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Title Key: Study β and A coefficient of some Heterocyclic …

Study β and A coefficient of some Heterocyclic Drugs at 29°C in Methanol-Water and Acetone-Water mixtures Viscometrically

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Abstract:

The basic principle of viscosity measurement is to study the interactions between solute and solvent. The viscometric measurement of heterocyclic drugs viz 1,5 dihydro-4H-pyrazolol (3,4-d) pyramidin 4-one (Ligand-1) and 4-Hydroxy-3-[1(4-nitrophenyl)-3oxobutyl]-2H-chromen-2-one (Ligand-2) were carried out at various concentrations of solvents Methanol and Acetone at 29°C. The data obtained during this investigation were used for the characterization as Structure Formers or Structure Breakers.

Key words :- β - coefficient, viscometry , viscosities and Densities.

Introduction:

The refractive index is an important additive property of molecular structure of liquid. Every liquid offers some resistance to flow. This resistance to flow is called viscosity. It is developed in liquids because of sharing effect of moving one layer of liquid past another motion of liquid can be visualized as a movement of one layer over another. A layer move quickly then second and so on. This type of flow is called laminar flow or streamlined flow. Useful information about solute-solute and solute -solvent interaction provides when the behavior of electrolytes are studied by viscometry . Many workers [1-3] have been studied these interactions in aqueous and non - aqueous solutions.

Ikhe [4]has studied the viscosity of [HBMPPI] ,[AHBMPPP] , [PHNMPMPP] and captopril in 70% dioxane water mixture at different concentrations. Molecular interactions of electrolyte in binary mixture of two liquids in terms of viscosity , β - coefficient have been studied by Mehrotra et.al.[5], Das et.al.[6] , Nikam[7], Kalra et.al.[8] , Pandy et.al.[9] and Raut et.al.[10]. Gadpayle M.R.[11] have studied the β -

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coefficient value of some substituted chalcones in 70% DMF-water mixture while Tambatkar G.D.[12] have studied viscosity and β - coefficient value of some heterocyclic and non-heterocyclic drugs in 70 % Dioxane-water mixture solution. Sonar et.al.[13] have been studied on viscosity, density and refractive index of substituted heterocyclic compounds in different media. Tayade et.al.[14] have been studied viscometric study of s-substituted triazinothiocarbamides at 35^{o}C in Dioxane-water mixture. Deosarkar et.al.[15] have been studied volumetric, viscometric and refracometric behavior of glycine+(aqueous isoniazid) ternary mixtures at 298.15^{o}K.Recently Yasmin Akhtar[16] have been studied volumetric and viscometric studies of solute-solvent and solute-solute interactions of glycine in aqueous electrolytes at 30^{o}C.

The present study deals with the study of molecular interactions in terms of viscosity, β-coefficient of different ligands in different concentrations of Methanol-water and Acetone-water mixtures in different concentrations.

Experimental:

The viscosities were measured by means of Ostwald's Viscometer (±0.11%Kgm^{-1}s^{-1}) which was kept in equilibrium with elite thermostatic water bath (± 0.1 ^{o}C) . Ligand solutions of different concentrations were prepared in 70 % Methanol -water and Acetone- water. The ligands used are Ligand$_1$- 1,5 dihydro-4H-pyrazolol (3,4-d) pyramidin 4-one Ligand$_2$- 4-Hydroxy-3-[1(4-nitrophenyl)-3oxobutyl]-2H-chromen-2-one.

The relative viscosity of each solution is determined by following empirical formula

η_r = (ds x ts) / (dw x tw) ----------(1)

Where η_r = relative viscosity of ligand solution, ds = density of ligand solution ,dw=density of distilled water, ts=time of flow for solution, tw=time of flow for distilled water

The relative viscosity and density data for ternary mixture at different concentrations are presented in Tables 1 to 4.

The relative viscosities have been analyzed by Jones -Dole equation

$(\eta_r - 1) / \sqrt{c}$ = A + B $\sqrt{c}$----------(2)

Where C =molar concentration of the ligand solution ,A=Falkenhagen coefficient, B=Jones-Dole coefficient

A is the measure of solute - solute interactions and B is the measure of solute - solvent interaction.

The graphs are plotted between $(\eta_r - 1) / \sqrt{c}$ Vs. $\sqrt{c}$. The graph for each system gives linear straight line showing validity of Jones - Dole equation. The slope of straight line gives value of β-coefficient.

In the present study, relative viscosity of ligand solutions decreases with increase in the concentration of ligand may be attributed to increase in solute - solvent interactions. From the graph of $(\eta_r - 1) / \sqrt{c}$ versus $\sqrt{c}$, `A' which is the measure of solute - solute

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interactions and `B' which is the measure of solute - solvent interactions has been calculated .

Result and discussion:

The large and small values of `A' show the stranger and weaker solute - solute interactions respectively as listed in tables 5 and 6 .

Solutes with positive viscosity β-coefficient are characterized as "Structure formers" and will impose a new order by reorientation of the adjacent water molecules indicating strong solute- solvent interactions.

Solutes with negative viscosity β- coefficient is characterized as "Structure Breakers" indicating weak solute - solvent interactions.

