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ULTRASONIC VELOCITY, DENSITY MEASUREMENT OF SUBSTITUTED HETEROCYCLIC DRUG IN DIOXANE-WATER AT 303.15 k

A. N. Sonar* R.D. Talele[1], J.P. Nehete[2] R.B. Dhake[3]
[*,1] Shri V.S. Naik College,Raver.Dist.Jalgaon (M.S.) India **E-mail**: ansonar1968@rediffmail.com
2- S.V.P. College, Ainpur. 3- D.D.N. Bhole College, Bhusaval

Abstract

The acoustical properties have been investigated from the ultrasonic velocity and density measurements of substituted heterocyclic drug in mixed medium at 300K. The measurement have been perform to evaluate acoustical parameter such as adiabatic compressibility (βs), Partial molal volume (ϕv), intermolecular free length (Lf), apparent molal compressibility (□k), specific acoustic impedance (Z), relative association (RA), solvation number (Sn).

Key word: - *Ultrasonic velocity, viscosity, adiabatic compressibility, apparent molal volume.*

Subject Classification: Physical chemistry.

INTRODUCTION

In the recent years, measurements of the Ultrasonic velocity are helpful to interpreted solute-solvent, ion-solvent interaction in aqueous and non aqueous medium [1-6]. Fumio Kawaizumi[5] have been studied the acoustical properties of complex in water. Jahagirdar et. al. has studied the acoustical properties of four different drugs in methanol and he drawn conclusion from adiabatic compressibility . The four different drugs compress the solvent methanol to the same extent but it shows different solute-solvent interaction due to their different size, shape and structure [6]. Meshram et. al. studies the different acoustical properties of some substituted Pyrazolines in binary mixture acetone-water and observed variation of ultrasonic velocity with concentration[7]. Palani have investigated the measurement of ultrasonic velocity and density of amino acid in aqueous magnesium acetate at constant temperature [8]. The ion-dipole interaction mainly depends on ion size and polarity of solvent. The strength of ion-dipole attraction is directly proportional to the size of the ions, magnitude of dipole. But inversely proportional to the distance between ion and molecules. Voleisines has been studied the structural properties of solution of lanthanide salt by measuring ultrasonic velocity [9]. Syal et.al. has been studied the ultrasonic velocity of PEG-8000, PEG- study of acoustical properties of substituted heterocyclic compounds under suitable condition[10].Tadkalkar et.al. have studied the acoustical and thermodynamic properties of citric acid in water at different temperature[11]. Mishra et.al. have investigated ultrasonic velocity and density in non aqueous solution of metal complex and evaluate acoustic properties of metal complex[13].M. Arvinthraj et.al. have determined the

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acoustic properties for the mixture of amines with amide in benzene at 303K-313K .They also determined thermodynamic parameters[14].S.K. Thakur et.al. have studied the different acoustical parameters of binary mixture of 1-propanol and water [14]. Mirikar et.sal. studied the molecular interaction between liquids.[14]

Preliminaries:

$$Adiabetic\ comprressibility(\beta o) = \frac{1}{Uo^2 \mathrm{do}}$$

$$Adiabetic\ comprressibility(\beta s) = \frac{1}{Us^2 \mathrm{ds}}$$

$$\text{Apparent molal volume}(\phi_v) = \left(\frac{M}{ds}\right) x \ \frac{(d_o - d_s)x10^3}{m\ x\ d_s\ x\ d_o}$$

$$\text{Apparent molal compressibility}(\phi_k) = 1000x \ \frac{(\beta_s d_o - \beta_o d_s)x10^3}{m\ x\ d_s\ x\ d_o} + \frac{\beta_s M}{d_o}$$

$$\text{Specific acoustic impedance } (Z) = U_s d_s$$

$$\text{Intermolecular free length } (L_f) = K\sqrt{\ } \ ds$$

$$\text{Relative association } (R_A) = x\ 1 \left(\frac{d_s}{d_o}\right)^{1/3}$$

$$\text{Solvation number}(Sn) = \frac{\phi_k}{\beta_o \left(\frac{M}{d_o}\right)}$$

$$\phi_\kappa = \phi^0{}_\kappa + S_k C$$

$$\phi_\varpi = \phi^0{}_\varpi + \Sigma_\varsigma X$$

Statement of problem:

After review of literature survey the detail study of substituted heterocyclic drug under identical set of experimental condition is still lacking. It was thought of interest to study the acoustical properties of substituted heterocyclic drug under suitable condition.

Material and Method

The double distilled 20% dioxane was used for preparation of different concentration of drug solution. The densities were determined by using specific gravity bottle by relative measurement method with accuracy □ $1x10^{-5}$ gm/cm^3. The ultrasonic velocities were measured by using ultrasonic interferometer having frequency 3MHz.The constant temperature was maintained by circulating water through the double wall measuring cell, made up of steel.

In the present investigation, different properties such as adiabatic compressibility (□s), apparent molal volume (□$_v$), intermolecular free length (L_f), apparent molal compressibility (□$_□$), specific acoustic impedance (Z), relative association (R_A), solvation number(S_n), limiting apparent molal compressibility (□$^□$$_□$), limiting apparent molal volume(□$^□$$_v$) and their constant ($S_k$, S_v).

