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Molecular Interaction Between Acetamide and Salt Solutions by Thermo-Acoustical Approach

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ABSTRACT

In Present work the ultrasonic velocity (U) and Density of (Acetamide+ H2O) & (Acetamide + KCL) at various temperature (283.15k to 298.15k) and different concentration it's ranging [0.02-0.2] have been measured with the help of ultrasonic technique. The Potassium Chloride as a solvent it takes as 0.2 mol/kg with the help of measurement data used to evaluate some important thermo-Acoustic Parameter .Such as Adiabatic Compressibility, Acoustic Impedance, Internal Pressure, Relative Association etc The variation in this all parameter with respect to change in molarity and temperature exhibit the existence of interaction and this all parameter shows solute-solvent interaction.

Keywords : Ultrasonic Velocity, Density, Acetamide, Acoustical Parameter.

I. INTRODUCTION

The Ultrasonic study in liquid structure plays a role in explaining the nature and strength of molecular interaction in liquid mixture Recently, ultrasonic technique has become a powerful tool to distribute information regarding the physico-chemical properties of liquid solution.[1] At present ultrasonic are considerably used for specify the thermo-acoustical properties of liquid solution. This technique plays an chief role in realize the nature of molecular interaction. This method has been used in biomedical, engineering, agriculture and medicine. In engineering it us used to study of structure of material. [2] .The magnitude of ultrasonic velocity in human body fluids a organic is of vital importance for carrying out thermo-acoustic analysis of human system.[3]

Ultrasonic investigate that the Acetamide (Drug) which is deeply dissolved in water and easily survey in solute-solvent interactions. In ultrasonic Potassium is the primary positive ion found the living cell. The red blood cells contain 420 mg necessarily red blood cell level is a greater in indication of an individual's potassium states than the regularly used serum level.[4]

This present paper deal the study of interaction between a) (Acetamide + KCL) (Acetamide + water) at different temperature and concentration by

observing some thermo-acoustic parameter. It is helpful in natural historian , pharmacist purpose.

II. MATERIAL AND MATHODS

Material:

The Chemical Acetamide used is as a analytical reagent (CAS No 60-35-5) molecular wt. 59.07 g/mol grade with 99% purity is used as a solute and distilled water (molecular wt. 18.01528 g/mol) and salt solution of potassium chloride (molecular wt. 74.55 g/mol) with density 1.98g/cm^3. All the glassware's are washed with the double distilled water and acetone before it used.

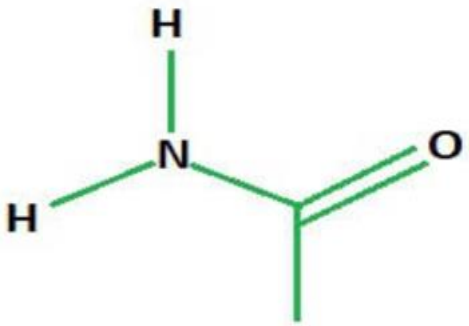

Fig:1 Acetamide structure

Method:

This process was takes places at different temperature (283.15k to 298.15k) and different concentration is maintained constant by digital thermostat. The weight of substance measure by using a digital weighing machine of an accuracy +0.1 mg .A digital ultrasonic interferometer is used to measure the ultrasonic velocity with 2MHz frequency and 0.1% accuracy .density of solution was perfectly determined by using a 10 ml gravity bottle By using these two parameter, we can calculate other different thermo-acoustic parameter at various temperature.

DEFINING RELATION

- **Adiabatic Compressibility (β):** $\{1//U^2 \rho\}$
- **Acoustic Impedance (Z):-**$(Z)=U\rho$
- **Relaxation Strength (r**):- $\{1 - (U/U\infty)^2\}$
- **Specific heat ratio(γ):**$\gamma = KT/\beta$
- **Surface tension (σ) :-** (6.3×10^{-4}) pu$^{3/4}$
- **Internal Pressure (πi):** $(\pi i) = \{T\times\alpha/KT\}$
- **Relative Association (RA) :** $(RA) = \{(\rho/\rho_o) (U_o/U)^{1/3}\}$

III.RESULT AND DISCUSSION

In the present work is obtained variation in ultrasonic velocity and density of Acetamide and salt solutions at different temperature and concentration [5]

