1 of 1

ION EXCHANGE AT TNX USING THE SKID UNIT (U)

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ION EXCHANGE AT TNX USING THE SKID UNIT (U)

INTRODUCTION

An ion exchange unit has been manufactured for WSRC by British Nuclear Fuels, Ltd. This unit consists of three columns, ancillary valving, pumps, lines, and computer controls. It has been delivered to TNX for use in testing a cesium-specific ion exchange resin, developed at WSRC as a potential second generation process for the decontamination of Defense Waste Processing Facility (DWPF) supernate. This resin also has Department of Energy (DOE) applications at both Oak Ridge and Hanford. Oak Ridge is interested in decontaminating the Melton Valley storage tank supernate, while Hanford is interested in decontaminating the 101-AW and 101-SY supernate streams. Another potential developmental interest is the Savannah River Site (SRS) DWPF recycle stream. The three primary waste streams of interest are the Oak Ridge, Hanford, and SRS, DWPF supernate streams. For these three waste streams, the cesium decontamination factor (DF) will be measured for a non-radioactive, simulated, high-level waste solution. The test objectives are as follows:

1. Investigate the resin hydraulic properties during water runs. This will include slurring the resin in and out of the columns using process water. Particle size studies at the Savannah River Technology Center (SRTC) will characterize any resin physical degradation after transport to and from the column. Information needed from these tests, in addition to the resin friability on transport, includes the ability to transport the resin as a slurry and pressure drops across each column with the resin in place.
2. Test the resin cesium DF in a once-through mode using Oak Ridge Melton Valley Tank 25 simulant.
3. Test the resin cesium DF in a once-through mode using SRS supernate simulant.
4. Test the resin cesium DF in a once-through mode using Hanford 101-AW simulant.

5. Test the resin cesium DF, elution with nitric acid, and resin half-life using Hanford 101-AW simulant. This will require repeated feed-elute cycles to determine how many cycles can be performed before the resin must be replaced.
6. Test the column performance in a once-through mode with Hanford 101-AW simulant containing 200 ppm simulated sludge solids. This will provide data to indicate whether prefiltration is necessary for ion exchange if solids are present in the supernate.
7. Test the column with a simulated DWPF recycle waste stream. This will provide cesium DF data for the resin. Additional prefiltration studies will be required, since the stream is known to contain significant quantities of solids.

PROCESS DESCRIPTION & DESIGN BASIS

The SKID, as its' name implies, is a skid-mounted ion exchange unit used to demonstrate cesium removal using a SRS developed resorcinol-formaldehyde (RF) resin. The resin material diameter ranges from 20-50 mesh with an absolute density, bulk density in caustic, and bulk density in water of 1.4, 0.36 and 0.5 g/ml respectively. Bench-scale tests indicate 200 column volumes of waste feed can be processed for every volume of resin material. This resin is hygroscopic and retains 26 weight percent in moisture.

The SKID facility consists of two primary areas: the feed/chemical and supply/receipt tanks, and the ion exchange columns. The feed/chemical and supply/receipt tanks provide storage for caustic (NaOH), acid (HNO₃), simulated feed, spent acid and washwater solutions. A preliminary sketch of the supply tank area is shown Figure 1.

The SKID has three identical ion exchange columns (V1001, V1002, V1003). The column design is based on a throughput of 10 bed volumes/hour so that the equipment is kept to a reasonable size. The SKID maximum operating temperature is 35 °C. The operating capacity is 754 gal/hr (≈12.6 gal/min), but has a maximum flow capacity of 2642 gal/hr (≈ 44 gal/min) for transferring the resin slurry in and out of the unit. Each ion exchange column has an empty volume of 219 gal, and a void volume of 142 gal when the resin is in place.

At any one time, two columns will be on-line, with the simulant being fed in series. The third column will be off-line from the process, being prepared for use in the ion-exchange sequence. The three columns are operated in a carousel configuration as summarized in Table 1. The SKID unit can operate in two different modes the *once-through* and the *regenerative* mode.

