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Studies of Additive Properties of Salicylic Acid in Different Solvent By Refractometrically

KEYWORDS: Salicylic acid, Acetone, Ethanol, Methanol, DMF, THF, DMSO, Additive properties,

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ABSTRACT *Refractive index, molar refractivity and molar polarizability constant of heterocyclic compound such as Salicylic acid have been studied in Ethanol, Methanol, Acetone, DMF, DMSO, and THF media at 303 K ± 0.10 C temperature and different concentration (0.625x 10-3 to 10.0x 10-3 M). The values of molar refraction (Rm) and molar polarizability (α) constant are found to be decreased with decreasing concentration of solute in solvent. Viscosity coefficient (A, B) evaluate by using jone-dole equation. These parameters throw the light on the solute – solvent interaction and solute – solute interaction.*

INTRODUCTION

The refractive index is an important additive property of molecular structure of liquid. For pure hydrocarbon, one can get an idea of aromatic content of liquid using refractive index. When a light of beam passes from one substance to another, the beam is bent so that it travels in different direction. If it is passed from less dense to denser medium it is refracted toward normal to form angle of refraction which is less than angle of incident. The refractive index is the ratio of angle of incident to the angle of refraction and it depends on the temperature and wave length of light. The extent of refraction depends on –i) the relative concentration of atom or molecule ii). Structure of an atom or a molecule. So refractive index gives idea about geometry and structure of molecule. Refraction of light is additive property, but also depends on the structural arrangement of atom in molecule. This can some time be used to determine the structure of an unknown compound whose molecular formula is known.

From literature it was found that much work have been done over many of the substituted heterocyclic drugs, chalcones, pyrazolines is oxazoline and various ketones by spectrophotometrically and Refractometrically.

Various researchers are interested to find out binary liquid mixture interaction along with soult[1] viscosity, molar refraction and polarizability constant of electrolytic and non electrolytic solvent with solute give various new physical parameters of solvent mixture [3,4] D.R. Nagargioje et al [5] have studied to viscosity and polarizability of 3 – acetyl -6 methyl – (2H) – pyran – 2, 4, - (3H) – dione derivative in different phase systems and nature of solute affects viscosity, molar refraction and polarizability constants.

The property of liquid such as viscosity refractive index and ultrasonic velocity of binary mixture are studied by many workers [6 - 13] Agrawal et al [14] have studied the molar refraction and polarizability constant. Oswal et al [15] have studied dielectric constant and refractive index indices of binary mixture. Theoretical study of refractivity of binary and ternary solutions has been done by J.D. Pandey and et al[7].

Thermo-physical properties of a solution provide complementary information about the mixing process and interactions between their components. In literature several correlation have been found between refractive index and density, Surface tension dielectric permittivity and use of refractive index to calculate the molecular composition of hydrogen bonded complex.

Experimental measurement of refractive index and dielectric constant of liquid and liquid mixture have gained much importance during recent past since these data given reliable information regarding the specific interactions between the components. The measurement of dielectric constant have been mostly in binary mixtures and for ternary system dielectric data are available. Different theoretical methods have been extensively applied to evaluate refractive index of liquid mixture.

Sangita Sharma et. al. has been studied density and refractive index of binary liquid mixture Eucalyptol with Hydrocarbon at different temperature. Yangang Liu has studied relationship of refractive index to mass density and consistency of the mixing rule use to calculate these two quantities of multicomponent mixture like ambient aerosols with the index-density relationship. Anand Yadava S.S. has studied refractive indices of binary mixture of bromoalkane and non polar hydrocarbons, also studied molecular interaction between the components of binary mixtures. Sonune et. al. has been studied additive properties such as molar refractivity and molar polarizability constant of allopurinal, acenocoumarol, warfarin and amoxicillin in different media.

However study of molar refractivity, molar polarizability constant and viscosity coefficients of substituted heterocyclic compound such as salicylic acid in non aqueous solvent such as ethanol, methanol, acetone, DMF, THF, DMSO under identical set of experimental condition.

This could cover manifold aspect of solute – solvent interaction scanty. Therefore the present work is undertaken to make the systematic study of above substituted studied the ultrasonic velocity and viscosity of PEG-8000, PEG-study of acoustical properties, viscosity coefficient of substituted heterocyclic compounds under suitable condition.

EXPERIMENTAL

The solution of salicylic acid is prepared in different solvent like ethanol, methanol, and acetone, DMF, DMSO and THF

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by dissolving an appropriate amount by weight. The compound is synthesized in the laboratory by standard method and purity is checked by M.P, TLC, IR, and NMR.

The solution of compound is prepared in different solvents like acetone, ethanol, methanol, DMF, DMSO, and THF by dissolving an appropriate amount by weight. All the weighing were made on mechaniki Zaktady Precyzying Gdansk Balance made in Poland (+0.001gm).