It is observed that ultrasonic velocity of water was measured in different concentration [0.02-0.2M] and various temperature [283.15k, 288.15k, 293.15k, and 298.15k] Fig [2] it show that the ultrasonic velocity increases with increasing concentration and temperature which is suggested that intermolecular interaction between solute-solvent where ultrasonic velocity is greater in Acetamide with KCL and water it is strong association in molecules .This association is due to hydrogen bonding between solute-solvent molecules.[6] The Density of water has be measured at various concentration [0.02-0.2M] and different temperature [283.15k, 288.15k, 293.15k, 298.15k] Fig [3] it is observed that the density of solution increase with increases in concentration of Acetamide in the solution of salt solution of potassium Chloride at different temperature but the density is decrease with increase in temperature due to thermal energy of system which decrease the intermolecular force.[7]

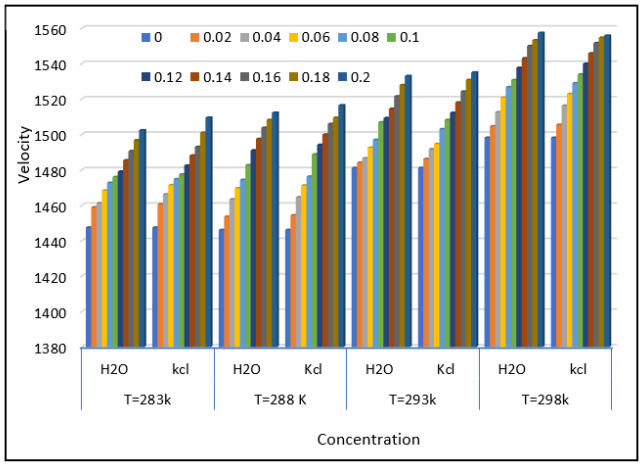

Fig.2 : Ultrasonic velocity at different temperature and concentration

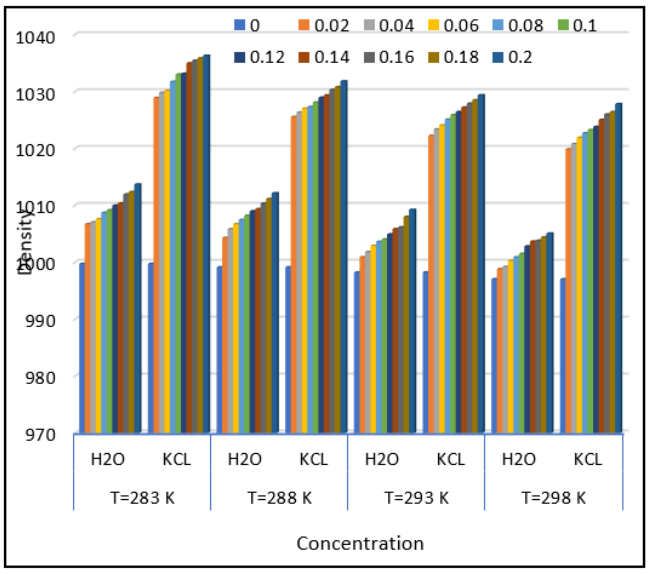

Fig.3 : Density at different temperature and concentration

Table 1: the values of ultrasonic velocity, Density and Adiabatic Compressibility at temperature (283.15K, 288.15K, 293.15K and 298.15K)

Conc.	Velocity (U) (m/s)		Density ((Kg/m^3)		Adiabatic Compressibility (m^{2}N^{-1})	
	H_2O	KCL	H_2O	KCL	H_2O	KCL
			283.15k			
0	1447.42	1447.42	999.7	999.7	4.7746E-10	4.7746E-10
0.02	1458.83	1460.637	1004.706	1026.706	4.6768E-10	4.5653E-10
0.04	1461.21	1466.16	1006.219	1038.688	4.6546E-10	4.5222E-10
0.06	1468.33	1471.32	1007.122	1031.688	4.6054E-10	4.4775E-10
0.08	1472.68	1474.72	1009.294	1033.075	4.5654E-10	4.4509E-10
0.1	1475.92	1477.35	1012.286	1036.831	4.5349E-10	4.4194E-10
0.12	1479.00	1482.42	1014 707	1039.569	4.5052E-10	4.3773E-10
0.14	1485.00	1488.10	1015.219	1042.059	4.4644E-10	4.3336E-10
0.16	1490.58	1492.95	1016.103	1045.219	4.4294E-10	4.2924E-10
0.18	1496.72	1500.92	1017.831	1047.822	4.3857E-10	4.2364E-10
0.2	1502.32	1509.45	1020.567	1048.688	4.3414E-10	4.1852E-19
			288.15k			
0	1446.02	1466.02	999.103	999.103	4.78671E-10	4.78671E-10
0.02	1453.48	1454.33	100.3284	1024.846	4.71793E-10	4.61334E-10
0.04	1463.41	1464.49	1004.801	1025.674	4.64717E-10	4.54584E-10
0.06	1469.59	1471.11	1005.265	1027.420	4.60603E-10	4.4974E-10
0.08	1474.30	1476.20	1007.214	1030.040	4.56780E-10	4.45508E-10
0.1	1482.65	1488.74	1008.837	1032.040	4.50922E-10	4.37186E-10
0.12	1490.99	1494.10	1011.957	1035.639	4.44527E-10	4.32543E-10

