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Research Article

THE STUDY OF INTERNAL PRESSURE AND CONDUCTANCE OF SOLUTIONS OF SODIUM-4-AMINO-2-HYDROXY BENZOIC ACID DIHYDRATE AT DIFFERENT TEMPERATURES

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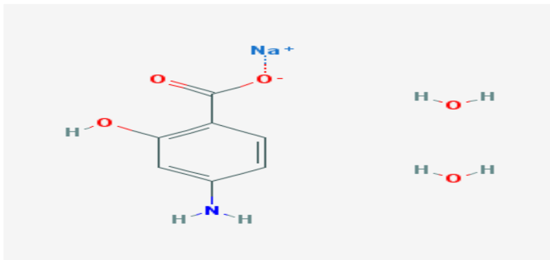
ABSTRACT

When water is used as the solvent, the inter-ionic forces are appreciable. Hence the molar conductance is directly related with the solute, ion-solvent molecular interactions or ion–solvent interactions. The study of internal pressure in liquid mixture provides a wealth of information about the liquid state. The internal pressure of the solution is a single factor which varies due to all the internal interactions like hydration, ion-solvent interactions, quantum mechanical forces of dispersion and dielectric constant effect. Therefore ion-solvent interaction in liquid can be explained by using internal pressure as well as conductance. In the present study, the aqueous solutions of sodium-4-amino-2-hydroxy benzoic acid dihydrate are taken and ultrasonic waves are propogated through the solution for different concentrations in the temperature range of 298.15K to 308.15K and the ultrasonic velocity through the solution is measured along with density and viscosity. Conductance of the solution is measured for the above concentration and temperature range. The variations of electrolytic conductance and internal pressure with temperature and concentration are studied.

INTRODUCTION

Electrolytic conductance is the important parameter to explain the behavior of molecular ions in liquid medium. Conductance is depend on the degree of dissociation of which is the fraction of total electrolytes in solvents exists in the form of its ions. A wealth of information can be obtained about the liquid state from the study of internal pressure to explain intra and inter molecular interactions in pure liquids (Bhatt S. C *et al*, 2000) aqueous solutions (Sekar S, 1996) and binary mixtures (Sastry G. L. N, 1986). Internal pressure is the acoustic parameter which is calculated by measuring the ultrasonic velocity. Suryanarayana (Suryanarayana C. V. *et al*, 1991; Bharti G. *et al*, 2009) showed that internal pressure and conductance are related with each other in term of cohesive energy barrier. Both parameters depend on the number of ions present in the liquid system and show certain interactions present in the system. Hence in the present investigation, both parameters can be interpreted in the form of molecular interactions in the system (G. Bharati *et al* 2009).



Sodium-4-amino-2-hydroxy benzoic acid dehydrate

Experimental section

Materials: For the present investigation, Analytical Range (AR) sodium-4-amino-2-hydroxy benzoic acid dihydrate is used. All the solutions were prepared by using distilled water as solvent. The concentration range selected was 0.1M, 0.01M and 0.001M.

METHODS

Weights of the solutes were taken on digital electronic balance Model-CB/CA/CT-Series Contech having accuracy ± 0.0001g. The densities of the solutions were measured accurately using

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digital densitometer (Model-DMA Anton Paar). Viscosity of the solutions was measured by Ostwald's viscometer which was calibrated with double distilled water at all three temperatures. The values are accurate to ± 0.001 cp.

The ultrasonic velocity was measured by using ultrasonic multi frequency interferometer (Model- M-83) supplied by Mittal Enterprises New Delhi, operating at 4MHz frequency with an accuracy of ± 2 m/s. The principle used in the measurement of ultrasonic velocity through medium is based on the accurate determination of wavelength of ultrasonic waves of known frequency produced by quartz crystal in measuring cell. The temperature of the solution was maintained by circulating water through the jacket of doubled walled cell. Measurements were made using constant temperature bath within ± 0.01K.

RESULTS AND DISCUSSIONS

The calculated values of electrolytic conductance and Internal pressure from the measured values of ultrasonic velocity(v), density (ρ), viscosity (η) and conductance (Kc) by using standard formulae and are given in Table-1.

