction, internal structure and behavior [14].

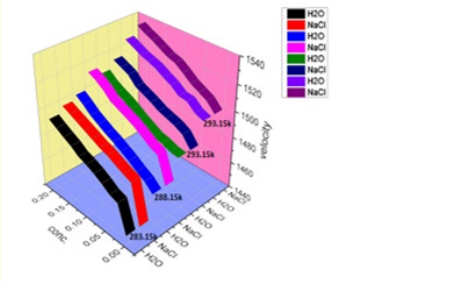

Figure 1: Ultrasonic velocity at different concentration and temperature.

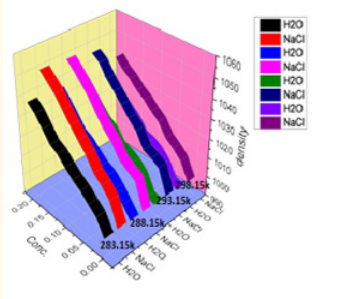

Figure 2: Density at different concentration and temperature.

Conc.	Velocity(U) (m/s)		Density ((Kg/m^3)		Internal Pressure ()(Nm^{-2})	
	H_2O	NaCl	H_2O	NaCl	H_2O	NaCl
283.15k						
0.00	1447.427	1447.427	999.7000	999.7000	4.72E+09	4.72E+09
0.02	1468.270	1477.241	1007.369	1011.004	4.90E+09	4.97E+09
0.04	1470.344	1479.616	1010.843	1015.563	4.93E+09	5.02E+09
0.06	1474.482	1482.517	1014.486	1019.115	4.98E+09	5.06E+09
0.08	1477.931	1485.537	1017.011	1025.425	5.02E+09	5.13E+09
0.10	1480.689	1487.586	1020.545	1029.877	5.06E+09	5.17E+09
0.12	1482.750	1490.345	1024.449	1034.622	5.10E+09	5.22E+09
0.14	1486.896	1493.103	1026.449	1039.661	5.10E+09	5.27E+09
0.16	1489.868	1495.892	1031.661	1044.803	5.20E+09	5.33E+09
0.18	1493.103	1498.620	1036.710	1048.326	5.25E+09	5.37E+09
0.20	1496.551	1501.379	1039.960	1052.003	5.30E+09	5.42E+09
288.15k						
0.00	1466.032	1466.032	999.1030	999.1030	4.85E+09	4.91E+09
0.02	1471.724	1485.517	1004.312	1012.140	4.97E+09	5.11E+09
0.04	1475.172	1488.275	1009.432	1014.423	5.03E+09	5.14E+09
0.06	1479.310	1492.409	1013.405	1017.084	5.08E+09	5.19E+09

0.08	1482.758	1496.409	1015.239	1023.379	5.12E+09	5.26E+09
0.10	1486.206	1499.310	1018.566	1027.206	5.16E+09	5.30E+09
0.12	1488.965	1502.068	1022.197	1032.475	5.20E+09	5.36E+09
0.14	1492.413	1504.827	1024.197	1038.415	5.24E+09	5.42E+09
0.16	1495.861	1510.344	1029.378	1042.902	5.30E+09	5.49E+09
0.18	1500.689	1514.482	1034.221	1047.245	5.36E+09	5.55E+09
0.20	1504.827	1517.241	1038.547	1050.910	5.42E+09	5.59E+09
293.15k						
0.00	1481.496	1481.496	998.2000	998.2000	5.06E+09	5.06E+09
0.02	1482.344	1489.655	999.2360	1010.225	5.08E+09	5.2E+09
0.04	1484.758	1493.103	1007.689	1012.723	5.15E+09	5.24E+09
0.06	1486.206	1495.172	1011.395	1014.395	5.19E+09	5.27E+09
0.08	1489.655	1497.241	1013.821	1021.821	5.23E+09	5.33E+09
0.10	1493.103	1500.689	1015.236	1025.725	5.26E+09	5.38E+09
0.12	1497.241	1503.448	1020.609	1030.609	5.32E+09	5.44E+09
0.14	1500.689	1506.206	1023.071	1035.071	5.36E+09	5.49E+09
0.16	1503.448	1512.413	1027.507	1039.507	5.41E+09	5.56E+09
0.18	1506.896	1515.172	1032.487	1045.487	5.47E+09	5.63E+09
0.20	1511.724	1517.930	1037.158	1048.158	5.54E+09	5.66E+09
298.15 k						
0.00	1498.101	1498.101	997.0000	997.0000	5.23E+09	5.23E+09
0.02	1500.689	1504.742	998.3960	1005.772	5.26E+09	5.34E+09
0.04	1506.137	1508.137	1005.275	1009.799	5.34E+09	5.39E+09
0.06	1506.896	1511.551	1009.628	1012.972	5.38E+09	5.44E+09
0.08	1511.724	1516.520	1011.989	1019.244	5.43E+09	5.52E+09
0.10	1514.861	1520.982	1013.187	1022.363	5.46E+09	5.57E+09
0.12	1518.620	1522.930	1018.503	1026.312	5.52E+09	5.61E+09
0.14	1520.896	1526.344	1021.929	1029.047	5.56E+09	5.66E+09
0.16	1523.034	1529.793	1025.882	1033.084	5.61E+09	5.71E+09
0.18	1526.280	1532.550	1029.882	1035.881	5.66E+09	5.75E+09
0.20	1529.280	1536.008	1033.749	1040.186	5.71E+09	5.81E+09

