**Isotope Separations Section
Progress Report for
Quarter Ending June 30, 1976**

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OAK RIDGE NATIONAL LABORATORY

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U.S. Department of Commerce
5285 Port Royal Road, Springfield, Virginia 22161
Price: Printed Copy \$3.50; Microfiche \$2.25

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Contract No. W-7405-eng-26

CHEMICAL TECHNOLOGY DIVISION

ISOTOPE SEPARATIONS SECTION PROGRESS REPORT

FOR QUARTER ENDING JUNE 30, 1976

E. Newman

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Date Published: October 1976

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ISOTOPE SEPARATIONS SECTION PROGRESS REPORT
FOR QUARTER ENDING JUNE 30, 1976

E. Newman

SUMMARY

The activities of the Isotope Separations Section of the Chemical Technology Division are described for the quarter ending June 30, 1976. Included is the status of the current electromagnetic separation of the isotopes of iron, nickel, and selenium. In-process research and development activities relating to current separations are described and assessed. The preparation of thin isotopically enriched palladium targets by ion deposition in the 180°-sector isotope separator using chlorine trifluoride as a halogenating agent has been achieved. Summary tabulations are given of elements chemically processed and new lots of isotopes released, or available, to inventory.

STABLE ISOTOPE SEPARATIONS

Isotopic separations of iron, nickel, and selenium were in progress in 24 beta-type electromagnetic isotope separators at the end of the reporting period. These separations, all of which were initiated during the quarter, were conducted on a 5-day, 24-hr basis. The objective of the iron, nickel, and selenium separations was to collect ~30 g of >93% ^{57}Fe , ~30 g of 95% ^{62}Ni and ~2 g of >75% ^{74}Se , primarily for replenishment of the Sales inventory. The nickel separation, which is being made with double arc equipment, is expected to terminate early in July, while the iron and selenium separations are scheduled to continue throughout the next quarter. Double arc equipment is also being employed in two of the eight separators allocated to selenium in order to increase the collection rate of ^{74}Se .

The separations of chlorine, germanium, and tin were completed early in the quarter, and the resulting products are currently undergoing final recovery and chemical purification. The actual quantity and isotopic purity of the ^{37}Cl , together with the estimated recovery weights of the remaining nuclides, are given in Table 1.

Table 1. Operations status for the period April-June 1976

Isotope	Series	Series Schedule		Hours		Charge material	Recovery (g)		Purity (%)		Requirements	
		Start	Finish	Innage	Tank		Est.	Actual	Est.	Actual	g	Purity (%)
³⁵ Cl	QC	1/1/76	4/30/76	9,600	15,936	LiCl NiCl ₂	135		>99		0 ^a	
³⁷ Cl	QC	1/1/76	4/30/76	9,600	15,936	NiCl ₂		30.506		98.21	57.5	>95
³⁷ Cl	QC	1/1/76	4/30/76	9,600	15,936	NiCl ₂		17.059		95.20		
⁷⁰ Ge	QD	4/1/76	6/4/76	5,782	6,480	GeCl ₄	40		>95		69	≥95
⁷² Ge	QD	4/1/76	6/4/76	5,782	6,480	GeCl ₄	50		>95		56	>95
⁷³ Ge	QD	4/1/76	6/4/76	5,782	6,480	GeCl ₄	15		>90		75	>95
⁷⁴ Ge	QD	4/1/76	6/4/76	5,782	6,480	GeCl ₄	70		>95		51	>95
⁷⁶ Ge	QD	4/1/76	6/4/76	5,782	6,480	GeCl ₄	15		>90		75	>95
¹¹² Sn	PZ	6/9/75	5/14/76	35,080	44,880	SnS + H ₂ S SnS	25 ^b		>80		31	>75
¹¹⁴ Sn	PZ	6/9/75	5/14/76	35,080	44,880	SnS + H ₂ S SnS	18 ^a		>55		10	>75
¹¹⁵ Sn	PZ	6/9/75	5/14/76	35,080	44,880	SnS + H ₂ S SnS	10		>20		4	>40
¹²⁴ Sn	PZ	6/9/75	5/14/76	35,080	44,880	SnS + H ₂ S SnS	150 ^a		>90		1	>85
¹¹⁸ Sn	PZ	6/9/75	5/14/76	35,080	44,880	SnS + H ₂ S SnS	280 ^a		>90		0 ^a	
¹¹⁹ Sn	PZ	6/9/75	5/14/76	35,080	44,880	SnS + H ₂ S SnS	100 ^a		>80		0 ^a	

^aNot to be recovered at this time.^bA total of 5.155 g of this material was inventoried on October 22, 1975, to provide material for Sales.

