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Subject Matter Expert	WRPS 222-S Laboratory	08/07/2013	William S. Callaway / W. S. Callaway 8/7/2013
Responsible Manager	WRPS 222-S Laboratory	08/07/2013	Gary A. Cooke / Gary A. Cooke 8/7/2013
Other: J. M. Frye	WRPS Organic Studies	09/23/2013	For Gary M. Seidel JMF- IDMS

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Results of Characterization and Retrieval Testing on Tank 241-C-110 Heel Solids

W. S. Callaway
Washington River Protection Solutions

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SUMMARY

Nine samples of heel solids from tank 241-C-110 were delivered to the 222-S Laboratory for characterization and dissolution testing. After being drained thoroughly, the sample solids were primarily white to light-brown with minor dark-colored inclusions. The maximum dimension of the majority of the solids was <2 mm; however, numerous pieces of aggregate, microcrystalline, and crystalline solids with maximum dimensions ranging from 5-70 mm were observed. In general, the larger pieces of aggregate solids were strongly cemented.

Natrophosphate [$Na_7F(PO_4)_2 \cdot 19H_2O$] was the dominant solid phase identified in the heel solids. Results of chemical analyses suggested that 85-87 wt% of the heel solids were the fluoride-phosphate double salt. The average bulk density measured for the heel solids was 1.689 g/mL; the reference density of natrophosphate is 1.71 g/mL.

Dissolution tests on composite samples indicate that 94 to 97 wt% of the tank 241-C-110 heel solids can be retrieved by dissolution in water. Dissolution and recovery of the soluble components in 1 kg (0.59 L) of the heel solids required the addition of ≈9.5 kg (9.5 L) of water at 15 °C and ≈4.4 kg (4.45 L) of water at 45 °C.

Calculations performed using the Environmental Simulation Program[1] indicate that dissolution of the ≈0.86 kg of natrophosphate in each kilogram of the tank 241-C-110 heel solids would require ≈9.45 kg of water at 15 °C and ≈4.25 kg of water at 45 °C. The slightly larger quantities of water determined to be required to retrieve the soluble components in 1 kg of the heel solids are consistent with that required for the dissolution of solids composed mainly of natrophosphate with a major portion of the balance consisting of highly soluble sodium salts.

At least 98% of the structural water, soluble phosphate, sodium, fluoride, nitrate, carbonate, nitrite, sulfate, oxalate, and chloride in the test composites was dissolved and recovered in the dissolution tests. Most of the ^{99}Tc and ^{137}Cs present in the initial heel solids composites was removed in the water dissolution tests. The estimated activities/weights of ^{129}I, ^{234}U, ^{235}U, ^{236}U, and ^{238}U in the dry residual solids were <25% of the weights/activities in the initial composite solids.

Gibbsite and nordstrandite [both $Al(OH)_3$] were the major solid phases identified in the solids remaining after completion of the dissolution tests. Chemical analysis indicated that the residual solids may have contained up to 62 wt% $Al(OH)_3$. Significant quantities of unidentified phosphate-, iron-, bismuth-, silicon-, and strontium- bearing species were also present in the residual solids. The reference density of gibbsite (and nordstrandite) is 2.42 g/mL. The measured density of the residual solids, 2.65 g/mL, would be a reasonable value for solids containing gibbsite as the major component with minor quantities of other, higher density solids.

[1] OLI Systems, Inc., Morris Plains, New Jersey.

Sieve analysis indicated that 22.2 wt% of the residual solids were discrete particles >710 µm in size, and 77.8 wt% were particulates <710 µm in size. Light-scattering measurements suggested that nearly all of the <710-µm particulates with diameters >12 µm were weakly bound aggregates of particles with diameters <2 µm.

The <710-µm residual solids settled very slowly when dispersed in reagent water. The physical appearance of a suspension containing ≈0.4 vol% of the solids in pure water changed very little over a period of 46.5 hours.

It should be noted that the distribution of particle sizes in the residual solids and the observed settling behavior were both strongly influenced by the procedures followed in the dissolution tests.

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LIST OF TERMS

Abbreviations and Acronyms

222-S	WRPS 222-S Laboratory
η	viscosity
k	extinction coefficient
λ	wavelength
A	acid digestion sample preparation identifier
AEA	alpha energy analysis
ATL	Advanced Technologies and Laboratories International, Inc.
C-110	single-shell waste tank 241-C-110
C-Liq	centrifuged [supernatant] liquid
C-Slds	centrifuged solids
d	particle diameter
d##	particle diameter at a specified (##) %-undersize cut point
D_{Bulk}	bulk density, i.e., the overall density of a sample including solids, liquids, and occluded void space.
D_{Liq}	density of a liquid
D_{Sld}	density of a solid
DSR	data summary report
ESP	Environmental Simulation Program (OLI Systems, Inc., Morris Plains, NJ)
F	fusion sample preparation in nickel crucible identifier
GEA	gamma energy analysis
HISI	Hanford Information System Inventory
IC	ion chromatography
I&C	WRPS Integration and Control group in the 222-S Laboratory
ICP-AES	inductively coupled plasma-atomic emission spectrometry
ICP-MS	inductively coupled plasma-mass spectrometry
n	real refractive index
N	complex refractive index
PLM	polarized light microscopy
PSD	particle size distribution
RPD	relative percent difference
RRI	relative refractive index
SEM/EDX	scanning electron microscopy/energy dispersive X-ray spectrometry
SPC	solid phase characterization
SpG	specific gravity
TGA	thermogravimetric analysis
TIC	total inorganic carbon
TOC	total organic carbon
ΔTOC	adjusted total organic carbon value
TSAP	tank sampling and analysis plan
V_{Stokes}	Stokes' settling velocity

Abbreviations and Acronyms (continued)

vol	volume
W	water leach sample preparation identifier
wt	weight
Δwt%	measured change in wt%
XRD	powder X-ray diffraction or diffractometry
Z	fusion sample preparation in zirconium crucible identifier

Units

°C	degrees Celsius
cm	centimeter
cm^2/cm^3	square centimeters per cubic centimeter (surface area per unit volume or specific surface of a population of particles)
cm/s	centimeters per second
cm/s^2	centimeters per second per second
cm^2/cm^3	square centimeters per cubic centimeter (specific surface area)
ft^3	cubic feet
g	acceleration due to gravity
g	gram(s)
g/cm^3	grams per cubic centimeter
g/cm·s	grams per centimeter second (Poise)
g/mL	grams per milliliter
hr(s)	hour(s)
in.	inch(es)
kg	kilogram(s)
kHz	kilohertz
L	liter(s)
µCi/g	microcuries per gram
µg/g	micrograms per gram
µg/mL	micrograms per milliliter
µm	micrometer
min	minute(s)
mL	milliliter(s)
mL/s	milliliters per second
mm	millimeter(s)
nm	nanometer(s)
oz	ounce (U.S. liquid)
rpm	revolution(s) per minute
s	second(s)
vol%	volume percent
W	watt(s)
wt%	weight percent
w/w	weight for weight

1.0 INTRODUCTION

In 2009, waste retrieval from single-shell tank 241-C-110 (C-110) using modified sluicing was completed. An estimated 17,200 U.S. liquid gallons (≈2,300 ft^3) of waste, primarily heel solids, remained in the tank after completion of the retrieval operations. This residual waste volume exceeded the residual waste volume requirements found in the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989): <360 ft^3 (≈2,700 U.S. liquid gallons) for 100 series single-shell tanks.

A tank sampling and analysis plan (TSAP) directing retrieval of samples of the residual waste in C-110 was issued in June 2010 (RPP-PLAN-46196, Tank *Sampling and Analysis Plan for Waste Solids in Tank 241-C-110*) and modified in October 2010 (Characterization Change Notice 10-CCN-11 issued October 12); in November 2010 (Characterization Change Notice 10-CCN-13 issued November 19); and in January 2011 (Characterization Change Notice 11-CCN-01 issued January 10). (The Characterization Change Notices are attached to the analytical report issued by Advanced Technologies and Laboratories International, Inc. [ATL], RPP-RPT-48654, *Final Report for the Analysis of Waste Solids in Tank 241-C-110*.) Additional modifications/guidance were provided by verbal direction in meetings with the client(s) on July 14, December 6, and December 17, 2010, and January 6 and February 14, 2011. The final TSAP directed that a test program be developed to provide data needed to evaluate retrieval technologies that could be used to remove more of the residual heel solids from C-110. At a minimum, the test program was required to produce the following information:

- The chemical and radiochemical composition of the C-110 heel solids
- The bulk density of the heel solids
- The mineralogical properties (i.e., the solid phase composition) of the heel solids
- The strength of grain adhesion in solid aggregates if present
- The rate of dissolution of the heel solids in water at temperatures ranging from 15 to 45 °C
- The amount of heel solids retrievable by addition(s) of water to the heel solids at temperatures ranging from 15 to 45 °C
- If a significant portion of the heel solids are not water soluble, the additional amount retrievable by addition of 50 wt% caustic at ≈25 °C
- The chemical and radiochemical composition of any solids remaining at the end of the dissolution test(s)
- The bulk density of any residual solids
- The particle size distribution in any residual solids
- The settling behavior of any residual solids in water

A laboratory test plan presenting a strategy to acquire the required information was issued in October 2010 (LAB-PLN-10-00011, *Test Plan for Tank 241-C-110 Heel Solids Characterization and Dissolution Testing*). The test plan was prepared by members of the Integration and Control group (I&C) at the 222-S Laboratory (222-S) and was reviewed and approved by the client(s).

2.0 TEST SAMPLES

2.1 TANK SAMPLES

Tank C-110 went into service in 1947 and was declared inactive in 1976. During its service life, the tank was used to store waste from several sources including the Bismuth Phosphate and Uranium Recovery processes, evaporator bottoms, ion exchange waste, and organic wash waste from the Plutonium-Uranium Extraction process. The tank was declared interim stabilized in May 1995.

Over the period from September 22, 2008 to April 27, 2009, ≈161,000 gallons of the waste in C-110 were transferred to a double-shell tank using modified sluicing. Post-sluicing videos showed that the remaining 17,200 gallons of "heel" solids covered nearly the entire bottom of the tank and extended part way up the tank knuckle. The solids were light in color and appeared to consist primarily of sand-like solids with some coarser material intermixed. Relatively little waste solids were observed on the tank walls and stiffener rings. A pool of liquid surrounded the slurry pump in the center of the tank and extended to the north and south sides of the tank where the sluicers were located (RPP-PLAN-46196).

On September 10 and 12 of 2010, nine samples of the post sluicing waste in C-110 were collected using the Off-Riser Sampling System. The samples were transferred to the 222-S 11A hot cells on September 12 and 13. The samples were collected in 250-mL fluoro-polymer sample bottles. Photographs and qualitative descriptions of the "as-received" samples are included in the ATL analysis report (RPP-RPT-48654).

2.2 DRAINABLE LIQUIDS COMPOSITE

On November 4-10, 2010, free liquid was removed from six of the nine C-110 heel samples and combined in a drainable liquid composite. Samples 10C-10-1, -3, -4, -7, -8, and -9 contained drainable liquid. Fine solids that were removed with the liquids were separated by centrifugation and returned to the parent samples. Approximately 145 g of clear, light-yellow liquid was transferred to Jar 20515; the liquid composite was assigned sample number S10R000352. No drainable free liquid was present in samples 10C-10-2, -5, and -6.

2.3 INITIAL HEEL SOLIDS COMPOSITES

The "as-received" heel solids samples were generally described as white/light-brown/brown saltcake-like solids with dark-colored inclusions. Observable maximum dimensions of the majority of the solid grains in the samples were ≤ 5 mm; however, numerous pieces of aggregates and monolithic solids with maximum dimensions ranging from 5-70 mm were also observed.

On November 9-10, 2010, at client direction, two composites of the drained, C-110 heel solids were prepared. For Composite 1-2 (S10T005970), all the solids in the following samples were transferred to a 600-mL container:

C-110 Heel Solids Composite 1-2	
Sample	**Wt to Composite**
10C-10-2	151.08 g
10C-10-5	252.09 g
10C-10-6	191.53 g
Total	594.70g

For Composite 3-4 (S10T007055), the following sample portions were transferred to a 600-mL container:

C-110 Heel Solids Composite 3-4	
Sample	**Wt to Composite**
10C-10-1	107.15 g
10C-10-3	105.01 g
10C-10-4	107.90 g
10C-10-7	105.47 g
10C-10-8	105.61 g
10C-10-9	109.32 g
Total	640.46 g

An attempt was made to transfer portions of sample solids that were representative of the range of observable grain sizes in the heel solids samples. Where this was not possible due to the presence of large pieces of solids, the composites were intentionally biased to containing the large-dimension solids from the samples.

The solids in both composites were mixed by stirring with a spatula. A 430.1-g portion of Composite 1-2 was transferred to a separate container and identified as Composite 1 (S10R000353); the remaining solids were identified as Composite 2 (S10T005972). A 430.5-g portion of Composite 3-4 was transferred to a separate container and identified as Composite 3 (S10R000358); the remaining solids were identified as Composite 4 (S10T007060). In the subdivision of Composites 1 and 2 and Composites 3 and 4, an attempt was again made to representatively subsample solids of all grain sizes and types. Where necessary and to the minimum degree required, large or visually unique pieces of solids were broken with a mortar and pestle to facilitate representative sampling.

The containers holding heel solids Composite 1 and Composite 3 were closed and set aside. These materials were used in the large-scale water dissolution tests discussed in Section 5.0.

The solids in Composite 2 were semi-homogenized. Large pieces of solids were crushed/ground in a mortar and pestle. The combined solids were then comminuted further using a tissue homogenizer. Subsamples S10T005975, -5976, and -5977 of the homogenized solids were collected and transferred to 222-S for chemical and radiochemical analysis (RPP-RPT-48654). Two additional subsamples were collected and transferred to I&C personnel for testing:

S10R000354 (3.4 g) for solid phase characterization (SPC), and S10R000355 (10.8 g) for a preliminary dissolution test (Section 3.5).

The solids in Composite 4 were processed in the same manner as those in Composite 2. Subsamples S10T007067, -7068, and -7070 of the homogenized solids were collected and transferred to 222-S for chemical and radiochemical analysis (RPP-RPT-48654). Subsamples S10R000362 (3.0 g) and S10R000363 (10.5 g) were collected and transferred to I&C personnel for SPC and preliminary dissolution tests, respectively.

2.4 FINAL HEEL SOLIDS COMPOSITES

As the goals and requirements for this test program were refined, the need for three composites derived from the four initial heel solids composites was established.

2.4.1 Homogenized Solids Composite

In mid-January 2011, all the homogenized solids remaining in Composite 2 (≈99 g) and Composite 4 (≈147 g) were combined and mixed by stirring with a spatula. The combined, homogenized, heel solids composite was assigned sample number S11T000760. The solids in this composite were used in the small-scale water dissolution tests discussed in Section 4.0.

2.4.2 Large-scale Dissolution Test Composites

On February 24, 2011, 426.66 g of unhomogenized solids from Composite 1 and 419.70 g of unhomogenized solids from Composite 3 were recombined to form composite sample S11T002253. Photographs of the Composite 1 and Composite 3 solids before combining are shown in Figure 2-01. The recombined solids were mixed by stirring with a spatula and then split into two new composites: the 15 °C Composite (S11R000119) and the 45 °C Composite (S11R000120). To the degree possible, both new composites were equally representative of the grain sizes and types present in Composites 1 and 3. It was necessary to break two large pieces of aggregate from Composite 1 (Figure 2-01a) in half (approximately) to make the two composites as similar as possible. Immediately after preparation, the 15 °C Composite weighed 413.58 g and the 45 °C Composite weighed 416.35 g. These two composites were used in the large-scale water dissolution tests discussed in Section 5.0.

Figure 2-01. Heel Solids Composite 1 and Composite 3.

[Sample trays are 17.5 cm (6.9 in.) in diameter]

(a) C-110 Composite 1	(b) C-110 Composite 3

3.0 ANALYSIS OF TANK 241-C-110 TEST COMPOSITES

3.1 SOLID PHASES IN INITIAL COMPOSITES

Subsamples S10R000354 and S10R000362 were taken from homogenized heel solids Composites 2 and 4, respectively, and submitted for SPC to identify the solid phases present. Powder X-ray diffraction (XRD), polarized light microscopy (PLM), and scanning electron microscopy/energy dispersive X-ray spectrometry (SEM/EDX) techniques were used. The results of the SPC measurements are presented in detail in LAB-RPT-11-00008, *Solid Phase Characterization of Heel Samples from Tank 241-C-110*.

The SPC measurements indicated that the homogenized solids from the two initial heel solids composites had essentially the same solid phase composition. Natrophosphate [$Na_7F(PO_4)_2 \cdot 19\ H_2O$] was the dominant solid phase in both samples and was the only phase identified by XRD. The presence of minor quantities of gibbsite [$Al(OH)_3$], nastrophite [$NaSr(PO_4) \cdot 9\ H_2O$], and some unidentified solids was indicated by PLM and SEM/EDX analyses. The XRD patterns did not indicate that the samples contained significant amounts of amorphous or very fine-grained (<10 µm) solids.

Subsamples S10R000375 (Composite 2) and S10R000378 (Composite 4) were taken from samples of the homogenized heel solids that had been through preliminary water dissolution tests (Section 3.5) and submitted for SPC measurements. Again, the SPC examinations indicated that the two initial composites had essentially the same solid phase composition. Following the removal of a significant portion of water soluble solids, SEM/EDX indicated the presence of minor/trace quantities of cancrinite [$(Na_8(Al_6Si_6O_{24})(CO_3) \cdot 2\ H_2O$], sodium diuranate ($Na_2U_2O_7$), Na-Al-phosphate solids, Fe-oxide solids, Fe-Bi-phosphate solids, and Bi-rich solids in the composite heel solids in addition to the minor phases previously identified.

3.2 CRUSH TESTING

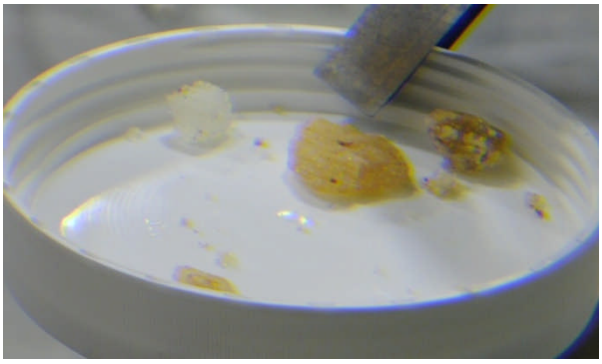
As was noted in Section 2.3, preparation of the initial, homogenized heel solids composites began by crushing larger pieces of aggregate and monolithic solids in a mortar and pestle. During this process, larger pieces of solids that represented all the visually distinct types of solids in the samples were selected, and the relative ease with which the solids were crushed was noted. This entirely qualitative test was intended to indicate whether larger pieces of the heel solids were weakly-cemented agglomerates/aggregates that were easily broken up or strongly-cemented aggregates and/or monolithic solids. The term “crushed” is used in absence of any strength testing that would address this question more quantitatively.

Two large pieces of solids were clearly visible in the photograph of the Composite 1 solids in Figure 2-01a. Photographs of other representative pieces of the large solids are shown in Figure 3-01.

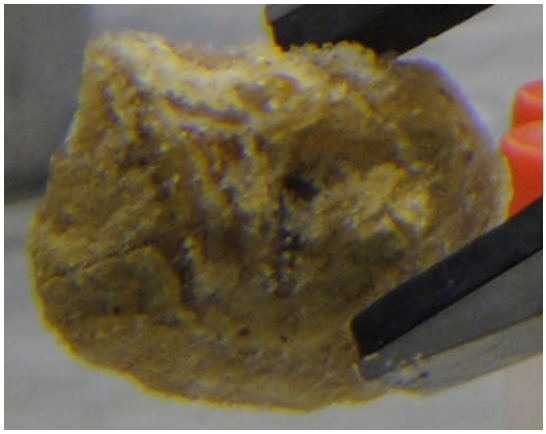
Figure 3-01. Representative Pieces of Solids Selected for Crush Testing.

(a) Large crystalline solid from Sample 10C-10-05A
(Inside diameter of jar is 6 cm)

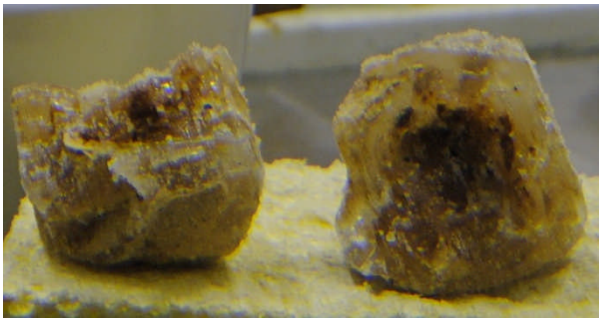
(b) Miscellaneous solids from Composite 3-4
(Cap is 12 cm in diameter)



(c) Largest solid piece received before fracture
(Manipulator fingers are 1.6 cm wide across back)



(d) Fractured solid piece from (c)



The larger pieces of solids in the C-110 heel solids samples (largest dimensions greater than ≈5 mm) were of four general types. Results of crush testing on solids of each type can be summarized as follows:

Test Solid	Crushability
Irregularly shaped solid with light-tan to light-brown exterior. Piece tested had largest dimension of nearly 7 cm (Figure 3-01c).	Fractured with gentle hammering with pestle. Fracture surface revealed brown/red, fine-grained, aggregate core surrounded by a clear, monolithic shell. (Figure 3-01d).
Irregularly shaped aggregate with dark brown/red exterior. Piece tested had largest dimension of 1.5 cm.	Crushed with moderate to strong pressing force with pestle. Crushed solids very similar to dominant fine-grained solids in composites in color and texture.
White to ivory colored solid without clearly visible facets. Piece tested was ≈1 cm in size.	Required gentle to moderate hammering with pestle to crush. Broke into clear shards with minor purple/brown coloration. No aggregate structure visible before or after crushing.
Tan-to-white solid with distinct crystal facets. Tested piece was clearly octahedral in shape with largest dimension of ≈2 cm (Figure 3-01a).	Required moderate to extreme hammering to crush into clear, colorless shards. Appeared to be a monolithic crystalline solid.

In general, the larger pieces of solids in the samples of the C-110 heel received were strongly cemented aggregates, microcrystalline, or crystalline solids. Solid phase characterization indicated that the octahedral crystals with dimensions up to ≈2 cm were natrophosphate.

3.3 LABORATORY ANALYSES

3.3.1 Drained Liquid and Initial Solids Composites

Samples of the drained liquid composite (S10R000352), Composite 2 (S10T005972), and Composite 4 (S10T007060) were submitted to 222-S for analysis. Analyses of the Composite 2 and Composite 4 solids were performed for a related project, and the results are presented in detail in RPP-RPT-48654. Those results are summarized here. Analysis of the drained liquid composite was performed as part of this test program. Transcripts of the data summary report presenting the results of the drained liquid analyses are presented in Attachment A.

The results of the physicochemical analyses of the drained liquid and heel solids composite samples are summarized in Table 3-01. Except for priority analytes, analytes for which the results of analyses of all test samples were reported as being less than the measurement detection limit have been omitted from the table. Where duplicate or repeat measurements were performed, average results are presented.

The results of radiochemical analyses performed on the initial heel solids composites (from RPP-RPT-48654) are summarized in Table 3-02. No radiochemical analyses were performed on the drained liquid composite.

The left-most entry for each analyte for each composite indicates the type of sample preparation used prior to the analytical measurement. The sample preparation codes used here and in all the results tables in this report are:

	Analysis of an unaltered portion of sample
(W)	Analysis of a liquid specimen prepared by water leaching of a portion of the sample
(A)	Analysis of a liquid specimen prepared by acid digestion of a portion of the sample
(F)	Analysis of a liquid specimen prepared by dissolution of the product of an alkali-metal hydroxide fusion of a portion of the sample in a nickel crucible
(Z)	Analysis of a liquid specimen prepared by dissolution of the product of an alkali-metal hydroxide fusion of a portion of the sample in a zirconium crucible

In Table 3-01, total inorganic carbon (TIC) analytical results are recalculated as carbonate (CO_3) by multiplying by the gravimetric factor 4.996. Phosphorous and sulfur concentrations, determined by inductively coupled plasma-atomic emission spectrometry (ICP-AES), are recalculated as phosphate (PO_4) and sulfate (SO_4) by multiplying by gravimetric factors of 3.066 and 2.996, respectively.

Adjusted total organic carbon (TOC) values, ΔTOC, were calculated by subtracting the carbon equivalents of the reported formate, acetate, and oxalate concentrations from the reported TOC concentrations:

$$\Delta TOC = TOC - [(Formate) \times 0.2668] - [(Acetate) \times 0.4068] - [(Oxalate) \times 0.2729] \quad (3\text{-}1)$$

The magnitudes of contributions of water-insoluble organic component(s), water-soluble but unanalyzed organic component(s), and/or combined analytical errors to ΔTOC are unknown.

Table 3-01. Analyses of Drained Liquid and Initial Heel Solids Composites.

Analyte	Drained Liquid Composite			Homogenized Heel Solids Composite 2			Homogenized Heel Solids Composite 4		
Density		1.186	g/mL		—			—	
Temperature		25.7	°C		—			—	
SpG		1.195	—		—			—	
TGA <200 °C		79.51	wt%		45.49	wt%		48.02	wt%
TGA >200 °C		< 1.0	wt%		< 1.0	wt%		< 1.0	wt%
Wt Loss 95 °C		78.26	wt%		—			—	
TOC		1,030	µg/mL		143	µg/g		295	µg/g
ΔTOC		372	µg/mL		101	µg/g		188	µg/g
TIC		9,110	µg/mL		770	µg/g		1,920	µg/g
TIC as CO_3		45,515	µg/mL		3,847	µg/g		9,593	µg/g
pH		—			12.20	—		12.05	—
pH as OH		—			2,695	µg/g		1,908	µg/g
Formate		76.5	µg/mL	(W)	< 8.96	µg/g	(W)	< 0.911	µg/g
Acetate		231	µg/mL	(W)	< 11.6	µg/g	(W)	< 1.18	µg/g
Oxalate		1,990	µg/mL	(W)	154	µg/g	(W)	393	µg/g
Nitrite		28,000	µg/mL	(W)	1,980	µg/g	(W)	5,340	µg/g
Nitrate		57,700	µg/mL	(W)	3,910	µg/g	(W)	10,600	µg/g
Fluoride		1,510	µg/mL	(W)	25,600	µg/g	(W)	23,700	µg/g
Phosphate		16,300	µg/mL	(W)	239,000	µg/g	(W)	206,000	µg/g
Sulfate		7,240	µg/mL	(W)	1,590	µg/g	(W)	2,450	µg/g
Chloride		621	µg/mL	(W)	46.7	µg/g	(W)	127	µg/g
Sodium		81,700	µg/mL	(Z)	216,000	µg/g	(Z)	214,000	µg/g
Aluminum		583	µg/mL	(Z)	7,790	µg/g	(Z)	7,880	µg/g
Silicon		< 15	µg/mL	(Z)	< 1,550	µg/g	(Z)	< 1,510	µg/g
Phosphorus		5,900	µg/mL	(Z)	77,900	µg/g	(Z)	69,100	µg/g
P as Phosphate		18,090	µg/mL		238,855	µg/g		211,873	µg/g
Sulfur		2,790	µg/mL	(Z)	< 5,150	µg/g	(Z)	< 5,050	µg/g
S as Sulfate		8,359	µg/mL		< 15,429	µg/g		< 15,129	µg/g
Potassium		546	µg/mL		—		(Z)	—	
Calcium		< 25	µg/mL	(Z)	< 2,580	µg/g	(Z)	< 2,520	µg/g
Chromium		187	µg/mL	(Z)	< 258	µg/g	(Z)	< 252	µg/g
Manganese		< 1.5	µg/mL	(Z)	< 155	µg/g	(Z)	< 151	µg/g
Iron		202	µg/mL	(Z)	1,190	µg/g	(Z)	1,890	µg/g
Nickel		55.7	µg/mL	(Z)	< 1,030	µg/g	(Z)	< 1,010	µg/g
Strontium		117	µg/mL	(Z)	470	µg/g	(Z)	177	µg/g
Zirconium		4.82	µg/mL	(Z)	—		(Z)	—	
Molybdenum		10.7	µg/mL	(Z)	< 1,030	µg/g	(Z)	< 1,010	µg/g
Bismuth		76.9	µg/mL	(Z)	< 5,150	µg/g	(Z)	< 5,050	µg/g
Uranium		1,080	µg/mL	(Z)	< 5,150	µg/g	(Z)	< 5,050	µg/g

SpG = specific gravity; TGA = thermogravimetric analysis; TOC = total organic carbon; TIC = total inorganic carbon

Table 3-02. Radiochemical Analyses of Initial Heel Solids Composites.

Analyte	Homogenized Heel Solids					
	Composite 2			Composite 4		
Strontium-89/90	(Z)	3.18E+01	µCi/g	(Z)	1.21E+01	µCi/g
Technetium-99	(A)	1.56E-01	µg/g	(A)	3.45E-01	µg/g
Iodine-129		1.75E-06	µCi/g		5.59E-06	µCi/g
Cesium-137	(Z)	1.29E+00	µCi/g	(Z)	3.25E+00	µCi/g
Uranium-233	(Z)	< 1.03E-01	µg/g	(Z)	< 1.01E-01	µg/g
Uranium-234	(Z)	8.12E-03	µg/g	(Z)	1.31E-02	µg/g
Uranium-235	(Z)	9.90E-01	µg/g	(Z)	1.72E+00	µg/g
Uranium-236	(Z)	8.41E-03	µg/g	(Z)	8.32E-03	µg/g
Neptunium-237	(Z)	< 5.15E-02	µg/g	(Z)	< 5.05E-02	µg/g
Uranium-238	(Z)	1.41E+02	µg/g	(Z)	2.39E+02	µg/g
Plutonium-238	(Z)	< 1.53E-03	µCi/g	(Z)	< 3.41E-03	µCi/g
Plutonium-239/240	(Z)	2.00E-02	µCi/g	(Z)	5.52E-02	µCi/g
Americium-241	(Z)	8.99E-04	µCi/g	(Z)	2.35E-03	µCi/g

The SPC measurements discussed in Section 3.1 indicated that natrophosphate was the major solid phase present in the C-110 heel solids. The results of analyses for phosphate and fluoride by ion chromatography (IC) and phosphorus by ICP-AES indicated that the Composite 2 solids may have contained as much as 90-96 wt% natrophosphate and that the Composite 4 solids may have contained as much as 77-89 wt% natrophosphate.

3.3.1.1 Density of Drained Liquid Composite: The density of the drained liquid composite was measured in the 11A hot cells by filling and weighing a Class A, 100-mL, volumetric flask. The nominal tolerance for this glassware is ±0.08 mL at 20 °C. The temperature of the liquid was measured in the flask immediately after the final weighing was completed.

Measurements of specific gravity (SpG) were performed in 222-S at unknown temperature(s).

3.3.1.2 Total Dissolved Solids in Drained Liquid Composite: Total dissolved solids in the drained liquid composite was measured in the 11A hot cells by evaporating a 6.312-g sample to dryness at ≈95 °C. The measured value of 21.74 wt% was converted to 'Wt Loss 95 °C' to facilitate comparison with thermogravimetric analysis (TGA) measurements performed in 222-S.

3.3.1.3 pH of Heel Solids Samples: For pH measurements, 1-g portions of sample solids were mixed with 10 g portions of reagent water. The pH of the resultant liquid was measured and reported as the pH for the solid sample.

All pH measurement results in this report are converted to OH concentrations. For liquid samples, the OH concentration is calculated as:

$$OH\ \frac{\mu g}{mL} = \left[10^{(pH-14)}\right]\left(\frac{17.007\times10^{6}}{1}\frac{\mu g\ OH}{mole}\right)\left(\frac{1\ L}{1000\ mL}\right) \tag{3-2}$$

For solid samples, the concentration of soluble OH is calculated as:

$$OH\ \frac{\mu g}{g} = \left[10^{(pH-14)}\right]\left(\frac{17.007\times10^{6}}{1}\frac{\mu g\ OH}{mole}\right)\left(\frac{1\ L}{1000\ mL}\right)\left(\frac{10\ mL\ specimen}{1\ g\ solids}\right) \tag{3-3}$$

3.3.2 Large-scale Dissolution Test Composites

The initial unhomogenized solids Composite 1 lost 3.47 g to drying from November 9-10, 2010, when the Composite 2 homogenized solids were prepared, to February 24, 2011, when the 15 °C and 45 °C Composites were prepared for the large-scale dissolution tests (Section 5.0). The unhomogenized Composite 3 solids lost 10.83 g to drying over the same period.

The 15 °C Composite lost an additional 0.38 g before dissolution testing was initiated on February 25, 2011. The 45 °C Composite lost an additional 4.44 g to drying before dissolution testing was initiated on April 28, 2011. The large-scale dissolution test composites were not analyzed after they were prepared. In Table 3-03, the Composite 2 and Composite 4 data presented in Table 3-01 and the noted weight loss values have been combined to generate the calculated composition of the 15 °C and 45 °C Composites immediately before the start of the large-scale dissolution tests.

Natrophosphate was the dominant solid phase identified in the heel solids by SPC measurements. The concentrations of phosphate and phosphorus (as phosphate) presented in Table 3-03 suggest that as much as 84.9-86.8 wt% of the heel solids in the large-scale test composites were the fluoride-phosphate double salt. The ratio of phosphate to fluoride in natrophosphate is 10:1 w/w; the calculated ratios of phosphate to fluoride in the test composites are 9.0-9.1 suggesting that a small excess of fluoride (relative to that required to form only natrophosphate) may have been present in the heel solids samples.

Table 3-03. Calculated Compositions of 15 °C and 45 °C Dissolution Test Composites.

Analyte	Unhomogenized Heel Solids					
	15 °C Composite (02/25/11)			45 °C Composite (04/28/11)		
Density		1.681	g/mL		1.698	g/mL
Temperature		22.0	°C		21.9	°C
SpG		—			—	
TGA <200 °C		45.81	wt%		45.27	wt%
TGA >200 °C		< 1.0	wt%		< 1.0	wt%
Wt Loss 95 °C		—			—	
TOC		223	µg/g		225	µg/g
ΔTOC		147	µg/g		148	µg/g
TIC		1,369	µg/g		1,383	µg/g
TIC as CO_3		6,841	µg/g		6,909	µg/g
OH from pH		2,343	µg/g		2,366	µg/g
Formate	(W)	< 9	µg/g	(W)	< 9	µg/g
Acetate	(W)	< 12	µg/g	(W)	< 12	µg/g
Oxalate	(W)	278	µg/g	(W)	281	µg/g
Nitrite	(W)	3,726	µg/g	(W)	3,763	µg/g
Nitrate	(W)	7,386	µg/g	(W)	7,459	µg/g
Fluoride	(W)	25,089	µg/g	(W)	25,337	µg/g
Phosphate	(W)	226,462	µg/g	(W)	228,696	µg/g
Sulfate	(W)	2,056	µg/g	(W)	2,077	µg/g
Chloride	(W)	88	µg/g	(W)	89	µg/g
Sodium	(Z)	218,836	µg/g	(Z)	220,994	µg/g
Aluminum	(Z)	7,975	µg/g	(Z)	8,053	µg/g
Silicon	(Z)	< 1,550	µg/g	(Z)	< 1,550	µg/g
Phosphorus	(Z)	74,809	µg/g	(Z)	75,547	µg/g
as Phosphate		229,379	µg/g		231,642	µg/g
Sulfur	(Z)	< 5,150	µg/g	(Z)	< 5,150	µg/g
as Sulfate		< 15,429	µg/g		< 15,429	µg/g
Potassium	(Z)	—		(Z)	—	
Calcium	(Z)	< 2,580	µg/g	(Z)	< 2,580	µg/g
Chromium	(Z)	< 258	µg/g	(Z)	< 258	µg/g
Manganese	(Z)	< 155	µg/g	(Z)	< 155	µg/g
Iron	(Z)	1,568	µg/g	(Z)	1,583	µg/g
Nickel	(Z)	< 1,030	µg/g	(Z)	< 1,030	µg/g
Strontium	(Z)	329	µg/g	(Z)	332	µg/g
Zirconium	(Z)	—		(Z)	—	
Molybdenum	(Z)	< 1,030	µg/g	(Z)	< 1,030	µg/g
Bismuth	(Z)	< 5,150	µg/g	(Z)	< 5,150	µg/g
Uranium	(Z)	< 5,150	µg/g	(Z)	< 5,150	µg/g

3.4 BULK DENSITY

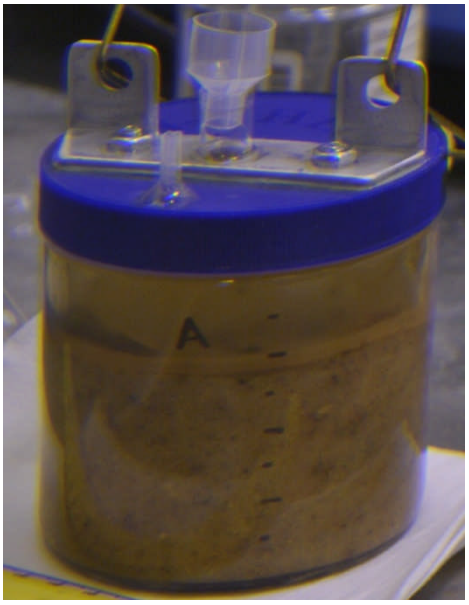
3.4.1 Bulk Density Measurements

The bulk density (D_{Bulk}) of the 15 °C and 45 °C Composites was measured by water displacement. In this report, D_{Bulk} is the density of a sample of subdivided solids including any interstitial and/or adsorbed liquids and any unpenetrated/occluded voids.

A special lid was fabricated for two wide-mouthed, 16-oz sample jars that allowed them to be consistently filled with liquid to a known volume (Figure 3-02a). This effectively converted the sample jars into pycnometers.

Figure 3-02. Measurement of Bulk Density of Dissolution Test Composites.

(a) 15 °C Composite before final filling



(b) Frothing during water addition to 45 °C Composite

The D_{Bulk} measurement was performed as part of the first water contact in the large-scale water dissolution test for each composite. The entire test composite was transferred to a pycnometer jar. The jar+lid+solids were then weighed. Portions of reagent water, cooled to 15 °C, were then added to the jar. As the water was added, the solids and water were periodically mixed gently with a spatula to ensure that significant volumes of air were not trapped in the solids. The pycnometer lid was then firmly attached and filling to the calibration mark completed. Immediately after the final weight of the filled pycnometer was recorded, the temperature of the D_{Bulk} liquid was measured by inserting a thermometer into the pycnometer jar.

As the 15 °C water was added to the sample solids during each D_{Bulk} measurement, a significant quantity of froth and small bubbles formed on the liquid surfaces (Figure 3-02b). A delay of approximately 1 hr was required before this frothing subsided sufficiently to allow the density measurements to be completed. As a result, the temperature of the D_{Bulk} liquid rose to 22 °C by the conclusion of each measurement.

3.4.2 Bulk Density of Heel Solids Samples

The weights of reagent water added to the heel solids composites were converted to volumes using the reference densities of water at the final D_{Bulk} measurement temperatures. The volumes of the composite solids were then calculated as the difference between the pycnometer jar volumes and the volumes of added water. The data recorded during the measurements and the calculated D_{Bulk} values follow.

