International Journal of Scientific Research in Science and Technology
Print ISSN: 2395-6011 | Online ISSN: 2395-602X (www.ijsrst.com)
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# Ultrasonic Investigations of Substituted 2-oxo-2H-Chromene-3-Carbohydrazide Derivatives in 80% (DMF+Water) Mixture at 305K

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## ABSTRACT

Ultrasonic study of substituted 2-oxo-2*H*-chromene-3-carbohydrazide derivatives is done. In the present work, different properties such as apparent molal volume ($\phi_v$), apparent molal compressibility ($\phi_k$), relative association ($R_A$) and solvation number ($S_n$) have evaluated for following substituted 2-oxo-2*H*-chromene-3-carbohydrazide derivatives in 80% (DMF+water) mixture at 305K in different concentrations of ligands.

**Keywords:** - Substituted 2-oxo-2*H*-chromene-3-carbohydrazide derivatives, apparent molal volume ($\phi_v$), apparent molal compressibility ($\phi_k$), relative association ($R_A$) and solvation number ($S_n$).

## I. INTRODUCTION

Ultrasonic technique is also useful to study the weak and strong molecular interactions. Studies of ultrasonic velocity and acoustic properties of binary liquid mixtures consisting of methyl benzoate are of interest because of its use as dye carrier formulations in textile processing and in purification of reagents . Acoustical properties of some substituted pyrazolines in acetone-water are observed with variation of ultrasonic velocity with concentration . Density and ultrasonic velocity for the binary mixtures of toluene with heptan-1-ol, octan-1-ol and decan-1-ol at different temperature (298.15 and 308.15K) have reported . The important acoustical parameters like apparent molal compressibility, relative association, apparent molal volume and solvation number of substituted N, N'bis(salicyliden)-arylmethanediamines in binary mixture of DMF-water have reported . The physico-chemical behavior in pure liquid components and their mixture is studied on the basis of acoustic and thermodynamic properties . The determination of ultrasonic properties of pure solvents and their solutions find wide range of applications in chemical, pharmaceutical, polymer and bio-chemical industries . Acoustic characteristics have studied for sodium salt of N-chloro-p-toluene sulphonamide in aqueous and binary aqueous media . Ultrasonic velocity and density have measured in non-aqueous solution of the ligands in DMSO solvent at 306K . Acoustical properties are studied for 1-(2'-hydroxy-5' bromophenyl)-3-(4'-chlorophenyl)-1, 3 pronandione in dioxane-water mixture and also in different percentage of dioxane . Ultrasonic study of substituted dihydroformazan at 288.15K and chlorosubstituted pyrazole have studied at different concentration and different percentages in dioxane-water mixture at 305K

There is no acoustical data for substituted 2-oxo-2H-chromene-3-carbohydrazide derivatives in literature survey. In the present work, different properties such

as apparent molal volume (□v), apparent molal compressibility (□k), relative association (RA) and solvation number (Sn) have evaluated for following substituted 2-oxo-2H-chromene-3-carbohydrazide derivatives in 80% (DMF+water) mixture at different concentrations of ligands. In the present work, following substituted coumarines have synthesized by standard method .

Ligand (LA) = N-[(E)-1-(5-bromo-2-hydroxy-phenyl) ethylideneamino]-2-oxo-chromene-3-carboxamide

Ligand (LB) = N-[(E)-1-(5-chloro-2-hydroxy-phenyl) ethylideneamino]-2-oxo-chromene-3-carboxamide

Ligand (LC) = N-[(E)-1-(3,5-dichloro-2-hydroxy-phenyl)ethylideneamino]-2-oxo-chromene-3-carboxamide

Ligand (LD) = N-[(E)-1-(2-hydroxy-5-methyl-phenyl) ethylideneamino]-2-oxo-chromene-3-carboxamide

## II. METHODS AND MATERIAL

THEORY AND FORMULAE

Single frequency ultrasonic interferometer is use to measured sound speeds. The micrometer is slowly moved until the anode current meter on a high frequency generator shows a maximum. The distance thus moved by the micrometer gives the values of wavelength .

The distance traveled by micrometer screw to get one maximum in ammeter (D) is used to calculate wavelength of ultrasonic wave using following relation:

$$2D = \lambda \qquad (1)$$

Where, λ is wavelength and D is distance in mm.

