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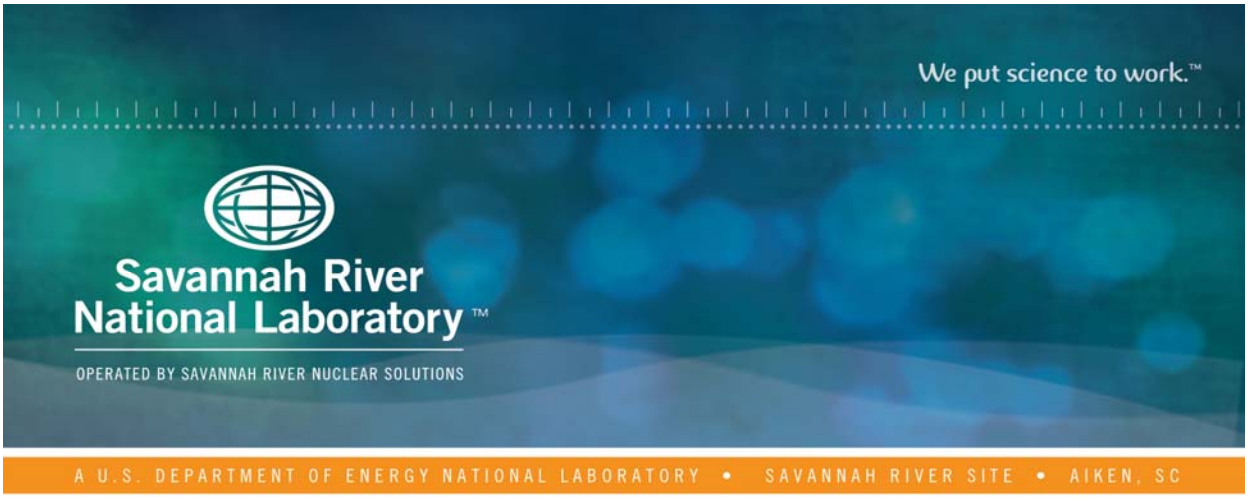

Characterization of the As-Received Sludge Batch 9 Qualification Sample (HTF-51-15-81)

J. M. Pareizs

September 2015

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EXECUTIVE SUMMARY

Savannah River National Laboratory (SRNL) personnel have been requested to qualify the next sludge batch (Sludge Batch 9 – SB9) for processing at the Defense Waste Processing Facility (DWPF). To accomplish this task, Savannah River Remediation (SRR) has sent SRNL a 3-L slurried sample of Tank 51H (HTF-51-15-81) to be characterized, washed, and then used in a lab-scale demonstration of the DWPF flowsheet (potentially after combining with Tank 40H sludge). This report documents the first steps of the qualification process – characterization of the as-received Tank 51H qualification sample. These results will be used to support a reprojection of SB9 by SRR from which final Tank 51H washing, frit development, and Chemical Processing Cell (CPC) activities will be based.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS

AF	alkali fusion
AR	aqua regia
CPC	Chemical Process Cell
CVHG	SRNL-AD method – cold vapor atomic absorption for Hg
DWPF	Defense Waste Processing Facility
IC	ion chromatography
ICPES	SRNL-AD method RADICPES (inductively coupled plasma – electron spectroscopy)
ICPES-S	ICPES special method for sulfur
ICPMS	SRNL-AD method RAD ICPMS (inductively coupled plasma – mass spectroscopy)
n	number of replicates
RSD	relative standard deviation
SB9	Sludge Batch 9
SRNL	Savannah River National Laboratory
SRNL-AD	Savannah River National Laboratory Analytical Development
SRR	Savannah River Remediation
TIC	total inorganic carbon
Titr	SRNL-AD method T BASE/OH/OTHER BASE EXC CO_3^{2-}
TOC	total organic carbon
TTQAP	Task Technical and Quality Assurance Plan
TTR	Technical Task Request
wt%	weight percent