15 °C Composite				
Wt pycnometer A	324.72	±	0.03	g
Wt (pycnometer + composite)	737.92	±	0.07	g
Wt composite solids	413.20	±	0.08	g
Wt (pycnometer + composite + H_2O)	964.83	±	0.10	g
Wt H_2O	226.91	±	0.12	g
Reference density of H_2O at 22.0 °C	0.997770			g/mL
Vol H_2O	227.42	±	0.12	mL
Vol pycnometer A	473.25	±	0.07	mL
Vol composite solids	245.83	±	0.14	mL
D_{Bulk} C-110 Heel Solids 15 °C Composite	1.681	±	0.001	g/mL

45 °C Composite				
Wt pycnometer B	323.56	±	0.03	g
Wt (pycnometer + composite)	735.45	±	0.07	g
Wt composite solids	411.90	±	0.08	g
Wt (pycnometer + composite + H_2O)	968.60	±	0.10	g
Wt H_2O	233.15	±	0.12	g
Reference density of H_2O at 21.9 °C	0.997793			g/mL
Vol H_2O	233.66	±	0.12	mL
Vol pycnometer B	476.30	±	0.07	mL
Vol composite solids	242.64	±	0.14	mL
D_{Bulk} C-110 Heel Solids 45 °C Composite	1.698	±	0.001	g/mL

The D_{Bulk} measured for the two portions of the large-scale dissolution composite are in good agreement. The average D_{Bulk} of the unhomogenized C-110 heel solids was 1.689 ± 0.008 g/mL at 22 °C. This value is close to the density of 1.71 g/mL reported for natrophosphate. This provides additional evidence that natrophosphate was the major solid phase present in the C-110 heel solids samples.

3.5 PRELIMINARY DISSOLUTION TESTS

As noted in Section 2.3, subsamples of the homogenized heel solids in Composites 2 and 4 were collected and used in preliminary dissolution tests to assist in finalizing the test parameters for the large-scale tests.

Approximately 10 g of each composite was transferred to a 50-mL centrifuge cone. A portion of reagent water approximately equal to two times the sample weight was then added to each cone. The cones were then sealed and placed on a Labquake®[2] Rotisserie mixer rotating at ≈8 rpm for 4 days. Hot cell ambient temperature during this period ranged from 25.7 to 27.5 °C.

After 4 days, the cones were centrifuged for 20 min at approximately 1000 × *g* and the centrifuged supernatant liquids (C-Liq) were decanted to separate containers. The centrifuged solids (C-Slds) were allowed to air-dry in the cones for 1 hr and then a final weight was recorded. The densities of the C-Liq were measured by filling and weighing a 10-mL, Class A volumetric flask. The total dissolved solids in the C-Liq were measured by evaporating ≈3-g portions of the samples to dryness at ≈85 °C.

The following gravimetric data was generated during the preliminary dissolution tests:

		Composite 2 Solids	Composite 4 Solids
Initial Sample Wt		10.777 g	10.533 g
Wt of water added		21.481 g	21.143 g
Decanted C-Liq:	Wt	21.854 g	22.774 g
	Density	1.060 g/mL	1.068 g/mL
	Dissolved Solids	1.44 g	1.69 g
		6.59 wt%	7.40 wt%
Final C-Slds:	Wt	10.192 g	8.735 g
	Wt lost	0.58 g	1.80 g
	Wt% lost	5.43 wt%	17.07 wt%

The test sample of Composite 4 solids was visibly wetter than the sample of Composite 2 solids. A significant portion of the greater weight loss recorded for the Composite 4 C-Slds is due to recovery of this additional moisture. The closer agreement of the quantity of dissolved solids in the C-Liq from the two tests supports this position.

Samples of the C-Liq from the Composite 2 (S10R000376) and Composite 4 (S10R000379) tests were submitted to 222-S for analysis. The analysis results are presented in Attachment A. As discussed in Section 3-1, samples S10R000375 and S10R000378 were taken from the final Composite 2 and Composite 4 C-Slds, respectively, and submitted for SPC measurements.

[2] Labquake is a registered trademark of Thermo Scientific, Dubuque, Iowa.

In Table 3-04, analytical concentration results have been converted into weights of key components in the starting samples of the homogenized heel solids and in the decanted C-Liq from the tests. The weights of the components in a portion of the drained liquid composite approximately equal in weight to the decanted C-Liq of the dissolution tests have been included for comparison.

Table 3-04. Analyses of Preliminary Dissolution Test Samples.

Analyte	(Units)	Liquid Composite	Composite 2		Composite 4	
			Initial Solids	C-Liq	Initial Solids	C-Liq
Total Wt	(g)	22.30	10.78	21.85	10.53	22.77
Total Vol	(mL)	18.80	—	20.62	—	21.32
Density	(g/mL)	1.186	—	1.060	—	1.068
Wt Loss <200 °C	(g)	17.45	4.90	20.41	5.06	21.09
Phosphate	(g)	0.31	(W) 2.58	0.62	(W) 2.17	0.62
Sodium	(g)	1.54	(Z) 2.33	0.56	(Z) 2.25	0.64
TIC as CO_3	(g)	0.86	0.04	0.05	0.10	0.11
Fluoride	(g)	0.03	(W) 0.28	0.06	(W) 0.25	0.07
Nitrate	(g)	1.08	(W) 0.04	0.03	(W) 0.11	0.10
Nitrite	(g)	0.53	(W) 0.02	0.02	(W) 0.06	0.05
Sulfate	(g)	0.14	(W) 0.02	0.01	(W) 0.03	0.02
Aluminum	(g)	0.01	(Z) 0.08	< 0.01	(Z) 0.08	0.01
Iron	(g)	< 0.01	(Z) 0.01	< 0.01	(Z) 0.02	< 0.01
SUM	(g)	21.94	10.30	21.77	10.13	22.70

The analysis results for the two C-Liq samples were quite similar suggesting that the two composites were very similar in composition. Only the weights of phosphate, fluoride, and water (represented by Wt Loss <200 °C) were greater in the decanted C-Liq samples than in the drained liquid composite. The ratios of phosphate to fluoride in the test C-Liq samples are 9.9-10.0 w/w, quite close to the stoichiometric ratio of 10:1 for natrophosphate. This suggests that dissolution of natrophosphate was the major cause in the reduction in mass of the homogenized heel solids test samples. Comparison of the analytical data for the initial solids and the decanted C-Liq samples suggests that 25-30 wt% of the natrophosphate in the homogenized composite solids was dissolved and recovered under the preliminary dissolution test conditions.

The weights of sodium, carbonate, nitrate, and nitrite in the decanted C-Liq samples were significantly smaller than in the drained liquid composite. This would be expected as undrained interstitial liquid, and very soluble evaporite salts left in the composite solids are diluted/dissolved and recovered in the dilution tests. The significantly smaller weights of phosphate and fluoride in the drained liquid composite, as compared with the test C-Liq samples, suggests that dissolution of natrophosphate from the composite solids is significantly inhibited by a sodium common ion effect.

4.0 SMALL-SCALE WATER DISSOLUTION TESTING

A small-scale water dissolution test series was performed January 20 – February 2, 2011. The small-scale tests were carried out to (a) ascertain the temperature sensitivity of the water solubility of the C-110 heel solids, and (b) to estimate dissolution rate(s) to finalize design of the large-scale dissolution tests.

4.1 SMALL-SCALE DISSOLUTION TESTS

As noted in Section 2.4.1, all the material remaining in the initial Composite 2 and Composite 4 homogenized solids were combined and mixed by stirring with a spatula. The heel solids in this composite (S11T000760) were used in the small-scale water dissolution tests. Samples of the homogenized heel solids composite were not submitted for laboratory analysis.

Small-scale dissolution tests were performed at three temperatures: 15 °C, hot cell ambient (≈28 °C), and 46 °C. For the 15 °C and 46 °C tests, ≈11-g portions of the homogenized heel solids were transferred to each of four 50-mL centrifuge cones. Five cones were prepared for the 28 °C test series.

A large volume of reagent water was chilled to 15 °C. One at a time, a 13-g portion of the chilled water was added to each of the 13 test cones. The contents of each cone were thoroughly mixed by shaking for 3 min and then the cone was centrifuged for 15 min. The clear supernatant C-Liq in each cone was then decanted off. The decanted wash liquids from all 13 cones were combined in a wash liquid composite (S11R000054).

For the 5 cones in the ambient temperature test series, a second portion of reagent water ≈3 times the initial weight of the test solids was added to each cone. The added water was at hot cell ambient temperature. The cone contents were thoroughly mixed by shaking for 3 min and then the cones were transferred to a rotisserie mixer and slow rotation was started. After 1 day (≈24 hrs), one of the test cones was removed from the mixer, shaken for 3 min, and then centrifuged for 15 min. The clear supernatant C-Liq was then decanted from the cone and the weights of the C-Liq and wet residual solids recorded. The density of the decanted liquid (D_{Liq}) was measured (Section 4.2.1). A portion of the C-Liq was then diluted 1:0.25 w/w (C-Liq:H_2O), transferred to a sample vial, and submitted to 222-S for analysis. This process was repeated for the remaining 4 cones after periods of 2, 4, 6, and 8 days. Hot cell ambient temperature ranged from 27.5-28.5 °C and averaged 28.0 °C during the 8 days of testing.

The same basic sequence was completed for the 4 cones in the 15 °C test series. The dissolution water was chilled to 15 °C before addition to the heel solids. After addition of the water and initial mixing, the cones were transferred to a water bath controlled at 15 ± 1 °C. Hourly during day shifts (including facility off days), the cones were removed from the bath, shaken vigorously for ≈3 min, and then returned to the bath. Mixing was not performed during swing and night shifts. After periods of 1, 2, 4, and 8 days, a cone was removed from the bath and processed as

described for the 28 °C test series. The supernatant C-Liq samples from the 15 °C test series were not diluted prior to submission to 222-S for analysis.

A similar sequence was completed for the 4 cones in the 46 °C test series. The dissolution water was heated to 47 °C before addition and initial mixing. The cones were then transferred to a small oven set to 45 ± 1 °C. As in the 15 °C series, the contents of the test cones were mixed by shaking vigorously for ≈3 min at 1 hr intervals during all days shifts spanned by the test. After periods of 1, 2, 4, and 8 days a cone was removed from the oven and processed. The samples of decanted C-Liq from the 46 °C test series that were submitted for analysis were diluted 1:1 w/w with reagent water before transfer to 222-S.

4.2 SMALL-SCALE DISSOLUTION TEST RESULTS

4.2.1 Hot Cell Measurements

The data recorded during execution of the small-scale dissolution test series in the 11A hot cells is summarized in Table 4-01.

Calculated %-weight loss values for the test samples (Δwt%) are included in Table 4-01. The Δwt% values are calculated relative to the initial weights of the test samples: since the residual solids were weighed as wet C-Slds, these values are biased low. Based on the gain in weight of the test samples after the preliminary wash with 15 °C water, the reported Δwt% values may be ≈6 wt% low for the 46 °C samples, ≈9 wt% low for the 28 °C samples, and ≈12 wt% low for the 15 °C samples.

The D_{Liq} values reported for liquid samples from the small-scale dissolution test series were measured in the 11A hot cells. One (or both) of two Class-A, 25-mL volumetric flasks were filled with test liquid and then weighed. The temperatures of the liquid in the volumetric flasks were measured immediately after the weights were recorded. Liquid densities were then calculated by dividing the liquid weights by the nominal 25-mL flask volumes.

Table 4-01. Small-scale Dissolution Test Results.

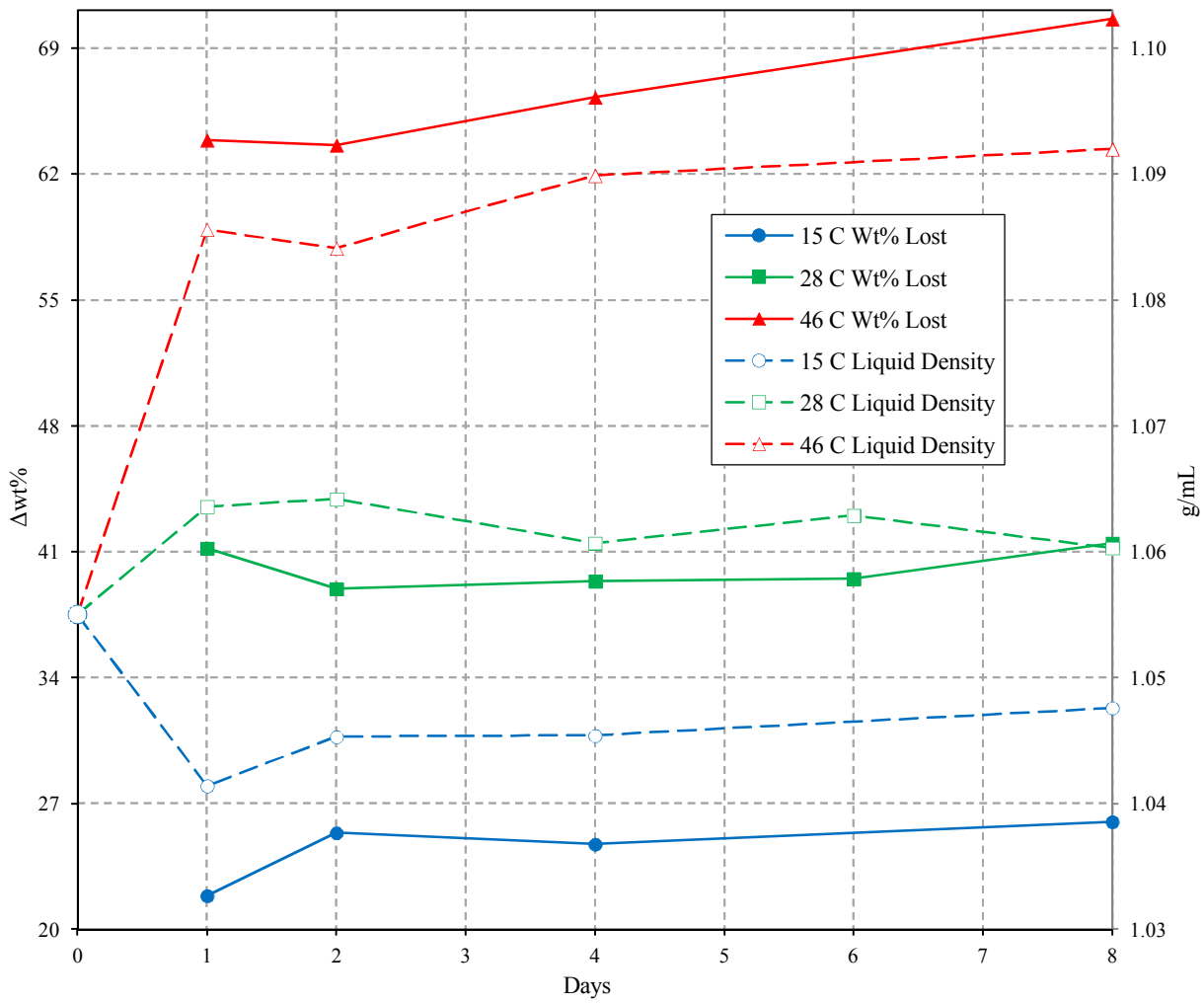
15 °C Test Duration (days)	1	2	4	6	8
Wt initial sample (g)	10.996	11.026	11.129	—	11.063
Wt wash H_2O added (g)	13.070	13.001	13.135	—	13.108
Wt wash liquid decanted (g)	11.454	11.652	11.335	—	11.400
Wt wet washed solids (g)	12.612	12.375	12.929	—	12.771
D_{Liq} wash liquid (g/mL)	1.055 (28.1 °C)				
Wt dissolution H_2O added (g)	31.429	31.769	31.586	—	31.500
Test temperature (°C)	15.1	15.1	14.9 - 15.1	—	15.0 – 15.1
Wt wet residual solids (g)	8.591	8.229	8.376	—	8.188
Δwt% wet residual solids	– 21.9	– 25.4	– 24.7	—	– 26.0
Wt liquid decanted (g)	35.449	35.912	36.138	—	36.084
D_{Liq} decanted liquid (g/mL)	1.041 (28.1 °C)	1.045 (28.0 °C)	1.045 (28.8 °C)	—	1.048 (27.8 °C)

28 °C Test Duration (days)	1	2	4	6	8
Wt initial sample (g)	11.019	11.049	11.089	11.125	10.972
Wt wash H_2O added (g)	13.023	13.084	13.029	13.155	12.973
Wt wash liquid decanted (g)	11.620	11.301	11.450	11.574	11.303
Wt wet washed solids (g)	12.422	12.832	12.668	12.706	12.642
D_{Liq} wash liquid (g/mL)	1.055 (28.1 °C)				
Wt dissolution H_2O added (g)	31.651	31.419	31.669	31.854	31.256
Test temperature (°C)	28.5	27.5 – 28.5	28.2 – 28.5	28.1	27.9 – 28.5
Wt wet residual solids (g)	6.479	6.747	6.723	6.731	6.420
Δwt% wet solids	– 41.2	– 38.9	– 39.4	– 39.5	– 41.5
Wt liquid decanted (g)	37.581	37.499	37.545	37.462	37.469
D_{Liq} decanted liquid (g/mL)	1.062 (28.5 °C)	1.064 (27.5 °C)	1.061 (28.2 °C)	1.063 (28.1 °C)	1.060 (29.0 °C)

46 °C Test Duration (days)	1	2	4	6	8
Wt initial sample (g)	11.080	11.101	10.976	—	10.934
Wt wash H_2O added (g)	13.700	13.195	12.980	—	12.881
Wt wash liquid decanted (g)	12.164	11.385	11.276	—	11.602
Wt wet washed solids (g)	12.616	12.911	12.680	—	12.213
D_{Liq} wash liquid (g/mL)	1.055 (28.1 °C)				
Wt dissolution H_2O added (g)	31.870	31.535	31.252	—	31.597
Test temperature (°C)	44.1 – 47.0	44.7 – 47.0	44.1 – 47.0	—	46.0 – 47.0
Wt wet residual solids (g)	4.000	4.038	3.702	—	3.211
Δwt% wet solids	– 63.9	– 63.6	– 66.3	—	– 70.6
Wt liquid decanted (g)	40.492	40.402	40.207	—	40.558
D_{Liq} decanted liquid (g/mL)	1.086 (28.0 °C)	1.084 (28.0 °C)	1.090 (28.8 °C)	—	1.092 (27.7 °C)

The variations in Δwt% for the heel solids and D_{Liq} of the decanted C-Liq with test temperature and test duration are displayed in Figure 4-01. The liquid density plotted at Day 0 is the D_{Liq} of the wash liquid composite.

Figure 4-01. Results of Small-scale Water Dissolution Tests.



Most of the weight loss in the heel solids measured in the small-scale dissolution tests had occurred by the time the initial Day-1 sample was processed. The Δwt% values increased with duration in the 46 °C series; however, this series was subject to the largest potential experimental errors. The D_{Liq} and Δwt% data displayed very similar trends with test duration indicating that the (relatively) easily measured D_{Liq} is a useful monitor of the dissolution of the C-110 heel solids.

Dissolution of the homogenized, C-110 heel solids was quite sensitive to test temperature. Relative to the 28 °C test series, the washed heel solids were ≈0.6 times less soluble at 15 °C and ≈1.6 times more soluble at 46 °C. In the 15 °C series, the solubility of the solids remaining after the preliminary water wash was insufficient to produce a dissolution liquid with a D_{Liq} at least equal to that of the wash liquid.

4.2.2 Chemical Analysis of Dissolution Liquid Samples

The results of the analyses of the liquid samples from the small-scale dissolution tests are summarized in Table 4-02. The results for the 28 °C and 46 °C test series have been adjusted to account for the dilution of these samples prior to submission to 222-S for analysis. Transcripts of the laboratory data summary reports for these samples and the sample weight and density data used for the dilution corrections are in Attachment A.

The chemical analysis data are plotted against test duration in Figure 4-02. The values plotted at Day 0 are the species concentrations in the preliminary wash liquid composite.

The analysis data confirm that natrophosphate was the major water soluble species in the test solids. The data also show that ≥ 90% of the fluoride and phosphate recovered after the preliminary 15 °C water wash was found in the Day 1 samples at all three test temperatures.

The ratio of phosphate to fluoride in the dissolution test liquids was consistently less than the 10:1 w/w ratio in natrophosphate. The measured ratios ranged from ≈8.2 for the 15 °C samples to ≈8.5 for the 28 °C samples to ≈9.4 for the 46 °C samples. These values may indicate that an additional fluoride-containing species was present in the heel solids.

The natrophosphate dissolution displayed significant temperature sensitivity. Relative to the Day 4, 28 °C test sample, the fluoride and phosphate concentrations in the dissolution liquids were ≈25% less at 15 °C and were ≈40% greater at 46 °C.

The analysis results for sodium generally reproduced the trends displayed by the Δwt% and D_{Liq} data in Figure 4-01. This is not surprising given that sodium is the major cation species in the C-110 heel samples and represents 22.6 wt% of natrophosphate.

The concentrations of nitrate, carbonate (TIC), oxalate, nitrite, chloride, chromium, and iron were significantly less in the Day 1 dissolution liquids than in the 15 °C wash liquid composite. The concentrations of these species in the dissolution liquids then remained essentially unchanged for the remaining 7 days of the tests. The nitrate data shown in Figure 4-02c is representative of the liquid concentration vs. test duration for all these components. The concentrations of these species in the Day 1-8 test liquids did not show any sensitivity to dissolution temperature. This suggests that most of these species were removed from the heel solids by the 15 °C water wash.

The measured concentrations of sulfate displayed a similar trend but also displayed a small increase in concentration with increasing dissolution temperature in the Day 1-8 test liquids. This suggests that most of the recovered sulfate was removed with the initial 15 °C wash but that a small additional quantity of sulfate solids were then dissolved and recovered in the post-wash dissolution liquids.

The concentrations of aluminum in the post-wash dissolution liquids appeared to increase with contact duration throughout the test. The increase was particularly prominent for the 46 °C test series and less so for the 28 °C samples.

Table 4-02. Chemical Composition of Small-scale Dissolution Test Liquids.

(All values in units of µg/mL)

	15 °C Test Series					
Test Duration (days)	**0**	**1**	**2**	**4**	**6**	**8**
TIC as CO_3	5,146	644	649	764	—	759
Oxalate	235	26	25	28	—	26
Nitrite	3,370	345	348	401	—	396
Nitrate	6,460	685	679	793	—	785
Fluoride	2,280	2,650	2,820	2,930	—	2,940
Phosphate	21,428	21,884	23,074	23,647	—	23,681
Sulfate	892	186	205	217	—	222
Chloride	74	8	8	9	—	9
Sodium	24,500	18,300	18,700	19,500	—	19,900
Aluminum	113	182	217	238	—	259
Chromium	21	3	4	4	—	4
Iron	21	5	7	7	—	7
	28 °C Test Series					
TIC as CO_3	5,146	837	703	708	810	893
Oxalate	235	28	26	24	27	25
Nitrite	3,370	411	365	349	391	392
Nitrate	6,460	819	721	698	777	776
Fluoride	2,280	3,780	3,776	3,899	3,820	3,599
Phosphate	21,428	32,168	32,081	31,992	33,195	31,964
Sulfate	892	265	248	253	268	270
Chloride	74	9	8	9	9	9
Sodium	24,500	24,735	25,213	25,825	27,111	25,980
Aluminum	113	332	376	442	454	523
Chromium	21	5	4	4	4	5
Iron	21	9	9	9	9	9
	46 °C Test Series					
TIC as CO_3	5,146	699	964	726	—	806
Oxalate	235	25	25	26	—	27
Nitrite	3,370	326	390	365	—	407
Nitrate	6,460	652	798	732	—	826
Fluoride	2,280	4,918	4,920	5,171	—	5,343
Phosphate	21,428	46,034	46,244	48,776	—	49,824
Sulfate	892	288	320	320	—	335
Chloride	74	7	11	8	—	11
Sodium	24,500	37,768	36,480	38,626	—	39,185
Aluminum	113	598	719	887	—	1,023
Chromium	21	4	4	4	—	5
Iron	21	10	11	9	—	9

Figure 4-02. Chemical Composition of Small-scale Dissolution Test Liquids. (2 sheets)

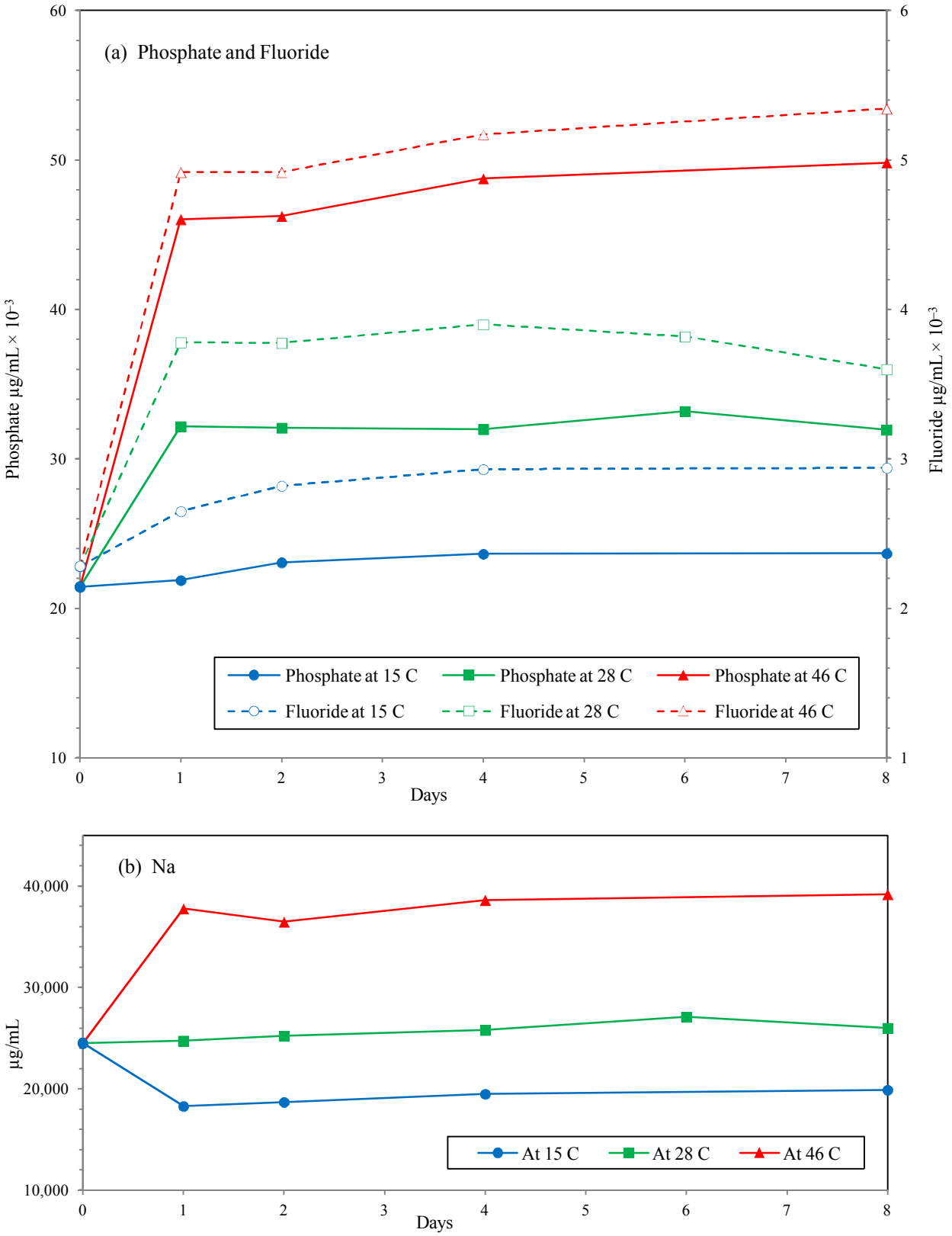
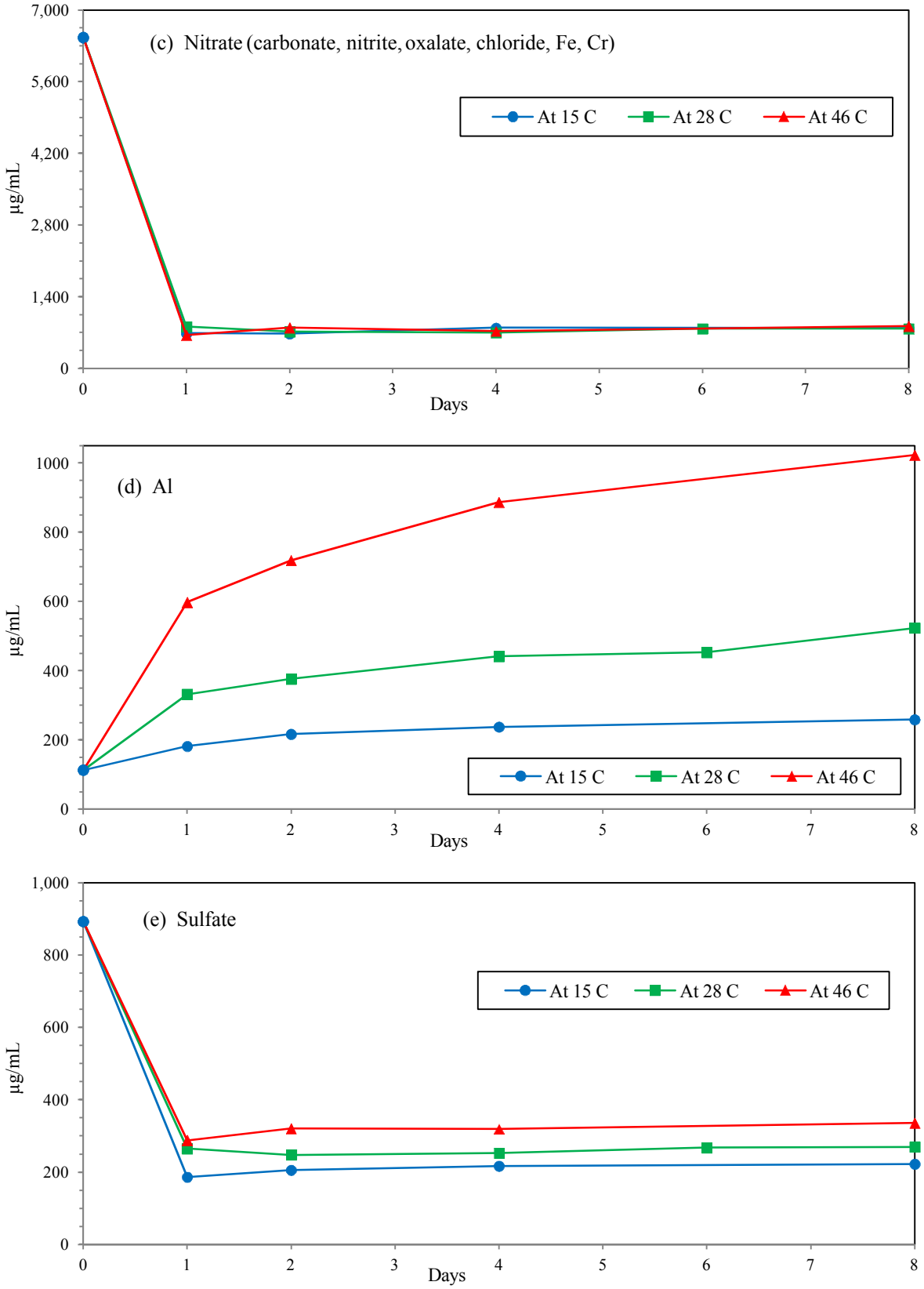


Figure 4-02. Chemical Composition of Small-scale Dissolution Test Liquids. (2 sheets)



5.0 LARGE-SCALE WATER DISSOLUTION TESTS

Based on the results of chemical analyses, SPC measurements, preliminary dissolution tests, and small-scale water dissolution tests, a set of two large-scale water dissolution tests were designed and performed on the C-110 heel solids. One of the large-scale tests was performed at a nominal temperature of 15 °C, the other at a nominal temperature of 45 °C.

5.1 TEST PROCEDURE

5.1.1 Test Samples

The final two composites of unhomogenized, C-110 heel solids (described in Section 2.4.2) were the source material for these tests. To the extent possible, these two composites contained the same types/sizes and quantities of the C-110 heel solids received for testing.

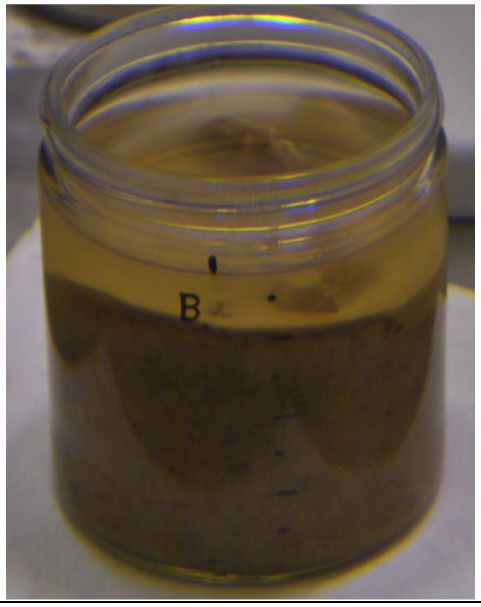
As described in Section 3.4, the first step in each large-scale dissolution test was the measurement of D_{Bulk} of the composite solids by displacement of 15 °C water. The photographs in Figure 5-01 show the appearance of the 45 °C test solids after being transferred to the pycnometer jar and ≈1 hr after the initial water addition.

Figure 5-01. Heel Solids at Start of 45 °C Dissolution Test.

(Outside diameter of jar is 9.0 cm)

(a) After transfer to pycnometer jar

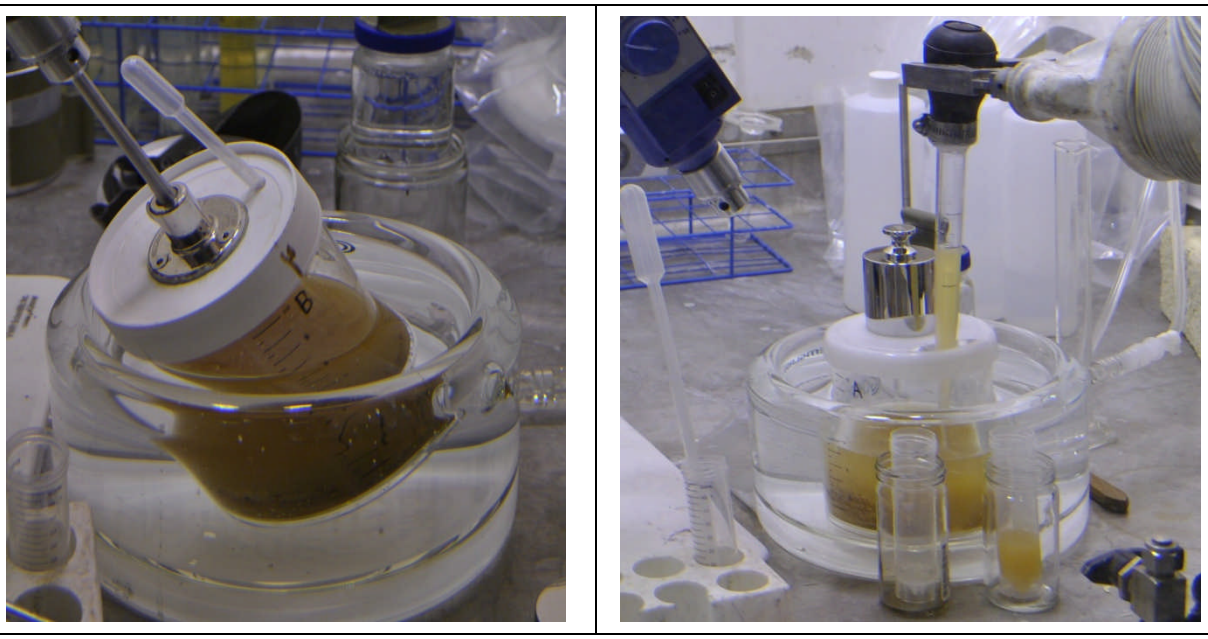
(b) ≈1 hr after addition of 15 °C water.



5.1.2 Test Apparatus

Photographs of the basic test apparatus used in the large-scale dissolution tests in 222-S hot cell 11A-6 are shown in Figure 5-02.

Figure 5-02. Large-scale Dissolution Test Apparatus.



The primary vessels used for the large-scale dissolution tests were fabricated from 1-L (1.18 L maximum capacity) polymethylpentene jars. Polymethylpentene containers are transparent, stable at temperatures up to 130 °C, and highly resistant to a wide range of liquids including concentrated caustic solutions. The inside diameter of the jars was 11 cm at the top and tapered down to 10.5 cm at the bottom. The total depth of the jars was 13 cm.

A stainless steel stir shaft was attached to the outside-center of a polypropylene jar lid that was used in both the 15 °C and 45 °C tests. An IKA®[3] RW-16 stirring motor was clamped to a test stand so that the axis of rotation of the motor was ≈45° from vertical. During testing, the shaft on the lid of the test vessel was secured in the hollow shaft of the stir motor. Before tightening the motor chuck, the length of the shaft inserted in the motor was adjusted so that the bottom outside edge of the test vessel was just above the inside bottom of a jacketed water bath. The motor was always set to the minimum rotation speed achievable. The nominal minimum speed of the stir motor was 40 rpm; rotation rates maintained during the tests ranged from 22-38 rpm.

The well of the jacketed water bath was 20 cm in diameter and 10 cm in depth. Heating or cooling water was supplied to the bath jacket from a circulating heater/chiller located outside of the hot cell. During testing, the level of temperature-controlled water in the bath well was adjusted, as required, so that it was always at or just above the liquid level inside the test vessel.

[3] IKA is a registered trademark of IKA-Werke GMBH & CO.KG, D 79 219 Staufen, Germany.

A small hole was drilled near the perimeter of the test vessel lid to facilitate measurement of the temperature of the vessel contents and to preclude any pressurization of the test vessel during the tests. A small disposable pipette was used to plug the hole during test operations.

5.1.3 Test Procedure

Other than the temperature maintained and the number of iterations, the large-scale 15 °C and 45 °C water dissolution tests were performed in the same manner. The basic test procedure is described here.

Contact 1 of each dissolution test was performed as follows. After completing the D_{Bulk} measurement for a test composite, the contents of the pycnometer jar were transferred to a dissolution test vessel. During the transfer, a small portion of the D_{Bulk} measurement liquid was collected and centrifuged until clear. The density of the liquid (and of all the liquid samples collected during the large-scale dissolution tests) was measured by filling and weighing two 25-mL, volumetric flasks (Section 4.2.1). A portion of the D_{Bulk} liquid was then transferred to 222-S for analysis.

Reagent water was used, as necessary, to transfer the slurried test solids to the dissolution test vessel as completely as possible. Additional water was then added to the vessel until the total weight of water added, i.e., the combined weight of the D_{Bulk}, pycnometer rinse, and final make-up water, was ≈1.05 times the starting weight of the test composite solids. The average D_{Bulk} of the test solids composites was 1.689 g/mL; therefore, the total volume of water added was ≈1.7 times the initial solids volume.

The modified lid was then securely attached to the test vessel and the filled vessel was carefully inserted into the stir motor/water bath apparatus. Rotation of the tilted test vessel was then started at the slowest speed possible and continued for 4 days. The temperature of the test liquid was checked periodically and, if required, the temperature of the supply water to the bath jacket was adjusted to maintain the target test temperature.

After 4 days, the test vessel was removed from the stirrer/bath apparatus, dried, and weighed. Any weight loss was attributed to evaporation from the test slurry and was subtracted from the initial weight of water added. The rotation lid was then removed from the test vessel. The vessel was returned to the water bath and covered with a non-threaded cover. The test slurry was allowed to settle for ≈30 min.

In pairs, four 50-mL centrifuge cones were then repeatedly filled with liquid from the test vessel (Figure 5-02) and centrifuged at ≈1000 × *g* until the supernatant C-Liq was clear. All the C-Liq decanted from the cones in each test contact were combined in a single container. After all the liquid that could be removed from the test vessel with reasonable effort was recovered, the total weight and density of the recovered C-Liq were measured, the weights of the solids remaining in the test vessel and the weights of C-Slds collected in the centrifuge cones were recorded, and the solids remaining in the test vessel were photographed. A sample of the combined recovered

C-Liq was transferred to a sample vial and submitted to 222-S for analysis; a 50-mL centrifuge cone was filled with an additional portion and set aside as a temporary archive sample.

