Stability Constants of Some Trivalent Metal Ions Chelates of Schiff Bases

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Potentiometric studies have been carried out on metal chelates of Y^{3+} Sm^{3+}, Nd^{3+}, Dy^{3+} and Gd^{3+} with N-(2-hydroxy-5-phenylbenzylidene)-2,5-dichloroaniline and N-(2-hydroxy-5-phenylbenzylidene)-3-chloroaniline. The proton-ligand formation constants and stability constants of their metal chelates are reported.

The present investigation is aimed at determining the stability constants of Y^{3+}, Sm^{3+}, Nd^{3+}, Dy^{3+} and Gd^{3+} with N-(2-hydroxy-5-phenylbenzylidene)-2,5-dichloroaniline and N-(2-hydroxy-5-phenylbenzylidene)-3-chloroaniline.

EXPERIMENTAL

The reagents N-(2-hydroxy-5-phenylbenzylidene) - 2,5-dichloroaniline (I) and N-(2-hydroxy-5-phenylbenzylidene)-3-chloroaniline (II) were prepared by condensing ethanolic solution of 4-hydroxy-3-aldehydobiphenyl with 2,5-dichloroaniline and 3-chloraniline respectively in equimolar ratios. The products were repeatedly crystallised to get analytically pure compounds. The purity was tested by TLC and elemental analysis.

TITRATION PROCEDURE :

The Calvin-Bjerrum titration techniques as adopted by Irving and Rossotti was used to determine the dissociation constants of the reagents and the formation constants of their metal chelates at 25 ± 0.1°C. All conditions are as in the preceeding paper(1).

RESULTS AND DISCUSSION

Formation functions $\bar{n}_A$, $\bar{n}$, pL were calculated using the standard expressions from the titration curve. The pK_1^H and pK_2^H values and those of log K_1 and log K_2 were determined(1). For those metal systems where difference in log K_1 and log K_2 was less than 1.78 log units, the values were better determined by least square method.

The pK values of the ligands were examined in the light of mesomeric and inductive effects of the substituents. The pK^H value of compound N-(2-hydroxy-5-phenylbenzylidene)-2,5-dichloroaniline, is higher than that of the N-(2-hydroxy-5-phenylbenzylidene)-3-chloroaniline. The-Cl group has a +M and -I effect. The higher pK^H value of the compound N-(2-hydroxy-5-phenylbenzylidene)-2,5-dichloroaniline, can be attributed to the additional -Cl group in this compound. This is in conformity with the observed pK^H values of the two compounds.

The order of the stability constants for t trivalent metal chelates of N-(2-hydroxy-phenylbenzylidene)-2,5-dichloroaniline, is Y^{3+} Nd^{3+} > Sm^{3+} > Gd^{3+} > Dy^{3+} and that of N-(2-hydroxy-phenylbenzylidene)-3-chloroaniline, is Y^{3+} > Gd Dy^{3+} > Sm^{3+} > Nd^{3+}

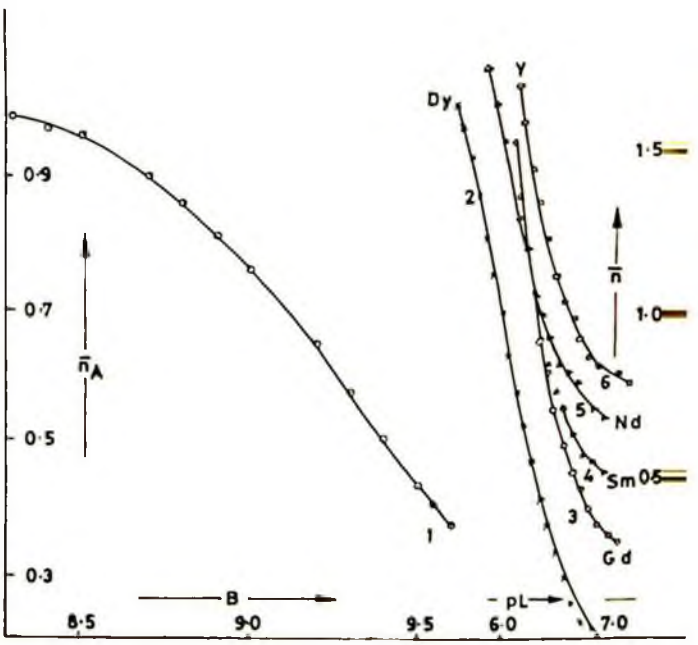


Fig. 1 Formation curves of complexes with ligand N-(2-hydroxy-5-phanyl benzylidene)-2,5-dicholoroaniline
1. Proton complex, 2-6, metal-ligand complex