Table 1: The values of ultrasonic velocity, Density and internal pressure at temperature 283.15K, 288.15K, 293.15K and 298.15K.

In relative association two factors are most important: 1. Disintegration of the solvent molecules on the adding of solute molecule in it, and 2. molecule of acetamide present in the solute. Relative association of different temperature and concentration is suggested that the relative association increase with the increase in concentration and temperature which is shown in figure 4, this is due to the salvation of sodium chloride and water molecule in acetamide which is also show the molecular association present in between solute and solvent [15].

The values of adiabatic compressibility in all system of water and sodium chloride show a decreasing trend, we can see that the values are decreasing with the concentration as well as with temperature shows in figure 5. Adiabatic compressibility's values is greater in water as compare to the sodium chloride this indicates that the molecular association is higher in water molecules, greater the electrostriction compression of water near the molecules results in a greater reduction in the compressibility of the com-

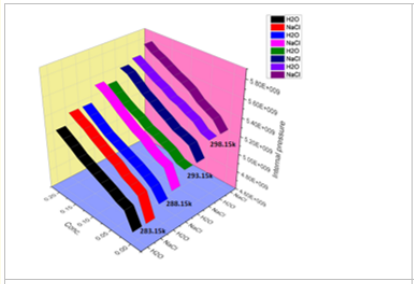

Figure 3: Internal pressure at different concentration and temperature.

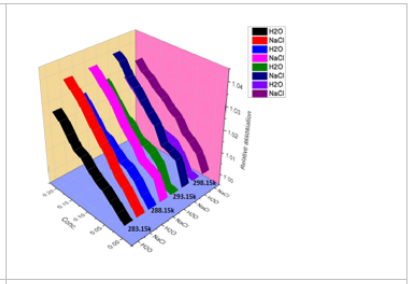

Figure 4: Relative association different concentration and temperature.

pound solutions. Figure 6 be seen the values of change in adiabatic compressibility (Δβ) of acetamide in electrolyte sodium chloride and distilled water solution at different temperatures, the negative values of change in adiabatic compressibility increases with increasing concentration of the solute but slightly decrease with increase in temperature. This is happened due to the disputation which seems that ideal systems caused by solute-solvent interactions [16].

Figure 7 shows the value of isothermal compressibility (K_{T1}) is decreasing beside increase in concentration of acetamide in water as well as in electrolyte sodium chloride, and also decreases with the increase in temperature. acetamide is dissolved in electrolyte of NaCl and water, a few of the neighboring molecules are tightly attach to the ions by causes of the electrostatics field of ions the ionic field the solvent molecules are oriented [17].

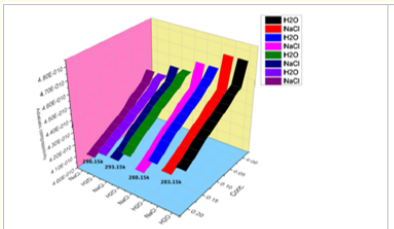

Figure 5: Adiabatic compressibility at different concentration and temperature.

