NOTE

Study of Thermodynamic Parameters and Viscosity Behaviour of Substituted Pyrazoline in 70% dioxane-water. Part-I

MS. V.G. RAUT*, P.B. RAGHUWANSHI† and A.G. DOSHI
Department of Chemistry
Vidya Bharti Mahavidyalaya, Amravati-444 602, India

Viscosity measurements have been made on system comprising 3-(2″-hydroxy-3″-nitro-5″-chlorophenyl)-5-(2′-furyl) pyrazoline in 70% dioxane-water mixture solvent at different temperatures. The data have been used to calculate viscosity and thermodynamic parameters such as ΔG*, ΔH*, and ΔS*. We have also studied the effect of solvent on the viscosity at 30°C. It has been found that viscosity increases with increase in the percentage of dioxane. Also viscosity increases due to increase in concentration of ligand in 70% dioxane-water system. In the present investigation we have calculated the value of β-coefficient and other thermodynamic parameters ΔG*, ΔH*, and ΔS* for the ligand which shows that the process is spontaneous and irreversible.

Viscosity is one of the physical properties of liquids and gases and it implies resistance to flow. The significance of viscosity may be further elucidated by considering the flow of liquid through a narrow pipe, Physical properties of liquid and binary liquid mixture have been the subject of interest in research laboratories[1–6].

The measurements of viscosities of electrolytes in solution provide an excellent method of obtaining data on solute-solvent and solute-solute interaction. These interactions have been studied by many workers in aqueous and non-aqueous solutions but such investigations in mixed solvents are scanty.

The John-Dole[7] equation accounts for the observed viscosity-concentration dependence of dilute electrolyte solutions, while Bresalu-Miller[8], Vand[9] and Thomson[10] equation accounts for the concentration dependence of viscosity in concentrated electrolyte solutions. Recently we[11] carry out studies on viscosity behaviour of different concentrated solutions of 3-hydroxy-6-chloro-8-bromo flavanol in 70% dioxane-water and 70% methanol-water. The present work deals with the study of interaction of ligand. 3-(2″-hydroxy-3″-nitro-5″-chlorophenyl)-5-(2′-furyl) pyrazoline in 70% dioxane-water mixture at different temperatures and also to study the effect of percentage of dioxane-water on viscosity by keeping ligand concentration constant.

†Department of Chemistry, S.S.K.R. Innani Mahavidyalaya, Karanja (Lad)-444 105, India.

Ligand 3-(2″-hydroxy-3″-nitro-5″-chlorophenyl)-5-(2′-furyl) pyrazoline was prepared in the laboratory[12] and confirmed by spectral data. Dioxane was purified by standard method of Vogel. Dioxane-water (70%) were mixed by volume and used as solvent. The different percentage of solvents (70%, 75%, 80%, 85%) were prepared by change in the volume of solvent and keeping the volume of ligand fixed. The solution of different molarities ($1 \times 10^{-6}, \ldots 2.5 \times 10^{-6}$ M) of ligands were prepared fresh by dissolving an appropriate amount of solvent mixture at 30°C. Densities of mixture were determined by the help of pyknometer having a bulb volume of 10 cm^3 and capillary having an internal diameter 1 mm. Viscosities were measured by means of Ostwald viscometer. Standard errors in viscosity measurements were less than ± 0.2%.

The data of viscosity in the present investigation are presented in Table-1 to study the effect of dioxane-water solvent. It could be seen from Table-1 that viscosity increases with increase in percentage of dioxane for ligand.

