4.5 Depleted Uranium Recycling/Products

Technology Need

DOE is responsible for managing 550,000 metric tons of depleted uranium hexafluoride generated during the uranium enrichment process. Currently, about 90 percent of the depleted uranium (DU) is stored in cylinders at the three gaseous diffusion plant sites. The unique properties of uranium hexafluoride, such as its high purity and density, as well as its large volume, make it appropriate to assess and determine its fate. DOE is currently assessing a number of options, including disposal, long-term storage as an energy resource for future breeder reactors, and reuse, primarily for shielding in spent nuclear fuel and high-level waste containers.

Technology Description

The initial objective of this project was to perform an assessment of the feasibility and economic incentives of alternative management options for storing, recycling, and/or disposing of the large DU reserves within the DOE system. Three economic options were developed in FY94. Costs of disposal were found to range from $4 to $12 billion. As an alternative to disposal, the Idaho National Engineering Laboratory (INEL) developed a concept for converting DU into an oxide aggregate (DUAGG) material for use in cement. The FY95 work scope continued to perform experimental tasks to improve on the concept and to develop manufacturing processes for fabrication of the DUAGG concrete material known as DUCRETE for use as a shielding material, as shown in Figure 4.5-1. In FY96, the major work effort is directed toward a pilot-scale demonstration of the low-cost briquetting process selected for development of DUAGG, and optimization of the DUCRETE formulation. Specific process variables to be optimized include DUCRETE mechanical properties, thermal conductivity, and gamma and neutron attenuation.

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Figure 4.5-1. Concrete Shielding from Recycled Depleted Uranium.

Benefits

Studies conducted in FY94 have shown that a high-density waste form can produce a minimum savings of $100 million to more than $500 million in disposal costs at Nevada Test Site and Hanford, respectively. These saving are derived directly from disposal of the DUAGG material, which has a greater uranium density compared to that of the bulk oxide used in the baseline disposal options study. The higher-density material will essentially reduce the transportation, container, and disposal cost inversely to the density. Thus, approximately two-thirds of the cost can be saved if the aggregate is disposed, rather than the bulk powder in containers.

If the depleted uranium aggregate can be successfully incorporated into the concrete product DUCRETE and used for high-level waste or spent fuel storage containers, disposal as a waste is eliminated entirely, and the savings to DOE will be measured in billions of dollars.

Collaboration/Technology Transfer

Information gained from this project will provide guidance to the DOE Manager of Uranium Programs in DOE's Office of Nuclear Energy and EM managers concerning the feasibility and economic incentives to pursue any of the DU management options: continued storage as is, disposal, or recycling. The findings will also provide input to the Programmatic Environmental Impact Statement, initiated by the Office of Nuclear Energy, to evaluate DU management options, as well as complement the Office of Civilian Radioactive Waste Management spent nuclear fuel storage, transport, and disposal cask development activities. A patent application has been filed for the process to develop the aggregate and its use as a shielding material.

Accomplishments

- Completed testing to examine the leaching characteristics of 80, 90, and 93 volume percent uranium oxide aggregates using the standard ANSI/ANS-16-1-1986 test procedures. After normalizing the results on an area basis, the samples have rates similar to iron-enriched basalt, and two orders of magnitude better than borosilicate glass.
- Received fabrication equipment including a 1.5-gallon attrition mill and an 18-inch disk pelletizer.
- Completed 120-hour interval leach testing of DUAGG. The leaching values were very low, comparable to good glass and glass ceramics.
- Continued leach testing on the iron-enriched basalt DUAGG and metallography activities to characterize the DUAGG microstructure.

TTP Information

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