THE SOLUBILITIES OF THIOCYANATE OF METALS.

By Kosaku MASAKI.

Received April 22nd, 1931. Published July 28th, 1931.

The author published on the solubilities of cyanide of metals in the previous paper[1]. Böttger[2] determined the solubility of lead thiocyanate in water by the method of using dissociation constant. But on the solubilities of thiocyanate of other metals, we have no information.

In this investigation, the solubilities of lead thiocyanate and cadmium thiocyanate were determined by the same method in the previous paper, and also the solubilities of zinc thiocyanate and cobalt thiocyanate were measured by means of the determination of specific conductances.

(1) Lead thiocyanate and Cadmium thiocyanate.

Lead chloride and lead thiocyanate were prepared from the dilute solutions of potassium salts by precipitating with purified lead acetate, and then precipitated lead salts were further purified with conductance water. Cadmium thiocyanate was prepared from the barium thiocyanate solution by precipitating with purified cadmium sulphate, and cadmium chloride was purified by washing with conductance water.

The amalgam employed are contained 2.5% of lead and cadmium, and also the cells used were of ordinary form.

The following cells are used to determine the solubilities of lead thiocyanate and cadmium thiocyanate.

(1) Pb (amalgam), Pb $(SCN)_2$ (sat.) || $PbCl_2$ (sat.), Pb (amalgam)

(2) Cd (amalgam), Cd $(SCN)_2$ (sat.) || $CdCl_2$ (0.01 M), Cd (amalgam)

The measured electromotive forces of the cells are 0.001917 and 0.1136 volt at $18° \pm 0.1°C$. respectively and constants necessary to carry out the calculation are given in Tables 1 and 2.

Table 1.

Salt	Moles per litre of water	Activity coeff.	Activity
$I.bCl_2$	0.039	0.39[3]	$1.521 \cdot 10^{-2}$
$CdCl_2$	0.01	0.532[4]	$5.32 \cdot 10^{-3}$

(1) This Bulletin, **6** (1931), 143.
(2) *Z. physik. Chem.*, **46** (1903), 603.
(3) *Z. physik. Chem.*, **56** (1906), 645.
(4) *J. Am. Chem. Soc.*, **41** (1919), 1787.

Table 2.[1]

Ion	Ionic conductance at 18°C.	Ion	Ionic conductance at 18°C.
Pb^{++}	60.2	Cl^-	65.5
Cd^{++}	46.4	SCN^-	56.7

In the previous paper, we obtained the following equation.

$$E = E_c - E_l = \left[\frac{1}{2} - \frac{\frac{\Lambda_C}{V_C} - \frac{\Lambda_A}{V_A}}{\Lambda_C + \Lambda_A}\right]\frac{RT}{F}\ln\frac{a_2}{a_1}$$

(1) Solubility of lead thiocyanate

$$0.001917 = \left[\frac{1}{2} - \frac{\frac{60.2}{2} - 61.1}{121.3}\right]0.0577\log\frac{1.521\times10^{-2}}{a_1}$$

$$a_1 = 1.37\times10^{-2}$$

(2) Solubility of cadmium thiocyanate

$$0.11360 = \left[\frac{1}{2} - \frac{\frac{46.4}{2} - 61.1}{107.5}\right]0.0577\log\frac{5.32\times10^{-3}}{a_1}$$

$$a_1 = 2.51\times10^{-5}$$

The calculated value of the solubility of lead thiocyanate is in good agreement with the value of Böttger (1.35×10^{-2}).

(2) Zinc thiocyanate and Cobalt thiocyanate.

Zinc thiocyanate and cobalt thiocyanate were prepared from the barium thiocyanate solution by precipitating with purified zinc sulphate and cobalt sulphate.

The conductivities of zinc thiocyanate and cobalt thiocyanate were measured at 18°±0.1°C. by the same method in the previous paper. The

(1) *J. Am. Chem. Soc.*, **34** (1912), 459.

specific conductances of zinc thiocyanate and cobalt thiocyanate were 6.55×10^{-2} and 1.496×10^{-1} respectively, and also the cell constant was 0.228. The conductivity water which used in this investigation had a specific conductance of 1.5×10^{-6}.

The solubilities of zinc thiocyanate and cobalt thiocyanate were calculated by the equation, $n = \frac{1000\,k}{\Lambda_\infty}$, and the values of Λ_∞ obtained by the addition of the ionic conductances are 103.7 for zinc thiocyanate and 99.7 for cobalt thiocyanate.

(1) Solubility of zinc thiocyanate

$$n = \frac{1000 \times 6.55 \times 10^{-2} \times 0.228}{103.7} = 1.44 \times 10^{-1}$$

(2) Solubility of cobalt thiocyanate

$$n = \frac{1000 \times 1.496 \times 10^{-1} \times 0.228}{99.7} = 3.41 \times 10^{-1}$$

Summary.

(1) The solubilities of lead thiocyanate and cadmium thiocyanate were determined by the potentiometric method.

(2) The solubilities of zinc thiocyanate and cobalt thiocyanate were determined by the measurements of the specific conductances.

Yokohama Higher Technical School.