Paper Electrophoretic Studies of Aluminium(III) and Thorium(IV) Complexes with Cysteine

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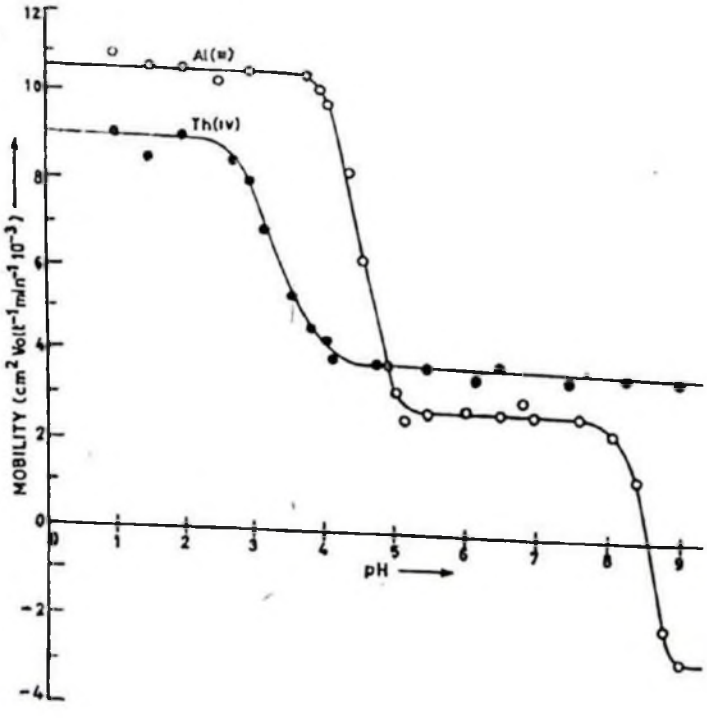
The use of paper electrophoretic techniques for the study of metal complex systems with single ligand seems to be well established [1-2]. The present work is an extension of the technique to study Al^{3+} and Th^{4+} complexes with cysteine.

EXPERIMENTAL

Solution of Al^{3+} and Th^{4+} metal perchlorate were prepared as described earlier [1-2]. The apparatus and procedure are as in the same reference. Stock solutions of 9.0 M perchloric acid, 2.0 N sodium hydroxide and 5.0 M cysteine were prepared from A.R. grade chemicals (BDH, England). The background electrolyte used in the study of binary complexes were 0.1 M perchloric acid and 1.0×10^{-2} M cysteine. Aluminium spots on the paper were detected using aluminon solution (BDH, England); 1-(2-Pyridilazo)-2-naphthol (E. Merck) (PAN) was used for thorium spots; glucose was detected as the black spot by spraying silver nitrate solution followed by 2% ethanolic sodium hydroxide.

RESULTS AND DISCUSSION

The ionophoretic mobility of metal spot against pH gives a curve with a number of plateaus shown in fig 1. The first plateau at low pH corresponds to uncomplexed metal ions. The second plateau in each case with positive mobility indicates 1:1 complexes of cationic nature. With further increase in pH, mobility of Al^{3+} metal ion decreases giving rise to a third plateau in negative region indicating anionic nature of 1:2 metal complexes; however the mobility of Th^{4+} remains constant with increase in pH indicating that only 1:1 complex is formed. Chemical literature shows prominent chelating property to



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unprotonated anionic species of cysteine and not to zwitter ion [3]. In view of above observations, the complexation reactions with cysteine anion [L^{2-}] may be represented as

$$Al^{3+} + L^{2-} \xrightleftharpoons{K_1} AlL^{+} \quad ....(1)$$

$$AlL^{+} + L^{2-} \xrightleftharpoons{K_2} AlL_2^{-} \quad ...(2)$$

$$Th^{4+} + L^{2-} \xrightleftharpoons{K_1} ThL^{2+} \quad ...(3)$$

The first stability constant is the reciprocal of concentration of cysteine anion [L^{2-}] at the pH where the mobility is the mean of the first and the second plateau [4]. This pH is determined from the graph and cystein anion concentration at this pH is calculated using dissociation constant of cysteine (log K_1 = 2.00, log K_2 = 8.25, log K_3 = 10.35). The values are given in Table 1.

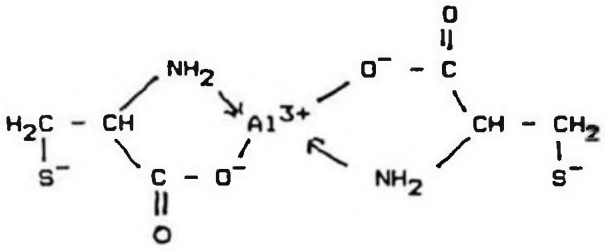
Table 1

Stability constants of binary complexes of Al^{3+} and Th^{4+}

Ionic strength 0.1 M Temperature 35°C

Metal Ion	log K_1	log K_2
Al^{3+}	11.60	15.78
Th^{4+}	13.61	-

In ML_2^- complexes, two cysteine molecules are bonded to Al^{3+} metal ion. The probable structure of this complex is given as below



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