To initiate Contact 2, reagent water was used to return the Contact 1 C-Slds from the centrifuge cones to the test vessel. Additional water was then added until the total weight added for Contact 2 was again ≈1.05 times the weight of the test solids at the beginning of the test series. The process described above was then repeated.

In each large-scale test the water contacts were repeated until the density of the recovered test C-Liq decreased significantly. This was used as a real-time indicator that adding more water would not result in the dissolution of an appreciably greater quantity of the test solids. Ten contacts were required in the 15 °C test and five contacts were required in the 45 °C test.

In the 45 °C tests, slight modifications were made to avoid precipitation of solids from the liquid samples upon cooling. The decanted C-Liq composite was staged in the water bath as it was collected. The samples of the recovered C-Liq submitted to 222-S for analysis were diluted 1:1 w/w with reagent water. Portions of both the undiluted and diluted combined C-Liq composites were transferred to centrifuge cones and set aside as temporary archive samples.

At the end of each test series, the fine and/or slow-settling solids collected in centrifuge cones and the coarse and/or fast-settling solids retained in the test vessel were allowed to partially air-dry. The weights of both solid fractions were then recorded. The D_{Bulk} of both solid fractions were then measured by water displacement (Section 5.4.2). Insufficient solids remained at the conclusion of the individual large-scale tests to perform all the analyses and tests specified in the test plan (LAB-PLN-10-00011) and TSAP (RPP-PLAN-46196). Therefore, the residual solids from the 15 °C and 45 °C tests were combined prior to initiating the chemical/radiological analyses and physical characterization tests described in Section 5.4 and Section 6.0.

5.2 15 °C DISSOLUTION TEST RESULTS

5.2.1 Test Narrative

The large-scale 15 °C dissolution test series was performed from February 25 to April 18, 2011. Ten water contacts were completed. Over the course of the test series the measured temperature of the test slurries ranged from 14.8 to 15.3 °C. The rotation rate of the dissolution test vessel ranged from 22-38 rpm.

Except for Contact 3 and Contact 10, each test contact was completed as described in Section 5.1.3. In Contact 3, a hot cell manipulator broke immediately after the chilled dissolution water was added on March 7. The test sample was placed in the 15 °C water bath until manipulator repairs were completed on March 8. The test sample was then rotated in the water bath for 3 days prior to processing.

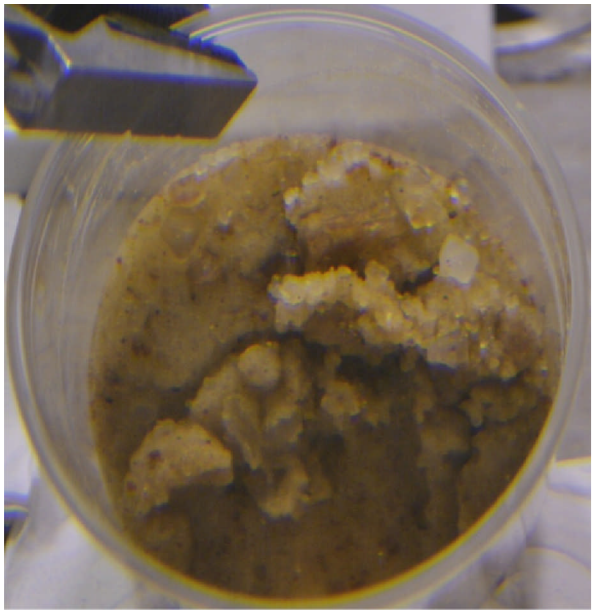
In Contact 10, the chilled dissolution water was added to the test solids on April 7, and the test sample was transferred to the water bath. Sample rotation was started on April 8 and continued for 4 days (April 12). Rotation was stopped and the test sample was staged (upright) overnight in the bath before sample processing was initiated on April 13.

Through Contact 5, the turbidity of the test liquids decreased significantly in the ≈30 min the test slurries were allowed to settle after being weighed and returned to the water bath. Centrifuging for 8 min at ≈1000 × *g* produced a clear C-Liq. Beginning with Contact 6, the turbidity of the test slurries decreased very little as the samples were processed; however, through Contact 9, 8 min of centrifugation at ≈1000 × *g* still produced a clear C-Liq. In Contact 10, little visual evidence of settling of the test slurry was noted even after sitting undisturbed in the water bath overnight; two 2-hr periods of centrifugation of the decanted Contact 10 liquids were required to produce a clear C-Liq sample.

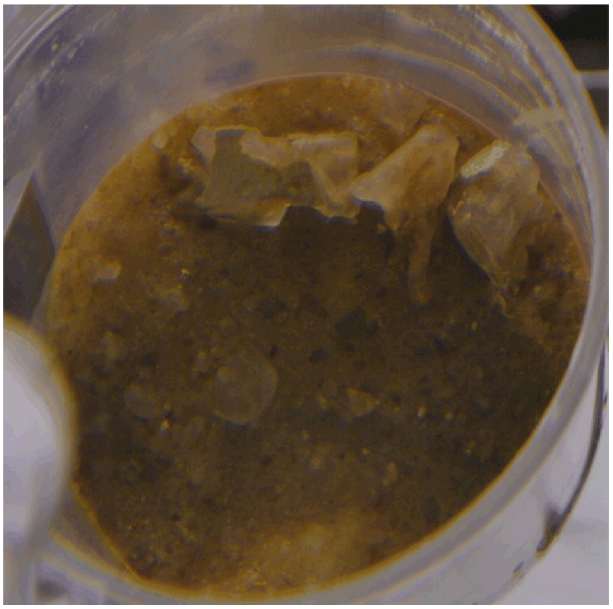
Photographs of the test solids at various stages of the large-scale 15 °C dissolution test are presented in Figure 5-03.

Figure 5-03. Appearance of Heel Solids during 15 °C Dissolution Test. (2 sheets)

(a) Coarse solids after Contact 1 decant



(b) Coarse solids after Contact 4 decant



(c) Coarse solids after Contact 6 decant

(d) Fine C-Slds from Contact 6

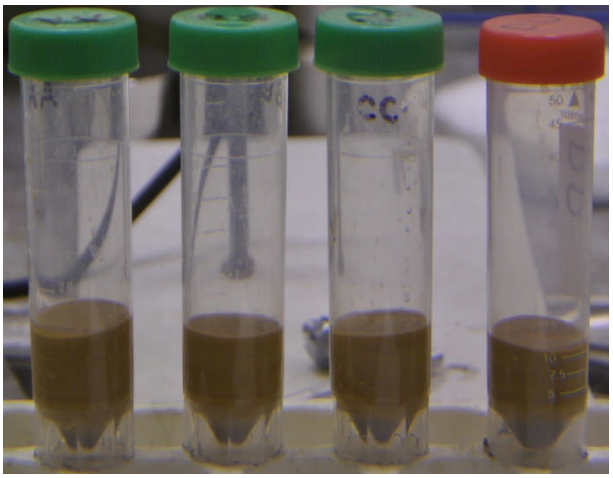
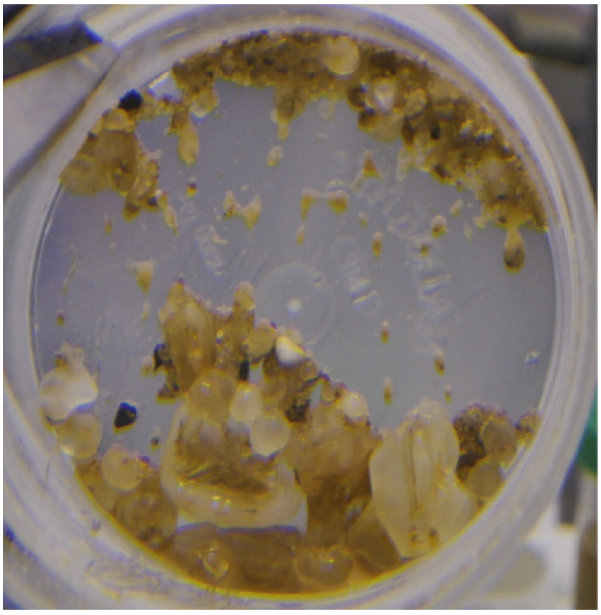
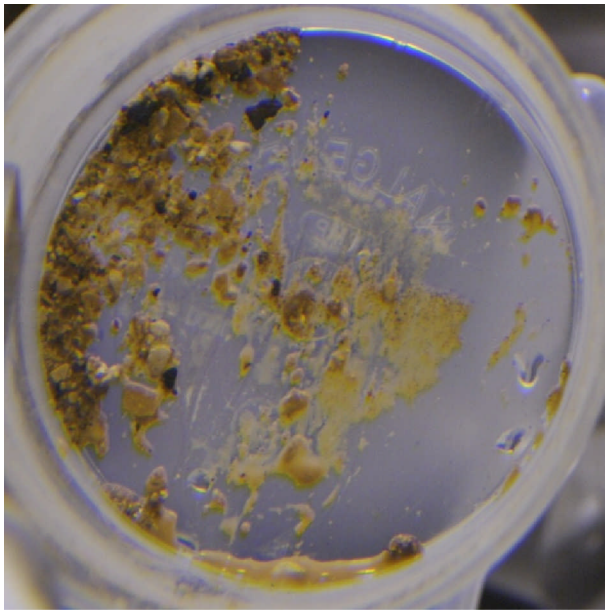


Figure 5-03. Appearance of Heel Solids during 15 °C Dissolution Test. (2 sheets)

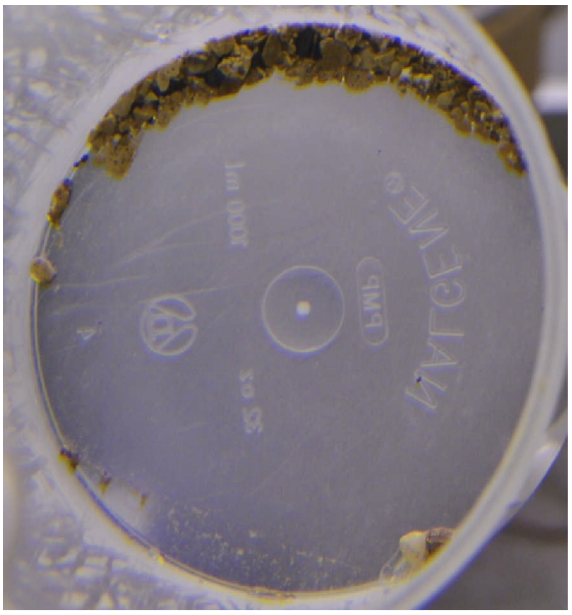
(e) Coarse solids after Contact 8 decant



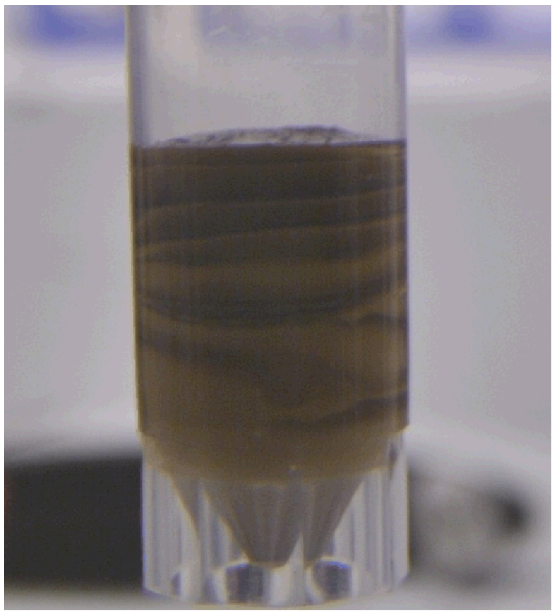
(f) Coarse solids after Contact 9 decant



(g) Coarse solids after Contact 10 decant



(h) Fine C-Slds after Contact 10



5.2.2 Gravimetric/Volumetric Results

The results of the gravimetric and volumetric measurements completed in the 11A hot cells and derived quantities are summarized in Table 5-01. The volumes of water added in the test contacts were calculated using the reference density of pure water at 15 °C (0.999099 g/mL). The actual temperatures of the C-Liq samples when D_{Liq} were measured are recorded below the measured densities.

Table 5-01. Hot Cell Results for 15 °C Dissolution Test.

Contact		1		2	3	4	5
		D_{Bulk}	—				
Initial Composite Solids	(g)	413.15		—	—	—	—
	(mL)	245.78					
H_2O Added	(g)	226.91	207.56	433.30	432.57	433.56	433.46
	(mL)	227.11	207.75	433.69	432.96	433.95	433.85
Cumulative H_2O Added	(g)	434.47		867.77	1,300.3	1,733.9	2,167.4
	(mL)	434.86		868.55	1,301.5	1,735.5	2,169.3
Liquid Removed	(g)	26.01	409.08	481.42	473.11	480.78	477.15
D_{Liq}	(g/mL)	1.053	1.054	1.046	1.044	1.044	1.044
	(°C)	(25.7)	(26.3)	(26.9)	(24.3)	(25.1)	(26.7)
Residual Solids		**Wet**					
Fine C-Slds	(g)	4.20		6.74	6.32	6.54	5.39
Coarse Slds	(g)	405.11		352.68	311.30	262.85	218.83
Total Solids Remaining	(g)	409.31		359.42	317.62	269.39	224.22
	(wt%)	99.1		87.0	76.9	65.2	54.3

Contact		6	7	8	9	10	
H_2O Added	(g)	433.31	433.78	433.70	454.94	433.76	
	(mL)	433.70	434.17	434.09	455.35	434.15	
Cumulative H_2O Added	(g)	2,600.7	3,034.4	3,468.2	3,923.1	4,356.8	
	(mL)	2,603.0	3,037.2	3,471.3	3,926.6	4,360.8	
Liquid Removed	(g)	451.74	480.61	487.64	502.82	441.61	
D_{Liq}	(g/mL)	1.045	1.046	1.046	1.040	0.999	
	(°C)	(26.1)	(25.5)	(25.4)	(24.2)	(24.9)	
Residual Solids		**Wet**				**Damp**	**Dry (Est.)**
Fine C-Slds	(g)	60.16	66.00	53.21	43.87	24.39	9.75
Coarse Slds	(g)	143.41	88.68	45.46	5.18	3.37	3.20
Total Solids Remaining	(g)	203.57	154.68	98.67	49.05	27.76	12.95
	(wt%)	49.3	37.4	23.9	11.9	6.7	3.1

The tabulated 'Fine C-Slds' weights are the weights of the fine-grained/slow-settling solids that were separated (by centrifugation) from the liquid decanted from the test vessel at the conclusion of each test contact. The 'Coarse Slds' weights are the weights of the solids that remained in the vessel after decanting was completed in each test contact. The tabulated wt% values for the total residual solids for each contact were calculated relative to the starting weight of the semi-dry, composite solids, 413.15 g.

With the exception of Contact 10, all weights of the 'Wet' residual solids were measured soon after the decant/centrifuge separations were completed. The final weights of the residual solids from Contact 10 were recorded several days after completion of the recovery operations; nevertheless, a significant portion of unrecovered liquid is still included in the final 'Damp' weights. The estimated 'Dry' weight of the Contact 10 residual solids, based on the results of sieve analysis (Section 6.1), was approximately one-half of the tabulated damp weights.

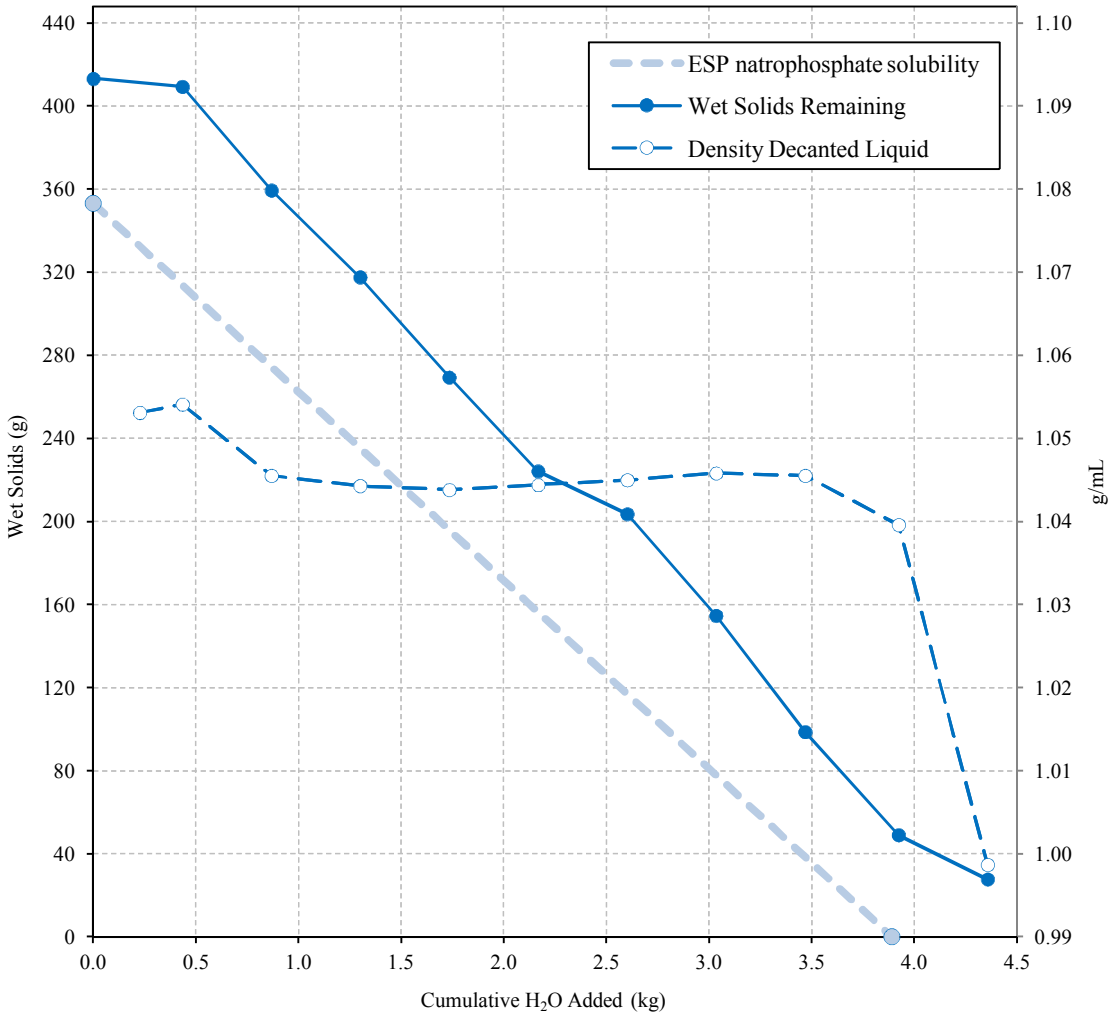
The weight of the wet/damp solids remaining after each of the test contacts and the D_{Liq} of the solids-free C-Liq recovered at the conclusion of each are displayed in Figure 5-04. The data point on the 'weight' ordinate axis represents the starting weight of the semi-dry test composite sample. The first D_{Liq} value plotted is the density of the ≈22 °C liquid at the end of the D_{Bulk} measurement measured after the retrieved sample had warmed to 25.7 °C.

The data in Table 5-01 and Figure 5-04 show that the dissolution and recovery of solids from the test composite using 15 °C water was essentially complete after Contact 9. Through Contact 9, a cumulative total of 3,923 g of reagent water had been added to the initial 413.15 g sample of composite heel solids. After completion of Contact 10, >93 wt% of the initial solids had been dissolved and recovered, and the D_{Liq} of the recovered liquid was essentially that of pure water.

When using 15 °C water, the quantity of heel solids dissolved and removed in the first water addition just barely outweighed the interstitial liquid co-recovered with the wet residual solids. The nearly equal D_{Liq} values for the D_{Bulk} and Contact 1 liquids suggest that a significant portion of the solutes in both originated from the highly soluble salts present in the initial composite solids. Dissolution of highly soluble sodium salts would be expected to inhibit dissolution of the natrophosphate solids comprising the bulk of the test composite solids due to a sodium common ion effect.

The partial flattening of the observed weight loss plot between Contact 5 and Contact 6 is probably an artifact resulting from the large increase in the quantity of fine C-Slds recovered in Contact 6. The significant increase in the weight of liquid co-recovered with the C-Slds would cause the weight of the total solids remaining at the end of the contact (and Contacts 7-10 also) to appear larger than it actually was.

Figure 5-04. Hot Cell Results for 15 °C Dissolution Test.



Chemical analysis of the composite solids (Tables 3-03 and 5-09) suggests that the 413.2-g 15 °C Composite test sample probably contained ≈353 g of natrophosphate. The Environmental Simulation Program[4] (ESP) was used to calculate the quantity of 15 °C water required to dissolve 353 g of natrophosphate. The results of the ESP calculations are displayed as the dashed line in Figure 5-04. The calculated 3.89 kg of 15 °C water required to dissolve the natrophosphate was slightly smaller than the 3.92 kg required for the soluble components of the test composite. After Contact 1, the slopes of the ESP-predicted and observed weight loss plots are very similar.

[4] OLI systems, Inc., Morris Plains, New Jersey.

5.2.3 Analysis-based Results

The results of chemical analyses of the test liquids from the large-scale 15 °C water dissolution test are summarized in Table 5-02. Transcripts of the laboratory data summary reports for these samples are included in Attachment A.

Table 5-02. Analyses of 15 °C Dissolution Test Liquids. (2 sheets)

(All results, except for density and pH, in units of µg/mL)

Analyte	D_{Bulk} Liquid	Liquid from 15 °C Test Contact				
		1	2	3	4	5
Density (g/mL)	1.053 (at 25.7 °C)	1.054 (at 26.3 °C)	1.046 (at 26.9 °C)	1.044 (at 24.3 °C)	1.044 (at 25.1 °C)	1.044 (at 26.7 °C)
TOC	149	82	< 20	112	17	< 7
ΔTOC	38	13	< 20	112	17	< 7
TIC	1,610	1,080	188	28	24	47
as CO_3	8,044	5,396	939	140	122	235
pH	11.45	12.00	12.00	12.00	12.00	12.10
as OH	48	170	170	170	170	214
Fluoride	1,550	2,300	2,960	2,950	2,860	2,575
Chloride	112	72	10	2	< 1	2
Nitrite	4,855	2,820	438	64	12	6
Sulfate	1,285	862	223	134	123	120
Oxalate	331	209	29	< 2	< 2	< 2
Nitrate	9,355	5,540	912	136	31	19
Phosphate	14,500	19,700	22,900	22,700	22,400	23,250
Aluminum	122	265	273	268	241	195
Bismuth	< 200	< 200	< 200	< 200	< 200	< 10
Calcium	< 100	< 100	< 100	< 100	< 100	< 5
Chromium	32	26	< 10	< 10	< 10	1
Iron	32	25	< 10	< 10	< 10	1
Manganese	—	—	—	—	—	< 1
Sodium	25,000	26,900	21,600	21,400	18,600	17,700
Phosphorus	4,945	6,840	7,420	7,370	7,270	7,670
as phosphate	15,162	20,973	22,751	22,598	22,291	23,518
Sulfur	457	295	< 200	< 200	< 200	40
as sulfate	1,369	884	< 599	< 599	< 599	120
Silicon	< 60	< 60	< 60	< 60	< 60	10
Strontium	< 6	< 6	< 6	< 6	< 6	< 1
Uranium	—	—	—	—	—	< 10

Table 5-02. Analyses of 15 °C Dissolution Test Liquids. (2 sheets)

(All results, except for density and pH, in units of µg/mL)

Analyte	Liquid from 15 °C Test Contact				
	6	**7**	**8**	**9**	**10**
Density (g/mL)	1.045 (at 26.1 °C)	1.046 (at 25.5 °C)	1.046 (at 25.4 °C)	1.040 (at 24.2 °C)	0.999 (at 24.9 °C)
TOC	< 7	< 7	< 20	< 40	< 40
ΔTOC	< 7	< 7	< 20	< 40	< 40
TIC	23	22	21	28	32
as CO_3	116	112	104	141	161
pH	12.10	12.20	12.30	12.30	11.30
as OH	214	270	339	339	34
Fluoride	2,660	2,520	2,440	2,090	188
Chloride	< 1	< 1	< 1	< 1	< 1
Nitrite	3	2	4	2	8
Sulfate	145	136	108	66	3
Oxalate	< 2	< 2	< 2	< 2	< 2
Nitrate	10	10	15	23	2
Phosphate	23,600	24,800	24,400	21,000	1,820
Aluminum	305	267	260	204	100
Bismuth	< 10	< 10	< 10	< 10	41
Calcium	< 5	< 5	< 5	< 5	< 5
Chromium	1	1	1	1	1
Iron	2	1	1	1	35
Manganese	< 1	< 1	< 1	< 1	< 1
Sodium	19,000	19,600	18,400	16,600	1,460
Phosphorus	8,200	8,460	8,340	7,170	595
as phosphate	25,143	25,940	25,572	21,985	1,824
Sulfur	48	46	36	22	< 10
as sulfate	144	139	109	66	< 30
Silicon	7	8	7	9	12
Strontium	< 1	< 1	< 1	< 1	1
Uranium	< 10	< 10	< 10	< 10	< 10

In Table 5-03, the analytical data is recalculated to show the changes in the calculated weights of the components in the initial test composite as the 15 °C dissolution test proceeded. The components are presented in decreasing order of their weights and wt%s in the initial composite. The table column for each test contact shows the weights of the components dissolved and recovered in the contact and the cumulative wt% of the components dissolved and recovered through the test series. The final 'Total' column tabulates the total weight and wt% of each component dissolved and recovered in the 10 test contacts.

Table 5-03. Component Inventories in 15 °C Dissolution Test. (2 sheets)

		Initial	Dissolved and Removed in 15 °C Contact (Stepwise wt and cumulative wt%)				
		Composite	1	2	3	4	5
Phosphate	g	94.16	8.26	10.51	10.26	10.29	10.68
	wt%	22.8	8.8	19.9	30.8	41.8	53.1
Sodium	g	90.41	11.06	9.95	9.70	8.57	8.09
	wt%	21.9	12.2	23.2	34.0	43.4	52.4
Fluoride	g	10.37	0.93	1.36	1.34	1.32	1.18
	wt%	2.51	9.0	22.1	35.0	47.7	59.1
Aluminum	g	3.30	0.11	0.13	0.12	0.11	0.09
	wt%	0.80	3.2	7.0	10.7	14.1	16.8
Nitrate	g	3.05	2.38	0.42	0.062	0.014	0.009
	wt%	0.74	78.0	91.8	93.8	94.3	94.6
TIC as CO_3	g	2.83	2.29	0.43	0.063	0.056	0.11
	wt%	0.68	81.1	96.4	98.7	101	104
Nitrite	g	1.54	1.21	0.20	0.029	0.006	0.003
	wt%	0.37	78.9	92.0	93.9	94.3	94.4
OH from pH	g	0.97	0.067	0.078	0.077	0.078	0.098
	wt%	0.23	6.9	15.0	23.0	31.1	41.2
Sulfate	g	0.85	0.37	0.10	0.061	0.057	0.055
	wt%	0.21	43.1	55.2	62.4	69.1	75.5
Iron	g	0.65	0.010	< 0.005	< 0.005	< 0.005	0.0005
	wt%	0.16	1.6	—	—	—	1.7
Strontium	g	0.14	< 0.002	< 0.003	< 0.003	< 0.003	< 0.0001
	wt%	0.03	—	—	—	—	—
Oxalate	g	0.12	0.089	0.013	< 0.001	< 0.001	< 0.001
	wt%	0.03	77.7	89.2	—	—	—
ΔTOC	g	0.06	0.006	< 0.009	0.051	0.008	< 0.003
	wt%	0.01	9.8	—	93.3	106	—
Chloride	g	0.04	0.031	0.005	0.001	< 0.0005	0.001
	wt%	0.01	84.1	97.0	100	—	103

Table 5-03. Component Inventories in 15 °C Dissolution Test. (2 sheets)

		Dissolved and Removed in 15 °C Contact (Stepwise wt and cumulative wt%)					
		6	**7**	**8**	**9**	**10**	**Total**
Phosphate	g	10.54	11.66	11.65	10.40	0.81	95.06
	wt%	64.3	76.7	89.1	100	101	101
Sodium	g	8.21	9.01	8.58	8.03	0.65	81.83
	wt%	61.5	71.4	80.9	89.8	90.5	90.5
Fluoride	g	1.15	1.16	1.14	1.01	0.08	10.66
	wt%	70.2	81.3	92.3	102	103	103
Aluminum	g	0.13	0.12	0.12	0.10	0.04	1.07
	wt%	20.8	24.5	28.2	31.2	32.5	32.5
Nitrate	g	0.005	0.005	0.007	0.011	0.001	2.91
	wt%	94.7	94.9	95.1	95.4	95.5	95.5
TIC as CO_3	g	0.050	0.051	0.049	0.068	0.071	3.24
	wt%	106	108	110	112	115	115
Nitrite	g	0.001	0.001	0.002	0.001	0.004	1.46
	wt%	94.5	94.6	94.7	94.8	95.0	95.0
OH from pH	g	0.093	0.124	0.158	0.164	0.015	0.95
	wt%	50.7	63.5	79.9	96.8	98.4	98.4
Sulfate	g	0.063	0.063	0.050	0.032	0.002	0.85
	wt%	82.9	90.3	96.2	100	100	100
Iron	g	0.001	0.0003	0.0003	0.0003	0.015	0.03
	wt%	1.8	1.9	1.9	2.0	4.3	4.3
Strontium	g	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0004	0.0004
	wt%	—	—	—	—	0.3	0.3
Oxalate	g	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.10
	wt%	—	—	—	—	—	89.2
ΔTOC	g	< 0.003	< 0.003	< 0.009	< 0.019	< 0.018	0.06
	wt%	—	—	—	—	—	106
Chloride	g	< 0.0004	< 0.0005	< 0.0005	< 0.0005	< 0.0004	0.04
	wt%	—	—	—	—	—	103

In the plots in Figure 5-05, the cumulative wt% of components of the initial composite that were dissolved and recovered during the large-scale 15 °C dissolution test are displayed.

Figure 5-05. Component Inventories in 15 °C Dissolution Test. (2 sheets)

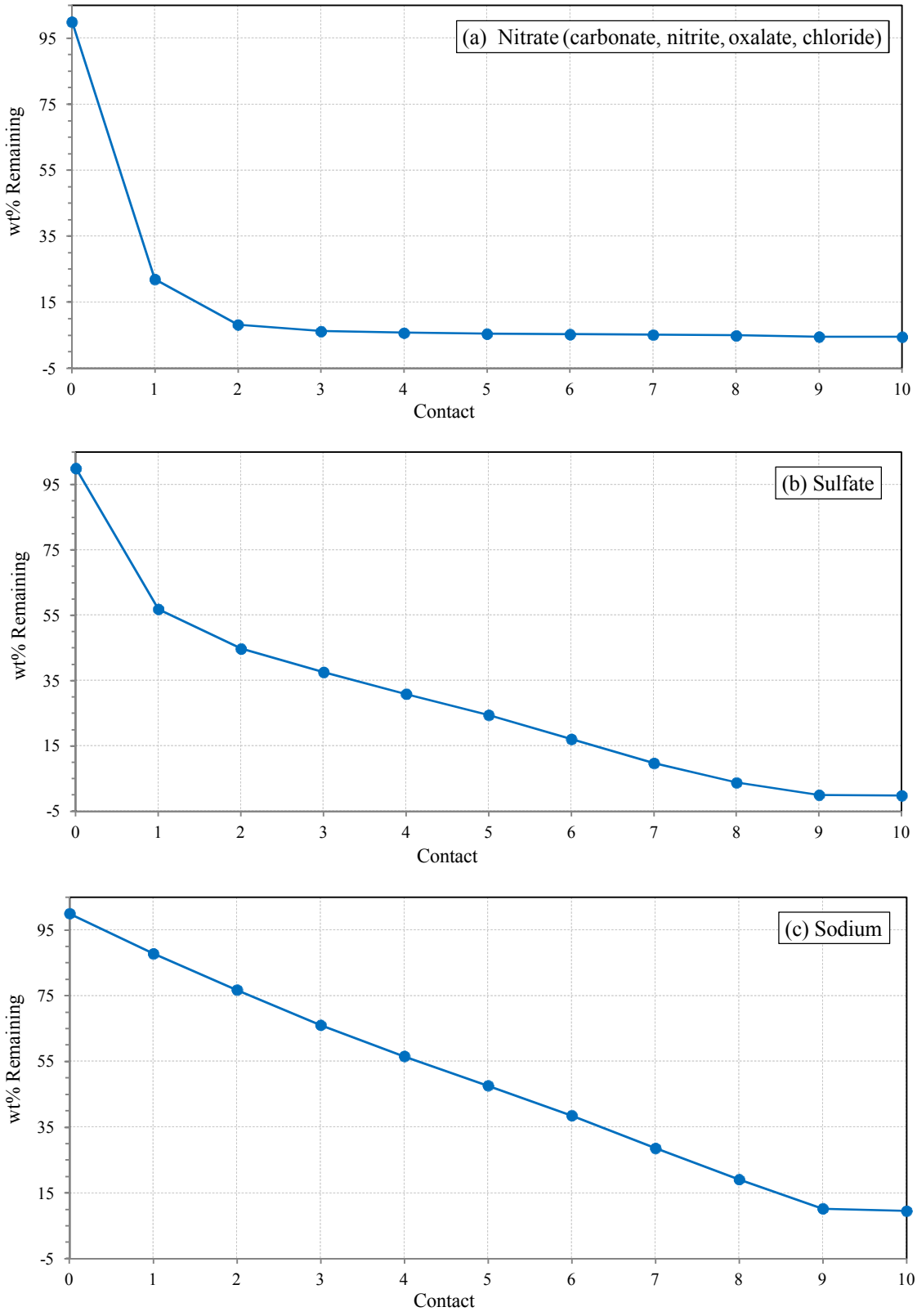
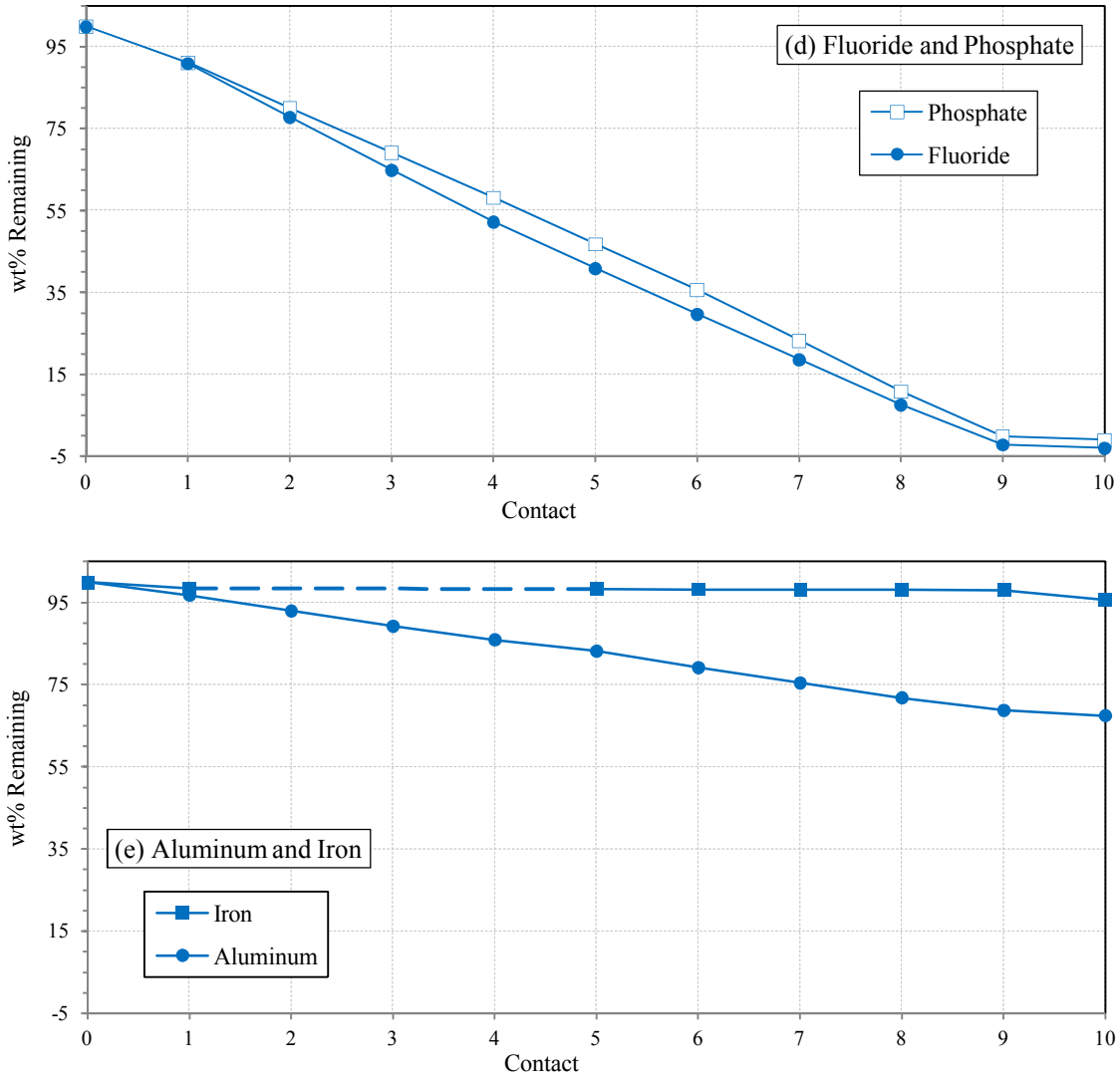


Figure 5-05. Component Inventories in 15 °C Dissolution Test. (2 sheets)



Nearly all of the highly- to moderately-soluble (probably sodium) salts in the test composite—nitrate, carbonate, nitrite, oxalate, and chloride—were dissolved and recovered in the first water contact (Figure 5-05a). After Contact 2, analysis of the recovered test liquids indicated that essentially all of these components present in the composite solids had been removed.

Approximately 43 wt% of the sulfate was also dissolved and recovered in the Contact 1 liquid (Figure 5-05b). In Contact 2 through Contact 9, the balance of the sulfate found in the initial composite was dissolved and recovered in significantly smaller aliquots. This suggests that two sulfate phases were present in the initial composite: a very soluble (probably sodium) salt, and a slightly soluble salt, possibly kogarkoite [$Na_3F(SO_4)$].

The entire 25.3 wt% of phosphate and fluoride in the initial composite was dissolved and recovered in Contact 1 through Contact 9 (Figure 5-05d). The relative amounts removed in each contact were very similar: essentially equal quantities were recovered in Contact 2 through

Contact 9 with a smaller quantity removed in the Contact 1 liquids. After accounting for co-recovery of a portion of the sodium in the initial composite with the very soluble salts, it displayed a similar trend with the balance being dissolved and removed in nearly equal aliquots in Contact 2 through Contact 9 (Figure 5-05c). These observations are consistent with the dissolution and recovery of natrophosphate. If stoichiometric quantities of sodium and water are included with the weights of phosphate and fluoride dissolved and recovered, 86-97 wt% of the initial composite solids were recovered as $Na_7F(PO_4)_2 \cdot 19\ H_2O$.

The chemical analysis data indicates that ≈32 wt% of the aluminum in the initial composite was dissolved and recovered in the 15 °C dissolution test (Figure 5-05e). The aluminum was recovered in small aliquots in Contact 1 through Contact 9 with a somewhat smaller portion removed in Contact 10. Very little of the iron found in the initial composite solids was dissolved and recovered in the test series.