From the knowledge of the wavelength, the ultrasonic velocity can be obtained by the relation:

Ultrasonic velocity (U) = λ x Frequency x 103 (2)

Using the measured data some acoustical parameters can be calculated using the standard relations.

Do and ds are density of solvent and solution respectively.

The apparent molal volume (□v) and apparent molal compressibility (□k) are given by following equations .

Apparent molal volume (□_v)=M/d_s +(( d_o-d_s )×10^3)/(( md_s d_0)) (3)

Apparent molal compressibility (□_k)=(1000(□_s d_o-□_o d_s))/(md_s d_o )+(□_s M)/d_s (4)

Where, do and ds are the densities of the pure solvent and solution, respectively.

m is the molality and M is the molecular weight of solute.

The relative association (RA) is given by the equation:

Relative association (R_A )=(d_s/d_o )×(U_o/U_s )^( 〖1/〗 _3 ) (5)

The solvation number (Sn) is given by the equation.

Solvation number (Sn) = □k /β0 x (M/ d0) (6)

EXPERIMENTAL

All the chemicals used are of analytical grade. The density measurements are made with the specific gravity bottle. All the weighings are made on one pan digital balance (petit balance AD-50B) with an accuracy of + 0.001 gm. The speed of sound is obtained by using variable path crystal interferrometer (Mittal Enterprises, Model MX-3) with accuracy of + 0.03% and frequency 1MHz. In the present work, a steel cell fitted with a quartz crystal of variable frequency is employed. The instrument is calibrated by measuring ultrasonic velocity of water at 32o C.

## III. RESULTS AND DISCUSSION

In this work ultrasonic measurement of substituted 2-oxo-2H-chromene-3-carbohydrazide derivatives in 80% DMF+water solvent. The data which is from this is use to determine acoustical parameters such as relative association(RA), apparent molal volume (□v), apparent molal compressibility (□k) and solvation

number (Sn) of of substituted 2-oxo-2H-chromene-3-carbohydrazide derivatives in 80% DMF+water solvent. From table no. 1 shows that there is decrease in concentration, ultrasonic velocity also decreases for all the system this is due to the very strong dipole-induce dipole interaction between the components. Table no. 1 shows the apparent molal volume (v) increases with decreases in concentration in all the system indicate the existence of strong ion solvent interaction. The apparent molal compressibility (k) increases with decreases in concentration show the weak electrostatic attractive force in the vicinity of ion causing electrostatic salvation of ion. The relative association (RA) increases with decreases found that there is weak solute solvent interaction. The salvation number (SN) increases as the concentration decreases due to the solute solvent interaction in all the system.

## IV.CONCLUSION

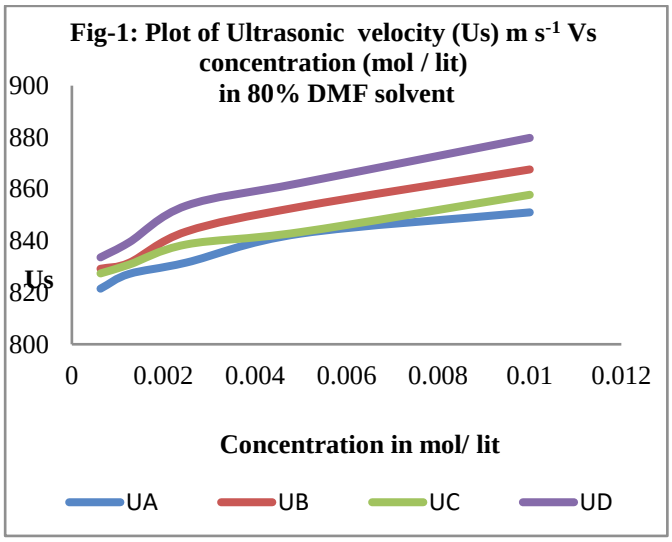
The value of intermolecular free length corresponds to the molecular shape. The increase in value of apparent molal compressibility (k) with decrease in concentrations shows the weak electrostatic attractive force in the vicinity of ions causing electrostatic salvation of ions. Relative association (RA) is the property useful to understand the solute-solvent interaction. The solvation number (Sn) increases with decrease in concentration due to weak solute-solvent interaction in all the systems.