1.0 Introduction

Savannah River National Laboratory (SRNL) personnel have been requested to qualify the next sludge batch (Sludge Batch 9 – SB9) for processing at the Defense Waste Processing Facility (DWPF).[1] To accomplish this task, Savannah River Remediation (SRR) sent SRNL a 3-L slurried sample of Tank 51H to be characterized, washed, and then used in a lab-scale demonstration of the DWPF flowsheet (potentially after combining with Tank 40H sludge). This report documents the first steps of the qualification process – characterization of the as-received Tank 51H qualification sample. These results will be used to support a reprojection of SB9 by SRR from which final Tank 51H washing, frit development, and Chemical Processing Cell (CPC) activities will be based. This task is governed by a Task Technical and Quality Assurance Plan (TTQAP).[2]

2.0 Experimental Procedure

2.1 Sample Receipt ant Subsampling

SRNL received the Tank 51H SB9 qualification sample (HTF-51-15-81) on July 23, 2015. The sample was transferred from the Tank Farm sampler to a one gallon glass bottle. Sample volume was just under 3 L and sample mass was 3,685 g. The bulk sample was well mixed and a subsample of approximately 500 mL was taken using a peristaltic pump with Tygon® chemical tubing. From this subsample, another approximately 100 mL subsample was taken. A portion of the original subsample was filtered to obtain filtrate for weight percent (wt%) dissolved solids. The 100 mL subsample was allowed to settle over a weekend; the aqueous phase was decanted and used for supernatant analyses. A decanted supernatant better represents Tank Farm operations compared to filtering, although filtrate and supernatant are chemically equivalent. Decanted supernatant was used in this case because time (a weekend) was available for settling prior to sample preparations. All other analyses utilized well mixed slurry from the first 500 mL subsample.

2.2 Weight Percent Solids and Density

Aliquots of slurry and filtrate were dried to a constant weight at 110 °C for wt% total solids and wt% dissolved solids, respectively. Filtrate was obtained by filtering slurry through a 0.45 µm nylon filter. Filtrate, instead of supernatant, was used in this measurement to facilitate drying samples over a three day weekend; using decanted supernatant would have required waiting over the weekend for a sludge sample to settle. Wt% insoluble and soluble solids were calculated from the total and dissolved solids measurements.

Slurry and supernatant densities were determined gravimetrically from sample weights in vessels of known volume. As stated in Section 2.1, supernatant was obtained by decanting from a sub-sample of slurry that was allowed to settle over a weekend.

Based on previous experience, a direct measurement of wt% calcined solids may not be possible with a high sodium sample such as this Tank 51H material. Also, the calcining furnace in the Shielded Cells is temporarily not functional, preventing an attempt at a measurement. Therefore, wt% calcined solids were calculated from elemental analyses of the total solids and the wt% total solids. This methodology and calculation are described in Section 3.5.

2.3 Sample Preparations for Total Solids Characterization

To characterize the solids of the Tank 51H sample, aliquots of slurry were digested and submitted to Savanah River National Laboratory-Analytical Development (SRNL-AD). Slurry samples were digested by two methods, aqua regia (AR) and alkali fusion (AF). For the AR digestions, aliquots of slurry were mixed with aqua regia and heated. The resulting liquids were diluted to 100 mL and submitted to SRNL-AD for analysis. For the AF digestions, aliquots of slurry were dried and fused at 675 °C with sodium peroxide. The fusions were then dissolved with water and nitric acid. The resulting liquids were diluted to 100 mL. The SRNL-AD results were then converted from a slurry basis to a wt% total solids basis using the measured wt% total solids. In general,

aqua regia results have better detection limits compared to alkali fusions; alkali fusions must be diluted more prior to analysis due to the sodium used in the sample preparation. The alkali fusion is a more rigorous digestion, and is better for some forms of aluminum (e.g., boehmite) and silicon. In addition to slurry samples, reagent blanks and digested glass of known composition were processed. Results of these samples were used in evaluating AR and AF results of the slurry digestions. The SRNL-AD analyses performed on the digestions are given in Table 2–1.

2.4 Sample Preparations for Supernatant Characterization

The required results of supernatant characterization include various elements, anions, Cs-137, and free hydroxide. Supernatant, decanted from a subsample of settled slurry, was diluted by approximately 30X with deionized water to reduce personnel radioactivity exposure prior to submission to SRNL-AD. Supernatant was diluted in quadruplicate, and the water used in the dilutions was submitted as a blank. The analyses performed on the diluted supernatant are given in Table 2–1.

