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Thermodynamic Parameters and Viscosity Behaviour of Nitro Pyrazoline in 70% Methanol-Water

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Viscosity measurements have been made on system 3-(2″-hydroxy-3″-Nitro-5″-chlorophenyl)-5-(2′-furyl) pyrazoline in 70% methanol-water 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 viscosity at 25°C. It has been found that viscosity increases with increase in the percentage of solvent methanol. We have also calculated the thermodynamic parameters ΔG*, ΔH* and ΔS* for nitropyrazoline, which shows that the process is spontaneous and irreversable.

Viscosity is one of the physical properties of liquids and gases and it implies resistance to flow, as fluids (liquids and gases) exhibit a characteristic property of flowing under applied force, even the force of their own weight. Physical properties of liquids and binary mixtures 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 interaction. These interactions have been studied by many workers in aqueous and non-aqueous solutions, but such investigations in mixed solvents are rare.

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

3-(2″-Hydroxy-3″-nitro-5″-chlorophenyl)-5-(2′-furyl) pyrazoline was prepared in the laboratory[12] and confirmed by its spectral data. Methanol was purified

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by standard method of Vogel. Methanol-water (70%) were mixed by volume and used as solvent. The different percentages of solvents (70%, 75%, 80%, 85%) were prepared by change in the volume of solvent and keeping the volume of ligand fixed. The solutions of different molarities (1×10^{-6}, 1.5×10^{-6}, 2×10^{-6}, 2.5×10^{-6}) of ligands were prepared fresh by dissolving an appropriate amount of solvent mixture at 25°C. Densities of mixtures were determined by the help of a pyknometer having a bulb of volume of 10 cm^3 and capillaries 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 methanol-water solvent. It could be seen from Table-1 that viscosity increases with increase in percentage of methanol solvent at different temperature (298K, 303K, 308K) in 70% methanol-water solvent for the ligand nitro-pyrazoline, and thermodynamic parameters such as ΔG*, ΔH*, and ΔS* were evaluated. The data of viscosity obtained at different temperatures for ligand are presented in Table-2, which conclude that viscosity increases with increase in the concentration of ligand because interaction of ligand (solute)-solvent increases with respect to change in 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*. It is also seen from Table-3 that the values of ΔG* are found to be positive (ΔG* > 0) and of ΔS* are found to be negative (ΔS* < 0) which shows that the process is spontaneous and irreversible.

TABLE-1
VISCOSITY OF LIGAND IN DIFFERENT PERCENTAGES OF METHANOL-WATER AT 298 K

Percentage of solvent (%)	Viscosity in poise
70	0.4969
75	0.5011
80	0.5019
85	0.5109

TABLE-2
VISCOSITY OF LIGAND OF DIFFERENT CONCENTRATIONS AT DIFFERENT TEMPERATURES

Concentration (mole lit^{-1})	298 K	303 K	308 K
1×10^{-6}	0.7397	0.7052	0.7066
1.5×10^{-6}	0.7514	0.7080	0.7112
2×10^{-6}	0.7714	0.7107	0.7126
2.5×10^{-6}	0.7917	0.7109	0.7137

β-*Coefficient Value:* The relative viscosity (η_r) and specific viscosity ($\eta_r - 1$) were calculated. Jones-Dole[7] 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 1.565×10^6. This showed greater interaction between ligand and methanol solvent.

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

Concentration (mole lit^{-1})	ΔG*	ΔH*	ΔS*
1×10^{-6}	59999	36360	–79.0
1.5×10^{-6}	59144	34460	–83.0
2×10^{-6}	59876	41160	–62.7
2.5×10^{-6}	59662	36160	–78.0

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