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Study of Fluoride Corrosion of Nickel and Nickel Alloys

In the fluoride volatility process for the recovery of uranium and plutonium from partially spent nuclear reactor fuels, volatile fluorides of uranium, plutonium, and selected fission products are formed by reaction with fluorine. Nickel or nickel alloys such as Monel are extensively used in construction of both laboratory-scale and pilot plant-scale equipment which is to be exposed to fluorine and to corrosive fluorides at elevated temperatures. To make estimates of the expected useful lifetimes of such equipment exposed to fluorine, uranium hexafluoride, and volatile fission product fluorides at high temperatures, a knowledge of the rates of corrosion by these fluorides is required.

A report has been published that contains the results of a survey program 1) to determine the resistance of several commonly used construction materials to volatile fluorides likely to be encountered in the fluoride volatility process and 2) to identify the more promising construction metals.

The metals investigated include: nickel-200, nickel-201, Monel, Inconel, Duranickel-301, HyMu-80, and INOR-8 coupons containing areas of nickel-200 weld, nickel-61 weld, or silver solder. Exposures of these metals for periods up to 30 hours at 500°C were carried out in elemental fluorine, UF_6, SF_6 and some of the following volatile fission product fluorides, both individually and in the presence of fluorine: GeF_4, AsF_5, NbF_5, SbF_5, BrF_5, SeF_6, MoF_6, and TeF_6. Corrosion rates were calculated from both the weight gain of the coupons after exposure and the weight loss of the coupons after descaling in a KNO_3–$NaNO_3$ bath at 500°C. All of the exposed coupons were examined microscopically for intergranular penetration of the base metal.

A survey of the unclassified literature on the rates of corrosion of nickel and nickel alloys by fluorine, uranium hexafluoride, and the volatile fission product fluorides is included in the report.

Notes:

1. The findings have been published in "Laboratory Investigations in Support of Fluid-Bed Fluoride Volatility Processes—Part XIV. The Corrosion of Nickel and Nickel Alloys by Fluorine, Uranium Hexafluoride, and Selected Fission Product Fluorides at 500°C," by W. H. Gunther and M. J. Steindler of Argonne National Laboratory. ANL-7241, December 1966. The report is available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151: Price: $3.00 (microfiche $0.65).
2. This information adds to the data currently available in literature concerning the corrosion of nickel and nickel alloys by fluorides.
3. This information may also have application to the chemical industries that handle fluorine products or in metal refining processes for semiconductor materials.
4. Inquiries concerning this report may be directed to:

   Office of Industrial Cooperation
   Argonne National Laboratory
   9700 South Cass Avenue
   Argonne, Illinois 60439
   Reference: B69-10048

Source: W. H. Gunther, and M. J. Steindler
Chemical Engineering Division
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(ARG-10224)

(continued overleaf)

Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

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