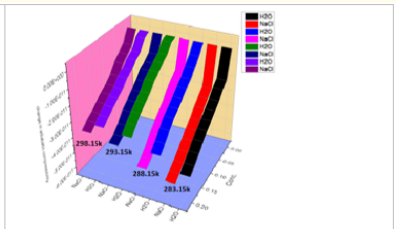

Figure 6: Change in adiabatic compressibility different concentration and temperature.

Conc.	Relative Association (RA)		Adiabatic Compressibility (m^2N^{-1})		Change in Adiabatic Compressibility (Δβ)(m^2N^{-1})	
	H_2O	NaCl	H_2O	NaCl	H_2O	NaCl
283.15K						
0.00	1	1	4.7746E-10	4.7746E-10	0	0
0.02	1.00288	1.00446	4.60468E-10	4.53257E-10	-1.6992E-11	-2.4203E-11
0.04	1.00587	1.00845	4.57592E-10	4.49774E-10	-1.9868E-11	-2.7686E-11
0.06	1.00855	1.01131	4.53393E-10	4.46455E-10	-2.4067E-11	-3.1005E-11
0.08	1.01027	1.01689	4.50159E-10	4.41905E-10	-2.7301E-11	-3.5555E-11
0.10	1.01315	1.02083	4.46931E-10	4.38783E-10	-3.0529E-11	-3.8677E-11
0.12	1.01655	1.02490	4.43990E-10	4.35155E-10	-3.3470E-11	-4.2305E-11

0.14	1.01759	1.02926	4.40658E-10	4.31448E-10	-3.6802E-11	-4.6012E-11
0.16	1.02208	1.03371	4.36684E-10	4.27725E-10	-4.0776E-11	-4.9735E-11
0.18	1.02634	1.03656	4.32676E-10	4.24737E-10	-4.4784E-11	-5.2723E-11
0.20	1.02876	1.03956	4.29339E-10	4.21698E-10	-4.8121E-11	-5.5762E-11
288.15K						
0.00	1	1	4.65696E-10	4.65696E-10	0	0
0.02	1.00392	1.0086	4.59704E-10	4.47718E-10	-5.9920E-12	-1.7978E-11
0.04	1.00825	1.01025	4.55237E-10	4.45056E-10	-1.0459E-11	-2.0640E-11
0.06	1.01127	1.01196	4.50919E-10	4.41436E-10	-1.4777E-11	-2.4260E-11
0.08	1.01232	1.01732	4.48013E-10	4.36378E-10	-1.7683E-11	-2.9318E-11
0.10	1.01485	1.02047	4.44481E-10	4.33071E-10	-2.1215E-11	-3.2625E-11
0.12	1.01784	1.02507	4.41262E-10	4.29280E-10	-2.4434E-11	-3.6416E-11
0.14	1.01904	1.03034	4.38367E-10	4.25261E-10	-2.7329E-11	-4.0435E-11
0.16	1.02341	1.03353	4.34152E-10	4.20344E-10	-3.1544E-11	-4.5352E-11
0.18	1.02712	1.03689	4.29344E-10	4.16316E-10	-3.6352E-11	-4.938E-11
0.20	1.03047	1.03988	4.25207E-10	4.13357E-10	-4.0489E-11	-5.2339E-11
293.15K						
0.00	1	1	4.56438E-10	4.56438E-10	0	0
0.02	1.00085	1.0102	4.55442E-10	4.46078E-10	-9.9600E-13	-1.036E-11
0.04	1.00877	1.01191	4.50155E-10	4.42925E-10	-6.2830E-12	-1.3513E-11
0.06	1.01215	1.01312	4.47632E-10	4.40971E-10	-8.8060E-12	-1.5467E-11
0.08	1.01379	1.02006	4.44495E-10	4.36558E-10	-1.1943E-11	-1.988E-11
0.10	1.01443	1.02318	4.41828E-10	4.32900E-10	-1.4610E-11	-2.3538E-11
0.12	1.01885	1.02742	4.37076E-10	4.29269E-10	-1.9362E-11	-2.7169E-11
0.14	1.02053	1.03124	4.34023E-10	4.25854E-10	-2.2415E-11	-3.0584E-11
0.16	1.02433	1.03424	4.30565E-10	4.20564E-10	-2.5873E-11	-3.5874E-11
0.18	1.02850	1.03955	4.26529E-10	4.16636E-10	-2.9909E-11	-3.9802E-11
0.20	1.03206	1.04158	4.21900E-10	4.14066E-10	-3.4538E-11	-4.2372E-11
298.15K						
0.00	1	1	4.46913E-10	4.46913E-10	0	0
0.02	1.00082	1.00731	4.44750E-10	4.39113E-10	-2.1630E-12	-7.8000E-12
0.04	1.0065	1.01059	4.38517E-10	4.35395E-10	-8.3960E-12	-1.1518E-11
0.06	1.01069	1.01300	4.36186E-10	4.32073E-10	-1.0727E-11	-1.4840E-11
0.08	1.01198	1.01816	4.32394E-10	4.26604E-10	-1.4519E-11	-2.0309E-11

