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GENERAL ELECTRIC

HANFORD ATOMIC PRODUCTS OPERATION - RICHLAND, WASHINGTON

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TITLE

EXTRACTION OF TRITIUM
FROM (LiAlO₂) TARGETS

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AUTHOR

R. Cooperstein

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FROM (L1A102) TARGETS

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By DK Ruben 1/18/94
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HANFORD ATOMIC PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
RICHLAND, WASHINGTON

REPORT OF INVENTION

A.E.C. CASE NO.

G. E. CASE NO.

TO:

I: ATTACHED HERETO IS A DESCRIPTION OF WHAT MAY BE AN INVENTION IN:

Extraction of tritium from lithium aluminate targets

II: THE NAME, TITLE OR POSITION, WORKS LOCATION, AND PERMANENT ADDRESS OF THE INVENTOR(S) ARE:

Raymond Cooperstein
Senior Engineer, Chemistry and Metallurgy
General Electric Company
Hanford Atomic Products Dept.
Richland, Washington

4510 West 4th Avenue
Kennewick, Washington

III: EVIDENCE AS TO WHEN AND WHERE THE INVENTION WAS MADE CAN BE FOUND IN THE FOLLOWING LISTED WRITTEN OR PICTORIAL MATERIAL (NOTEBOOK, FILE REPORTS OR DRAWINGS, ETC.):

Hanford Atomic Products Department Monthly Reports for January to March 1966
Memorandum from R. Cooperstein to W. H. Yunker, BNW, January 24, 1966
Document No. RL-GEN-900, April 1, 1966

IV: THE APPROXIMATE DATE OF THE FIRST ENTRY IN SAID WRITTEN OR PICTORIAL MATERIAL DESCRIBING OR SHOWING SAID INVENTION IS:

(Concept) January 18, 1966
(Initial Studies) January 24, 1966

V: PERSONS WHO COULD TESTIFY AS TO WHEN AND WHERE THE INVENTION WAS MADE INCLUDE THE FOLLOWING:

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Richland, Washington

SIGNED (SUPERVISOR)

Milton Lewis, Mgr. Chem. & Met.
RECEIVED

DATE

March 31, 1967

NOTE: SUGGESTIONS FOR PREPARING THE INVENTION DESCRIPTION ARE CONTAINED ON THE REVERSE SIDE OF THIS FORM.

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EXTRACTION OF TRITIUM FROM (LiAlO₂) TARGETS

This invention relates to the process of extracting tritium from irradiated lithium aluminate target elements.

Various procedures have been employed or suggested for extracting tritium from ceramic targets containing lithium, such as lithium aluminate.

These prior processes all require many tedious operations and the use of costly reagents to effect the complete extraction of tritium. The present invention leads to the complete extraction of tritium from irradiated lithium containing ceramic targets with the elimination of these tedious, costly process steps and process reagents which were previously considered essential.

Various other objects and advantages of the invention will become apparent as the description proceeds.

The process for extracting tritium from lithium aluminum alloy targets, which is already in place at the Savannah River Plant, consists of melting the targets still enclosed in their aluminum cans in a refractory metal furnace under vacuum. The evolved gases, consisting mostly of tritium, as oxide and helium, are passed through a train of purification and separation units which remove oxygen and helium and finally effect a concentration of tritium with respect to protium. These furnaces are normally operated at about , but have a stated capability of operating

Inventor Raymond C. S. S. S. Date 3-18-67

Read and understood by the undersigned

W. R. S. S. Date 4-1-67

R. S. S. Date 3/31/67

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A prime requirement for the tritium extraction process for the ceramic target materials is that it must be accommodated by the existing Savannah River plant equipment.

This invention, in its broader aspects, is also predicated upon the observations that the above requirement is met while complete extraction is effected.

The selection of lithium aluminate as the target material made certain reactor safeguards problems more tractable but introduced technical problems in the area of extraction of tritium based upon the above noted requirement.

A flux extraction process was developed at Pacific Northwest Laboratory to recover tritium from irradiated lithium aluminate targets that was compatible with existing Savannah River Plant facilities. Molten sodium tetraborate (borax) was the flux employed. The dissolution of the irradiated lithium aluminate in borax in vacuo resulted in fairly complete release of the tritium. The extraction mixtures were composed of lithium aluminate pellets in anhydrous borax. The duration of the extraction was of the order of . The basic extraction procedure is described in the following:

1. Dehydrate and purify required weight of borax ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$) in a mild steel reaction vessel by refluxing it .
2. Chemically reduce residual water to less than
3. Cast borax into a usable form.

Inventor L. J. [Signature] Date 3/30/67

Read and understood by the undersigned

[Signature] Date 4-1-67

[Signature] Date 3/31/67

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4. Charge extraction furnace crucible with aluminum clad lithium aluminate targets - prefused borax.
5. Vacuum outgas charge at _____.
6. Raise temperature to extraction temperature while collecting evolve gases.

The latter are then ready for processing in Savannah River Plant's equipment according to their standard procedure.

Typical results from extractions performed at Pacific Northwest Laboratory and Savannah River Laboratory are listed in Table I.

TABLE I

FLUX EXTRACTIONS PERFORMED AT PNL AND SRL
WITH SINTERED LiAlO_2 TARGETS

<u>Extraction Conditions</u>	<u>Pacific Northwest Laboratory</u>	<u>Savannah River Laboratory</u>
Temperature, C		
Extraction Time, hr		
w/o Target in Flux		
<u>Tritium Recovery</u>		
Percent Extracted		
$T/H + T \times 100$		

*Values noted are for noncondensable gas fraction only; maximum isotopic purity levels are limited by moisture content in flux to

In this invention, a direct thermal-vacuum extraction is employed thereby eliminating the use of a flux and its related processing. This process also permits the tritium extraction from five times the quantity allowed

Inventor Kaymuller Date 5-30-67

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W. R. Richey Date 4/1/67
MAX. T. T. Date 3/31/67

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The process I claim for extracting tritium from irradiated lithium containing ceramic targets is as follows:

OUTGASSING: 2. Outgas the furnace while heating to

EXTRACTION: 3. Continue heating, under vacuum, until a temperature in the range _____ is attained. Hold the temperature in this range for periods ranging from _____ whereby a residual tritium content of _____ percent in the reaction products will result. The evolved gases are processed according to Savannah River Plant's standard procedure.

Read and understood by the undersigned

W. R. R. R. R. Date 4/1/67
W. R. R. R. R. Date 3/31/67

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Typical results obtained from the use of this vacuum-thermal extraction process are listed in Table II.

TABLE II

VACUUM-THERMAL EXTRACTIONS PERFORMED AT PNL AND SRL
WITH SINTERED LiAlO_2 TARGETS (NO FLUX)

<u>Extraction</u> <u>Conditions</u>	<u>Pacific Northwest</u> <u>Laboratory</u>	<u>Savannah River</u> <u>Laboratory</u>
Temperature, C		
Extraction Time, hr		
<u>Tritium Recovery</u>		
Percent Extracted		
T/T+H, x 100		

*Values noted are for noncondensable gas fraction only.

**Vacuum outgassing results in an increase in T/T+H x 100 to values in the range

Inventor Kaynard G. Johnston Date 3-30-67

Read and understood by the undersigned

W. K. Johnston Date 4/1/67
W. K. Johnston Date 3/31/67

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