2.5 Sample Preparations for Oxalate Analysis (Slurry Dilutions)

Sodium oxalate solubility increases significantly as aqueous sodium concentration decreases.[3] This behavior was used to determine total oxalate. A slurry aliquot was diluted with water by ~3x, lowering sodium to below 1 M (near the projected end point). A second slurry aliquot was diluted with water by ~50x; at the resulting sodium concentration, nearly all sodium oxalate should be soluble and measurable in the aqueous phase. The aqueous phases of the dilutions were then submitted to SRNL-AD in quadruplicate for oxalate quantification (see Table 2–1) by Ion Chromatography (IC). The SRNL-AD results and slurry dilution factors were then used to calculate slurry oxalate concentration on a slurry basis.

2.6 SRNL-AD Methods

Given in Table 2–1 are the types of samples (described above) and the SRNL-AD methods used for characterization. Table 2–2 lists the SRNL-AD methods and the analytes reported from these methods.

Table 2–1. Analyses Performed by SRNL-AD

SRNL-AD Method	Supernatant Dilutions	Slurry Dilutions (Aqueous Phase, for Oxalate)	Aqua Regia Digestions	Alkali Fusion Digestions
RAD Inductively Coupled Plasma – Electron Spectroscopy (ICPES) LEEMAN	X	–	X	X
RAD ICPES SULFUR (ICPES-S) AXIAL	X	–	X	–
Cold Vapor Atomic Absorption (CVHG)		–	X	–
CVHG DIGESTED	X	–	–	–
IC ANIONS	X	X	–	–
T BASE/OH/OTHER BASE EXC CO_3^{2-}	X	–	–	–
Total Inorganic Carbon/Total Organic Carbon (TICTOC)	X	–	–	–
RAD Inductively Coupled Plasma – Mass Spectroscopy (ICPMS)	–	–	X	–
GAMMA SCAN	X	–	–	X
PU238/241	–	–	–	X

X: Sample prep submitted to SRNL-AD; –: Sample prep not submitted to SRNL-AD for this analysis.

Table 2–2. Analytes from SRNL-AD Methods

SRNL-AD Method	Expected Results to Satisfy TTR Requirements
RAD ICPES LEEMAN	Ag, Al, B, Ba, Be, Ca, Cd, Ce, Co, Cr, Cu, Fe, Gd, K, La, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Si, Sn, Sr, Th, Ti, U, V, Zn, Zr
RAD ICPES SULFUR AXIAL	S
CVHG and CVHG DIGESTED	Hg
IC ANIONS	Bromide, Chloride, Fluoride, Formate, Nitrate, Nitrite, Oxalate, Phosphate, Sulfate
T BASE/OH/OTHER BASE EXC CO_3^{2-} (Titr)	Free OH^-
TICTOC	Total inorganic carbon ($CO_3^{2-}$is calculated from TIC result)
RAD ICPMS	Mass numbers are used to calculate Pd, Ru, Rh, Nd, Th-232, U-233, U-235, U-236, U-238, Pu-239
GAMMA SCAN	Cs-137
PU238/241	Pu-238, Pu-241

2.7 Quality Assurance

Requirements for performing reviews of technical reports and the extent of review are established in Manual E7, Procedure 2.60. SRNL documents the extent and type of review using the SRNL Technical Report Design Checklist contained in WSRC-IM-2002-00011, Rev. 2.

3.0 Results and Discussion

3.1 Density and Wt% Solids

Presented in Table 3–1 are the density and wt% solids results. As stated in Section 2.2, decanted supernatant was used for supernatant density, and filtrate was used for wt% dissolved solids.

The wt% insoluble solids and soluble solids are calculated from the measured wt% total and dissolved solids.[4] Wt% calcined solids were calculated from elemental analyses of the total solids and the wt% total solids. This methodology and calculation is described in Section 3.5.

Table 3–1. Densities and Wt% Solids

Property	Result	RSD*
Slurry Density (g/mL)	1.22	0.5%
Supernatant Density (g/mL)	1.14	0.4%
Wt% Total Solids (Slurry Basis)	27.4	0.2%
Wt% Dissolved Solids (supernatant basis)	17.2	0.4%
Wt% Insoluble Solids (Slurry Basis)	12.3	NA
Wt% Soluble Solids (Slurry Basis)	15.1	NA
Wt% Calcined Solids (Slurry Basis)	19.8	NA

* RSD = relative standard deviation with number of measurements (n) = 4. NA = not applicable; result is calculated.