5.3 45 °C DISSOLUTION TEST RESULTS

5.3.1 Test Narrative

The large-scale 45 °C dissolution test series was performed April 28 through May 25, 2011. Five water contacts were completed. During the test series the temperature of the test slurries ranged from 43.7 to 45.6 °C; the temperatures of the slurries just prior to removal from the heated water bath in each contact ranged from 45.0 to 45.6 °C. The rotation rate of the dissolution test vessel during the contacts ranged from 26-32 rpm.

Except for Contact 1 and Contact 3, each test contact was completed as described in Section 5.1.3. After the dissolution water was added in Contact 1 and Contact 3, the test samples were allowed to sit undisturbed at hot cell ambient temperature for 3 days and 2 days, respectively, before they were transferred to the water bath and the 4-day rotation periods were started.

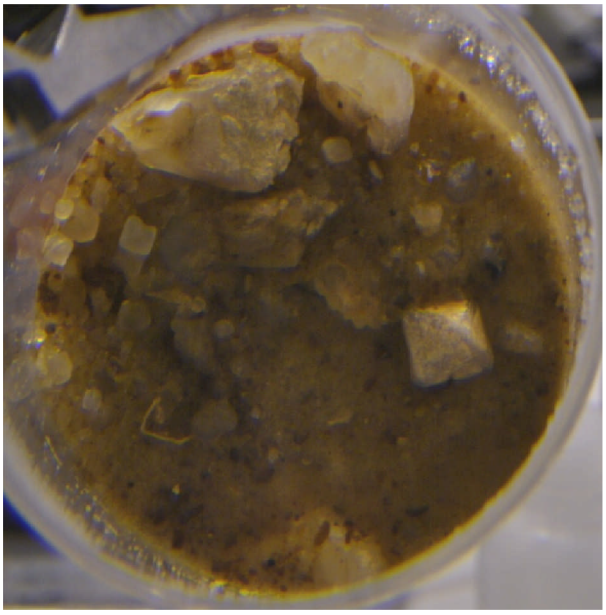
Evaporative weight loss during the 45 °C test contacts ranged from 12.3 g in Contact 2 to 63.3 g in Contact 1. The water additions reported for the test contacts have been reduced to account for the evaporative losses.

In each contact, a single pair of 50-mL centrifuge cones was used to process the liquid removed from the test vessel to minimize cooling during the pipetting and centrifuging operations. In Contact 1 and Contact 2, the turbidity of the test liquids decreased significantly in the ≈30 min the test slurries were allowed to settle after being weighed and returned to the water bath. Centrifuging for 8 min at ≈1000 × *g* produced a clear C-Liq. In Contacts 3-5, the turbidity of the test slurries decreased only slightly as the samples were processed; however, 8-10 min of centrifugation at ≈1000 × *g* was still sufficient to produce a clear C-Liq.

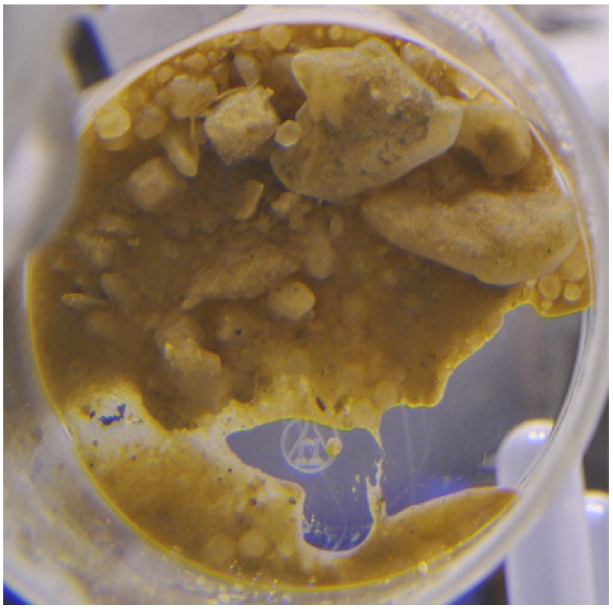
Photographs of the test solids at various stages of the large-scale 45 °C dissolution test are presented in Figure 5-06.

Figure 5-06. Appearance of Heel Solids during 45 °C Dissolution Test.

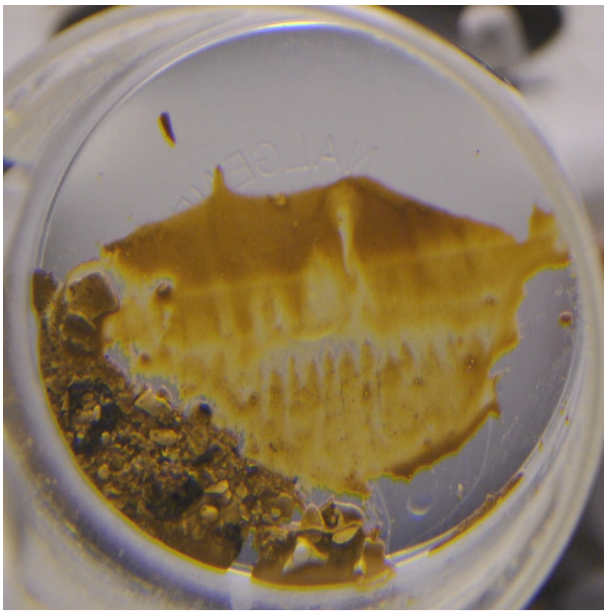
(a) Coarse solids after Contact 1 decant



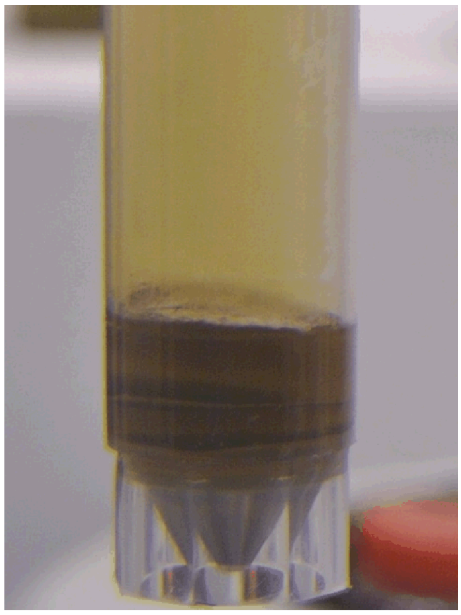
(b) Coarse solids after Contact 3 decant



(c) Coarse solids after Contact 5 decant



(d) Fine C-Slds after Contact 5



As noted in Section 5.1.3, portions of undiluted C-Liq from each 45 °C test contact were transferred to 50-mL centrifuge cones and set aside as temporary archive samples. As soon as these liquids began to cool to hot cell ambient temperature, fine crystalline solids (probably dominated by natrophosphate) began to precipitate from solution.

5.3.2 Gravimetric/Volumetric Results

The results of the gravimetric and volumetric measurements completed in the 11A hot cells and derived quantities are tabulated in Table 5-04 and displayed in Figure 5-07. The data formats are the same used to report the 15 °C test results in Table 5-01 and Figure 5-04. The tabulated weights of water added in each contact are those remaining at the end of the contacts and have been adjusted to account for evaporative losses. The volumes of water added in the test contacts were calculated using the reference density of water at 45 °C (0.990213 g/mL).

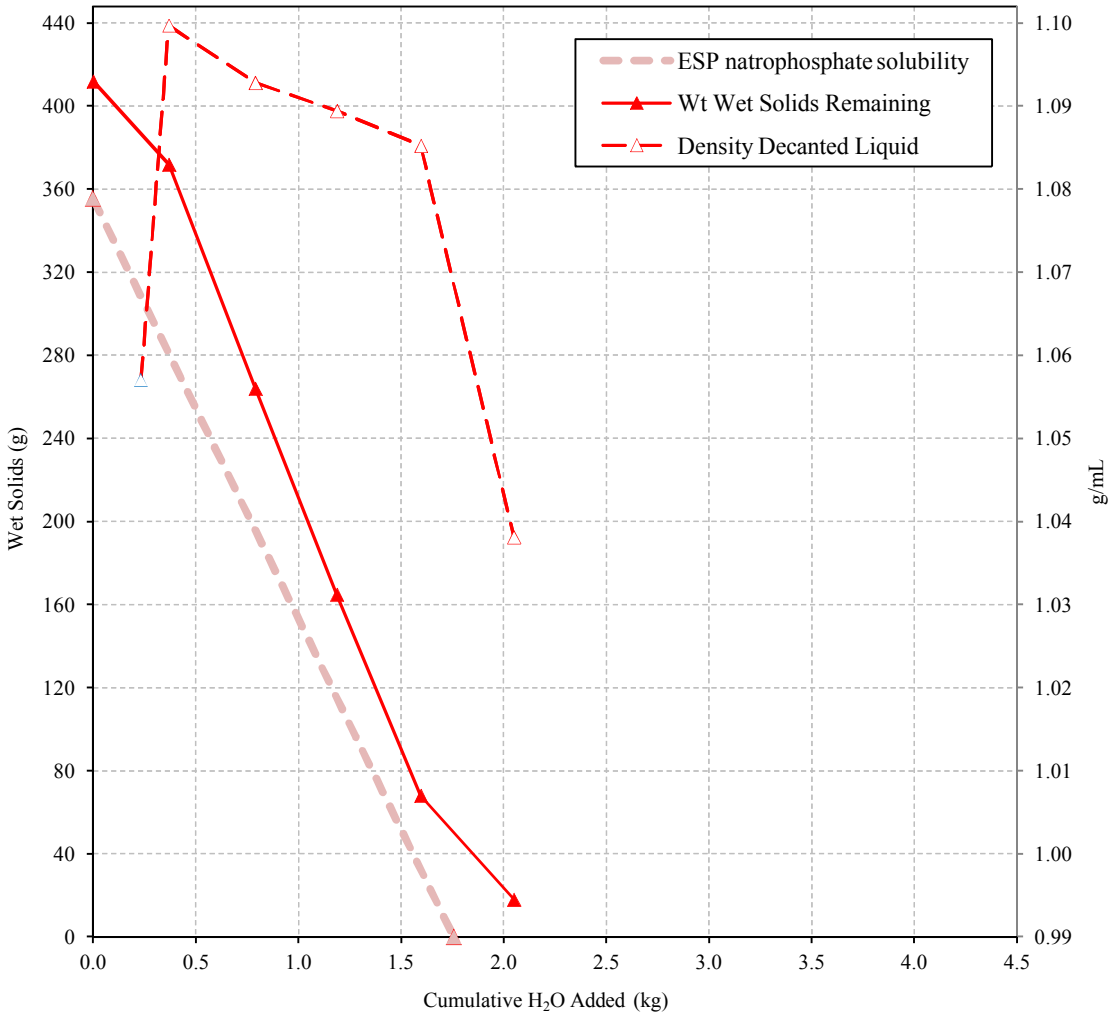
Table 5-04. Hot Cell Results for 45 °C Dissolution Test.

Contact		1		2	3	4	5	
		D_{Bulk}	—					
Initial Composite Solids	(g)	411.86		—	—	—	—	
	(mL)	242.61						
H_2O Added	(g)	233.15	136.13	420.24	397.77	409.00	453.01	
	(mL)	235.45	137.48	424.39	401.70	413.04	457.49	
Cumulative H_2O Added	(g)	369.28		789.52	1,187.3	1,596.3	2,049.3	
	(mL)	372.93		797.32	1,199.0	1,612.1	2,069.6	
Liquid Removed	(g)	16.95	383.65	518.95	486.81	496.78	488.77	
D_{Liq}	(g/mL)	1.057	1.100	1.093	1.089	1.085	1.038	
	(°C)	(24.8)	(43.2)	(37.2)	(42.8)	(41.8)	(40.3)	
Residual Solids		**Wet**					**Damp**	**Dry (Est.)**
Fine C-Slds	(g)	4.59		5.92	30.16	28.15	14.29	5.71
Coarse Slds	(g)	367.21		258.08	134.72	39.84	3.72	3.53
Total Solids Remaining	(g)	371.80		264.00	164.88	67.98	18.01	9.25
	(wt%)	90.3		64.1	40.0	16.5	4.4	2.2

The data show that dissolution and recovery of solids from the initial 411.86 g of test composite using 45 °C water was completed with a cumulative addition of between 1.60 kg (Contact 4) and 2.05 kg (Contact 5) of water. Extrapolation of the Contact 4 weight loss data indicates that ≈1.80 kg of 45 °C water was required to dissolve the soluble components in the composite test sample; interpolation of the Contact 5 D_{Liq} data indicates that ≈1.82 kg of 45 °C water was required. After completion of Contact 5, >95 wt% of the initial solids had been dissolved and recovered. As in the 15 °C tests, the estimated dry weight of the residual solids (based on sieve analysis results) was significantly smaller than the initially recorded damp weight.

When using 45 °C water, the quantity of heel solids dissolved and removed in the first water contact significantly outweighed the interstitial liquid co-recovered with the wet residual solids. The significant increase in D_{Liq} for the final 45 °C Contact 1 liquid compared to the D_{Bulk} portion (collected at 15 °C) supports this observation. However, the smaller decrease in the weight of the remaining solids for Contact 1 relative to those in Contacts 2-4 shows that the inhibition of dissolution of natrophosphate solids due to a sodium common ion effect is still significant.

Figure 5-07. Hot Cell Results for 45 °C Dissolution Test.



Chemical analysis suggested that the 411.9-g 45 °C test composite contained ≈355 g of natrophosphate. Model calculations using ESP indicate that 1.76 kg of 45 °C water would be required to dissolve this quantity of natrophosphate in the absence of other soluble components of the heel solids.

5.3.3 Analysis-based Results

The results of chemical analyses of the test liquids from the large-scale 45 °C water dissolution test are summarized in Table 5-05. The analysis results have been adjusted to correct for the dilution of the test samples prior to transfer to 222-S for analysis. Otherwise the data format is the same as that used to report the 15 °C test results in Table 5-02. Transcripts of the laboratory data summary reports for these samples and the weight and density data used for the dilution corrections are included in Attachment A.

Table 5-05. Analyses of 45 °C Dissolution Test Liquids.

(All results, except for density, in units of µg/mL)

Analyte	D_{Bulk} Liquid	Undiluted Liquid from 45 °C Contact				
		1	2	3	4	5
Density (g/mL)	1.057 (at 24.8 °C)	1.100 (at 43.2 °C)	1.093 (at 37.2 °C)	1.089 (at 42.8 °C)	1.085 (at 41.8 °C)	1.038 (at 40.3 °C)
TOC	202	< 84	< 42	< 42	< 42	< 41
ΔTOC	76	< 84	< 42	< 42	< 42	< 41
TIC	1,700	1,317	210	63	36	38
as CO_3	8,493	6,580	1,049	316	182	187
OH from pH	68	180	358	283	448	552
Fluoride	1,625	5,193	5,403	5,539	5,292	2,333
Chloride	121	82	11	3	< 2	< 2
Nitrite	5,485	3,589	494	61	12	< 4
Sulfate	1,400	1,136	330	313	236	69
Oxalate	371	247	22	< 5	< 5	< 5
Nitrate	10,650	7,051	982	141	39	19
Phosphate	15,450	48,765	49,407	49,304	47,483	22,106
Aluminum	112	800	921	1,217	881	278
Bismuth	< 50	< 106	< 105	< 105	< 105	< 51
Calcium	< 25	< 53	< 53	< 52	< 52	< 26
Chromium	32	22	< 5	< 5	< 5	< 3
Iron	30	37	10	7	< 5	< 3
Manganese	< 2	< 3	< 3	< 3	< 3	< 2
Sodium	27,200	43,065	41,628	40,702	38,907	19,731
Phosphorus	5,210	15,157	16,609	16,553	15,856	7,614
as phosphate	15,975	46,474	50,926	50,754	48,617	23,346
Sulfur	499	342	125	< 105	< 105	< 51
as sulfate	1,495	1,025	374	< 315	< 315	< 153
Silicon	< 15	< 32	< 32	< 32	< 31	22
Strontium	< 2	< 3	< 3	< 3	< 3	< 2
Uranium	189	< 106	< 105	< 105	< 105	< 51

In Table 5-06, the analytical data is recalculated to show the changes in the calculated weights of the components in the initial test composite as the 45 °C dissolution test proceeded. The data format is the same as that used to report the 15 °C test results in Table 5-03.

Table 5-06. Component Inventories in 45 °C Dissolution Test.

		Initial Composite	Dissolved and Removed in 45 °C Contact (Stepwise wt and cumulative wt%)					
			1	2	3	4	5	Total
Phosphate	g	94.80	16.86	23.82	22.36	22.00	10.70	95.74
	wt%	23.0	17.8	42.9	66.5	89.7	101	101
Sodium	g	91.02	15.46	19.77	18.19	17.81	9.29	80.52
	wt%	22.1	17.0	38.7	58.7	78.3	88.5	88.5
Fluoride	g	10.44	1.84	2.57	2.48	2.42	1.10	10.40
	wt%	2.53	17.6	42.2	65.9	89.1	99.7	99.7
Aluminum	g	3.32	0.28	0.44	0.54	0.40	0.13	1.80
	wt%	0.81	8.5	21.6	38.0	50.2	54.1	54.1
Nitrate	g	3.07	2.63	0.47	0.063	0.018	0.009	3.19
	wt%	0.75	85.6	101	103	104	104	104
TIC as CO_3	g	2.85	2.43	0.50	0.14	0.083	0.088	3.24
	wt%	0.69	85.5	103	108	111	114	114
Nitrite	g	1.55	1.34	0.24	0.027	0.005	< 0.002	1.61
	wt%	0.38	86.5	102	103	104	—	104
OH	g	0.97	0.064	0.17	0.13	0.21	0.26	0.83
	wt%	0.24	6.6	24.0	37.0	58.0	84.7	84.7
Sulfate	g	0.86	0.42	0.16	0.14	0.11	0.032	0.86
	wt%	0.21	49.0	67.4	83.7	96.4	100	100
Iron	g	0.65	0.013	0.005	0.003	< 0.002	< 0.001	0.02
	wt%	0.16	2.0	2.8	3.2	—	—	3.2
Strontium	g	0.14	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0
	wt%	0.033	—	—	—	—	—	0
Oxalate	g	0.12	0.092	0.011	< 0.002	< 0.002	< 0.002	0.10
	wt%	0.028	79.3	88.8	—	—	—	88.8
ΔTOC	g	0.06	0.001	< 0.020	< 0.019	< 0.019	< 0.019	0.001
	wt%	0.015	1.6	—	—	—	—	1.6
Chloride	g	0.04	0.030	0.005	0.001	< 0.001	< 0.001	0.036
	wt%	0.009	81.1	94.6	97.3	—	—	97.3

In the plots in Figure 5-08, the cumulative wt% of components of the initial composite that were dissolved and recovered during the large-scale 45 °C dissolution test are displayed. The display format is the same as that used to display the 15 °C test data in Figure 5-05.

Figure 5-08. Component Inventories in 45 °C Dissolution Test. (2 sheets)

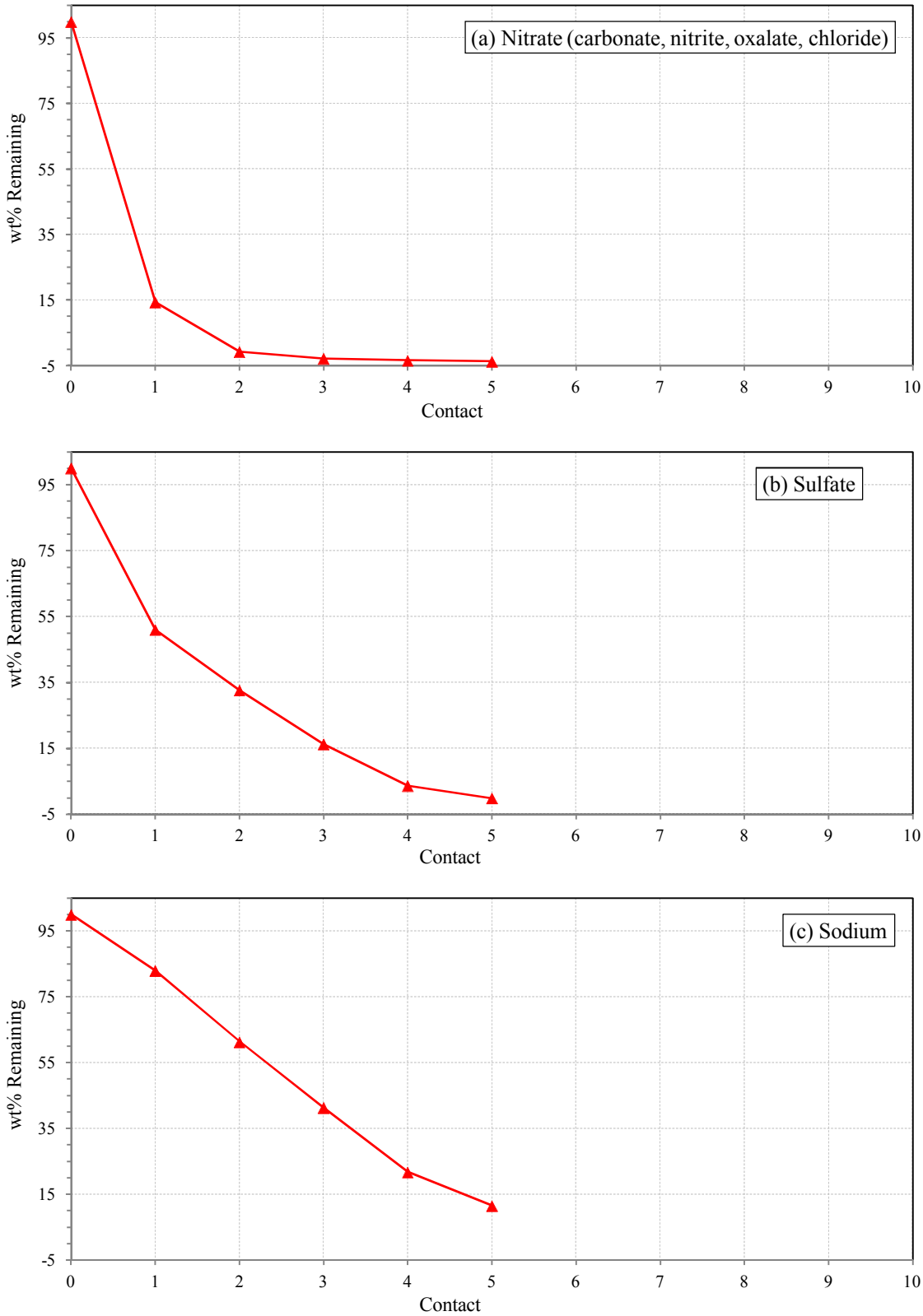
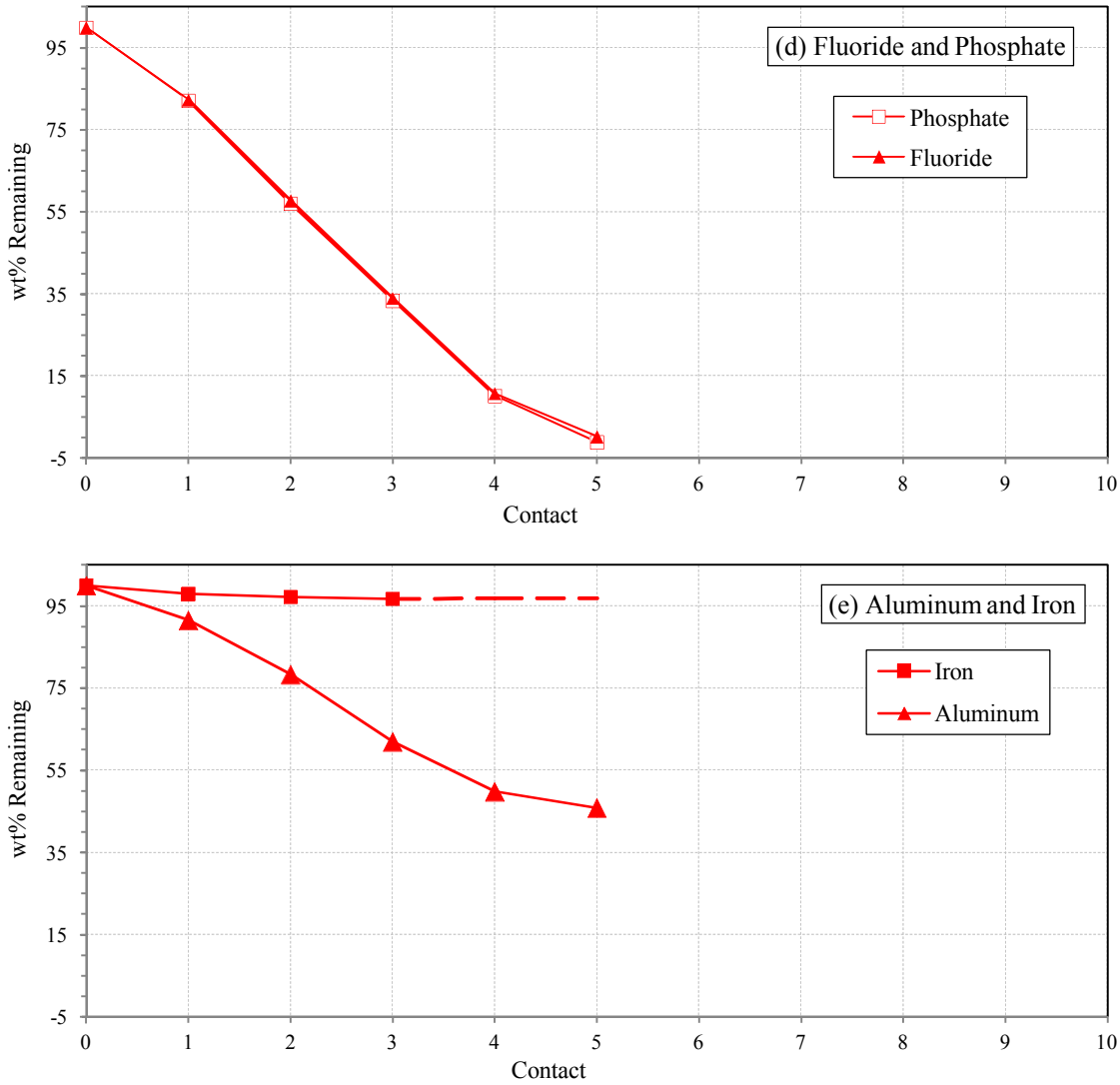


Figure 5-08. Component Inventories in 45 °C Dissolution Test. (2 sheets)



Nearly all of the highly to moderately soluble (probably sodium) salts in the test composite—nitrate, carbonate, nitrite, oxalate, and chloride—were dissolved and recovered in the first water contact (Figure 5-08a). After Contact 2, analysis of the recovered test liquids indicated that essentially all of these components present in the composite solids had been removed.

Approximately 49 wt% of the sulfate was also dissolved and recovered in the Contact 1 liquid (Figure 5-08b). In Contact 2 through Contact 4, the balance of the sulfate found in the initial composite was dissolved and recovered in approximately equal but significantly smaller portions. Again, this suggests that two sulfate phases were present in the initial composite: a very soluble (probably sodium) salt, and a slightly soluble salt, possibly kogarkoite [$Na_3F(SO_4)$].

The entire 25.6 wt% of phosphate and fluoride in the initial composite was dissolved and recovered in the five 45 °C water contacts (Figure 5-08d). Approximately 90 wt% of the fluoride

and phosphate were dissolved and recovered through Contact 4 with the balance recovered in Contact 5. As in the 15 °C tests, dissolution and recovery of sodium followed a trend (Figure 5-08c) very similar to that of fluoride and phosphate. These observations are consistent with the dissolution and recovery of natrophosphate. If stoichiometric quantities of sodium and water are included with the weights of phosphate and fluoride dissolved and recovered in the 45 °C test series, as much as 87-95 wt% of the initial composite solids were recovered as $Na_7F(PO_4)_2 \cdot 19\ H_2O$.

The chemical analysis data indicates that ≈54 wt% of the aluminum in the initial composite was dissolved and recovered in the 45 °C dissolution test (Figure 5-08e). The aluminum was recovered in small, nearly equal portions in Contact 2 through Contact 4 with somewhat smaller portions removed in Contact 1 and Contact 5. Very little of the iron found in the initial composite solids was dissolved and recovered in the test series.

5.4 RESIDUAL SOLIDS

5.4.1 Processing of Residual Solids

The final 'Damp' weights of the Fine C-Slds and Coarse Slds portions of the solids remaining at the conclusion of the 15 °C and 45 °C dissolution tests were recorded on May 31, 2011. At that point the four solids fractions had been consolidated in four 50-mL centrifuge cones (two containing Coarse Slds and two containing Fine C-Slds). Photographs of the two fractions of the Fine C-Slds are shown in Figure 5-03h and 5-06d. The D_{Bulk} of each of the four fractions of residual solids was measured by water displacement as described in Section 5.4.2.

The two Coarse Slds fractions were then combined, and the D_{Bulk} measurement was repeated on June 3, 2011. The two Fine C-Slds fractions were combined and the D_{Bulk} measurement repeated on June 6, 2011.

On June 7-8, 2011, all the residual solids were wet sieved as described in Section 6.1. The solids were separated into four size fractions: >1/4 in.; <1/4 in. but >1.4 mm; <1.4 mm but >710 µm; and <710 µm. After recording the weights of the individual fractions, all the >710-µm solids were combined in a 4.926-g composite. All the <710-µm solids were captured as a slurry of solids in reagent water.

The slurry of <710-µm solids remaining after the wet sieving was allowed to evaporate at hot cell ambient temperatures until June 20, 2011. The resulting slurry was moderately viscous and weighed 72.333 g. A 5.502-g portion of the slurry was transferred to a sample vial and evaporated to dryness at <90°C; the slurry was found to contain 23.88 wt% solids. Therefore, the combined <710-µm solids from the dissolution tests weighed 17.275 g.

On June 22, samples for SPC measurements (S11R000162), particle size distribution (PSD) measurements (S11R000163), and settling behavior (S11R000160 A and B) were taken from the <710-µm slurry and transferred to 222-S for analysis. An additional 1-2 mL of reagent water

was added to the PSD and settling behavior samples to insure that they did not dry out prior to initiation of the test measurements. The weight of the remaining slurry of <710-µm solids was 35.314 g.

The 4.926 g of air-dry, >710-µm solids were then crushed and thoroughly mixed in a small mortar and pestle. A portion of the crushed solids weighing 2.362 g was then added to the remaining slurry of <710-µm solids. This mixture contained 93.7 wt% <710-µm solids slurry and 6.3 wt% crushed >710-µm solids. The mixture was prepared to reproduce the combined residual solids present at the end of the wet sieving operation: 93.6 wt% <710-µm solids slurry and 6.4 wt% of air-dry >710-µm solids. The remaining crushed, >710-µm solids were transferred to a sample vial (sample S11R000188) and submitted to the laboratory for SPC measurements.

After mixing on June 22, the slurry of mixed residual solids weighed 37.68 g, 26.88 g of which were water (based on weight loss data for the wet <710-µm slurry). The mixed slurry was allowed to dry further at hot cell ambient temperature until June 27. The resulting thick paste weighed 12.875 g and contained 10.80 g of solids and 2.08 g of water. After thorough mixing, 12.36 g of the paste was transferred to a sample vial and submitted to 222-S for analysis (sample S11R000161).

5.4.2 Bulk Density Measurements

The D_{Bulk} of the slower settling 'Fine C-Slds' and faster settling 'Coarse Slds' were measured at the conclusion of the 15 °C and 45 °C dissolution tests. For each measurement, the test solids were transferred to a 50-mL centrifuge cone and weighed. The cone was then weighed after sequential filling to nominal volumes of 45, 47.5, and 50 mL with reagent water of known temperature. The average volume displaced by the test solids and the resulting D_{Bulk} values were then calculated. Following the initial set of four D_{Bulk} measurements, the Fine C-Slds and Coarse Slds from the 15 °C and 45 °C tests were combined, and the D_{Bulk} measurements were repeated. The results of the D_{Bulk} measurements on the wet Fine C-Slds and air-dry Coarse Slds from the water dissolution tests are summarized in Table 5-07.

Table 5-07. Bulk Densities of Residual Solids from Water Dissolution Tests.

15 °C Test		45 °C Test		Calculated Average
Wet Fine C-Slds	Coarse Slds	Wet Fine C-Slds	Coarse Slds	
1.35 ± 0.01 g/mL	2.79 ± 0.13 g/mL	1.42 ± 0.03 g/mL	2.34 ± 0.13 g/mL	1.48 g/mL
Combined Wet Fine C-Slds		Combined Coarse Slds		
1.42 ± 0.01 g/mL		2.43 ± 0.06 g/mL		1.54 g/mL
Dry <710-µm Solids		Dry >710-µm Solids		
2.76 g/mL		2.30 g/mL		2.65 g/mL

The relatively low D_{Bulk} values for the Fine C-Slds are due, at least in part, to the retention of a significant portion of water in the centrifuged bulk solids. After sieve analysis (Section 5.4.1 and Section 6.1) the residual solids were found to contain 4.926 g of >710-µm solids and 17.275 g of

<710-µm solids. Combining these weights with the volume measurements completed for the wet Fine C-Slds and Coarse Slds yields the densities in the last row of Table 5-07.

5.4.3 Solid Phase Characterization

Samples of the combined solids remaining after the 15 °C and 45 °C large-scale dissolution tests were submitted for SPC measurements to identify the solid phases present. Samples of the solids that were <710 µm in size (S11R000162) and >710 µm in size (S11R000188) were submitted. Detailed results of the SPC measurements are presented in LAB-RPT-11-00008.

The XRD measurements indicated that gibbsite and nordstrandite [both $Al(OH)_3$] were the dominant solid phases present in both size fractions of the residual solids. No other solid phases were identified in either sample by XRD.

Examination of the two residual solids samples using PLM identified the presence of gibbsite as well as remnants of the dominant natrophosphate [$Na_7F(PO_4)_2 \cdot 19\ H_2O$] solids of the original C-110 heel solids composite. Unidentified opaque solids were also observed in both size fractions using PLM.

Characterization of the >710-µm solids using SEM/EDX indicated that gibbsite was the dominant solid phase present. The presence of major amounts of Fe-oxide and Fe-Cr-oxide solids were also reported. The presence of minor to trace quantities of Al-Fe-Sr-phosphate solids, nastrophite [$NaSr(PO_4) \cdot 9\ H_2O$], Bi-rich solids, and possibly nordstrandite were also indicated by SEM/EDX.

Characterization of the <710-µm solids using SEM/EDX indicated that gibbsite and Na-Al-silicate solids [possibly cancrinite, $Na_8(Al_6Si_6O_{24})(CO_3) \cdot 2\ H_2O$] were the dominant solid phases present. The presence of major amounts of amorphous Al-Fe-Bi-phosphate solids was also reported. The presence of trace quantities of sodium diuranate ($Na_2U_2O_7$) and nastrophite solids were also indicated by SEM/EDX.

5.4.4 Laboratory Analysis

The results of chemical and radiochemical analyses of the remixed sample of residual solids (sample S11R000161 described in Section 5.4.1) are summarized in Table 5-08. The results in the table are presented on a dry-solids basis, i.e., the 16.1 wt% water estimated to have been present in the sample submitted to 222-S for analysis has been removed by calculation. Transcripts of the laboratory data summary reports for the sample of residual solids submitted to the laboratory are included in Attachment A.

The sample preparation codes in the table are the same as those defined in Section 3.3.1 and Attachment A. When the results of analyses of different sample preparations were similar, average concentrations and multiple preparation codes are tabulated.

Table 5-08. Composition of Dry Residual Solids from Water Dissolution Tests.

Analyte	Prep Codes		
Density		1.54	g/mL
Wt% H_2O (calculated)		0	wt%
TOC		678	µg/g
ΔTOC		678	µg/g
TIC		1,092	µg/g
TIC as CO_3		5,457	µg/g
pH		—	
Oxalate	W	< 44	µg/g
Nitrite	W	45	µg/g
Nitrate	W	181	µg/g
Fluoride	W	1,902	µg/g
Phosphate	W	31,299	µg/g
Sulfate	W	46	µg/g
Chloride	W	28	µg/g
Lithium	A	29	µg/g
Sodium	A/F/Z	68,590	µg/g
Magnesium	A/F	4,757	µg/g
Aluminum	A/F/Z	216,710	µg/g
Silicon	F/Z	18,004	µg/g
Phosphorus	A/F/Z	55,906	µg/g
as Phosphate		171,419	µg/g
Sulfur	F/Z	< 7,106	µg/g
as Sulfate		< 21,290	µg/g
Calcium	A/F	2,859	µg/g
Titanium	A/F	61	µg/g
Chromium	A/F/Z	1,197	µg/g
Manganese	A/F/Z	382	µg/g
Iron	A/F/Z	94,643	µg/g
Nickel	A	200	µg/g
Copper	A/F	193	µg/g
Zinc	A/F/Z	727	µg/g
Strontium	A/F/Z	11,847	µg/g
Barium	A/F	189	µg/g
Cerium	A	550	µg/g
Neodymium	A	78	µg/g
Lead	A/F/Z	4,769	µg/g
Bismuth	A/F/Z	47,336	µg/g
Uranium	A	1,657	µg/g

Analyte	Prep Codes		
Strontium-89/90	F	6.71E+02	µCi/g
Technetium-99	A	4.82E-01	µg/g
Iodine-129		< 3.66E-05	µCi/g
Cesium-137	F	7.87E+00	µCi/g
Uranium-233	F	< 2.79E-01	µg/g
Uranium-234	F	7.77E-02	µg/g
Uranium-235	F	1.03E+01	µg/g
Uranium-236	F	7.86E-02	µg/g
Neptunium-237	F	4.03E-01	µg/g
Uranium-238	F	1.49E+03	µg/g
Plutonium-238	F	5.51E-03	µCi/g
Plutonium-239/240	F	9.13E-01	µCi/g
Americium-241	F	3.27E-02	µCi/g

In Table 5-09, the analytical data for chemical components is recalculated as weights and wt%s of the components present in the 22.2 g of dry solids that remained after the 15 °C and 45 °C dissolution tests. The components are presented in decreasing order of their concentrations in the residual solids. The calculated combined inventory of the components in the initial 15 °C and 45 °C test composites are also tabulated for comparison.

Table 5-09. Component Inventories in Test Composite and Dry Residual Solids.

