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MONTHLY REPORT OF RADIOISOTOPES RESEARCH AND DEVELOPMENT

HANFORD LABORATORIES, 1 SEPTEMBER 1964

Submitted by:

M.T. Walling

Chemical Laboratory
Hanford Laboratories

October 30, 1964

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RICHLAND, WASHINGTON

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PROMETHIUM

Isotopic Composition - Pm-146 vs. Pm-147 Content

Analytical examination of specimens of fuel exposed in the Vallecitos Boiling Water Reactor and the pressurized water Yankee Reactor was begun. These refined analyses are being conducted to resolve the question of Pm-146 content of promethium recoverable from typical power reactor fuels. Initially the indicated burnups were being checked by Cs-137 determinations. Results for the three VBWR samples were found to be very close to the indicated values, about 5,000, 10,500 and 14,800 Mwd/t. The four Yankee samples were in process. All of these samples are to be intensively analyzed for essentially the whole spectrum of fission products and transuranic isotopes in order to verify the results obtained by the usual computational techniques.

Compatibility and Re-entry Studies

Metallographic examinations have been completed on the pneumatically impacted high-temperature cladding material compatibility test samples. These had been heated for 1000 hours at 1100 C, the Nd_2O_3 serving as a stand-in for Pm_2O_3 . No attack whatever was detected on the samples of 310 stainless, molybdenum, Hastalloy-N, Hastalloy-X, Hastalloy-C, or Haynes-25. Platinum showed a diffusional attack to a depth of about 0.06 inch.

Plasma jet runs on neodymium and samarium metals (stand-ins for promethium metal) with 80 percent argon, 20 percent oxygen showed that both melt readily (with considerable oxidation) and form fairly fluid melts. Implication is that promethium metal will behave predictably on re-entry. A similar test of stainless-clad neodymium oxide did not succeed in melting either the stainless can or the contained neodymium oxide (before failure of the quartz tube surrounding the jet). These results indicate that stainless-clad rare earth oxides will be difficult to burn up on re-entry. Alternately, they should be good candidates for intact re-entry.

In laboratory synthesis work, high purity SmF_3 , NdF_3 and SrF_2 were prepared for compaction and compatibility studies. Strontium borate ($\text{Sr}_2\text{B}_2\text{O}_5$) was also prepared. An alternate route to the synthesis of di-strontium silicide was explored which should be more suitable for hot-cell use than the hydride reaction. Proposed synthesis is the high-temperature reaction of SrF_2 with elemental silicon. Advantage is taken of the volatility of SiF_4 .

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NON-DESTRUCTIVE TESTING

Cladding thickness measurements on spherical sources have been performed with good correlation between ultrasonic and radiographic readings. The spherical containers generally show uniform properties over the entire surface. Cylindrical shapes occasionally contained areas which were highly worked. This makes it difficult to obtain accurate ultrasonic readings. The spherical capsules had a very nearly uniform cladding thickness and appeared to have nearly uniform working.

Design of a mechanical system with which either spherical or cylindrical samples may be scanned for a 100 percent inspection was progressing. Special design considerations have been incorporated to insure that this equipment will be compact and thus will require a minimum of hood space.

RELATED STUDIES (Supported by Other Than DID Funds)

Polonium Chemistry

Preliminary experiments have established the relative ease with which polonium-210 may be volatilized from 0.25 molar nitric acid solutions containing bismuth and either diphenylcarbazone or diphenylcarbazide. Problems with bismuth nitrate precipitation and polonium volatility require limits on bismuth concentration and acidity of about 0.25 and 0.5, respectively.

Cerium-Rare Earth Partition

The problem of rare earth losses in the persulfate-D2EHPA process was established as caused by persulfate decomposition. HEDTA and citric acid were both found to be effective in preventing the losses while maintaining efficient D2EHPA extraction of Ce(IV).

Technetium Chemistry

For the current (second kilogram-scale) recovery demonstration, sugar denitration was shown to be an improvement over distillation by minimizing corrosion and iron contamination. The recovered acid was also shown to be suitable for reuse.

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