TABLE-1
VISCOSITY OF LIGAND IN DIFFERENT PERCENTAGES OF DIOXANE-WATER AT 303 K

Percentage of solvent	Viscosity in poise
70	1.0389
75	1.0684
80	1.0973
85	1.1408

The determination of viscosities at different temperatures (303 K, 308 K, 313 K) in 70% dioxane-water mixture solvent for ligand has been done in the present investigation with a limited aim to evaluate the thermodynamic parameters such as ΔG*, ΔH* and ΔS*. The data of viscosity obtained at different temperatures for a ligand is presented in Table-2. It could be seen from Table-2 that viscosity increases with increase in the concentration of ligand because interaction of ligand (solute)-dioxane (solvent) increased with respect to change in the concentration. The data evaluated in the present work of ΔG*, ΔH* and ΔS* are presented in Table-3. It is observed from Table-3 that there is no appreciable change in the values of ΔG*, ΔH* and ΔS* for different concentra-

TABLE-2
VISCOSITY OF LIGAND AT DIFFEPENT TEMPERATURES

Concentration mole lit^{-1}	303 K	308 K	313 K
1×10^{-6}	0.9569	0.7923	0.7405
1.5×10^{-6}	0.9815	0.8173	0.7344
2×10^{-6}	1.0050	0.8425	0.7776
2.5×10^{-6}	1.0205	0.8921	0.8355

tions of ligand. It would also be seen from Table-3 that the values of ΔG^* are positive and those of ΔS^* are found to be negative ($\Delta G^* > 0$, $\Delta S^* < 0$) which shows that the process is spontaneous and irreversible.

TABLE-3
DATA OF THERMODYNAMIC PARAMETERS IN J/mol FOR LIGAND

Concentration	ΔG^*	ΔH^*	ΔS^*
1×10^{-6}	62.109×10^3	18.764×10^3	-0.141×10^3
1.5×10^{-6}	62.172×10^3	19.233×10^3	-0.139×10^3
2×10^{-6}	62.224×10^3	18.965×10^3	-0.140×10^3
2.5×10^{-6}	62.369×10^3	16.753×10^3	-0.147×10^3

β-Coefficient Value: The relative viscosity (η_r) and specific viscosity ($\eta_r - 1$) were calculated. Jones-Dole have applied the equation

$$\frac{\eta_r - 1}{\sqrt{c}} = A + B\sqrt{c}$$

and investigated the role of solute-solvent interaction. In the present investigation, the β-coefficient value of ligand is found to be 0.105×10^6. This shows greater interaction between ligand (solute) and dioxane (solvent).

REFERENCES

1. S.S. Joshi, T.M. Aminabhai, R.H. Balundgi and S.S. Shukla, *J. Chem. Eng. Data*, **35,** 185 (1990).
2. S.S. Joshi, T.M. Aminabhai and S.S. Shukla, *Can J. Chem.*, **68,** 319 (1990).
3. S.S. Joshi and T.M. Aminabhai, *Fluid Phase Equil.*, **60,** 251 (1990).
4. V.A. Aminabhai, T.M. Aminabhai and R.H. Balundgi, *Ind. Eng. Chem. Res.*, **29,** 2106 (1990).
5. M.I. Aralaguppi, T.M. Aminabhai, R.H. Balundgi and S.S. Joshi, *J. Phys. Chem.*, **95,** 5299 (1991).
6. M.I. Aralaguppi, T.M. Aminabhai and R.H. Balundgi, *Fluid Phase Equil.*, **71,** 99 (1992).
7. G. Jones and M. Dole, *J. Am. Chem.*, **51,** 2950 (1992).
8. B.K. Bresalu and J.F.J. Miller, *Phys. Chem.*, **74,** 1056 (1970).
9. V. Vand, *J. Phys. Colloid Chem.*, **52,** 277 (1948).
10. D.J. Thomson, *J. Colloid Sci.*, **20,** 267 (1965).
11. P.B. Raghuwanshi, A.G. Doshi and M.L. Narwade, *Oriental J. Chem.*, **14,** 341 (1998).
12. P.B. Raghuwanshi and A.G. Doshi, *Asian J. Chem.*, **6,** 291 (1994).

(*Received*: 6 January 2000; *Accepted*: 29 April 2000) AJC-2022