Table 1. SKID Unit Carousel Configuration

	V1001	V1002	V1003
Position 1	lead	lag	offline
Position 2	offline	lead	lag
Position 3	lag	offline	lead

Figure 1. Process Flowsheet

Once-Through Mode

In the *once-through* mode the resin batch is only used a single time until it reaches a desired breakthrough or becomes spent. A typical operating sequence is as follows:

1. Fill the empty column with water, and slurry a water/resin mixture into the column.
2. Wash the resin with process water in the backflow mode to redistribute the resin and send the wash water to drain.
3. Condition the resin using caustic in the downflow mode. Drain the caustic into a neutralization holding tank.
4. Supply simulated waste feed to the ion exchange columns in the downflow mode until the desired breakthrough is attained on the lead column. Send any simulated residual waste feed to the feed supply tank.
5. Wash the resin with caustic.
6. Wash the resin with water in the downflow mode.
7. Wash the resin a second time with water in the downflow mode.
8. Wash the resin with acid to elute the collected ion off the column.
9. Wash the resin with water in the downflow mode.
10. Transfer the resin out of the column, collecting the resin material in a filtration device.
11. Drain and rinse the ion exchange columns with a small volume of water. Transfer any residual resin out of the ion exchange columns.

Regenerative Mode

In the *regenerative* mode, a sequence of operations are carried out to chemically treat the resin so that it can be re-used in the ion exchange process. The initial steps for the *regenerative* mode are the same as those mentioned in steps 1-6 for the *once-through* mode. To regenerate the column, the following additional operational sequence is completed:

1. The spent resin is eluted with acid in the upflow mode to remove any cesium ions from the resin. This also converts the resin back into the hydrogen form.
2. Water wash the resin column in the upflow mode displacing the acid to a separate receipt tank and water wash to a neutralization holding tank.
3. Condition the resin using caustic in the downflow mode. Drain the caustic into a neutralization holding tank.

TEST OBJECTIVES**Once-Through Operating Mode Using Chemical Simulants**

Once-through testing on the waste simulants will involve processing a simulated supernate through two resin beds in series until 50% cesium breakthrough is obtained on the lead column (See Figure 2).

Figure 2. Carousel Operation of Three Ion Exchange Columns

When breakthrough is attained, both columns will be washed with caustic. Following a water wash, both columns will also be eluted with an appropriate volume of 0.5 M HNO_3 and the eluate analyzed to determine the concentration of sodium, potassium, and cesium ions. Both columns will be washed with water and reconditioned with NaOH prior to any treatment of a new supernate simulant.

During chemical runs, three supernate streams and a supernate stream with sludge solids added are planned for testing. The three supernate simulants are based on the Oak Ridge Melton Valley Tank 25 Waste, the Savannah River Site High-Level Waste, and the Hanford 101-AW Waste stream. The first supernate simulant to be tested will be the Melton Valley Tank 25 composition from Oak Ridge. Although it contains the same major components as the SRS and Hanford supernates, it is the most dilute of the three streams. Table 2 gives the composition of Oak Ridge, SRS, and Hanford simulants that will be used in the once-through tests. Once the Oak Ridge test is complete, the simulant will be removed from the system for disposal. The SRS feed stream

will be used for both the SRS and Hanford testing. This will be accomplished by adjusting the feed composition by chemical addition to the SRS simulant. The feed solutions will require continuous agitation to ensure feed uniformity.

Table 2. Chemical Composition of Supernate Simulants

<u>Chemical</u>	<u>Oak Ridge</u>		<u>Savannah River</u>		<u>Hanford 101-AW</u>	
	<u>g/Liter</u>	<u>Molarity</u>	<u>g/liter</u>	<u>Molarity</u>	<u>g/Liter</u>	<u>Molarity</u>
NaOH	2.4	0.061	116	2.9	280	7.1
Al(NO ₃) ₃ ·9 H ₂ O	0.060	1.6 E-4	143	0.38	190	0.50
NaNO ₃	220	2.6	101	1.2	200	2.4
NaNO ₂	----	-----	49	0.71	75.9	1.1
Na ₂ CO ₃ ·H ₂ O	1.24	0.01	25	0.20	27	0.21
Na ₂ SO ₄	7.4	0.052	24	0.17	1.4	0.01
KNO ₃	43	0.43	1.5	0.012	111	1.1
CsNO ₃	2.6E-6	1.3E-8	0.049	2.4E-4	0.028	1.4E-4
TOTAL [Na ⁺]		3.6		5.6		11

