54-9-32

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INVENTORY

of

Electromagnetically-Enriched

ISOTOPES

STABLE ISOTOPE RESEARCH AND PRODUCTION DIVISION

C. P. KEIM, DIRECTOR

REPOSITORY MMES-ORNL

COLLECTION Central Files

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FOLDER

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OAK RIDGE NATIONAL LABORATORY
operated for the
U. S. ATOMIC ENERGY COMMISSION
BY CARBIDE AND CARBON CHEMICALS COMPANY
A Division of Union Carbide and Carbon Corporation

A-00530

Human Studies Project

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INTRODUCTION

Natural isotopes of the elements that have predominately nonradioactive isotopes are being enriched in the large Oak Ridge mass spectrographs.

Two pairs of mass spectrographs, each pair in a separate magnetic field, are used. The positively charged ions in two of these mass spectrographs travel in a 24-in.-radius semicircle from ion source to isotope collector, while the ions in the other two units travel in a 48-in.-radius semicircle. The voltage which accelerates the ions is about 35 kv, and the magnetic field can be varied from a few hundred oersteds up to several thousand, depending on the mass of the ions. Ion currents up to several hundred milliamperes are often recorded at the isotope collectors. These production-type mass spectrographs operate in vacuums of approximately 10^{-5} mm Hg.

The enrichment of all naturally occurring stable isotopes was started in early 1946, the ultimate goal being the processing of all elements that have predominately nonradioactive isotopes in nature. It is now believed there are no insurmountable technical barriers to that goal.

Since the first shipment of an enriched isotope in 1946, several thousand deliveries have gone to Atomic Energy Commission, government, university, medical, and industrial laboratories. More than 500 technical papers have been issued from various laboratories on research accomplished with these enriched isotopes; most of these papers are unclassified and have been published in the open literature.

In addition to the uses of these isotopes in basic research, their use in applied fields, such as in isotope-dilution analysis, as starting materials for reactor-produced radioactive isotopes, and in targets for cyclotron-produced radioactive isotopes, is also increasing. Newly improved, simplified mass-spectrometer techniques offer many opportunities for using these isotopes. Inquiries as to possible applications are invited by the Stable Isotope Research and Production Division, Oak Ridge National Laboratory.

The justification for enriching stable isotopes in the Oak Ridge mass spectrographs is based on their value in research and in other scientific applications. When reports of the uses of stable isotopes are published, it will be appreciated if the source of the isotopes is acknowledged. Also, the producers are anxious to receive reprints and other information related to stable-isotope uses. In these ways the level of the stable-isotope production activity can be evaluated most accurately and the needs of researchers most adequately satisfied.

The enrichment of isotopes in the mass spectrographs is done at Oak Ridge National Laboratory, operated by Carbide and Carbon Chemicals Company under contract with the Atomic Energy Commission, and is the result of the joint efforts of all personnel of the Stable Isotope Research and Production Division. The supervisory personnel

include Dr. C. E. Normand and L. O. Love (mass-spectrograph separations and development), Boyd Weaver (chemistry research and development), Dr. Russell Baldock (mass spectrometry), Dr. J. R. McNally, Jr., and J. A. Norris (spectroscopy and spectrochemistry), and Dr. P. S. Baker (special materials, separation development, and isotope utilization).

THE INVENTORY

This inventory lists all enriched isotopes which are produced by the Stable Isotope Research and Production Division, Oak Ridge National Laboratory, in large mass spectrographs. As an assistance to the user in his selection of the most desirable isotopes, the isotopic purity of each isotope is listed, as well as the lot designation, the approximate quantity of the isotope in stock, and the product form regularly stocked.

Weights shown in this inventory are approximate element weights converted from compound weights by standard gravimetric factors. It is recognized that the use of standard gravimetric factors introduces some error, but the modification of these factors in accordance with isotopic abundance has been considered as unwarranted in most cases, either in this inventory or for weighing isotopes for shipment.

Where either the quantity of isotope available for shipment or isotopic-analysis data has been left blank in this inventory, it is to be assumed that the isotope has been enriched in the mass spectrograph but that its chemical treatment or isotopic-analysis determination has not been completed.

Revisions of this inventory will be made frequently, as necessitated by shipments, production of new lots, or availability of additional data.

Ion currents and rates of collection of isotopes are, in most cases, first runs with experimental equipment and do not represent what can be expected on a production basis.

All questions related to this inventory and to the information shown, as well as to that not shown in this inventory, such as complete isotopic-analysis data, spectrochemical-analysis data, the availability of product forms other than those shown, etc., should be directed to Oak Ridge National Laboratory, the producer. The official address is: Stable Isotope Research and Production Division, Attention: Dr. C. P. Keim, Director; P.O. Box P, Oak Ridge, Tennessee.

