

Electrochemical Separation and Destruction - DWPF Vitrification

In the proposed process, concentrated supernate and dissolved salt cake solution are treated with MST to reduce the concentration of soluble alpha activity and then filtered to remove entrained sludge solids. The filtrate is then processed in an electrochemical cell to convert nitrates and nitrites to hydroxides. Nitrogen, nitrous oxide and ammonia are generated and evolved as gases. The liquid exiting the electrolytic cell is next processed in a multistaged electrochemical membrane unit to produce a small volume of alkaline solution enriched in cesium and a large volume of caustic solution. It may be feasible to separate potassium in the form of potassium hydroxide from cesium in a separate electrochemical cell. At least a portion of the NaOH can be recycled to the tank farm. The remaining caustic stream would be grouted in the Saltstone facility. The Cs-enriched stream is evaporated to reduce the volume, overheads are processed through ETF and the bottoms are combined with sludge for vitrification in the DWPF.

The proposed process would include these steps: (1) combine concentrated supernate and dissolved salt cake solution and transfer the salt solution to a tank for treatment with MST to remove soluble alpha; (2) filter to remove entrained sludge solids and MST; (3) electrolyse filtered salt solution in an electrochemical unit to convert nitrate and nitrite salts to caustic; (4) process caustic solution in an multistage electromembrane unit to produce a small volume of solution enriched in Cs, a stream containing potassium hydroxide and a large volume of sodium hydroxide solution depleted in Cs; (5) recycle part or all of the sodium hydroxide to the tank farm; (6) Mix the remaining decontaminated sodium hydroxide solution with the potassium hydroxide solution and transfer to the Saltstone facility to make a Class A waste grout; (7) Evaporate Cs-rich caustic solution to reduce volume (overheads to ETF); (8) transfer evaporator bottom for vitrification in DWPF.

Variation:

- 1) Consider Nafion™ membrane as well as ceramic membranes
- 2) Eliminate potassium separation
- 3) Consider electrodialysis for separation of the alkali materials

Merits:

- 1) Beneficial re-use of caustic
- 2) Reduced volume of glass

