Density and viscosity of 2- Hydroxy Substituted Chalcone Dibromide and Quinoxaline in Ethanol, Solvent at 297,301 and 305 K Temperature

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***Abstract*—** The density (d) and viscosity (h) values have been measured in the solvent ethanol, containing 2-hydroxy substituted chalcone di-bromide using 0.01 M concentration at 297, 301 and 305 K . From the experimental data, the relative viscosity hr in different solvents has been calculated at various temperatures. The relative viscosity have been used to discuss the presence of molecular interactions, ion-solvent interactions and solute-solvent interactions.

Keywords- *Viscosity, density, relative viscosity, 2-hydroxy substituted chalcone dibromide, quinoxaline.*

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INTRODUCTION :-

Viscosity is one of the important physical property of liquid and gases and it implies resistance to flow as fluids (liquid and gases) exhibit a characteristic property of flowing under applied force of their own weight. The study of viscosity is widely used to obtain the molecular interaction in case of gases and liquids. In liquids of the binary mixtures, the additional forces between molecules are important. The viscosity measurements are easy and simple to carry out. The viscosity measurements is the best method used to determine Jone-Dole coefficient and Falkenhagen coefficient. These coefficients are directly related to solute-solvent and solute-solute interactions.[1]

Viscosity and density measurements for electrolytes in various mixtures of water with tert butyl alcohol and tert butyl amine[2] Density and viscosity studies of paracetamol in ethanol and water system at 301.5 K. [3].Viscosity of lithium chloride in different composition of lactose at different temperatures 303.15, 308.15, 313.15 and 318.15 K[4]. Viscosities (h) and densities (d) for the binary liquid mixture of dimethyl sulfoxide with benzene, ethyl benzene, chlorobenzene and bromobenzene system were found out as a function of mole fraction at atmospheric pressure and at a temperature of 303.15 K, 308.15 K and 313.15 K[5].Density and viscosities for the binary mixtures of 1,4-dioxane and benzene or chlorobenzene at 303.15, 308.15 and 313.15 K[6]. The observed molecular interaction, complex formation and hydrogen bond formation are responsible for the hetero molecular interaction in the liquid mixture. This provides useful information about inter and intra
molecular interactions of the mixture as existing in the liquid systems[7].Volumetric and viscometric behaviour of acrylic esters with hexane-2-ol at 298.15 and 308.15 K[8]. Density and viscosity of zirconyl soaps in benzene, methanol solvent[9].

For the present work we have chosen the density and viscosity, relative viscosity in order to discuss solute-solvent interactions. From the literature
survey it was seen that much work has been done on various concentration[10-12] but scanty work is found in pure ethanol, 1,4-dioxane and CCl4 solvents. Also the review does not reveal any attempt made on density and viscometric study of 2-hydroxy substituted chalcone dibromide and quinoxaline. We have intended to analyze study of these ligands in different solvents to investigate protic- aprotic nature, polarity-non polarity, hydrogen bonding, dielectric constant and density, viscosity of solvent on solute-solvent, ion-solvent and molecular interactions.

EXPERIMENTAL

In this present investigation attempt is made to understand behavior of 2- hydroxy substituted chalcone dibromide and quinoxaline viz. 2'-hydroxy-5'-chloro-4-methoxy chalcone dibromide (IIIa), 2'-hydroxy-5'-chloro chalcone dibromide (IIIb), 2'-hydroxy-3'-bromo-5'-chloro-4-methoxy chalcone dibromide (IIIc), 2'-hydroxy-3'-bromo-5'-chloro chalcone dibromide (IIId), 2-(2-hydroxy-5-chloro) benzyl-3-(4-methoxy phenyl) quinoxaline (IVa), 2-(2-hydroxy-5-chloro) benzyl-3-phenyl quinoxaline (IVb), 2-(2-hydroxy-3-bromo-5-chloro) benzyl-3-(4-methoxy phenyl) quinoxaline (IVc) and 2-(2-hydroxy-3-bromo-5-chloro) benzyl-3-phenyl quinoxaline (IVd) have been carried out in organic solvents like ethanol, 1,4-dioxane and CCl4. These chalcone dibromide (IIIa-IIId) and quinoxaline (IVa-IVd) have been synthesized by known method[13]. Then the viscosity and density measurements of 0.01 M solution of all ligands at 297, 301 and 305 K temperature was calculated. All chemicals used to synthesized substituted chalcone dibromide and quinoxaline were of A.R. grade.

