



Research Article

STUDIES OF ACOUSTIC BEHAVIOR OF 3-(2-BENZIMIDAZOL)-3-NITRO-6-METHYL-CHROMEN-4-ONE (BNMC) IN A DIFFERENT SOLVENTS SYSTEM BY USING ULTRASONIC INTERFEROMETER

S.A.Quazi¹, D.T.Mahajan², Vijay Masand³, Noor Mohammad⁴, M.R. Ingle⁵

1. Department of chemistry, VidyaBhartiMahavidyalaya, Camp, Amravati (M.S) India
2. Department of chemistry, Govt.Vidarbha Institute of Sci. and Humanities, Amravati (M.S) India
3. Department of chemistry, G.S college, Khamgaon

*Corresponding Author: Email: quazi.azhar@rediffmail.com

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ABSTRACT

By using various acoustic parameters ultrasonic velocity of 3-(2-benzimidazol)-3-nitro-6-methyl-chromen-4 one (BNMC) in different solvent mixtures has been investigated to understand the effect of (BNMC) in interaction with water and organic solvent.

Keywords: Apparent molal adiabatic compressibility, Hydration numbers, 3-(2-benzimidazol)-3-nitro-6-methyl-chromen-4-one(BNMC),dioxane-water mixture, Interferometer.

INTRODUCTION

Vibrational waves of frequency above hearing range of normal ear are referred as Ultrasonic waves. All waves of frequencies more than 20 KHz are Ultrasonic waves. The waves are being used for detected of flaws of materials, mechanical cleaning of surface etc,in the field of technology. In medicinal science too, the waves are being used to detect cancer tumors, bone fractures, cardiology etc. In present day applications of Ultrasonic are emerging in the field of forensic sciences, space research and in wars.Studies of stability constants and thermodynamically parameters (ΔH , ΔG , ΔS) of inner transition metal ions complexes with substituted chromoneschiff bases 70% dioxane – water solvent¹.Studies of some acoustic parameters of $Cu(NO_3)_2$ in water-dioxane mixture at 298.15K by physico-chemical

method².Adiabatic molal Compressibility and apparent molal volumes of many electrolytes in mixed organic solvent are found out earlier³⁻⁸. Recently some co-workers have investigated acoustic parameters of some binary liquids mixture at different temperatures ⁹⁻¹⁵.Narwade et al¹⁶have studied the adiabatic compressibility and apparent molar volume of substitute pyrazoles in water-dioxane mixture.Deosarkar¹⁷have investigated the adiabaticcompressibility, apparent molar compressibility and other parameters of pyrazoles in aqueous acetone-mixture. Hydration numbers are calculated using partial molal volume and adiabatic compressibility data.Pawar¹⁸have studied the apparent molal adiabatic compressibility andhydration numbers of some peptides. Khobragadeet al¹⁹have investigated apparent molal compressibility for isoxazoline

in 70% dioxane-water mixture. This paper is in continuation to our research work on ultrasonic investigation of adiabatic molal compressibilities and apparent molal volume of 3-(2-benzimidazol)-3-nitro-6-methyl-chromen-4-one (BNMC), dioxane-water mixture.

EXPERIMENTAL SECTION

Instruments

Pyknometer:

Pyknometer (Borosil make) are used in the present investigation for measuring the densities. Pyknometer were standardized by the standard procedure²⁰.

Balance

Weighing was made on Mechaniki Zaktady Precyzyjnej Gdansk balance, made in Poland (± 0.001 gm).

Ultrasonic Interferometer:

An ultrasonic interferometer MX-3 model (Mittal Enterprises, Delhi) having frequency 2MHz and accuracy $\pm 0.03\%$ was used for the measurement of ultrasonic velocity in solutions.

Thermostat

A special thermostatic arrangement was done for density and ultrasonic velocity measurements. Elite Thermostatic water bath was used, in which continuous stirring of water was carried out with the help of electric stirrer and temperature variation was maintain within $\pm 0.10^\circ\text{C}$.

Solvents and chemicals

All chemicals are analytical reagent (AR) grade with were obtained from SdFine chemicals, India which is used as such without further purification. Water used in the experiment was demonized, distilled and degassed prior to making solutions. The cell of ultrasonic interferometer was filled fully with the solution and needle of ammeter was adjusted in the range of 20 to 60 with the help of "Adj" knob. It was warmed for 10 minutes so that the range should remain steady. Micrometer reading was noted. Screw was moved anticlockwise to get the maximum deflections of needle. To movement of screw was co untied to gate 5 deflection. After retuning back to its original position, Micrometer screw was noted. The difference between these two readings gave the distance travelled by screw for getting five maxima. From this distance required though which micrometer screw should move for one maximum was calculated by dividing it by 5. Same procedure repeated many times. The apparent molal volume (Φ_v) and apparent molar adiabatic compressibility ($\Phi K(s)$) of (BNMC) in solution are determined from density (d_s) and adiabatic compressibility (β_s) of solution calculated by using following equations.

$$\Phi K(s) = ((\rho_{sdo} - \rho_{ods}) [10]^3) / (m \times d_s \times d_o) + \rho_{sM} / d_s \dots \dots \dots (1)$$