**Table-1 Concentration (m), Apparent molal volume (v), Apparent molal compressibility (k), Relative association (RA) and Solvation number (Sn) at 80% (DMF+Water) solvent at 305K**

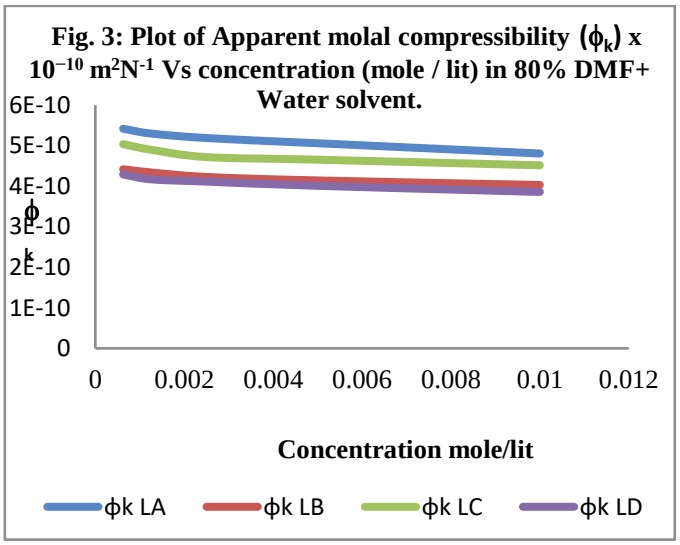
| Conc. (m) (mol lit$^{-1}$) | Density ($d_s$) (kg m$^{-3}$) | Ultrasonic Velocity ($U_s$) (m s$^{-1}$) | Apparent molal volume ($\phi_v$) (m$^3$mol$^{-1}$) | Apparent molal compressibility ($\phi_k$) x $10^{-10}$ (m$^2$N$^{-1}$) | Relative association ($R_A$) | Solvation number ($S_n$) |
|---|---|---|---|---|---|---|
| **Ligand $L_A$** | | | | | | |
| 0.01 | 1222.7 | 851.0 | 6.8961 | 4.4084 | 1.2155 | 0.6133 |
| 0.005 | 1219.9 | 842.8 | 13.5005 | 4.8974 | 1.2226 | 0.6813 |
| 0.0025 | 1218.1 | 831.6 | 26.8553 | 5.1081 | 1.2256 | 0.7106 |
| 0.00125 | 1215.4 | 827.2 | 53.3225 | 5.2073 | 1.2270 | 0.7244 |
| 0.000625 | 1213.6 | 821.5 | 105.391 | 5.5394 | 1.2294 | 0.7700 |
| **Ligand $L_B$** | | | | | | |
| 0.01 | 1167.6 | 867.6 | 5.1220 | 3.8554 | 1.1666 | 0.6049 |
| 0.005 | 1164.9 | 853.2 | 10.0812 | 4.0109 | 1.1688 | 0.6293 |
| 0.0025 | 1161.2 | 843.6 | 19.8978 | 4.2085 | 1.1600 | 0.6603 |
| 0.00125 | 1158.5 | 831.5 | 39.5284 | 4.2585 | 1.1718 | 0.6682 |
| 0.000625 | 1154.9 | 829.2 | 78.4884 | 4.3676 | 1.1725 | 0.6853 |
| **Ligand $L_C$** | | | | | | |
| 0.01 | 1193.8 | 857.8 | 6.0806 | 4.2742 | 1.1970 | 0.6130 |
| 0.005 | 1188.3 | 843.4 | 11.9961 | 4.4297 | 1.1971 | 0.6353 |
| 0.0025 | 1185.6 | 838.6 | 23.8614 | 4.6552 | 1.1989 | 0.6662 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 0.00125 | 1182.9 | 830.8 | 47.4593 | 4.7268 | 1.2014 | 0.6779 |
| 0.000625 | 1182.0 | 827.4 | 94.3881 | 4.8441 | 1.2058 | 0.6947 |
| Ligand $L_D$ | | | | | | |
| 0.01 | 1166.7 | 879.8 | 4.7957 | 3.6220 | 1.1726 | 0.6012 |
| 0.005 | 1163.1 | 862.4 | 9.4672 | 3.8086 | 1.1797 | 0.6322 |
| 0.0025 | 1158.5 | 853.6 | 18.6827 | 3.9370 | 1.1844 | 0.6535 |
| 0.00125 | 1154.9 | 839.4 | 36.8404 | 3.9990 | 1.1869 | 0.6639 |
| 0.000625 | 1152.2 | 833.6 | 72.9052 | 4.1314 | 1.1924 | 0.6858 |