Analyte	Dry Residual Solids				Initial Composites			
Total Wt	22.20	g	—		825.01	g	—	
Aluminum	4.81	g	21.67	wt%	6.61	g	0.80	wt%
Insoluble phosphate	3.11	g	14.01	wt%	2.42	g	0.29	wt%
Iron	2.10	g	9.46	wt%	1.30	g	0.16	wt%
Sodium	1.52	g	6.86	wt%	181.43	g	21.99	wt%
Bismuth	1.05	g	4.73	wt%	< 4.3	g	< 0.52	wt%
Soluble phosphate	0.70	g	3.13	wt%	187.75	g	22.76	wt%
Silicon	0.40	g	1.80	wt%	< 1.3	g	< 0.16	wt%
Strontium	0.26	g	1.18	wt%	0.27	g	0.03	wt%
TIC as CO_3	0.12	g	0.55	wt%	5.67	g	0.69	wt%
Lead	0.11	g	0.48	wt%	< 2.2	g	< 0.26	wt%
Magnesium	0.11	g	0.48	wt%	< 2.2	g	< 0.26	wt%
Calcium	0.06	g	0.29	wt%	< 2.2	g	< 0.26	wt%
Fluoride	0.04	g	0.19	wt%	20.80	g	2.52	wt%
Uranium	0.04	g	0.17	wt%	0.16	g	0.02	wt%
Chromium	0.03	g	0.12	wt%	< 0.22	g	< 0.03	wt%
Zinc	0.02	g	0.07	wt%	< 0.22	g	< 0.03	wt%
ΔTOC	0.02	g	0.07	wt%	0.12	g	0.01	wt%
Cerium	0.01	g	0.06	wt%	< 1.3	g	< 0.16	wt%
Manganese	0.008	g	0.04	wt%	< 0.13	g	< 0.02	wt%
Nickel	0.004	g	0.02	wt%	< 0.86	g	< 0.10	wt%
Copper	0.004	g	0.02	wt%	< 0.22	g	< 0.03	wt%
Barium	0.004	g	0.02	wt%	< 0.13	g	< 0.02	wt%
Nitrate	0.004	g	0.02	wt%	6.12	g	0.74	wt%
Neodymium	0.002	g	0.01	wt%	< 0.43	g	< 0.05	wt%
Titanium	0.001	g	0.01	wt%	< 0.22	g	< 0.03	wt%
Soluble sulfate	0.001	g	< 0.01	wt%	1.70	g	0.21	wt%
Nitrite	0.001	g	< 0.01	wt%	3.09	g	0.37	wt%
Lithium	0.001	g	< 0.01	wt%	< 0.13	g	< 0.02	wt%
Chloride	0.001	g	< 0.01	wt%	0.07	g	0.01	wt%
Oxalate	< 0.001	g	—		0.23	g	0.03	wt%
OH from pH	—		—		1.94	g	0.24	wt%
H_2O (Loss at <100 °C)	—		—		375.70	g	45.54	wt%

The 'soluble phosphate' and 'soluble sulfate' components in Table 5-09 are based on the results of IC analyses for phosphate and sulfate performed on aqueous leachates of the test solids. The 'insoluble phosphate' components were calculated by first converting phosphorous concentrations reported from ICP-AES analyses of fusion sample preparations to equivalent phosphate values and then subtracting the corresponding 'soluble phosphate' quantities. This is a descriptive convenience and is not intended to imply that the excess phosphorous measured by ICP-AES is present wholly or in part as phosphate. No sulfur concentrations above minimum detection limits were reported for ICP-AES analyses of fusion preparations of the test composites or the residual solids.

The estimated inventories of radiochemical components in the dry residual solids and in the initial test composites are tabulated in Table 5-10.

Table 5-10. Inventories of Radionuclides in Residual Solids and Test Composites.

Analyte	Dry Residual Solids	Initial Composites
Strontium-89/90	1.49E+04 µCi	1.85E+04 µCi
Technetium-99	1.07E+01 µg	2.11E+02 µg
Iodine-129	< 8.13E-04 µCi	3.10E-03 µCi
Cesium-137	1.75E+02 µCi	1.92E+03 µCi
Uranium-234	1.73E+00 µg	8.95E+00 µg
Uranium-235	2.29E+02 µg	1.14E+03 µg
Uranium-236	1.74E+00 µg	7.06E+00 µg
Neptunium-237	8.95E+00 µg	< 4.30E+01 µg
Uranium-238	3.31E+04 µg	1.60E+05 µg
Plutonium-238	1.22E-01 µCi	< 2.08E+00 µCi
Plutonium-239/240	2.03E+01 µCi	3.17E+01 µCi
Americium-241	7.26E-01 µCi	1.37E+00 µCi

In order of decreasing weight lost, the wt%s of the following components were smaller in the residual solids than in the initial composite solids: H_2O, soluble phosphate, sodium, fluoride, nitrate, carbonate (TIC as CO_3), nitrite, soluble sulfate, oxalate, and chloride. Less than 2% of the amount of each component present in the initial test composites was estimated to remain in the dry residual solids.

The removal of ≈99.7% (207.8 g) of soluble phosphate+fluoride from the composite solids is consistent with dissolution and removal of a dominant natrophosphate solid phase. This would also account for 88.2% (160.1 g) of the sodium and 90.6% (340.4 g) of the water removed from the composite heel solids. The ratios of these components removed from the initial composites are 8.7 Na:1 F:9.0 PO_4:17.7 H_2O by weight; the ratios of these components in natrophosphate are 8.5 Na:1 F:10 PO_4:18 H_2O.

The wt%s of all the remaining components in Table 5-09 were greater in the dry residual solids than in the initial composite solids. At 21.7 wt%, aluminum was the largest component, by weight, in the residual solids. The SPC examinations of the residual solids indicated that $Al(OH)_3$, as gibbsite and nordstrandite, was the dominant component. If the entire 4.81 g of

aluminum estimated to be present was in the form of $Al(OH)_3$, it would represent 62.6 wt% of the residual solids.

The significant portions of insoluble phosphate, iron, bismuth, silicon, and strontium in the dry residual solids (and the smaller quantities of chromium and uranium) are consistent with the presence of the solid phases identified in the SPC examinations (Sections 3.1 and 5.4.3).

Of the radionuclides tabulated in Table 5-10, the estimated activities/weights of ^{99}Tc, ^{129}I, ^{137}Cs, ^{234}U, ^{235}U, ^{236}U, and ^{238}U in the dry residual solids were <25% of the weights/activities in the initial composite solids. In particular, most of the ^{99}Tc and ^{137}Cs present in the initial heel solids composites were removed in the water dissolution tests.

5.5 SUMMARY WATER DISSOLUTION RESULTS

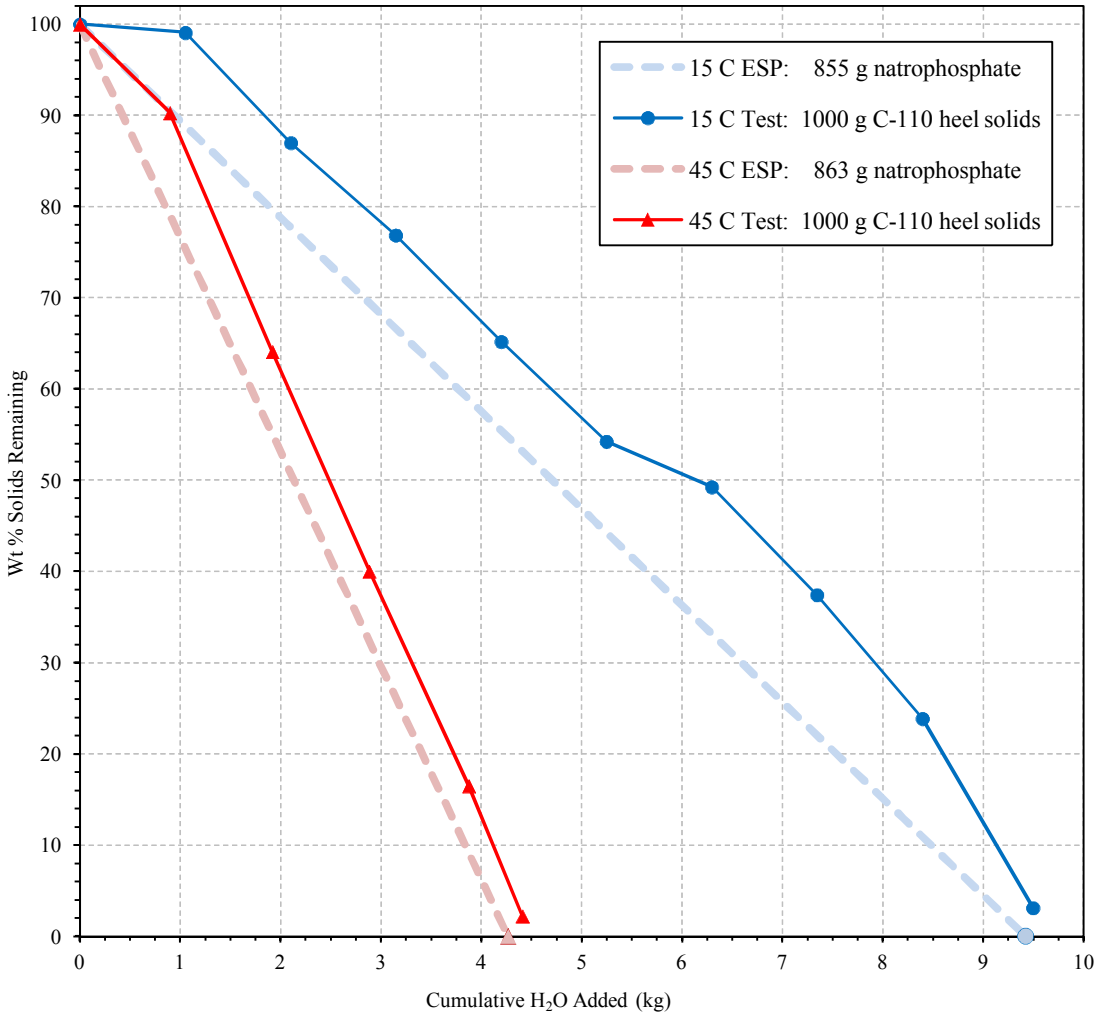
The combined weight of the two test composites of semi-dry, C-110 heel solids composites at the beginning of the 15 °C and 45 °C water dissolution test series was 825.0 g. The combined weight of solids remaining at the conclusion of the two tests was < 45.8 g and ≥ 22.2 g. These values indicate that 94-97 wt% of the C-110 heel solids can be retrieved by dissolution in water.

Chemical analysis and SPC measurements indicated that the initial heel solids were 84.9-86.8 % natrophosphate by weight and that nearly all the natrophosphate was dissolved and recovered in the dissolution tests. The major solid phase identified in the residual solids was $Al(OH)_3$ (as gibbsite and nordstrandite). Significant quantities of unidentified phosphate-, Fe-, Bi-, Si-, and Sr-bearing species were also present in the residual solids.

The quantity of water required to dissolve and recover the soluble components in 1 kg of the C-110 heel solids is displayed in Figure 5-09. Dissolution and removal of ≈969 g of water soluble components from 1 kg of the C-110 heel solids composite required the stepwise addition of ≈9.50 kg of water at 15 °C. Dissolution and removal of ≈978 g of water soluble components from 1 kg of the C-110 heel solids composite required the stepwise addition of ≈4.40 kg of water at 45 °C.

Chemical and SPC analyses indicated that 1 kg of the 15 °C test composite contained ≈855 g of natrophosphate and that 1 kg of the 45 °C test composite contained ≈863 g of natrophosphate. Calculations using ESP indicated that, in the absence of other soluble components of the heel solids, 9.42 kg of 15 °C water would be required to dissolve the natrophosphate in 1 kg of the 15 °C test composite and that 4.27 kg of 45 °C water would be required to dissolve the natrophosphate in 1 kg of the 45 °C test composite.

Figure 5-09. Water Required to Dissolve Soluble Components of Heel Solids.



The quantities of water required to retrieve the soluble heel solids components in the large-scale dissolution tests are consistent with the dissolution of solids composed mainly of natrophosphate with a major portion of the balance composed of highly soluble sodium salts. The ESP calculations indicate that dissolution of natrophosphate at 15 °C requires 2.23 times more water than at 45 °C. The dissolution test results indicate that ≈2.14 times more water is required to dissolve the soluble components in the heel composite at 15 °C than at 45 °C. Given the multiple sources of potential error in the combined data sets of the dissolution tests, this difference between the ESP calculations and the test data is not considered to be significant.

Gibbsite and nordstrandite [both $Al(OH)_3$] were the major solid phases definitively identified in the residual solids. Analyses of decanted liquids indicated that 32.5% (1.07 g) of the Al in the test composite was dissolved and recovered in the 15 °C dissolution test, and 54.1% (1.80 g) of the Al in the test composite was dissolved and recovered in the 45 °C dissolution test. Analyses of the initial composite and residual solids samples indicated that 27.2% (1.8 g) of the Al in the test composites was dissolved and recovered in the dissolution tests. While the consistency of these data sets is not optimal, the analyses indicate that approximately one-third of the Al-bearing solids in the initial composite solids can be retrieved by dissolution in water. The test data also indicate that significantly more of the Al-bearing solids can be retrieved using 45 °C water. The identity of the Al-bearing solids removed by water dissolution is unknown.

6.0 PHYSICAL CHARACTERIZATION OF RESIDUAL SOLIDS

Tests were performed to characterize the PSD and settling behavior of the solids remaining after the dissolution tests were completed. The results of these measurements should be used with caution.

The degree to which the samples of heel solids retrieved from C-110 were representative of the size and chemical composition of the material in the tank is unknown but suspect. Also, while preservation of the overall size distribution and chemical composition of the received heel solids samples during preparation of the test composites was a primary goal, the degree to which that goal was achieved is difficult to access.

The PSD in the residual solids was affected not only by dissolution of the composite solids but also by the physical reduction in grain sizes during the dissolution tests. The slow rotation of the test solids for 39 days in the 15 °C test series and 20 days in the 45 °C test series was almost certainly more efficient in reducing the grain sizes of the test solids than any mixing likely to be performed during actual retrieval of C-110 heel solids.

Finally, a slurry containing ≈1% by weight of residual solids that were <710 µm in size in reagent water was prepared for the settling test. Relatively small changes in the pH and/or salt content of the fluid phase actually present during retrieval operations could significantly alter the stability of suspensions of heel solids.

6.1 SIEVE ANALYSIS

6.1.1 Samples and Apparatus

At the conclusion of D_{Bulk} measurements on the residual solids from the large-scale dissolution tests, the Coarse Slds from the 15 °C and 45 °C tests had been combined in one test sample and the Fine C-Slds from the 15 °C and 45 °C tests had been combined in another. Both samples were wet sieved to characterize a coarse PSD for the residual solids.

Three sieves were used in the sieve analysis: a ¼-in. sieve, a U.S. Standard No. 14 sieve, and a U.S. Standard No. 25 sieve. Each sieve was 3 in. in diameter with stainless steel frame and wire cloth. Key dimensions of the sieve wire cloths taken from ASTM E11, *Standard Specification for Wire Cloth and Sieves for Testing Purposes* are:

Sieve	Nominal Opening	Variation in Average Opening	Opening Dimension Exceeded by <5% of Openings	Maximum Opening Dimension
¼-in.	6.3 mm	± 0.200 mm	6.64 mm	6.78 mm
U.S. Standard No.14	1.4 mm	± 0.050 mm	1.505 mm	1.565 mm
U.S. Standard No. 25	710 µm	± 30 µm	775 µm	815 µm

The inner diameter of the neck of a 16-oz wide-mouth jar (the receiver jar) was widened slightly so that the bottom of the 710-µm test sieve slid into it easily and was supported on the top rim of the jar.

A 125-mL plastic wash bottle was used to direct a stream of deionized water on the solids to facilitate the sieve separation.

6.1.2 Sieving Operations

The sieve analysis was begun on June 7, 2011, in the 11A hot cells. At the conclusion of the D_{Bulk} measurements on the residual solids (Section 5.4.2), all the wet residual solids were contained in two 50-mL centrifuge cones. The three test sieves and the receiver jar were weighed. The 710-µm sieve was then placed on the receiver jar, the 1.4-mm sieve was stacked on the 710-µm sieve, and the ¼-in. sieve was stacked on the 1.4-mm sieve. The residual Coarse Slds were then transferred to the wire cloth of the ¼-in. sieve. Using the small wash bottle, a stream of deionized water was used to sequentially wash the residual solids through the ¼-in., 1.4-mm, and 710-µm sieves. The slurry of water and <710-µm solids was captured in the receiver jar.

After air-drying at hot cell ambient temperatures, the weights of the residual solids retained on the three test sieves were recorded. All the Coarse Slds retained on the three sieves were then combined in a single container and set aside.

The wet sieving operation was then repeated for the sample of residual Fine C-Slds. None of the Fine C-Slds were retained on the 1/4-in. and 1.4-mm sieves. After weighing, the solids retained on the 710-µm sieve were added to the >710-µm solids from the Coarse Slds sieve separation. The slurry of water and <710-µm solids was captured in the receiver jar with the slurry from the Coarse Slds sieving.

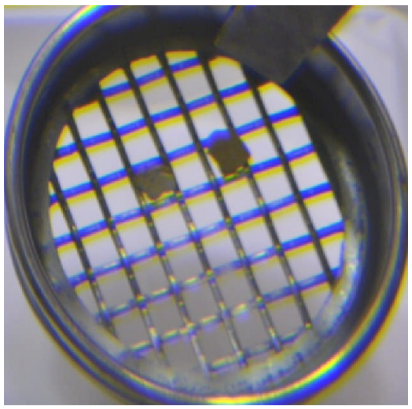
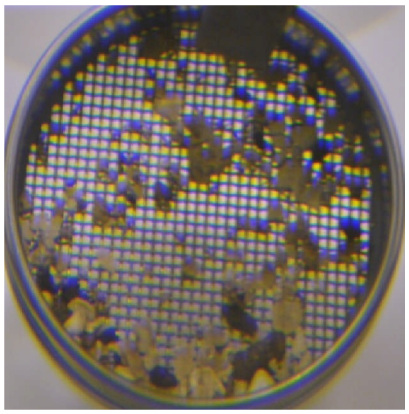
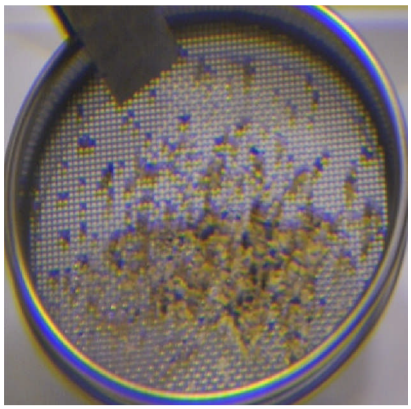
Over the period from June 8–June 20, the ≈380 mL of <710-µm solids slurry was allowed to evaporate at hot cell ambient temperatures. On June 20 the slurry weighed 72.333 g. A small sample was evaporated to dryness and the slurry was found to contain 23.88 wt% solids (Section 5.4.1).

6.1.3 Wet Sieving Results

Photographs of the damp Coarse Slds retained on the three test sieves are shown in Figure 6-01. Photographs of the Fine C-Slds from the two dissolution tests, which were almost entirely <710 µm in size, are shown in Figures 5-03h and 5-06d.

Figure 6-01. Size Fractions of Residual Coarse Solids after Sieving.

(Inside diameter of sieves is 7.5 cm.)

>1/4 in.	<1/4 in. but >1.4 mm	<1.4 mm but >710 µm
		

The gravimetric results of the wet-sieving tests are summarized in Table 6-01.

Table 6-01. Wet Sieving of Residual Solids.

Size fraction	Coarse Slds (g)	Fine C-Slds (g)	Combined Dry Residual Solids (g)	Combined Dry Residual Solids (wt%)
> 1/4 in.	0.411	0	0.411	1.85
< 1/4 in. but > 1.4 mm	3.451	0	3.451	15.54
< 1.4 mm but > 710 µm	1.054	0.010	1.064	4.79
< 710 µm	—	—	17.275	77.81
Total			22.201	—

6.2 LIGHT-SCATTERING MEASUREMENTS

6.2.1 Test Sample and Apparatus

The PSD within the <710-µm sieve size fraction of the residual solids was measured using a light-scattering-based technique. A sample (S11R000163) of the slurry of <710-µm solids generated in the sieve analysis was used for this measurement.

The PSD measurements were performed using the Horiba®[5] LA-910 Laser Scattering Particle Size Distribution Analyzer in 222-S. The LA-910 is an ensemble type, light-scattering-based PSD analyzer. The measurement actually performed defines the light-scattering pattern created when a large number of sample particles scatter the light in the focused beam(s) of the analytical probe(s). The reported results describe a virtual population of optically isotropic and homogeneous, spherical particles with a distribution of diameters that would, given the same

[5] Horiba is a registered trademark of Horiba, Ltd. Corporation Japan, Kyoto, Japan.

experimental parameters, generate a similar light-scattering pattern. The reported particle sizes are the diameters of the spherical particles in this virtual population, i.e., equivalent spherical diameters.

The full details of the PSD measurement, complete data results including raw data files, relevant limitations, and quality control measurement results are presented in Attachment B.

6.2.2 Light Scattering Particle Size Distribution Measurements

The PSD in the <710-µm sieve size fraction of residual solids from the large-scale dissolution tests on the C-110 heel solids was measured in triplicate. A separate portion was removed from sample vial S11R000163 for each measurement. Each of the triplicate PSD measurements consisted of a set of three consecutive PSD runs.

Run 1 was initiated as quickly as possible after transfer of the sample solids to 210 mL of reagent water circulating in the PSD analyzer. The minimum circulation pump and stirrer speeds consistent with reliable PSD measurements were utilized. The Run 1 results represent PSDs measured in the minimum time and under the lowest shear conditions possible.

In Run 2, initiated immediately following completion of Run 1, the speed settings of both the circulation pump and stirrer in the analyzer were kept constant. The specimen slurry was circulated through the analyzer for 2 min prior to initiation of the second light-scattering measurement. The Run 2 results represent PSDs where dissolution or dispersion resulting from extended exposure to water under relatively low shear forces may be evidenced.

In Run 3, initiated immediately following the completion of Run 2, the pump and stirrer speeds were unchanged but the specimen slurry underwent low-power ultrasonic treatment (sonication) for 2 min prior to initiation of the third (and final) light-scattering measurement. The Run 3 results represent PSDs after exposure of the specimen solids to mild-to-moderate shear forces.

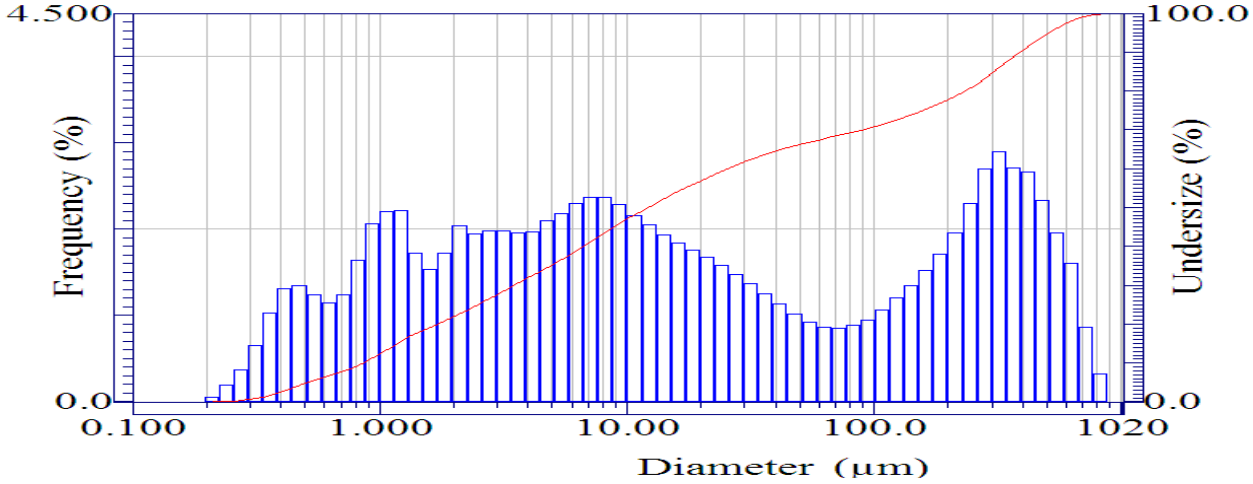
6.2.3 Results of Light-scattering Measurements

6.2.3.1 Histograms and %-Undersize Curves: The averaged, volume-based histograms and cumulative %-undersize curves displaying the results of the triplicate PSD measurements on the <710-µm C-110 residual solids are presented in Figure 6-02.

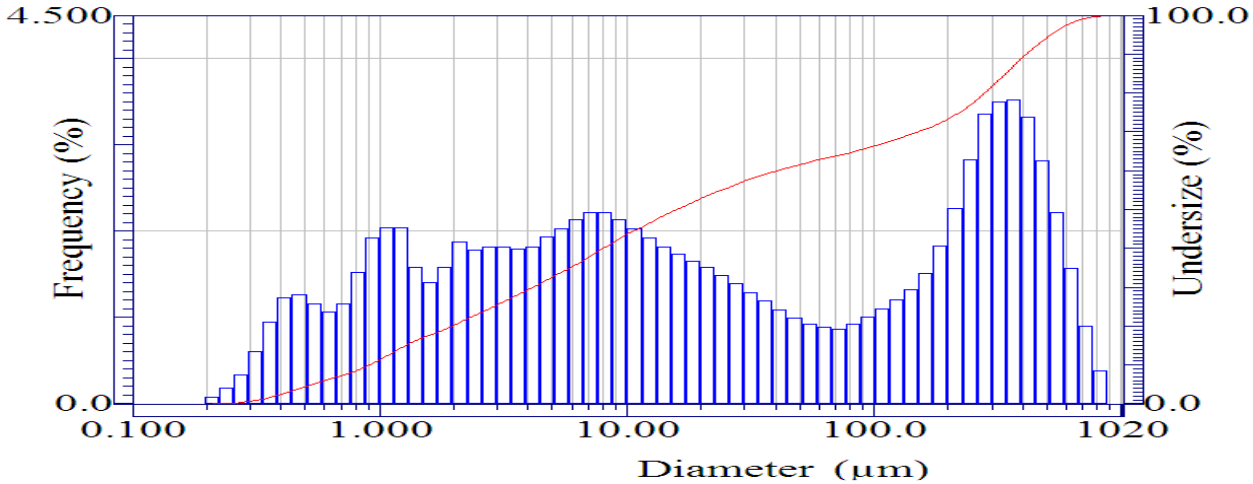
The header for each PSD run in Figure 6-02 displays the stirrer speed setting, the circulation pump speed setting, whether the specimen slurry was sonicated for 2 min, and the average duration of the run (in minutes). For Run 1, the average duration includes the approximate time required to introduce the PSD specimen into the analyzer sample tank.

Figure 6-02. Volume-based Particle Size Distributions in <710-µm Residual Solids.

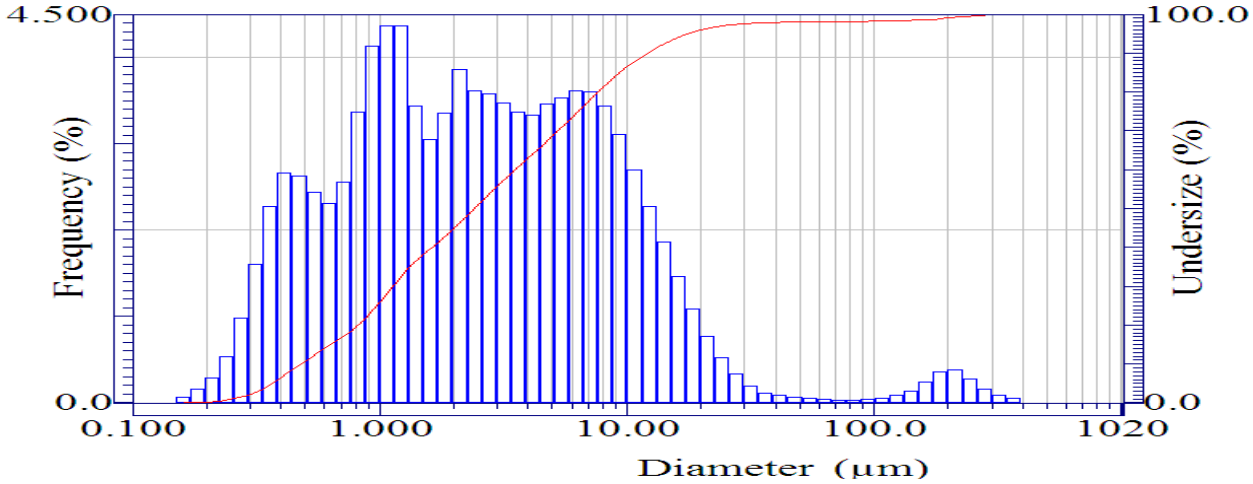
Run 1 — Stir Speed: S1-3 Pump Speed: P3-5 Sonication: None Duration: 2.3 min



Run 2 — Stir Speed: S3 Pump Speed: P5 Sonication: None Duration: 3.2 min



Run 3 — Stir Speed: S3 Pump Speed: P5 Sonication: 2.0 min Duration: 3.4 min



6.2.3.2 Cumulative %-Undersize Data: The particle diameters associated with five pre-selected points on the cumulative %-undersize curves describing the volume-based PSDs for the <710-µm C-110 residual solids are presented in Table 6-02. The particle diameters associated with 10-, 25-, 50-, 75-, and 90 %-undersize cut points are presented in the table. (These values are commonly reported as d10, d25, d50, d75, and d90 particle diameters, respectively.)

Table 6-02. Diameter vs. %-Undersize Data for <710-µm Residual Solids.

PSD Run	Diameters of Particles (µm) at Volume-based %-Undersize Cut Points				
	10%	25%	50%	75%	90%
1	0.86	2.5	12	160	389
2	0.91	2.9	16	221	414
3	0.48	0.97	2.4	6.4	12

6.2.3.3 Summary Light-scattering Results: The averaged PSDs for Run 1 and Run 2 on the C-110 <710-µm residual solids are very similar qualitatively and quantitatively. This suggests that dissolution of sample solids, precipitation of new solids, or dispersal of weakly bound agglomerates was occurring quite slowly, if at all, under the low-shear conditions applied.

In the Run 3 distributions, most of the population of particulates with equivalent diameters >20 µm observed in the Run 1 and Run 2 PSDs is absent while the population with diameters <20 µm was essentially the same as in Runs 1 and 2. A significant decrease in the %-transmission of blue light (λ = 450 nm) through the Run 3 specimen suspensions confirmed that the relative proportion of smaller particulates was significantly greater than in Runs 1 and 2. The changes in the Run 3 PSDs are probably due to the breakup of weakly bound aggregates of the residual solids during the 2 min of low-energy sonication applied. The PSD data suggests that nearly all of the particulates in the analyzed slurries that were >12 µm in diameter were actually weakly bound aggregates of particles that were <1-2 µm in size.

6.3 SETTLING BEHAVIOR

The settling behavior of a slurry containing ≈1% by weight of the <710-µm C-110 residual solids was observed. A series of settling rate tests to determine the weights of C-110 residual solids that settle from a well-mixed aqueous slurry at predefined rates were cancelled at client direction.

6.3.1 Test Sample and Apparatus

6.3.1.1 Settling Test Apparatus: A glass settling column was used in the settling tests. The total length of the column was 50 cm; the internal diameter was 4 cm. The settling column had screw-cap closures on both ends to facilitate introduction and recovery of test samples. The

column was mounted in a stand and clamp system that allowed it to be rotated end-over-end about an axis perpendicular to the long axis of the column.

The distance from the 0.0-cm mark ≈5 cm down from the top of the column to the top of a rubber plug sealing the bottom of the column was 44.5 cm. The volume of the 44.5-cm working depth of the column was 544.1 mL. A settling distance scale, extending 43 cm down from the 0.0 mark, was inscribed on the outside of the column.

6.3.1.2 Settling Test Sample: As described in Section 5.4.1, material for the settling test was taken from the slurry of <710-µm residual solids created during wet sieving of the residual solids (Section 6.1). The settling test sample was collected in two sample vials (S11R000160 A and B) containing a combined 22.913 g of slurry. Before the samples were withdrawn, the parent slurry of <710-µm residual solids was found to contain 23.88 wt% solids. The settling test sample, therefore, contained a combined 5.472 g of the <710-µm solids.

The settling test specimen was a 544.1-mL slurry of the 5.472 g of <710-µm solids in water at ≈22 °C. Using the calculated density of 2.76 g/mL for the <710-µm residual solids (Table 5-07), the test specimen contained 1.00 wt% and 0.36 vol% solids. Using the 2.42 g/mL reference density of gibbsite for the solids, the test specimen contained 1.00 wt% and 0.42 vol% solids.

6.3.2 Settling Test Procedure

The settling test was performed as follows:

1. The bottom plug and screw cap were assembled on the bottom of the settling column.
2. All the material in the two vials of <710-µm C-110 residual solids (S11R000160 A and B) were then quantitatively transferred into the column. The vials were rinsed with reagent water as required to complete the transfer.
3. The column was filled to the 0.0-cm mark with reagent water, and the top screw cap was attached.
4. The column was rotated end-over-end until the sample solids appeared to be well dispersed. The final half-rotation brought the top of the settling column from the 6 o'clock to the 12 o'clock position.
5. Immediately after bringing the column upright a test timer was started.
6. The settling solids were observed and photographed periodically for 46.5 hr.

The average temperature near the face of the hood in 222-S/Room 1C where the settling tests were performed was 22 °C during the test.

At the conclusion of the settling behavior test, the test slurry was removed from the column and disposed of as waste.

6.3.3 Settling Test Results

Photographs of the settling column at the beginning of the test (after 5 min) and after 24 and 46.5 hrs of settling are shown in Figure 6-03.

The <710-µm C-110 residual solids settled very slowly from the test slurry containing ≈0.4 vol% solids in water. The test slurry was completely opaque at the beginning of the test. After 24 hrs the solids loading in the top 1-2 cm of the slurry had visibly decreased but no layer of clear supernatant liquid was observed.

After 46.5 hrs, a ≈2-mm layer of semi-clear liquid was observed at the top of the column. The solids loading in the upper 7-10 cm of the test slurry had continued to decrease but the suspension was still only slightly translucent. The bottom ≈35 cm of the settling slurry remained completely opaque and was essentially unchanged in appearance. No layer of accumulating solids in the bottom of the column was observable.

For solids with a density of 2.50 g/mL, Stokes' Law[6] calculations indicate that 3-µm diameter particles should require ≈14.5 hrs to settle 40 cm in a suspension containing 0.4 vol% solids in water at 22 °C; 1-µm particles should settle up to 14.2 cm in 46.5 hrs. For solids with a density of 1.50 g/mL, 3-µm diameter particles should settle 40 cm in ≈43.5 hrs and 1-µm particles should settle up to 4.8 cm in 46.5 hrs.

---

[6] The terminal settling velocity of a smooth spherical particle settling under laminar (non-turbulent) flow through a homogeneous fluid of infinite extent is given by Stokes' Law:

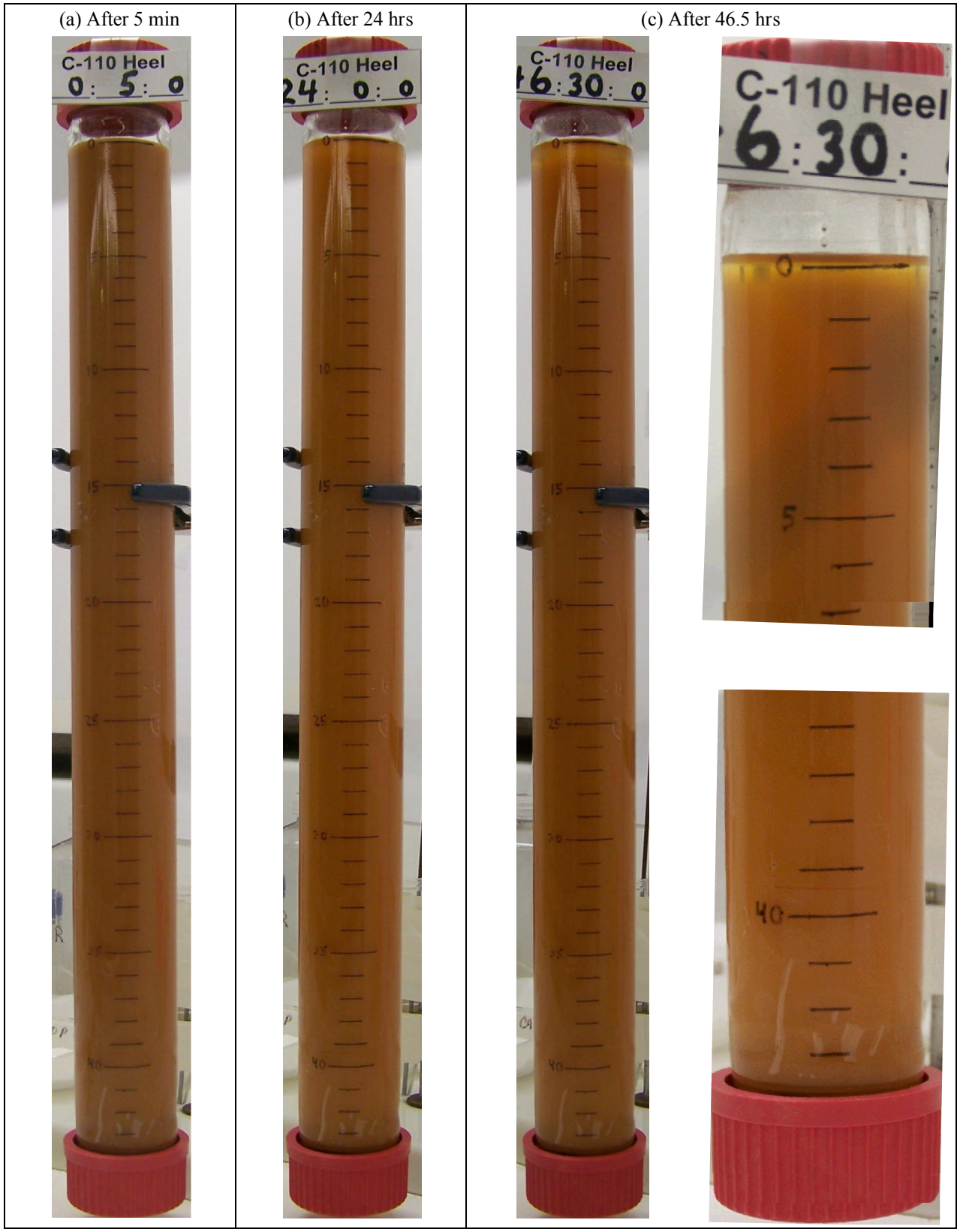
$$d = \sqrt{\frac{18\,\eta\,V_{Stokes}}{(D_{Sld} - D_{Liq})\,g}}$$

where

d	=	particle diameter (cm)
η	=	viscosity of the fluid (0.009643 g/cm·s)
V_{Stokes}	=	Stokes settling velocity (cm/s)
D_{Sld}	=	density of the solid particle (g/cm^3)
D_{Liq}	=	density of the fluid (0.99777 g/cm^3)
g	=	acceleration due to gravity (980.66 cm/s^2)

Stokes' Law is not applicable when the gravitational settling velocity is not much greater than Brownian motion of the particles. This is generally the case for particles of moderate density with diameters less than ≈1 µm.

Figure 6-03. Appearance of Settling Slurry of <710-µm Residual Solids.



The observed settling velocity of the solids in the test slurry of <710-µm residual solids was significantly slower than any of the estimated Stokes' settling velocities. This could suggest:

- That a major portion of the residual solids had Stokes' diameters of <1 µm, or
- That most of the settling particulates were aggregates with effective densities <1.5 g/mL, or
- That settling of the C-110 residual solids is best characterized as hindered settling[7], or
- That a combination of small particle sizes and very low dissolved salt concentration in the liquid phase yielded a very stable suspension, or
- That a combination of some or all of the above applies.

The PSD and settling test samples were collected from the same parent material at approximately the same time and, presumably, contained solids with similar distributions of phase, size, and density. The test specimens for both measurements were dilute slurries of the <710-µm solids in reagent water. The PSD results indicated (a) that a significant portion of the well-bound particulates had diameters smaller than 1-2 µm, and (b) that a large portion of the particulate volume in these slurries could be in the form of relatively large, weakly-bound aggregates with effective densities well below that of the small constituent particles.

The distinct interface between settling solids and supernatant liquid characteristic of hindered settling may have been observed near the end of the settling test though not definitively. No visual evidence of gelling or flocculation was observed. However, the test observations could be interpreted as the settling of small, low-to-medium density solids where weak to moderate interparticle and/or particle-liquid interactions caused significant retardation (i.e., hindering) of the settling velocity.

[7] The terms 'hindered settling' or 'mass subsidence' generally describe the settling of an initially homogeneous and relatively dense suspension of particles at a constant rate with a well-defined interface between supernatant fluid and settling particles. All the particles settle at the same rate, regardless (within limits) of size, and the suspension does not change in concentration until the top of the accumulating layer of settled solids is reached.