The densities of solutions were determined by a bi-capillary pynometer (+0.2%) having a bulb volume of about 10 cm^3 and capillary having an internal diameter of 1mm. The refractive indices of solvent mixture and solutions were measure by Abbe's refractometer at 27 ^{0}C. The accuracy of Abbe's refractometer was within (+0.001) unit.

27+0.1 ^{0}C refractometer is initially calibrated with glass piece. (n=1.5220) provide with the instrument.

The regractive indices and molar refraction at different molarity and polarizability constant can be calculated the equations.

Where :- M – is the mass of ligand in gram, d – is the density of solution of ligand n – is refractive index and Rm – is the molar refraction.

$$R_m = \frac{4}{3}\ \pi - Nc. \text{ ---------- (2)}$$

$$\alpha = \frac{3}{4} \cdot \frac{R_m}{N_C} \text{ ---------- (3)}$$

Per mole, α – is the polarizability constant.

$$R_m = X_1 R_{M1} + X_2 R_{m2} \text{ ---------- (4)}$$

Where :- Molar refraction.

X_1 and X_2 – mole fraction of solvent and solute in solution.

Rm_1 and Rm_2 be the molar refractivity of solvent and solute.

The molar refraction represents actual or true volume of the substance molecules in mole.

The molar refraction of solute can be calculated as.

The refractive index of solvents and solutions at different concentration are measured from Abbe's refractometer and the values of index molar refraction and polarizability constant are evaluated presented in 1to 6 different system.

Table – 1:- Refractometry data, system – Salicylic acid, Solvent – DMF (Dimethylformamide $3H_7NO$(73.09 g/mole)

Sr.No	Molarity	Refractive Index (n)	Density (d)	Specific Refraction (r)	Molr Refraction Rm	Polarizability Constant (
1	0.01	1.3998	0.358	0.6767	0.0233	$0.00922x10^{-23}$
2	0.005	1.3942	0.3544	0.6752	0.0117	$0.000701x10^{-23}$
3	0.0025	1.389	0.3502	0.6673	0.0058	$0.000233x10^{-23}$
4	0.00125	1.3762	0.346	0.6634	0.0029	$0.000037x10^{-23}$
5	0.00625	1.3521	0.3422	0.6321	0.0013	$0.00005x10^{-23}$

Sr.No	Molarity	Refractive Index (n)	Density (d)	Specific Refraction (r)	Molr Refraction Rm	Polarizability Constant (
1	0.01	1.3988	0.3714	0.651	0.0224	$0.00088x10^{-23}$
2	0.005	1.3689	0.3581	0.6297	0.0108	$0.00042x10^{-23}$
3	0.0025	1.3611	0.3554	0.6223	0.0053	$0.00021x10^{-23}$
4	0.00125	1.3583	0.3598	0.6209	0.0026	$0.00010x10^{-23}$
5	0.00625	1.3542	0.3504	0.207	0.0013	$0.00005x10^{-23}$

Table – 2 :- Refractometry data, system – Salicylic acid, Solvent – Methanol, M.F – CH_3OH , M.W 32.

Table – 3 Refractometry data:- System – Salicylic acid, Solvent – THF .
Tetrahydrofuran ($_4H_8O(CH_2)_4O$) M.W= 72.11 g/mole

Srn-No	Molarity	Refractie Index (n)	Density (d)	Specific Refraction (r)	Molr Refraction Rm	Polarizability Constant (
1	0.01	1.3787	0.3093	0.7465	0.00257	$0.000101x10^{-23}$
2	0.005	1.3773	0.309	0.7446	0.0128	$0.0050x10^{-23}$
3	0.0025	1.3752	0.3088	0.7415	0.0063	$0.00024x10^{-23}$
4	0.00125	1.3697	0.3086	0.7323	0.0031	$0.00012x10^{-23}$
5	0.00625	1.3082	0.3082	0.7287	0.0015	$0.00005x10^{-23}$

Table – 4 Refractometry data:- System – Salicylic acid, Solvent – DMSO (Dimethyl sulfoxide) M.F – C_2H_6OS M.W – 78.13.

Sr.No	Molarity	Refractive Index (n)	Density (d)	Specific Refraction (r)	Molr Refraction Rm	Polarizability Constant (
1	0.01	1.3858	0.3999	0.5868	0.0506	$0.00200x10^{-23}$
2	0.005	1.3848	0.3998	0.5857	0.0251	$0.00099x10^{-23}$
3	0.0025	1.3789	0.3967	0.5822	0.0216	$0.00049x10^{-23}$
4	0.00125	1.3762	0.3954	0.5804	0.0063	$0.00024x10^{-23}$
5	0.00625	1.3742	0.3951	0.5782	0.0003	$0.000011x10^{-23}$

Table – 5 Refractometry data:- System – Salicylic acid, Solvent – Ethanol , M.F – C_2H_5OH , M.W – 46 .