3.2 Supernatant Analytical Results

Presented in Table 3–2 are supernatant results. These analytes were determined from analysis of water-diluted supernatant (nominally 30X). Anions (with the exception of carbonate and hydroxide) were determined by IC. Cs-137 was determined by γ-scan. Carbonate was determined from a TIC analysis by assuming all TIC was carbonate. Free hydroxide was determined from a titration. Mercury was determined by a digestion technique performed by SRNL-AD followed by cold vapor atomic absorption (SRNL-AD method CVHG). The remaining elements were quantified by ICPES. Specific analytical technique for each analyte is reiterated in the table.

As has been seen in Tank Farm samples, sulfate by IC is approximately 75% of the total sulfur as measured by ICPES-S (see, for example, the Tank 40 Sludge Batch 8 composition report where sulfate was 79% of the sulfur, on a molar basis[5]). This difference is likely due to non-sulfate species in the sludge slurry. Therefore, it is recommended that sulfur be projected and tracked with sulfur via ICPES instead of by IC, particularly if sulfur content approaches DWPF limits.

Silicon is not reported for the supernatant. It was detected. However, silicon is known to be present in colloidal form, and not accurately measureable without a digestion method.[6] A digestion of supernatant for silicon quantification was not performed since silicon was not requested in the TTR.[1] Elements that were less than the detection limit by ICPES were Ba, Be, Cd, Ce, Co, Cu, Gd, Mg, Mn, Ni, Pb, Sb, Sn, Sr, Th, Ti, U, V, Zn, and Zr, with detection limits ranging between 0.1 and 41 mg/L, depending on the element.

Table 3–2. Supernatant Results

Analyte	Analytical Method*	Units	Result	RSD†
Bromide	IC	M	<0.02	NA
Chloride	IC	M	<0.008	NA
Fluoride	IC	M	<0.02	NA
Formate	IC	M	<0.006	NA
Nitrate	IC	M	0.529	0.7%
Nitrite	IC	M	1.04	1%
Oxalate	IC	M	0.014	2%
Phosphate	IC	M	<0.003	NA
Sulfate	IC	M	0.023	1%
Carbonate	TIC	M	0.124	9%
Free OH	Titr.	M	0.855	4%
Hg	CVHG	mg/L	195	9%
Cs-137	γ-scan	dpm/mL	5.67E+08	3%
Al	ICPES	M	0.195	0.5%
B	ICPES	M	4.27E-03	0.3%
Ca	ICPES	M	1.92E-05	19%
Cr	ICPES	M	6.40E-04	0.6%
Fe	ICPES	M	4.49E-05	12%
K	ICPES	M	0.0122	1%
La	ICPES	M	5.14E-06	6%
Li	ICPES	M	4.26E-04	23%
Mo	ICPES	M	3.00E-04	3%
Na	ICPES	M	3.15	0.3%
P	ICPES	M	1.48E-03	4%
S	ICPES-S	M	0.0305	0.7%

*IC = ion chromatography; TIC = total inorganic carbon (all inorganic carbon is assumed to be carbonate); Titr. = titration; ICPES = inductively coupled plasma-electron spectroscopy; ICPES-S = ICPES for sulfur: CVHG = cold vapor atomic absorption for mercury; γ-scan = gamma scan

† RSD = relative standard deviation with number of measurements (n) = 4.

3.3 Slurry Oxalate

Sodium oxalate solubility increases significantly as aqueous sodium concentration decreases.[3] To determine total oxalate, the sodium concentration in slurry was decreased by diluting slurry aliquots with water. Two dilutions were done: a 3x and a 50x (nominal). The aqueous phases of the dilutions were then submitted to SRNL-AD for oxalate quantification by IC. The SRNL-AD results and slurry dilution factors were then used to calculate oxalate concentration on a slurry basis. Results are presented in Table 3–3. The soluble oxalate in the as-received supernatant reported in Table 3–2 above corresponds to 950 mg oxalate per kg slurry. Thus, 90% of the oxalate in the as-received sample is insoluble. However, as shown by the 3x dilution (diluent Na concentration is comparable to the SB9 wash endpoint), most of the oxalate will become soluble as the wash endpoint is reached.

