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SEPARATION OF BARIUM(II) FROM STRONTIUM(II) BY MEANS OF THE SOLVENT EXTRACTION WITH DIBENZO-24-CROWN-8

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Barium(II) (3.00×10^{-4} M) was easily separated from strontium(II) (3.00×10^{-4}-1.70×10^{-2} M) by means of the solvent extraction procedure with a nitrobenzene solution of dibenzo-24-crown-8. Average recovery of barium(II) was 97% and only 10^{-3} part of the strontium(II) in the initial sample solution was recovered.

The separation of barium(II) from strontium(II) has been investigated by precipitation method[1)] and ion-exchange chromatography.[2)] However, solvent extraction methods have been scarcely reported because there are almost no suitable extractants which complex more selectively with Ba than Sr.

It is known that crown ethers form stable complexes particularly with alkali and alkaline earth metal ions and show a remarkable selectivity for one of these ions in each series.[3)] Dicyclohexyl-18-crown-6[4)] and 18-crown-6[5)] have been used as extractants to separate Sr from Ca and Ba from Ca, respectively. However, it is impossible to separate Ba from Sr with dicyclohexyl-18-crown-6 by the solvent extraction method.[4)]

In this work dibenzo-24-crown-8 (DB24C8) was used as the extractant of Ba in the presence of Sr. Nitrobenzene was used as an extraction solvent because of its polar property.

DB24C8 was obtained from Nisso Co., Ltd.. After the impurities insoluble in n-hexane was filtered off, DB24C8 was recrystallized from n-hexane and dried at 50 °C in a vacuum oven before use. Nitrobenzene, HNO_3, $Sr(NO_3)_2$, $Ba(NO_3)_2$, and picric acid were analytical grade reagents. Nitrobenzene was washed three times with distilled water before use. Emission and absorption measurements were conducted on Seiko atomic absorption spectrophotometers, models SAS-720 and SAS-725. pH measurements were made on a Hitachi-Horiba pH meter, model F-5.

The overall extraction procedure to separate Ba from Sr is given in Fig. 1. The aqueous phase of the sample solution contained 3.00×10^{-4} M Ba, 3.00×10^{-4}-1.70×10^{-2} M Sr ions, and 2.00×10^{-2} M picric acid (pH 1.7-1.8), and the organic phase was the nitrobenzene solution of DB24C8 (4.50×10^{-3} M). The volume of each phase was 10 ml. The two phases in a stoppered glass tube (volume 30 ml) were shaken in a thermostated water bath for about 20 min at 25±0.2 °C, and then separated by centrifugation. An 8 ml portion of the organic phase in the sample solution (org. phase-1) and an equal volume of the aqueous solution containing picric acid (2.00×10^{-2} M) were placed in another stoppered glass tube, shaken under the same conditions as described above, and then centrifuged. The same procedure was repeated with 6 ml portion of the org. phase-1 (org. phase-2). A 5 ml portion of the org. phase-2 (org. phase-3) was transferred into another stoppered glass tube, shaken with an equal volume of the 1 M nitric acid solution, and the Ba ions were back-extracted into the aqueous phase. The concentrations of the Ba and the Sr ions in the aqueous phase-4 were determined by flame photometry and atomic absorption spectrophotometry, respectively.

The results are given in Table 1. From Table 1 it is found that in each case, the experimentally found concentration of the Ba in the aqueous phase-4 well agrees with the one initially added to the sample solution, while only 10^{-3} part of the Sr in the initial sample solution was recovered. The average recovery of Ba in these systems was 97%.

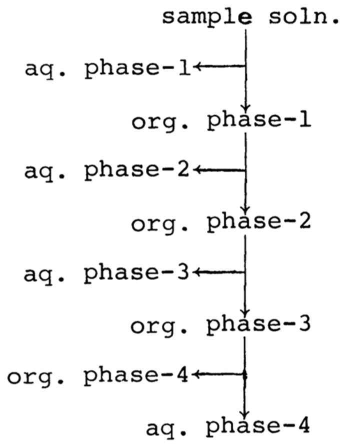

Fig. 1. Overall extraction procedure for the separation of Ba from Sr

Table 1. Results of the separation of Ba from Sr

Initial concn. of Ba ($\times10^{-4}$ M)	Initial concn. of Sr ($\times10^{-4}$ M)	Ba found in aq. phase-4 ($\times10^{-4}$ M)	Sr found in aq. phase-4 ($\times10^{-5}$ M)	Recovery (%)
3.00	3.00	2.9_4	0.10	98
3.00	30.0	2.9_0	0.70	97
3.00	120	2.9_1	2.20	97
3.00	150	2.9_0	2.50	97
3.00	170	2.9_0	2.40	97

This separation method is simpler and more rapid than the precipitation method[1)] and the ion-exchange chromatography.[2)] The analytical applications of DB24C8 for environmental samples, e.g., rocks, minerals, and living bodies, are now under investigation.

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