Here I was found that both Ligands in Methanol system and Acetone system shows positive value i.e. Structure forming activity and no one shows Structure Breaking activity. Such type of results is also shown by Pandey et al[13].

Observations and Calculations:

Table -1
Densities and viscosities of systems in Methanol-Water at 29°C(±0.1°C)
System: Ligand -L_1

Sr. No.	Concentration C (mole/liter)	$\sqrt{c}$ x10^{-2} (mole$^{1/2}$/liter$^{1/2}$)	Density (gm./c.c.)	Time (sec.)	η_r	η_r-1/$\sqrt{c}$
1	50 x 10^{-4}	7.0711	0.902	63	1.5001	7.0736
2	40 x 10^{-4}	6.3246	0.932	58	1.4269	6.7706
3	30 x 10^{-4}	5.4772	0.947	56	1.3999	7.2974
4	20 x 10^{-4}	4.4721	0.954	51	1.3999	8.9463
5	10 x 10^{-4}	3.623	0.961	44	1.1162	3.6772

Table -2
Densities and viscosities of systems in Methanol-Water at 29°C(±0.1°C)
System: Ligand -L_2

Sr. No.	Concentration C (mole/liter)	$\sqrt{c}$ x10^{-2} (mole$^{1/2}$/liter$^{1/2}$)	Density (gm./c.c.)	Time (sec.)	η_r	η_r-1/$\sqrt{c}$
1	50 x 10^{-4}	7.0711	0.902	64	1.4475	6.3296
2	40 x 10^{-4}	6.3246	0.932	57	1.3321	5.2547
3	30 x 10^{-4}	5.4772	0.947	53	1.2586	4.7190
4	20 x 10^{-4}	4.4721	0.954	49	1.1722	3.8523

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5	10 x 10^{-4}	3.1623	0.961	44	1.0603	1.9082

Table -3 Densities and viscosities of systems in Acetone-Water at 29°C(±0.1°C)
System: Ligand -L_1

Sr. No.	Concentration C (mole/liter)	$\sqrt{c}$ x10^{-2} (mole$^{1/2}$/liter$^{1/2}$)	Density (gm./c.c.)	Time (sec.)	η_r	η_r-1/$\sqrt{c}$
1	50 x 10^{-4}	7.0711	0.906	53	1.2676	3.7850
2	40 x 10^{-4}	6.3246	0.937	54	1.3357	5.3117
3	30 x 10^{-4}	5.4772	0.951	53	1.3305	6.0310
4	20 x 10^{-4}	4.4721	0.959	49	1.2404	5.3781
5	10 x 10^{-4}	3.1623	0.963	44	1.1185	3.7500

Table -4 Densities and viscosities of systems in Acetone-Water at 29°C(±0.1°C)
System: Ligand -L_2

Sr. No.	Concentration C (mole/liter)	$\sqrt{c}$ x10^{-2} (mole$^{1/2}$/liter$^{1/2}$)	Density (gm./c.c.)	Time (sec.)	η_r	η_r-1/$\sqrt{c}$
1	50 x 10^{-4}	7.0711	0.906	54	1.2915	4.1231
2	40 x 10^{-4}	6.3246	0.937	56	1.3851	6.0937
3	30 x 10^{-4}	5.4772	0.952	53	1.3319	6.0566
4	20 x 10^{-4}	4.4721	0.959	49	1.2404	5.3781
5	10 x 10^{-4}	3.1623	0.963	45	1.1439	4.5538

Table-5 A and β coefficient values in Methanol-Water Medium

Sr. No.	System	A	β (lit/mole)
1	Lgand-L1	+4.453	+0.574
2	Lgand-L2	+2.527	+0.075

Table-6A and B coefficient values in Acetone-Water Medium

Sr. No.	System	A	β (lit/mole)
1	Lgand-L1	-1.256	+1.069

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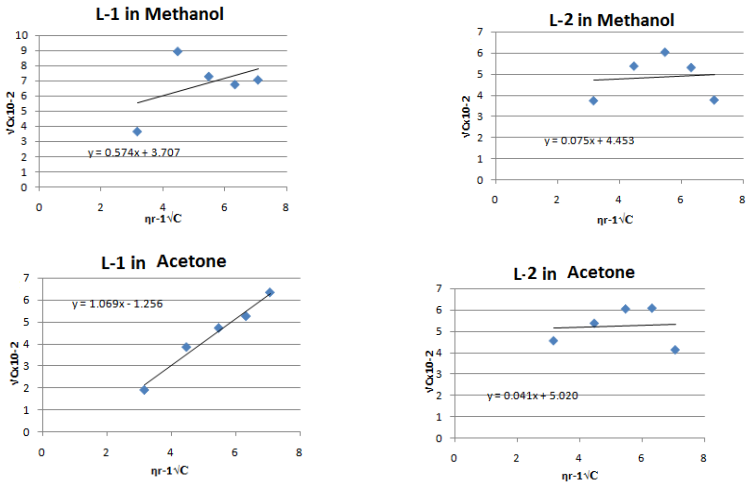
2	Lgand-L2	+5.020	+0.041

Graphs:



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