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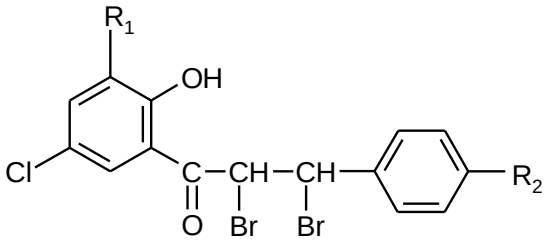
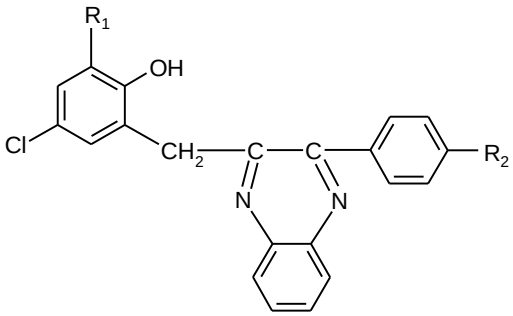
297 - 300



(IIIa-d)



(IVa-d)

Where, R_1 = □ H, □ Br R_2 = □ H, □ OCH_3

Ethanol, was purified by described method[14] The viscosity and density were measured by Ostwald's viscometer and pyknometer. Densities were measured with the help of bicapillary
pyknometer, 0.01 M solution of ligand in ethanol, dioxane and CCl4 solvents were prepared separately, that weighed on Mechaniki Zaktady Precynyjeij Gdansk balance (± 0.001 g). A special thermostatic arrangement was done for density and viscosity 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 maintained within ± 0.1°C. The densities and viscosities were measured at 297, 301 and 305 K.

RESULTS AND DISCUSSION

In the present investigation measurement of densities and viscosities of III a- III d and IV a – IV d in ethanol has been carried out and given in Tables 1 to 3 and graphical presentation for density and viscosity are shown in Fig. 1 to 2.

Table 1 Ligand (III a-IV d) Solvent-Ethanol (T=297K)

Ligand	ÖC mole½/lit½	Density d x 103 kgm-3	Time flow 't' sec	Relative viscosity (hr)
III a	0.1	0.9321	105	1.0939
III b	0.1	0.9312	110	1.1449
III c	0.1	0.9341	100	1.044
III d	0.1	0.9333	101	1.0536
IV a	0.1	0.9307	112	1.1651
IV b	0.1	0.9303	114	1.1854
IV c	0.1	0.9327	103	1.0737
IV d	0.1	0.9315	108	1.1244

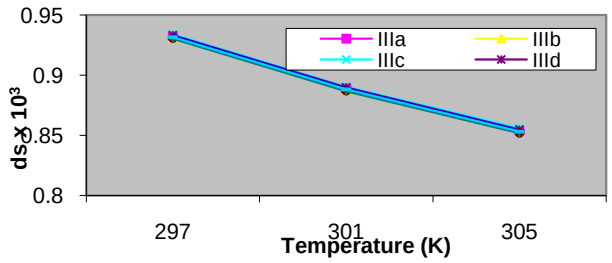
Table 2 Ligand (III a-IV d) Solvent-Ethanol (T=301K)

Ligand	ÖC mole½/lit½	Density d x 103 kgm-3	Time flow 't' sec	Relative viscosity (hr)
III a	0.1	0.8888	110	1.081
III b	0.1	0.8878	114	1.1191
III c	0.1	0.8904	104	1.0239
III d	0.1	0.8899	105	1.0332
IV a	0.1	0.8873	116	1.1381
IV b	0.1	0.8868	118	1.157
IV c	0.1	0.8891	107	1.0519
IV d	0.1	0.8892	111	1.0901

Table 3 Ligand (III a-IV d) Solvent-Ethanol (T= 305 K)

Ligand	ÖC mole½/lit½	Density d x 103 kgm-3	Time flow 't' sec	Relative viscosity (hr)
III a	0.1	0.8537	111	1.0652
III b	0.1	0.8529	115	1.1026
III c	0.1	0.8661	105	1.0105
III d	0.1	0.8547	106	1.0184
IV a	0.1	0.8522	117	1.1208
IV b	0.1	0.8519	120	1.1492
IV c	0.1	0.854	108	1.0368
IV d	0.1	0.8532	113	1.0838

Fig. 1. Density of ligand III a-III d and IV a-IV d in Ethanol



Density (d) :- Density measurements have been carried out

for different ligands. The solution was filled in pyknometer. It was kept in thermostat for 15-20 minute. It was weighed after checking liquid level in it. Weight of solution was found out by deducting weight of empty pyknometer from weight of pyknometer filled with solution. Using the weight of solution and volume of pyknometer, density of solution was calculated and average of three density values was considered in calculations.