0.14	1497.46	1499.92	1012.706	1037.303	4.40358E-10	4.28507E-10
0.16	1503.79	1505.96	1014.098	1040.415	4.35724E-10	4.23805E-10
0.18	1508.16	1509.42	1016.875	1042.082	4.32571E-10	4.2119E-10
0.2	1512.24	1516.43	1019.081	1045.140	4.29092E-10	4.16084E-10
			293.15k			
0	181.101	1481.101	998.2	998.2	4.56681E-10	4.5678E-10
0.02	1484.03	1486 12	1001.818	1021.348	4.53237E-10	4.4332E-10
0.04	1486.50	1491.72	1002.187	1022.075	4.51566E-10	4.3969E-10
0.06	1492.51	1494.62	1004.875	1024.219	4.46739E-10	4.3706E-10
0.08	1496.92	1502.97	1005.628	1025.294	4.43778E-10	4.3176E-10
0.1	1406.85	1508.16	1006.420	1026.219	4.37603E-10	4.2842E-10
0.12	1506.22	1512.18	1007.378	1033.078	4.35812E-10	4.2331E-10
0.14	1514.48	1518.02	1009.233	1034.122	4.31997E-10	4.1964E-10
0.16	1521.53	1524.22	1011.197	1035.688	4.27172E-10	4.156E-10
0.18	1527.84	1530.71	1013.528	1036.851	4.22677E-10	4.1162E-10
0.2	1532.97	1534.98	1014.418	1037.766	4.19480E'10	4.0897E-10
			298.15 k			
0	1498.101	1498.101	997	997	4.4691E-10	4.4691E-10
0.02	1504.58	1505.48	999.114	1016.135	4.4213E-10	4.3421E-10
0.04	1512.51	1516.15	1000.188	1018.116	4.3704E-10	4.2728E-10
0.06	1520.68	1522 86	1001.140	1019.874	4.3195E-10	4.2280E-10
0.08	1526.67	1528.92	1002.787	1020.891	4.2786E-10	4.1940E-10
0.1	1530.67	1533.85	1003.145	1023.045	4.2547E-10	4.1547E-10
0.12	1537.65	1539.88	1004.507	1024.898	4.2105E-10	4.1148E-10
0.14	1542.98	1545.75	1006.147	1025.891	4.1746E-10	4.0796E-10
0.16	1549.92	1551.58	1008.843	1025.886	4.1263E-10	4.0490E-10
0.18	1553.19	1554.65	1009.433	1026.865	4.1065E-10	4.0292E-10
0.2	1557.35	1555.75	1012.298	1026.891	4.0730E-10	4.0234E-10

In Adiabatic Compressibility increases with Compressibility in the solutions. The hydrogen bond between the different component break down the value of Adiabatic Compressibility which can show in Fig [4] is found to decreases with increases in the concentration of the solute (Acetamide) and salt solutions of KCL (solvent) the weakening of the hydrogen bond in the solution may be the cause of the observed drop in Adiabatic Compressibility in the solvent [8]Fig [5] Show that the acoustic impedance is increasing with temperature as well as concentration of Acetamide appear that the molecular interaction is associative and there is a greater interaction between solute-solvent [9] Fig [6] show that the significant associative interaction in solution of Acetamide and Potassium Choride the increases variation of surface tension with various temperature as well as concentration [10] Fig [7] show the Relative Association is depend upon two factors 1) Breaking of solvent and addition of solute in it. 2) Acetamide is present in solute salvation of potassium Choride and water in Acetamide that show the close association in interaction of solute and solvent relative association is increases with increasing concentration as well as temperature. [11]