0.10	1.01247	1.02027	4.30095E-10	4.22811E-10	-1.6818E-11	-2.4102E-11
0.12	1.01695	1.02378	4.25735E-10	4.20108E-10	-2.1178E-11	-2.6805E-11
0.14	1.01986	1.02574	4.23039E-10	4.17119E-10	-2.3874E-11	-2.9794E-11
0.16	1.02332	1.02899	4.20226E-10	4.13618E-10	-2.6687E-11	-3.3295E-11
0.18	1.02658	1.03115	4.16816E-10	4.11018E-10	-3.0097E-11	-3.5895E-11
0.20	1.02977	1.03466	4.13629E-10	4.07476E-10	-3.3284E-11	-3.9437E-11

Table 2: The values of relative association, adiabatic compressibility, change in adiabatic compressibility at temperature 283.15K, 288.15K, 293.15K and 298.15K.

The specific heat ratio of a number of weights of concentration (0.02-0.2M) of the acetamide with water and also in 0.1M electrolyte solutions of sodium chloride at four different temperatures are noted in table 3. The amount of heat is necessary for each of temperature growth is determine by the specific heat of liquid. From Figure 8 it is understood that the concentration of solution increasing, the heat capacity consistently decreases which is establish the intermolecular interaction [5].

The graph of acoustic impedance verses concentration of water and sodium chloride for the four different temperatures are given in figure 9, the acoustic impedance increases with increase in concentration of acetamide in water and electrolyte NaCl + H_2O and also increase with the temperature (table 3). The acoustic impedance increasing with the concentration as it may be described on the basis of lyophobic interaction between solute molecule and solvent molecules, due to this intermolecular distance increases and

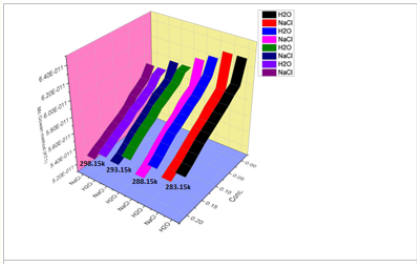

Figure 7: Isothermal compressibility at different concentration and temperature.

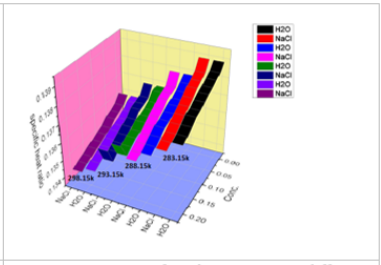

Figure 8: Specific heat ratio different concentration and temperature.

Conc.	Isothermal compressibility (K_T)(m^2N^{-1})		Specific heat ratio (($kg^{1/3}m^{-1}$)$^{-1}$		Acoustic impedance (Z) (m^3mol^{-1})	
	H_2O	NaCl	H_2O	NaCl	H_2O	NaCl
283.15K						
0.00	6.3597E-11	6.3597E-11	0.139076709	0.139076709	1446992.77	1446992.77
0.02	6.0881E-11	5.9729E-11	0.138722857	0.138556401	1479090.56	1493497.45
0.04	6.0376E-11	5.9113E-11	0.138563756	0.138348748	1486287.82	1502644.45
0.06	5.9672E-11	5.8546E-11	0.138397711	0.138187851	1495842.51	1510855.76
0.08	5.9139E-11	5.7741E-11	0.138283071	0.137903819	1503072.81	1523307.22
0.10	5.8585E-11	5.7190E-11	0.138123291	0.137704806	1511109.76	1532031.50
0.12	5.8069E-11	5.6561E-11	0.137947592	0.137493974	1519002.44	1541944.47
0.14	5.7537E-11	5.5917E-11	0.137857941	0.137271476	1526223.51	1552321.85

