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Research Article

Ultrasonic Characterization On Glycine And Proline Dissolve In Saline Salt (Na_2SO_4) Solution In View To Sustainable Farming.

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Abstract
Ultrasonic probing of liquid mixture becomes eminent in agricultural, chemical and pharmaceutical industries. Ultrasonic method is significant mechanism to understand intermolecular interaction. The liquid state is mostly employed because it is most accurate and relatively simple. Amino acids are the elementary unit of macromolecules that nature has selected for use in human physiology, including proteins, which perform a variety of vital roles in sustaining life in individuals. Among the numerous additional organic substances of biological significance in living systems with varying structural complexity are amino acids. Glycine increases the effectiveness of photosynthesis, promoting the production of chlorophyll, promoting the development of plants, and aiding in pollination and fruitfulness. Glycine is excellent alternative to chemical fertilisers. The variation in thermodynamic parameter provides crucial information regarding intermolecular forces existing in solution. The ultrasonic velocity measurement of solution serves as the powerful probe to understand physio-chemical properties of solution. The ultrasonic velocity and density values are utilized in the determination of different parameter. The degree of interaction is higher for Glycine than Proline in saline salt solution (Na_2SO_4) therefore, Glycine is more effective on saline soil. It may improve physical properties of saline soil.

Keywords:- saline soil, physio-chemical properties, Glycine, Proline, Hydrogen bonding

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Introduction.
Ultrasonic probing of liquid mixture becomes eminent in agricultural, chemical and pharmaceutical industries.(Nain, A. K, 2011)Ultrasonic method is significant mechanism to understand intermolecular interaction. The liquid state is mostly employed because it is most accurate and relatively simple. It has no impact on sample and can not cause any structural damage. (Praharaj, M. K. 2019) it is most suitable technique to study thermo-physical and structural properties of pure, binary and ternary mixture. Understanding protein structural and functional features requires an understanding of their solution stability.(Nagarjun, B.2013) Amino acid is basic constituent of proteins. It plays crucial role in protein synthesis. Amino acids are participating actively in stress defense and development of plant. It also compensates damage cause during decomposition and respiration process. (Juglan, K. C., 2020) It increases water uptake, vegetative growth, carbon assimilation rate. It also

enhances plant pigment, natural hormones, cell division and grain quality. It improves the soil mineralization and major source of nitrogen.(Hema,2020) Plant undergoes variety of environmental stresses during their life cycle such as salinity, drought.

Plants requires soil medium for their development. Sustainable agriculture is farming in which amending something to improve the soil fertility with less harmful environmental effects with rise in crop yield. it reduces environmental pollution. (Kumar, P.,2020) The higher concentration of salts like sodium, calcium, potassium leads to the salty soil. salinity of soil affects the physiological properties of plants. Salinity of soil affects the plants growth and biochemical properties of soil. The use of fertilisers containing K, NH_4, P are effective and covers the adverse effect of salinity. (Wang, T.,2021)

A significant amount of costly and harmful fertilizers is typically used in agricultural production to provide plants with necessary nutrients for a limited duration. (Khedr, E.,2018) The majority of applied fertilizers responsible for environmental pollution and degradation of the ecosystem. Efficient utilization of nutrients from fertilizers is crucial for meeting environmental standards and addressing economic concerns. By using sustainable methods, it is feasible to increase the biological uptake of nutrients by plants by applying amino acids or incorporating microorganisms. (Tajabadipour, A., 2018) Application of amino acids can improve the vegetative, reproductive, and quantitative characteristics of plants, among other aspects of their growth. Their beneficial impacts on plant growth were enhanced under salt stress conditions. Amino acids are great alternatives for biofortifying agricultural crops along with replacing chemical fertilisers. (Hassanein, R. A., 2013) The fertilization of amino acids has positive influence on development and yield enhancement. Spraying amino acids to plants results in higher leaves area, vegetative development and have higher levels of chlorophyll, which enhanced food production and nutritional value. (Noroozlo, 2020) Amino acids have a variety of roles in metabolism of plant, and their fertilization of amino acids may have beneficial and stimulating impacts on plant development and yield. (Gupta P., 2021)Amino acids perform, involving the removal of heavy metals and pollutants, enhances nutrient uptake, and metabolism, biosynthesis of vitamins, stimulate growth of plant, and enhancing resistance to ecological stresses. (Noroozlo .Y.A, 2019)

Amino acids are the elementary unit of macromolecules that nature has selected for use in human physiology, including proteins, which perform a variety of vital roles in sustaining life in individuals. Among the numerous additional organic substances of biological significance in living systems with varying structural complexity are amino acids. ()Amino acids are chemical molecules with biological significance that consist of amine (–NH_2) and carboxylic acid (–COOH) functional groups, accompanied by a side-chain unique to each amino acid. They are vital to the biotic processes, industry, fertilisers, dietary supplements, (Mohammad Kazem, 2019) and food technology. The study of amino aqueous surroundings is useful tool to boost our knowledge about behaviour of molecules in aqueous solution. (Tarlok S., 2006;Hamid R.R.,2016) Glycine increases the effectiveness of photosynthesis, promoting the production of chlorophyll, promoting the development of plants, and aiding in pollination and fruitfulness.(Essa T.A.,2002) Glycine is excellent alternative to chemical fertilisers. Exogenous amino acids have a stronger growth stimulating impact under the unfavourable environmental conditions such as, drought, salinity. (Chen, H., 2010) Green vegetable crops can produce more and of higher quality when glycine is applied. The smallest proteinogenic acid found in plant cells is glycine.(Zhu, M., 2022) It is non-polar and hydropholic amino acid having important role in horticultural crop.(Khalid M., 2022) proline may be involved in flowering and development as a signal molecule and metabolite, in addition to its functions in protein synthesis and the plant cells sensitivity to environmental stresses. Although there exists growing evidence that proline has a special function throughout the reproductive phase.(Mattioli R., 2009)

proline is a proteogenic amino acid that builds up in plants under both stressful and non-stressful circumstances. Proline is vital for plant growth and differentiation throughout the life cycle, according to recent research. It is a crucial factor in the development of plants and an important regulator of numerous cell wall proteins. (Kavi B., 2015)

Material and Method

All chemicals used in experiment such as Glycine and sodium sulphate and magnesium sulphate are SR grade and AR grade with purity ≥99% were purchased from Himedia.

