INTERNATIONAL JOURNAL OF PURE AND APPLIED RESEARCH IN ENGINEERING AND TECHNOLOGY

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ULTRASONIC INTERFEROMETRIC INVESTIGATONS OF SUBSTITUTED FLAVONES IN AQUEOUS ETHANOL MEDIUM AT 301K

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Accepted Date: 15/03/2016; Published Date: 01/05/2016

Abstract: Ultrasonic velocity and density measurements of substituted flavones were carried out at 301K in aqueous ethanol media. Acoustic parameters like Adiabatic compressibility (βs), Apparent molar volume(Φv) and Apparent molar compressibility(Φk) provides a better insight into molecular environment in liquid molecular interaction. In this investigation, the comparative study of effects of solvents and effect of substituents in solute are studied.

Keywords: substituted flavones, Adiabatic compressibility (βs), Apparent molar volume(Φv), Apparent molar compressibility(Φk), molecular interaction.

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Access Online On:

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How to Cite This Article:

Shubhangi L. Sayre, IJPRET, 2016; Volume 4 (9): 77-85

PAPER-QR CODE

INTRODUCTION

Sound waves of high frequency are called ultrasonic. Vibrational waves of frequency above audible range are called ultrasonic waves or ultrasound. Ultrasound frequency range extends from 20KHz to 106 KHz. The interferometer method is the most widely used technique for the measuring of sound velocity with high accuracy. It is easy to maintain the temperature steady for the sample. There are the three techniques which are the generally used for the measurement of ultrasonic velocity viz. optical diffraction technique, Echo pulse technique, Interferometric Technique. In the present study, Interferometric Technique has been used for the determination of ultrasonic velocity. The principle used in the measurement of velocity (v) in the based on accurate determination of wavelength (λ) in the medium ultrasonic waves of known frequency (f) are the produced by quartz crystal fix at the bottom of cell. The interferometer is an instrument for exact measurement of wavelength of any wave motion. Ultrasonic waves, in recent years ,have acquired the status of an important probe for the study of structure and properties of matter in basic sciences. Ultrasonic techniques are best suited for physico-chemical studies of a system. Ultrasonic studies are useful in extensive research in different field of science 1-4. It is also found to be most suitable for investigating various liquid mixtures and solutions of organic and inorganic compounds, polymers, etc 5-10. The study of acoustical parameters gives a new sight of ion-solvent interactions 11 occurring in the solutions. A considerable work on solutions of organic compounds has been reported12-15.

The structural arrangement are influenced by the shape of the molecules as well as mutual interactions. The ultrasonic velocity and other acoustic parameters can be measured with great accuracy and consequently provides a powerful way to determine intermolecular interactions.

Hence, in this present investigation attempt is made to understand behavior of substituted flavones.

6-methyl-2-phenylchromen-4-one (L1)

6-methyl-8-nitro-2-phenylchromen-4-one (L2)

6-methyl-8-bromo-2-phenylchromen-4-one (L3)

6-chloro-2- phenylchromen-4-one (L4)

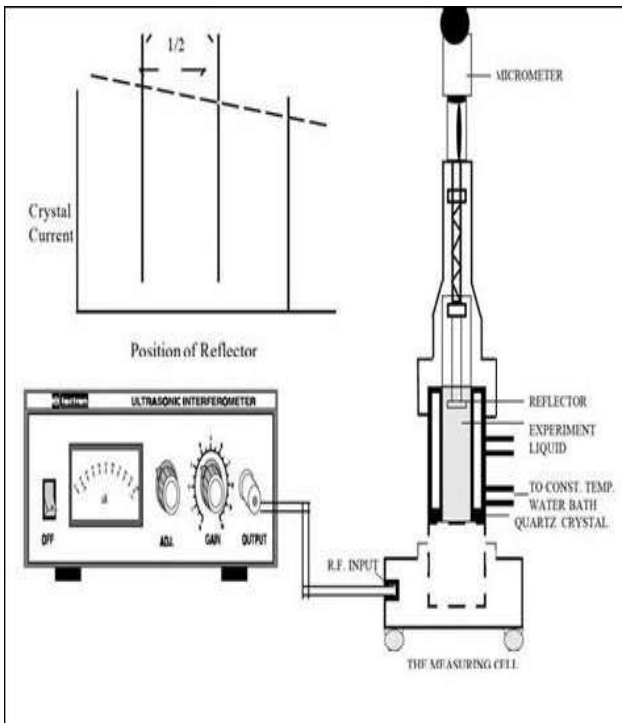
6-chloro-8-nitro-2- phenylchromen-4-one (L5)

6-chloro-2- phenylchromen-4-one (L6)

The above compounds of different concentrations (%) of aqueous ethanol studied interferometrically to calculate acaustic parameters velocity(v),density(d),adiabatic compressibility(βs),apparent molar volume(Φv),apparent molar compressibility(Φk).

