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Short Communication

Ultrasonic wave technique utilize for study the behavior of peptides pentaglycine and dl-phenylalanine in a different solvents

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Abstract

The Ultrasonic velocity of pentaglycine and DL-Phenylalanine in different solvents mixtures have been investigated to understand the effect of pentaglycine and DL-Phenylalanine in interaction with water and organic solvents the various parameter such as molality, Do, do, Us, Uo, φ k(s), φv, Bo, Bs, Ds, ds, determined as well as the results have been discussed.

Keywords: Apparent molar adiabatic compressibility, Hydration numbers, Apparent molal volume.

Introduction

In a view of an analytical applications ultrasonic wave study has been undertaken. Ultrasonic wave propagation in liquids has been the subject of exhaustive research, which has been carried out both theoretically and experimentally. The efforts to correlate the ultrasonic velocity and the attenuation coefficient with the physical parameters of liquid have been quite encouraging.

Mathur et al[1] has studied molecular compressibility from ultrasonic data. Pankanti[2] has investigated the adiabatic compressibility and hydration number of amino acids in water and water-dioxanemixutes. Narwade et al[3] has the apparent molal volume, intermolecular free length, specific acoustic impedance, relative association and solvation number of mono chloro acetic acid (MCAA) in water-acetone mixtures.

Kaulgud et al[4] have studied the apparent molal volumes of alcohols in aqueous solutions at different temperatures.

Adiabatic compressibilities are used to obtain salvation number of ions. For this the wave lengths of ultrasonic velocities in solvents and solutions have been calculated. From these velocities and densities of solutions, adiabatic compressibilities are obtained. Compressibility values are used to calculate the hydration number.

In 1938, Pasynski[5] has drawn the conclusion from adiabatic compressibility studies of aqueous electrolyte solutions that the structure of water becomes highly coordinated and compacted with the introduction of ions. The absorption of sound by aqueous solution of electrolytes is investigated for frequency, concentration and temperature measurements.

Adiabatic compressibility of gelatin sol, aqueous solution of sugar and of carboxylic and hydroxycarbocylic acids are studied. Asai[6] has studied ultrasonic velocities of hydration and dehydration of polyelectrolyte solution in 1951.

Millerio and Coworkers[7] have investigated the apparent molal volume and adiabatic molal compressibilities of 15 amino acids in aqueous medium.

Hydration numbers are calculated using partial molal volume and adiabatic compressibility data. This particular field is attracting the attention of several workers in our county, which can be judged from recent publications in this field khobragade[8] have studied the apparent molal volume and adiabatic molal compressibility of Some peptides such as Glycyl-Glycine, L-Alanyl-L-Alanyl, DL-Alanyl-DlPhynylalanine and DL-Alanyl-Glycine have been studied.

Compressibility and apparent molal volumes of many electrolytes in mixed organic solvents are found out earlier. But compressibilities and apparent molal volumes of peptides in aqueous as well as in water-organic solvent mixtures are not studied so far. Therefore, *the present work is undertaken to make a systematic study of compressibilities and apparent molal volumes of:* i. DL-Phenylalanine (L_1) {M.W. 165.19} [$C_9H_{11}NO_2$], ii. Pentaglycine (L_2) {M.W. 303.30} [$C_{10}H_{17}N_5O_6$] in ethanol-water, methanol-water and acetone-water mixtures.

Materials and methods

Solvents and chemicals: Solvents and chemicals used are of Ar grade purity.

Instruments: Ultrasonic Interferometer: Ultrasonic Interferpmeter from Mittal Enterprises Model F-80 with accuracy upto ± 0.03% and frequency 2 MHz. is used for the measurement of ultrasonic velocities of different solutions.

Thermostat: A special thermostatic arrangement was done for density and ultrasonic velocity measurements. Thermostatic water bath (capacity 10-liters) supplied by Yarco Company having continuous stirring of water was carried out with the help of electric stirrer.

Ultrasonic Velocity Measurements: The sound velocities of peptides {i.e. ligands (L_1), (L_2), (L_3) and (L_4)} are measured in the concentration range of 0.0072 to 0.001512 molality in different percentage of Ethanol-water, methanol-water and acetone-water mixtures.

Results and discussion

Apparent molal compressibilities {$\phi_{K(s)}$} apparent molal (ϕ_v) of peptides in different percentage of Ethanol-water methanol-water and acetone-water mixtures at 27^0C are evaluated in the present investigation. The values of volume of Pyknometer and density of ligand solutions are calculated.

It is observed from data obtained that density of ligand solutions decreases with increasing percentage of methanol and acetone. This may be due to the liberation of heat energy (exothermic process) at higher percentage of organic solvents. Density of ligand solution, in general, increases with increasing percentage of Ethanol. This may be due to the effect of addition of bulky solvent.

