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IODINE-123 PRODUCTION BY IRRADIATION AT THE C.N.R.S. CYCLOTRON IN ORLEANS

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Abstract.- O.R.I.S. - C.E.A. has undertaken a regular production of Iodine-123 by irradiation at the C.N.R.S. cyclotron in Orléans. The enriched tellurium oxyde target is irradiated with protons according to the reaction ^{124}Te (p, 2n) ^{123}I. Iodine-123 is then extracted from the target in the O.R.I.S. laboratories in Saclay. The irradiation device and the dry process extraction of radioiodine are described.

1. Introduction.- Iodine-123 is of great interest in nuclear medicine. At the present time the main application is the study of the thyroïd function but there are also interesting diagnostic prospects with labelled compounds. This is why O.R.I.S. - C.E.A., since October 15th 1980, has been regularly producing iodine-123 (once a week), by irradiation at the C.N.R.S. cyclotron in Orléans. After irradiation, the tellurium oxyde target is conveyed to O.R.I.S. laboratories in Saclay (C.E.A.) where the extraction process is performed.

2. Irradiation system.- Enriched target is irradiated at the end of the beam line n°3 of the cyclotron.

Irradiation is carried out at atmospheric pressure and beam line is closed by a 25 µm titanium foil. Ahead of this foil, an automatic irradiation system allows irradiation of the TeO2 target with 20-25 µA beam current.

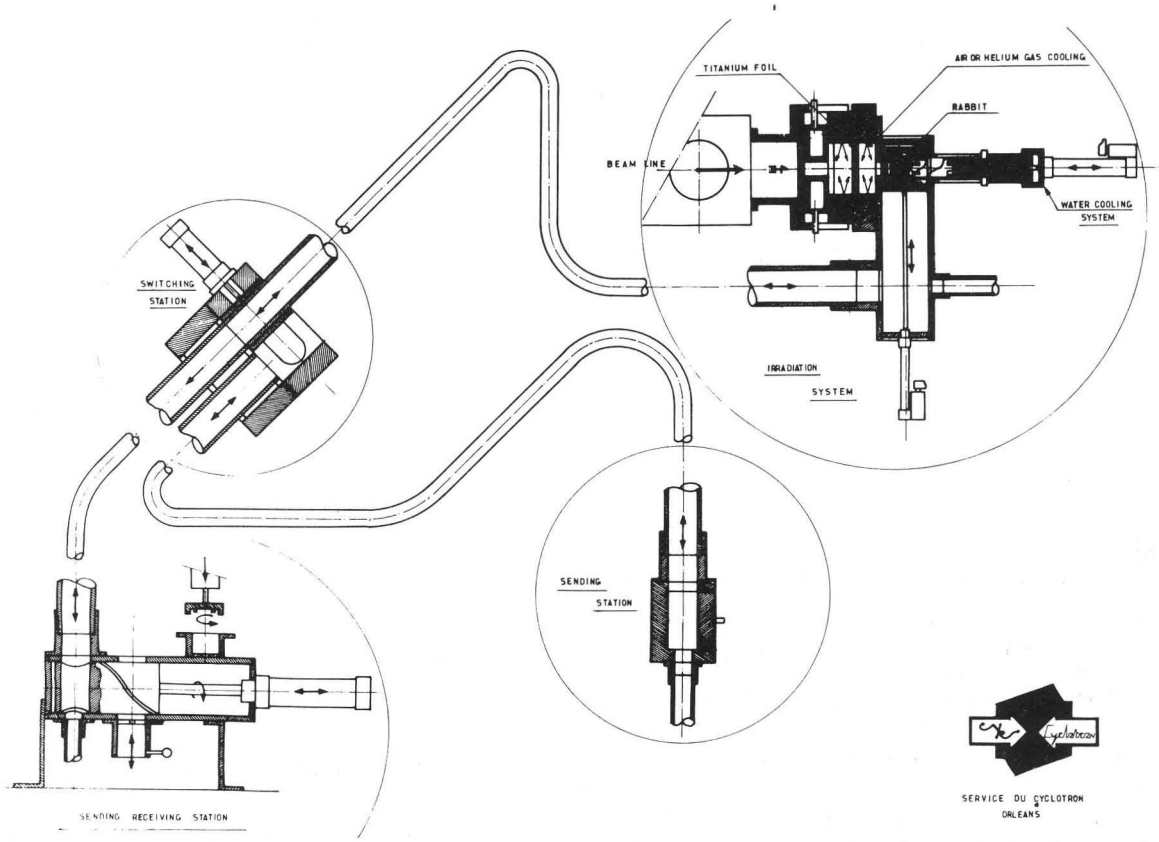

Fig. 1: Irradiation system for solid targets and its rabbit pneumatic transfer system.

A pneumatic transfer system connects this irradiation system with a hot cell located in a high activity laboratory. A control unit in the hot area allows all the irradiation and handling operations.