Table 3–3. Slurry Oxalate Concentration

Nominal Slurry Dilution	Oxalate Concentration (mg/kg slurry)	RSD†
3X	9,110	3%
50X	9,390	1%

† RSD = relative standard deviation with number of measurements (n) = 4.

3.4 Analysis of Total Solids

Presented in Table 3–4 are elemental analyses of the total dried solids of the Tank 51H sample. As described above, slurry was digested by both aqua regia and alkali fusion. Both digestions were submitted for RAD ICPES; aqua regia digestions were submitted for CVHG and ICPMS; and alkali fusions were submitted for SRNL-AD's γ-scan and PU238-241 methods. In addition to the slurry samples, reagent blanks and digestions of a reference glass were analyzed by RAD ICPES.[7] The results of the blanks and reference glass digestions were used in evaluating slurry results (as discussed below).

- The element Hg was determined from aqua regia digestions and SRNL-AD method CVHG.
- For the elements Al, Ba, Cr, Cu, Fe, Gd, Li, Mg, Mn, Ni, Sr, Ti, and Zn, both RAD ICPES from aqua regia and alkali fusions were used because there was no significant difference between the digestions.
- For Ca, results from the aqua regia digestion were used because the alkali fusion results were high in the reference glass digestion (likely due to a Ca impurity in the reagent chemicals).
- For Ce, the alkali fusion results were used. The results from the alkali fusions were almost ten times higher than the result from the aqua regia results. No Ce was detected in the reagent blank or the reference glass, thus, this high result, compared to the aqua regia result, is likely not due to reagent impurities. It is possible that the aqua regia digestion did not completely digest the Ce in the sludge.
- For Na and Zr, the aqua regia digestion results were used; alkali fusions utilize Na as a reagent and they are performed in Zr crucibles.
- For Si, results from the alkali fusion digestion were used because the aqua regia results were low in the reference glass digestion.
- Several elements were determined from RAD ICPMS results from aqua regia digestions. Rh was determined from mass 103. Ru was calculated from the sum of masses 101, 102, and 104. Pd was calculated from mass 105 and fission yield values from masses 105-108 and 110.[8] U was calculated from the sum of masses 233-236 and 238. Th was determined from mass 232.
- The remaining elements and those below detection limits were obtained from aqua regia digestions.

Table 3–4. Elemental Composition of Total (Dried) Solids

Element	Dig, Analytical Method*	wt% of Total Solids	RSD, n‡	Element	Dig, Analytical Method*	wt% of Total Solids	RSD, n‡
Ag	AR, ES	0.00572	4%, 4	Mo	AR, ES	0.0146	4%, 4
Al	AR/AF, ES	5.25	3%, 8	Na	AR, ES	25.1	2%, 4
B	AR, ES	0.0131	14% 4	Ni	AR/AF, ES	0.455	5%, 8
Ba	AR/AF, ES	0.03	5%, 8	P	AR, ES	0.120	1%, 4
Be	AR, ES	0.00085	1% 4	Pb	AR, ES	0.0209	14%, 4
Ca	AR, ES	0.613	2%, 4	Pd	AR, MS†	0.00116	6%, 4
Cd	AR, ES	0.00942	1% 4	Rh	AR, MS†	0.00528	4%, 4
Ce	AF, ES	0.105	12%, 4	Ru	AR, MS†	0.0299	6%, 4
Co	AR, ES	0.00512	1%, 4	S	AR, ES-S	0.303	4%, 4
Cr	AR/AF, ES	0.0651	6%, 8	Sb	AR, ES	<0.03	NA
Cu	AR/AF, ES	0.0227	3%, 8	Si	AF, ES	1.03	2%, 4
Fe	AR/AF, ES	10.6	2%, 8	Sn	AR, ES	<0.008	NA
Gd	AR/AF, ES	0.0428	11%, 8	Sr	AR/AF, ES	0.0135	4%, 8
Hg	AR, CVHG	1.88	1%, 4	Th	AR, MS†	0.467	4%, 4
K	AR, ES	0.162	8%, 4	Ti	AR/AF, ES	0.0195	5%, 8
La	AR, ES	0.0140	2%, 4	U	AR, MS†	1.83	3%, 4
Li	AR/AF, ES	0.0435	4%, 8	V	AR, ES	<0.0003	NA
Mg	AR/AF, ES	0.128	7%, 8	Zn	AR/AF, ES	0.0178	3%, 8
Mn	AR/AF, ES	3.47	4%, 8	Zr	AR, ES	0.0284	5%, 4