Oak Ridge Simulant Test

The influent and effluent volumes and destinations for the once-through test using the Oak Ridge simulated supernate are given in Table 3. Because of the required feed volume, available tankage, and the simulant preparation cost, the feed will be recycled. Since the RF resin will only remove cesium, the feed can be recycled to the feed tank. The cesium concentration will be maintained at a constant level by metering a CsNO₃ solution into the feed tank. Each time a new resin bed is used, the resin will be slurried into the column with a minimum of 3 m³ (793 gal) of process water. It will also be treated with 2.85 m³ (378 gal) of 2 M NaOH for two reasons: 1) to convert the resin to the sodium form 2) to make the bed caustic. If the bed is not maintained at a high pH, the aluminum in the feed will precipitate as it meets the resin aqueous interface. This would decrease the ion exchange efficiency, and cause a significant column pressure drop.

To minimize waste volume, simulated supernate will be used to push any residual 2 M NaOH off the resin column to the neutralization tank. Feeding of the simulated supernate will continue until 50% cesium ion breakthrough on the lead column is obtained. To remove the cesium ion when the feed cycle has been completed for the lead column, the resin in both columns is treated again with 2 M NaOH. The volume of interstitial feed solution that is displaced by the caustic treatment will be returned to the neutralization tank. The caustic treatment is followed by a water wash generating a slightly caustic liquid destined for the neutralization tank. Elution of the cesium ion from the resin is accomplished using 0.5 M HNO₃, and is sent to the acid receipt tank. The operating sequence and wastewater generation rate is shown in Table 3. A process flow diagram for the various streams is shown in Attachment 1.

Table 3. Once-Through Component Volumes Using Oak Ridge Simulant on Two Columns in Series

<u>Process Step</u>	<u>Component</u>	<u>Cycle Volume</u>	<u>Destination</u>
Float off fines	Process water Resin fines	300 gallons 13 gallons*	Drain Bag filter/Clean waste
Slurry resin into columns	Process water Resin	1,424 gallons 160 gallons	Process drain Next test
Condition with 2 M NaOH	2 M NaOH	756 gallons	Neutralization tank
Feed simulant	OR simulant (See Table 2)	1,500 gallons	Disposal ETP/ETF
Feed simulant (interstitial)	OR simulant	3 gallons	Neutralization tank
Add Cs ⁺ to feed	CsNO ₃	1 gallon	Feed tank
Caustic wash	2 M NaOH	756 gallons	Neutralization tank
Water wash	Process water	756 gallons	Neutralization tank
Elution	0.5 M HNO ₃	1600 gallons	Disposal ETP/ETF
Water wash	Process water	756 gallons	Neutralization tank

ETP-TNX Effluent Treatment Plant

ETF-H-Area Effluent Treatment Facility

* fines are estimated as 8 % of the total resin volume feed of 160 gallon

Another perspective for this test, relative to the influents and effluents and their destinations follows:

Influents for two columns:

- Ion exchange resin: 160 gallons
- Filtered process water : 1,424 (1,584 - 160) gallons used for slurring in resin
1,512 gallons for washing resin
300 gallons for fines removal
- 2 M NaOH: 2,268 gallons from caustic tank
- Feed: 1,500 gallons simulated Oak Ridge supernate
- 0.5 M HNO₃: 1600 gallons

Effluents from two columns:

- Neutral process water: 1,424 gallons to process drain
- Caustic process water: 1512 gallons to neutralization tank
- Acidic process water: 756 gallons to neutralization tank

- 2 M NaOH: 1,512 gallons to neutralization tank [The hydroxide concentration in the neutralization tank will be approximately 1 M and will have to be neutralized prior to disposal due to constraints of process sewer.]
- Feed simulant: 3 gallons to neutralization tank to be mixed with 3024 gallons of 1 M NaOH for a total volume of 3027 gallons. [Cs^+ concentration will be $1.6 \text{ E-}6 \text{ mg/l}$ in the neutralization tank.] The original 1500 gallon feed solution will be sent to the H-Area ETF for disposal.
- Filter used to capture fines: one to solid waste
- Filter cartridge on process water inlet stream: unknown number - to solid waste
- Acid eluate: 0.5 M HNO_3 containing $9.5 \text{ E-}4 \text{ mg/l Cs}^+$ - 1600 gallons to be neutralized and disposed at the ETP or ETF.

