Short Communications

The Complex Formation between Tin(II) and Acetate Ions

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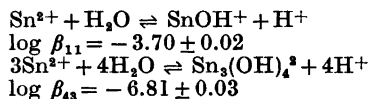
The equilibria between tin(II) and acetate ions have been studied by means of potentiometric titrations using tin amalgam and glass electrodes. The measurements were made at 25 °C using 3 M $NaClO_4$ as an ionic medium.

The tin(II) ions were added by constant current electrolysis to the titrant solutions which were prepared from stock solutions of $HClO_4$, NaAc and $NaClO_4$. The analytical concentrations of tin and acetate ions, c_{Sn} and c_{Ac}, were usually kept constant in the titrations and the free acetate ion concentration was increased by the stepwise addition of NaAc solution. The initial pH was 2 and the titrations were interrupted when a precipitate of black SnO became visible on the amalgam electrode used in the generation of the tin(II) ions. This normally occurred at pH ≈ 4. The emf measurements and the coulometry were performed with an automatic titrator described previously.[1]

The dominating species in the solutions were found to be the three mononuclear complexes $SnAc^+$, $SnAc_2$, and $SnAc_3^-$. Preliminary calculations based on the experimental values yielded the formation constants $\log \beta_1 = 3.3$, $\log \beta_2 = 6.0$, and $\log \beta_3 = 7.3$. There was no indication of mixed complexes with both Ac^- and OH^- as ligands in the concentration regions investigated.

In some titrations tin was excluded in order to determine the formation constant of acetic acid in the ionic medium used. The result of these measurements, $\log K_1 = 5.015 \pm 0.010$ agreed very well with the value found by Martin and Rossotti, $\log K_1 = 5.014 \pm 0.009$,[2] in the same ionic medium.

To allow for the amount of tin bound as hydroxide complexes, the hydrolysis of tin(II) was also studied. The measurements were carried out in the same range of c_{Sn} and pH as the acetate titrations. The data could be interpreted by the following reactions and equilibrium constants.

$$Sn^{2+} + H_2O \rightleftharpoons SnOH^+ + H^+$$
$$\log \beta_{11} = -3.70 \pm 0.02$$
$$3Sn^{2+} + 4H_2O \rightleftharpoons Sn_3(OH)_4^{2+} + 4H^+$$
$$\log \beta_{43} = -6.81 \pm 0.03$$

The result of this investigation was in good agreement with previous work on the hydrolysis of tin(II) by Tobias.[3] He found $\log \beta_{11} = 3.92 \pm 0.15$, $\log \beta_{22} = -4.45 \pm 0.15$, and $\log \beta_{43} = -6.77 \pm 0.03$. From the present measurements the formation of $Sn_2(OH)_2^{2+}$ could not be ascertained in the region investigated. Since Tobias studied the hydrolysis at higher values of c_{Sn}, $2-40$ mM, his titrations were performed in more acid solutions, i.e. pH < 3.

The studies made of the hydrolysis of tin(II) and the complex formation between tin(II) and acetate ions will be described in detail in forthcoming papers.

1. Gobom, S. and Kovacs, J. Chem. Scr. 2 (1972) 103.
2. Martin, D. L. and Rossotti, F. J. C. Proc. Chem. Soc. London (1959) 60.
3. Tobias, S. Acta Chem. Scand. 12 (1958) 198.