Name of compound	Molecular weigth	Volume	Molality (Mole)
Glycine	119.14g.mol^{-1}	30ml	0-0.2
Proline	115.13g.mol^{-1}	30ml	0-0.2
Sodium sulphate	142.04g.mol^{-1}	350ml	0.2

The Weight of chemical was determined by following formula.

Weight of substance= $\frac{Molecular\ Weigth \times Molality \times Volume}{1000}$

Preparation of Systems: -

i) Glycine ($C_2H_5NO_2$)+ H_2O
ii) Glycine($C_2H_5NO_2$) + H_2O+Sodium Sulphate(Na_2SO_4)
iii) Proline($C_5H_9NO_2$)+ H_2O

iv) Proline($C_5H_9NO_2$) + H2O+Sodium Sulphate(Na_2SO_4)

Apparatus:-

i) Ultrasonic interferometer operating on 2MH$_z$ along with water bath maintained at desired temprature
ii) 10ml Density bottle and weighing balance was used for determination of density.

The 0.2 M aqueous Na_2SO_4 stock solution was prepared in double distilled water. It is used as solvent for preparation of desired experimental solution. The concentration of Glycine and Proline is varying over the range 0.02-0.2M. The specific conductivity of doubly distilled water used was less than $18 \cdot 10^{-6}$ Ω−1 cm−1. All the solutions were stored in airtight bottle to keep away from dissipation and explosion to air. An ultrasonic interferometer (Mittal-M-77, India) is measured at 2MHz with varying temperature. It is based on variable path principle. The average of 20values is taken as final measured value of ultrasonic velocity. The thermostat is used to maintain the temperature of water circulating through insulated surrounding of brass around quartz crystal and cell. A thermostated water bath and ultrasonic interferometer was used to measure ultrasonic velocity. The instruments were keeping at experimental temperature for 30 minutes before recording. The densities of water and experimental solution were carried with 10ml density bottle and electronic mass balance. Electronic balance having the accuracy of ±0.01gm. The average of Three readings of density was taken as calculated density of solution. All the glassware and cell were cleaned with acetone before experiment and instrument is calibrated with double distilled water. The variation in thermodynamic parameter provides crucial information regarding intermolecular forces existing in solution. The ultrasonic velocity measurement of solution serves as the powerful probe to understand physio-chemical properties of solution.

The ultrasonic velocity and density values are utilized in the following parameter computations.

- Adiabatic compressibility (β) $=\frac{1}{\rho U^2}$ -----------. (M^2N^{-1})
- Acoustic impedance (Z)= ρU^2--------. (Kgm^2s^{-1})
- Wada Constant(W)=$V_m \beta^{\frac{-1}{7}}$ ----------(m^3mole^{-1})$(ms^{-1})^{-1/7}$
- Rao Constant(R)=$V_m U^{\frac{1}{3}}$----------(m^3mole^{-1})$(m/s)^{1/3}$
- Specific Heat Ratio(γ)= $\frac{17.1}{T^{\frac{4}{9}}\rho^{\frac{1}{3}}}$ ------- $(K^{\frac{4}{9}})^{-1}\left(Kg^{\frac{1}{3}}m^{-1}\right)^{-1}$
- Intermolecular Free length(L_f)= $K\beta^{\frac{1}{2}}$--------(m)
- Lenard-Jones potential(η) $=\left\{6(\frac{V_m}{V_a})-13\right\}$-----------($J\ mol^{-1}$)
- Non-Linearity Parameter (B/A)=$\left\{2+\frac{0.98*10^4}{U}\right\}$---------($m^{-1}s$)

Result and Discussion

Ultrasonic velocity (U)

Temperature has a substantial impact on the energy of molecules in liquids that are joined by hydrogen bonds. As the temperature rises, the number of hydrogen bonds in the liquid is expected to increase because thermal movements of the molecules raise activation energy. (Thirumaran S.,2010) The ultrasonic velocity (U) concentration-dependent linear rise exhibits The cohesive forces increased as a result of strong molecular contact. However, as temperature (T) grew, so did these characteristics as cohesive forces did. The enhancement of cohesive forces was aided by an increase in ultrasonic velocity. Solute-solvent interactions are the main source of the tendency to form structures, while thermal fluctuations are the cause of the expansion of structures that have already been formed.(Rao J. P.,2017)From Fig:-01 and Table :-01, it has been noted that ultrasonic velocity rises as an concentration of $C_2H_5NO_2$, $C_5H_9NO_2$ in Na_2SO_4, suggest the association between molecules of Sodium sulphate and amino acids. There is larger ion –dipole interaction between $C_2H_5NO_2$ +Na_2SO_4 than $C_5H_9NO_2$ +Na_2SO_4. It conform stronger interaction between $C_2H_5NO_2$ + Na_2SO_4.

Density (ρ)

Density with concentration is represented graphically in Fig:-02 and Table:-02. The density of solution rises with concentration of $C_2H_5NO_2$ and $C_5H_9NO_2$ in Na_2SO_4 whereas decreases with rise in temperature. Volume decreases with increasing density, suggesting that constituent molecules are associated. As a result of physical changes that show the molecules are closely packed together, the density increases. As a result, there is less compression in the liquid mixture. (Kumari L, 2023) The density (ρ) of the mixture drops as the temperature rises. When the temperature rises, the density (ρ) decreases. A higher temperature leads kinetic energy and volume expansion, which subsequently drives density to decrease. $C_2H_5NO_2$+Na_2SO_4 molecules are more closely packed than $C_5H_9NO_2$ in Na_2SO_4.