Recycled Substances

Treated simulant feed will be recycled to the simulant feed tank. Cesium nitrate will be metered into the recycle stream to replenish the Cs^+ . This stream, 1,500 gallons maximum, will be disposed by sending it to the ETP/ETF.

Savannah River Simulant Test

Although reconstituting the Oak Ridge simulant with additional chemicals would generate less waste, the sodium and potassium nitrate concentrations for the Savannah River simulant is less than the Oak Ridge simulant concentration. The Savannah River simulant can only be produced by making a fresh simulant. The Savannah River simulant will be processed in the same manner as the Oak Ridge simulant, and Table 4 describes the solution volumes needed/generated during the test. A process flow diagram for the various streams is shown in Attachment 1. The resin from the previous test will be reused after being treated with 2 M NaOH.

Table 4. Once-Through Component Volumes Using Savannah River Simulant on Two Columns in Series

<u>Process Step</u>	<u>Component</u>	<u>Cycle Volume</u>	<u>Destination</u>
Condition with 2 M NaOH	2 M NaOH	756 gallons	Neutralization tank
Feed simulant	SRS simulant (See Table 2)	1,500 gallons reused	Feed tank; reconstitute for next test series
Feed simulant (interstitial)	SRS simulant	3 gallons	Neutralization tank
Add Cs^+ to feed	CsNO_3	1 gallon	Feed tank
Caustic wash	2 M NaOH	756 gallons	Neutralization tank
Water wash	Process water	756 gallons	Neutralization tank
Elution	0.5 M HNO_3	1600 gallons	ETP/ETF
Water wash	Process water	756 gallons	Neutralization tank
Slurry resin out	Process water Resin	6,124 gallons 160 gallons	Drain Bag filter

The various influent and effluent destinations are described in the following text:

Influents :

- Filtered process water : 6,124 gallons used for slurring in resin out of columns
1,512 gallons for washing resin
- 2 M NaOH: 756 gallons from caustic tank
- Feed: 1,500 gallons simulated Savannah River supernate
- 0.5 M HNO₃: 1600 gallons

Effluents :

- Neutral process water: 6,124 gallons to process drain
- Caustic process water: 756 gallons to neutralization tank
- Acidic process water: 756 gallons to neutralization tank
- 2 M NaOH: 1,512 gallons to neutralization tank [The hydroxide concentration in the neutralization tank will be approximately 1 M and will have to be neutralized prior to disposal due to process sewer constraints.]
- Feed simulant: 3 gallons to neutralization tank to be mixed with 3,024 gallons of 1 M NaOH for a total volume of 3027 gallons. [Cs⁺ concentration will be 0.03 mg/l in the neutralization tank.]
- Filter used to capture fines: one to solid waste
- Filter cartridge on process water inlet stream: unknown number - to solid waste
- Acid eluate: 0.5 M HNO₃ containing 319 mg/l Cs⁺ - 1600 gallons to be neutralized and disposed of at ETP/ETF

Recycled Substances

Treated simulant feed will be recycled to the feed tank. Cesium nitrate will be metered into the recycle stream to replenish the Cs⁺ that is removed by the ion exchange columns. This stream, 1,500 gallons maximum, will be saved and chemicals will be added to make the composition equivalent to that of the Hanford 101-AW simulant.

The resin will be removed from the columns and new resin introduced for the Hanford simulant because extended operating runs are planned in the elution mode to determine the resin operating life.

Hanford 101-AW Simulant Tests Once-Through & Elution Mode of Operation

Once Through

Tests using the Hanford 101-AW simulant are primarily directed at determining the resin operating life. The resin operating life is defined as the number of feed/elute cycles that can be completed before the resin must be replaced. Data generated in the first cycle will be equivalent to a once-through mode test. After satisfying the once-through test conditions, the columns will be operated in successive elution cycles until it is determined that 20% of the resin capacity has been lost. When this reduced resin capacity is observed, the test will be terminated.

