

Purification of ^{121m}Te by anion exchange chromatography

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Radioactive tellurium nuclides, such as ^{129}Te , ^{131}Te , and ^{132}Te , were released into the environment by the Fukushima accident. These are the parent nuclide of radioactive iodine, ^{129}I , ^{131}I , and ^{132}I , respectively, regarded as critical for internal exposure, and their fission yield is relatively high. The data on the environmental behavior of tellurium are required to estimate the radiation doses after the accidents. To obtain such data, tracer experiments using radioactive tellurium are essential. This report describes the purification of ^{121m}Te to prepare an adequate tracer for plant and animal experiments.

Tellurium-121m was produced by the bombardment of Sb_2O_3 pellets with 24 MeV deuterons at the RIKEN AVF cyclotron.¹⁾ Sb_2O_3 powder with a purity of 99.999% was pressed to form a pellet with a diameter of 15 mm. The irradiated pellets were transported to the Institute for Integrated Radiation and Nuclear Science, Kyoto University for further treatment.

Tellurium was purified from antimony by anion chromatography where two methods were applied, namely, Downs's method²⁾ and its modification. Downs *et al.* reported that the irradiated sample dissolved in HCl was diluted to 2 M HCl and then added with hypochlorite, thereby separating tellurium and antimony by anion chromatography.²⁾ In the other method, the mixture of antimony dissolved in conc. HCl and NaClO was poured into an anion exchange column and then tellurium was recovered in eluant.

Figure 1 shows the result of an attempt to purify tellurium by the Downs's method where only antimony is expected to be eluted with 2 M HCl. Both elements

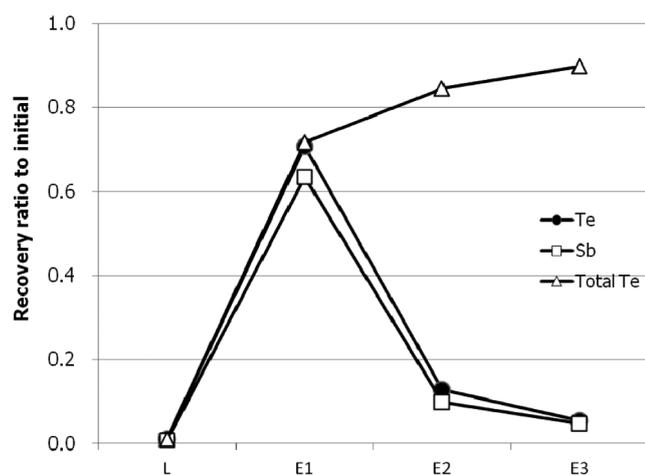


Fig. 1. Recovery of tellurium and antimony in each eluate. L denotes the loading solution of 1 mL and E1, E2, and E3 denote the eluent of 2 mL of 2 M HCl.

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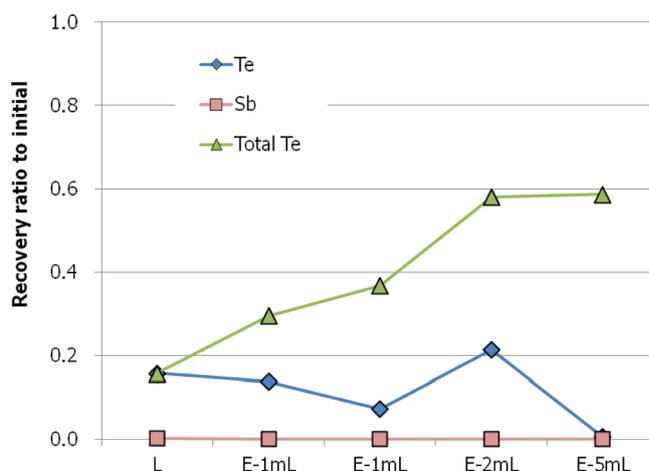


Fig. 2. Recovery of tellurium and antimony in each eluate. L denotes the loading solution of 1.4 mL and E denotes the eluent of a mixture of conc. HCl and 5% NaClO in the ratio of 10:1 (v/v).

were, however, similarly eluted; hence, tellurium cannot be purified.

Figure 2 shows the purification of tellurium by the modification method. Tellurium was eluted first in the reverse elution order described in Downs's method and was consequently separated from antimony with a recovery of 60%.

Antimony forms Sb(V)-chloro complex ion in oxidizing $\text{HCl}^{3)}$ to be strongly adsorbed onto anion exchange resin. Thus, the concentration of antimony in the eluate can be ignored for the loading solution in both methods. The fate of antimony depended on the following eluents, whose redox potential and chloride concentration are critical for the separation where tellurium can be obtained without antimony when both values are high.

Because Te(VI) is not adsorbed onto the anion exchange resin at any concentration of HCl,⁴⁾ the valency of tellurium in the eluate is 6 and that of remaining would be 4. The rate of redox reaction with NaClO is considered to affect the elution property. Therefore, an appropriate regulation of redox potential would yield a higher tellurium recovery with high purity. In addition, the disadvantage of the purification method used here naturally causes to evolve toxic chlorine gas.

The purification method was established to provide a tracer of carrier free radioactive tellurium without antimony. Further investigations are still required from the perspective of safety as well as recovery.

References

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