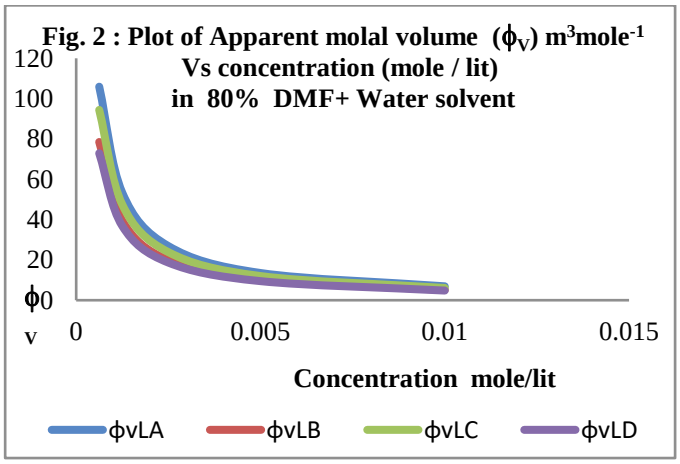
Graphical representation of acoustical parameters in 80% of DMF-Water solvent



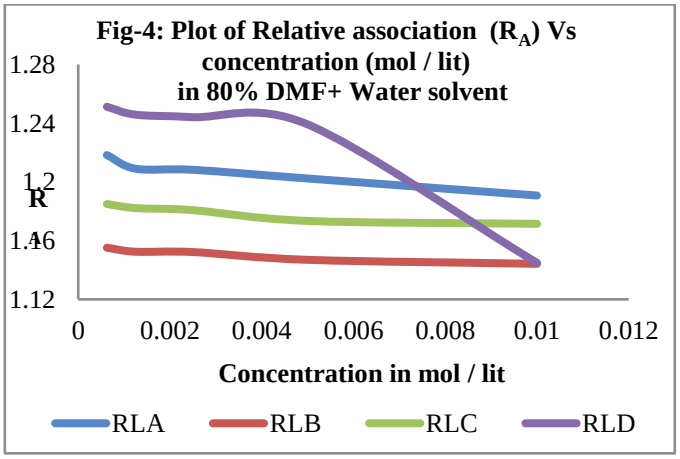

Plots of Apparent molal compressibility (ϕk) of different ligand at different concentration in 80% (DMF + water) solvents




Plots of Apparent molal volume ($\phi_v$) of different ligand at different concentration in 80% (DMF + water) solvents




Plots of Relative association (RA) of different ligand at different concentration in 60%, 70% and 80% (DMF + water) solvents



**Plots of Salvation number (Sn) of different ligand at different concentration in 80% (DMF + Water) solvents**

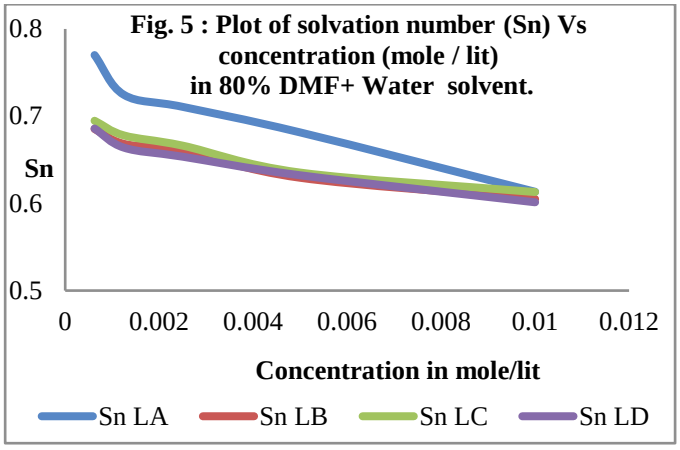



**Fig. 5 : Plot of solvation number (Sn) Vs concentration (mole / lit) in 80% DMF+ Water solvent.**

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