* Dig, Analytical Method: AR=Aqua Regia; AF=Alkali Fusion; ES= ICPES; ES-S=ICPES-S; MS=ICPMS; CVHG=cold vapor atomic absorption for mercury

†.For the elements quantified by MS: Rh is determined from mass 103; Ru is calculated by summing masses 101, 102, and 104; Pd is calculated from mass 105 and fission yields from masses 105-108 and 110; Th is determined from mass 232; and U is calculated from the sum of masses 233-236 and 238.

‡ RSD = relative standard deviation; n = number of replicates.

Gamma scan, ICPMS, and alpha counting were used to quantify Cs-137, and the isotopes of uranium and plutonium. Those results are presented in Table 3–5. Cs-137 was determined from gamma scan. U-233, U-235, U-238, and Pu-239 were determined from ICPMS. Pu-238 was quantified by alpha counting. Pu-241 was determined from liquid scintillation counting. Pu-240 was calculated from the difference of alpha counting result (the sum of Pu-239 and Pu-240) and the ICPMS Pu-239 result.

Table 3–5. Cs-137, Uranium Isotopes, and Pu Isotopes

Isotope	Result	RSD†
Cs-137 (dpm/g of total solids)	2.54E+09	3%
U-233 (Wt% of Total Solids)	4.27E-04	4%
U-235 (Wt% of Total Solids)	2.62E-02	4%
U-238 (Wt% of Total Solids)	1.80E+00	3%
Pu-238 (Wt% of Total Solids)	4.41E-04	7%
Pu-239 (Wt% of Total Solids)	3.82E-03	3%
Pu-240 (Wt% of Total Solids)	2.33E-04	NA
Pu-241(Wt% of Total Solids)	1.66E-05	9%

† RSD = relative standard deviation with number of measurements (n) = 4.

3.5 Calculation of Wt% Calcined Solids

Based on previous experience, a direct measurement of wt% calcined solids may not be possible with a high sodium sample such as this Tank 51H material. Also, the calcining furnace in the Shielded Cells is temporarily not functional. Instead, the wt% calcined solids is calculated. First, the elements detected at greater than 0.1 wt% from Table 3–4, with the exception of Hg, were converted to oxides and summed (see Table 3–6). In this calculation, it is assumed that these elements are converted to oxides and all Hg and anions such as nitrite, nitrate, and hydroxide are driven off in the calcining process. Therefore, this sum represents the mass of oxides (calcined solids) in 100 g of total dried solids. The sum was then used to calculate the wt% calcined solids (slurry basis):

$$\frac{72.3\ g\ oxides}{100\ g\ total\ dried\ solids} \times \frac{27.4\ g\ total\ dried\ solids}{100\ g\ slurry} \times 100 = 19.8\%$$

Table 3–6. Elements to Oxides Conversion

Element	Wt% of Total Solids	Oxide	El. to Oxide Conv.*	Oxide (wt% of total solids)
Al	5.246	Al_2O_3	1.8895	9.91
Ca	0.613	CaO	1.3992	0.858
Ce	0.105	Ce_2O_3	1.1713	0.123
Fe	10.6	Fe_2O_3	1.4297	15.1
K	0.162	K_2O	1.2046	0.195
Mg	0.128	MgO	1.6583	0.212
Mn	3.47	MnO	1.5825	5.48
Na	25.1	Na_2O	1.3480	33.8
Ni	0.455	NiO	1.2726	0.579
P	0.120	P_2O_5	2.2914	0.275
S	0.303	SO_4	2.9959	0.907
Si	1.03	SiO_2	2.1393	2.19
Th	0.467	ThO_2	1.1379	0.531
U	1.83	U_3O_8	1.1792	2.16
			Total	**72.3**

* The Element to Oxide Conversion factor (El. to Oxide Conv), also known as the gravimetric factor, is the ratio of the mass of the oxide to the mass of the element in that oxide.