Plots Between ϕ_V VS Mole fraction of Organic Solvents: Graphs are constructed between ϕ_v against mole fraction of organic solvents. Representative graphs are shown in Figures-1 and (4). The graphs show a good linear relationship for all the systems. The values of ϕ_v are in good agreement with Masson equation as the plots of ϕ_v vs mole fraction are linear. The values of ϕ_v are found to be increased with increasing the mole fraction or percentage of organic solvents excepts ligand (L_1) in Ethanol-water solvent. In this case the values of ϕ_v decrease with increasing the mole fraction or percentage of organic solvents.

Plots Between $\phi_{K(s)}$ VS Molality: Graphs are constructed between $\phi_{K(s)}$ against molality and representative graphs are shown in Figures-1 to 4. It is observed from the graphs that there is linear relationship. Same linear relationship is observed by Narwade and Khobragade for substituted sulphonic acids in methanol-water, ethanol-water and propanol-water mixtures.

Conclusion

It's observed that the values of $\phi_{K(s)}$ decrease for (L1) with increasing in percentage of acetone- water mixture and have no regular order for (L2), the reason of such behavior may be due to the fact of polar nature of organic solvent. It's also observed that, the values of ϕ_v in general, there is no regular order of $\phi_{K(s)}$ and ϕ_v values for both the system under investigation.

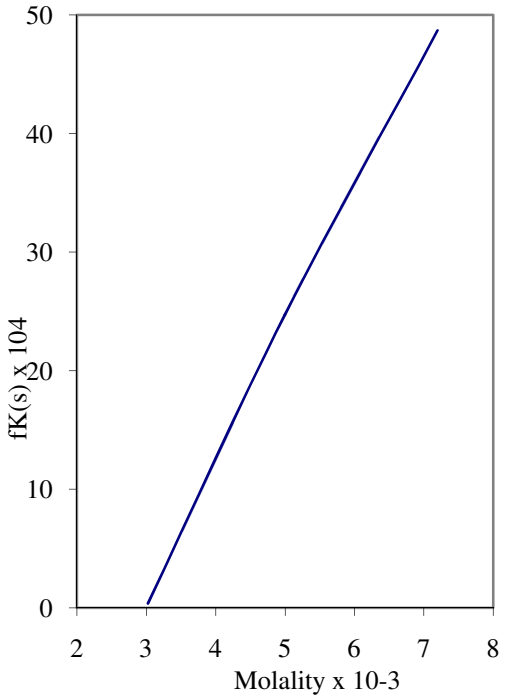

Figure-1: Plot between fK(s) Vs Molality System - Ligand (L_1) Acetone-Water Mixture.

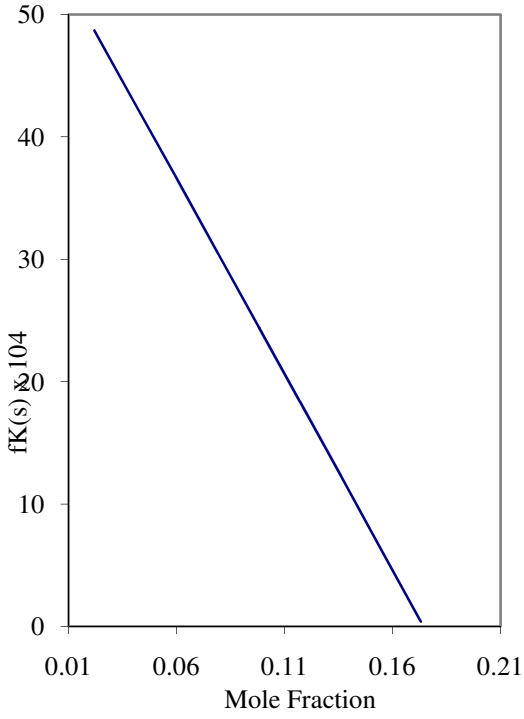

Figure-2: Plot between fV Vs Molality System - Ligand (L_1) Acetone-Water Mixture.