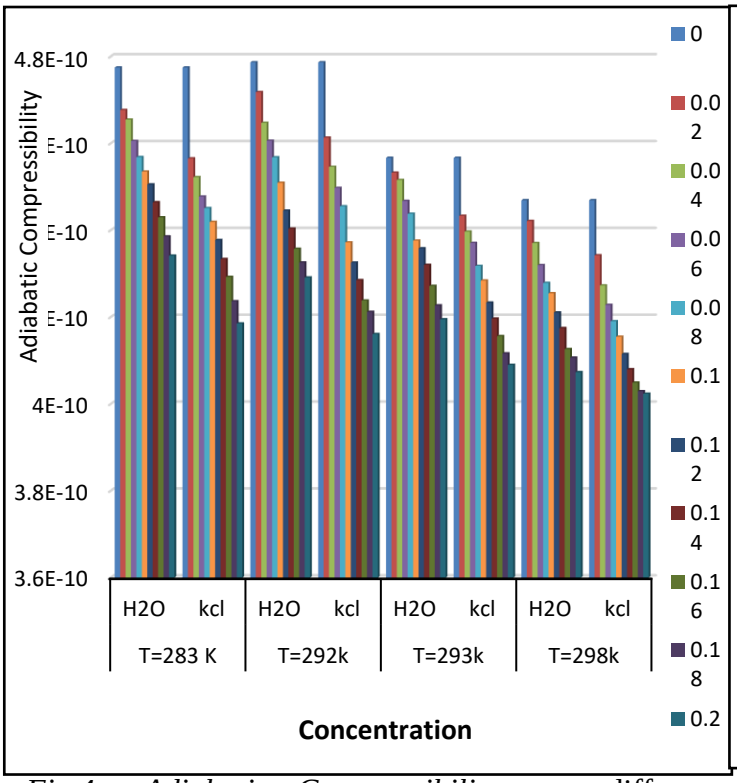

Fig.4:: Adiabatic Compressibility at different temperature and concentration

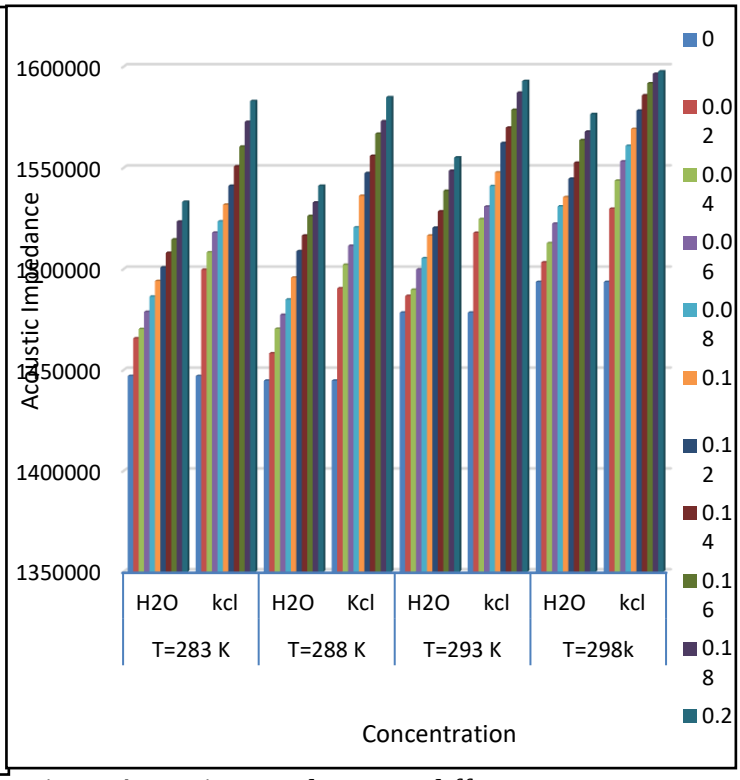

Fig5:: Acoustic Impedance at different temperature and concentration

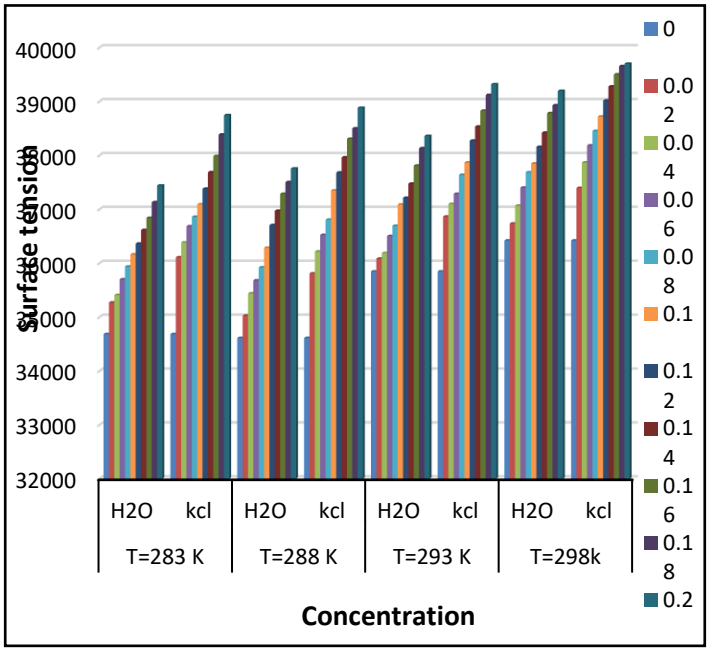

Fig. 6:Surface tension at different temperature and concentration

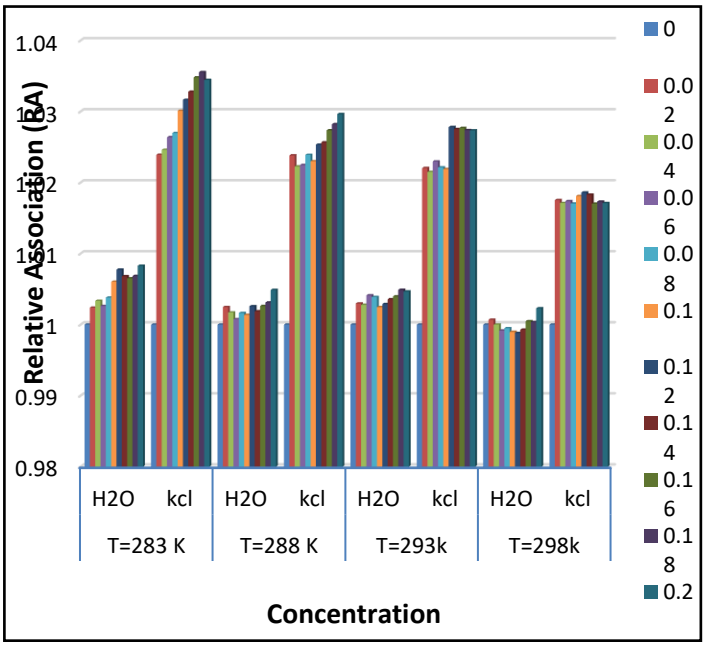

Fig. 7:Relative Association at different temperature and concentration

Table 2 The values of Acoustic Impedance, surface tension, Relative Association at temperature (283.15K, 288.15K, 293.15K and 298.15K)

Conc.	relative association (RA)		Acoustic Impedance (Z) (m^3mol^{-1})		Surface tension (σ)(Nm^{-1})	
	H_2O	KCL	H_2O	KCL	H_2O	KCL
			283.15k			
0	1	1	1446992.77	1446992.77	34682.0881	34682.0888
0.02	1.00238278	1.0239093	1456492.73	1499645.79	35268.49085	36107.7471
0.04	1.00334715	1.0245596	1465696.27	1508222.22	35408.08223	36382.8377
0.06	1.00262083	1.0263815	1470298.50	1517944.21	3569.171780	36681.7402
0.08	1.00379283	1.0269707	1478787.44	1523497.10	35935.26271	3685.84410
0.1	1.00603129	1.0300928	1486367.08	1531763.31	36160.79807	37091.4585
0.12	1.00773682	1.0316343	1494053.15	1541079.06	36160.80306	37871.0161
0.14	1.00680278	1.0327848	1500751.65	1550684.57	36614.46088	37686.0082
0.16	1.00650381	1.0347969	1507977.18	1560461.05	36839.30888	37985.3484
0.18	1.00683502	1.0355343	1514583.70	1572698.04	37130.20655	38385.2761
0.2	1.00828483	1.0344342	1523409.06	1582943.15	37439.12966	38744.9617
