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Fast Separation of Tin(IV) from Tin(II) and from Numerous Metal Ions on Ion-Exchange Papers

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NOTE

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Summary

A fast method for the separation of Sn^{4+} and Sn^{2+} has been developed on titanic tungstate ion-exchange papers. Sn^{4+} can also be separated from 40 other cations on these papers in only 20 min.

INTRODUCTION

The use of papers impregnated with inorganic ion exchangers for the separation of metal ions has been recently reviewed (*1*). These papers achieve fast and selective separations owing to the combined effect of partition and ion-exchange (*2–4*). Time of separation is a particularly important factor in the separation of a metal in different valence states. If the separation time is long, the interconversion of valence state may occur. Janardhan and Paul (*5*) have recently reviewed the work on the separation of tin(IV) and tin(II). They have reported a paper chromatographic separation of these ions with no consideration of the time of separation. However, no study of the separation of tin in different valence states on titanic tungstate, an inorganic ion exchanger (*6*), papers has been reported. It was therefore decided to employ these papers for the separation of tin(IV) from tin(II) and from other metal ions.

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EXPERIMENTAL

Apparatus. Chromatography was performed in a glass tank using the ascending method on 14.5 × 3 cm Whatman No. 1 paper strips.

Reagents. Chemicals and solvents were either E. Merck (Darmstadt) Pro-analyst or B.D.H., Analar Reagents. Titanic chloride solution (15%) of B.D.H. (England) was used.

Preparation of Ion-Exchange Papers. Titanic tungstate papers were prepared as reported earlier (*4*).

Cation Solutions. A 0.1 M solution of $SnCl_4 \cdot 4H_2O$ was prepared in 4 M HCl. A fresh 0.1 M solution of $SnCl_2 \cdot 2H_2O$ was prepared in 4 M HCl each day. Chloride, nitrate, or sulfate solutions (0.1 M) of most of the cations were used. Their preparation and procedure for spotting have been described (*4*).

Spraying Reagents. Sn^{2+} was detected by aqueous solution of phosphomolybdic acid. Sn^{4+} was detected by alcoholic solutions of oxine or Alizarine Red S. Other cations were detected as reported earlier (*4*).

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RESULTS

To develop a suitable method of separation, a large number of solvent systems were tried. A mixture of 0.5 M ammonium acetate and 0.1 M acetic acid in the volume ratio 2:1 was found to be the most suitable solvent system for fast separations. The developer was allowed to ascend 11 cm. The separations are recorded in Tables 1 and 2. Instead of simply giving the R_F value of the cation, the R_T (rear limit) and R_L (front limit) are given to give a clear picture of the spot.

TABLE 1

Separations of Sn^{4+} and Sn^{2+}

Solvent system	Separation	Time (min)
0.5 M Ammonium acetate + 0.1 M acetic acid (2:1)	Sn^{4+} (1.00–0.82)–Sn^{2+} (0.23–0.00)[a]	20
	Sn^{4+} (0.97–0.86)–Sn^{2+} (0.23–0.00)[a]	20
	Sn^{4+} (1.00–0.92)–Sn^{2+} (0.20–0.00)[a]	20

[a] R_F values are the average of three chromatograms.

TABLE 2

Separation of One Cation from Numerous Metal Ions

Separation	Solvent system	Ions which interfere	Time (min)
Sn^{4+} (1.00–0.87) from 40 cations	0.5 *M* Ammonium acetate + 0.1 *M* acetic acid (2:1)	Pd^{2+}, Au^{3+}, Pt^{4+}, Mn^{2+}, Zn^{2+}, Cd^{2+}, Al^{3+}, Ga^{3+}, Nb^{5+}, Be^{2+}	20

DISCUSSION

As is clear from Table 1, a fast separation method for tin in different valence states has been developed using 0.5 *M* ammonium acetate + 0.1 *M* acetic acid as developer in the volume ratio 2:1. The Sn^{4+} can also be separated easily in this solvent from numerous other metal ions, including Sb^{3+}, As^{3+}, Fe^{3+}, Zr^{4+}, Ge^{4+}, and Cu^{2+}, which interfere in tin determination. This is probably the best separation of tin from numerous metal ions yet reported. Qureshi and Khan (*7*) have classified fast and slow paper chromatographic separations. According to them, a separation time of up to 30 min is a fast separation. Hence, the separations of tin reported here may be classified as fast.

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