REQUESTS FOR ALLOCATION

Isotopes listed in this inventory are available for distribution on loan as approved by the U.S. Atomic Energy Commission. Requests for loan should be made to the AEC by using Form AEC-100, copies of which may be obtained from the Isotopes Division, U.S. Atomic Energy Commission, P.O. Box E, Oak Ridge, Tennessee. A rental fee of $50.00 is made on each isotope shipped on loan.

The completed forms requesting an allocation of an isotope should be returned to the Atomic Energy Commission Isotopes Division, which has sole authority to pass on all requests for loan. If the requester wishes to mail the request forms and purchase order at one time to the Stable Isotope Research and Production Division, Oak Ridge National Laboratory, they will forward the request forms to the Atomic Energy Commission for approval.

The approximate amount of each isotope lot in stock is shown in this inventory, but it is urged that the amount requested by the user for allocation be the absolute minimum which will satisfy his experimental requirements.

PURCHASE ORDERS

All purchase orders are to be sent to the Stable Isotope Research and Production Division, Attention: Dr. C. P. Keim, Oak Ridge National Laboratory, P.O. Box P, Oak Ridge, Tennessee. One copy of the approved Form AEC-100 must accompany the purchase order or have been forwarded to the supplier by the Atomic Energy Commission Isotopes Division.

SHIPPING

Packaging and shipping of enriched stable isotopes listed in this inventory are done by the supplier on Wednesday of each week. Requesters should keep this shipping day in mind when sending in their purchase orders.

LOAN PERIODS

Users of stable isotopes generally receive them on a loan period of six months. If extensions of this loan period are necessary, the user should write the Atomic Energy Commission, Isotopes Division, Oak Ridge, Tennessee.

RETURNED ISOTOPES

It will greatly aid the supplier of enriched stable isotopes to keep a full inventory if isotopes are returned to the supplier when the user has completed his need for them. All unused and uncontaminated portions of the original shipment will be replaced in stock. If it is possible and economical, the supplier will recover enriched isotopes from products returned by the user. Only materials which can be returned without extra shielding protection other than the shipping package are to be returned to the supplier.

Returned isotopes are to be sent to the Stable Isotope Research and Production Division, Attention: Dr. C. P. Keim, Oak Ridge National Laboratory, P.O. Box P, Oak Ridge, Tennessee. An outline of the treatment the isotope has received by the user should accompany the shipment; this will aid the producer in chemical recovery of the isotopes prior to their return to stock.

ELEMENTS NOT LISTED

The following 21 elements are not listed in this inventory because the most accurate mass-abundance determinations made to date indicate that all naturally occurring atoms of each of these elements are of the same mass; these elements are, therefore, nonisotopic in nature.

ELEMENT	SYMBOL	ATOMIC NUMBER	ATOMIC WEIGHT	NATURAL ISOTOPIC ABUNDANCE	
				Mass	Per Cent
Aluminum	Al	13	26.98	27	100
Arsenic	As	33	74.91	75	100
Beryllium*	Be	4	9.013	9	100
Bismuth	Bi	83	209.00	209	100
Cesium	Cs	55	132.91	133	100
Cobalt	Co	27	58.94	59	100
Fluorine	F	9	19.00	19	100
Gold	Au	79	197.0	197	100
Holmium	Ho	67	164.94	165	100
Iodine	I	53	126.91	127	100
Manganese	Mn	25	54.94	55	100
Niobium	Nb	41	92.91	93	100
Phosphorus	P	15	30.975	31	100
Praseodymium	Pr	59	140.92	141	100
Rhodium	Rh	45	102.91	103	100
Scandium	Sc	21	44.96	45	100
Sodium	Na	11	22.991	23	100
Tantalum	Ta	73	180.95	181	100
Terbium	Tb	65	158.93	159	100
Thulium	Tm	69	168.94	169	100
Yttrium	Y	39	88.92	89	100

*Be^{10}, produced by the $Be^{9}(n,\gamma)Be^{10}$ reaction, was successfully enriched 1200-fold in the ORNL mass spectrographs to an isotopic abundance of 0.3% Be^{10}.

Fourteen other elements not included in this inventory are the radioactive elements tabulated below.

ELEMENT	SYMBOL	ATOMIC NUMBER	ATOMIC WEIGHT
Actinium	Ac	89	227.
Americium	Am	95	243.
Astatine	At	85	211.
Berkelium	Bk	97	245.
Californium	Cf	98	246.
Curium	Cm	96	243.
Francium	Fr	87	223.
Neptunium	Np	93	237.
Polonium	Po	84	210.
Promethium	Pm	61	145.
Protactinium	Pa	91	231.
Radium	Ra	88	226.05
Radon	Rn	86	222.
Technetium	Tc	43	99.