155c Fractional Crystallization of Sodium Salts from Low- and Medium-Curie Wastes

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Large quantities of aqueous mixed waste are awaiting appropriate treatment at the Hanford site. These wastes may be classified as low-, medium, or high-curie, depending upon the activity of the radionuclides (primarily ^{137}Cs). Fractional crystallization has been chosen as a viable technology for dividing the medium-curie waste into low- and high-curie streams, which would accelerate the overall remediation at the site. In the process, water is evaporated and crystals of various sodium salts are nucleated, grown, and recovered from the residual mother liquor. The radionuclides are expected to remain in the liquid, so that the recovered crystals are low enough in radioactivity to be treated as low-activity waste.

In the present work, solutions simulating those expected to be found in streams produced from single- and double-shell tanks at Hanford have been subjected to various crystallization protocols. The experiments have utilized evaporative crystallization at nearly isothermal conditions to generate a slurry that contains crystals and mother liquor. The crystals are filtered, washed, and subjected to subsequent processing that depends on the run objectives. In some instances the crystals are sieved immediately to prevent alteration of the CSD, either by further crystallization or crystal aggregation. The wash liquor was either pure water, in which case a substantial fraction of the recovered crystals were redissolved, or a solution that was nearly saturated with the primary salts. In some cases, the filtrate and spent wash liquor were combined and fed to a second batch crystallizer in which a run similar to the first stage was conducted.

In all cases, the evaporation was conducted at a known (but not necessarily constant) rate until a specified mass of condensate had been recovered. Seed crystals were added in some of the runs. The important properties of the crystal products included size distribution and morphology (for ease of filtration and washing) and purity. Size distributions were determined by sieve analyses, while of morphologies were determined by PLM microscopy and x-ray diffraction. Crystal purities and means of impurity incorporation were evaluated using chemical analyses and PLM observation.