7.0 QUALITY ASSURANCE

7.1 LABORATORY ANALYSES

Quality control measurements required to ensure the quality of the physicochemical analyses of samples generated during completion of this test program are specified in ATS-MP-1032, *222-S Laboratory Quality Assurance Project Plan*, and in ATL-MP-1011, *ATL Quality Assurance Project Plan for 222-S Laboratory*. The results of all quality control measurements performed in conjunction with the 222-S chemical analyses are included in the data summary report transcripts in Attachment A.

7.2 CHARACTERIZATION TESTS

7.2.1 Supporting Data

Raw data and test observations supporting this report are recorded in notebook HNF-N-723 1. Other supporting data and documentation is maintained in project file 'C110 Heel Solids' until final wrap-up of the project. At that point the project file is scanned into the Integrated Document Management System and can be accessed at:

Enterprise \ Managed Information \ Electronic Records \ Tank Operations/WRPS \ 222S Laboratory \ Analytical Data Packages-Non-Sensitive

A set of ten, single-use, Excel spreadsheets were used to process the test data and generate the test results, tables, and plots included in this report. Copies of the spreadsheets and the release forms documenting their verification/validation are registered as System# 3436 in the Hanford Information Systems Inventory (HISI).

7.2.2 Repeat Tests

As discussed in Section 4.2.1 and Section 5.1.3, all the D_{Liq} values reported for the large-scale dissolution test liquids were the average of duplicate measurements.

As discussed in Section 6.2 and in Attachment B, three sets of light-scattering-based PSD measurements were completed on separate portions of a sample (S11R000163) of the <710-µm residual solids from the large-scale dissolution testing.

7.2.3 Standards

Light-scattering-based measurement of the PSD of a certified particle size standard was performed before sample measurements began and after they were completed. The results of the standard measurements are presented in Attachment B. The measured mean particle diameters were within 10% of the certified values for all standards.

7.2.4 Calibrations

7.2.4.1 Gravimetric: The majority of the quantitative measurements during the characterization of the C-110 heel solids were gravimetric. The in-tolerance status of each analytical balance used during the test program was verified before use or daily, whichever was less frequent (ATS-LO-140-008, "222-S Laboratory Routine Use and Quality Assurance for Analytical Balances at 222-S Laboratory Complex"). The calibration verification measurements were recorded on Balance Calibration Verification Check Sheets. Copies of the check sheets are included in the project file.

7.2.4.2 Volumetric: Volumes were key components of three measurement results in this report.

D_{Bulk} of Composite Solids: The total volumes of the two pycnometer jars fabricated to measure D_{Bulk} of the C-110 heel solids (Section 3.4.1) were measured by repeated filling with reagent water and weighing. Seven calibration measurements were completed for each jar using water at temperatures ranging from 17.4-32.4 °C.

The calculated average volume of pycnometer jar A used in the D_{Bulk} measurement of the 15 °C composite was 473.25 ± 0.07 mL. The calculated average volume of pycnometer jar B used in the D_{Bulk} measurement of the 45 °C composite was 476.30 ± 0.07 mL.

D_{Liq}: The densities of test liquids from the small-scale and large-scale dissolution tests were measured by filling one (or both) of two Class-A, 25-mL volumetric flasks with test liquid and then weighing. The reported, Class-A tolerance for this glassware is ±0.03 mL at 20 °C.

The nominal 25-mL flask volumes were used to calculate the reported D_{Liq} values. Over the course of this test program the density of reagent water was measured 14 times in each flask at temperatures ranging from 18-46 °C. The average difference between the calculated density and the reference density for water was – 0.003 g/mL for one of the flasks and – 0.0004 g/mL for the other. When both flasks were used and an average calculated density reported, the average difference was – 0.002 g/mL.

D_{Bulk} Residual Solids: The D_{Bulk} of the residual solids from the dissolution tests were measured by water displacement in three 50-mL, polypropylene centrifuge cones (Section 5.4.2). In each measurement, the cones containing the test solids were sequentially filled to 45-, 47.5-, and 50-mL volume marks with reagent water at a known temperature.

The actual volumes of the empty cones at the three fill marks were measured by filling with reagent water and weighing. Four sets of measurements were made for each cone using water at temperatures ranging from 21.4 to 22.1 °C. The calculated average cone volume at each fill mark was used to calculate a volume displaced by a test sample. The average of the three displaced volumes was then used to calculate the reported D_{Bulk} values.

The calculated average cone volumes at the 45-mL marks ranged from 44.60 ± 0.09 mL to 44.70 ± 0.08 mL. The calculated average cone volumes at the 47.5-mL marks ranged from

47.29 ± 0.05 mL to 47.35 ± 0.08 mL. The calculated average cone volumes at the 50-mL marks ranged from 49.53 ± 0.06 mL to 49.59 ± 0.14 mL.

7.3 DEVIATIONS FROM TEST PLAN

This test program was the first tank solids characterization test series performed at 222-S that was based on large-scale testing on as-received samples. As such, numerous changes in the test strategy outlined in the TSAP (RPP-PLAN-46196) and the laboratory test plan (LAB-PLAN-10-00011) were made before the start of and during the execution of the test program. Major changes were documented in the Characterization Change Notices cited in Section 1.0. All other changes were made after consulting with and with the concurrence of the clients.

8.0 REFERENCES

ASTM E11-95, 1995, *Standard Specification for Wire Cloth and Sieves for Testing Purposes,* Vol. 14.02, *General Test Methods, Nonmetal; Laboratory Apparatus; Statistical Methods; Forensic Sciences*, American Society for Testing and Materials International, West Conshohocken, Pennsylvania.

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ATS-LO-140-008, "222-S Laboratory Routine Use and Quality Assurance for Analytical Balances at 222-S Laboratory Complex," Rev. I-0, Washington River Protection Solutions LLC, Richland, Washington.

ATS-MP-1032, *222-S Laboratory Quality Assurance Project Plan*, Rev. 12, Washington River Protection Solutions LLC, Richland, Washington.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order – Tri-Party Agreement*, 1 vol., as amended, State of Washington Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

LAB-PLN-10-00011, 2010, *Test Plan for Tank 241-C-110 Heel Solids Characterization and Dissolution Testing*, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

LAB-RPT-11-00008, 2011, *Solid Phase Characterization of Heel Samples from Tank 241-C-110*, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

HNF-N-723 1, 2011, "222-S Process Chemistry: Tank Waste Testing and Characterization," 222-S Laboratory Notebook/Logbook issued March 2, 2011, Washington River Protection Solutions, LLC, Richland, Washington.

RPP-PLAN-46196, 2010, *Tank Sampling and Analysis Plan for Waste Solids in Tank 241-C-110*, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

RPP-RPT-48654, 2011, *Final Report for the Analysis of Waste Solids in Tank 241-C-110*, Rev. 0, prepared for Washington River Protection Solutions, LLC by Advanced Technologies and Laboratories International, Inc., Richland, Washington.

ATTACHMENT A

LABORATORY ANALYSIS DATA

ATTACHMENT A — Laboratory Analysis Data

Transcripts of the laboratory data summary reports (DSRs) for the analyses of liquid and solid samples generated during the characterization and retrieval testing of the C-110 heel solids described in this report are presented in this attachment. The order of presentation of the DSR transcripts is shown in Table A-1.

All analyses were performed at 222-S by ATL. Some samples were diluted prior to submission to 222-S for analysis. Weight and volume data for the diluted specimens follow the tabulated post-dilution concentrations. When discussed in the main body of this report, the tabulated analytical values are converted to undiluted sample concentrations by multiplying by a dilution factor equal to:

$$\frac{Vol_{Sample} + Vol_{Added\ H2O}}{Vol_{Sample}}$$

Table A-1. Contents.

Test Sample(s)	Sample Group(s)	Page
Drained Liquid Composite	20120763	A- 6
Preliminary Dissolution Tests	20100764	A- 8
Small-scale Water Dissolution Tests	—	—
Preliminary Wash Composite	20100764	A-13
15 °C Test Series		A-15
28 °C Test Series		A-23
46 °C Test Series		A-33
Large-scale 15 °C Water Dissolution Test	20100764	A-41
Large-scale 45 °C Water Dissolution Test	20100764	A-63
Large-scale Dissolution Test Residual Solids	20111097 20100764	A-75

The measurements and analyses performed were specified in the TSAP (RPP-PLAN-46196) and the laboratory test plan (LAB-PLN-10-00011). The analyses performed are summarized in Table A-2.

Table A-2. Sample Identifications and Analyses Completed. (2 sheets)

Test Sample(s)	Sample Preparations	Analyses
Drained Liquids Composite	None	Specific gravity (SpG) TGA (percent water) TIC/TOC IC (inorganic and organic acid anions) ICP-AES (elemental components)
Preliminary Water Dissolution	None – Direct analysis	Specific gravity TGA (percent water) TIC/TOC IC (inorganic and organic acid anions) ICP-AES (total metals)
Small-scale Water Dissolution	None – Direct analysis	Specific gravity TGA (percent water) TIC/TOC IC (inorganic and organic acid anions) ICP-AES (total metals)
Large-scale 15 °C Water Dissolution	None – Direct analysis	Specific gravity TGA (percent water) TIC/TOC IC (inorganic and organic acid anions) ICP-AES (total metals) pH
Large-scale 45 °C Water Dissolution	None – Direct analysis	TIC/TOC IC (inorganic and organic acid anions) ICP-AES (total metals) pH

Table A-2. Sample Identifications and Analyses Completed. (2 sheets)

Test Sample(s)	Sample Preparations	Analytes
Large-scale Dissolution Test: Residual Solids	None – Direct analysis	TIC/TOC GEA (^{129}I)
	Water digest	IC (inorganic and organic acid anions)
	Acid digest	ICP-AES (total metals) ICP-MS (^{99}Tc)
	KOH fusion – Ni crucible	ICP-AES (total metals) $^{89/90}$Sr (separation and β-counting) GEA (^{137}Cs and opportunistic isotopes) ICP-MS (Actinides: ^{233}U, ^{234}U, ^{235}U, ^{236}U, ^{237}Np, and ^{238}U) AEA (^{238}Pu, $^{239/240}$Pu, ^{241}Am)
	KOH fusion – Zr crucible	ICP-AES (total metals)

Table Notes:

AEA	Alpha energy analysis
GEA	Gamma energy analysis
IC	Ion chromatography
ICP-AES	Inductively coupled plasma-atomic emission spectrometry
ICP-MS	Inductively coupled plasma-mass spectrometry
TGA	Thermogravimetric analysis
TIC/TOC	Total inorganic carbon/total organic carbon by silver-catalyzed persulfate oxidation

Abbreviations and codes used throughout the data summary tables are summarized in Table A-3.

Table A-3. Abbreviations and Codes in Data Summary Tables.

Header	A	Sample Preparation Code
	Std %-Rec	Standard percent recovery
	RPD	Relative Percent Difference
	Spk %-Rec	Spike percent recovery
	Det Limit	Minimum Detection Limit
	Count %-Error	% Counting Error
	Qual Flag	Data qualifier code(s)
Sample Preparation Codes	[Blank]	Direct analysis of sample
	W	Water leach/digest
	A	Acid digest
	F	KOH/KNO_3 fusion in Ni crucible
	Z	KOH/KNO_3 fusion in Zr crucible
Qualifier Codes	a	LCS outside range
	b	MS/MSD outside range
	B	Found in blank
	e	SERDIL outside range
	J	Estimated
	n/a	Not calculated or not analyzed
	U	Less than detection limit
	Y	Comment attached

C-110 Heel Solids: Drained Liquid Composite (2 sheets) **Group: 20100763** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S10R000438		%WATER	Percent water	%	96.6	n/a	79.5	n/a	n/a	n/a	n/a	0.0100	n/a	
S10R000438		16984-48-8	Fluoride	ug/mL	96.3	<1.61E-03	1.51E+03	n/a	n/a	n/a	n/a	1.79	n/a	
S10R000438		666-14-8	Glycolate	ug/mL	95.0	<9.37E-03	<10.4	n/a	n/a	n/a	n/a	10.4	n/a	U
S10R000438		71-50-1	Acetate	ug/mL	98.6	<6.04E-03	231	n/a	n/a	n/a	n/a	6.71	n/a	
S10R000438		12311-97-6	Formate	ug/mL	97.4	<4.67E-03	76.5	n/a	n/a	n/a	n/a	5.19	n/a	J
S10R000438		16887-00-6	Chloride	ug/mL	99.2	0.0121	621	n/a	n/a	n/a	n/a	11.1	n/a	
S10R000438		14797-65-0	Nitrite	ug/mL	93.8	<0.0192	2.80E+04	n/a	n/a	n/a	n/a	196	n/a	
S10R000438		14808-79-8	Sulfate	ug/mL	99.3	<0.0187	7.24E+03	n/a	n/a	n/a	n/a	20.8	n/a	
S10R000438		338-70-5	Oxalate	ug/mL	99.3	<0.0231	1.99E+03	n/a	n/a	n/a	n/a	25.7	n/a	
S10R000438		24959-67-9	Bromide	ug/mL	98.8	<0.0580	<64.4	n/a	n/a	n/a	n/a	64.4	n/a	U
S10R000438		14797-55-8	Nitrate	ug/mL	99.0	0.0818	5.77E+04	n/a	n/a	n/a	n/a	212	n/a	
S10R000438		14265-44-2	Phosphate	ug/mL	98.9	<0.0167	1.63E+04	n/a	n/a	n/a	n/a	18.6	n/a	
S10R000438		7440-22-4	Silver	ug/mL	99.0	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S10R000438		7429-90-5	Aluminum	ug/mL	100	<0.0300	583	n/a	n/a	n/a	n/a	15.0	n/a	
S10R000438		7440-38-2	Arsenic	ug/mL	105	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S10R000438		7440-42-8	Boron	ug/mL	104	<0.0300	<15.0	n/a	n/a	n/a	n/a	15.0	n/a	U
S10R000438		7440-39-3	Barium	ug/mL	105	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S10R000438		7440-41-7	Beryllium	ug/mL	103	<1.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S10R000438		7440-69-9	Bismuth	ug/mL	104	<0.100	76.9	n/a	n/a	n/a	n/a	50.0	n/a	J
S10R000438		7440-70-2	Calcium	ug/mL	103	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S10R000438		7440-43-9	Cadmium	ug/mL	106	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S10R000438		7440-45-1	Cerium	ug/mL	107	<0.0300	<15.0	n/a	n/a	n/a	n/a	15.0	n/a	U
S10R000438		7440-48-4	Cobalt	ug/mL	106	<0.0100	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S10R000438		7440-47-3	Chromium	ug/mL	106	<5.00E-03	187	n/a	n/a	n/a	n/a	2.50	n/a	
S10R000438		7440-50-8	Copper	ug/mL	103	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S10R000438		7440-53-1	Europium	ug/mL	101	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S10R000438		7439-89-6	Iron	ug/mL	105	<5.00E-03	202	n/a	n/a	n/a	n/a	2.50	n/a	
S10R000438		7440-09-7	Potassium	ug/mL	97.5	<0.500	546	n/a	n/a	n/a	n/a	250	n/a	J
S10R000438		7439-91-0	Lanthanum	ug/mL	102	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S10R000438		7439-93-2	Lithium	ug/mL	98.6	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U

C-110 Heel Solids: Drained Liquid Composite (2 sheets) **Group: 20100763** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S10R000438		7439-95-4	Magnesium	ug/mL	103	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S10R000438		7439-96-5	Manganese	ug/mL	105	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S10R000438		7439-98-7	Molybdenum	ug/mL	104	<0.0200	10.7	n/a	n/a	n/a	n/a	10.0	n/a	J
S10R000438		7440-23-5	Sodium	ug/mL	97.7	<0.100	8.17E+04	n/a	n/a	n/a	n/a	50.0	n/a	
S10R000438		7440-00-8	Neodymium	ug/mL	102	<0.0100	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S10R000438		7440-02-0	Nickel	ug/mL	105	<0.0200	55.7	n/a	n/a	n/a	n/a	10.0	n/a	J
S10R000438		7723-14-0	Phosphorus	ug/mL	106	<0.0500	5.90E+03	n/a	n/a	n/a	n/a	25.0	n/a	
S10R000438		7439-92-1	Lead	ug/mL	107	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S10R000438		7704-34-9	Sulfur	ug/mL	106	<0.100	2.79E+03	n/a	n/a	n/a	n/a	50.0	n/a	
S10R000438		7440-36-0	Antimony	ug/mL	102	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S10R000438		7782-49-2	Selenium	ug/mL	107	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S10R000438		7440-21-3	Silicon	ug/mL	94.8	<0.0300	<15.0	n/a	n/a	n/a	n/a	15.0	n/a	U
S10R000438		7440-19-9	Samarium	ug/mL	104	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S10R000438		7440-24-6	Strontium	ug/mL	104	<3.00E-03	117	n/a	n/a	n/a	n/a	1.50	n/a	
S10R000438		7440-29-1	Thorium	ug/mL	102	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S10R000438		7440-32-6	Titanium	ug/mL	105	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S10R000438		7440-28-0	Thallium	ug/mL	108	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S10R000438		7440-61-1	Uranium	ug/mL	102	<0.100	1.08E+03	n/a	n/a	n/a	n/a	50.0	n/a	
S10R000438		7440-62-2	Vanadium	ug/mL	106	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S10R000438		7440-65-5	Yttrium	ug/mL	103	<2.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S10R000438		7440-66-6	Zinc	ug/mL	103	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S10R000438		7440-67-7	Zirconium	ug/mL	102	<5.00E-03	4.82	n/a	n/a	n/a	n/a	2.50	n/a	J
S10R000438		SPECGRAVITY	Specific gravity	unitless	100.0	n/a	1.195	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S10R000438		TOC	Total organic carbon	ug/mL	97.0	<20.0	1.03E+03	n/a	n/a	n/a	n/a	200	n/a	J
S10R000438		TIC	Total inorganic carbon	ug/mL	97.7	<7.00	9.11E+03	n/a	n/a	n/a	n/a	70.0	n/a	

C-110 Heel Solids: Preliminary Dissolution Test – Composite 2 (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S10R000376		%WATER	Percent water	%	96.6	n/a	89.8	81.9	85.8	9.23	n/a	0.0100	n/a	
S10R000376		16984-48-8	Fluoride	ug/mL	96.3	<1.61E-03	3.16E+03	3.14E+03	3.15E+03	0.651	93.6	8.29	n/a	
S10R000376		666-14-8	Glycolate	ug/mL	95.0	<9.37E-03	<10.4	<10.4	n/a	n/a	92.5	10.4	n/a	U
S10R000376		71-50-1	Acetate	ug/mL	98.6	<6.04E-03	<6.71	28.7	n/a	n/a	94.8	6.71	n/a	U
S10R000376		12311-97-6	Formate	ug/mL	97.4	<4.67E-03	1.32	1.27	1.30	4.59	86.2	0.472	n/a	J
S10R000376		16887-00-6	Chloride	ug/mL	99.2	0.0121	19.6	21.0	20.3	6.76	98.8	1.01	n/a	B
S10R000376		14797-65-0	Nitrite	ug/mL	93.8	<0.0192	799	792	796	0.893	91.4	1.94	n/a	
S10R000376		14808-79-8	Sulfate	ug/mL	99.3	<0.0187	366	362	364	0.997	97.3	1.89	n/a	
S10R000376		338-70-5	Oxalate	ug/mL	99.3	<0.0231	61.9	60.7	61.3	1.95	97.2	2.33	n/a	
S10R000376		24959-67-9	Bromide	ug/mL	98.8	<0.0580	<5.86	<5.86	n/a	n/a	98.2	5.86	n/a	U
S10R000376		14797-55-8	Nitrate	ug/mL	99.0	0.0818	1.64E+03	1.63E+03	1.63E+03	0.613	94.8	2.10	n/a	
S10R000376		14265-44-2	Phosphate	ug/mL	98.9	<0.0167	3.00E+04	2.97E+04	2.99E+04	1.03	95.6	86.0	n/a	
S10R000376		7440-22-4	Silver	ug/mL	99.0	<5.00E-03	<1.00	<1.00	n/a	n/a	94.7	1.00	n/a	U
S10R000376		7429-90-5	Aluminum	ug/mL	100	<0.0300	208	210	209	0.544	98.2	6.00	n/a	
S10R000376		7440-38-2	Arsenic	ug/mL	105	<0.0500	<10.0	<10.0	n/a	n/a	101	10.0	n/a	U
S10R000376		7440-42-8	Boron	ug/mL	104	<0.0300	<6.00	<6.00	n/a	n/a	98.3	6.00	n/a	U
S10R000376		7440-39-3	Barium	ug/mL	105	<3.00E-03	<0.600	<0.600	n/a	n/a	99.5	0.600	n/a	U
S10R000376		7440-41-7	Beryllium	ug/mL	103	<1.00E-03	<0.200	<0.200	n/a	n/a	98.4	0.200	n/a	U
S10R000376		7440-69-9	Bismuth	ug/mL	104	<0.100	<20.0	<20.0	n/a	n/a	103	20.0	n/a	U
S10R000376		7440-70-2	Calcium	ug/mL	103	<0.0500	<10.0	<10.0	n/a	n/a	97.8	10.0	n/a	U
S10R000376		7440-43-9	Cadmium	ug/mL	106	<5.00E-03	<1.00	<1.00	n/a	n/a	100	1.00	n/a	U
S10R000376		7440-45-1	Cerium	ug/mL	107	<0.0300	<6.00	<6.00	n/a	n/a	99.3	6.00	n/a	U
S10R000376		7440-48-4	Cobalt	ug/mL	106	<0.0100	<2.00	<2.00	n/a	n/a	102	2.00	n/a	U
S10R000376		7440-47-3	Chromium	ug/mL	106	<5.00E-03	8.13	7.63	7.88	6.29	101	1.00	n/a	J
S10R000376		7440-50-8	Copper	ug/mL	103	<5.00E-03	<1.00	<1.00	n/a	n/a	99.9	1.00	n/a	U
S10R000376		7440-53-1	Europium	ug/mL	101	<5.00E-03	<1.00	<1.00	n/a	n/a	97.7	1.00	n/a	U
S10R000376		7439-89-6	Iron	ug/mL	105	<5.00E-03	12.0	12.5	12.3	3.94	99.8	1.00	n/a	
S10R000376		7440-09-7	Potassium	ug/mL	97.5	<0.500	<100	<100	n/a	n/a	96.1	100	n/a	U
S10R000376		7439-91-0	Lanthanum	ug/mL	102	<3.00E-03	<0.600	<0.600	n/a	n/a	97.0	0.600	n/a	U
S10R000376		7439-93-2	Lithium	ug/mL	98.6	<3.00E-03	<0.600	<0.600	n/a	n/a	97.0	0.600	n/a	U

C-110 Heel Solids: Preliminary Dissolution Test – Composite 2 (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S10R000376		7439-95-4	Magnesium	ug/mL	103	<0.0500	<10.0	<10.0	n/a	n/a	98.3	10.0	n/a	U
S10R000376		7439-96-5	Manganese	ug/mL	105	<3.00E-03	<0.600	<0.600	n/a	n/a	101	0.600	n/a	U
S10R000376		7439-98-7	Molybdenum	ug/mL	104	<0.0200	<4.00	<4.00	n/a	n/a	99.2	4.00	n/a	U
S10R000376		7440-23-5	Sodium	ug/mL	97.7	<0.100	2.72E+04	2.70E+04	2.71E+04	0.858	81.6	20.0	n/a	
S10R000376		7440-00-8	Neodymium	ug/mL	102	<0.0100	<2.00	<2.00	n/a	n/a	96.0	2.00	n/a	U
S10R000376		7440-02-0	Nickel	ug/mL	105	<0.0200	<4.00	<4.00	n/a	n/a	99.6	4.00	n/a	U
S10R000376		7723-14-0	Phosphorus	ug/mL	106	<0.0500	1.07E+04	1.08E+04	1.08E+04	1.04	97.8	10.0	n/a	
S10R000376		7439-92-1	Lead	ug/mL	107	<0.0500	<10.0	<10.0	n/a	n/a	103	10.0	n/a	U
S10R000376		7704-34-9	Sulfur	ug/mL	106	<0.100	131	126	128	3.79	101	20.0	n/a	J
S10R000376		7440-36-0	Antimony	ug/mL	102	<0.0500	<10.0	<10.0	n/a	n/a	98.8	10.0	n/a	U
S10R000376		7782-49-2	Selenium	ug/mL	107	<0.100	<20.0	<20.0	n/a	n/a	103	20.0	n/a	U
S10R000376		7440-21-3	Silicon	ug/mL	94.8	<0.0300	<6.00	<6.00	n/a	n/a	91.1	6.00	n/a	U
S10R000376		7440-19-9	Samarium	ug/mL	104	<0.0500	<10.0	<10.0	n/a	n/a	97.2	10.0	n/a	U
S10R000376		7440-24-6	Strontium	ug/mL	104	<3.00E-03	<0.600	<0.600	n/a	n/a	98.4	0.600	n/a	U
S10R000376		7440-29-1	Thorium	ug/mL	102	<0.0500	<10.0	<10.0	n/a	n/a	98.6	10.0	n/a	U
S10R000376		7440-32-6	Titanium	ug/mL	105	<5.00E-03	<1.00	<1.00	n/a	n/a	98.2	1.00	n/a	U
S10R000376		7440-28-0	Thallium	ug/mL	108	<0.100	<20.0	<20.0	n/a	n/a	101	20.0	n/a	U
S10R000376		7440-61-1	Uranium	ug/mL	102	<0.100	41.2	37.4	39.3	9.68	97.0	20.0	n/a	J
S10R000376		7440-62-2	Vanadium	ug/mL	106	<5.00E-03	<1.00	<1.00	n/a	n/a	101	1.00	n/a	U
S10R000376		7440-65-5	Yttrium	ug/mL	103	<2.00E-03	<0.400	<0.400	n/a	n/a	98.8	0.400	n/a	U
S10R000376		7440-66-6	Zinc	ug/mL	103	<5.00E-03	<1.00	<1.00	n/a	n/a	100	1.00	n/a	U
S10R000376		7440-67-7	Zirconium	ug/mL	102	<5.00E-03	<1.00	<1.00	n/a	n/a	100	1.00	n/a	U
S10R000376		SPECGRAVITY	Specific gravity	unitless	100.0	n/a	1.081	1.072	1.076	0.8360	n/a	1.000E-03	n/a	
S10R000376		TOC	Total organic carbon	ug/mL	97.0	<20.0	<80.0	<80.0	n/a	n/a	98.3	80.0	n/a	U
S10R000376		TIC	Total inorganic carbon	ug/mL	97.7	<7.00	478	488	483	2.07	98.9	28.0	n/a	

C-110 Heel Solids: Preliminary Dissolution Test – Composite 4 (3 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S10R000379		%WATER	Percent water	%	98.7	n/a	91.3	90.6	91.0	0.758	n/a	0.0100	n/a	
S10R000379		16984-48-8	Fluoride	ug/mL	96.3	<1.61E-03	3.10E+03	n/a	n/a	n/a	n/a	8.29	n/a	
S10R000379		666-14-8	Glycolate	ug/mL	95.0	<9.37E-03	<0.946	n/a	n/a	n/a	n/a	0.946	n/a	U
S10R000379		71-50-1	Acetate	ug/mL	98.6	<6.04E-03	16.2	n/a	n/a	n/a	n/a	0.610	n/a	J
S10R000379		12311-97-6	Formate	ug/mL	97.4	<4.67E-03	6.31	n/a	n/a	n/a	n/a	0.472	n/a	J
S10R000379		16887-00-6	Chloride	ug/mL	99.2	0.0121	57.0	n/a	n/a	n/a	n/a	1.01	n/a	
S10R000379		14797-65-0	Nitrite	ug/mL	93.8	<0.0192	2.25E+03	n/a	n/a	n/a	n/a	21.3	n/a	
S10R000379		14808-79-8	Sulfate	ug/mL	99.3	<0.0187	750	n/a	n/a	n/a	n/a	1.89	n/a	
S10R000379		338-70-5	Oxalate	ug/mL	99.3	<0.0231	177	n/a	n/a	n/a	n/a	2.33	n/a	
S10R000379		24959-67-9	Bromide	ug/mL	98.8	<0.0580	<5.86	n/a	n/a	n/a	n/a	5.86	n/a	U
S10R000379		14797-55-8	Nitrate	ug/mL	99.0	0.0818	4.63E+03	n/a	n/a	n/a	n/a	23.1	n/a	
S10R000379		14265-44-2	Phosphate	ug/mL	98.9	<0.0167	2.93E+04	n/a	n/a	n/a	n/a	86.0	n/a	
S10R000379		7440-22-4	Silver	ug/mL	99.0	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S10R000379		7429-90-5	Aluminum	ug/mL	100	<0.0300	481	n/a	n/a	n/a	n/a	6.00	n/a	
S10R000379		7440-38-2	Arsenic	ug/mL	105	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S10R000379		7440-42-8	Boron	ug/mL	104	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S10R000379		7440-39-3	Barium	ug/mL	105	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S10R000379		7440-41-7	Beryllium	ug/mL	103	<1.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S10R000379		7440-69-9	Bismuth	ug/mL	104	<0.100	25.2	n/a	n/a	n/a	n/a	20.0	n/a	J
S10R000379		7440-70-2	Calcium	ug/mL	103	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S10R000379		7440-43-9	Cadmium	ug/mL	106	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S10R000379		7440-45-1	Cerium	ug/mL	107	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S10R000379		7440-48-4	Cobalt	ug/mL	106	<0.0100	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S10R000379		7440-47-3	Chromium	ug/mL	106	<5.00E-03	18.1	n/a	n/a	n/a	n/a	1.00	n/a	
S10R000379		7440-50-8	Copper	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S10R000379		7440-53-1	Europium	ug/mL	101	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S10R000379		7439-89-6	Iron	ug/mL	105	<5.00E-03	24.3	n/a	n/a	n/a	n/a	1.00	n/a	
S10R000379		7440-09-7	Potassium	ug/mL	97.5	<0.500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S10R000379		7440-22-4	Silver	ug/mL	99.0	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S10R000379		7429-90-5	Aluminum	ug/mL	100	<0.0300	481	n/a	n/a	n/a	n/a	6.00	n/a	

C-110 Heel Solids: Preliminary Dissolution Test – Composite 4 (3 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S10R000379		7440-38-2	Arsenic	ug/mL	105	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S10R000379		7440-42-8	Boron	ug/mL	104	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S10R000379		7440-39-3	Barium	ug/mL	105	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S10R000379		7440-41-7	Beryllium	ug/mL	103	<1.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S10R000379		7440-69-9	Bismuth	ug/mL	104	<0.100	25.2	n/a	n/a	n/a	n/a	20.0	n/a	J
S10R000379		7440-70-2	Calcium	ug/mL	103	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S10R000379		7440-43-9	Cadmium	ug/mL	106	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S10R000379		7440-45-1	Cerium	ug/mL	107	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S10R000379		7440-48-4	Cobalt	ug/mL	106	<0.0100	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S10R000379		7440-47-3	Chromium	ug/mL	106	<5.00E-03	18.1	n/a	n/a	n/a	n/a	1.00	n/a	
S10R000379		7440-50-8	Copper	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S10R000379		7440-53-1	Europium	ug/mL	101	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S10R000379		7439-89-6	Iron	ug/mL	105	<5.00E-03	24.3	n/a	n/a	n/a	n/a	1.00	n/a	
S10R000379		7440-09-7	Potassium	ug/mL	97.5	<0.500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S10R000379		7439-91-0	Lanthanum	ug/mL	102	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S10R000379		7439-93-2	Lithium	ug/mL	98.6	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S10R000379		7439-95-4	Magnesium	ug/mL	103	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S10R000379		7439-96-5	Manganese	ug/mL	105	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S10R000379		7439-98-7	Molybdenum	ug/mL	104	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S10R000379		7440-23-5	Sodium	ug/mL	97.7	<0.100	2.99E+04	n/a	n/a	n/a	n/a	20.0	n/a	
S10R000379		7440-00-8	Neodymium	ug/mL	102	<0.0100	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S10R000379		7440-02-0	Nickel	ug/mL	105	<0.0200	5.32	n/a	n/a	n/a	n/a	4.00	n/a	J
S10R000379		7723-14-0	Phosphorus	ug/mL	106	<0.0500	1.05E+04	n/a	n/a	n/a	n/a	10.0	n/a	
S10R000379		7439-92-1	Lead	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S10R000379		7704-34-9	Sulfur	ug/mL	106	<0.100	277	n/a	n/a	n/a	n/a	20.0	n/a	
S10R000379		7440-36-0	Antimony	ug/mL	102	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S10R000379		7782-49-2	Selenium	ug/mL	107	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S10R000379		7440-21-3	Silicon	ug/mL	94.8	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S10R000379		7440-19-9	Samarium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S10R000379		7440-24-6	Strontium	ug/mL	104	<3.00E-03	7.38	n/a	n/a	n/a	n/a	0.600	n/a	

C-110 Heel Solids: Preliminary Dissolution Test – Composite 4 (3 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S10R000379		7440-29-1	Thorium	ug/mL	102	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S10R000379		7440-32-6	Titanium	ug/mL	105	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S10R000379		7440-28-0	Thallium	ug/mL	108	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S10R000379		7440-61-1	Uranium	ug/mL	102	<0.100	82.4	n/a	n/a	n/a	n/a	20.0	n/a	J
S10R000379		7440-62-2	Vanadium	ug/mL	106	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S10R000379		7440-65-5	Yttrium	ug/mL	103	<2.00E-03	<0.400	n/a	n/a	n/a	n/a	0.400	n/a	U
S10R000379		7440-66-6	Zinc	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S10R000379		7440-67-7	Zirconium	ug/mL	102	<5.00E-03	1.62	n/a	n/a	n/a	n/a	1.00	n/a	J
S10R000379		SPECGRAVITY	Specific gravity	unitless	100.0	n/a	1.085	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S10R000379		TOC	Total organic carbon	ug/mL	97.0	<20.0	115	n/a	n/a	n/a	n/a	80.0	n/a	J
S10R000379		TIC	Total inorganic carbon	ug/mL	97.7	<7.00	1.05E+03	n/a	n/a	n/a	n/a	28.0	n/a	

C-110 Heel Solids: Small-scale Dissolution Test — Preliminary Wash Liquid Composite (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000067		%WATER	Percent water	%	98.9	n/a	98.8	n/a	n/a	n/a	n/a	0.0100	n/a	
S11R000067		16984-48-8	Fluoride	ug/mL	104	<1.61E-03	2.28E+03	n/a	n/a	n/a	n/a	16.1	n/a	
S11R000067		666-14-8	Glycolate	ug/mL	101	<9.37E-03	26.6	n/a	n/a	n/a	n/a	0.937	n/a	
S11R000067		71-50-1	Acetate	ug/mL	105	<6.04E-03	13.4	n/a	n/a	n/a	n/a	0.604	n/a	J
S11R000067		12311-97-6	Formate	ug/mL	102	<4.67E-03	18.1	n/a	n/a	n/a	n/a	0.467	n/a	
S11R000067		16887-00-6	Chloride	ug/mL	103	<9.98E-03	74.3	n/a	n/a	n/a	n/a	0.998	n/a	
S11R000067		14797-65-0	Nitrite	ug/mL	102	<0.0192	3.37E+03	n/a	n/a	n/a	n/a	19.2	n/a	
S11R000067		14808-79-8	Sulfate	ug/mL	105	<0.0187	886	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000067		338-70-5	Oxalate	ug/mL	106	<0.0231	235	n/a	n/a	n/a	n/a	2.31	n/a	
S11R000067		24959-67-9	Bromide	ug/mL	105	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000067		14797-55-8	Nitrate	ug/mL	103	<0.0208	6.46E+03	n/a	n/a	n/a	n/a	20.8	n/a	
S11R000067		14265-44-2	Phosphate	ug/mL	104	<0.0167	2.13E+04	n/a	n/a	n/a	n/a	167	n/a	
S11R000067		7440-22-4	Silver	ug/mL	102	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000067		7429-90-5	Aluminum	ug/mL	104	<0.0300	113	n/a	n/a	n/a	n/a	6.00	n/a	
S11R000067		7440-38-2	Arsenic	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000067		7440-39-3	Barium	ug/mL	104	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000067		7440-41-7	Beryllium	ug/mL	102	<1.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S11R000067		7440-69-9	Bismuth	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000067		7440-70-2	Calcium	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000067		7440-43-9	Cadmium	ug/mL	106	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000067		7440-45-1	Cerium	ug/mL	106	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000067		7440-48-4	Cobalt	ug/mL	104	<0.0100	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000067		7440-47-3	Chromium	ug/mL	106	<5.00E-03	20.5	n/a	n/a	n/a	n/a	1.00	n/a	
S11R000067		7440-50-8	Copper	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000067		7439-89-6	Iron	ug/mL	104	<5.00E-03	21.2	n/a	n/a	n/a	n/a	1.00	n/a	
S11R000067		7440-09-7	Potassium	ug/mL	99.5	<0.500	110	n/a	n/a	n/a	n/a	100	n/a	J
S11R000067		7439-91-0	Lanthanum	ug/mL	101	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000067		7439-93-2	Lithium	ug/mL	108	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000067		7439-95-4	Magnesium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000067		7439-96-5	Manganese	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U

C-110 Heel Solids: Small-scale Dissolution Test — Preliminary Wash Liquid Composite (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000067		7439-98-7	Molybdenum	ug/mL	103	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000067		7440-23-5	Sodium	ug/mL	108	<0.100	2.45E+04	n/a	n/a	n/a	n/a	20.0	n/a	
S11R000067		7440-02-0	Nickel	ug/mL	105	<0.0200	7.36	n/a	n/a	n/a	n/a	4.00	n/a	J
S11R000067		7723-14-0	Phosphorus	ug/mL	105	<0.0500	7.03E+03	n/a	n/a	n/a	n/a	10.0	n/a	
S11R000067		7439-92-1	Lead	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000067		7704-34-9	Sulfur	ug/mL	104	<0.100	300	n/a	n/a	n/a	n/a	20.0	n/a	
S11R000067		7440-36-0	Antimony	ug/mL	99.9	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000067		7782-49-2	Selenium	ug/mL	107	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000067		7440-21-3	Silicon	ug/mL	96.1	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000067		7440-19-9	Samarium	ug/mL	103	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000067		7440-24-6	Strontium	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000067		7440-29-1	Thorium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000067		7440-32-6	Titanium	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000067		7440-61-1	Uranium	ug/mL	104	<0.100	114	n/a	n/a	n/a	n/a	20.0	n/a	J
S11R000067		7440-62-2	Vanadium	ug/mL	105	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000067		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<0.400	n/a	n/a	n/a	n/a	0.400	n/a	U
S11R000067		7440-66-6	Zinc	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000067		7440-67-7	Zirconium	ug/mL	101	<5.00E-03	1.12	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000067		SPECGRAVITY	Specific gravity	unitless	100.0	n/a	1.066	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000067		TOC	Total organic carbon	ug/mL	95.3	<20.0	105	n/a	n/a	n/a	n/a	20.0	n/a	J
S11R000067		TIC	Total inorganic carbon	ug/mL	95.8	<7.00	1.03E+03	n/a	n/a	n/a	n/a	7.00	n/a	