			288.15k			
0	1	1	1444728.91	1444728.91	34611.06517	34611.06517
0.02	1.0024678	1.03810060	1458266.50	1490464.28	35025.39363	35809.11635
0.04	100170440	1022267762	1470435.10	1502095.47	35438.01760	36214.46156
0.06	1.00076040	1.022464603	1477326.95	1511448.57	35679.21282	36522.16362
0.08	1.00163170	1.023892743	1484935.06	1520546.22	35920.38050	36805.83554
0.1	1.00135959	1.022991477	1495752.77	1547353.56	36284.37834	37347.8293
0.12	1.00257972	1.025329754	1508817.767	1555872.71	36970.11056	
0.14	1.00187470	1.025648087	1516486.727	1566823.30	36970.62377	37961.96308
0.16	1.00261400	1.027347173	1526165.34	1584871.35	3728.1361	38306.04455
0.18	1.00310706	1.028208663	1532835.00	1572940.16	3750.45239	38499.74051
0.2	1.00488585	1.029632303	1541094.447	1584871.35	37755.49474	38882.00144
			293.15 k			
0	1	1	1448435.01	1478435.02	35845.54004	36420.62117
0.02	1.00296381	1.02203485	1486727.96	1517854.01	36082.2325	37394.29534
0.04	1.002778066	1.02148313	1489752.16	1524650.46	37065.4751	37866.39725
0.06	1.004115477	1.022962626	1499786.13	1530824.67	37684.8983	38183.64465
0.08	1.003880041	1.02213509	1505344.66	1540993.35	37846.6082	38450.07909
0.1	1.002458903	1.02188483	1516523.97	1547703.84	38157.4976	38717.70644
0.12	1.002887311	1.02780246	1520361.26	1562201.25	38418.9895	39016.78789
0.14	1.003570406	1.02751918	1528464.10	1569817.88	38781.8836	39278.13164
0.16	1.003997853	1.02767755	1538567.33	1578616.43	38781.8836	39500.3779