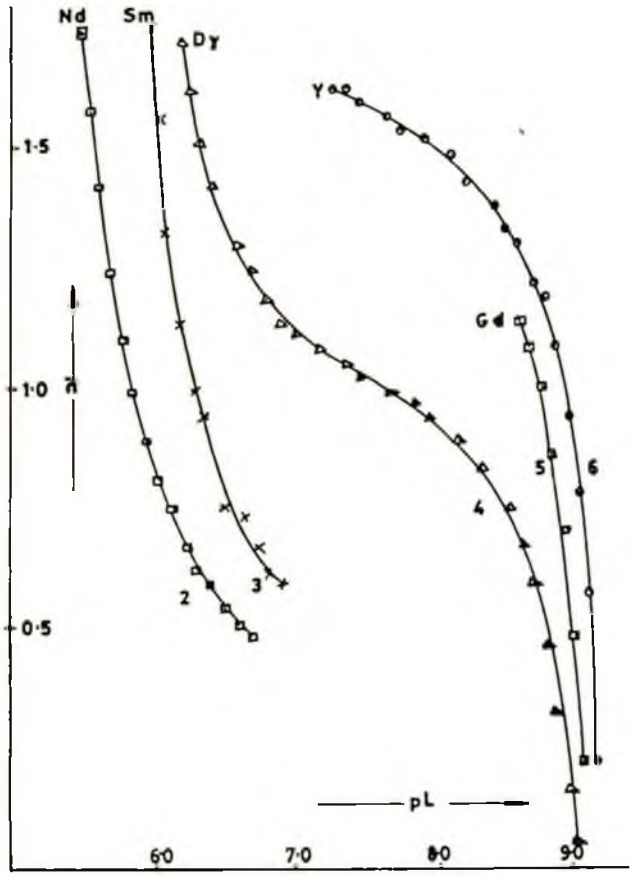


Fig. 2 Formation curves of complexes with ligand N-(2-hydroxy-5-phenyl benzylidene)-3-Chloroaniline, 7 proton complex, 2-6 metal-ligand complex

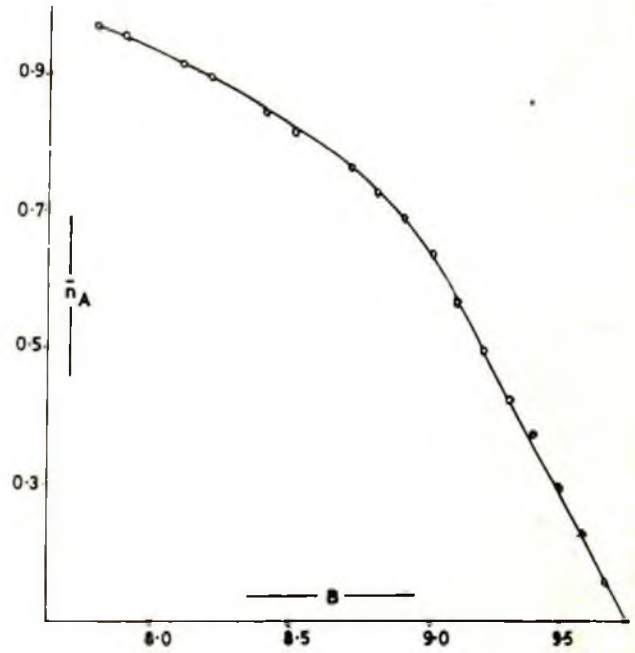


Fig. 3 Formation curve of the proton complex o the ligand N-(2-hydroxy-5-phenyl benzyl idene)-3-Chloroaniline

TABLE 1

STEPWISE STABILITY CONSTANTS OF VARIOUS COMPLEXES:

t = 25 ± 0.1°C. Dioxane 75% μ = 0.1 M

	Ligand I		Ligand II	
Cation	log K_1	log K_2	log K_1	log K_2
H^+	9.39	-	9.20	-
Sm^{3+}	6.988	5.70	6.985	5.71
Nd^{3+}	7.321	5.66	6.536	5.10
Dy^{3+}	6.223	5.77	8.77	6.30
Y^{3+}	7.543	5.70	9.14	7.74
Gd^{3+}	6.40	5.874	9.006	6.57

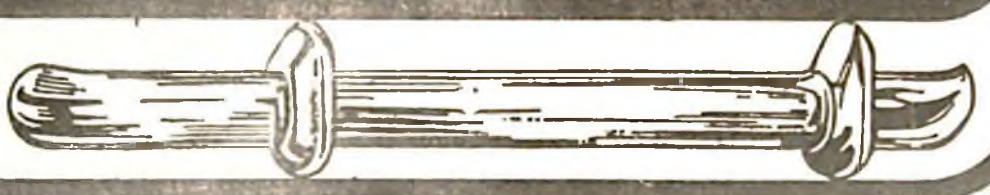
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REFERENCE

1. M.S. Mayadeo and R.K. Banavali, J. Electrochem Soc. India 34 (1985) 24.

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