$\lambda_m = K_c\,[1000/N]$ ---------- 1

or

$\lambda_m = K_c / C$

Where K_c - Specific Conductance
λ_m - Molar Conductance

$\pi_i = bRT(k\eta/v)^{1/2}(\rho^{2/3}/M_{eff}^{7/6})$ Pa ----------2

Where b is Packing factor,
R- Gas cinstant, T- Temperature, k – Constant = 4.28×10^{-09}
v and ρ are ultrasonic velocity and density.

Table 1 Conductance (λ_m) of sodium-4-amino-2-hydroxy benzoic acid dihydrate in water and 50% ethanol as a solvent

Sr.No.	Temperature (^{0}K)	Concentration (M)	(λ_m) Solvent-Water	(λ_m) Solvent – 50% Ethanol
1		0.1	5.10E+04	18470
2	298.15	0.01	1.06E+05	35600
3		0.001	2.04E+05	134000
4		0.1	5.51E+04	22100
5	303.15	0.01	1.33E+05	47000
6		0.001	2.60E+05	130000
7		0.1	6.28E+04	26000
8	308.15	0.01	1.52E+05	59000
9		0.001	3.50E+04	160000

Table 2 Internal Pressure (π_i) of sodium-4-amino-2-hydroxy benzoic acid dihydrate in water and 50% ethanol as a solvent.

Sr.No.	Temperature (^{0}K)	Concentration (M)	(π_i) Solvent-Water	(π_i) Solvent – 50% Ethanol
1		0.1	1.65E+08	2.43E+08
2	298.15	0.01	1.40E+08	2.66E+08
3		0.001	1.38E+08	2.76E+08
4		0.1	1.51E+08	2.00E+08
5	303.15	0.01	1.23E+08	2.82E+08
6		0.001	1.79E+08	2.57E+08
7		0.1	1.43E+08	2.38E+08
8	308.15	0.01	1.26E+08	2.46E+08
9		0.001	1.60E+08	2.57E+08

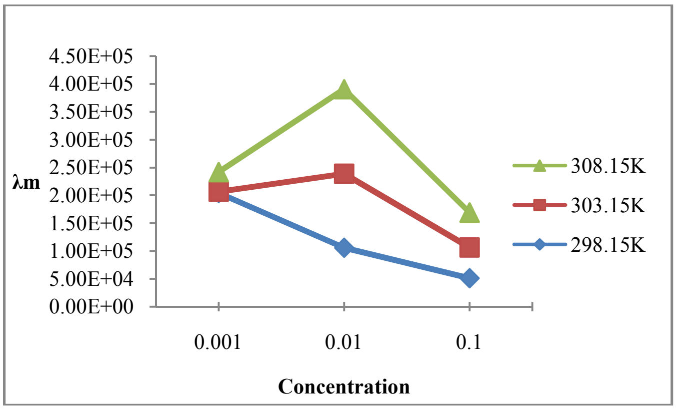

Fig 1 Conductance (λ_m) Vs Concentration (Solvent-Water) (Sodium-4-amino-2-hydroxy benzoic acid dihydrate)

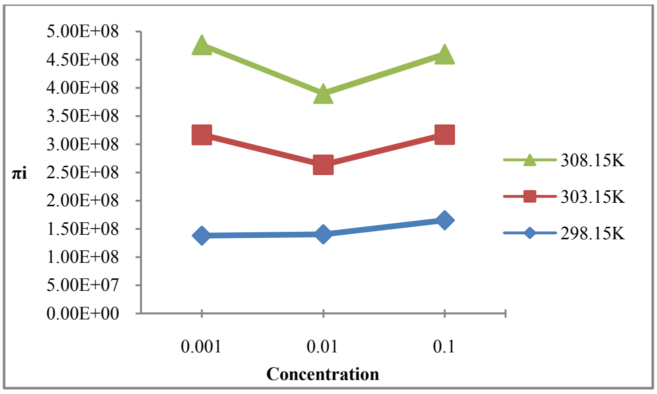

Fig 2 Internal Pressure (π_i) Vs Concentration (Solvent-Water) (Sodium-4-Amino-2-Hydroxy Benzoic Acid Dihydrate)