Sr.No	Molarity	Refractive Index (n)	Density (d)	Specific Refraction (r)	Molr Refraction Rm	Polarizability Constant (
1	0.01	1.3798	0.3093	0.7484	0.0834	$0.0033x10^{-23}$
2	0.005	1.3776	0.3091	0.745	0.0414	$0.00163x10^{-23}$
3	0.0025	1.3765	0.3088	0.7438	0.0207	$0.00082x10^{-23}$
4	0.00125	1.3754	0.3086	0.7423	0.0103	$0.00040x10^{-23}$
5	0.00625	1.3744	0.3082	0.7414	0.005	$0.00019x10^{-23}$

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Table – 6 Refractometry data :- System – Salicylic acid, Solvent – Acetone , M.F – C_3H_6O , M.W – 58.08.

Sr.No	Molarity	Refractive Index (n)	Density (d)	Specific Refraction (r)	Molr Refraction Rm	Polarizability Constant (
1	0.01	1.3879	0.3095	0.7621	0.0262	$0.00103x10^{-23}$
2	0.005	1.3868	0.3093	0.7608	0.013	$0.00053x10^{-23}$
3	0.0025	1.3858	0.3088	0.76	0.0065	$0.00025x10^{-23}$
4	0.00125	1.3787	0.3086	0.7482	0.0032	$0.00012x10^{-23}$
5	0.00625	1.377	0.3084	0.7467	0.0015	$0.00005x10^{-23}$

RESULTS AND DISCUSSION

The value of molar refraction (R) and molar polarizability constant (α) of polar solvents, like Ethanol, Methanol, and Acetone are found to be greater than non polar solvents like DMF. Because polar solvent contains H- bonding, may form complex with solute, but non polar solvent does not contains H-bonding and does not form complex with solute.

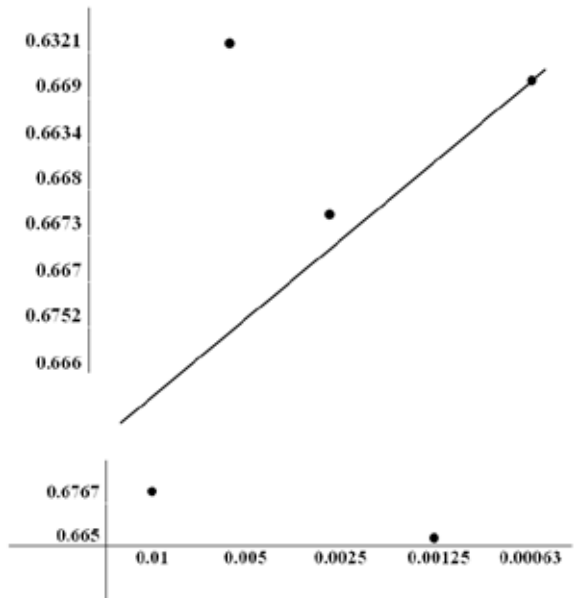
This may be characteristics to the fact that the dipole in the compound lies perpendicular to the longer axis of the molecule shows intermolecular attraction take place which will be accompanied by increase the value of molar refraction and molar polarizability constant with increasing concentration of solution because of mutual compensation of dipoles.

The values of molar refraction and polarizability constant of different ligands are presented in table 1 to 6.

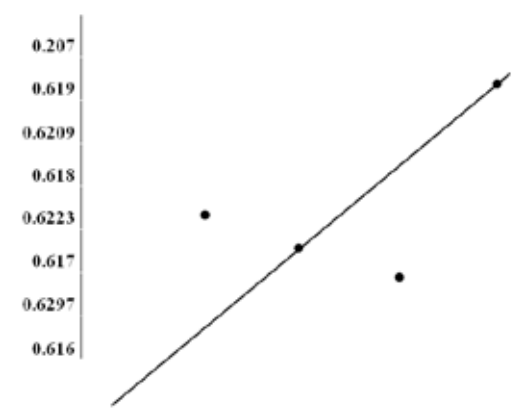
The graphs between specific refraction verses concentration are plotted and show in figure 1 to 6 it could be seen that there is linear relationship between molar refraction and concentration from this. The concentration of unknown solution of the ligand calculated.

It is also observed that the refractive index is linearly related to percentage of dissolved solids in a solution in deferent solvent. By related to percentage the value of the refractive index of a solution to that of a stander curves the concentration of solute can be determined with good accuracy. It is observed that the substances containing more polarizability (soft) group will normally have higher refractive indexes than substances containing less polarizability (hard) groups.

