POLAROGRAPHIC BEHAVIOUR OF CADMIUM, IRON, COBALT, NICKEL AND ZINC IONS AS PIPERIDINE COMPLEXES AND THEIR SIMULTANEOUS DETERMINATION IN BINARY MIXTURES

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In continuation of our earlier work [1,2,3] to use piperidine as complexing agent, we have undertaken the analysis of few metal ions individually and in their binary mixtures and the results are presented here.

EXPERIMENTAL

Polarograms were recorded at 25 ± 1 °C with Elico D.C. Recording polarograph. 0.5 M ammonium acetate to suppress the precepitation of metal ions and 0.1 M KNO_3 were used as supporting electrolyte. (Mannitol is used in the case of iron to suppress the precipitation of metal ion). 0.002% Triton X-100 was used as a maxima suppressor. Piperidine used was a Riedel sample. All precautions required in polarography are taken.

TABLE 1

EFFECT OF PIPERIDINE CONCENTRATION

(NH_4OAc) = 0.5 M (KNO_3) = 0.1 M
(Metal) = 1 mM Triton X-100 = 0.002%

[Pip] M		Cd^{2+}	Co^{2+}	Ni^{2+}	Zn^{2+}	Fe^{2+}
0.0	$-E_{1/2}$(V)	0.58	1.23	1.025	1.19	-
	$(i_d)\mu A$	9.00	7.50	8.0	10.50	-
0.1	$-E_{1/2}$ V	0.64	1.23	1.090	1.26	0.48
	$(i_d)\mu A$	9.00	8.10	11.0	12.25	1.625
0.2	$-E_{1/2}$	0.69	1.24	1.140	1.29	0.52
	$(i_d)\mu A$	9.00	8.50	12.0	12.25	1.863
0.3	$-E_{1/2}$	0.71	1.25	1.190	1.33	0.54
	$(i_d)\mu A$	9.25	8.75	13.0	12.25	2.188
0.4	$-E_{1/2}$	0.71	1.26	1.196	1.33	-
	$(i_d)\mu A$	9.25	8.75	13.0	12.50	-
0.5	$-E_{1/2}$	0.71	1.26	1.199	1.33	-
	$(i_d)\mu A$	9.25	8.75	13.0	12.55	-

TABLE 2

EFFECT OF THE CONCENTRATION OF METAL ION ON CURRENT FUNCTION i_d / C ($\mu A/mM$)
(NH_4OAC) = 0.5 M (KNO_3) = 0.1 M
(Piperidine) = 0.2 M Triton X-100 = 0.002%

[Metal ion] mM	Cd^{2+}	Co^{2+}	Ni^{2+}	Zn^{2+}	Fe^{2+}
0.5	8.50	8.50	11.20	12.50	2.50
0.8	8.43	8.50	11.30	12.50	2.50
1.0	9.00	8.50	11.25	12.55	2.20
1.5	9.00	8.50	11.30	12.56	2.25
2.0	9.00	8.52	11.25	12.53	2.30

TABLE 3

ANALYSIS OF BINARY MIXTURES
(Pip) = 0.3 M, (KNO_3) = 0.1 M, (NH_4OAc) = 0.5M
Triton X-100 = 0.002%

Amount Taken (mg)		Amount Found (mg)		Error (%)	
Cadmium	Cobalt	Cadmium	Cobalt	Cadmium	Cobalt
0.1124	0.0589	0.1152	0.0584	+2.50	-1.00
0.2248	0.0294	0.2250	0.0300	+0.08	+2.00
0.0562	0.0883	0.0562	0.0886	0.00	+0.33
Cadmium	Nickel	Cadmium	Nickel	Cadmium	Nickel
0.1124	0.0587	0.1095	0.0581	-2.5	-1.0
0.2248	0.0293	0.2248	0.0287	0.0	-2.0
0.0562	0.0880	0.0556	0.0871	-1.0	-1.0
Cadmium	Zinc	Cadmium	Zinc	Cadmium	Zinc
0.1124	0.0653	0.1096	0.0637	-2.6	-2.45
0.2248	0.0326	0.2248	0.0310	0.0	-5.00
0.0562	0.0653	0.0556	0.0640	-1.0	-2.00
Iron	Cobalt	Iron	Cobalt	Iron	Cobalt
0.0558	0.0589	0.0550	0.0574	-1.4	-2.54
0.0558	0.0294	0.0550	0.0294	-1.4	0.00
0.0558	0.0883	0.0550	0.0868	-1.4	-1.70
Iron	Nickel	Iron	Nickel	Iron	Nickel
0.0558	0.0587	0.0558	0.0572	0	-2.5
0.0558	0.0293	0.0558	0.0293	0	0.0
0.0279	0.0880	0.0279	0.0862	0	-2.0
Iron	Zinc	iron	Zinc	Iron	Zinc
0.0558	0.0653	0.0558	0.0653	0	0.0
0.0558	0.0326	0.0558	0.0309	0	-5.2
0.0279	0.0980	0.0279	0.0947	0	-3.3

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RESULTS AND DISCUSSION

The shift in half wave - potentials of the ions indicate the formation of stable complexes with Piperidine. The reduction waves remain well defined and diffusion controlled at all concentrations of piperidine from 0.1 to o.5 M and the values are reported in Table 1. A series of polarograms were recorded with different aliquots of metal ions in 0.2 M piperidine along with the supporting electrolyte. Linear plots of diffusion current vs concentration 0.5 to 2 mM (Table 2) indicated the feasibility of this method for the quantitative determination of the metal ions.

The slope values from log — plots are different from those required for reversible reduction except in the case of cadmium. Hence these metals, except cadmium are reduced irreversibly.

Different synthetic mixtures of these metal ions. (i)Cd-Co, ii) Cd-Ni, iii) Cd-Zn, iv) Fe-Co, v) Fe-Ni and vi) Fe-Zn were prepared-to examine the feasibility of simultaneous determination.

The results obtained are satisfactory and the values are reported in Table 3

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