Table – 1 Ultrasonic Velocity in Distilled Water; Ultrasonic Frequency = 2 MHZ; Temp. $27 \pm 0.1^\circ\text{C}$

Sr. No.	Number of rotation of Screw	Micrometer Reading (mm)	Difference between Reading (mm)	Distance traveled by Screw for one maxima [(D)mm]	Ultrasonic Velocity [(U)msec-1]
1	5	25.15		0.392	1649
2	10	23.17	1.86	0.393	1645
3	15	21.21	1.8	0.393	1645
4	20	19.25	1.84	0.392	1641
5	25	17.34	1.83	0.391	1637
6	30	15.32	1.82	0.3905	1633

Table - 2 Ultrasonic Velocity In 20% of ethanol-water, acetone-water & Dioxane-water mixtures

System - (BNMC) Ultrasonic Frequency = 2 MHz
 Temp. 27± 0.1°C Molality =0.0091

Ultrasonic Velocity In 20% Ethanol-Water Mixture					
Sr. No.	Number of rotation of Screw	Micrometer Reading (mm)	Difference between Reading (mm)	Distance traveled by Screw for one maxima [(D)mm]	Ultrasonic Velocity [(U)msec-1]
1	5	22.75		0.3840	1650
2	10	21.50	1.96	0.3825	1645
3	15	21.20	1.92	0.3878	1635
4	20	18.90	1.90	0.3844	1630
5	25	17.85	1.87	0.3851	1627
6	30	17.20	1.84	0.3867	1622
Average				0.3850	1634
Ultrasonic Velocity In 20% Acetone- Water Mixture					
1	5	27.15		0.3750	1540
2	10	26.90	1.98	0.3720	1535
3	15	25.21	1.94	0.3770	1535
4	20	23.95	1.92	0.3740	1531
5	25	22.34	1.90	0.3750	1527
6	30	21.30	1.87	0.3760	1523
Average				0.3748	1531

Contd.

Ultrasonic Velocity In 20% Ethanol-Water Mixture					
Number of rotation of Screw	Micrometer Reading (mm)	Difference between Reading (mm)	Distance traveled by Screw for one maxima [(D)mm]	Ultrasonic Velocity [(U)msec ⁻¹]	
Ultrasonic Velocity In 20% Dioxane- Water Mixture					
1	5	26.10		0.3950	1544
2	10	25.90	1.99	0.3920	1552
3	15	24.25	1.97	0.3970	1536
4	20	22.91	1.96	0.3940	1539
5	25	21.30	1.93	0.3950	1528
7	30	20.35	1.89	0.3960	1526
Average				0.3944	1537.5

Table 3 $\Phi K(s)$ & Φv values along with other parameters in 20% of ethanol-water, acetone-water & dioxane-water mixtures of ligand (BMNC) Ultrasonic frequency: 2MHz Temp 27+0.1°C

Parameters	Solvent percentage (v/v) 20		
	Ethanol-Water	Dioxane- Water	Acetone- Water
Molality	0.0091	0.0091	0.0091
D_0	0.4680	0.4623	0.4666
d_0	1.0651	0.0398	0.0365
U_0	1570.0	1592.0	1559.0
B_0	46.5551	44.8001	48.6050
D_s	0.4850	0.4948	0.4632
d_s	1.0743	1.0203	1.0091
U_s msec ⁻¹	1610.0	1657.0	1582.0
$\beta_s \times 10^8$	44.30	40.91	48.23
$\beta_s d_s \times 10^8$	47.5213	45.6740	45.8760
$\beta_s d_0 \times 10^8$	45.2543	43.4876	49.5678
$\Phi K(s) \times 10^4$	0.8932	-26.4237	49.76521
Φv	540.87	2457.32	7321.10

$$\Phi v = ((d_0 - d_s) \left[\frac{10}{\rho} \right]^3) / (m \times d_s \times d_0) + M/d_s \dots\dots\dots (2)$$

Where, d_0 is the density of pure solvent.

M is the molecular weight of solute

β_0 is adiabatic compressibility of pure solvent & β_s is adiabatic compressibility of solution.

The adiabatic compressibility is calculated from ultrasonic velocity using the equation

$$\beta_0 = 1 / \left[\left(\frac{U_0}{\rho} \right)^2 \right]_{d_0} \dots\dots\dots \text{for solvent}$$

$$\beta_s = 1 / \left[\left(\frac{U_s}{\rho} \right)^2 \right]_{d_s} \dots\dots\dots \text{for solution}$$

Velocity of ultrasonic wave in solvent is represented by U_0 & in solution by U_s .

RESULTS & DISCUSSION

After the study of following observation table 1, 2 & 3 the values of $\Phi K(s)$ Φv is higher in case of acetone-water mixture than ethanol water of methanol water mixture due to electron releasing group present in acetone and difference in functional group and hydration numbers. The values of Φv is in the order as follows,

Acetone-Water > Dioxane-water > Ethanol-water at 20% solutions. After the investigation it is to be concluded that there is no regular order of $\Phi K(s)$ and Φv values for all the system.

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