0.16	5.6845E-11	5.5272E-11	0.137625385	0.137045903	1537039.60	1562913.65
0.18	5.6156E-11	5.4769E-11	0.137401605	0.136892247	1547915.56	1571042.31
0.20	5.5603E-11	5.4257E-11	0.137258336	0.136732531	1556353.48	1579456.56
288.15K						
0.00	6.2608E-11	6.1851E-11	0.138026409	0.138026409	1464716.97	1464716.97
0.02	6.0837E-11	5.8884E-11	0.137787365	0.137431215	1478070.07	1503551.47
0.04	6.0058E-11	5.8441E-11	0.137553973	0.137328017	1489087.00	1509741.43
0.06	5.933E-11	5.7849E-11	0.137374017	0.137208171	1499140.15	1517905.61
0.08	5.8860E-11	5.6972E-11	0.137291233	0.136926256	1505354.19	1531393.99
0.10	5.8267E-11	5.6408E-11	0.137141602	0.136755990	1513798.90	1540100.98
0.12	5.7715E-11	5.5746E-11	0.136978991	0.136522950	1522016.75	1550848.71
0.14	5.7247E-11	5.5040E-11	0.136889771	0.136262137	1528526.11	1559770.99
0.16	5.6521E-11	5.4237E-11	0.136659723	0.136066463	1539807.60	1575140.93
0.18	5.572E-11	5.3569E-11	0.136446097	0.135878102	1552044.53	1586034.16
0.20	5.503E-11	5.3071E-11	0.136256372	0.135719944	1562834.32	1594484.80
293.15K						
0.00	6.0489E-11	6.0489E-11	0.137016391	0.137016391	1478829.31	1478829.31
0.02	6.0318E-11	5.8683E-11	0.136968981	0.136470571	1481212.82	1504886.72
0.04	5.9343E-11	5.8163E-11	0.136584948	0.136358271	1496174.6	1512099.75
0.06	5.8887E-11	5.7838E-11	0.136417890	0.136283276	1503142.51	1516696.20
0.08	5.8371E-11	5.7031E-11	0.136309027	0.135952366	1510243.52	1529912.30
0.10	5.7947E-11	5.6413E-11	0.136245629	0.135779647	1515853.26	1539294.82
0.12	5.7133E-11	5.5782E-11	0.136006151	0.135564831	1528097.94	1549467.36
0.14	5.6633E-11	5.5193E-11	0.135896952	0.135369753	1535312.15	1559030.45
0.16	5.6034E-11	5.4335E-11	0.135701116	0.135176919	1544803.64	1572164.20
0.18	5.5344E-11	5.3649E-11	0.135482575	0.134918684	1555851.28	1584093.39
0.20	5.4576E-11	5.3226E-11	0.136317167	0.135838625	1567897.55	1591031.38
298.15K						
0.00	5.9098E-11	5.9098E-11	0.136044896	0.136044896	1493606.70	1493606.70
0.02	5.8745E-11	5.7749E-11	0.135981449	0.135648228	1498282.19	1513427.37
0.04	5.7671E-11	5.7113E-11	0.135670565	0.135467642	1514082.32	1522916.14
0.06	5.7234E-11	5.6557E-11	0.135475317	0.135326077	1521404.39	1531158.84
0.08	5.6625E-11	5.5623E-11	0.135369879	0.135047903	1529848.06	1545704.67
0.10	5.6261E-11	5.5004E-11	0.135316477	0.134910447	1534838.38	1554995.87
0.12	5.5511E-11	5.4530E-11	0.135080628	0.134737195	1546720.39	1563001.33
0.14	5.5046E-11	5.4039E-11	0.134929512	0.134617686	1554248.95	1570680.94
0.16	5.4556E-11	5.3451E-11	0.134756018	0.134442134	1562453.17	1580404.98
0.18	5.3979E-11	5.3019E-11	0.134581327	0.134320992	1571888.39	1587540.81
0.20	5.3440E-11	5.2424E-11	0.134413274	0.134135462	1580892.89	1597734.32

Table 3: The values of isothermal compressibility, specific heat ratio and acoustic impedance at temperature 283.15K, 288.15K, 293.15K and 298.15K.

creating relatively extra gap in between the molecules. It is further exhibiting that acoustic impedance for sodium chloride mixture is greater than water systems [18].

