The Separation of Thorium(IV) and Cerium(III) Ions by Using Alginate as Cation Exchanger

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Recently the separation of thorium(IV) and cerium(III) ions by the use of strongly acidic cation exchange resins, such as Dowex 50 or Amberlite IR-120 has been reported by a few workers[1-4].

The present authors will report here a new method for the separation of thorium (IV) and cerium(III) by using alginate as ion exchanger and dilute nitric acid as eluant.

Alginic acid, a natural polyacid, has a property of cation exchanger for several metallic ions in a moderately acid solution of pH 1~3. Metallic ions adsorbed on alginic acid can be eluted easily and separately with dilute acid solutions of varying concentration.

Preparation of Alginate Exchanger and Column.—The alginate exchanger was prepared by swelling the thread* of calcium alginate in a dilute sodium hydroxide solution (less than 0.1 N) for about 30 min. and then by immersing in 0.5 N nitric acid. The product was packed appropriately into a glass tube (1.5 cm. in diameter, 30 cm. in length). The column packed with the adsorption bed of alginate (length, about 20 cm.) was washed successively with 250 ml. each of 0.5 N nitric acid and distilled water. Thus, the alginate was converted completely into acid form.

Procedure.—The mixed solution of thorium(IV) and cerium(III) ions was poured onto the column, the pH being adjusted to 2~2.5 with aqueous ammonia. The bed was then washed with 100 ml. of distilled water, and 200 ml. of 0.075 N nitric acid was passed through the column at a flow rate of about 1 ml./min. By this treatment, all the cerium(III) ions were completely eluted, and then all the thorium-(IV) ions remaining on the column were eluted in the same manner with 100 ml. of 1 N nitric acid.

The amount of throium(IV) and cerium-(III) ions in the effluents was colorimetrically determined with Neo-thoron for thorium(IV) (580 mμ)[5] and with hydrogen peroxide for cerium(III) (320 mμ)[6].

Result.—An example of elution diagrams of the solution containing 35.5 mg. of thorium(IV) and 30 mg. of cerium(III) ions is shown in Fig. 1, and the amounts initially taken are given in Table I in comparison with the amount finally found.

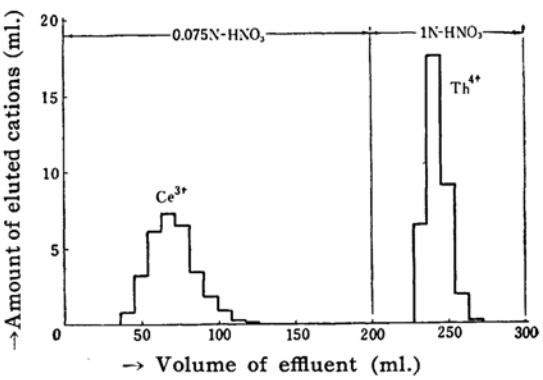

Fig. 1. The elution diagram in the separation of thorium(IV) and cerium(III). The eluants were 0.075 N nitric acid for cerium and 1 N for thorium.

1) L. Gordon et al., *Anal. Chem.*, **28**, 1476 (1956).
2) T. Taketatsu, This Bulletin, **32**, 291 (1959).
3) T. Nishi et al., *III Atomic Energy Symposium (Abstr.)*, *Japan*, 69 (1959). Japan Scientific Council, Tokyo.
4) T. Nozaki, *J. Chem. Soc. Japan, Pure Chem. Sec. (Nippon Kagaku Zasshi)*, **76**, 996 (1955).

* The alginate thread was supplied from Kamogawa Kako Co., Ltd., to whom the authors are indebted to appreciate.

5) Y. Ishibashi and S. Higashi, *Japan Analyst*, **4**, 14 (1955).
6) M. Malinek and L. Klir, *Chem. Abstr.*, **50**, 13659*a* (1956).

TABLE I. ANALYTICAL RESULT
(CALCULATED FROM FIG. 1)

	Taken (mg.)	Found (mg.)	Error (mg.)
Th(IV)	35.5	35.4	0.1
Ce(III)	30·0	30.3	0.3

It would be concluded that the new method with alginate as ion exchanger has an advantage as an industrial and an analytical method for the separation of thorium(IV) and cerium(III).

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