MATERIALS AND METHODS:

All the chemicals were of A. R. grade. Double –distilled water was used during the study, the six ligands were synthesized by standard method. Densities were measured with the help of bicapillary pkynometer,0.01M solution of ligand at different percentage of ethanol were prepared separately. Weighing was made on Mechaniki Zaktady Precynyneij Gdansk balance made in Poland. A special thermostatic arrangement was done for density and ultrasonic measurements. Single crystal interferometer (Mittal Enterprises, Model MX-3) with accuracy of ±0.035% and frequency of 1MHz was used in the present work. The densities and ultrasonic velocity of ligands L1,L2,L3,L4,L5 and L6 in aqueous ethanol at 301K.



The Adiabatic compressibility of solvent (β0) and (βs) are given by –

βs = 1/(vs2 ds)

Apparent molar compressibility (ϕk) was obtained from,

(ϕk) = 1000 (βs do – β0 ds)/ C ds do + (βs M/ds).

Apparent molar volume (ϕv) has been calculated from the relation.

(ϕv) = 1000 (do – ds)/Cds do + M/ds M = Molecular weight of ligand and

C = Molarity of the solution.

All these acoustic parameters were computed for all the six ligands at different percentage of ethanol.

RESULT AND DISCUSSIONS:

TABLE 1.

Acaustic parameters at different percentages of aqueous ethanol

System:Ligand -L_1 **Temp.=301 K**

Concentration:0.01M **Ultrasonic Frequency=1Mz**

%Ethanol	V(m.sec^{-1})	ds X 10^3 (kg.m^{-3})	βs X 10^{-7} (pa^{-1})	Φk X 10^{-3} ($m^3mol^{-1}pa^{-1}$)	Φv (m^3mol^{-1})
75	1471.6	0.84901	5.4389	-13.7581	-111.98
80	1423.4	0.84492	5.8416	-14.135	-175.02
85	1396.8	0.8392	6.1075	-14.3963	-176.36
90	1382.4	0.81845	6.3935	-15.8769	-132.92
95	1358.6	0.8126	6.6672	-16.5026	-161.71

TABLE 2:

Acaustic parameters at different percentages of aqueous ethanol					
System:Ligand -L_2				Temp.=301 K	
Concentration:0.01M				Ultrasonic Frequency=1Mz	
%Ethanol	V(m.sec^{-1})	ds X 10^3 (kg.m^{-3})	βs X 10^{-7} (pa^{-1})	Φk X 10^{-3} ($m^3mol^{-1}pa^{-1}$)	Φv (m^3mol^{-1})
75	1551.8	0.85286	4.869	-14.2724	-134.69
80	1560	0.85026	4.833	-15.1014	-208.21
85	1531.6	0.84714	5.032	-15.3297	-227.66
90	1506.8	0.83822	5.254	-16.3157	-263.64
95	1504	0.82894	5.333	-17.3098	-266.69

TABLE 3:

Acaustic parameters at different percentages of aqueous ethanol					
System:Ligand -L_3				Temp.=301 K	
Concentration:0.01M				Ultrasonic Frequency=1Mz	
%Ethanol	V(m.sec^{-1})	ds X 10^3 (kg.m^{-3})	βs X 10^{-7} (pa^{-1})	Φk X 10^{-3} ($m^3mol^{-1}pa^{-1}$)	Φv (m^3mol^{-1})
75	1434.4	0.83908	5.792	-13.7349	-31.53
80	1516	0.83562	5.207	-15.2856	-99.656
85	1381.2	0.83009	6.315	-14.5387	-103.14
90	1378.6	0.8128	6.474	-16.0483	-85.449
95	1374.4	0.81154	6.523	-16.7279	-144.97

Table4:

Acaustic parameters at different percentages of aqueous ethanol					
System:Ligand -L_4				Temp.=301 K	
Concentration:0.01M				Ultrasonic Frequency=1Mz	
%Ethanol	V(m.sec^{-1})	ds X 10^3 (kg.m^{-3})	βs X 10^{-7} (pa^{-1})	Φk X 10^{-3} ($m^3mol^{-1}pa^{-1}$)	Φv (m^3mol^{-1})
75	1401.4	0.85398	5.962	-12.9453	-145.78
80	1522.4	0.83752	5.152	-15.2721	-120.04
85	1381.6	0.83346	6.286	-14.4301	-133.63
90	1364.6	0.82549	6.505	-15.4035	-178.22
95	1351.2	0.82232	6.661	-16.025	-224.43

TABLE 5:

Acaustic parameters at different percentages of aqueous ethanol					
System:Ligand -L_5				Temp.=301 K	
Concentration:0.01M				Ultrasonic Frequency=1Mz	
%Ethanol	V(m.sec^{-1})	ds X 10^3 (kg.m^{-3})	βs X 10^{-7} (pa^{-1})	Φk X 10^{-3} ($m^3mol^{-1}pa^{-1}$)	Φv (m^3mol^{-1})
75	1824	0.85688	3.508	-15.7044	-161.83
80	1806.2	0.84786	3.615	-16.6424	-188.45
85	1839.6	0.8425	3.507	-17.3461	-192.02
90	1805	0.83423	3.679	-18.395	-233.23
95	1798.2	0.82655	3.742	-19.3587	-247.82