C-110 Heel Solids: Small-scale Dissolution Test — 1 day at 15 °C (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000079		%WATER	Percent water	%	98.9	n/a	93.5	n/a	n/a	n/a	n/a	0.0100	n/a	
S11R000079		16984-48-8	Fluoride	ug/mL	104	<1.61E-03	2.65E+03	n/a	n/a	n/a	n/a	16.1	n/a	
S11R000079		666-14-8	Glycolate	ug/mL	101	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000079		71-50-1	Acetate	ug/mL	105	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000079		12311-97-6	Formate	ug/mL	102	<4.67E-03	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000079		16887-00-6	Chloride	ug/mL	103	<9.98E-03	8.46	n/a	n/a	n/a	n/a	0.998	n/a	
S11R000079		14797-65-0	Nitrite	ug/mL	102	<0.0192	345	n/a	n/a	n/a	n/a	1.92	n/a	
S11R000079		14808-79-8	Sulfate	ug/mL	105	<0.0187	201	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000079		338-70-5	Oxalate	ug/mL	106	<0.0231	25.7	n/a	n/a	n/a	n/a	2.31	n/a	
S11R000079		24959-67-9	Bromide	ug/mL	105	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000079		14797-55-8	Nitrate	ug/mL	103	<0.0208	685	n/a	n/a	n/a	n/a	2.08	n/a	
S11R000079		14265-44-2	Phosphate	ug/mL	104	<0.0167	2.16E+04	n/a	n/a	n/a	n/a	167	n/a	
S11R000079		7440-22-4	Silver	ug/mL	102	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000079		7429-90-5	Aluminum	ug/mL	104	<0.0300	182	n/a	n/a	n/a	n/a	6.00	n/a	
S11R000079		7440-38-2	Arsenic	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000079		7440-39-3	Barium	ug/mL	104	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000079		7440-41-7	Beryllium	ug/mL	102	<1.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S11R000079		7440-69-9	Bismuth	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000079		7440-70-2	Calcium	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000079		7440-43-9	Cadmium	ug/mL	106	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000079		7440-45-1	Cerium	ug/mL	106	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000079		7440-48-4	Cobalt	ug/mL	104	<0.0100	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000079		7440-47-3	Chromium	ug/mL	106	<5.00E-03	2.98	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000079		7440-50-8	Copper	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000079		7439-89-6	Iron	ug/mL	104	<5.00E-03	4.81	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000079		7440-09-7	Potassium	ug/mL	99.5	<0.500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000079		7439-91-0	Lanthanum	ug/mL	101	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000079		7439-93-2	Lithium	ug/mL	108	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000079		7439-95-4	Magnesium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000079		7439-96-5	Manganese	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U

C-110 Heel Solids: Small-scale Dissolution Test — 1 day at 15 °C (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000079		7439-98-7	Molybdenum	ug/mL	103	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000079		7440-23-5	Sodium	ug/mL	108	<0.100	1.83E+04	n/a	n/a	n/a	n/a	20.0	n/a	
S11R000079		7440-02-0	Nickel	ug/mL	105	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000079		7723-14-0	Phosphorus	ug/mL	105	<0.0500	7.23E+03	n/a	n/a	n/a	n/a	10.0	n/a	
S11R000079		7439-92-1	Lead	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000079		7704-34-9	Sulfur	ug/mL	104	<0.100	57.1	n/a	n/a	n/a	n/a	20.0	n/a	J
S11R000079		7440-36-0	Antimony	ug/mL	99.9	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000079		7782-49-2	Selenium	ug/mL	107	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000079		7440-21-3	Silicon	ug/mL	96.1	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000079		7440-19-9	Samarium	ug/mL	103	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000079		7440-24-6	Strontium	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000079		7440-29-1	Thorium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000079		7440-32-6	Titanium	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000079		7440-61-1	Uranium	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000079		7440-62-2	Vanadium	ug/mL	105	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000079		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<0.400	n/a	n/a	n/a	n/a	0.400	n/a	U
S11R000079		7440-66-6	Zinc	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000079		7440-67-7	Zirconium	ug/mL	101	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000079		SPECGRAVITY	Specific gravity	unitless	100.0	n/a	1.049	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000079		TOC	Total organic carbon	ug/mL	95.3	<20.0	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000079		TIC	Total inorganic carbon	ug/mL	95.8	<7.00	129	n/a	n/a	n/a	n/a	7.00	n/a	

C-110 Heel Solids: Small-scale Dissolution Test — 2 days at 15 °C (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000056		%WATER	Percent water	%	86.6	n/a	88.6	97.4	93.0	9.39	n/a	0.0100	n/a	
S11R000056		16984-48-8	Fluoride	ug/mL	102	<1.61E-03	2.82E+03	n/a	n/a	n/a	n/a	16.1	n/a	
S11R000056		666-14-8	Glycolate	ug/mL	98.5	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000056		71-50-1	Acetate	ug/mL	102	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000056		12311-97-6	Formate	ug/mL	99.0	<4.67E-03	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000056		16887-00-6	Chloride	ug/mL	101	<9.98E-03	7.78	n/a	n/a	n/a	n/a	0.998	n/a	
S11R000056		14797-65-0	Nitrite	ug/mL	101	<0.0192	348	n/a	n/a	n/a	n/a	1.92	n/a	
S11R000056		14808-79-8	Sulfate	ug/mL	102	<0.0187	204	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000056		338-70-5	Oxalate	ug/mL	103	<0.0231	24.6	n/a	n/a	n/a	n/a	2.31	n/a	
S11R000056		24959-67-9	Bromide	ug/mL	102	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000056		14797-55-8	Nitrate	ug/mL	99.5	<0.0208	679	n/a	n/a	n/a	n/a	2.08	n/a	
S11R000056		14265-44-2	Phosphate	ug/mL	101	<0.0167	2.26E+04	n/a	n/a	n/a	n/a	167	n/a	
S11R000056		7440-22-4	Silver	ug/mL	102	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000056		7429-90-5	Aluminum	ug/mL	104	<0.0300	217	n/a	n/a	n/a	n/a	6.00	n/a	
S11R000056		7440-38-2	Arsenic	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000056		7440-39-3	Barium	ug/mL	104	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000056		7440-41-7	Beryllium	ug/mL	102	<1.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S11R000056		7440-69-9	Bismuth	ug/mL	104	<0.100	27.4	n/a	n/a	n/a	n/a	20.0	n/a	J
S11R000056		7440-70-2	Calcium	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000056		7440-43-9	Cadmium	ug/mL	106	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000056		7440-45-1	Cerium	ug/mL	106	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000056		7440-48-4	Cobalt	ug/mL	104	<0.0100	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000056		7440-47-3	Chromium	ug/mL	106	<5.00E-03	3.57	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000056		7440-50-8	Copper	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000056		7439-89-6	Iron	ug/mL	104	<5.00E-03	7.34	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000056		7440-09-7	Potassium	ug/mL	99.5	<0.500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000056		7439-91-0	Lanthanum	ug/mL	101	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000056		7439-93-2	Lithium	ug/mL	108	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000056		7439-95-4	Magnesium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000056		7439-96-5	Manganese	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U

C-110 Heel Solids: Small-scale Dissolution Test — 2 days at 15 °C (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000056		7439-98-7	Molybdenum	ug/mL	103	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000056		7440-23-5	Sodium	ug/mL	108	<0.100	1.87E+04	n/a	n/a	n/a	n/a	20.0	n/a	
S11R000056		7440-02-0	Nickel	ug/mL	105	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000056		7723-14-0	Phosphorus	ug/mL	105	<0.0500	7.68E+03	n/a	n/a	n/a	n/a	10.0	n/a	
S11R000056		7439-92-1	Lead	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000056		7704-34-9	Sulfur	ug/mL	104	<0.100	69.0	n/a	n/a	n/a	n/a	20.0	n/a	J
S11R000056		7440-36-0	Antimony	ug/mL	99.9	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000056		7782-49-2	Selenium	ug/mL	107	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000056		7440-21-3	Silicon	ug/mL	96.1	<0.0300	6.80	n/a	n/a	n/a	n/a	6.00	n/a	J
S11R000056		7440-19-9	Samarium	ug/mL	103	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000056		7440-24-6	Strontium	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000056		7440-29-1	Thorium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000056		7440-32-6	Titanium	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000056		7440-61-1	Uranium	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000056		7440-62-2	Vanadium	ug/mL	105	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000056		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<0.400	n/a	n/a	n/a	n/a	0.400	n/a	U
S11R000056		7440-66-6	Zinc	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000056		7440-67-7	Zirconium	ug/mL	101	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000056		SPECGRAVITY	Specific gravity	unitless	100.0	n/a	1.057	1.054	1.056	0.2842	n/a	1.000E-03	n/a	
S11R000056		TOC	Total organic carbon	ug/mL	95.3	<20.0	<20.0	<20.0	n/a	n/a	97.0	20.0	n/a	U
S11R000056		TIC	Total inorganic carbon	ug/mL	95.8	<7.00	130	130	130	0.0	98.2	7.00	n/a	

C-110 Heel Solids: Small-scale Dissolution Test — 4 days at 15 °C (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000057		%WATER	Percent water	%	91.6	n/a	92.9	n/a	n/a	n/a	n/a	0.0100	n/a	
S11R000057		16984-48-8	Fluoride	ug/mL	102	<1.61E-03	2.93E+03	n/a	n/a	n/a	n/a	16.1	n/a	
S11R000057		666-14-8	Glycolate	ug/mL	98.5	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000057		71-50-1	Acetate	ug/mL	102	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000057		12311-97-6	Formate	ug/mL	99.0	<4.67E-03	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000057		16887-00-6	Chloride	ug/mL	101	<9.98E-03	8.78	n/a	n/a	n/a	n/a	0.998	n/a	
S11R000057		14797-65-0	Nitrite	ug/mL	101	<0.0192	401	n/a	n/a	n/a	n/a	1.92	n/a	
S11R000057		14808-79-8	Sulfate	ug/mL	102	<0.0187	223	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000057		338-70-5	Oxalate	ug/mL	103	<0.0231	27.9	n/a	n/a	n/a	n/a	2.31	n/a	
S11R000057		24959-67-9	Bromide	ug/mL	102	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000057		14797-55-8	Nitrate	ug/mL	99.5	<0.0208	793	n/a	n/a	n/a	n/a	2.08	n/a	
S11R000057		14265-44-2	Phosphate	ug/mL	101	<0.0167	2.35E+04	n/a	n/a	n/a	n/a	167	n/a	
S11R000057		7440-22-4	Silver	ug/mL	102	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000057		7429-90-5	Aluminum	ug/mL	104	<0.0300	238	n/a	n/a	n/a	n/a	6.00	n/a	
S11R000057		7440-38-2	Arsenic	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000057		7440-39-3	Barium	ug/mL	104	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000057		7440-41-7	Beryllium	ug/mL	102	<1.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S11R000057		7440-69-9	Bismuth	ug/mL	104	<0.100	23.4	n/a	n/a	n/a	n/a	20.0	n/a	J
S11R000057		7440-70-2	Calcium	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000057		7440-43-9	Cadmium	ug/mL	106	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000057		7440-45-1	Cerium	ug/mL	106	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000057		7440-48-4	Cobalt	ug/mL	104	<0.0100	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000057		7440-47-3	Chromium	ug/mL	106	<5.00E-03	3.70	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000057		7440-50-8	Copper	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000057		7439-89-6	Iron	ug/mL	104	<5.00E-03	7.30	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000057		7440-09-7	Potassium	ug/mL	99.5	<0.500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000057		7439-91-0	Lanthanum	ug/mL	101	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000057		7439-93-2	Lithium	ug/mL	108	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000057		7439-95-4	Magnesium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000057		7439-96-5	Manganese	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U

C-110 Heel Solids: Small-scale Dissolution Test — 4 days at 15 °C (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000057		7439-98-7	Molybdenum	ug/mL	103	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000057		7440-23-5	Sodium	ug/mL	108	<0.100	1.95E+04	n/a	n/a	n/a	n/a	20.0	n/a	
S11R000057		7440-02-0	Nickel	ug/mL	105	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000057		7723-14-0	Phosphorus	ug/mL	105	<0.0500	7.76E+03	n/a	n/a	n/a	n/a	10.0	n/a	
S11R000057		7439-92-1	Lead	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000057		7704-34-9	Sulfur	ug/mL	104	<0.100	70.1	n/a	n/a	n/a	n/a	20.0	n/a	J
S11R000057		7440-36-0	Antimony	ug/mL	99.9	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000057		7782-49-2	Selenium	ug/mL	107	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000057		7440-21-3	Silicon	ug/mL	96.1	<0.0300	6.09	n/a	n/a	n/a	n/a	6.00	n/a	J
S11R000057		7440-19-9	Samarium	ug/mL	103	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000057		7440-24-6	Strontium	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000057		7440-29-1	Thorium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000057		7440-32-6	Titanium	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000057		7440-61-1	Uranium	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000057		7440-62-2	Vanadium	ug/mL	105	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000057		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<0.400	n/a	n/a	n/a	n/a	0.400	n/a	U
S11R000057		7440-66-6	Zinc	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000057		7440-67-7	Zirconium	ug/mL	101	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000057		SPECGRAVITY	Specific gravity	unitless	100.0	n/a	1.051	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000057		TOC	Total organic carbon	ug/mL	95.3	<20.0	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000057		TIC	Total inorganic carbon	ug/mL	95.8	<7.00	153	n/a	n/a	n/a	n/a	7.00	n/a	

C-110 Heel Solids: Small-scale Dissolution Test — 8 days at 15 °C (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000058		%WATER	Percent water	%	97.7	n/a	92.2	n/a	n/a	n/a	n/a	0.0100	n/a	
S11R000058		16984-48-8	Fluoride	ug/mL	102	<1.61E-03	2.94E+03	n/a	n/a	n/a	n/a	16.1	n/a	
S11R000058		666-14-8	Glycolate	ug/mL	98.5	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000058		71-50-1	Acetate	ug/mL	102	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000058		12311-97-6	Formate	ug/mL	99.0	<4.67E-03	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000058		16887-00-6	Chloride	ug/mL	101	<9.98E-03	9.40	n/a	n/a	n/a	n/a	0.998	n/a	
S11R000058		14797-65-0	Nitrite	ug/mL	101	<0.0192	396	n/a	n/a	n/a	n/a	1.92	n/a	
S11R000058		14808-79-8	Sulfate	ug/mL	102	<0.0187	221	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000058		338-70-5	Oxalate	ug/mL	103	<0.0231	26.1	n/a	n/a	n/a	n/a	2.31	n/a	
S11R000058		24959-67-9	Bromide	ug/mL	102	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000058		14797-55-8	Nitrate	ug/mL	99.5	<0.0208	785	n/a	n/a	n/a	n/a	2.08	n/a	
S11R000058		14265-44-2	Phosphate	ug/mL	101	<0.0167	2.36E+04	n/a	n/a	n/a	n/a	167	n/a	
S11R000058		7440-22-4	Silver	ug/mL	102	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000058		7429-90-5	Aluminum	ug/mL	104	<0.0300	259	n/a	n/a	n/a	n/a	6.00	n/a	
S11R000058		7440-38-2	Arsenic	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000058		7440-39-3	Barium	ug/mL	104	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000058		7440-41-7	Beryllium	ug/mL	102	<1.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S11R000058		7440-69-9	Bismuth	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000058		7440-70-2	Calcium	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000058		7440-43-9	Cadmium	ug/mL	106	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000058		7440-45-1	Cerium	ug/mL	106	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000058		7440-48-4	Cobalt	ug/mL	104	<0.0100	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000058		7440-47-3	Chromium	ug/mL	106	<5.00E-03	3.81	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000058		7440-50-8	Copper	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000058		7439-89-6	Iron	ug/mL	104	<5.00E-03	6.52	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000058		7440-09-7	Potassium	ug/mL	99.5	<0.500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000058		7439-91-0	Lanthanum	ug/mL	101	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000058		7439-93-2	Lithium	ug/mL	108	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000058		7439-95-4	Magnesium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000058		7439-96-5	Manganese	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U

C-110 Heel Solids: Small-scale Dissolution Test — 8 days at 15 °C (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000058		7439-98-7	Molybdenum	ug/mL	103	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000058		7440-23-5	Sodium	ug/mL	108	<0.100	1.99E+04	n/a	n/a	n/a	n/a	20.0	n/a	
S11R000058		7440-02-0	Nickel	ug/mL	105	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000058		7723-14-0	Phosphorus	ug/mL	105	<0.0500	7.75E+03	n/a	n/a	n/a	n/a	10.0	n/a	
S11R000058		7439-92-1	Lead	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000058		7704-34-9	Sulfur	ug/mL	104	<0.100	74.5	n/a	n/a	n/a	n/a	20.0	n/a	J
S11R000058		7440-36-0	Antimony	ug/mL	99.9	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000058		7782-49-2	Selenium	ug/mL	107	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000058		7440-21-3	Silicon	ug/mL	96.1	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000058		7440-19-9	Samarium	ug/mL	103	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000058		7440-24-6	Strontium	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000058		7440-29-1	Thorium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000058		7440-32-6	Titanium	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000058		7440-61-1	Uranium	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000058		7440-62-2	Vanadium	ug/mL	105	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000058		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<0.400	n/a	n/a	n/a	n/a	0.400	n/a	U
S11R000058		7440-66-6	Zinc	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000058		7440-67-7	Zirconium	ug/mL	101	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000058		SPECGRAVITY	Specific gravity	unitless	100.0	n/a	1.052	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000058		TOC	Total organic carbon	ug/mL	95.3	<20.0	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000058		TIC	Total inorganic carbon	ug/mL	95.8	<7.00	152	n/a	n/a	n/a	n/a	7.00	n/a	

C-110 Heel Solids: Small-scale Dissolution Test — 1 day at 28 °C; diluted sample [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000059		%WATER	Percent water	%	91.6	n/a	89.9	77.3	83.6	15.1	n/a	0.0100	n/a	
S11R000059		16984-48-8	Fluoride	ug/mL	102	<1.61E-03	2.98E+03	n/a	n/a	n/a	n/a	16.1	n/a	
S11R000059		666-14-8	Glycolate	ug/mL	98.5	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000059		71-50-1	Acetate	ug/mL	102	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000059		12311-97-6	Formate	ug/mL	99.0	<4.67E-03	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000059		16887-00-6	Chloride	ug/mL	101	<9.98E-03	7.09	n/a	n/a	n/a	n/a	0.998	n/a	
S11R000059		14797-65-0	Nitrite	ug/mL	101	<0.0192	324	n/a	n/a	n/a	n/a	1.92	n/a	
S11R000059		14808-79-8	Sulfate	ug/mL	102	<0.0187	217	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000059		338-70-5	Oxalate	ug/mL	103	<0.0231	22.1	n/a	n/a	n/a	n/a	2.31	n/a	J
S11R000059		24959-67-9	Bromide	ug/mL	102	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000059		14797-55-8	Nitrate	ug/mL	99.5	<0.0208	646	n/a	n/a	n/a	n/a	2.08	n/a	
S11R000059		14265-44-2	Phosphate	ug/mL	101	<0.0167	2.53E+04	n/a	n/a	n/a	n/a	167	n/a	
S11R000059		7440-22-4	Silver	ug/mL	102	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000059		7429-90-5	Aluminum	ug/mL	104	<0.0300	262	n/a	n/a	n/a	n/a	6.00	n/a	
S11R000059		7440-38-2	Arsenic	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000059		7440-39-3	Barium	ug/mL	104	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000059		7440-41-7	Beryllium	ug/mL	102	<1.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S11R000059		7440-69-9	Bismuth	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000059		7440-70-2	Calcium	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000059		7440-43-9	Cadmium	ug/mL	106	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000059		7440-45-1	Cerium	ug/mL	106	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000059		7440-48-4	Cobalt	ug/mL	104	<0.0100	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000059		7440-47-3	Chromium	ug/mL	106	<5.00E-03	3.56	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000059		7440-50-8	Copper	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000059		7439-89-6	Iron	ug/mL	104	<5.00E-03	7.40	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000059		7440-09-7	Potassium	ug/mL	99.5	<0.500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000059		7439-91-0	Lanthanum	ug/mL	101	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000059		7439-93-2	Lithium	ug/mL	108	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000059		7439-95-4	Magnesium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000059		7439-96-5	Manganese	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U

C-110 Heel Solids: Small-scale Dissolution Test — 1 day at 28 °C; diluted sample [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000059		7439-98-7	Molybdenum	ug/mL	103	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000059		7440-23-5	Sodium	ug/mL	108	<0.100	1.95E+04	n/a	n/a	n/a	n/a	20.0	n/a	
S11R000059		7440-02-0	Nickel	ug/mL	105	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000059		7723-14-0	Phosphorus	ug/mL	105	<0.0500	8.29E+03	n/a	n/a	n/a	n/a	10.0	n/a	
S11R000059		7439-92-1	Lead	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000059		7704-34-9	Sulfur	ug/mL	104	<0.100	67.0	n/a	n/a	n/a	n/a	20.0	n/a	J
S11R000059		7440-36-0	Antimony	ug/mL	99.9	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000059		7782-49-2	Selenium	ug/mL	107	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000059		7440-21-3	Silicon	ug/mL	96.1	<0.0300	6.08	n/a	n/a	n/a	n/a	6.00	n/a	J
S11R000059		7440-19-9	Samarium	ug/mL	103	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000059		7440-24-6	Strontium	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000059		7440-29-1	Thorium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000059		7440-32-6	Titanium	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000059		7440-61-1	Uranium	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000059		7440-62-2	Vanadium	ug/mL	105	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000059		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<0.400	n/a	n/a	n/a	n/a	0.400	n/a	U
S11R000059		7440-66-6	Zinc	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000059		7440-67-7	Zirconium	ug/mL	101	<5.00E-03	1.56	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000059		SPECGRAVITY	Specific gravity	unitless	100.0	n/a	1.053	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000059		TOC	Total organic carbon	ug/mL	95.3	<20.0	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000059		TIC	Total inorganic carbon	ug/mL	95.8	<7.00	132	n/a	n/a	n/a	n/a	7.00	n/a	

[a] Small-scale H_2O: 1 day at 28 °C

	Wt	Vol at 28.0 °C	D_{Liq}
Test Liquid	14.409 g	13.568 mL	1.062 g/mL
H_2O	3.629 g	3.643 mL	0.996233 g.mL

C-110 Heel Solids: Small-scale Dissolution Test — 2 days at 28 °C; diluted sample [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000060		%WATER	Percent water	%	97.7	n/a	93.8	n/a	n/a	n/a	n/a	0.0100	n/a	
S11R000060		16984-48-8	Fluoride	ug/mL	102	<1.61E-03	2.98E+03	n/a	n/a	n/a	n/a	16.1	n/a	
S11R000060		666-14-8	Glycolate	ug/mL	98.5	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000060		71-50-1	Acetate	ug/mL	102	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000060		12311-97-6	Formate	ug/mL	99.0	<4.67E-03	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000060		16887-00-6	Chloride	ug/mL	101	<9.98E-03	6.40	n/a	n/a	n/a	n/a	0.998	n/a	
S11R000060		14797-65-0	Nitrite	ug/mL	101	<0.0192	288	n/a	n/a	n/a	n/a	1.92	n/a	
S11R000060		14808-79-8	Sulfate	ug/mL	102	<0.0187	204	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000060		338-70-5	Oxalate	ug/mL	103	<0.0231	20.2	n/a	n/a	n/a	n/a	2.31	n/a	J
S11R000060		24959-67-9	Bromide	ug/mL	102	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000060		14797-55-8	Nitrate	ug/mL	99.5	<0.0208	569	n/a	n/a	n/a	n/a	2.08	n/a	
S11R000060		14265-44-2	Phosphate	ug/mL	101	<0.0167	2.51E+04	n/a	n/a	n/a	n/a	167	n/a	
S11R000060		7440-22-4	Silver	ug/mL	102	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000060		7429-90-5	Aluminum	ug/mL	104	<0.0300	297	n/a	n/a	n/a	n/a	6.00	n/a	
S11R000060		7440-38-2	Arsenic	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000060		7440-39-3	Barium	ug/mL	104	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000060		7440-41-7	Beryllium	ug/mL	102	<1.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S11R000060		7440-69-9	Bismuth	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000060		7440-70-2	Calcium	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000060		7440-43-9	Cadmium	ug/mL	106	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000060		7440-45-1	Cerium	ug/mL	106	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000060		7440-48-4	Cobalt	ug/mL	104	<0.0100	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000060		7440-47-3	Chromium	ug/mL	106	<5.00E-03	3.31	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000060		7440-50-8	Copper	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000060		7439-89-6	Iron	ug/mL	104	<5.00E-03	7.20	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000060		7440-09-7	Potassium	ug/mL	99.5	<0.500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000060		7439-91-0	Lanthanum	ug/mL	101	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000060		7439-93-2	Lithium	ug/mL	108	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000060		7439-95-4	Magnesium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000060		7439-96-5	Manganese	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U

C-110 Heel Solids: Small-scale Dissolution Test — 2 days at 28 °C; diluted sample [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000060		7439-98-7	Molybdenum	ug/mL	103	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000060		7440-23-5	Sodium	ug/mL	108	<0.100	1.99E+04	n/a	n/a	n/a	n/a	20.0	n/a	
S11R000060		7440-02-0	Nickel	ug/mL	105	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000060		7723-14-0	Phosphorus	ug/mL	105	<0.0500	8.33E+03	n/a	n/a	n/a	n/a	10.0	n/a	
S11R000060		7439-92-1	Lead	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000060		7704-34-9	Sulfur	ug/mL	104	<0.100	62.5	n/a	n/a	n/a	n/a	20.0	n/a	J
S11R000060		7440-36-0	Antimony	ug/mL	99.9	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000060		7782-49-2	Selenium	ug/mL	107	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000060		7440-21-3	Silicon	ug/mL	96.1	<0.0300	6.14	n/a	n/a	n/a	n/a	6.00	n/a	J
S11R000060		7440-19-9	Samarium	ug/mL	103	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000060		7440-24-6	Strontium	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000060		7440-29-1	Thorium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000060		7440-32-6	Titanium	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000060		7440-61-1	Uranium	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000060		7440-62-2	Vanadium	ug/mL	105	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000060		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<0.400	n/a	n/a	n/a	n/a	0.400	n/a	U
S11R000060		7440-66-6	Zinc	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000060		7440-67-7	Zirconium	ug/mL	101	<5.00E-03	1.32	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000060		SPECGRAVITY	Specific gravity	unitless	100.0	n/a	1.058	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000060		TOC	Total organic carbon	ug/mL	95.3	<20.0	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000060		TIC	Total inorganic carbon	ug/mL	95.8	<7.00	111	n/a	n/a	n/a	n/a	7.00	n/a	

[a] Small-scale H_2O: 2 days at 28 °C

	Wt	Vol at 28.0 °C	D_{Liq}
Test Liquid	13.496 g	12.684 mL	1.064 g/mL
H_2O	3.374 g	3.387 mL	0.996233 g/mL

C-110 Heel Solids: Small-scale Dissolution Test — 4 days at 28 °C; diluted sample [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000061		%WATER	Percent water	%	86.6	n/a	85.9	n/a	n/a	n/a	n/a	0.0100	n/a	
S11R000061		16984-48-8	Fluoride	ug/mL	102	<1.61E-03	3.08E+03	n/a	n/a	n/a	n/a	16.1	n/a	
S11R000061		666-14-8	Glycolate	ug/mL	98.5	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000061		71-50-1	Acetate	ug/mL	102	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000061		12311-97-6	Formate	ug/mL	99.0	<4.67E-03	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000061		16887-00-6	Chloride	ug/mL	101	<9.98E-03	7.09	n/a	n/a	n/a	n/a	0.998	n/a	
S11R000061		14797-65-0	Nitrite	ug/mL	101	<0.0192	276	n/a	n/a	n/a	n/a	1.92	n/a	
S11R000061		14808-79-8	Sulfate	ug/mL	102	<0.0187	205	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000061		338-70-5	Oxalate	ug/mL	103	<0.0231	18.8	n/a	n/a	n/a	n/a	2.31	n/a	J
S11R000061		24959-67-9	Bromide	ug/mL	102	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000061		14797-55-8	Nitrate	ug/mL	99.5	<0.0208	551	n/a	n/a	n/a	n/a	2.08	n/a	
S11R000061		14265-44-2	Phosphate	ug/mL	101	<0.0167	2.54E+04	n/a	n/a	n/a	n/a	167	n/a	
S11R000061		7440-22-4	Silver	ug/mL	102	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000061		7429-90-5	Aluminum	ug/mL	104	<0.0300	349	n/a	n/a	n/a	n/a	6.00	n/a	
S11R000061		7440-38-2	Arsenic	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000061		7440-39-3	Barium	ug/mL	104	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000061		7440-41-7	Beryllium	ug/mL	102	<1.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S11R000061		7440-69-9	Bismuth	ug/mL	104	<0.100	25.3	n/a	n/a	n/a	n/a	20.0	n/a	J
S11R000061		7440-70-2	Calcium	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000061		7440-43-9	Cadmium	ug/mL	106	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000061		7440-45-1	Cerium	ug/mL	106	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000061		7440-48-4	Cobalt	ug/mL	104	<0.0100	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000061		7440-47-3	Chromium	ug/mL	106	<5.00E-03	3.20	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000061		7440-50-8	Copper	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000061		7439-89-6	Iron	ug/mL	104	<5.00E-03	7.40	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000061		7440-09-7	Potassium	ug/mL	99.5	<0.500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000061		7439-91-0	Lanthanum	ug/mL	101	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000061		7439-93-2	Lithium	ug/mL	108	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000061		7439-95-4	Magnesium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000061		7439-96-5	Manganese	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U

C-110 Heel Solids: Small-scale Dissolution Test — 4 days at 28 °C; diluted sample [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000061		7439-98-7	Molybdenum	ug/mL	103	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000061		7440-23-5	Sodium	ug/mL	108	<0.100	2.04E+04	n/a	n/a	n/a	n/a	20.0	n/a	
S11R000061		7440-02-0	Nickel	ug/mL	105	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000061		7723-14-0	Phosphorus	ug/mL	105	<0.0500	8.20E+03	n/a	n/a	n/a	n/a	10.0	n/a	
S11R000061		7439-92-1	Lead	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000061		7704-34-9	Sulfur	ug/mL	104	<0.100	64.8	n/a	n/a	n/a	n/a	20.0	n/a	J
S11R000061		7440-36-0	Antimony	ug/mL	99.9	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000061		7782-49-2	Selenium	ug/mL	107	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000061		7440-21-3	Silicon	ug/mL	96.1	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000061		7440-19-9	Samarium	ug/mL	103	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000061		7440-24-6	Strontium	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000061		7440-29-1	Thorium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000061		7440-32-6	Titanium	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000061		7440-61-1	Uranium	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000061		7440-62-2	Vanadium	ug/mL	105	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000061		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<0.400	n/a	n/a	n/a	n/a	0.400	n/a	U
S11R000061		7440-66-6	Zinc	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000061		7440-67-7	Zirconium	ug/mL	101	<5.00E-03	1.64	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000061		SPECGRAVITY	Specific gravity	unitless	100.0	n/a	1.059	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000061		TOC	Total organic carbon	ug/mL	95.3	<20.0	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000061		TIC	Total inorganic carbon	ug/mL	95.8	<7.00	112	n/a	n/a	n/a	n/a	7.00	n/a	

[a] Small-scale H_2O: 4 days at 28 °C

	Wt	Vol at 28.0 °C	D_{Liq}
Test Liquid	13.376 g	12.607 mL	1.061 g/mL
H_2O	3.340 g	3.353 mL	0.996233 g/mL

C-110 Heel Solids: Small-scale Dissolution Test — 6 days at 28 °C; diluted sample [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000055		%WATER	Percent water	%	97.7	n/a	91.9	93.1	92.5	1.35	n/a	0.0100	n/a	
S11R000055		16984-48-8	Fluoride	ug/mL	102	<1.61E-03	3.08E+03	2.95E+03	3.02E+03	4.37	105	16.1	n/a	
S11R000055		666-14-8	Glycolate	ug/mL	98.5	<9.37E-03	<0.937	<0.937	n/a	n/a	82.3	0.937	n/a	U
S11R000055		71-50-1	Acetate	ug/mL	102	<6.04E-03	<0.604	<0.604	n/a	n/a	85.8	0.604	n/a	U
S11R000055		12311-97-6	Formate	ug/mL	99.0	<4.67E-03	<0.467	<0.467	n/a	n/a	95.2	0.467	n/a	U
S11R000055		16887-00-6	Chloride	ug/mL	101	<9.98E-03	7.47	6.88	7.17	8.17	101	0.998	n/a	
S11R000055		14797-65-0	Nitrite	ug/mL	101	<0.0192	311	308	309	0.870	98.3	1.92	n/a	
S11R000055		14808-79-8	Sulfate	ug/mL	102	<0.0187	216	214	215	0.806	101	1.87	n/a	
S11R000055		338-70-5	Oxalate	ug/mL	103	<0.0231	21.5	21.0	21.2	2.05	101	2.31	n/a	J
S11R000055		24959-67-9	Bromide	ug/mL	102	<0.0580	<5.80	<5.80	n/a	n/a	103	5.80	n/a	U
S11R000055		14797-55-8	Nitrate	ug/mL	99.5	<0.0208	614	612	613	0.253	97.0	2.08	n/a	
S11R000055		14265-44-2	Phosphate	ug/mL	101	<0.0167	2.60E+04	2.50E+04	2.55E+04	3.84	102	167	n/a	
S11R000055		7440-22-4	Silver	ug/mL	102	<5.00E-03	<1.00	<1.00	n/a	n/a	97.3	1.00	n/a	U
S11R000055		7429-90-5	Aluminum	ug/mL	104	<0.0300	354	361	358	1.94	99.1	6.00	n/a	
S11R000055		7440-38-2	Arsenic	ug/mL	104	<0.0500	<10.0	<10.0	n/a	n/a	101	10.0	n/a	U
S11R000055		7440-39-3	Barium	ug/mL	104	<3.00E-03	<0.600	<0.600	n/a	n/a	98.8	0.600	n/a	U
S11R000055		7440-41-7	Beryllium	ug/mL	102	<1.00E-03	<0.200	<0.200	n/a	n/a	97.5	0.200	n/a	U
S11R000055		7440-69-9	Bismuth	ug/mL	104	<0.100	21.4	<20.0	n/a	n/a	102	20.0	n/a	J
S11R000055		7440-70-2	Calcium	ug/mL	107	<0.0500	<10.0	<10.0	n/a	n/a	105	10.0	n/a	U
S11R000055		7440-43-9	Cadmium	ug/mL	106	<5.00E-03	<1.00	<1.00	n/a	n/a	101	1.00	n/a	U
S11R000055		7440-45-1	Cerium	ug/mL	106	<0.0300	<6.00	<6.00	n/a	n/a	97.3	6.00	n/a	U
S11R000055		7440-48-4	Cobalt	ug/mL	104	<0.0100	<2.00	<2.00	n/a	n/a	101	2.00	n/a	U
S11R000055		7440-47-3	Chromium	ug/mL	106	<5.00E-03	3.41	3.50	3.45	2.50	102	1.00	n/a	J
S11R000055		7440-50-8	Copper	ug/mL	103	<5.00E-03	<1.00	<1.00	n/a	n/a	98.1	1.00	n/a	U
S11R000055		7439-89-6	Iron	ug/mL	104	<5.00E-03	7.64	7.24	7.44	5.35	100	1.00	n/a	J
S11R000055		7440-09-7	Potassium	ug/mL	99.5	<0.500	<100	<100	n/a	n/a	90.6	100	n/a	U
S11R000055		7439-91-0	Lanthanum	ug/mL	101	<3.00E-03	<0.600	<0.600	n/a	n/a	95.1	0.600	n/a	U
S11R000055		7439-93-2	Lithium	ug/mL	108	<3.00E-03	<0.600	<0.600	n/a	n/a	92.2	0.600	n/a	U
S11R000055		7439-95-4	Magnesium	ug/mL	104	<0.0500	<10.0	<10.0	n/a	n/a	96.1	10.0	n/a	U
S11R000055		7439-96-5	Manganese	ug/mL	103	<3.00E-03	<0.600	<0.600	n/a	n/a	101	0.600	n/a	U

C-110 Heel Solids: Small-scale Dissolution Test — 6 days at 28 °C; diluted sample [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000055		7439-98-7	Molybdenum	ug/mL	103	<0.0200	<4.00	<4.00	n/a	n/a	101	4.00	n/a	U
S11R000055		7440-23-5	Sodium	ug/mL	108	<0.100	2.13E+04	2.15E+04	2.14E+04	1.15	80.9	20.0	n/a	e
S11R000055		7440-02-0	Nickel	ug/mL	105	<0.0200	<4.00	<4.00	n/a	n/a	101	4.00	n/a	U
S11R000055		7723-14-0	Phosphorus	ug/mL	105	<0.0500	8.72E+03	8.83E+03	8.78E+03	1.25	75.7	10.0	n/a	
S11R000055		7439-92-1	Lead	ug/mL	107	<0.0500	<10.0	<10.0	n/a	n/a	104	10.0	n/a	U
S11R000055		7704-34-9	Sulfur	ug/mL	104	<0.100	68.1	70.5	69.3	3.55	100	20.0	n/a	J
S11R000055		7440-36-0	Antimony	ug/mL	99.9	<0.0500	<10.0	<10.0	n/a	n/a	98.1	10.0	n/a	U
S11R000055		7782-49-2	Selenium	ug/mL	107	<0.100	<20.0	<20.0	n/a	n/a	103	20.0	n/a	U
S11R000055		7440-21-3	Silicon	ug/mL	96.1	<0.0300	8.75	9.62	9.19	9.51	93.3	6.00	n/a	J
S11R000055		7440-19-9	Samarium	ug/mL	103	<0.0500	<10.0	<10.0	n/a	n/a	94.7	10.0	n/a	U
S11R000055		7440-24-6	Strontium	ug/mL	103	<3.00E-03	<0.600	<0.600	n/a	n/a	97.4	0.600	n/a	U
S11R000055		7440-29-1	Thorium	ug/mL	104	<0.0500	<10.0	<10.0	n/a	n/a	102	10.0	n/a	U
S11R000055		7440-32-6	Titanium	ug/mL	103	<5.00E-03	<1.00	<1.00	n/a	n/a	98.1	1.00	n/a	U
S11R000055		7440-61-1	Uranium	ug/mL	104	<0.100	<20.0	<20.0	n/a	n/a	93.3	20.0	n/a	U
S11R000055		7440-62-2	Vanadium	ug/mL	105	<5.00E-03	<1.00	<1.00	n/a	n/a	101	1.00	n/a	U
S11R000055		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<0.400	<0.400	n/a	n/a	n/a	0.400	n/a	U
S11R000055		7440-66-6	Zinc	ug/mL	103	<5.00E-03	<1.00	<1.00	n/a	n/a	101	1.00	n/a	U
S11R000055		7440-67-7	Zirconium	ug/mL	101	<5.00E-03	1.35	1.30	1.32	3.16	95.7	1.00	n/a	J
S11R000055		SPECGRAVITY	Specific gravity	unitless	100.0	n/a	1.050	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000055		TOC	Total organic carbon	ug/mL	95.3	<20.0	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000055		TIC	Total inorganic carbon	ug/mL	95.8	<7.00	128	n/a	n/a	n/a	n/a	7.00	n/a	

[a] Small-scale H_2O: 6 days at 28 °C

	Wt	Vol at 28.0 °C	D_{Liq}
Test Liquid	13.191 g	12.409 mL	1.063 g/mL
H_2O	3.299 g	3.311 mL	0.996233 g/mL

