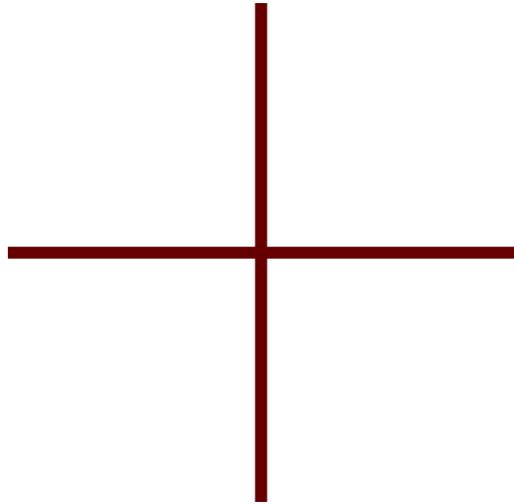


SRNL Work to Support the Removal of Slurries from Waste Tanks, the Transport of Slurries in Pipelines, and the Separation of Solids from Liquids at SRS



We Put Science To Work

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Introduction

- Savannah River Site (SRS) liquid waste contains slurries composed of solid particles and salt solution
- Effective processing of these slurries important to Tank Farm and DWPF operation
- Slurry processes include mixing, retrieval, transport, and solid-liquid separations
- Talk will discuss SRNL experience in testing and recommending processing methods for these slurries

Slurry Mixing (Tank Farm Processes)

- Occurs in waste tanks (~1 million gallons) and process tanks (1,000 – 30,000 gallons)
- Waste tanks generally mixed with slurry pumps (jets), spargers
- Process tanks generally mixed with agitators, spargers

Approaches to Recommending Mixing Equipment and Operating Parameters

- Tank Farm Experience
 - Limited data
 - Anecdotal
- SRNL Testing
 - Simulant rather than actual waste
- Computational Fluid Dynamics (CFD)
- Other DOE Site Testing
- Technical Literature

SRNL Testing

- Evaluated mixing of Bingham plastic slurries in a 85 ft diameter tank
 - Developed model of effective cleaning radius
- Testing to evaluate resuspension of sludge/MST slurries after sitting for 6 weeks at elevated temperature
 - Able to resuspend high yield strength slurries even though cavern model predicted they would not be resuspended
 - Fraction resuspended was a function of time
 - Yield stress was a function of setting time
- Measure rheology (yield stress) of SRS slurries

Waste Retrieval

- Bulk sludge removal
 - Mix sludge with 1 – 4 slurry pumps and transfer to downstream process
- Sludge Heel Removal
 - Remove sludge heels from waste tanks prior to closure
 - Slurry pumps
 - Flygt mixers
 - Chemical Cleaning (oxalic acid dissolution)
 - “New Technologies”
- Salt Removal
 - Add “water”, dissolve salt with or without agitation, and transfer to downstream tank

Waste Retrieval Testing and Demonstrations

- Flygt mixers to remove heels in sludge tanks
 - Testing performed at 4 scales
 - 1.5 ft, 6 ft, 18 ft, and 85 ft diameter
 - Different scaling for sludge and zeolite
- Waste Tank Salt Removal Demonstration
- Chemical Cleaning Demonstration
 - Laboratory-scale testing of sludge heel dissolution using oxalic acid
 - Actual waste and simulant

Slurry Transport

- Need to pump slurries between waste tanks, process tanks, and facilities
- Concentrated sludge slurries
 - 12 – 18 wt % solids
- Dilute slurries
 - < 5 wt % solids

Slurry Transport Testing

- 1980s
- Georgia Iron Works (Chris Randall, Dave Lewis)
- TNX (John Fazio)
 - 500 foot, 3 inch stainless steel pipe
- Feed concentrated slurry (Bingham plastic)
- Measured pressure drop as a function of flow rate and rheological properties
 - Compared with Hanks model – good agreement
- Resuspension Tests
 - Allowed to sit for 7 days
 - Flow immediately established when pump started
- Flushing Tests
 - 2 – 3 line volumes needed to flush transfer line

Slurry Transport Calculations

- Fast-settling or slow settling
- Fast-settling slurries
 - Use correlations by Durand, Wasp, Turian, Walton, others to calculate minimum transport velocity
- Slow settling slurries
 - If Bingham plastic, use Hanks model
- Calculate needed flow rate, pump discharge pressure by both approaches

Solid-Liquid Separation

- Needed for many processes
 - Salt Waste Processing Facility
 - Actinide Removal Process
 - Enhanced Processes for Radionuclide Removal
 - Small Column Ion Exchange
 - Effluent Treatment Facility
 - Sludge Washing
- Impacts process throughput
- Technologies investigated include filtration, centrifugation, flocculation, settling-decanting

Solid-Liquid Separation Technology Assessments

- **Alternative Filters for ETF (Georgeton and Poirier)**
 - Pilot-scale
 - Rotary filter, tubular ultrafilter, and ceramic microfilter performed best
- **Solid-Liquid Separation Technologies for DOE Applications (McCabe)**
 - Paper study
 - Tubular crossflow filter recommended technology
 - Testing needed
 - Baseline in many SRS processes
- **Solid-Liquid Separation Technologies for SRS Salt Processing (Poirier and Fink)**
 - Paper study, bench-scale testing, pilot-scale testing
 - Identified rotary filter as plausible technology
- **Evaluation of Alternative Filter Membrane media (with INL)**
 - Bench-scale Testing
 - Ceramic membranes produced higher flux than stainless steel membranes

Filter Testing

- Tubular crossflow filter
 - Bench-scale with simulant
 - Bench-scale with actual waste (SRS and Hanford)
 - Pilot-scale with simulant
 - Obtained design data
 - Evaluated alternative filter media
- Rotary microfilter
 - Bench-scale with actual waste
 - Pilot-scale with simulant
 - Full-scale with simulant
 - Evaluating new technology

Lessons Learned

- Pore size dependent on manufacturer
- Filter flux
 - Polymer > ceramic > stainless steel
- Need to test to select best pore size
- Many commercially available flocculants not suitable for high pH, high ionic strength material in SRS Tank Farm
- Centrifuge not effective at separating particles typical of SRS waste
- Flocculation + settling-decanting could remove fraction of the solids, but would need polishing filter