Acoustic impedance (Z)

The resistance a material offers to the transmission of ultrasonic waves is measured by its acoustic impedance (Z). As shown in Fig:-03 and Table:-03, the acoustic impedance values rises with Concentration of $C_2H_5NO_2$, $C_5H_9NO_2$ in Na_2SO_4 with rising temperature. Significant interaction between the component molecules is suggested by the rise in acoustic impedance with mixture composition. When sound pressure is present, sounds can pass through materials. A wave travels through a liquid due to an excess pressure because the atoms or molecules in the liquid are elastically bonded to one another. As the concentrations of $C_2H_5NO_2$, $C_5H_9NO_2$ in Na_2SO_4 rises, consequently increases the acoustic impedance. The lyophobic interaction between solute and solvent molecules occurs, which increases the intermolecular distance and creates a relatively larger gap between the molecules. (Awasthi N., 2021) it is the basis for the rise in acoustic impedance with concentration. As compared to the other three systems, the acoustic impedance of the $C_2H_5NO_2$ in Na_2SO_4 system is higher which suggests strong molecular association between solute-solvent molecules.

Lenard-Jones Potential (n)

Leonard-Jones Potential is also employed in binary and ternary liquid mixtures to measure the strength of intermolecular interactions. Lenard-jones Potential is related to attractive and repulsive forces. The repulsive forces are weaker when n is larger. The dominance of attractive forces over repulsive forces is thus indicated by a large value of n. From Fig:- 04 and Table:-04, As the concentrations of $C_2H_5NO_2$, $C_5H_9NO_2$ in Na_2SO_4 for a constant frequency, the values of n rise as well. In the liquid mixture, the growing dominance of attractive forces over repulsive forces is indicated by the increase in n. The force of attraction is stronger in mixture of $C_2H_5NO_2$ in Na_2SO_4 than $C_5H_9NO_2$ with Na_2SO_4.

Adiabatic Compressibility (β)

Adiabatic compressibility, essentially determines the orientation and intermolecular structure of constituent molecules, is crucial in the ultrasonic investigation of liquids and liquid mixtures.(Stepanov V. P., 2019) From Fig-05 and Table:-05, The values of adiabatic compressibility decrease with increase in concentration of $C_2H_5NO_2$, $C_5H_9NO_2$ in Na_2SO_4 due to electrostriction compression of solute around the molecule. When an ion enters the solvent environment, due to electrostrictive forces bulk solvent attracted towards ion. Hence a smaller number of ions are available for next incoming ion called compression. The electrostrictive forces cause breaking of water molecule and reduces the compressibility and compact packing of water molecule surrounds the solute. Therefore, decrease in adiabatic compressibility indicates strong solute – solvent interaction. (Padmanaban. R., 2023) the strong solute-solvent interaction is observed between $C_2H_5NO_2$ + Na_2SO_4 than $C_5H_9NO_2$ +Na_2SO_4.

Molar Compressibility or Wada Constant (W)

Some percentage of free space always exists between liquid molecules since they are not densely packed. The Wada constant varies with temperature, as seen in Fig:-06 and Table:-06, which also indicates that as the temperature rises, the distance between solute solvent molecules decreases as they approach one another. This supports the strong solute-solvent interaction occurs in liquid solutions. It was reported that if the variation in Wada's Constant is linear, then it shows that there is an absence of complex formation in the mixture and so is found in the present investigation which means that there is no complex formation in the mixture.(Panda S., 2021) In Fig:-06 and Table:-06 we observed that the Wada constant for Glycine +Na_2SO_4 and Proline +Na_2SO_4 systems is rises with solute concentration and temperature. The strong solute- solvent interaction is observed between $C_2H_5NO_2$ +Na_2SO_4 than $C_5H_9NO_2$ +Na_2SO_4.

Non-linearity parameter (B/A)

Non-linear parameter (B/A) obtain by Hartmann-Balizer is related to the internal pressure, hardness, intermolecular potential, molecular structure and molecular interaction of liquid.(Mishra P.L, 2021) Fig:-07 and Table:-07 show the non-linearity parameter for both the systems as a function of concentration at 323.15K and 328.15K temperature. The decreasing trends of this parameter exhibits the interaction between the components of solute and solvent is stronger at higher concentration. The nonlinearity parameter for solutions decreases with increase in concentration of solute molecules of $C_2H_5NO_2$ and $C_5H_9NO_2$. Decrease in non-linearity parameter suggests solute solvent interaction occurs in constituent molecules. The strength of interaction is stronger in $C_2H_5NO_2$ +Na_2SO_4 than $C_5H_9NO_2$ +Na_2SO_4.

Specific Heat Ratio

The variation specific heat ratio of $C_2H_5NO_2$ +Na_2SO_4 and $C_5H_9NO_2$ +Na_2SO_4 is shown Fig: -08 and Tablr:-08. The specific heat ratio decreases with increase in solute $C_2H_5NO_2$ and $C_5H_9NO_2$) concentration and temperature. Decrease in specific heat ratio lowers the transfer of heat hence thermal conductivity reduces. (Hepat S.V., 2023) The reduction in thermal conductivity is higher in $C_2H_5NO_2$ +Na_2SO_4 than $C_5H_9NO_2$ +Na_2SO_4

Free length (L_f)

A vital physical characteristic of a liquid that relates the strength of interaction with density and sound speed is the intermolecular free length. It is the separation between the surfaces of molecules that are nearest to their neighbour in a liquid. The study of free length is useful to understand intermolecular interactions. Free length is depending upon adiabatic compressibility. When the value of free length is long then free volume is large and decreasing the free available space. (Geetha R., 2023) Fig:-09 and Table:-09, shows the reduction in free length with increase in solute ($C_2H_5NO_2$ and $C_5H_9NO_2$) concentration and temperature suggests those strong intermolecular interactions among constituent molecules. It supports structure promoting behaviour, close packing and stronger association in distinct molecules by hydrogen bonding. From Fig-09, we conclude that, free length is decreases with increase in temperature and concentration of solute ($C_2H_5NO_2$ and $C_5H_9NO_2$) indicative of close packing of molecules. The Free length for $C_2H_5NO_2$ is lower than $C_5H_9NO_2$ in sodium sulphate suggests stronger interaction between Glycine in saline salt solution.