DEVELOPMENT ACTIVITIES

In preparing for a new series for the enrichment of selenium and iron, past separations data were analyzed in an effort to increase the overall performance. Equipment design and operating parameters were chosen to emphasize isotopic enhancement.

A method of providing continuous peak-to-valley current readings was designed and installed in one iron receiver. The normal method of obtaining the readings is to periodically move the beam out of the monitor pocket and record the valley current between two adjacent mass peaks. Continuous peak-to-valley monitoring can eliminate this need for beam movement and be used as an additional diagnostic tool to maintain optimum beam focusing and hence higher isotopic purity. Two probes were installed in the receiver. The first was an exposed strip located at the mass 55 position; the second was a pocket located at the mass 53.5 position. The response of the mass 55 probe was much more sensitive to changes in beam conditions than was the mass 53.5 probe, however, the readings from either of these probes did not correlate well with the normal peak-to-valley ratios. This apparent discrepancy may be due to the isotopic mass abundance distribution for iron.

The observed peak-to-valley ratio was less than that calculated to obtain the required isotopic purity at the start of the series, but exceeded it for most of the remaining time. As the assay of the runs becomes available, the correlation coefficient between the peak-to-valley ratios and the isotopic contamination will be calculated to assess the sensitivity of the method.

The ion current monitored in collector pockets in the iron series is averaging 10 to 15% lower than that anticipated. The efforts to remedy this situation have not yet been successful. Changes that were introduced include the repositioning of the arc ribbon to the most forward position in the arc chamber, J_0 . In addition, the angular acceptance of the receiver to the incoming beam was increased by 40% (from $+6^\circ$, -6° to $+6^\circ$, -11°) without either an improved ion output or a deterioration of beam quality. We had expected one, or both, of these effects.

The feed for this separation is FeCl_2 , which was purchased and specially fused for a prior separation. The feed is assumed to be of good quality since it has been stored in a sealed plastic container and the moisture content does not present a major problem. However, the charge consumption rate is lower than before and is limited by the early appearance of drain problems in the ion source operation. At present, change to a new batch of feed appears to be the only obvious approach left in raising the ion output to past levels.

RADIOACTIVE ISOTOPE SEPARATIONS

Recovery of ^{41}Ca Charge Material

A ^{41}Ca enrichment program was completed in one electromagnetic isotope separator in the radioactively contained area during September 1975. However, the unresolved charge material, which was involved in the second cycling through the separator, was not removed from the separator until March 1976. Chemical recovery was subsequently delayed until early this quarter. This material, originally containing 1.53% ^{41}Ca , was produced by a three-year irradiation of enriched ^{40}Ca in the High Flux Isotopes Reactor. The recovered product is potentially a valuable sample for research and/or future ^{41}Ca enrichment programs.

The recovery of the unresolved calcium was accomplished by stripping all metallic components with hot, dilute nitric acid. Graphite components were first leached in nitric acid and then consumed by ignition in oxygen. The calcium extracts were combined and subsequently purified through chemical recovery steps including electrolysis, precipitation with oxalic acid, and precipitation with ammonium carbonate. The product, which consists of ~ 1.33% ^{41}Ca , contains significant quantities of cadmium, lanthanum, and zinc and is considered impure as compared with inventory material. The known impurities, however, are not expected to compromise the value of the sample as future charge material.

TARGET PREPARATION BY ION DEPOSITION

Isotopically enriched thin targets of ^{102}Pd and ^{104}Pd were prepared during the quarter in the 180° -sector isotope separator by the surface deposition method. Deposits of $50\text{ }\mu\text{g}/\text{cm}^2$ on $75\text{-}\mu\text{g}/\text{cm}^2$ carbon backings were made for each isotope. The ion beams, which were produced from the in situ reaction of chlorine trifluoride and palladium metal to produce the volatile PdF_2 , were decelerated from about 35 keV to $\sim 200\text{ eV}$ at the point of impact on the substrate. The isotopic purity of the deposited target was estimated to be $>99\%$ in each case, and the initial feed was natural isotopic material. These targets were prepared for use in coulomb excitation studies.

CHEMICAL PROCESSING

Material in Process

The following elements were in chemical processing during the quarter: chlorine, iron, germanium, nickel, selenium, tin, and ytterbium.

Material Added to Inventory

Table 1 identifies the isotopic material that was released or made available to Sales during this report period; the appropriate separation data are also included. In addition to the two new lots of ^{37}Cl released to Sales, ten loan-returned samples were processed and returned to the Research Materials Collection for inventory.

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