4.0 Recommendations

The results of this characterization are comparable to projections (see Tank Farm planning spreadsheet SB9_072115.xlsm), suggesting the as received sample is representative of Tank 51H. Therefore, it is recommended that SRNL proceed with SB9 qualification using this sample. See Table 4–1 for a comparison between projections and measurements for several analyses.

Table 4–1. Comparison Between Tank Farm Projections and Measurements for the Tank 51 SB9 Qualification Sample

	Projection	Measurement	Difference
Wt% Insoluble Solids	10.77	12.3	14%
Wt% Total Solids	26.33	27.4	4%
Supernatant Density (g/mL)	1.118	1.14	2%
Sodium (M)	2.944	3.15	7%
Nitrite (M)	1.059	1.04	-2%
Nitrate (M)	0.517	0.529	2%
Free Hydroxide (M)	0.956	0.855	-11%

Difference = (Measurement – Projection) / Projection x 100

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John Pareizs
Entered on
09/28/2015

Generic Approval Routing

Tracking Number
GenAppr-2015-00024
Status: Approved

Title SRNL-STI-2015-00442, Revision 0 - Characterization of the As-Received Sludge Batch 9 Qualification Sample (HTF-51-15-81),

Attachments

SRNL-STI-15-442 Rev 0.docx

Approval Routing: Approved on 10/15/2015

Approvers	Title	Assigned	Received	Status Changed	Status
Michael Stone	Manager, PTP	10/07/2015 04:20:29 PM	10/08/2015 08:24:22 PM	10/08/2015 08:26:06 PM	Approved
John Pareizs	Author	10/07/2015 04:20:29 PM	10/07/2015 04:35:00 PM	10/13/2015 02:50:07 PM	Approved
David Newell	Technical Reviewer	10/07/2015 04:20:29 PM	10/13/2015 02:32:49 PM	10/13/2015 02:33:16 PM	Approved
A Fellinger	Manager, ERPS	10/07/2015 04:20:29 PM	10/07/2015 04:27:01 PM	10/15/2015 10:45:01 AM	Approved
Maria Rios-Armstrong	Customer - Tank Farm	10/07/2015 04:20:29 PM	10/07/2015 04:26:34 PM	10/08/2015 03:43:44 PM	Approved
Helen Boyd	Customer - DWPF	10/07/2015 04:20:29 PM	10/08/2015 08:34:46 AM	10/08/2015 10:07:54 AM	Approved
Eric Freed	SRR Saltstone/DWPF Eng	10/07/2015 04:20:29 PM	10/07/2015 04:33:24 PM	10/08/2015 11:57:32 AM	Approved
John Contardi	SRR-Tank Farm Eng	10/07/2015 04:20:29 PM	10/07/2015 04:23:06 PM	10/07/2015 04:23:13 PM	Approved
Richard Edwards	SRR-NS&EI	10/07/2015 04:20:29 PM	10/13/2015 11:39:33 AM	10/13/2015 11:41:42 AM	Approved

Previous Process - Approval Routing: Denied on 09/29/2015

Approvers	Title	Assigned	Received	Status Changed	Status
Michael Stone	Manager	09/28/2015 05:07:01 PM	09/28/2015 05:08:11 PM	-	-
John Pareizs	Author	09/28/2015 05:07:01 PM	09/28/2015 05:27:01 PM	09/29/2015 08:05:54 AM	Denied
David Newell	Technical Reviewer	09/28/2015 05:07:01 PM	09/29/2015 07:54:11 AM	09/29/2015 08:01:58 AM	Approved
A Fellinger	Customer	09/28/2015 05:07:01 PM	-	-	-
Maria Rios-Armstrong	Customer Manager	09/28/2015 05:07:01 PM	09/28/2015 05:07:21 PM	-	-
Helen Boyd		09/28/2015 05:07:01 PM	-	-	-
Eric Freed		09/28/2015 05:07:01 PM	09/29/2015 06:09:41 AM	-	-
John Contardi		09/28/2015 05:07:01 PM	09/29/2015 05:33:20 AM	-	-
Richard Edwards		09/28/2015 05:07:01 PM	09/29/2015 07:55:32 AM	-	-

Reviewers

Name	Date Time	Action
John Pareizs	9/29/2015 8:41:02 AM	Reviewed