Molar sound velocity or Rao Constant

The linear increase in values of R confirms absence of complex formation in system. The values of Rao constant are increasing with increase in concentration of $C_2H_5NO_2$, C5H9NO2. The trend toward higher R values shows that there are more components available in specific regions, which causes the medium to compact packing and increases solute-solvent interactions. (Panda S., 2021) The solute-solvent interaction is higher for $C_2H_5NO_2$ +Na_2SO_4 than $C_5H_9NO_2$ +Na_2SO_4.

Conclusion

- The rise in ultrasonic velocity suggests there is larger ion –dipole interaction between $C_2H_5NO_2$ +Na_2SO_4 than $C_5H_9NO_2$ +Na_2SO_4. It conform stronger interaction between $C_2H_5NO_2$ + Na_2SO_4. Volume decreases with increasing density, suggesting association between constituent molecules solution.
- The rising trend of acoustic impedance strong molecular association between solute-solvent molecules. The larger values of n shows dominance of attractive forces over repulsive forces. The force of attraction is higher for Glycine than Proline in sodium sulphate solution.
- The linearly increasing trend of Wada constant and Rao constant supports the strong solute-solvent interaction occurs in liquid solutions. it shows that there is an absence of complex formation in the mixture. The decrease in Non-linearity parameter suggests the strength of solute solvent interaction is higher in system of Glycine with sodium sulphate.
- When the value of free length is long then free volume is large and decreasing the free available space, adiabatic compressibility. The decreasing trend of free length and adiabatic compressibility confirms structure promoting behaviour, close packing and stronger association in distinct molecules by hydrogen bonding.

The degree of interaction is higher for Glycine than Proline in saline salt solution (Na_2SO_4) therefore, Glycine is more effective on saline soil. It may improve physical properties of saline soil.

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Table and Graph

Table:-01- Variation in ultrasonic velocity of Gly+H_2O, Gly+H_2O+Na_2SO_4, Pro+H_2O, Pro+H_2O+Na_2SO_4 at 323.15K and 328.15K.

Ultrasonic Velocity (U) (m/s)								
concentration	T=323.15K				T=328.15K			
	Gly+H2O	Gly+H2O+Na2SO4	Pro+H2O	Pro+H2O+Na2SO4	Gly+H2O	Gly+H2O+Na2SO4	Pro+H2O	Pro+H2O+Na2SO4
0.00	1450.030	1450.030	1450.030	1450.030	1548.023	1548.023	1548.023	1548.023
0.02	1540.376	1565.372	1554.420	1560.403	1555.620	1577.740	1555.400	1562.257
0.04	1552.320	1574.412	1557.969	1565.963	1558.000	1589.344	1558.000	1567.657
0.06	1553.898	1585.670	1560.999	1569.776	1560.337	1611.200	1561.745	1570.052
0.08	1564.470	1598.028	1561.069	1571.962	1565.710	1620.319	1566.324	1572.448
0.1	1566.991	1607.710	1562.387	1574.659	1567.708	1624.019	1570.881	1576.834
0.12	1577.678	1610.526	1563.210	1580.471	1579.449	1630.482	1574.876	1580.970

0.14	1592.320	1614.328	1563.615	1585.331	1594.366	1650.213	1576.754	1587.503
0.16	1596.669	1620.018	1564.413	1592.454	1602.201	1658.704	1577.013	1598.930
0.18	1630.300	1620.578	1568.615	1598.834	1632.084	1665.704	1577.937	1601.679
0.2	1638.889	1645.526	1571.000	1604.380	1647.830	1680.406	1578.666	1609.407

Table:-02- Variation in Density of Gly+H_2O, Gly+H_2O+Na_2SO_4, Pro+H_2O, Pro+H_2O+Na_2SO_4 at 323.15K and 328.15K.

Density(ρ)(KgM^{-3})								
concentration	T=323.15K				T=328.15K			
	Gly+H2O	Gly+H2O+Na2SO4	Pro+H2O	Pro+H2O+Na2SO4	Gly+H2O	Gly+H2O+Na2SO4	Pro+H2O	Pro+H2O+Na2SO4
0.00	989.02	989.02	989.02	989.02	985.65	985.65	985.65	985.65
0.02	989.47	992.13	988.89	991.276	989.10	991.38	987.57	990.02
0.04	990.84	992.67	989.323	991.9	990.06	992.11	988.62	990.76
0.06	991.02	993.78	990.07	992.56	990.29	992.89	989.57	991.57
0.08	991.93	994.69	990.777	993.23	991.67	993.68	990.46	992.45
0.1	991.98	995.37	991.454	994.06	991.67	994.98	990.99	993.32
0.12	992.89	995.44	992.088	994.95	992.35	995.01	991.05	994.4
0.14	993.52	996.21	993.119	995.41	993.08	995.92	992.36	995.12
0.16	994.43	997.29	994.057	996.3	994.1	996.78	993.78	995.98
0.18	995.57	998.99	994.96	997.28	995.00	997.65	994.275	996.22
0.2	996.19	999.47	995.48	998.00	996.01	998.86	994.99	997.52

Table:-03- Variation in Acoustic impedance of Gly+H_2O, Gly+H_2O+Na_2SO_4, Pro+H_2O, Pro+H_2O+Na_2SO_4 at 323.15K and 328.15K.