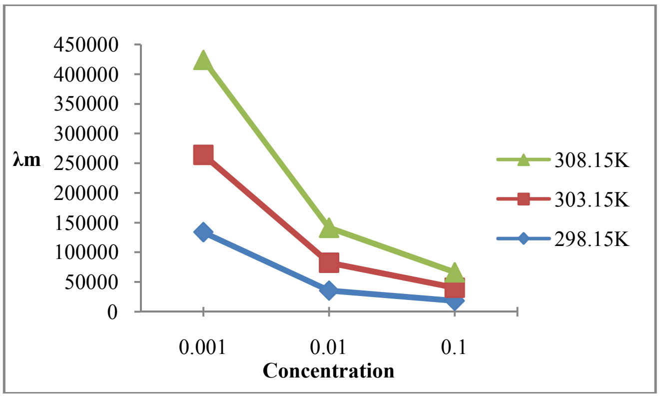

Fig 3 Conductance (λ_m) Vs Concentration (Solvent-50% Ethanol) (Sodium-4-amino-2-hydroxy benzoic acid dihydrate)

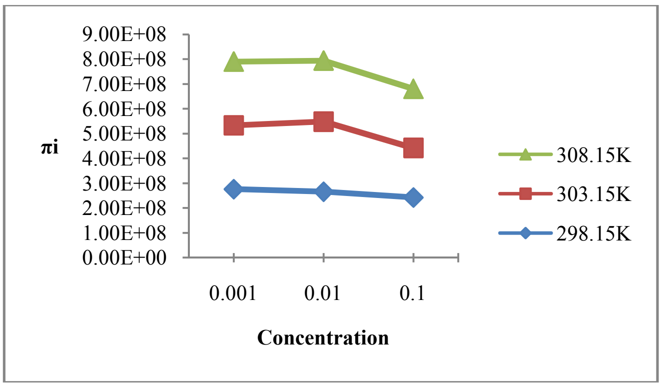

Fig 4 Internal Pressure (π_i) Vs Concentration (Solvent-50% Ethanol) (Sodium-4-Amino-2-Hydroxy Benzoic Acid Dihydrate)

The calculated values of molar conductance and internal pressure for system sodium-4-amino-2-hydroxy benzoic acid dihydrate + water and sodium-4-amino-2-hydroxy benzoic acid dihydrate + 50% ethanol are presented in Table 1 and 2.

The variation in the values of molar conductance against concentration for system sodium-4-amino-2-hydroxy benzoic acid dihydrate + water is not linear as shown in fig. 1. This variation in the values of molar conductance may be due to bulkiness of the solute molecules. The linear trend is observed in the values of molar conductance against concentration for the system sodium-4-amino-2-hydroxy benzoic acid dihydrate + 50% ethanol (Fig. 4). For this system, molar conductance decreases with increase in concentration. It is observed that the value of internal pressure shows somewhat irregular trend for sodium-4-amino-2-hydroxy benzoic acid dihydrate + water system presented graphically in fig. 2. Internal pressure helps to explain the forces of dispersion, repulsion, ionic and dipolar interactions that contribute to the overall forces of the liquid systems (D. Muraliji *et al*, 2009). The internal pressure decreases at 0.01M concentration for system sodium-4-amino-2-hydroxy benzoic acid dihydrate + water and there is rise in internal pressure of the system at 0.1M concentration. This indicates that molecular interactions are minimum at.0.01M and maximum at 0.1M concentration. For system sodium-4-amino-2-hydroxy benzoic acid dihydrate + 50% ethanol, internal pressure increases suddenly at 0.01M and has sudden dip in the value at 0.1M concentration. The variation of internal pressure may be due to combinational effect of hydration, ion-solvent interaction and quantum mechanical forces of dispersion, dielectric constant effect or incomplete dissociation of solute. The variation of internal pressure may be due to combinational effect of hydration, ion-solvent interaction and quantum mechanical forces of dispersion, dielectric constant effect or incomplete dissociation of solute. Extensive study of literature shows that internal pressure in liquid solution seems to be such a single factor which varies due to all the above mentioned internal forces (K. Ganthimathi *et al*, 1992).

CONCLUSION

The variation of internal pressure and conductance may be due to combinational effect of hydration, ion-solvent interaction and quantum mechanical forces of dispersion, dielectric constant effect or incomplete dissociation of solute.

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