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Determination of the Half-Life of Tc^{105}

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Tc^{105} can be obtained only as a fission product. Its half-life is given as "short" in the table of isotopes.[1] The value of approximately 15 minutes was published in 1947.[2]

While the other technetium isotopes found in fission processes (mass numbers 99, 101 and 102) disintegrate by the emission of electrons to give stable isotopes of ruthenium, the 105 isotope disintegrates into ruthenium-105 having a half-life of 4.5 hours which can readily be measured.

Advantage was taken of this property to measure the half-life since it is difficult to do it directly. This is due to the fact that technetium-101 which has a similar half-life and greater activity also appears in large yield in fission processes.

In order to obtain the fission products, a few grams of ammonium diuranate were exposed to the neutron beam from a 1.2 Mev cascade accelerator for 10 to 15 minutes. The diuranate was dissolved in hydrochloric acid and, after copper had been added as a carrier, copper sulfide was precipitated by means of a rapid flow of hydrogen sulfide. The copper sulfide retains the activities of the elements of the second analytical group, among which molybdenum and technetium are to be found.

The copper sulfide was redissolved in hydrochloric acid with a small amount of bromide, adding molybdate, perrhenate and ferric ions as carriers. By adding ammonia, ferric hydroxide was precipitated, and retained the activities of tin, antimony, ruthenium, selenium, tellurium and possibly rhodium and palladium. The molybdenum and technetium passed to the filtrate from which lead molybdenum was precipitated by acidifying with acetic acid and adding lead acetate. The lead molybdate can be obtained in this fashion within 5 minutes if the filtrations are carried out under a vacuum. The technetium (with a rhenium carrier) is found in the filtrate of lead molybdate.

The solution was divided into three equal parts. In each one, technetium was coprecipitated with rhenium by means of tetraphenylarsonium chloride at 10 minute intervals. In Fig. 1 on the left-hand side, the three disintegration curves of Tc^{101} can be seen. They showed that the precipitations were nearly complete. After decay of the Tc^{101}, the various preparations were measured again in order to determine the Ru^{105} content of each one of them. Plotting

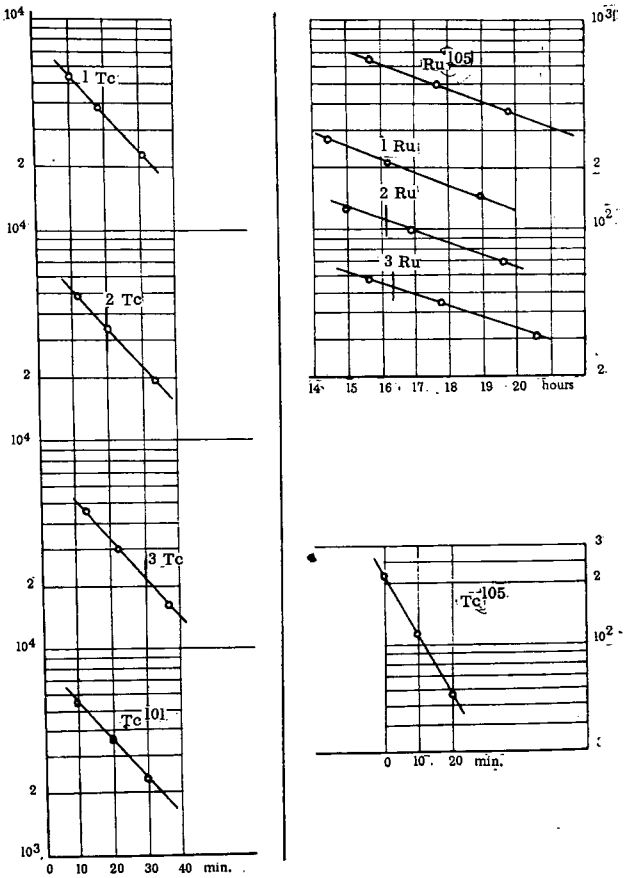

Figure 1. Determination of the half-life of Tc^{105}

the activities of Ru^{105} at appropriate intervals on semilogarithmic paper gave a half-life of 10.5 minutes for technetium-105 (Fig. 1 on the right).

This way of proceeding is correct only if there is no coprecipitation of the ruthenium with the technetium preparation. In order to confirm this, a radioactive ruthenium tracer was added (Ru^{106}) to the technetium solution before the precipitations were carried out. Two weeks after the test, the technetium preparations were measured again in order to determine their Ru^{106} content. In all cases, coprecipitation of ruthenium with technetium was less than 2 per cent.

REFERENCES

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