Acoustic Impedance (Z) (Kgm^{2}s^{-1})								
concentration	T=323.15K				T=328.15K			
	Gly+H2O	Gly+H2O+Na2SO4	Pro+H2O	Pro+H2O+Na2SO4	Gly+H2O	Gly+H2O+Na2SO4	Pro+H2O	Pro+H2O+Na2SO4
0.00	1429222	1429222	1429222	1429222	1529454	1529454	1529454	1529454
0.02	1524155	1555317	1537399	1581035	1539534	1581589	1538066	1590481
0.04	1544310	1588614	1542892	1590011	1545629	1598800	1540269	1598120
0.06	1546159	1601305	1547522	1594105	1549867	1632113	1545456	1603491
0.08	1558102	1645473	1548856	1599384	1558930	1650035	1551381	1606975
0.1	1565079	1659751	1552315	1607266	1562487	1659901	1559869	1611392
0.12	1577504	1665992	1554593	1615640	1576842	1670983	1563930	1618923
0.14	1602224	1671168	1559110	1623174	1601349	1692293	1567861	1625460
0.16	1610128	1678808	1561842	1638151	1612262	1704898	1573512	1640341
0.18	1647532	1680523	1567055	1642121	1647703	1714126	1576792	1643060
0.2	1657228	1706690	1575524	1652667	1665362	1734918	1580228	1660797

Table:-04- Variation in Lenard Jones Potential of Gly+H_2O, Gly+H_2O+Na_2SO_4, Pro+H_2O, Pro+H_2O+Na_2SO_4 at 323.15K and 328.15K.

Lenard-Jones potential(γ *E-06)(J mol^{-1})								
concentration	T=323.15K				T=328.15K			
	Gly+H2O	Gly+H2O+Na2SO4	Pro+H2O	Pro+H2O+Na2SO4	Gly+H2O	Gly+H2O+Na2SO4	Pro+H2O	Pro+H2O+Na2SO4
0.00	7.61	7.61	7.61	7.61	5.45	5.45	5.55	5.35
0.02	7.59	8.64	8.14	8.55	7.81	8.53	8.08	8.46
0.04	7.96	8.86	8.32	8.76	7.97	8.86	8.14	8.57
0.06	8.09	9.16	8.38	8.83	8.03	9.28	8.22	8.63
0.08	8.29	9.37	8.39	8.88	8.15	9.47	8.31	8.68
0.1	8.36	9.54	8.53	8.93	8.20	9.55	8.51	8.78
0.12	8.56	9.60	8.55	9.04	8.52	9.68	8.58	8.87
0.14	8.96	9.77	8.59	9.23	8.83	10.10	8.63	9.09
0.16	9.05	9.86	8.61	9.36	8.97	10.20	8.67	9.29

0.18	9.59	9.87	8.69	9.46	9.46	10.30	8.80	9.34
0.2	9.72	10.02	8.87	9.56	9.70	10.50	8.83	9.48

Table:-05- Variation in Adiabatic Compressibility of Gly+H_2O, Gly+H_2O+Na_2SO_4, Pro+H_2O, Pro+H_2O+Na_2SO_4 at 323.15K and 328.15K.

Adiabatic Compressibility (β*E-10) (M^2N^{-1})								
concentration	T=323.15K				T=328.15K			
	Gly+H2O	Gly+H2 O+Na2S O4	Pro+H2O	Pro+H2O+ Na2SO4	Gly+H2O	Gly+H2 O+Na2S O4	Pro+H2O	Pro+H2O+ Na2SO4
0.00	4.2236	4.2236	4.2236	4.2236	4.8252	4.8252	4.8252	4.8252
0.02	4.2593	4.0043	4.1845	4.0293	4.1754	4.0074	4.1855	4.0486
0.04	4.1714	3.9313	4.1601	3.9958	4.1526	3.9353	4.1671	4.0118
0.06	4.1622	3.8659	4.1396	3.9727	4.1351	3.8027	4.1431	3.9954
0.08	4.1023	3.8029	4.1358	3.9586	4.0969	3.7403	4.1152	3.9762
0.1	4.0775	3.7475	4.1231	3.9410	4.0824	3.7102	4.0810	3.9457
0.12	4.0180	3.7270	4.1149	3.9082	4.0151	3.6703	4.0600	3.9150
0.14	3.9196	3.7067	4.1019	3.8806	3.9167	3.5808	4.0450	3.8807
0.16	3.8897	3.6768	4.0927	3.8399	3.8712	3.5361	4.0299	3.8178
0.18	3.7230	3.6718	4.0681	3.8066	3.7185	3.5023	4.0191	3.8020
0.2	3.6818	3.5607	4.0401	3.7757	3.6440	3.4301	4.0085	3.7596

Table:-06- Variation in Wada constant or molar compressibility of Gly+H_2O, Gly+H_2O+Na_2SO_4, Pro+H_2O, Pro+H_2O+Na_2SO_4 at 323.15K and 328.15K.

