ORDER OF STABILITY OF SOME AZOLE COMPLEXES OF LEAD

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One of the applications of potentiometry is to employ it for the determination of stability constants of complex compounds. A metal electrode reversible with its own ions can be employed for such study. The determination of potential of a metal electrode and its ions in presence and absence of a ligand is useful for the study of stability constant. In the present work, the potentials of lead electrode and lead ions in presence and absence of various azoles were determined. The stability constants were calculated and the order of stability from these data was also obtained.

EXPERIMENTAL

The lead electrode was prepared and its reversibility was checked. The following cells were employed for the study.

Cell: A

-Pb	1 ml	10^{-3} M	$Pb(NO_3)_2$	KNO_3	
	2 ml	10^{-1} M	KNO_3	Salt	SCE+
	15 ml		C_2H_5OH	Bridge	
	2 ml		H_2O.		

Cell: B

-Pb	1 ml	10^{-3} M	$Pb(NO_3)_2$	KNO_3	
	2 ml	10^{-1} M	KNO_3	Salt	SCE+
	15 ml		C_2H_5OH	Bridge	
	2 ml	10^{-2} M	ligand (azole)		

The temperature was 30° ± 0.2°C throughout the experiment. The medium was 75% ethanol and the ionic strength was 0.01.

The five azoles used in this study are Sodium-2-mercaptobenzothiazole, (Na-MBT), Sodium-2-mercaptobenzimidazole, (Na-MBA), Sodium-1,2,3-benzotriazole, (Na-BTA), Benzimidazole, (BMA), 2-Methylbenzothiazole (2 Me-BT).

RESULTS

The emf with various azoles are recorded in Table 1. The formula of all the lead- azole complexes were found to be 1:2 previously. The stability constants were calculated on the lines similar to the one shown below:

TABLE 1

THE EMF OF CELL A (E_A) IS 0.480 VOLTS AT 30°C

No.	Ligand	EMF (volts) E_B	$\Delta E = E_B - E_A$	Activity of Pb^{++}	Stability constant (K)	log K
1.	Na-MBT	0.526	0.046	2.75×10^{-6}	1.82×10^{7}	7.26
2.	Na-MBA	0.626	0.146	1.26×10^{-9}	3.97×10^{10}	10.60
3.	Na-BTA	0.540	0.060	9.33×10^{-7}	5.37×10^{7}	7.33
4.	BMA	0.520	0.040	4.37×10^{-5}	1.15×10^{7}	7.06
5.	2Me-BT	0.522	0.042	3.39×10^{-5}	1.48×10^{7}	7.17

For Na-MBT.

$$E_B - E_A = \Delta E = 0.03 \log a_A / a_B$$
$$0.046 = 0.03 \log a_A / a_B \quad \log a_A / a_B$$
$$\therefore 1.53 = \log a_A - \log a_B - \log a_B$$
$$\therefore 1.53 = \log 5\times10^{-5} - \log a_B$$

$a_B = a_{Pb^{++}}$ in the complex $= 2.75\times10^{-6}$

As the complex is assumed to be 1:2, the value of K is given by

$$K = \frac{a_{Complex}}{a_{Pb^{++}} \cdot (a_{ligand})^2}$$

The $a_{complex}$ is assumed to be equal to total concentration of Pb^{++}. This is true because the complex is comparatively stable and ligand concentration is large a_{ligand} is also taken equal to that present in the mixture. The amount of ligand in complex can be neglected in comparison to the total concentration of ligand.

$$K = \frac{5 \times 10^{-5}}{2.75 \times 10^{-6} \times (1\times10^{-3})^2} = 1.82 \times 10^{7}$$

for Pb-MBT complex.

Log K = 7.26

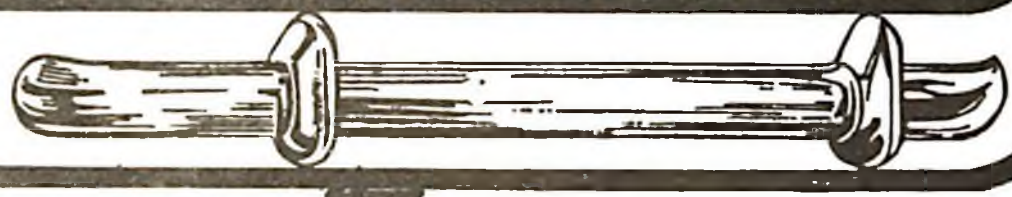
Similarly the values of log K were obtained for all the lead-azole complexes. The values are reported in Table 1.

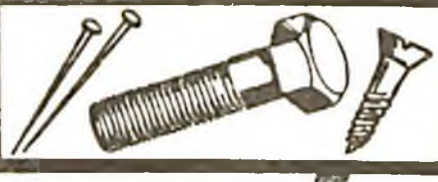
From the values of log K, the order of stability for the five lead-azole complexes is as under.

$Pb(MBA)_2 > Pb(BTA)_2 > Pb\ (MBT)_2 > Pb\ (Me\text{-}BT)_2 > Pb\ (BMA)_2$.

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