The following chemicals will be added to the feed tank to convert the remaining Savannah River simulant to Hanford 101-AW simulant:

- 164 g NaOH/liter (this will probably be added as ~50% NaOH solution and will require enough solution to add a total of 953 kg of NaOH)

- 254 kg of $\text{Al}(\text{NO}_3)_3 \cdot 9 \text{H}_2\text{O}$
- 153 kg of NaNO_2
- 7.3 kg of $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
- 160 g CsNO_3
- 561 kg NaNO_3
- Process water will be added to bring the total volume to about 1,500 gallons (5.7 E+3 liters).

The simulant will be sampled and analyzed prior to system testing to verify the feed components concentration.

Elution Mode

For this series of tests, all three SKID columns unit will be utilized. They will be operated in a carousel fashion as described in Table 1. Table 5 outlines the process steps and solution volumes needed for the first once-through test. Table 6 notes the process steps for continual column elution after saturation with cesium ion. Table 7 lists the process steps for the last elution cycle, which includes slurring the resin out of the ion exchange columns. The process flow diagrams for each scenario are shown in Attachment 1.

Table 5. Once-Through (First Cycle) Component Volumes Using Hanford 101-AW Simulant on Two Columns in Series

<u>Process Step</u>	<u>Component</u>	<u>Cycle Volume</u>	<u>Destination</u>
Float off fines	Process water Resin fines	1,000 gallons 19 gallons*	Drain Bag filter/Clean waste
Slurry resin into columns	Process water Resin	2,028 gallons 240 gallons	Process drain Next test
Condition with 6 M NaOH (Columns 1 & 2)	6 M NaOH	756 gallons	Neutralization tank
Feed simulant	101-AW (See Table 3)	1,500 gallons reused	Feed tank; reconstitute for next test series
Feed simulant (interstitial)	101-AW	3 gallons	Neutralization tank
Add Cs^+ to feed	CsNO_3	1 gallon	Feed tank
Caustic wash	6 M NaOH	756 gallons	Neutralization tank
Water wash	Process water	756 gallons	Neutralization tank
Elution	0.5 M HNO_3	1600 gallons	ETP/ETF
Water wash	Process water	756 gallons	Neutralization tank

*-estimated as 8 % of the total resin volume feed

Influent and effluent volumes for this test are shown below.

Influents:

- Ion exchange resin: 240 gallons
- Filtered process water : 2,028 (2,268 - 240) gallons used for slurring in resin
1,512 gallons for washing resin
1,000 gallons for fines removal
- 6 M NaOH: 1,512 gallons from caustic tank
- Feed: 1,500 gallons simulated Hanford 101-AW supernate
- 0.5 M HNO₃: 1600 gallons

Effluents:

- Neutral process water: 2,028 gallons to process drain
- Caustic process water: 756 gallons to neutralization tank
- Acidic process water: 756 gallons to neutralization tank
- 6 M NaOH: 1,512 gallons to neutralization tank [The hydroxide concentration in the neutralization tank will be approximately 3.0 M and will have to be neutralized prior to disposal.]
- Feed simulant: 3 gallons to neutralization tank to be mixed with 3,024 gallons of 3 M NaOH for a total volume of 3027 gallons. [Cs⁺ concentration will be 0.013 mg/l in the neutralization tank.]
- Filter used to capture fines: one to solid waste
- Filter cartridge on process water inlet stream: unknown number - to solid waste
- Acid eluate: 0.5 M HNO₃ containing 372 mg/l Cs⁺ - 1600 gallons to be neutralized and sent to F/H ETF or to a vendor for disposal

Table 6. Volumes Generated From a Single Column for Carousel Operation Using the Hanford 101-AW Simulant

<u>Process Step</u>	<u>Component</u>	<u>Cycle Volume</u>	<u>Destination</u>
Condition with 6 M NaOH (Columns 1, 2 & 3)	6 M NaOH	1134 gallons	Neutralization tank
Feed simulant	101-AW (See Table 2)	1,500 gallons reused	Feed tank; reconstitute for next test series
Feed simulant (interstitial)	101-AW	3 gallons	Neutralization tank
Add Cs ⁺ to feed	CsNO ₃	1 gallon	Feed tank
Caustic wash (Column 1)	6 M NaOH	378 gallons	Neutralization tank
Water wash (Column 1)	Process water	378 gallons	Neutralization tank
Elution (Column 1)	0.5 M HNO ₃	1600 gallons	ETP/ETF
Water wash	Process water	378 gallons	Neutralization tank