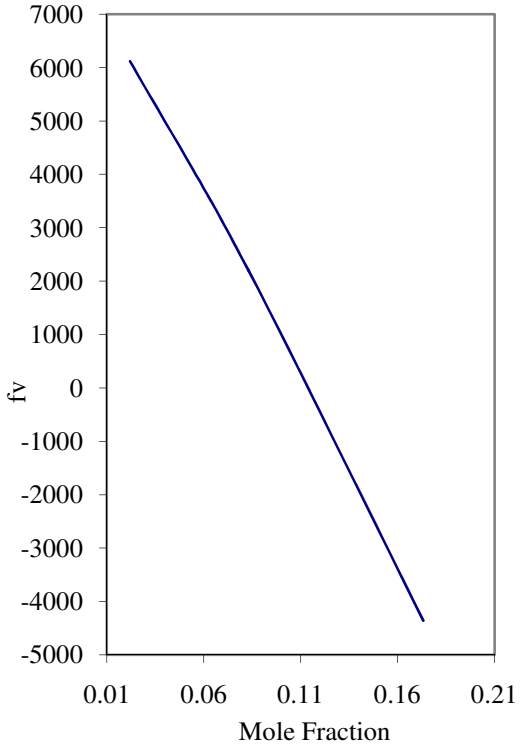

Figure-3: Plot between fK(s) Vs Mole Fraction System - Ligand (L_1) Acetone-Water Mixture.

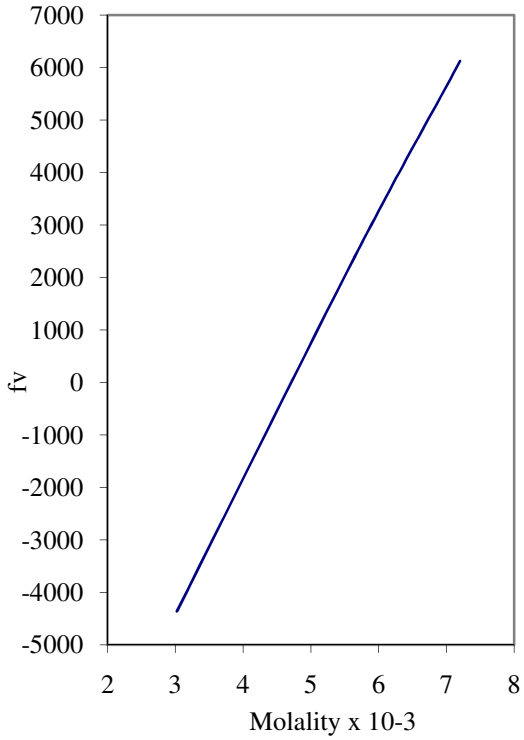

Figure-4: Plot between fv Vs Mole Fraction System - Ligand (L_1) Acetone-Water Mixture.

Table-1: ϕK(s) andϕv values along with other parameters in different percentage of Acetone-Water mixtures.

Parameter	Solvent Percentage (v/v)			
	20	30	40	50
Molality	0.0072	0.0050	0.0030	0.001512
D_0	0.3660	0.3551	0.3369	0.3498
d_0	1.0492	1.0378	1.0333	1.0149
U_0 msec^{-1}	1464.00	1420.40	1347.60	1399.20
B_0 x 10^8	44.4	47.7	53.2	50.3
Ds	0.3658	0.3547	0.3840	0.3930
ds	1.0091	1.0276	1.0460	1.0178
Us msec^{-1}	1463.30	1418.80	1536.0	1572.00
Bs x 10^8	46.2	48.3	40.5	39.7
B_0ds x 10^8	44.8040	49.0165	55.6472	51.1953
Bsd_o x 10^8	48.4730	50.1257	41.8486	40.2915
$\phi K_{(s)}$ x 10^4	48.6895	24.7164	0.3726	0.1275
ϕv	6119.7	2394.6	-4360.2	-177517

System Ligand (L_1), Ultrasonic Frequency: 2 MHz, Temp. 27± 0.1°C.

Table-2: $\phi K(s)$ and ϕv values along with other parameters in different percentage of Acetone -Water mixtures.

Parameter	Solvent Percentage (v/v)			
	20	30	40	50
Molality	0.0072	0.0050	0.0030	0.0015
D_0	0.3802	0.3871	0.3790	0.3810
d_0	1.0777	1.0249	1.0088	1.0024
U_0 msec^{-1}	1520.80	1548.40	1516.00	1524.00
$B_0 \times 10^8$	40.1	41.7	43.1	42.9
Ds	0.3831	0.3865	0.3760	0.3812
ds	1.0918	1.0283	1.0343	1.1902
Us msec^{-1}	1532.00	1546.00	1504.00	1524.80
Bs $\times 10^8$	39.0	40.6	42.7	36.1
B_0ds $\times 10^8$	43.7811	42.8801	44.5783	51.0595
Bs$d_o \times 10^8$	42.0303	41.6109	43.0757	36.1866
$\phi K_{(s)} \times 10^4$	-27.5139	-25.5348	-50.9917	-1182.0151
ϕv	-1382.85	-417.78	-8571.77	-149112.45

System Ligand (L_2), Ultrasonic Frequency: 2 MHz, Temp. 27± 0.1°C.

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