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ALUMINUM REMOVAL FROM WASHED SLUDGE*

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TECHNOLOGY SUMMARY

ALUMINUM REMOVAL FROM WASHED SLUDGE

Task Description

The purpose of this project is to reduce the volume of storage tank sludge to be treated by removing the aluminum and other nonradioactive components. Successful caustic dissolution and separation of aluminum and other components from solid tank waste could result in a simple process for substantially reducing the amount of waste requiring valuable repository space.

Specific tasks being addressed include: (1) preparation and testing of surrogate sludges; (2) measurement of the caustic dissolution behavior of selected sludge components; (3) optimization of the time, temperature, and NaOH concentration for dissolution of selected sludge components; (4) testing the caustic dissolution behavior of an actual sludge sample; and (5) evaluation of the feasibility of recovering the soluble components and recycle of the caustic solution.

Because of the difficulties in obtaining and working with actual radioactive waste sludge, several Hanford sludge surrogates are used in these studies. Samples of dried synthetic sludges are washed at different temperatures and for varying times with NaOH solutions ranging from 0.1 *M* to 6.0 *M*. Samples are analyzed for various elements, including aluminum, chromium, zinc, bismuth, cerium, strontium, zirconium, iron, uranium, and thorium.

Technology Needs

Storage tank sludge generally contains mixtures of hydrated metal oxides, hydroxides, and phosphates. Separation technology is the primary means to reduce the large volumes of storage tank waste to smaller volumes of more concentrated and well-defined waste. Aluminum and several other waste constituents are amphoteric. Consequently, in addition to forming insoluble hydroxides and oxides, these materials also have the potential of forming soluble chemical species under highly caustic conditions. There is increasing emphasis on removing these materials through "enhanced sludge washing." If these materials could be preferentially solubilized, then the volume of the remaining radioactive waste to be treated and/or stored would be significantly reduced.

Accomplishments and Future Work

In initial sludge surrogate studies, aluminum, chromium, and zinc showed the highest solubility in NaOH solutions. Cerium and zirconium were the least soluble of the elements tested. The removal of iron and bismuth approached 2%, but the rest of the elements studied showed <1% removal. The amount of aluminum removed from the sludge surrogates increased as the NaOH concentration increased from 0.1 to 6.0 *M*. Sequential washing of the sludge surrogate with 3.0 *M* NaOH removed 84% of the aluminum, 39% of the chromium, and 65% of the zinc.

Surrogate sludges containing uranium and thorium were also prepared, and their dissolution behavior was characterized. In one of the sludges the uranium was precipitated as a hydrous oxide. In another sludge, the uranium, along with calcium and magnesium, were precipitated as both hydrous oxides and phosphates. In addition, samples of the sludges were "aged" by refluxing them at 100°C for several days in an aqueous solution at pH 10.

Kinetic data at 70°C showed that the dissolution of Cr, Fe, U, Bi, and Ca increased with time. Larger amounts of each of these elements, as well as aluminum, were removed at 70°C compared to room temperature.

Initial results were obtained on the caustic dissolution of an actual sludge sample from ORNL Melton Valley Storage Tank (MVST) W-25. As with the Hanford surrogate sludges, the most leachable elements were aluminum, chromium, and zinc. However, the percentage removal was much less from the MVST W-25 sample.

Preparation and testing of additional sludge surrogates is continuing. These tests will be used to measure the dissolution behavior of additional components such as silicon and phosphates. Studies on MVST W-25 sludge will be extended, and efforts are also being made to obtain samples of Hanford sludge for testing.

Benefits

The technology developed in this project would be of potential benefit to several DOE sites. Separating the nonradioactive elements would result in a much smaller amount of solid tank waste to be managed or handled in downstream processing, and in a substantial reduction in the amount of waste requiring valuable repository space.

Collaboration

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