As Figure 10 shows the relaxation strength (r), in which it is observed that (r) decrease with increasing concentration for both H_2O and NaCl, it is also seen that the relaxation strength is decreasing with increase in a temperature. The decrease in with concentration may be the reason of accumulation of solvent molecules surrounding by the solute molecules, signifying the existence of solute-solvent interactions [19].

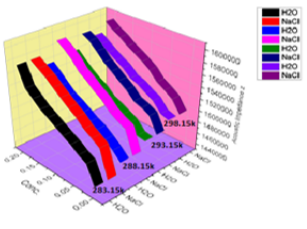

Figure 9: Acoustic impedance at different concentration and temperature.

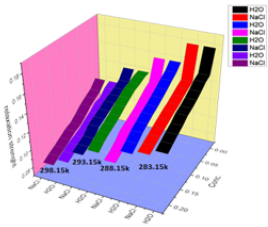

Figure 10: Relaxation strength ratio different concentration and temperature.

Conc.	Relaxation strength (r)		Available volume (V_a) (m^3mole^{-1})		Surface tension (σ)(Nm^{-1})	
	H_2O	NaCl	H_2O	NaCl	H_2O	NaCl
283.15K						
0.00	0.181623078	0.181623078	1.72E-06	1.87E-06	34682.09	34682.09
0.02	0.157884065	0.147562120	1.47E-06	1.49E-06	35705.76	36163.52
0.04	0.155503329	0.144818942	1.45E-06	1.45E-06	35904.84	36414.24
0.06	0.150742487	0.141462244	1.40E-06	1.41E-06	36186.47	36649.11
0.08	0.146765609	0.137960868	1.36E-06	1.37E-06	36403.88	36988.76
0.10	0.143578158	0.135581208	1.32E-06	1.34E-06	36632.66	37226.25
0.12	0.141192358	0.132371789	1.30E-06	1.30E-06	36849.62	37501.85
0.14	0.136382924	0.129157590	1.25E-06	1.27E-06	37076.52	37789.16
0.16	0.132927087	0.125901220	1.21E-06	1.23E-06	37376.58	38082.52
0.18	0.129157590	0.122710194	1.17E-06	1.19E-06	37681.89	38315.47
0.20	0.125130900	0.119476992	1.13E-06	1.16E-06	37931.02	38556.13
288.15K						
0.00	0.160449287	0.160449287	1.51E-06	1.64E-06	35331.82	35331.82
0.02	0.153917370	0.137984079	1.44E-06	1.39E-06	35723.07	36508.81
0.04	0.149948270	0.134780283	1.40E-06	1.35E-06	36031.47	36693.13
0.06	0.145172627	0.129966944	1.34E-06	1.30E-06	36325.57	36942.75
0.08	0.141183091	0.125296916	1.30E-06	1.24E-06	36518.62	37320.95
0.10	0.137184268	0.121902158	1.26E-06	1.20E-06	36766.16	37569.50
0.12	0.133977824	0.118668642	1.23E-06	1.17E-06	37000.04	37866.47
0.14	0.129962280	0.115428008	1.19E-06	1.13E-06	37201.28	38189.30
0.16	0.125937449	0.108930079	1.15E-06	1.06E-06	37519.12	38565.41

