

Caustic Side Solvent Extraction

The basic principle of solvent extraction (liquid-liquid extraction) is to use a sparingly soluble diluent material that carries an extractant that will complex with cesium ions in the caustic solution. The separated cesium can then be stripped back into an aqueous phase ready for transfer to DWPF. The solvent is contacted in a countercurrent fashion with the caustic waste solution (in the Extraction Stages). Following cesium extraction, the solvent is scrubbed with dilute caustic to remove other salts from the solvent stream (in the Scrub Stages). The solvent is then contacted in a countercurrent flow with a dilute acid stream to transfer cesium to the acid stream (in the Strip Stages). The solvent will then need to be scrubbed or purged to remove degradation products prior to recycling to the front of the process. The other two resultant streams are a raffinate stream depleted of cesium and a strip effluent containing the separated cesium ions.

The proposed process has the following characteristics: a) the feed solution will be clarified prior to solvent extraction, probably through a filtration process that returns the solid phase to the Tank Farm, b) 8 extraction stages, 2 scrub stages and 10 strip stages using an appropriate diluent (e.g., Isopar) and extractant (e.g., a crown ether), c) this process will likely provide only a 3 fold increase in cesium ion concentration. Additional concentration of effluent could be achieved through evaporation or through the use of additional strip stages, d) the raffinate stream will likely contain at least trace concentrations of both the organic solvent and its degradation products, these organics may require removal to meet Saltstone feed requirements, e) an additional Hg removal stage would be required for some tank wastes, f) if an evaporator is employed to concentrate the strip effluent, the overheads may require organic removal prior to transfer to ETF, g) the solvent extraction process may not remove actinides, in which case the addition of monosodium titanate to the waste prior to filtration could be employed, h) this process would likely use centrifugal contactors to provide each extraction stage.

Variations:

- 1) TRU ion exchange resin in place of MST

Merits:

- 1) Acidic cesium waste stream is compatible with DWPF
- 2) Reduced volume of glass based on potassium going to Saltstone
- 3) Potential use of existing solvent extraction canyons
- 4) Solvent extraction is widely used commercially in high radiation environments throughout the world.

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