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 POST OFFICE BOX P
 OAK RIDGE, TENNESSEE

EXTERNAL TRANSMITTAL AUTHORIZED

ORNL
CENTRAL FILES NUMBER

CF-56-8-200

DATE: August 31, 1956
 SUBJECT: A Proposed Fuel Element Design to Facilitate
 Reprocessing by the Hermex Method
 TO: F. L. Culler
 FROM: O. C. Dean

Photostat Price \$ 1.80Microfilm Price \$ 1.80

Available from the
 Office of Technical Services
 Department of Commerce
 Washington 25, D. C.

CLASSIFICATION CANCELLED

DATE 4-1-57

For The Atomic Energy Commission

H. F. Canale

Chief, Declassification Branch *ml***LEGAL NOTICE**

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The Hermex process promises to be a cheap method for purification of uranium metal and alloys up to 2% in zirconium. However, at the present stage of development it is not adaptable to alloys of 10% and more of molybdenum or zirconium. It is my understanding that the prime reasons for substituting alloys for pure uranium are: (1) the alloys are more dimensionally stable under conditions of irradiation and thermal cycling; (2) the alloys are more resistant to the attacks of water at high temperatures.

If the objectionable features of uranium could be circumvented by reactor and/or fuel element design, the Hermex processing scheme might show considerable economic advantage over other reprocessing schemes for power reactors.

I should like to propose a fuel element of the following approximate structure. A can, positioned vertically in the reactor is to be filled with small rods, wires, or pellets of uranium, and the voids filled with molten sodium. The ends of the cans should be so equipped that they can be remotely removed without destruction, in order to discharge the contents to a Hermex reprocessing vessel. The fuel element is to be surrounded by another tube, which provides a channel for sodium coolant. A gas space should be provided at the top of each element, connected to a header to serve as a pressure relief and as a bleed for fission product gases (Fig. 1).

It is my belief that a system similar to this could be made simple to unload, reprocess, and reload, and that dimensional stability of U would be unimportant.

Metals having good resistance to reasonably oxygen-free Na or NaK at 300-800°C are pure iron, ferritic stainless steel (25-20, Cr-Ni), austenitic stainless (18-8, Cr-Ni), chromium, cobalt-base alloys, molybdenum, niobium, tantalum, tungsten, nickel alloys with Fe, Cr, or Mo, zirconium or Zircaloy. Of these, the materials of low thermal cross

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Fig. 1 REACTOR FUEL ELEMENT

section are zirconium, Zircaloy, niobium, and, to a lesser extent, iron and the ferrous alloys.

Sodium does not alloy with uranium, and the solubility of U in Na is of the order of 10 ppm at 350°C. The feasibility of forming U pellets from molten uranium using a rotating disc has been proven in recent experiments at Fernald.

The Hermex reprocessing flowsheet is shown in Fig. 2. Present thinking is to eliminate the amalgam washing step and depend on recrystallization for purification. It is suggested that the Hermex dissolver and the bottom of the reactor element be so engineered that the spent reactor fuel may be directly discharged into the dissolver pot, and the dissolver pot be attached by quick disconnects to the Hermex processing train.

O. C. Dean

OCD/jr

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OAK RIDGE NATIONAL LAB., TENN. A PROPOSED FUEL ELEMENT DESIGN TO FACILITATE REPROCESSING BY THE HERMEX METHOD. O. C. DEAN. AUG. 31, 1956. DECL. APR. 1, 1957. 5P. CONTRACT [W-7405-ENG-26]. <i>\$1.80 (photo); \$1.80 (negs).</i>		DATE CATALOGED W/INITIALS 6/18/57 CF AM	
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- A fuel element design is reported which will facilitate reprocessing by the Hermex method. A can, positioned vertically in the reactor, is to be filled with small rods, wires, or pellets of U and the voids filled with molten Na. The ends of the cans ~~must~~ should be so equipped that they can be remotely removed without destruction, in order to discharge the contents to a Hermex reprocessing vessel. The fuel element is to be surrounded by another tube which provides a channel for Na coolant. A gas space should be provided at the top of each element connected to a header to serve as a pressure relief and as a bleed for fission product gases. (L.T.W.)

1. Hermex Process
2. Reactor Fuel Elements -- Design

Hermex Process -- fuel element design to facilitate reprocessing by
Reactor fuel ~~elm~~ elements -- design, to facilitate reprocessing by the ~~h~~ Hermex Process

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