TABLE 6:

Acaustic parameters at different percentages of aqueous ethanol					
System:Ligand -L_6				Temp.=301 K	
Concentration:0.01M				Ultrasonic Frequency=1Mz	
%Ethanol	V(m.sec^{-1})	ds X 10^3 (kg.m^{-3})	βs X 10^{-7} (pa^{-1})	Φk X 10^{-3} (m^{3}mol^{-1}pa^{-1})	Φv (m^{3}mol^{-1})
75	1421.2	0.85068	5.82	-13.2381	-116.61
80	1609.4	0.84253	4.582	-15.7297	-150.39
85	1386.2	0.84066	6.191	-14.2301	-179.12
90	1362.6	0.8326	6.469	-15.1154	-222.05
95	1245.8	0.82045	7.853	-14.6552	-206.48

Adiabatic Compressibility

Adiabatic compressibility βs is one of the important properties during the study of solute-solvent interactions and represented by Table1-6,Fig.7-9,it can be noted that the βs values of ligands L1,L2,L3,L4,L5 and L6 are increase with increase in percentage of ethanol at 301K.

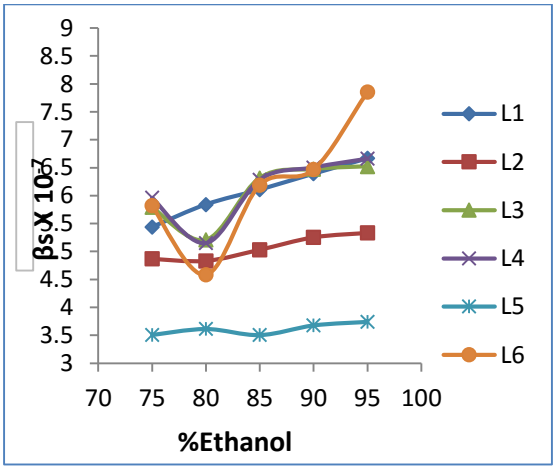


Fig:7

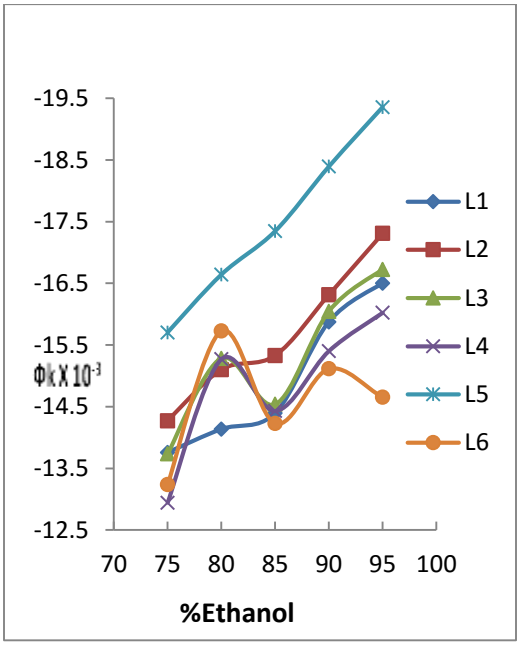


Fig: 8

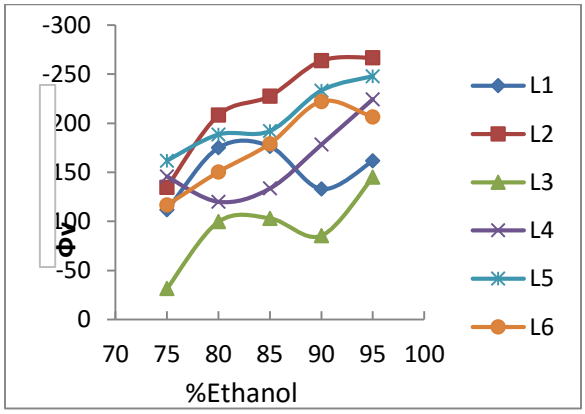


Fig:9

Apparent Molar Compressibility(Φk):

Φk explains the solute-solvent interactions in solution ,the increase in Φk values increase with increase in percentage of ethanol.From Fig8 revealed L5 shows straight line,L6,L3 with up and fall in graph.It is observed that almost all values are negative.This interprete interms of loss of compressibility of solute due to strong electrostatic salvation of ions.

Apparent Molar Volume(Φv):

Φv values increases with increase in percentage of ethanol. Φv values for six ligands at 301K is negative for all composition,it is due to temperature effect on ligand .From Fig:9 L2 shows highest Φv values where L3 with lowest ,L4 shows specific trend.The presence of –NO2 group having –I,-R effect ,more predominant.

CONCLUSION

The relative strength of intermolecular interaction has been found to depend upon the presence of electron-donar and electron-accepter group. The ultrasonic parameters found useful in determining the relative strength of homo-molecular interaction in pure liquids.

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