Wada Constant(W*E-04)(m3mole-1)(ms-1)-1/7								
Concentration	T=323.15K				T=328.15K			
	Gly+H2O	Gly+H2 O+Na2S O4	Pro+H2O	Pro+H2O+ Na2SO4	Gly+H2O	Gly+H2 O+Na2S O4	Pro+H2O	Pro+H2O+ Na2SO4
0.00	3.9826	3.9826	3.9826	3.9826	3.9170	3.9170	3.9170	3.9170
0.02	3.9801	3.9868	4.1548	3.9826	4.0601	4.0527	4.1609	4.0084
0.04	3.9897	3.9776	4.0881	3.9900	3.9838	4.0570	4.0941	4.0123
0.06	4.0627	3.9848	4.0943	3.9970	3.9890	4.0565	4.1013	4.0180
0.08	3.9796	3.9984	4.0992	4.0034	3.9925	4.0526	4.1092	4.0211
0.1	3.9901	4.0041	4.1029	4.0093	3.9983	4.0509	4.1113	4.0245
0.12	4.0026	4.0070	4.1078	4.0176	4.0088	4.05344	4.1217	4.0261
0.14	4.0131	4.0149	4.1065	4.0253	4.0066	4.0730	4.1261	4.0365
0.16	4.0208	4.0231	4.1103	4.0325	4.0134	4.0788	4.1218	4.0453
0.18	4.0283	4.0289	4.1187	4.0421	4.0311	4.0874	4.1248	4.0523
0.2	4.0336	4.0536	4.1144	4.0492	4.0462	4.0940	4.1268	4.0598

Table:-07- Variation in Non-linearity parameter of Gly+H_2O, Gly+H_2O+Na_2SO_4, Pro+H_2O, Pro+H_2O+Na_2SO_4 at 323.15K and 328.15K.

Non-linearity Parameter(B/A) ($m^{-1}s$)								
Concentration	T=323.15K				T=328.15K			
	Gly+H2O	Gly+H2 O+Na2S O4	Pro+H2O	Pro+H2O+ Na2SO4	Gly+H2O	Gly+H2 O+Na2S O4	Pro+H2O	Pro+H2O+ Na2SO4
0.00	8.3307	8.3307	8.3307	8.3307	8.7584	8.7584	8.7584	8.7584
0.02	8.3620	8.2604	8.3046	8.2804	8.2997	8.2114	8.3006	8.2729
0.04	8.3131	8.2245	8.2902	8.2581	8.2901	8.1660	8.2901	8.2513
0.06	8.3067	8.1803	8.2780	8.2429	8.2806	8.0824	8.2750	8.2418
0.08	8.2641	8.1325	8.2777	8.2342	8.2591	8.0481	8.2566	8.2323
0.1	8.2540	8.0956	8.2724	8.2235	8.2511	8.0344	8.2385	8.2149
0.12	8.2116	8.0849	8.2691	8.2006	8.2046	8.0104	8.2227	8.1987
0.14	8.1545	8.0706	8.2675	8.1816	8.1466	7.9386	8.2153	8.1732
0.16	8.1377	8.0493	8.2643	8.1540	8.1165	7.9082	8.2142	8.1290
0.18	8.0111	8.0472	8.2475	8.1294	8.0045	7.8833	8.2106	8.1185
0.2	7.9796	7.9555	8.2380	8.1082	7.9472	7.8319	8.2077	8.0891

Table:-08- Variation in Specific heat Ratio of Gly+H_2O, Gly+H_2O+Na_2SO_4, Pro+H_2O, Pro+H_2O+Na_2SO_4 at 323.15K and 328.15K.

Specific heat ratio(γ) $(K^{\frac{4}{9}})^{-1}(Kg^{\frac{1}{3}}m^{-1})^{-1}$								
Concentration	T=323.15K				T=328.15K			
	Gly+H2O	Gly+H2O+Na2SO4	Pro+H2O	Pro+H2O+Na2SO4	Gly+H2O	Gly+H2O+Na2SO4	Pro+H2O	Pro+H2O+Na2SO4
0.00	0.131658	0.131658	0.131658	0.131658	0.130868	0.130868	0.130868	0.130868
0.02	0.131594	0.130305	0.131611	0.130299	0.130691	0.130133	0.130783	0.129721
0.04	0.131357	0.130006	0.131556	0.130245	0.130585	0.129981	0.130737	0.129625
0.06	0.131349	0.129896	0.131510	0.130205	0.130531	0.129680	0.130695	0.129580
0.08	0.131309	0.129858	0.131474	0.130171	0.130427	0.129452	0.130656	0.129503
0.1	0.131184	0.129745	0.131413	0.130126	0.130384	0.129301	0.130544	0.129411
0.12	0.131135	0.129659	0.131372	0.130084	0.130310	0.129178	0.130542	0.129300
0.14	0.130860	0.129627	0.131257	0.130042	0.130049	0.129150	0.130484	0.129278
0.16	0.130764	0.129582	0.131202	0.129974	0.129967698	0.129052	0.130335	0.129191
0.18	0.130672	0.129552	0.131174	0.129943	0.129826364	0.129001	0.130270	0.129161
0.2	0.130645	0.129545	0.131005	0.129890	0.129780	0.128860	0.130196	0.129092

Table:-09- Variation in Free length of Gly+H_2O, Gly+H_2O+Na_2SO_4, Pro+H_2O, Pro+H_2O+Na_2SO_4 at 323.15K and 328.15K.

Free Length(L_f*E-11)(m)								
Concentration	T=323.15K				T=328.15K			
	Gly+H2O	Gly+H2O+Na2SO4	Pro+H2O	Pro+H2O+Na2SO4	Gly+H2O	Gly+H2O+Na2SO4	Pro+H2O	Pro+H2O+Na2SO4
0.00	4.15	4.15	4.15	4.15	4.44	4.44	4.44	4.44
0.02	4.17	4.04	4.13	4.05	4.13	4.04	4.13	4.06
0.04	4.12	4.00	4.12	4.04	4.11	4.01	4.12	4.04
0.06	4.12	3.97	4.11	4.02	4.11	3.94	4.11	4.04
0.08	4.09	3.94	4.11	4.02	4.09	3.91	4.10	4.03
0.1	4.08	3.91	4.10	4.01	4.08	3.89	4.08	4.01
0.12	4.05	3.90	4.10	3.99	4.05	3.87	4.07	4.00
0.14	4.00	3.89	4.09	3.98	4.00	3.82	4.06	3.98
0.16	3.98	3.87	4.09	3.96	3.97	3.80	4.05	3.95
0.18	3.90	3.87	4.07	3.94	3.89	3.78	4.05	3.94
0.2	3.87	3.81	4.06	3.92	3.85	3.74	4.04	3.92

Table:-10- Variation in Rao Constant of Gly+H_2O, Gly+H_2O+Na_2SO_4, Pro+H_2O, Pro+H_2O+Na_2SO_4 at 323.15K and 328.15K.