0.18	1.004894857	1.02737659	1548509.23	1587119.27	38927.62092	39655.45841
0.2	1.004652863	1.02732895	1555080.53	1592857.88	39194.7834	39698.5586
			298.15 k			
0	1	1	1493606.69	1493606.69	36420.62117	36420.62117
0.02	1.00067985	1.00731780	1503246.94	1529773.10	36734.87115	37394.29534
0.04	1.00000175	1.01059890	1512794.35	1553126.53	37065.4751	37866.39725
0.06	1.99915788	1.01752433	1522413.72	1543623.89	37401.77022	38183.64465
0.08	1.99949170	1.0171106	1530926.05	1553126.53	37684.89837	38450.07909
0.1	1.99897681	1.01736956	1535485.18	1560861.27	37846.6082	38717.70644
0.12	1.99881673	1.0170364	1544580.65	1569197.57	38157.4976	39016.78789
0.14	1.99929241	1.01808877	1552473.12	1578219.93	38418.98955	39278.13164
0.16	1.00047332	1.01829476	1544580.65	1585771.63	38418.98955	39500.37790
0.18	1.00035433	1.0170132	1552473.27	1585771.63	38927.62092	39655.45841
0.2	1.00230103	1.01709865	1563627.96	1591737.37	39194.78343	39698.55860

Relaxation Strength is related to Adiabatic Compressibility addition of solute in a solvent the value of relaxation strength decreases it indicates solute-solvent interaction. Fig[8] show that relaxation strength of Acetamide solution decreases with increases in concentration which suggest that higher molecular associationbetween solute-solvent molecules relaxation strength depends on the factor [1-U/Uo] U is Ultrasonic velocity Uo is constant with value of 1600 m/S relaxation strength decreases with increases in concentration as well as temperature [12] The specific heat ratio plays the role in thermo-physical the specific heat ratio is present in the liquid of state that link pressure temperature and volume of investigations liquid Fig[9] show that specific heat ratio increases with concentration of solution the specific heat ratio continuously decreases which is show the intermolecular interaction [13] Internal Pressure is useful to understand the intermolecular interaction and structure Fig[10] show that the internal pressure at different temperature as well as concentration is increases with increasing temperature and concentration this show binding forces or cohesive force between solute-solvent is because stronger and it appear that is become stronger and it appear that there is greater intermolecular interaction [14]

