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CATALOG OF THE ISOTOPES OF THE HEAVY ELEMENTS

J. A. Martin
F. N. Case
V. O. Haynes

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ELECTRONUCLEAR RESEARCH DIVISION

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ABSTRACT

This catalog lists the available amounts and the purity of the isotopes of uranium, thorium, and plutonium which have been separated electromagnetically and U^{233} and Am^{241} which have been separated chemically from reactor-irradiated materials.

INTRODUCTION

Small quantities of highly enriched isotopes[1] of uranium, thorium, and plutonium have been prepared for use on projects sponsored by the Atomic Energy Commission. The following heavy-element isotopes are now available for research purposes: U^{233}, U^{234}, U^{235}, Th^{230}, Pu^{239}, Pu^{240}, Pu^{241}, and Am^{241}. The isotopic composition, if known, the chemical form, and the amounts available are listed.

The U^{233}, the Am^{241}, and a portion of the Pu^{239} were isolated from reactor-irradiated materials by the Chemical Technology Division. The remaining isotopes are enriched materials separated in improved electromagnetic separation equipment operated by the Electronuclear Research Division. Mass analysis of all material was performed by the Mass Spectrometer Laboratory, Y-12.

Persons in need of these materials should communicate with the Research and Development Division, Oak Ridge Operations, United States Atomic Energy Commission, Oak Ridge, Tennessee. The proposed use of the materials, the quantity, and batch number should be specified.

Should additional information be required concerning U^{233} or Am^{241}, the requester should communicate with J. H. Gillette or H. F. Stringfield of the ORNL Operations Division. Questions concerning the other isotopes should be addressed to R. S. Livingston or J. A. Martin of the Electronuclear Research Division.

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[1]For information concerning stable isotopes, see C. P. Keim, *Inventory and Price List of Electromagnetically Enriched and Other Stable Isotopes*, Oak Ridge National Laboratory, April 1956.

URANIUM-233*

Batch No.	Isotopic Composition (wt %)			Quantity Available (g of uranium)
	U^{233}	U^{234}	U^{238}	
IP-13	97.27	1.13	1.60	121.94
IP-14	97.27	1.13	1.60	132.49
IP-15	97.27	1.13	1.60	69.66
IP-18	98.66	1.16	0.18	14.99

*As $UO_2(C_2H_3O_2)_2$.

ENRICHED URANIUM-234

Enriched Batch No.	Isotopic Composition (wt %)			Chemical Form	Quantity Available (g of uranium)
	U^{234}	U^{235}	U^{238}		
WS-1*	93.01	5.27	1.72	U_3O_8	0.36
W-5	51.70	35.60	12.70	U_3O_8	0.060
W-8	13.50	21.90	64.60	$UO_2(NO_3)_2$	30.51
W-7-2	10.68	70.04	19.24	U_3O_8	1.34

*Requires purification of from 30 to 60 days before available for shipment.

ENRICHED URANIUM-235

Enriched Batch No.	Isotopic Composition (wt %)				Chemical Form	Quantity Available (g of uranium)
	U^{235}	U^{238}	U^{234}	U^{236}		
WR-1*	99.994	0.001**	0.0013	0.004**	U_3O_8	4.46
R-1	99.94	0.038	0.022		U_3O_8	3.30
R-2, 4	99.93	0.043	0.027		U_3O_8	10.66
R-5	99.92	0.049	0.031		U_3O_8	1.70
R-11	99.91	0.070	0.020		U_3O_8	6.65
R-20*	99.88	0.09	0.03		U_3O_8	21.27
R-21*	99.78	0.15	0.07		U_3O_8	7.21
VR-25*	99.86	0.07	0.03	0.04	$UO_2(NO_3)_2$ solution	46.19
VR-14	99.80	0.08	0.05	0.07	$UO_2(NO_3)_2$ solution	22.10
VR-15	99.79	0.09	0.04	0.08	$UO_2(NO_3)_2$ solution	17.65
VR-16	99.78	0.12	0.04	0.06	$UO_2(NO_3)_2$ solution	19.71
VR-17*	99.76	0.12	0.06	0.06	$UO_2(NO_3)_2$ solution	141.3
VR-26*	99.72	0.13	0.05	0.10	$UO_2(NO_3)_2$ solution	11.24
VR-20	99.61	0.25	0.05	0.09	$UO_2(NO_3)_2$ solution	17.03

*Composite of severol physically distinct batches.