When the rabbit (irradiation holder) (Fig. 2.) in which the target is contained, has reached its irradiation position, two jacks automatically connect it with a cooling circuit (output : 4 l/mn) and the back surface of the target is water cooled.

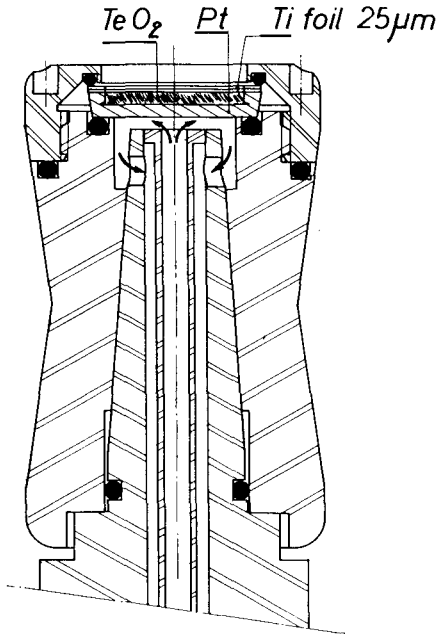

Fig. 2 : Irradiation holder rabbit.

The two titanium foils (in front of the surface target) are cooled by air or helium gas.

The beam is swept on the target (low frequency) to improve the irradiation homogeneity. The irradiated area on the target is about 5 cm^2.

3. Irradiation.-

Reaction	:	^{124}Te (p, 2 n) ^{123}I Ep = 25 MeV
Target	:	Enriched ^{124}Te about 95 % Molten TeO2 in a platinum support (Ø 20 mm) 350 mg/cm^2
Beam current	:	20 - 25 µA
Irradiation time	:	1 to 2 hours.

4. Extraction of radioiodine from the TeO2-target by a dry-process.- Radioiodine extraction is carried out in a quartz glass apparatus. After irradiation TeO2 target is heated at a temperature higher than the melting point (735°C) : the radioiodine escapes quickly (< 10 mn) and quantitatively (99 %). During the heating step, an air flow carries iodine to a vessel filled with 0,01 N sodium hydroxyde solution where the product gets dissolved as iodine chemical form.

The apparatus for this process is schematically presented in Fig. 3.

At first, the oven B is preheated to 750°C. Then the target is inserted for 15 minutes while an air flow preheated at 550°C (oven C) passes over the target.

The liberated iodine passes through an alumina absorber (tellurium trap) kept at 650°C in a third oven A.

In order to avoid substantial absorption of iodine between oven A and the vessel with sodium hydroxyde, the glass tube is maintained at 300°C with an infrared heating device.

Rate of iodine recuperation : 98 %.

5. Present status of routine production.- We irradiate a TeO2 target once a week, end of bombardment at 8: 30 a.m. Then, the irradiated target is conveyed by road, to C.E.N. Saclay.

Radioiodine process is performed in O.R.I.S. laboratories, using a hot cell shielded with 10 cm of lead with remote handling.

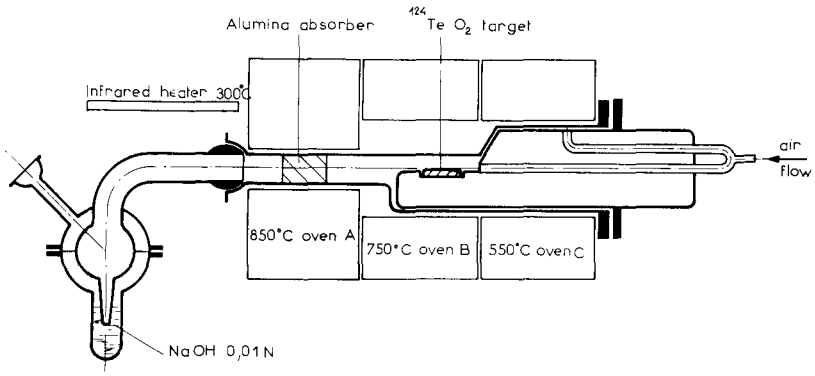

Fig. 3: Apparatus for radioactive iodine extraction from the irradiated target.

Extraction is achieved at about 11:30 - 12:00 a.m. Iodine-123 filling process and quality controls (radionucleidic purity, radiochemical and biological tests) are performed during the immediate afternoon. Delivery to french customers (Nuclear Medicine Departments) is made the same evening. The material is calibrated in the following day at 10:00 a.m.

200 to 250 millicuries of Iodine-123 are produced per batch, equivalent to 60 to 80 millicuries at calibration time.

Routine production started on October, 15th, 1980. During those 10 months, 43 batches were programmed and 40 of them were successfully delivered on schedule. One of the three missing batches resulted from a cyclotron breakdown, one from an oven failure and the third one from a target damage during irradiation causing a low yield, which resulted in a partial delivery.

Average yield of production turned to be 7 to 9.5 mCi/µA-h (at the end of bombardment).

Radionucleidic impurities :

^{124}I : 0.9 % (E.O.B.)

^{126}I : 0.05 % (E.O.B.)

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