Rao Constant (R*E-04)(($m^3 mole^{-1}$)$(m/s)^{1/3}$)								
Concentration	T=323.15K				T=328.15K			
	Gly+H2O	Gly+H2O+Na2SO4	Pro+H2O	Pro+H2O+Na2SO4	Gly+H2O	Gly+H2O+Na2SO4	Pro+H2O	Pro+H2O+Na2SO4
0.00	2.10537	2.10537	2.10537	2.10537	2.07130	2.07130	2.08262	2.05998
0.02	2.11346	2.15966	2.15461	2.15737	2.13199	2.16533	2.16665	2.16983
0.04	2.13048	2.16381	2.16784	2.17154	2.14467	2.18230	2.16786	2.17233
0.06	2.14279	2.18062	2.16925	2.17331	2.14574	2.19226	2.16959	2.17343
0.08	2.14764	2.18627	2.16928	2.17431	2.14820	2.19638	2.17171	2.17454
0.1	2.14879	2.19067	2.18149	2.17556	2.14912	2.19806	2.18544	2.17656
0.12	2.15366	2.19195	2.18188	2.17823	2.16611	2.20097	2.18729	2.17846
0.14	2.17198	2.20541	2.18207	2.19212	2.17291	2.22163	2.18816	2.19312
0.16	2.17396	2.20799	2.18244	2.19540	2.17647	2.22543	2.18828	2.19837
0.18	2.18912	2.20825	2.18439	2.19833	2.18991	2.22856	2.20035	2.19963
0.2	2.19295	2.21952	2.19712	2.20087	2.19693	2.23509	2.20069	2.20316