1. Graph Between Specific Refraction [R] Vs Concentration [C] For – Salicylic acid Solvent - DMF



2. Graph Between Specific Refraction [R] Vs Concentration [C] For – Salicylic acid Solvent - Methenol



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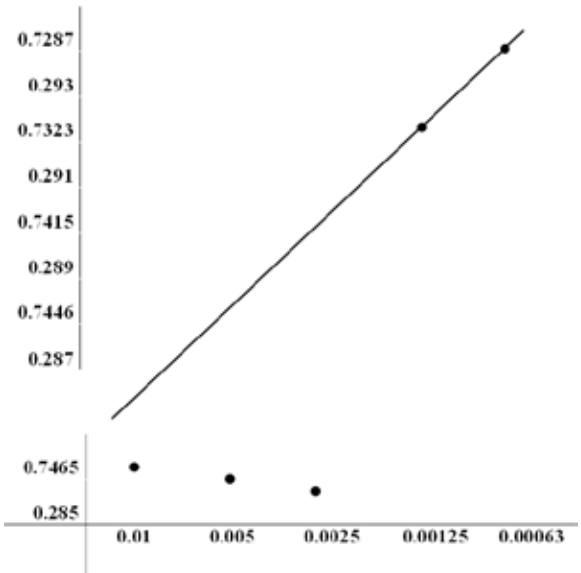
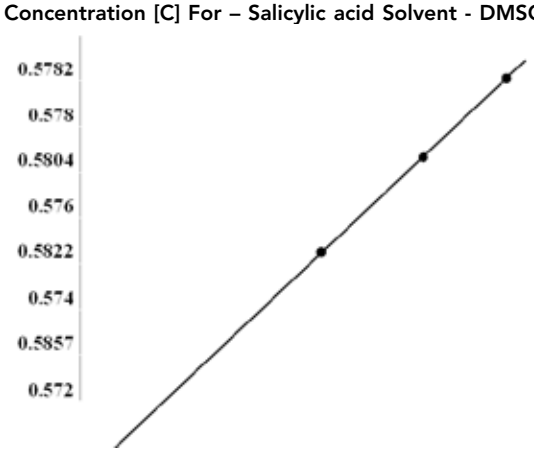
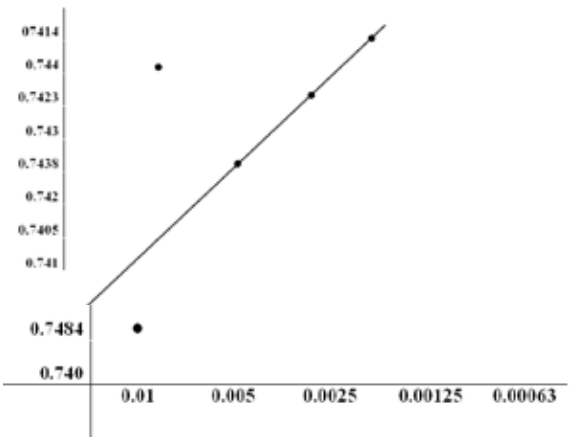
3. Graph Between Specific Refraction [R]
Vs
Concentration [C] For – Salicylic acid Solvent - THF



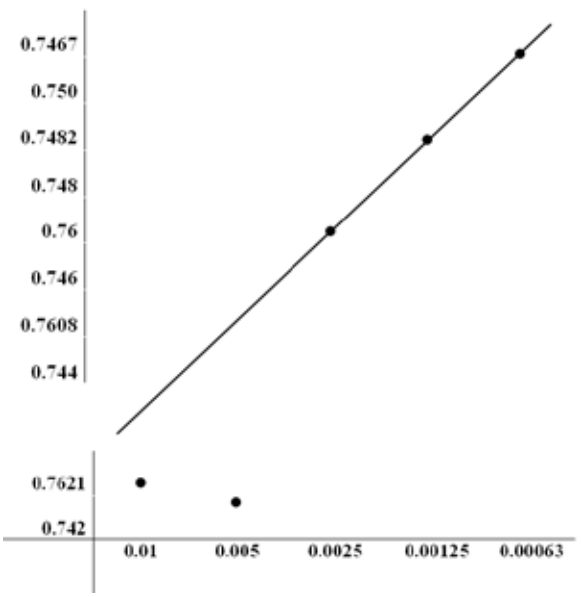
4. Graph Between Specific Refraction [R]
Vs
Concentration [C] For – Salicylic acid Solvent - DMSO



5. Graph Between Specific Refraction [R]
Vs
Concentration [C] For – Salicylic acid Solvent - Ethanol



6. Graph Between Specific Refraction [R]
Vs
Concentration [C] For – Salicylic acid Solvent - Acetone



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