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POLAROGRAPHIC STUDY OF ZINC AT DROPPING MERCURY ELECTRODE USING 2 – AMINO 2 – HYDROXY ETHANOIC ACID AS COMPLEXING AGENT AND KNO_3 AS SUPPORTING ELECTROLYTE

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ABSTRACT

The polarographic behaviour of Zinc, Cadmium, Manganese and Thallium has been studied in both organic and inorganic compounds as supporting electrolytes. The reduction wave of hydrogen falls too closely to Zn(II) that is why sometimes it becomes difficult to estimate Zn(II) in strongly acidic media supporting electrolyte used is potassium nitrate for the reduction of Zn(II). Methy amine (1974), diethylenetriamine and triethylene tetramine, thiocarbohydrazide (1982), potassium salicylate and iminodiacetic acid have also been used as supporting electrolyte. Complexing agent used is 2 – amino 2 – hydroxy ethanoic acid.

KEYWARDS: Supporting electrolyte, Zinc, Cadmium, Manganese, Thallium.

It was observed that the variation in the diffusion current and half wave potential of Zn(II) with the concentration of supporting electrolyte are brought about by a number of factors, such as viscosity, complex formation, ionic strength, interionic attraction and hydrogen voltage. Von strackelberg and his coworkers (1953) determined the diffusion coefficient of the depolarizer in different supporting electrolytes and have compared their results, with those obtained by cotrell (1902) method. In most of the cases the value of diffusion coefficient decreases with increasing concentration of the supporting electrolyte and ionic strength.

Lingane and Loveridge (1944) suggested a correction in with Ilkovic equation after taking into consideration the spherical diffusion and according to their modified quation the diffusion current constant, I should be a linear function of $t^{1/6}$ / $m^{1/3}$. They tested this relation for Zn(II) ions in presence of 0.1 NKCl and gelatine as maximum suppressor.

EXPERIMENTAL

All the chemicals used were of analytical grades and their stock solutions were prepared in conductivity water. Freshly prepared solutions were always used to avoid the effect of air oxidation. For each polarographic measurement the solution to be polarographed was prepared in a 20ml standard measuring flask by the addition of a known volume of standard solutions so as to give the required concentration of various contents. This solution was thoroughly mixed and then transferred to the polarographic cell. Purified nitrogen gas was passed through the solution for about 15 minutes to remove the dissolved oxygen and the polarograms were recorded with a manual Toshniwal polarograph at 25 + 0.1°C. A saturated Calomel electrode was used as the reference electrode and was connected to the polarographic cell through a potassium chloride – agar – 2 bridge. Double distilled mercury was used. The dropping mercury electrode had the following characteristics: $m=2.86\ mgs^{-1}$, $t = 2.74sec.$, $m^{2/3}\ t^{1/6} = 2.36mg^{2/3}\ sec^{-1/6}$ and $h_{corr} = 46.9cm$ in distilled water with an open circuit. The number of electrons (n) involved in the reduction process was determined by the millicoulometric method of Devries and krron (1953). The present section deals with the polarographic determination of Zn(II) using 2-A-2-HEA as complexing agent Ionic strength was kept constant by using KNO_3 as supporting electrolyte. Temperature was kept constant by using a thermostatic control. 0.002% Triton x-100 was used as maximum suppressor (T. Devries and J.L. Kroon 1953).

RESULTS AND DISCUSSION

Well defined waves of Zn(II) are obtained in presence of varying concentrations of 2-A-2HEA. However, the half wave potential shifts towards more negative values and the diffusion current, decreases with increasing concentrations of ligands plots of log i/i_d-I vs. $-E_{d.e.}$ are found to be linear, indicating the reversible reduction involving 2 electrons. It is observed that Zn(II) forms two complexes with 2-A-2HEA because a smooth curve with two segments is obtained by plotting – log Cx with $E_{1/2}$. Value of Fo [2-Amino acid] were calculated from equation – Fo(X) = derived function.

$$F_o[X] = \exp \int_o^{[x]} n \ d \ \log [\bar{X}]$$

Where, $F_o[X]$ = derived function

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$\overline{n}$ = ligand number and [X] = free ligand concentration using the fact that the residual itegral is given by:

$$\lim Fo\ [2\text{-Amino acid}] = \frac{1}{1 - n}$$

Calculation of stability constants then followed in the normal way, by graphical extrapolation.

The effect of interfacial tension on the diffusion current constant and on diffusion coefficient have been studied for Zn(II) with KNO_3 as supporting electrolyte and the observations in the ratio $i_d/m^{2/3}\ t^{1/6}$, $i_d/\ \sqrt{h}$, $t^{1/6}\ /\ m^{1/3}$ by changing the effective pressure of mercury column in each system have also been studied.

Effect of Complexing agent concentration

Well defined waves were obtained in case of Zn(II) when concentrations of complexing agent 2-A-2-HEA was increased from 0.0 to 0.5 M though the half wave potential was shifted to more negative values probably due to the complex formation, results are summarized in Table - 2.

Effect of metal ion concentration

A number of polarograms were recorded by taking different concentrations of Zn(II) ions in 0.1 M complexing agent, keeping other factors constant. The diffusion current were measured by the method of extrapolation. The values of diffusion current constants were calculated under these conditions using the Ilkovic equation in Table-1.

Supporting electrolyte used	- KNO_3
Concentration of supporting electrolyte	- 0.1 M
$M^{2/3}\ t^{1/6}$ mg/sec	- 2.162
Temperature	- 25°C
$E_{1/2}$	- 1.042 Volt.

Table-1 represents change in diffusion current (i_d) and log i_d/C with change in conc. of Zn(II) ions keeping conc. of supporting electrolyte (KNO_3) constant (.1 M).

Conc. of Ion (mM)	i_d µA	I	$Dx10^6$ cm^2/sec	i_d/C	log i_d/C
0.5	4051	4.18	8.86	9.02	0.9552
1.0	8.94	4.22	9.26	8.94	0.9513
2.0	19.46	4.32	9.42	9.73	0.9881
5.0	37.55	4.38	9.42	7.51	0.8756

Concentration of depolarizer Zn(II)	-	1 x 10-3 M
Concentration of supporting electrolyte KNO_3	-	0.1
Temperature	-	25°C + .05°C
pH	-	5.57
Complexing agent	-	(2-Amino-2Hydroxy Ethanoic Acid)

Table-2 represents change in half wave potential ($E_{1/2}$) and diffusion current (id) with change in conc. of complexing agent (2-A-2HEA) at 10^{-3}M conc. of Zn (II) ion.

Concentration	E1/2 Volt	id(µA)	$F_o[X]$	$F_1[X]$	$F_2[X]$	$\Delta E_{1/2}$
0.0	1.042	4.34	2.642	0.180	1.24	0.000
0.1	1.043	4.86	6.412	0.341	1.26	0.001
0.2	1.046	5.23	15.430	0.622	1.26	0.004
0.3	1.047	15.42	22.642	0.662	1.34	0.005
0.4	1.049	26.32	26.125	0.712	1.36	0.007
0.5	1.052	40.610	40.610	0.821	1.44	0.010

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