

CHARACTERIZATION OF THE SOLIDS WASTE IN THE HANFORD WASTE TANKS USING A COMBINATION OF XRD, SEM, AND PLM

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The Department of Energy's River Protection Project (RPP) is tasked with retrieving highly radioactive waste from Hanford double-shell and single-shell tanks to provide feed for vitrification for long-term storage. Approximately 330,000 metric tons of sodium-rich radioactive waste originating from separation of plutonium from irradiated uranium fuel is stored in 177 underground tanks at Hanford. The tanks contain various amounts of liquid and solid wastes and over twenty different waste types have been identified for the various tanks. The RPP organization needs chemical and physical data to evaluate technologies for retrieving the waste.

Accurate chemical modeling of the solids in the tank waste system depends to a large extent on a proper identification of the solid phases in equilibrium with the joints in solution. Analyses of solids from Hanford Tank BY-109 were performed using the three-pronged approach of x-ray diffraction (XRD), polarized light microscopy (PLM), and scanning electron microscopy with energy dispersive x-ray spectroscopy (SEM/EDS).

Chemical phases identified by all three techniques included Na_3FSO_4 , $\text{Na}_7\text{F}(\text{PO}_4)_2 \cdot 19\text{H}_2\text{O}$, $\text{Na}_2\text{C}_2\text{O}_4$, and NaF . Aluminum hydroxide was suspected by PLM, confirmed by SEM/EDS, and identified by XRD as the specific crystalline form of $\text{Al}(\text{OH})_3$ known as bayerite. Cryolite, Na_6AlF_6 , was identified by SEM/EDS and confirmed by XRD. This phase has not been observed before in Hanford tank waste.

A computer-modeling program known as the Environmental Simulation Program (ESP), produced by OLI Systems, Inc. of Morris Plains, New Jersey, is being used by the RPP organization to predict solubilities during dilution and retrieval of all tank waste types. The identification of the double salts such as Na_3FSO_4 and $\text{Na}_7\text{F}(\text{PO}_4)_2 \cdot 19\text{H}_2\text{O}$ has proven to be very important in predicting the solubilities during dilution and retrieval of tank wastes.