The caustic, water wash and acid elution will be repeated for columns 2 and 3. A minimum of six cycles is estimated for each position (e. g. 1, 2, 3). The total waste volume generation is therefore, six times the operating volumes mentioned in Table 7. The influents, effluents and their destinations on a per cycle basis is as follows:

Influents:

- Filtered process water : 1,512 gallons for washing resin
- 6 M NaOH: 1134 gallons for preconditioning, 378 gallons for caustic washes
- Feed: 1,500 gallons simulated Hanford 101-AW supernate
- 0.5 M HNO₃: 1600 gallons

Effluents:

- Caustic process water: 378 gallons to neutralization tank
- Acidic process water: 378 gallons to neutralization tank
- 6 M NaOH: 1,134 gallons for preconditioning, 378 gallons for caustic washes to neutralization tank [The hydroxide concentration in the neutralization tank will be 3 M during each caustic and water wash cycle assuming neutralization to pH 7 prior to disposal. Adjustment of the pH is required due to process sewer constraints.]
- Feed simulant: 3 gallons to neutralization tank to be mixed with 2,268 gallons of 3 M NaOH for a total volume of 2,271 gallons. [Cs⁺ concentration will be 0.0168 mg/l in the neutralization tank prior to final pH adjustment]
- Filter cartridge on process water inlet stream: unknown number - to solid waste
- Acid eluate: 0.5 M HNO₃ containing 372 mg/l Cs⁺ - 1600 gallons to be neutralized and disposed at the ETP/ETF

It is understood that a certain amount of simulated supernate will have to be added to the feed tank to replenish supernate lost to the neutralization tank and due to sampling. The final operating cycle with the Hanford 101-AW simulant containing cesium ion will follow the outline in Table 7. The only difference in the final elution cycle mentioned in Table 8 compared to the volumes in Table 6 is the ion exchange resin removal.

Table 7. Final Elution Cycle Volumes Using Hanford 101-AW Simulant

<u>Process Step</u>	<u>Component</u>	<u>Cycle Volume</u>	<u>Destination</u>
Condition with 6 M NaOH	6 M NaOH	378 gallons	Neutralization tank
Feed simulant	101-AW (See Table 3)	1,500 gallons reused	Feed tank; reconstitute for next test series
Feed simulant (interstitial)	101-AW	3 gallons	Neutralization tank
Add Cs ⁺ to feed	CsNO ₃	1 gallon	Feed tank
Caustic wash	6 M NaOH	378 gallons	Neutralization tank
Water wash	Process water	378 gallons	Neutralization tank
Elution	0.5 M HNO ₃	1600 gallons	ETP/ETF
Water wash	Process water	378 gallons	Neutralization tank

Slurry resin out	Process water	9,186 gallons	Drain
	Resin	240 gallons	Bag filter

The influents, effluents and their destinations is as follows:

Influents :

- Filtered process water : 9,186 gallons used for slurring in resin out of columns
756 gallons for washing resin
- 6 M NaOH: 378 gallons from caustic tank
- Feed: 1,500 gallons simulated Hanford 101-AW supernate
- 0.5 M HNO₃: 1600 gallons

Effluents :

- Neutral process water: 9,186 gallons to process drain
- Caustic process water: 378 gallons to neutralization tank
- Acidic process water: 378 gallons to neutralization tank
- 6 M NaOH: 756 gallons to neutralization tank [The hydroxide concentration in the neutralization tank will be approximately 3 M and will have to be neutralized prior to disposal due to process sewer constraints.]
- Feed simulant: 3 gallons to neutralization tank to be mixed with 1512 gallons of 3 M NaOH for a total volume of 1515 gallons. [Cs⁺ concentration will be 0.0275 mg/l in the neutralization tank.]
- Filter used to capture fines: one to solid waste
- Filter cartridge on process water inlet stream: unknown number - to solid waste
- Acid eluate: 0.5 M HNO₃ containing 372 mg/l Cs⁺ - 1600 gallons to be neutralized and disposed of at ETP/ETF
- Ion exchange resin: 240 gallons to bag filter for ultimate disposal as solid waste

The feed simulant will be retained for use in the sludge solids test.

