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NOTES

Complex Formation of Some Bivalent Metal Ions with Oxygen Sulphur Donor Ligands

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Complexation reactions of thiomalic acid (TMA), thiolactic acid (TLA) and thioglycolic acid (TGA) with Mn(II), Ni(II), Co(II), Cu(II) and Zn(II) have been studied in solution phase using the technique of paper electrophoresis at a fixed ionic strength μ = 0.1 M ($HClO_4$) at 25 ± 1°C and their stability constants have been reported. The values are in good agreement with the Irving and Williams series.

An upto date survey of literature shows no reference in the binary complexes of thiomalic acid (TMA), thioglycolic acid (TGA) and thiolactic acid (TLA) with Mn(II), Co(II), Ni(II), Cu(II) and Zn(II) by paper electrophoresis. However, complexes of these ligands with a number of metal ions have been studied by other techniques[1–7]. Hence it was thought worthwhile to undertake the present investigation electrophoretically in aqueous medium at a fixed ionic strength μ = 0.1 M ($HClO_4$) at 25 ± 1°C.

The solution of TMA was prepared by direct weighing and those of TGA (Sisco) and TLA (Fluka) from the stock solutions by diluting a calcuiated quantity of the acids with CO_2-free double distilled water. All other chemicals used were of AR grade. Metal perchlorates were prepared by dissolving metal carbonates in calculated quantity of perchloric acid and were standardised by usual procedures[8]. The concentrations of the ligand and metal solutions used were 1.0×10^{-2} M and 5.0×10^{-3} M, respectively, throughout the studies. Electrophoresis was carried out for 30 min. for each set of experiments. Instrument used was Systronics paper electrophoresis equipment No. 604 (India). Suitable arrangements were made[9] for maintaining the temperature at 25 ± 1°C.

Stability constants were calculated taking the help of curve between mobility of the metal ion spot and pH. The dissociation constants of the ligands are reported in the literature[7]. Stepwise formation constants of the complexes are presented in Table 1.

For Co(II)–, Ni(II)–, and Zn(II)–TMA, –TGA and –TLA systems, three plateaus are obtained in the pH vs. mobility curve, the last two of which indicate formation

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TABLE 1
STABILITY CONSTANTS OF THE COMPLEXES

Temp. 25 ± 1°C, μ = 0.1 M ($HClO_4$)

Ligand	Constants	Mn(II)	Co(II)	Ni(II)	Cu(II)	Zn(II)
TMA	$\log K_1$	4.30	6.36	6.29	6.86	6.84
	$\log K_2$	—	5.30	5.59	6.19	6.19
TLA	$\log K_1$	2.24	7.06	6.45	8.99	7.44
	$\log K_2$	—	4.88	5.95	8.09	6.71
TGA	$\log K_1$	3.59	8.05	6.78	9.81	7.81
	$\log K_2$	—	5.88	5.70	8.45	7.05

of 1 : 1 and 1 : 2 complexes. In Mn(II)–TMA, Mn(II)–TGA and Mn(II)–TLA systems, only two plateaus are obtained which are attributed to the formation of 1 : 1 complex only. Reddy and Bhattacharya[1] also reported the formation of 1 : 1 complex between Mn(II) and TMA. The Cu(II)–TMA, Cu(II)–TGA and Cu(II)–TLA systems show only two plateaus giving the idea of formation of a single complex. Nepal and Dubey[7] reported that it is 1 : 2 complex formed in a single step. The first plateau in all the systems is assigned to the uncomplexed metal ion.

The order of stability was found in the ligand order: TMA > TGA > TLA. The increased stability of TMA complexes may be attributed to the terdentate nature of the ligand. The stability constant values are in accordance with Irving and Williams[10] series except the Co(II)–TGA complex in which higher stability as compared to that of Ni(II) has been observed[11, 12]. The literature values are in good agreement with the values reported in these studies[7].

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