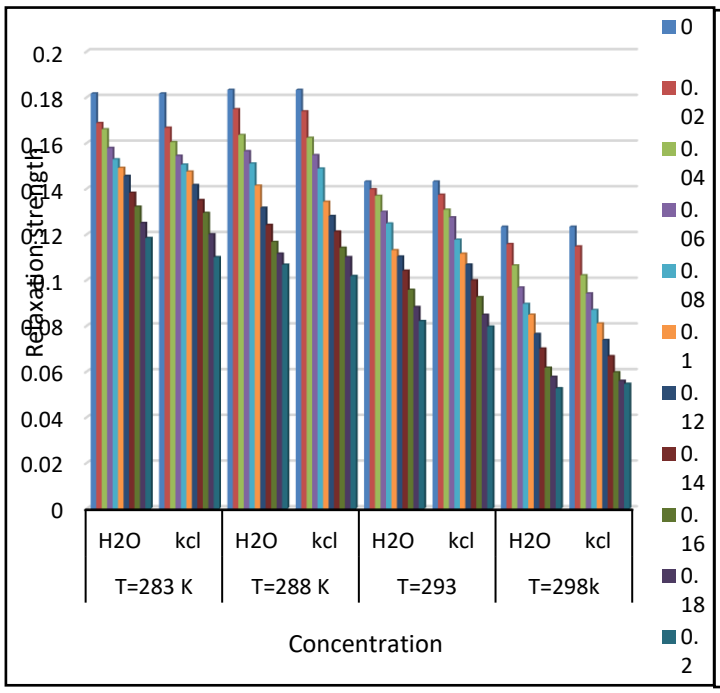

Fig. 8: Relaxation Strength at different temperature and concentration

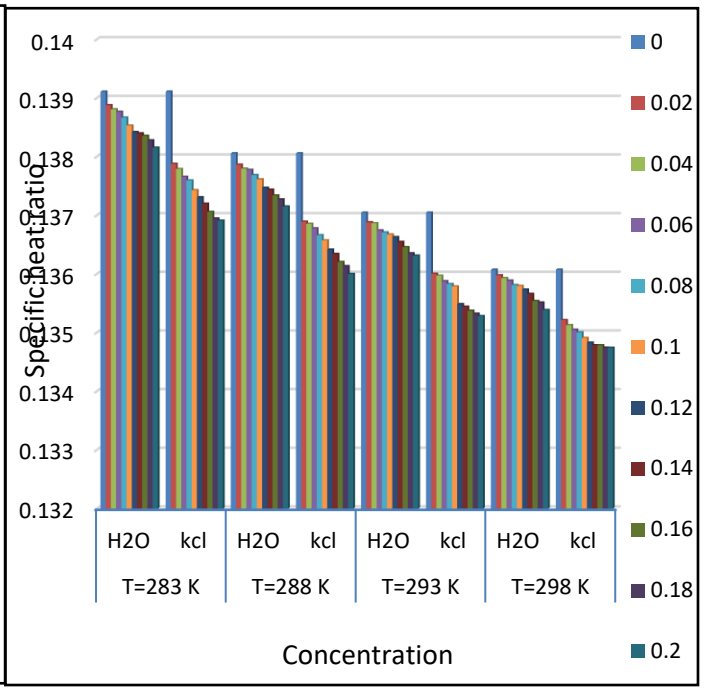

Fig. 9:Specific heat ratio at different temperature and concentration

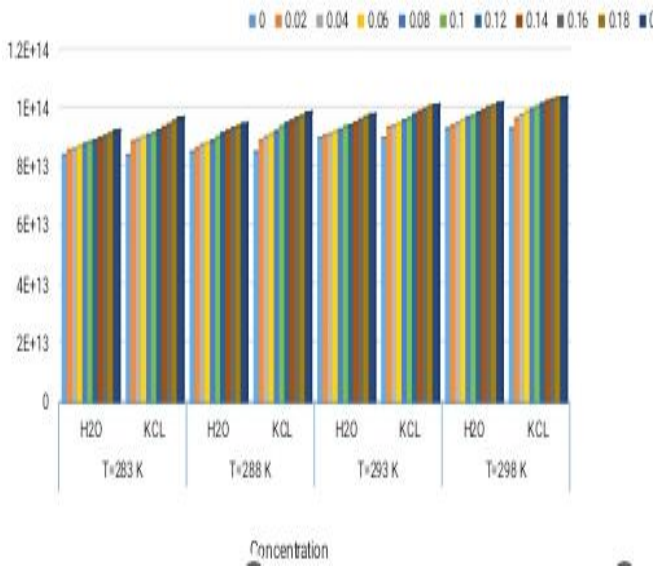

Fig:10. Intetnar Pressure at different temperature and concentration

Table 3. the values of Relaxation Strength Specific heat ratio and internal pressure at temperature (283.15K, 288.15K, 293.15K and 298.15K)

Conc.	Relaxation Strength (r)		specific heat ratio (Y)($kg^{1/3}m^{-1})^{-1}$		Internal Pressure (πi)(Nm^{-2})	
	H2O	KCL	H2O	KCL	H2O	KCL
			283.15k			
0	0.181623078	0.181623078	0.139910946	0.13910947	8.39752E+13	8.39752E+13