Results and Discussion

In the present investigation, different acoustical properties such as ultrasonic velocity (Us), adiabatic compressibility (□s), intermolecular free length (L_f), specific acoustic impedance (Z), are listed in table-1. Partial molal volume (ϕ_v), apparent molal compressibility (ϕ_κ), relative association (R_A), solvation number (Sn) are listed in table-2. Limiting apparent molal compressibility ($\phi^0{}_\kappa$), limiting apparent molal volume (□□$^{□}$$_v$) and their constant ($S_k$, S_v) are listed in table-3. It was found that the ultrasonic velocity decreased with the increase in concentration for system (Table-1). Variation of ultrasonic velocity in solution depends upon the increase or decrease of molecular free length after mixing the component. This is based on a model for sound propagation proposed by Eyring and Kincaud[13]. Intermolecular free length increased linearly on increase in concentration of substituted heterocyclic drug (Naloxone) in mixed medium. Hence, decreased in ultrasonic velocity with increase in concentration of drug. It happened because there was significant interaction between ions and solvent molecules suggesting a structure promoting behavior of the added electrolyte. The specific acoustic impedance (Z) increased with the decrease in concentration of drug in aqueous medium. When concentration of electrolyte was increased, the thickness of oppositely charged ionic atmosphere increases due to decrease in ionic strength. This is suggested by decrease in acoustic impedance with concentration in system. It was seen that the intermolecular free length increased with the increase in concentration in system. The intermolecular free length increased due to greater force of attraction between solute and solvent by forming hydrogen bonding. The adiabatic compressibility increased with the increase in concentration of solution. It happened due to collection of solvent molecule around ions, this supporting weak ion-solvent interaction. This indicates that there is significant solute-solvent interaction.

It was observed that apparent molal volume increased with concentration in system. It indicates the existence of strong ion-solvent interaction. It was found that the value of apparent adiabatic compressibility was increased with the increase in concentration of Naloxone in mixed medium. It shows strong electrostatic attractive force in the vicinity of ions. From the data, we were concluded that strong molecular association was found in drug. The value of relative association increased with the increase in concentration in system. It has been found that there was strong interaction between solute and solvent. There were regular increases in solvation number with the increase in concentration; it indicates the solvent molecule forms strong coordination bond in primary layer. It indicates the increase in size of secondary layer of Solvation. The value of S_k exhibits positive. It indicates the existence of ion-ion or solute-solute interactions in naloxone system. The value of S_k exhibits positive, it indicates the strong existence of ion-ion or solute-solute interactions. From table-3, it was found that the value of limiting apparent molal volume was positive. It indicates that the ion-dipolar interaction in naloxone and mixed medium. The positive value of Sv indicates the strong solute-solvent interaction. This value indicates an induced effect of water on solute-solvent interaction. The value of S_k and Sv has been determine from fig. 1 and 2.

Lables of fig. and tables :

Table-1 Ultrasonic velocity, density, adiabatic compressibility (□$_S$), Specific acoustic impedance (Z) Intermolecular free length (L_f).

Concentration moles lit^{-1} (m)	Density (ds) kg m-^{3}	Ultrasonic velocity (Us) m s^{-1}	Adiabatic compressibiliy (□S) x10^{-10} m^{2}N^{-1}	Intermolecular free length (L_f) x10^{-11} m	Specific acoustic impedance (Zx10^{6}) kg m^{-2} s^{-1}
1x10^{-3}	1030.98	1584.90	3.86029	3.95155	1.634476
2x10^{-3}	1031.28	1579.92	3.88364	3.96348	1.629767
3x10^{-3}	1031.55	1570.56	3.92908	3.98660	1.620519
4x10^{-3}	1031.81	1553.76	4.01350	4.02920	1.603589
5x10^{-3}	1032.07	1539.26	4.08840	4.06662	1.589039
6x10^{-3}	1032.34	1526.36	4.15683	4.10051	1.576088
7x10^{-3}	1032.58	1512.98	4.22998	4.13642	1.562545
8x10^{-3}	1032.76	1498.25	4.31273	4.17670	1.547617
9x10^{-3}	1032.95	1480.12	4.41903	4.22860	1.528889

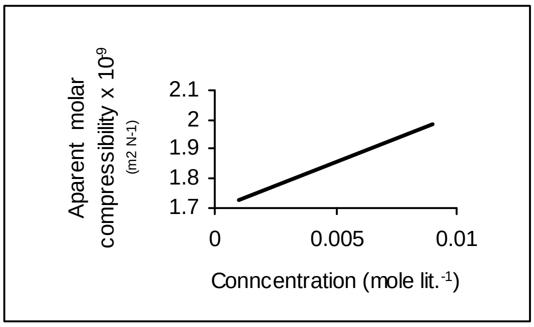
Table-2 Concentration (m), Relative association (R_A), Apparent molal compressibility (□□), Apparent molal volume (□v) , Solvation number (S_n)-