0.18	0.120286143	0.104040731	1.09E-06	1.01E-06	37878.26	38885.27
0.20	0.115428008	0.100773339	1.04E-06	9.71E-07	38194.14	39128.05
293.15K						
0.00	0.142644376	0.142644376	1.34E-06	1.45E-06	35859.88	35859.88
0.02	0.142644376	0.142644376	1.34E-06	1.45E-06	35859.88	35859.88
0.04	0.141662604	0.133174993	1.33E-06	1.34E-06	35927.96	36592.09
0.06	0.138864719	0.129157590	1.29E-06	1.29E-06	36320.40	36810.00
0.08	0.137184268	0.126742457	1.27E-06	1.27E-06	36507.34	36947.47
0.10	0.133174993	0.124323980	1.23E-06	1.24E-06	36722.34	37295.20
0.12	0.129157590	0.120286143	1.19E-06	1.19E-06	36901.38	37567.10
0.14	0.124323980	0.117048481	1.14E-06	1.15E-06	37250.97	37850.11
0.16	0.120286143	0.113806049	1.10E-06	1.12E-06	37469.90	38118.63
0.18	0.117048481	0.106487077	1.07E-06	1.04E-06	37736.19	38518.88
0.20	0.112993924	0.103224145	1.02E-06	1.00E-06	38049.62	38846.54
298.15 K						
0.00	0.123317732	0.123317732	1.15E-06	1.25E-06	36420.62	36420.62
0.02	0.120286143	0.115527935	1.12E-06	1.16E-06	36566.17	36985.64
0.04	0.113887241	0.111532340	1.05E-06	1.12E-06	37018.79	37259.49
0.06	0.112993924	0.107505302	1.04E-06	1.07E-06	37207.19	37503.53
0.08	0.107300995	0.101627769	9.86E-07	1.01E-06	37473.57	37921.99
0.10	0.103592246	0.096333498	9.50E-07	9.50E-07	37634.80	38206.02
0.12	0.099138006	0.094017272	9.04E-07	9.23E-07	37973.18	38427.30
0.14	0.096435686	0.089950779	8.77E-07	8.81E-07	38186.59	38659.37
0.16	0.093893529	0.085833350	8.50E-07	8.37E-07	38415.13	38942.63
0.18	0.090027094	0.082535351	8.12E-07	8.02E-07	38688.27	39153.70
0.20	0.086446360	0.078390400	7.77E-07	7.59E-07	38948.12	39449.53

Table 4: The values of relaxation strength, Available volume and Surface tension at temperature 283.15K, 288.15K, 293.15K and 298.15K.

In Available volume with increase in concentration of water and electrolyte NaCl in acetamide is decreases this is given in figure 11. V_a is a straight measurement of the concentration and strength of bonding of the molecules in the liquid mixture, decreasing in V_a as a result of the packing of molecules within the shell that is because of complexation bounded by unlike molecules, and though hydrogen bonding in between the acetamide with water and electrolyte sodium chloride and water [20].

Surface tension is generally known as interfacial tension is an important property of liquid. The surface tension of the solutions increasing with concentration and temperature is given in Figure 12, electrolyte NaCl has greater value than the water with acetamide. Strong intermolecular forces are existing between solute-solvent molecules in the solution is indicates over the highest value of surface tension [12].

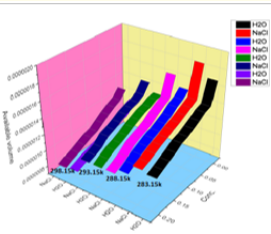

Figure 11: Available volume at different concentration and temperature.

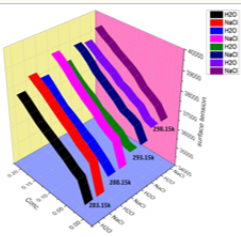

Figure 12: Surface tension ratio different concentration and temperature.

Conclusion

The volumetric and acoustical parameters have suggested that these presence of powerful molecular interaction, hydrogen bonding, charge transfer and dipole-dipole interaction in mixture of acetamide with water and electrolyte solution of sodium chloride. Likewise, it could be concluded that the molecular interaction in (acetamide + water + sodium chloride) (acetamide + water). The electrolyte sodium chloride has structure found properties in the solvent system it is known to provide great solubility. From the above experimental study, it is clear that this type of interaction helps to pharmaceutical industries for manufacturing drugs and medicine. As a result, such study definitely manifests its importance in biological and medicinal drug applications in future.

Bibliography

1. Dash Ashok Kumar and Rita Paikaray. "Visco metric, volumetric and acoustic studies in ternary mixture of dimethyl acetamide and diethyl ether in an aprotic solvent". *International Symposium on Ultrasonics* 22.24 (2015): 5-9.

2. Sasikumar S and G Meenakshi. "Evaluation of Acoustical Parameters of Aqueous Solution of Sodium Chloride and Potassium Chloride Using Ultrasonic Waves". *International Journal of Research in Engineering and Technology* 4.02 (2015): 263-268.