0.02	0.168677747	0.166617013	0.13887801	0.13787889	8.5741E+13	8.86046E+13
0.04	0.165963022	0.160302678	0.138808358	0.13779028	8.61695E+13	8.94357E+13
0.06	0.157815239	0.154381819	0.13876690	0.1376566	8.7016E+13	9.03593E+13
0.08	0.152817819	0.15046911	0.138667287	0.13759497	8.7735E+13	9.08978E+13
0.1	0.149085997	0.147436319	0.138553053	0.13742864	8.84432E+13	9.16517E+13
0.12	0.145530859	0.141574587	0.138420272	0.13730785	8.90673E+13	9.2548E+13
0.14	0.138154673	0.134983746	0.138396695	0.13719853	8.9804E+13	9.34854E+13
0.16	0.13209815	0.129336054	0.13835625	0.13705999	9.04674E+13	9.44238E+13
0.18	0.124933298	0.120015294	0.138278479	0.13694641	9.13401E+13	9.56441E+13
0.2	0.118372898	0.109984647	0.138154831	0.1369087	9.22893E+13	9.67105E+13
288.15k						
0	0.183206565	6.1851E-11	0.138058355	0.138058355	8.50763E+13	1464716.97
0.02	0.183206565	0.183206565	0.137866114	0.136892581	8.63558E+13	8.50763E+13
0.04	0.163449677	0.173798536	0.137796917	0.136855704	8.75769E+13	8.90866E+13
0.06	0.156369231	0.162208748	0.137775704	0.136778144	8.82828E+13	9.02824E+13
0.08	0.150952934	0.15462319	0.137686784	0.13660263	8.90225E+13	9.12168E+13
0.1	0.141308194	0.148763109	0.137617287	0.136573762	9.01121E+13	9.21015E+13
0.12	0.131620633	0.134239536	0.137471318	0.136415339	9.14E+13	9.37322E+13
0.14	0.124067792	0.127989546	0.137437418	0.136342356	9.21918E+13	9.47904E+13
0.16	0.116646733	0.121187498	0.137339244	0.136206316	9.31573E+13	9.56544E+13
0.18	0.11150524	0.110020025	0.137272471	0.136133627	9.38253E+13	9.67391E+13
0.2	0.106691477	0.101734397	0.13715025	0.136000742	9.46275E+13	9.7349E+13
293.15k						
0	0.143101495	0.143101495	0.137047562	0.13704756	8.99729E+13	8.99729E+13
0.02	0.139708968	0.137274831	0.136882383	0.13600428	9.07484E+13	9.34957E+13
0.04	0.136842871	0.130770094	0.136865545	0.13597201	9.10605E+13	9.42072E+13
0.06	0.12984918	0.127381293	0.136743431	0.13587705	9.20543E+13	9.48095E+13
0.08	0.124699419	0.117601616	0.136709297	0.13582958	9.26291E+13	9.58809E+13
0.1	0.113048077	0.11150524	0.136673426	0.13578872	9.1585E+13	9.65837E+13
0.12	0.110249961	0.106762362	0.136630052	0.13548753	9.41975E+13	9.79547E+13
0.14	0.104043097	0.099849719	0.136546299	0.13544196	9.50196E+13	9.87588E+13
0.16	0.095682211	0.09247584	0.136457844	0.13537363	9.60592E+13	9.96799E+13
0.18	0.08816599	0.084737069	0.136353156	0.13532300	9.70735E+13	9.96799E+13
0.2	0.08202403	0.079623594	0.136313254	0.13528321	9.77669E+13	1.01201E+14
298.15 k						
0	0.123317732	0.052601944	0.13607533	0.13607533	9.30202E+13	9.30202E+13
0.02	0.115718369	0.114657792	0.13597929	0.13521575	9.40071E+13	9.63849E+13
0.04	0.115718369	0.102058978	0.1359306	0.13512796	9.50204E+13	9.78537E+13
0.06	0.096692319	0.094100555	0.13588749	0.13505028	9.60498E+13	9.88535E+13
0.08	0.089561997	0.086876419	0.13581303	0.1300544	9.69384E+13	9.96835E+13
0.1	0.084784903	0.080978194	0.13579687	0.134911064	9.74326E+13	1.00546E+14
0.12	0.076418937	0.073738119	0.13573549	0.13482928	9.84003E+13	1.01499E+14

0.14	0.069995325	0.066662866	0.1356617	0.13478575	9.9228E+13	1.02317E+14
0.16	0.061617888	0.059609181	0.13554076	0.134778595	1.00389E+14	1.02993E+14
0.18	0.057648078	0.059609181	0.13551435	0.13474312	1.00844E+14	1.0349E+14
0.2	0.052601944	0.054547632	0.13539638	0.13474199	1.01724E+14	1.03622E+14

IV. CONCLUSION

We find the ultrasonic velocity and density of the Acetamide at different concentrations 0.02-0.2M in the 0.2M and salt solution of potassium Choride and water at different temperature ranging from 283.15K-298.15K. Related to velocity and density we calculate the other thermo- acoustical parameter like adiabatic Compressibility, internal pressure, acoustic impedance, relative association, Relaxation Strength, surface tension All the parameter gives the molecular interaction between solute and solvent . Hence there some of the parameter are showing association It is concluded that acetamide and salt solutions of potassium Choride is greater than acetamide and water. It Mean's that the (Acetamide+KCL)>(Acetamide+water) In the present paper we understand that this kind of relation is used to create a medicine and supply us in industries It is used in pharmancist, and chemist.

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