** Estimated values.

ENRICHED URANIUM-236

Enriched Batch No.	Isotopic Composition (wt %)				Chemical Form	Available Quantity (g of uranium)
	U^{236}	U^{235}	U^{238}	U^{234}		
IV-0	37.60	58.74	3.03	0.63	U_3O_8	0.03
IV-1	28.92	57.43	12.47	1.18	U_3O_8	2.21
					$UO_2(NO_3)_2$	1.62
2V-40	17.83	39.46	42.07	0.64	U_3O_8	0.16
2V-17	16.58	51.21	31.23	0.98	U_3O_8	2.70

ENRICHED URANIUM-238

Enriched Batch No.	Isotopic Composition (wt %)		Chemical Form	Quantity Available (g of uranium)
	U^{238}	U^{235}		
Q-505	99.9999	0.00008	U_3O_8	0.89
Q-510	99.997*	0.00030*	U_3O_8	49.24
QS-1	99.9988	0.00119	U_3O_8	4.52
QS-3	99.9956	0.00440	U_3O_8	89.18
BQ-39	99.981	0.019	U_3O_8	20,996
BQ-40	99.971	0.029	U_3O_8	22,128
BQ-41	99.981	0.019	Metal sheet 0.0065 and 0.050 in.	542
BQ-15	99.985	0.015	U_3O_8	135

*Estimated.

PLUTONIUM-239

Batch No.	Isotopic Composition (wt %)			Chemical Form	Quantity Available (g of plutonium)
	Pu^{239}	Pu^{240}	Pu^{241}		
PO-49	99.80	0.19	0.01	PuO_2	0.075
ST-1*	99.81	0.15	0.04	HNO_3 solution	1.68
ST-2*	99.81	0.15	0.04	HNO_3 solution	0.24
ST-3	99.81	0.15	0.04	HNO_3 solution	2.70
ST-4	99.89	0.09	0.02	HNO_3 solution	3.94
ST-5*	99.81	0.15	0.04	HNO_3 solution	1.28
ST-6*	99.81	0.15	0.04	HNO_3 solution	2.51
ST-8*	99.81	0.15	0.04	HCl solution	0.33
ST-9*	99.81	0.15	0.04	HCl solution	0.38
ST-13*	99.81	0.15	0.04	H_2SO_4 solution	0.59
ST-14*	99.81	0.15	0.04	HNO_3 solution	1.10

*Estimated isotopic compositions; assays to be made.

ENRICHED PLUTONIUM-240*

Enriched Batch No.	Isotopic Composition (at. %)			Quantity Available (g of plutonium)
	Pu^{240}	Pu^{239}	Pu^{241}	
P1-40	62.80	36.55	0.61	0.203
P4-40	87.17	12.20	0.58	0.322
P5-40-2	73.46	25.13	1.41	0.080
P7-40-2	74.89	24.14	0.94	0.061

*As PuO_2.

ENRICHED PLUTONIUM-241*

Enriched Batch No.	Isotopic Composition (at. %)			Quantity Available** (g of plutonium)
	Pu^{241}	Pu^{240}	Pu^{239}	
P1-41	14.30	19.66	65.92	0.084
P2-41	16.07	20.65	63.23	0.178
PS4-41	20.90	30.00	44.30	0.063
P3-41	22.80	15.30	61.80	0.118
P7-41-2	28.46	36.32	34.22	0.015

*As PuO_2.
**Additional batches of 50 to 70% purity will soon be available.

THORIUM-230*

Batch No.	Isotopic Composition (at. %)		Quantity Available (g of thorium)
	Th^{230}	Th^{232}	
T2-30	87.85	12.15	0.094
T3-30	90.02	9.98	0.389

*As ThO_2.

AMERICIUM-241*

Batch No.	Volume (ml)	Concentration (mg of Am per ml)	Americium (mg)
Am 1	117.6	14.8	1740.92
Am 1-1	44.0	6.79	306.68
Am 2	198.5	1.95	387.07
Am 3	99.35	0.89	88.42
Am 4	90.0	0.153	13.80
Am 5	79.0	0.0317	2.50

*As $AmCl_3$ in HCl solution.