In ethanol at 297, 301 and 305 K,

III c > III d > III a > III b

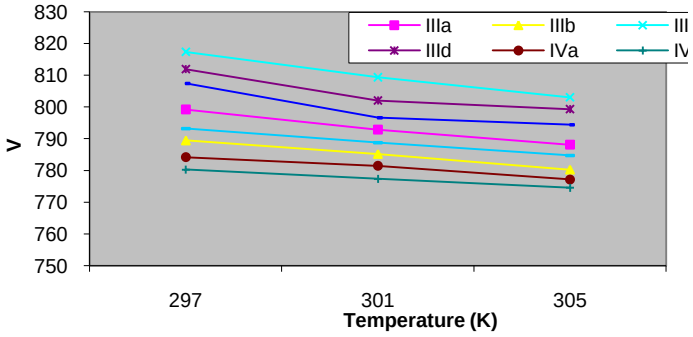
IV c > IV d > IV a > IV b

For ligands III a-III d and IV a-IV d, it is observed that, in case of ethanol the density values decrease with increase in temperature. The decrease in density with rise in temperature indicate decrease in intermolecular forces due to increase in thermal energy of the system [15].

Due to presence of -OH, -Cl, -Br groups, these group show -I effect and +R effect of which latter predominates +R effect increases the electron density.

Density is the measure of solvent-solvent and ion – solvent interactions. It is clear that solvent-solvent interactions bring about a bonding, probably hydrogen bonding between them. So, size of the resultant molecule increase and there will be decrease in density[16].

Fig. 02 : Plot of $\square_r$ vs Temperature
Solvent – Ethanol



Viscosity (h) :- The viscosity of each solution is determined by the following empirical formula.

$ή_2 = ή_1 \times d_2t_2/d_1t_1$

where, $ή_2$ and $ή_1$ are the viscosity of ligand solution and solvent,d1 and d2 are the densities of solvent and ligand respectively, t1 and t2 are the time of flow for solvent and ligand respectively.

$$ήr = ή_2/ή_1 = d_2t_2/d_1t_1$$

where, ήr = relative viscosity.

The relative viscosities have been analyzed by Jones-Dole equation[17].

Viscosity is important parameters in understanding the structure as well as molecular interactions occurring in the solutions. The values of viscosity decreases with increasing temperature.

The decreasing behavior of viscosity values with rise in temperature clearly establishes the weakening of ion-solvent interaction in the solvent mixture.18

From the tables 1 to 3 and fig. 1 and 2, Relative viscosity in ethanol at 297,301 and 305K,

IIIb > IIIa > IIId > IIIc

IVb > IVa > IVd > IVc

The viscosity values are higher for ligand IIIb and IVb, this may be due to presence of double bond and available for solute-solvent interaction. Viscosity decreases with increase in temperature indicates decrease in intermolecular forces due to increase in thermal energy of the system.[19]

In ethanol, relative viscosities for ligands III a-IV d at 297, 301 and 305 K.

$\square_r$ 305 < $\square_r$ 301 < $\square_r$ 297

Temperature increases the relative viscosity decreases. This shows decrease in solute-solvent interactions. This can be explained in terms of hole theory of liquid. According to this theory, there are vacancies or holes in liquid. The liquid molecule keep on moving continuously into these vacancies. As a consequence, the vacancies also keep on moving around, as otherwise the liquid will not be able to flow. This process, however, require energy. The liquid molecules therefore, need some energy to move into hole. At increasing temperature, the energy becomes increasingly available and so liquid can flow more easily. Thus the viscosity falls appreciably with rise in temperature.

CONCLUSION

Density and viscosity are determined which explain ion-solvent, solvent-solvent, solute-solvent and molecular interactions in the solution. So in the present work these densities and viscosities were studied for synthesized ligands, which are used as solutes using ethanol, at temperatures 297, 301 and 305 K in 0.01 M concentration.

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