Concentration(m) moles lit^{-1}	Apparent molal volume (□v) m^{3}mole^{-1}	Apparent molar compressibility (□k□□x10^{-10}) m^{2} N^{-1}	Relative association (R_A)	Solvation number (S_n)
1x10^{-3}	0.15232	1.75064	1.003724	1.013889
2x10^{-3}	0.16169	1.76076	1.005413	1.019751
3x10^{-3}	0.17418	1.78099	1.008493	1.031467
4x10^{-3}	0.18276	1.81896	1.013999	1.053458
5x10^{-3}	0.18789	1.85259	1.018845	1.072935
6x10^{-3}	0.18971	1.88323	1.023201	1.090679
7x10^{-3}	0.19504	1.91607	1.027767	1.109699
8x10^{-3}	0.20608	1.95336	1.032856	1.131296
9x10^{-3}	0.21361	2.00133	1.039203	1.159078

Table-3 Limiting Apparent molal compressibility (□□□), Limiting Apparent molal volume

(□ $^{□}_{v}$), S_v and S_k

Limiting Apparent molal volume (□ $^{□}_{v}$) m^3mole^{-1}	Limiting Apparent molal compressibility (□ $^{□}_{□}$)x 10^{-9} $m^2 N^{-1}$	S_v $m^3kg^{1/2}$ mole-$^{3/2}$	S_k $m^3mole^{-2}kg. N^{-1}$
0.1492	1.6980	7.1166	31.917



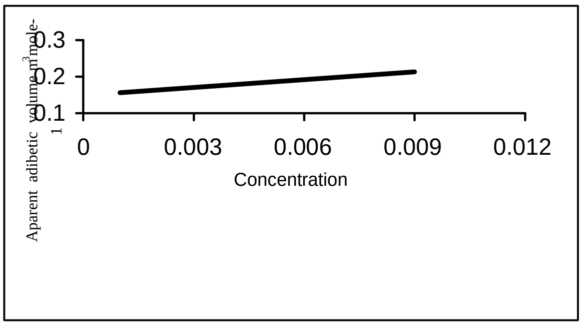


Fig.-1 -Apparent molal volume (m^3mole^{-1}) Vs Concentration (mole lit^{-1})

Fig.-2- Aparent molar compressibility10^{-9} ($m^2 N^{-1}$) Vs Concentration (mole lit^{-1})

Conclusion

The present study shows the experimental data for ultrasonic velocity, density and viscosity at 300.15K for substituted heterocyclic drug in aqueous medium. From experimental data, the acoustical properties were calculated. The solute-solvent interaction and ion-ion / solute-solute interaction existing between drug and aqueous medium were also studied with the help of experimental data. Lastly it has been concluded from the experimental data, that the solute-solvent interaction in drug - aqueous medium systems are weak.

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References

[1] S. Baluja and S. Oza , *Fluid phase equlibria.* , **2005**, 200(1): 49-54.
[2] M. K. Rawat and Sangeeta, *Ind. J. pure Appl. Phy.* , **2008**, 46: 187-192.
[3] A Ali. and A K Nain, *Acoustics Lett.* **, 1996,** 19: 53.
[4] H. Ogawa and S J Murakami, *J. Solution. Chem*., **1987**, 16:315.
[5] D. Ubagaramary, Dr.P.Neeraja, *Journal of Applied Chemistry, . 2012, Volume 2, Issue 5 , PP 01-19*
[6] A.V. Kachare , D.D.Patil, S.R.Patil, and A.N.Sonar, *Journal of Applicable Chemistry*, 2013, 2 (5):1207-1215

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[7] G. R. Bedare, V. D. Bhandakkar ,B. M. Suryavanshi, *Science park*, 2013, Volume-1, Issue-4, 15:1-32.:

[5] F. Kawaizumi, K. Matsumoto and H. Nomura, *J. Phys. Chem.*, **1983**,87(16): 3161-3166.

[6] D. V. Jahagirdar , B. R. Arbad , S. R. Mirgane, M. K. Lande and A. G. Shankarvar , *J. Molecular Liq.* **, 1998**,75: 33-43.

[7] Y. K. Meshram and M. L. Narwade , *Acta Ciencia Indica*, **2001**,XXVII.C No.2 : 67-70.

[8] R. Palani and S. Saravanan, *Research J. Phy*., **2008**, 2(1):13-21.

[9] B. Voleisiene and A. Voleisis , *J. Ultrasound* **, 2008**,63(4) : 7-18.

[10] V. K. Syal, A.Chauhan and S. Chauhan, *J. Pure Ultrasound.* **, 2005,** 27: 61-69.

[11] A. Tadkalkar, P.Pawar and G.K. Bichile, *J.Chem. Pharm.Res*., **2011,**Vol.3(3) :165.

[12] M. Arvinthraj , S. Venktesan and D. Meera, *J.Chem. Pharm.Res*, **2011,** Vol.3 (2):623.

[13] S.K. Thakur and S.Chauhan, *J.Chem. Pharm.Res*., **2011,**Vol.3(2) :657.

[14] Shilpa A. Mirikar, Pravina P. Pawar, Govind K. Bichile, American Journal of Pharmacology and Pharmacotherapeutics,2015Vol.2(1):2-7.