Once-Through Operation With SRS Sludge Solids

Pumping actual supernate from a waste tank into an ion exchange pretreatment system is expected to incorporate small amounts of sludge particles suspended in the supernate. The major components in the sludge are presented in Table 8. It is expected that sludge accumulation on the resin bed top will cause a high pressure drop across the column. To determine how sludge solids suspension affects the ion exchange process, a test will be conducted using 200 parts per million suspended solids. A single column of fresh resin will be used for the test. Supernate containing the sludge solids will be processed through the column until 24,000 gallons of feed has been treated, or until the column pressure drop limits are exceeded. Since the test objective is only to identify the effect of sludge addition, cesium addition will not be made during this run. The process steps and material volumes are given in Table 10. A process flow diagram for the various streams is shown in Attachment 1.

Table 8. Major Components of SRS Simulated Sludge (Based on Dried Sludge)

<u>Element</u>	<u>Weight %</u>
Fe	12.1
Si	5.1
Mn	2.8
B	0.64
Mg	0.30
Na	7.1
Al	3.5
Ca	1.7
Li	0.53
Zn	0.20

Table 9. Component Volumes Using Hanford 101-AW Simulant Containing 200 ppm SRS Sludge Solids on One Column

<u>Process Step</u>	<u>Component</u>	<u>Cycle Volume</u>	<u>Destination</u>
Float off fines	Process water Resin fines	300 gallons 6.4 gallons*	Drain Bagfilter/Clean waste
Slurry resin into columns	Process water Resin	712 gallons 80 gallons	Process drain Solid waste
Condition with 6 M NaOH	6 M NaOH	378 gallons	Neutralization tank
Feed simulant	101-AW + solids	1,500 gallons	Disposal at ETP/ETF
Feed simulant (interstitial)	101-AW	3 gallons	Neutralization tank
Add solids to feed	Solids concentrate	1 gallon	Feed tank
Caustic wash	6 M NaOH	378 gallons	Neutralization tank
Water wash	Process water	378 gallons	Neutralization tank
Slurry resin out	Process water Resin	3,062 gallons 80 gallons	Drain Bag filter; solid waste

*-estimated as 8 % of the total resin volume feed

Influents :

- Ion exchange resin: 80 gallons
- Filtered process water : 712 (792 - 80) gallons used for slurring in resin
3,062 gallons for slurring out resin
378 gallons for washing resin
300 gallons for fines removal
- 6 M NaOH: 756 gallons from caustic tank

- Feed: 1,500 gallons simulated Hanford 101-AW simulant plus solids (no Cs^+)

Effluents from two columns:

- Neutral process water: 3,062 gallons to process drain
- Caustic process water: 378 gallons to neutralization tank
- 6 M NaOH: 756 gallons to neutralization tank [The hydroxide concentration in the neutralization tank will be approximately 4 M and will have to be neutralized prior to disposal due to process sewer constraints.]
- Feed simulant: 3 gallons to neutralization tank to be mixed with 1,134 gallons of 4 M NaOH for a total volume of 1,137 gallons.
- Filter used to capture fines: one to solid waste
- Filter cartridge on process water inlet stream: - to solid waste
- Feed simulant: 1,500 gallons: Disposal at ETP/ETF
- Resin: 80 gallons to bag filter for reuse or disposal to solid waste

DWPF Recycle Tests

The scope of these tests is not currently defined in the same detail as the previously discussed testing. Since the composition, particle content and dissolved solids for the DWPF recycle stream is currently indeterminate, a test plan cannot be specified. Once the chemical and physical nature of the feed stream have been defined, the tests will be performed as deemed appropriate. Additional prefiltration studies are also anticipated to process this waste stream using ion exchange.

QUALITY ASSURANCE

The bases and calculations for the nitrate and cesium ion concentrations presented in this document are contained in WSRC-92-339 and maintained by Michael L. Meyer.

October 21, 1993

16

WSRC-TR-93-564 Rev. 0

ATTACHMENT 1

Oak Ridge Process Flow Diagram

Savannah River Process Flow Diagram

Hanford Process Flow Diagram (First Cycle)

Hanford Process Flow Diagram (First Feed/Elute Cycle)

Hanford Process Flow Diagram (Final Elution Cycle)

Hanford Sludge Solids Process Flow Diagram

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