The fuel in a molten-salt reactor should be reducing to be compatible with the container materials. The degree of reduction of the fuel can be represented by the ratio $\frac{U^{3+}}{U^{4+}}$, and this ratio is expected to be kept in the range 0.01 to 0.04. In such a fuel the more noble fission products, formed as fluorides, can be expected to oxidize $U^{3+}$ to $U^{4+}$ and in the process to be reduced to metal. The metal would then remain in suspension, deposit on the metal walls and deposit on the graphite, or more likely be distributed between the surfaces and the salt.

The elements in this category are all the stable or very long-lived end products of the decay chains of mass 95 through 130. They include molybdenum, technetium, ruthenium, rhodium, palladium, silver, cadmium, indium, tin, antimony, and tellurium. The total yield of these products is about 40%, with molybdenum, technetium, ruthenium, and tellurium respectively contributing about 21, 5, 6, and 4%, and rhodium and palladium most of the remainder.

The 250-Mw(e) module of a 1000-Mw(e) plant operates at a thermal power of about 560 Mw, has in contact with the fuel 9600 ft$^2$ of metal surface in the pump and heat exchanger, 1100 ft$^2$ of metal surface in the plenum in the reactor vessel, and 3600 ft$^2$ of graphite. When the reactor is at full power, $U^{233}$ will fission at a rate of approximately 560 g or 2.4 moles per day. In 30 full-power years, the total uranium fissioned will be $2.6 \times 10^8$ moles. The total production of metals listed above will be about $1.0 \times 10^4$ moles.

Since molybdenum is the main constituent, we convert the total production of metals to equivalent volume of molybdenum metal. One mole of molybdenum metal has a volume of $10 \text{ cm}^3$, so the total equivalent volume of metal produced is $1 \times 10^5 \text{ cm}^3$. If this volume of metal were spread as a uniform dense coating over all the 14,300 ft$^2$ or $1.3 \times 10^7 \text{ cm}^2$ metal and graphite surface, the thickness of the coating would be $0.77 \times 10^{-2} \text{ cm}$ or 3 mils. The coating would be 4.5 mils thick if it were deposited uniformly on the tubes in the heat exchanger only.

A dense, nearly uniform metallic coating would not appreciably change the heat transfer or pressure drop in the heat exchanger or adversely
affect the flow in the piping. However, these same materials, if deposited as clusters of tiny crystals at the cold end of the heat exchanger, could seriously affect the performance of the system in a few years. It is important to learn how these metals and molybdenum in particular will deposit from salt under conditions of flow and temperature proposed for the MSBR.

RBB:alg

R. B. Briggs

Distribution

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