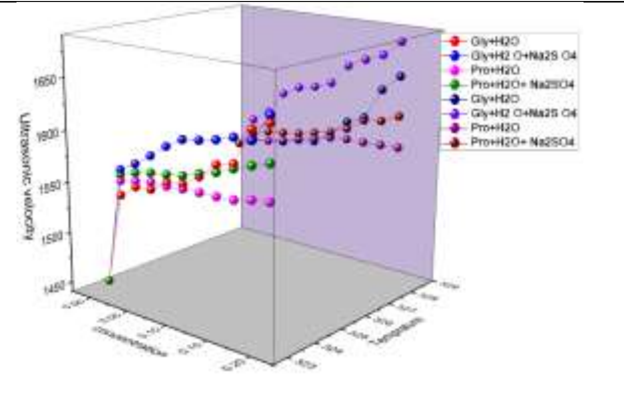

Fig:-01: Variation in Ultrasonic Velocity at 323.15K, 328.15K

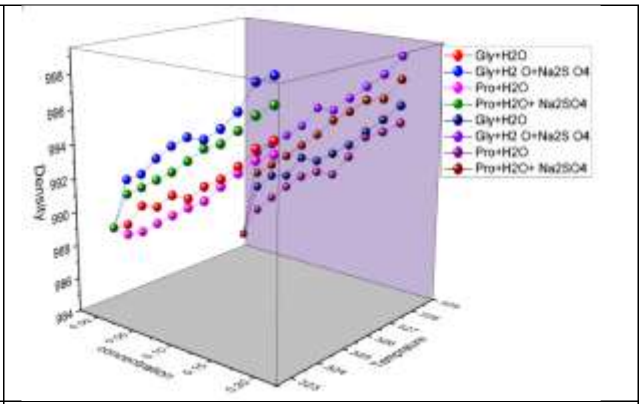

Fig:-02: Variation in Density at 323.15K, 328.15K

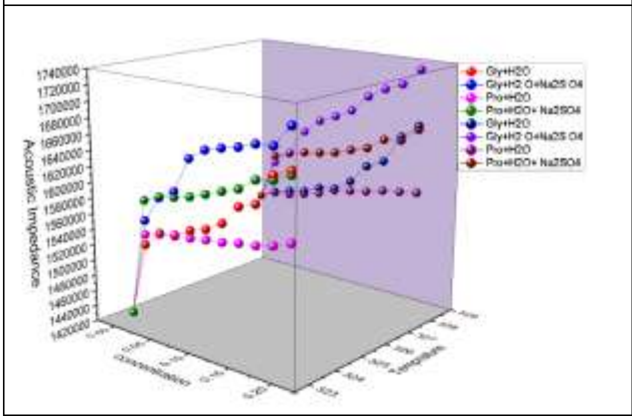

Fig:-03: Variation in Acoustic Impedance at 323.15K, 328.15K

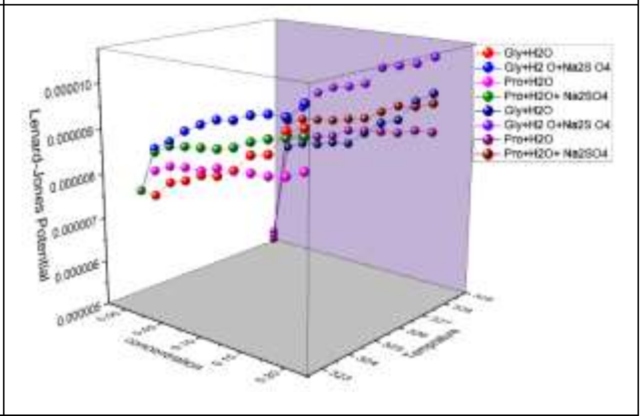

Fig:-04: Variation in Lenard-Jones Potential at 323.15K, 328.15K

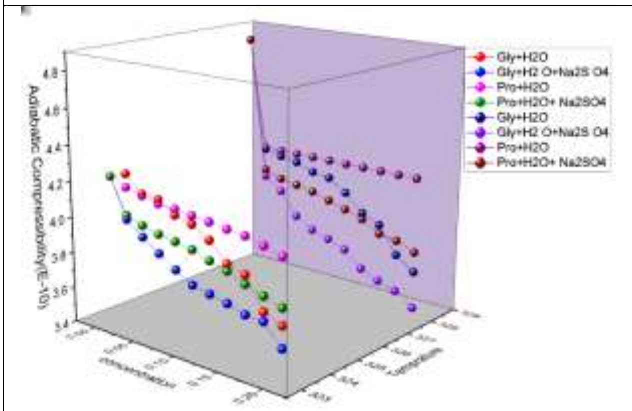

Fig:-05: Variation in Adiabatic Compressibility at 323.15K, 328.15K

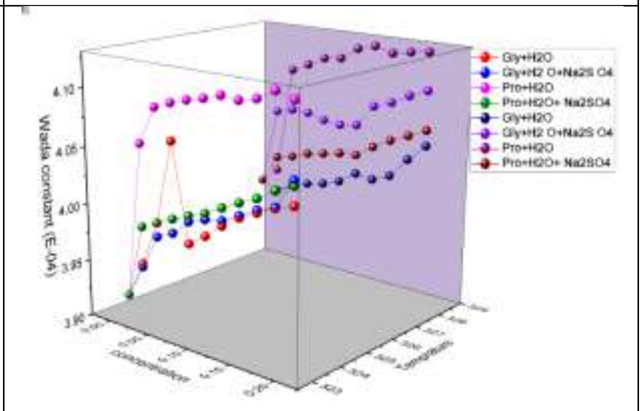

Fig:-06: Variation in Wada Constant at 323.15K, 328.15K

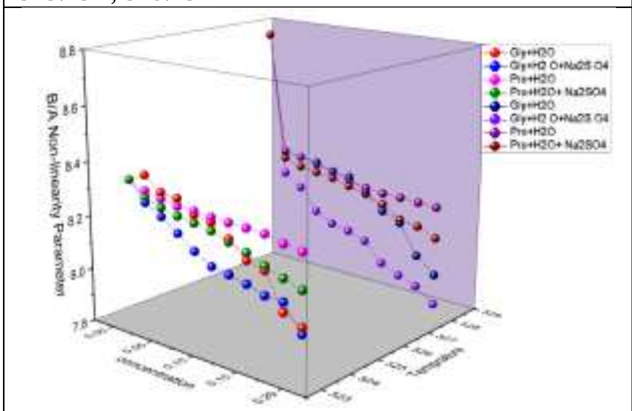

Fig:-07: Variation in B/A Non-linearity parameter at 323.15K, 328.15K

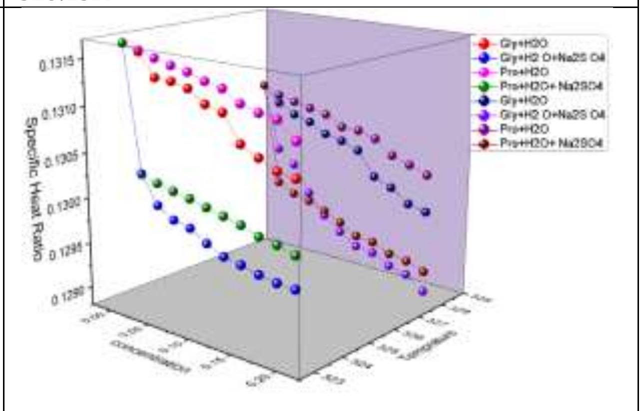

Fig:-08: Variation in Specific Heat Ratio at 323.15K, 328.15K

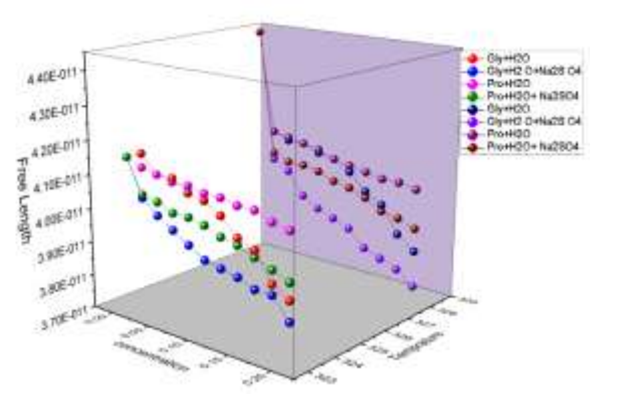

Fig:-09: Variation in Intermolecular free length at 323.15K, 328.15K

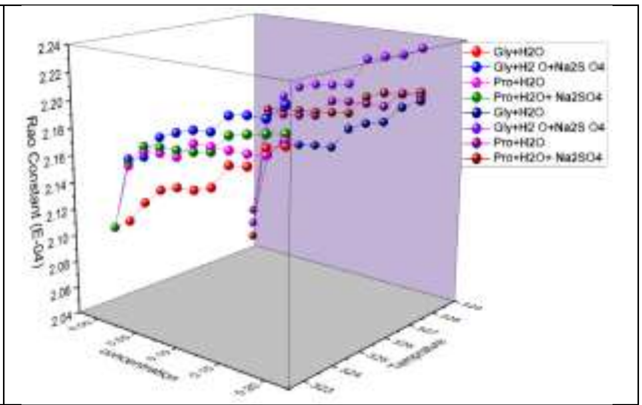

Fig:-10: Variation in Rao constant at 323.15K, 328.15K