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INFORMAL AEC RESEARCH & DEVELOPMENT REPORT

FISSION PRODUCT ELEMENT YIELDS AND CHARACTERISTICS

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FISSION PRODUCT ELEMENT YIELDS AND CHARACTERISTICS

In considering the possible physical and chemical effects of fission product elements at high temperatures on graphites and other materials, the following table has proven useful. The primary data summarized is that of the fission yields of the elements taken as the sum of the yields of all mass chains ending with a stable nuclide of the given element or a nuclide which has a half-life of one year or more. This gives a distribution of the elements which corresponds approximately to that obtained from U^{235} where a fuel element has run for an extended period of time (order of a year). The fission yields were taken from Schmitt and Zumwalt[1] who have compiled a reasonably up-to-date summary of thermal neutron, U^{235} fission yields.* Also included in the table are the boiling points of the elements[2] and qualitative data on the carbides.[3] The volatility category of the elements is listed in the first column. Elements in category three are expected to show negligible vapor phase in-pore migration in graphite at 1500°K in the gaseous state. Metallic elements of categories 1, 2 and 3, however, tend to be strongly sorbed by graphite and, depending on temperature and concentration, will tend to migrate through graphite in the sorbed state. The vapor pressure of the sorbed elements will determine whether or not they escape from the graphite.

1. R. A. Schmitt and L. R. Zumwalt, Fission-Product Chains and Yields, Section 8j, American Institute of Physics Handbook, 2nd Edition (1963).

2. D. R. Stull and G. C. Sinke, "Thermodynamic Properties of the Elements," published by American Chemical Society, 1956.

3. Leo Brewer, L. A. Bromley, P. W. Gilles and N. L. Lofgren, Paper No. 4, The Chemistry and Metallurgy of Miscellaneous Materials: Thermodynamics, Quill, N.N.E.S., McGraw-Hill, 1950.

* It was assumed approximately 20 percent of Xe^{135} is converted to Xe^{136} in estimating the Cs and Xe yields.

Fission Product Element Yields and Characteristics

Volatility Category of Element*	Element	Fission Yield of Element $\sum Y$ (%)	b.p. (°K) of Element	Temp. (°K) at which Carbide Vapor Pressure $< 10^{-7}$ atm.
2	Ge	0.0024	3,100.	
1	As	0.0008	866.	
1	Se	0.485	958.	
1	Br	0.14	331.4	
1	Kr	3.9	119.75	
1	Rb	3.5	974.	
2	Sr	9.4	1,640.	
3	Y	4.8	(3,500.)	2000
3	Zr	31.0	4,650.	2500
3	Nb	0	5,200.	2500
3	Mo	24.5	5,100.	2500
3	Tc	6.1	4,900	
3	Ru	10.9	(4,000.)	
3	Rh	3.0	(4,000.)	
3	Pd	1.55	3,400.	
2	Ag	0.03	2,450.	
1	Cd	0.067	1,038.	
2	In	0.010	2,320.	
3	Sn	0.085	2,960.	
2	Sb	0.058	1,910.	
1	Te	2.42	1,260.	
1	I	1.03	456.	
1	Xe	21.8	165.04	
1	Cs	19.2	958.	
2	Ba	5.7	1,910.	
3	La	6.6	3,640.	2000
3	Ce	12.4	3,200.	1500
3	Pr	6.0	3,290	1500
3	Nd	21.1	3,360.	1500
3	Pm	2.4	(3,000.)	1500
2	Sm	1.93	(1,860.)	
2	Eu	0.20	(1,700.)	
3	Gd	0.022	(3,000.)	1500
3	Tb	0.0011	(2,800.)	1500
3	Dy	0.00008	2,600.	1500

* Volatility Category:

1. b.p. $< 1500°K$.
2. Intermediate between 1 and 3.
3. v.p. of element or carbide $< 10^{-7}$ atm at $1500°K$.