3. Ghosh Apurba M., *et al*. "Ultrasonic Study of Acoustical Parameters in Binary Liquid Mixture (Triethylamine With n-hexane) at 301.15 K". *International Symposium on Ultrasonics* 22.24 (2015): 1070-1080.

4. Suryanarayana CV. "Measurement of internal pressure in liquid systems". *Indian Journal of Chemistry* (1986): 538-540.

5. Sonunea Pooja R., *et al*. Ultrasonic Characterization on the Solutions of L-Histidine and Electrolyte Salts to understand their Interaction in view to Maintained Blood Pressure. No. 9388. EasyChair (2022)27-34

6. Kanhekar S R., *et al*. "Thermodynamic properties of electrolytes in aqueous solution of glycine at different temperatures". (2010): 95-99.

7. Thirumaran S and J Earnest Jayakumar. "Ultrasonic study of n-alkanols in toluene with nitrobenzene". *Indian Journal of Pure and Applied Physics* 47 (2009):265-272.

8. Mishra Paritosh L and Urvashi P Manik. "A Study on Thermodynamic and Sound Parameters of 2-phenylaniline in Ether Media at Different Temperature". *International Symposium on Ultrasonics* 22.24 (2015).

9. Hiremath Nandeesh., *et al*. "An overview of acoustic impedance measurement techniques and future prospects". *Metrology* 1.1 (2021): 17-38.

10. Raj A Moses Ezhil., *et al*. "Ultrasonic study on binary mixture containing dimethylformamide and methanol over the entire miscibility range (0< x< 1) at temperatures 303–323 K". *Fluid Phase Equilibria* 281.1 (2009): 78-86.

11. Saxena Indu., *et al*. "Introduction of ultrasonic interferometer and experimental techniques for determination of ultrasonic velocity, density, viscosity and various thermodynamic parameters". *International Journal of Applied Research* 1.9 (2015): 562-569.

12. Seethalakshmi P., *et al*. "The surface and soil properties of azadirachta indica oil in sodium dodecyl sulfate". *International Journal of Advanced Scientific Research and Management* 3.11, (2018): 52-57.

13. Praharaj Manoj Kumar and Sarmistha Mishra. "Ultrasonic study of mixture, containing Aqueous solution of 'NaCl'and 'KCl' for different ratios of Sodium to Potassium about Vitality ratio and about Human body Temperature". *Research Journal of Chemical Sciences* 5.6 (2015): 32-39.

14. Pawar N R., *et al*. "Synthesis and study of thermo acoustic properties of α-Al2O". *Journal of Pure and Applied Ultrasound* 38 (2016): 65-70.

15. Mirikar S., *et al*. " Intermolecular Interaction in the Binary Mixture of valine with Water at 303.15 K". *International Journal of Engineering Sciences and Research Technology* 3.12 (2014): 536-539.

16. Thirumaran S and K Sabu. "Ultrasonic investigation of amino acids in aqueous sodium acetate medium". *Indian Journal of Pure and Applied Physics* 47 (2009): 87-96.

17. Hakin Andrew W., *et al.* "Some thermodynamic properties of aqueous amino acid systems at 288.15, 298.15, 313.15 and 328.15 K: group additivity analyses of standard-state volumes and heat capacities". *Journal of the Chemical Society, Faraday Transactions* 90.14 (1994): 2027-2035.

18. Rajathi K., *et al*. "Ultrasonic study of molecular dynamics in some binary mixtures". *Journal of Chemical and Pharmaceutical Research* 3.5 (2011): 348-358.

19. Baluja Shipra., *et al*. "Studies on thermodynamic properties of some imidazolinone derivatives in DMF at 308.15 K". *Chinese Journal of Chemical Engineering* 18.2 (2010): 306-311.

20. Kumar Dash Ashok and Paikaray Rita. "Ultrasonic study on ternary mixture of dimethyl acetamide (DMAC) in diethyl ether and acetone". *Research Journal of Physical Sciences* (2013): 2320-4796.

21. Seethalakshmi P., et al. "The surface and soil properties of azadirachta indica oil in sodium dodecyl sulfate. *International Journal of Advanced Scientific Research and Management*, Volume 3 Issue 11, Nov (2018): 52-57.