C-110 Heel Solids: Small-scale Dissolution Test — 8 days at 28 °C; diluted sample [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000062		%WATER	Percent water	%	97.7	n/a	94.2	n/a	n/a	n/a	n/a	0.0100	n/a	
S11R000062		16984-48-8	Fluoride	ug/mL	104	<1.61E-03	2.84E+03	n/a	n/a	n/a	n/a	16.1	n/a	
S11R000062		666-14-8	Glycolate	ug/mL	101	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000062		71-50-1	Acetate	ug/mL	105	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000062		12311-97-6	Formate	ug/mL	102	<4.67E-03	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000062		16887-00-6	Chloride	ug/mL	103	<9.98E-03	7.42	n/a	n/a	n/a	n/a	0.998	n/a	
S11R000062		14797-65-0	Nitrite	ug/mL	102	<0.0192	309	n/a	n/a	n/a	n/a	1.92	n/a	
S11R000062		14808-79-8	Sulfate	ug/mL	105	<0.0187	216	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000062		338-70-5	Oxalate	ug/mL	106	<0.0231	19.8	n/a	n/a	n/a	n/a	2.31	n/a	J
S11R000062		24959-67-9	Bromide	ug/mL	105	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000062		14797-55-8	Nitrate	ug/mL	103	<0.0208	612	n/a	n/a	n/a	n/a	2.08	n/a	
S11R000062		14265-44-2	Phosphate	ug/mL	104	<0.0167	2.38E+04	n/a	n/a	n/a	n/a	167	n/a	
S11R000062		7440-22-4	Silver	ug/mL	102	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000062		7429-90-5	Aluminum	ug/mL	104	<0.0300	413	n/a	n/a	n/a	n/a	6.00	n/a	
S11R000062		7440-38-2	Arsenic	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000062		7440-39-3	Barium	ug/mL	104	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000062		7440-41-7	Beryllium	ug/mL	102	<1.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S11R000062		7440-69-9	Bismuth	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000062		7440-70-2	Calcium	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000062		7440-43-9	Cadmium	ug/mL	106	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000062		7440-45-1	Cerium	ug/mL	106	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000062		7440-48-4	Cobalt	ug/mL	104	<0.0100	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000062		7440-47-3	Chromium	ug/mL	106	<5.00E-03	3.89	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000062		7440-50-8	Copper	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000062		7439-89-6	Iron	ug/mL	104	<5.00E-03	7.34	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000062		7440-09-7	Potassium	ug/mL	99.5	<0.500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000062		7439-91-0	Lanthanum	ug/mL	101	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000062		7439-93-2	Lithium	ug/mL	108	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000062		7439-95-4	Magnesium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000062		7439-96-5	Manganese	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U

C-110 Heel Solids: Small-scale Dissolution Test — 8 days at 28 °C; diluted sample [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000062		7439-98-7	Molybdenum	ug/mL	103	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000062		7440-23-5	Sodium	ug/mL	108	<0.100	2.05E+04	n/a	n/a	n/a	n/a	20.0	n/a	
S11R000062		7440-02-0	Nickel	ug/mL	105	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000062		7723-14-0	Phosphorus	ug/mL	105	<0.0500	8.69E+03	n/a	n/a	n/a	n/a	10.0	n/a	
S11R000062		7439-92-1	Lead	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000062		7704-34-9	Sulfur	ug/mL	104	<0.100	70.0	n/a	n/a	n/a	n/a	20.0	n/a	J
S11R000062		7440-36-0	Antimony	ug/mL	99.9	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000062		7782-49-2	Selenium	ug/mL	107	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000062		7440-21-3	Silicon	ug/mL	96.1	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000062		7440-19-9	Samarium	ug/mL	103	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000062		7440-24-6	Strontium	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000062		7440-29-1	Thorium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000062		7440-32-6	Titanium	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000062		7440-61-1	Uranium	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000062		7440-62-2	Vanadium	ug/mL	105	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000062		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<0.400	n/a	n/a	n/a	n/a	0.400	n/a	U
S11R000062		7440-66-6	Zinc	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000062		7440-67-7	Zirconium	ug/mL	101	<5.00E-03	1.31	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000062		SPECGRAVITY	Specific gravity	unitless	100.0	n/a	1.063	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000062		TOC	Total organic carbon	ug/mL	95.3	<20.0	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000062		TIC	Total inorganic carbon	ug/mL	95.8	<7.00	141	n/a	n/a	n/a	n/a	7.00	n/a	

[a] Small-scale H_2O: 8 days at 28 °C

	Wt	Vol at 28.0 °C	D_{Liq}
Test Liquid	13.566 g	12.798 mL	1.060 g/mL
H_2O	3.408 g	3.421 mL	0.996233 g/mL

C-110 Heel Solids: Small-scale Dissolution Test — 1 day at 46 °C; diluted sample [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000063		%WATER	Percent water	%	86.6	n/a	88.8	n/a	n/a	n/a	n/a	0.0100	n/a	
S11R000063		16984-48-8	Fluoride	ug/mL	104	<1.61E-03	2.37E+03	n/a	n/a	n/a	n/a	16.1	n/a	
S11R000063		666-14-8	Glycolate	ug/mL	101	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000063		71-50-1	Acetate	ug/mL	105	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000063		12311-97-6	Formate	ug/mL	102	<4.67E-03	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000063		16887-00-6	Chloride	ug/mL	103	<9.98E-03	3.36	n/a	n/a	n/a	n/a	0.998	n/a	J
S11R000063		14797-65-0	Nitrite	ug/mL	102	<0.0192	157	n/a	n/a	n/a	n/a	1.92	n/a	
S11R000063		14808-79-8	Sulfate	ug/mL	105	<0.0187	150	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000063		338-70-5	Oxalate	ug/mL	106	<0.0231	12.0	n/a	n/a	n/a	n/a	2.31	n/a	J
S11R000063		24959-67-9	Bromide	ug/mL	105	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000063		14797-55-8	Nitrate	ug/mL	103	<0.0208	314	n/a	n/a	n/a	n/a	2.08	n/a	
S11R000063		14265-44-2	Phosphate	ug/mL	104	<0.0167	2.18E+04	n/a	n/a	n/a	n/a	167	n/a	
S11R000063		7440-22-4	Silver	ug/mL	102	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000063		7429-90-5	Aluminum	ug/mL	104	<0.0300	288	n/a	n/a	n/a	n/a	6.00	n/a	
S11R000063		7440-38-2	Arsenic	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000063		7440-39-3	Barium	ug/mL	104	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000063		7440-41-7	Beryllium	ug/mL	102	<1.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S11R000063		7440-69-9	Bismuth	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000063		7440-70-2	Calcium	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000063		7440-43-9	Cadmium	ug/mL	106	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000063		7440-45-1	Cerium	ug/mL	106	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000063		7440-48-4	Cobalt	ug/mL	104	<0.0100	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000063		7440-47-3	Chromium	ug/mL	106	<5.00E-03	1.90	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000063		7440-50-8	Copper	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000063		7439-89-6	Iron	ug/mL	104	<5.00E-03	4.61	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000063		7440-09-7	Potassium	ug/mL	99.5	<0.500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000063		7439-91-0	Lanthanum	ug/mL	101	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000063		7439-93-2	Lithium	ug/mL	108	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000063		7439-95-4	Magnesium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000063		7439-96-5	Manganese	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U

C-110 Heel Solids: Small-scale Dissolution Test — 1 day at 46 °C; diluted sample [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000063		7439-98-7	Molybdenum	ug/mL	103	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000063		7440-23-5	Sodium	ug/mL	108	<0.100	1.82E+04	n/a	n/a	n/a	n/a	20.0	n/a	
S11R000063		7440-02-0	Nickel	ug/mL	105	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000063		7723-14-0	Phosphorus	ug/mL	105	<0.0500	7.36E+03	n/a	n/a	n/a	n/a	10.0	n/a	
S11R000063		7439-92-1	Lead	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000063		7704-34-9	Sulfur	ug/mL	104	<0.100	42.5	n/a	n/a	n/a	n/a	20.0	n/a	J
S11R000063		7440-36-0	Antimony	ug/mL	99.9	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000063		7782-49-2	Selenium	ug/mL	107	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000063		7440-21-3	Silicon	ug/mL	96.1	<0.0300	6.76	n/a	n/a	n/a	n/a	6.00	n/a	J
S11R000063		7440-19-9	Samarium	ug/mL	103	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000063		7440-24-6	Strontium	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000063		7440-29-1	Thorium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000063		7440-32-6	Titanium	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000063		7440-61-1	Uranium	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000063		7440-62-2	Vanadium	ug/mL	105	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000063		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<0.400	n/a	n/a	n/a	n/a	0.400	n/a	U
S11R000063		7440-66-6	Zinc	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000063		7440-67-7	Zirconium	ug/mL	101	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000063		SPECGRAVITY	Specific gravity	unitless	100.0	n/a	1.045	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000063		TOC	Total organic carbon	ug/mL	95.3	<20.0	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000063		TIC	Total inorganic carbon	ug/mL	95.8	<7.00	67.4	n/a	n/a	n/a	n/a	7.00	n/a	J

[a] Small-scale H_2O: 1 day at 46 °C

	Wt	Vol at 28.0 °C	D_{Liq}
Test Liquid	8.168 g	7.521 mL	1.086 g/mL
H_2O	8.056 g	8.086 mL	0.996233 g/mL

C-110 Heel Solids: Small-scale Dissolution Test — 2 days at 46 °C; diluted sample [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000064		%WATER	Percent water	%	97.7	n/a	95.3	n/a	n/a	n/a	n/a	0.0100	n/a	
S11R000064		16984-48-8	Fluoride	ug/mL	104	<1.61E-03	2.36E+03	n/a	n/a	n/a	n/a	16.1	n/a	
S11R000064		666-14-8	Glycolate	ug/mL	101	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000064		71-50-1	Acetate	ug/mL	105	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000064		12311-97-6	Formate	ug/mL	102	<4.67E-03	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000064		16887-00-6	Chloride	ug/mL	103	<9.98E-03	5.29	n/a	n/a	n/a	n/a	0.998	n/a	
S11R000064		14797-65-0	Nitrite	ug/mL	102	<0.0192	187	n/a	n/a	n/a	n/a	1.92	n/a	
S11R000064		14808-79-8	Sulfate	ug/mL	105	<0.0187	158	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000064		338-70-5	Oxalate	ug/mL	106	<0.0231	12.1	n/a	n/a	n/a	n/a	2.31	n/a	J
S11R000064		24959-67-9	Bromide	ug/mL	105	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000064		14797-55-8	Nitrate	ug/mL	103	<0.0208	383	n/a	n/a	n/a	n/a	2.08	n/a	
S11R000064		14265-44-2	Phosphate	ug/mL	104	<0.0167	2.18E+04	n/a	n/a	n/a	n/a	167	n/a	
S11R000064		7440-22-4	Silver	ug/mL	102	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000064		7429-90-5	Aluminum	ug/mL	104	<0.0300	345	n/a	n/a	n/a	n/a	6.00	n/a	
S11R000064		7440-38-2	Arsenic	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000064		7440-39-3	Barium	ug/mL	104	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000064		7440-41-7	Beryllium	ug/mL	102	<1.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S11R000064		7440-69-9	Bismuth	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000064		7440-70-2	Calcium	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000064		7440-43-9	Cadmium	ug/mL	106	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000064		7440-45-1	Cerium	ug/mL	106	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000064		7440-48-4	Cobalt	ug/mL	104	<0.0100	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000064		7440-47-3	Chromium	ug/mL	106	<5.00E-03	2.00	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000064		7440-50-8	Copper	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000064		7439-89-6	Iron	ug/mL	104	<5.00E-03	5.44	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000064		7440-09-7	Potassium	ug/mL	99.5	<0.500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000064		7439-91-0	Lanthanum	ug/mL	101	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000064		7439-93-2	Lithium	ug/mL	108	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000064		7439-95-4	Magnesium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000064		7439-96-5	Manganese	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U

C-110 Heel Solids: Small-scale Dissolution Test — 2 days at 46 °C; diluted sample [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000064		7439-98-7	Molybdenum	ug/mL	103	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000064		7440-23-5	Sodium	ug/mL	108	<0.100	1.75E+04	n/a	n/a	n/a	n/a	20.0	n/a	
S11R000064		7440-02-0	Nickel	ug/mL	105	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000064		7723-14-0	Phosphorus	ug/mL	105	<0.0500	7.36E+03	n/a	n/a	n/a	n/a	10.0	n/a	
S11R000064		7439-92-1	Lead	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000064		7704-34-9	Sulfur	ug/mL	104	<0.100	49.8	n/a	n/a	n/a	n/a	20.0	n/a	J
S11R000064		7440-36-0	Antimony	ug/mL	99.9	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000064		7782-49-2	Selenium	ug/mL	107	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000064		7440-21-3	Silicon	ug/mL	96.1	<0.0300	6.82	n/a	n/a	n/a	n/a	6.00	n/a	J
S11R000064		7440-19-9	Samarium	ug/mL	103	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000064		7440-24-6	Strontium	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000064		7440-29-1	Thorium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000064		7440-32-6	Titanium	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000064		7440-61-1	Uranium	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000064		7440-62-2	Vanadium	ug/mL	105	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000064		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<0.400	n/a	n/a	n/a	n/a	0.400	n/a	U
S11R000064		7440-66-6	Zinc	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000064		7440-67-7	Zirconium	ug/mL	101	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000064		SPECGRAVITY	Specific gravity	unitless	100.0	n/a	1.046	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000064		TOC	Total organic carbon	ug/mL	95.3	<20.0	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000064		TIC	Total inorganic carbon	ug/mL	95.8	<7.00	92.6	n/a	n/a	n/a	n/a	7.00	n/a	

[a] Small-scale H_2O: 2 days at 46 °C

	Wt	Vol at 28.0 °C	D_{Liq}
Test Liquid	8.060 g	7.435 mL	1.084 g/mL
H_2O	8.034 g	8.064 mL	0.996233 g/mL

C-110 Heel Solids: Small-scale Dissolution Test — 4 days at 46 °C; diluted sample [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000065		%WATER	Percent water	%	98.9	n/a	93.1	92.8	92.9	0.334	n/a	0.0100	n/a	
S11R000065		16984-48-8	Fluoride	ug/mL	104	<1.61E-03	2.45E+03	n/a	n/a	n/a	n/a	16.1	n/a	
S11R000065		666-14-8	Glycolate	ug/mL	101	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000065		71-50-1	Acetate	ug/mL	105	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000065		12311-97-6	Formate	ug/mL	102	<4.67E-03	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000065		16887-00-6	Chloride	ug/mL	103	<9.98E-03	4.02	n/a	n/a	n/a	n/a	0.998	n/a	
S11R000065		14797-65-0	Nitrite	ug/mL	102	<0.0192	173	n/a	n/a	n/a	n/a	1.92	n/a	
S11R000065		14808-79-8	Sulfate	ug/mL	105	<0.0187	159	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000065		338-70-5	Oxalate	ug/mL	106	<0.0231	12.2	n/a	n/a	n/a	n/a	2.31	n/a	J
S11R000065		24959-67-9	Bromide	ug/mL	105	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000065		14797-55-8	Nitrate	ug/mL	103	<0.0208	347	n/a	n/a	n/a	n/a	2.08	n/a	
S11R000065		14265-44-2	Phosphate	ug/mL	104	<0.0167	2.27E+04	n/a	n/a	n/a	n/a	167	n/a	
S11R000065		7440-22-4	Silver	ug/mL	102	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000065		7429-90-5	Aluminum	ug/mL	104	<0.0300	420	n/a	n/a	n/a	n/a	6.00	n/a	
S11R000065		7440-38-2	Arsenic	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000065		7440-39-3	Barium	ug/mL	104	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000065		7440-41-7	Beryllium	ug/mL	102	<1.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S11R000065		7440-69-9	Bismuth	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000065		7440-70-2	Calcium	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000065		7440-43-9	Cadmium	ug/mL	106	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000065		7440-45-1	Cerium	ug/mL	106	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000065		7440-48-4	Cobalt	ug/mL	104	<0.0100	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000065		7440-47-3	Chromium	ug/mL	106	<5.00E-03	1.76	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000065		7440-50-8	Copper	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000065		7439-89-6	Iron	ug/mL	104	<5.00E-03	4.05	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000065		7440-09-7	Potassium	ug/mL	99.5	<0.500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000065		7439-91-0	Lanthanum	ug/mL	101	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000065		7439-93-2	Lithium	ug/mL	108	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000065		7439-95-4	Magnesium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000065		7439-96-5	Manganese	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U

C-110 Heel Solids: Small-scale Dissolution Test — 4 days at 46 °C; diluted sample [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000065		7439-98-7	Molybdenum	ug/mL	103	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000065		7440-23-5	Sodium	ug/mL	108	<0.100	1.83E+04	n/a	n/a	n/a	n/a	20.0	n/a	
S11R000065		7440-02-0	Nickel	ug/mL	105	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000065		7723-14-0	Phosphorus	ug/mL	105	<0.0500	7.67E+03	n/a	n/a	n/a	n/a	10.0	n/a	
S11R000065		7439-92-1	Lead	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000065		7704-34-9	Sulfur	ug/mL	104	<0.100	48.0	n/a	n/a	n/a	n/a	20.0	n/a	J
S11R000065		7440-36-0	Antimony	ug/mL	99.9	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000065		7782-49-2	Selenium	ug/mL	107	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000065		7440-21-3	Silicon	ug/mL	96.1	<0.0300	6.19	n/a	n/a	n/a	n/a	6.00	n/a	J
S11R000065		7440-19-9	Samarium	ug/mL	103	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000065		7440-24-6	Strontium	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000065		7440-29-1	Thorium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000065		7440-32-6	Titanium	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000065		7440-61-1	Uranium	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000065		7440-62-2	Vanadium	ug/mL	105	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000065		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<0.400	n/a	n/a	n/a	n/a	0.400	n/a	U
S11R000065		7440-66-6	Zinc	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000065		7440-67-7	Zirconium	ug/mL	101	<5.00E-03	1.06	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000065		SPECGRAVITY	Specific gravity	unitless	100.0	n/a	1.055	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000065		TOC	Total organic carbon	ug/mL	95.3	<20.0	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000065		TIC	Total inorganic carbon	ug/mL	95.8	<7.00	68.8	n/a	n/a	n/a	n/a	7.00	n/a	J

[a] Small-scale H_2O: 4 days at 46 °C

	Wt	Vol at 28.0 °C	D_{Liq}
Test Liquid	8.109 g	7.439 mL	1.090 g/mL
H_2O	8.232 g	8.263 mL	0.996233 g/mL

C-110 Heel Solids: Small-scale Dissolution Test — 8 days at 46 °C; diluted sample [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000066		%WATER	Percent water	%	98.9	n/a	84.6	n/a	n/a	n/a	n/a	0.0100	n/a	
S11R000066		16984-48-8	Fluoride	ug/mL	104	<1.61E-03	2.55E+03	n/a	n/a	n/a	n/a	16.1	n/a	
S11R000066		666-14-8	Glycolate	ug/mL	101	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000066		71-50-1	Acetate	ug/mL	105	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000066		12311-97-6	Formate	ug/mL	102	<4.67E-03	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000066		16887-00-6	Chloride	ug/mL	103	<9.98E-03	5.12	n/a	n/a	n/a	n/a	0.998	n/a	
S11R000066		14797-65-0	Nitrite	ug/mL	102	<0.0192	194	n/a	n/a	n/a	n/a	1.92	n/a	
S11R000066		14808-79-8	Sulfate	ug/mL	105	<0.0187	171	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000066		338-70-5	Oxalate	ug/mL	106	<0.0231	12.7	n/a	n/a	n/a	n/a	2.31	n/a	J
S11R000066		24959-67-9	Bromide	ug/mL	105	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000066		14797-55-8	Nitrate	ug/mL	103	<0.0208	394	n/a	n/a	n/a	n/a	2.08	n/a	
S11R000066		14265-44-2	Phosphate	ug/mL	104	<0.0167	2.37E+04	n/a	n/a	n/a	n/a	167	n/a	
S11R000066		7440-22-4	Silver	ug/mL	102	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000066		7429-90-5	Aluminum	ug/mL	104	<0.0300	488	n/a	n/a	n/a	n/a	6.00	n/a	
S11R000066		7440-38-2	Arsenic	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000066		7440-39-3	Barium	ug/mL	104	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000066		7440-41-7	Beryllium	ug/mL	102	<1.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S11R000066		7440-69-9	Bismuth	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000066		7440-70-2	Calcium	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000066		7440-43-9	Cadmium	ug/mL	106	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000066		7440-45-1	Cerium	ug/mL	106	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000066		7440-48-4	Cobalt	ug/mL	104	<0.0100	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000066		7440-47-3	Chromium	ug/mL	106	<5.00E-03	2.27	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000066		7440-50-8	Copper	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000066		7439-89-6	Iron	ug/mL	104	<5.00E-03	4.09	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000066		7440-09-7	Potassium	ug/mL	99.5	<0.500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000066		7439-91-0	Lanthanum	ug/mL	101	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000066		7439-93-2	Lithium	ug/mL	108	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000066		7439-95-4	Magnesium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000066		7439-96-5	Manganese	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U

C-110 Heel Solids: Small-scale Dissolution Test — 8 days at 46 °C; diluted sample [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000066		7439-98-7	Molybdenum	ug/mL	103	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000066		7440-23-5	Sodium	ug/mL	108	<0.100	1.87E+04	n/a	n/a	n/a	n/a	20.0	n/a	
S11R000066		7440-02-0	Nickel	ug/mL	105	<0.0200	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000066		7723-14-0	Phosphorus	ug/mL	105	<0.0500	7.78E+03	n/a	n/a	n/a	n/a	10.0	n/a	
S11R000066		7439-92-1	Lead	ug/mL	107	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000066		7704-34-9	Sulfur	ug/mL	104	<0.100	49.8	n/a	n/a	n/a	n/a	20.0	n/a	J
S11R000066		7440-36-0	Antimony	ug/mL	99.9	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000066		7782-49-2	Selenium	ug/mL	107	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000066		7440-21-3	Silicon	ug/mL	96.1	<0.0300	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000066		7440-19-9	Samarium	ug/mL	103	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000066		7440-24-6	Strontium	ug/mL	103	<3.00E-03	<0.600	n/a	n/a	n/a	n/a	0.600	n/a	U
S11R000066		7440-29-1	Thorium	ug/mL	104	<0.0500	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000066		7440-32-6	Titanium	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000066		7440-61-1	Uranium	ug/mL	104	<0.100	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000066		7440-62-2	Vanadium	ug/mL	105	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000066		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<0.400	n/a	n/a	n/a	n/a	0.400	n/a	U
S11R000066		7440-66-6	Zinc	ug/mL	103	<5.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000066		7440-67-7	Zirconium	ug/mL	101	<5.00E-03	1.32	n/a	n/a	n/a	n/a	1.00	n/a	J
S11R000066		SPECGRAVITY	Specific gravity	unitless	100.0	n/a	1.055	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000066		TOC	Total organic carbon	ug/mL	95.3	<20.0	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000066		TIC	Total inorganic carbon	ug/mL	95.8	<7.00	77.0	n/a	n/a	n/a	n/a	7.00	n/a	

[a] Small-scale H_2O: 8 days at 46 °C

	Wt	Vol at 28.0 °C	D_{Liq}
Test Liquid	8.077 g	7.397 mL	1.092 g/mL
H_2O	8.072 g	8.103 mL	0.996233 g/mL

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Bulk Density Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000123		%WATER	Percent water	%	103	n/a	92.8	92.7	92.8	0.0970	n/a	0.0100	n/a	
S11R000123		16984-48-8	Fluoride	ug/mL	102	<1.61E-03	1.54E+03	1.56E+03	1.55E+03	1.21	103	3.22	n/a	
S11R000123		666-14-8	Glycolate	ug/mL	99.2	<9.37E-03	<0.937	<0.937	n/a	n/a	83.1	0.937	n/a	U
S11R000123		71-50-1	Acetate	ug/mL	102	<6.04E-03	42.2	39.5	40.8	6.58	104	0.604	n/a	
S11R000123		12311-97-6	Formate	ug/mL	101	<4.67E-03	17.0	15.9	16.4	6.87	99.3	0.467	n/a	
S11R000123		16887-00-6	Chloride	ug/mL	100	<9.98E-03	111	112	112	0.323	104	0.998	n/a	
S11R000123		14797-65-0	Nitrite	ug/mL	99.2	<0.0192	4.83E+03	4.88E+03	4.86E+03	0.869	99.3	38.4	n/a	
S11R000123		14808-79-8	Sulfate	ug/mL	102	<0.0187	1.29E+03	1.28E+03	1.29E+03	0.690	99.4	1.87	n/a	
S11R000123		338-70-5	Oxalate	ug/mL	99.5	<0.0231	333	330	331	0.948	92.5	2.31	n/a	
S11R000123		24959-67-9	Bromide	ug/mL	101	<0.0580	<5.80	<5.80	n/a	n/a	97.8	5.80	n/a	U
S11R000123		14797-55-8	Nitrate	ug/mL	99.4	<0.0208	9.27E+03	9.44E+03	9.36E+03	1.74	99.6	41.6	n/a	
S11R000123		14265-44-2	Phosphate	ug/mL	100	<0.0167	1.44E+04	1.46E+04	1.45E+04	1.30	100	33.4	n/a	
S11R000123		7429-90-5	Aluminum	ug/mL	98.1	<0.0300	113	130	122	14.3	99.0	60.0	n/a	J
S11R000123		7440-42-8	Boron	ug/mL	97.9	<0.0300	<60.0	<60.0	n/a	n/a	n/a	60.0	n/a	U
S11R000123		7440-39-3	Barium	ug/mL	99.5	<3.00E-03	<6.00	<6.00	n/a	n/a	102	6.00	n/a	U
S11R000123		7440-41-7	Beryllium	ug/mL	94.6	<1.00E-03	<2.00	<2.00	n/a	n/a	97.4	2.00	n/a	U
S11R000123		7440-69-9	Bismuth	ug/mL	96.3	<0.100	<200	<200	n/a	n/a	98.1	200	n/a	U
S11R000123		7440-70-2	Calcium	ug/mL	94.5	<0.0500	<100	<100	n/a	n/a	97.8	100	n/a	U
S11R000123		7440-45-1	Cerium	ug/mL	104	<0.0300	<60.0	<60.0	n/a	n/a	n/a	60.0	n/a	U
S11R000123		7440-47-3	Chromium	ug/mL	97.6	<5.00E-03	31.1	33.4	32.2	7.24	100	10.0	n/a	J
S11R000123		7440-50-8	Copper	ug/mL	99.7	<5.00E-03	<10.0	<10.0	n/a	n/a	99.6	10.0	n/a	U
S11R000123		7439-89-6	Iron	ug/mL	97.5	<5.00E-03	33.0	30.2	31.6	8.83	99.0	10.0	n/a	J
S11R000123		7440-09-7	Potassium	ug/mL	104	<0.500	<1.00E+03	<1.00E+03	n/a	n/a	104	1000	n/a	U
S11R000123		7439-91-0	Lanthanum	ug/mL	97.2	<3.00E-03	<6.00	<6.00	n/a	n/a	97.5	6.00	n/a	U
S11R000123		7439-93-2	Lithium	ug/mL	107	<3.00E-03	<6.00	<6.00	n/a	n/a	104	6.00	n/a	U
S11R000123		7439-95-4	Magnesium	ug/mL	100	<0.0500	<100	<100	n/a	n/a	99.4	100	n/a	U
S11R000123		7439-98-7	Molybdenum	ug/mL	94.8	<0.0200	<40.0	<40.0	n/a	n/a	n/a	40.0	n/a	U
S11R000123		7440-23-5	Sodium	ug/mL	106	<0.100	2.54E+04	2.46E+04	2.50E+04	2.99	106	200	n/a	
S11R000123		7723-14-0	Phosphorus	ug/mL	98.6	<0.0500	4.91E+03	4.98E+03	4.94E+03	1.41	n/a	100	n/a	
S11R000123		7439-92-1	Lead	ug/mL	101	<0.0500	<100	<100	n/a	n/a	104	100	n/a	U

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Bulk Density Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000123		7704-34-9	Sulfur	ug/mL	98.8	<0.100	465	449	457	3.45	n/a	200	n/a	J
S11R000123		7440-36-0	Antimony	ug/mL	94.5	<0.0500	<100	<100	n/a	n/a	n/a	100	n/a	U
S11R000123		7782-49-2	Selenium	ug/mL	97.7	<0.100	<200	<200	n/a	n/a	100	200	n/a	U
S11R000123		7440-21-3	Silicon	ug/mL	90.4	<0.0300	<60.0	<60.0	n/a	n/a	n/a	60.0	n/a	U
S11R000123		7440-19-9	Samarium	ug/mL	102	<0.0500	<100	<100	n/a	n/a	n/a	100	n/a	U
S11R000123		7440-24-6	Strontium	ug/mL	98.8	<3.00E-03	<6.00	<6.00	n/a	n/a	99.7	6.00	n/a	U
S11R000123		7440-29-1	Thorium	ug/mL	102	<0.0500	<100	<100	n/a	n/a	n/a	100	n/a	U
S11R000123		7440-32-6	Titanium	ug/mL	97.2	<5.00E-03	<10.0	<10.0	n/a	n/a	n/a	10.0	n/a	U
S11R000123		7440-62-2	Vanadium	ug/mL	98.4	<5.00E-03	<10.0	<10.0	n/a	n/a	101	10.0	n/a	U
S11R000123		7440-65-5	Yttrium	ug/mL	99.0	<2.00E-03	<4.00	<4.00	n/a	n/a	n/a	4.00	n/a	U
S11R000123		7440-66-6	Zinc	ug/mL	96.1	<5.00E-03	<10.0	<10.0	n/a	n/a	98.3	10.0	n/a	U
S11R000123		7440-67-7	Zirconium	ug/mL	94.9	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000123		SPECGRAVITY	Specific gravity	unitless	100.3	n/a	1.059	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000123		TOC	Total organic carbon	ug/mL	96.1	<20.0	149	n/a	n/a	n/a	n/a	20.0	n/a	J
S11R000123		TIC	Total inorganic carbon	ug/mL	96.1	<7.00	1.61E+03	n/a	n/a	n/a	n/a	7.00	n/a	
S11R000123		PH	pH	unitless	n/a	n/a	11.5	11.4	11.5	0.262	n/a	0.0100	n/a	

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 1 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000148		%WATER	Percent water	%	103	n/a	90.0	n/a	n/a	n/a	n/a	0.0100	n/a	
S11R000148		16984-48-8	Fluoride	ug/mL	102	<1.61E-03	2.30E+03	n/a	n/a	n/a	n/a	8.05	n/a	
S11R000148		666-14-8	Glycolate	ug/mL	99.2	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000148		71-50-1	Acetate	ug/mL	102	<6.04E-03	24.1	n/a	n/a	n/a	n/a	0.604	n/a	
S11R000148		12311-97-6	Formate	ug/mL	101	<4.67E-03	9.93	n/a	n/a	n/a	n/a	0.467	n/a	J
S11R000148		16887-00-6	Chloride	ug/mL	100	<9.98E-03	72.1	n/a	n/a	n/a	n/a	0.998	n/a	
S11R000148		14797-65-0	Nitrite	ug/mL	99.2	<0.0192	2.82E+03	n/a	n/a	n/a	n/a	96.0	n/a	
S11R000148		14808-79-8	Sulfate	ug/mL	102	<0.0187	862	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000148		338-70-5	Oxalate	ug/mL	99.5	<0.0231	209	n/a	n/a	n/a	n/a	2.31	n/a	
S11R000148		24959-67-9	Bromide	ug/mL	101	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000148		14797-55-8	Nitrate	ug/mL	99.4	<0.0208	5.54E+03	n/a	n/a	n/a	n/a	104	n/a	
S11R000148		14265-44-2	Phosphate	ug/mL	100	<0.0167	1.97E+04	n/a	n/a	n/a	n/a	83.5	n/a	
S11R000148		7429-90-5	Aluminum	ug/mL	98.1	<0.0300	265	n/a	n/a	n/a	n/a	60.0	n/a	J
S11R000148		7440-42-8	Boron	ug/mL	97.9	<0.0300	<60.0	n/a	n/a	n/a	n/a	60.0	n/a	U
S11R000148		7440-39-3	Barium	ug/mL	99.5	<3.00E-03	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000148		7440-41-7	Beryllium	ug/mL	94.6	<1.00E-03	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000148		7440-69-9	Bismuth	ug/mL	96.3	<0.100	<200	n/a	n/a	n/a	n/a	200	n/a	U
S11R000148		7440-70-2	Calcium	ug/mL	94.5	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000148		7440-45-1	Cerium	ug/mL	104	<0.0300	<60.0	n/a	n/a	n/a	n/a	60.0	n/a	U
S11R000148		7440-47-3	Chromium	ug/mL	97.6	<5.00E-03	26.1	n/a	n/a	n/a	n/a	10.0	n/a	J
S11R000148		7440-50-8	Copper	ug/mL	99.7	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000148		7439-89-6	Iron	ug/mL	97.5	<5.00E-03	24.7	n/a	n/a	n/a	n/a	10.0	n/a	J
S11R000148		7440-09-7	Potassium	ug/mL	104	<0.500	<1.00E+03	n/a	n/a	n/a	n/a	1000	n/a	U
S11R000148		7439-91-0	Lanthanum	ug/mL	97.2	<3.00E-03	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000148		7439-93-2	Lithium	ug/mL	107	<3.00E-03	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000148		7439-95-4	Magnesium	ug/mL	100	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000148		7439-98-7	Molybdenum	ug/mL	94.8	<0.0200	<40.0	n/a	n/a	n/a	n/a	40.0	n/a	U
S11R000148		7440-23-5	Sodium	ug/mL	106	<0.100	2.69E+04	n/a	n/a	n/a	n/a	200	n/a	
S11R000148		7723-14-0	Phosphorus	ug/mL	98.6	<0.0500	6.84E+03	n/a	n/a	n/a	n/a	100	n/a	
S11R000148		7439-92-1	Lead	ug/mL	101	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 1 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000148		7704-34-9	Sulfur	ug/mL	98.8	<0.100	295	n/a	n/a	n/a	n/a	200	n/a	J
S11R000148		7440-36-0	Antimony	ug/mL	94.5	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000148		7782-49-2	Selenium	ug/mL	97.7	<0.100	<200	n/a	n/a	n/a	n/a	200	n/a	U
S11R000148		7440-21-3	Silicon	ug/mL	90.4	<0.0300	<60.0	n/a	n/a	n/a	n/a	60.0	n/a	U
S11R000148		7440-19-9	Samarium	ug/mL	102	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000148		7440-24-6	Strontium	ug/mL	98.8	<3.00E-03	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000148		7440-29-1	Thorium	ug/mL	102	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000148		7440-32-6	Titanium	ug/mL	97.2	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000148		7440-62-2	Vanadium	ug/mL	98.4	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000148		7440-65-5	Yttrium	ug/mL	99.0	<2.00E-03	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000148		7440-66-6	Zinc	ug/mL	96.1	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000148		7440-67-7	Zirconium	ug/mL	94.9	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000148		SPECGRAVITY	Specific gravity	unitless	100.3	n/a	1.059	1.061	1.060	0.1887	n/a	1.000E-03	n/a	
S11R000148		TOC	Total organic carbon	ug/mL	96.1	<20.0	82.4	n/a	n/a	n/a	n/a	40.0	n/a	J
S11R000148		TIC	Total inorganic carbon	ug/mL	96.1	<7.00	1.08E+03	n/a	n/a	n/a	n/a	14.0	n/a	
S11R000148		PH	pH	unitless	n/a	n/a	12.0	n/a	n/a	n/a	n/a	0.0100	n/a	

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 2 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000149		%WATER	Percent water	%	103	n/a	99.7	n/a	n/a	n/a	n/a	0.0100	n/a	
S11R000149		16984-48-8	Fluoride	ug/mL	102	<1.61E-03	2.96E+03	n/a	n/a	n/a	n/a	8.05	n/a	
S11R000149		666-14-8	Glycolate	ug/mL	99.2	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000149		71-50-1	Acetate	ug/mL	102	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000149		12311-97-6	Formate	ug/mL	101	<4.67E-03	1.38	n/a	n/a	n/a	n/a	0.467	n/a	J
S11R000149		16887-00-6	Chloride	ug/mL	100	<9.98E-03	10.2	n/a	n/a	n/a	n/a	0.998	n/a	
S11R000149		14797-65-0	Nitrite	ug/mL	99.2	<0.0192	438	n/a	n/a	n/a	n/a	1.92	n/a	
S11R000149		14808-79-8	Sulfate	ug/mL	102	<0.0187	223	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000149		338-70-5	Oxalate	ug/mL	99.5	<0.0231	28.9	n/a	n/a	n/a	n/a	2.31	n/a	
S11R000149		24959-67-9	Bromide	ug/mL	101	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000149		14797-55-8	Nitrate	ug/mL	99.4	<0.0208	912	n/a	n/a	n/a	n/a	2.08	n/a	
S11R000149		14265-44-2	Phosphate	ug/mL	100	<0.0167	2.29E+04	n/a	n/a	n/a	n/a	83.5	n/a	
S11R000149		7429-90-5	Aluminum	ug/mL	98.1	<0.0300	273	n/a	n/a	n/a	n/a	60.0	n/a	J
S11R000149		7440-42-8	Boron	ug/mL	97.9	<0.0300	<60.0	n/a	n/a	n/a	n/a	60.0	n/a	U
S11R000149		7440-39-3	Barium	ug/mL	99.5	<3.00E-03	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000149		7440-41-7	Beryllium	ug/mL	94.6	<1.00E-03	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000149		7440-69-9	Bismuth	ug/mL	96.3	<0.100	<200	n/a	n/a	n/a	n/a	200	n/a	U
S11R000149		7440-70-2	Calcium	ug/mL	94.5	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000149		7440-45-1	Cerium	ug/mL	104	<0.0300	<60.0	n/a	n/a	n/a	n/a	60.0	n/a	U
S11R000149		7440-47-3	Chromium	ug/mL	97.6	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000149		7440-50-8	Copper	ug/mL	99.7	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000149		7439-89-6	Iron	ug/mL	97.5	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000149		7440-09-7	Potassium	ug/mL	104	<0.500	<1.00E+03	n/a	n/a	n/a	n/a	1000	n/a	U
S11R000149		7439-91-0	Lanthanum	ug/mL	97.2	<3.00E-03	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000149		7439-93-2	Lithium	ug/mL	107	<3.00E-03	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000149		7439-95-4	Magnesium	ug/mL	100	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000149		7439-98-7	Molybdenum	ug/mL	94.8	<0.0200	<40.0	n/a	n/a	n/a	n/a	40.0	n/a	U
S11R000149		7440-23-5	Sodium	ug/mL	106	<0.100	2.16E+04	n/a	n/a	n/a	n/a	200	n/a	
S11R000149		7723-14-0	Phosphorus	ug/mL	98.6	<0.0500	7.42E+03	n/a	n/a	n/a	n/a	100	n/a	
S11R000149		7439-92-1	Lead	ug/mL	101	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 2 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000149		7704-34-9	Sulfur	ug/mL	98.8	<0.100	<200	n/a	n/a	n/a	n/a	200	n/a	U
S11R000149		7440-36-0	Antimony	ug/mL	94.5	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000149		7782-49-2	Selenium	ug/mL	97.7	<0.100	<200	n/a	n/a	n/a	n/a	200	n/a	U
S11R000149		7440-21-3	Silicon	ug/mL	90.4	<0.0300	<60.0	n/a	n/a	n/a	n/a	60.0	n/a	U
S11R000149		7440-19-9	Samarium	ug/mL	102	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000149		7440-24-6	Strontium	ug/mL	98.8	<3.00E-03	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000149		7440-29-1	Thorium	ug/mL	102	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000149		7440-32-6	Titanium	ug/mL	97.2	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000149		7440-62-2	Vanadium	ug/mL	98.4	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000149		7440-65-5	Yttrium	ug/mL	99.0	<2.00E-03	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000149		7440-66-6	Zinc	ug/mL	96.1	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000149		7440-67-7	Zirconium	ug/mL	94.9	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000149		SPECGRAVITY	Specific gravity	unitless	100.3	n/a	1.048	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000149		TOC	Total organic carbon	ug/mL	96.1	<20.0	<20.0	<20.0	n/a	n/a	92.1	20.0	n/a	U
S11R000149		TIC	Total inorganic carbon	ug/mL	96.1	<7.00	184	191	188	3.73	102	7.00	n/a	
S11R000149		PH	pH	unitless	n/a	n/a	12.0	n/a	n/a	n/a	n/a	0.0100	n/a	

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 3 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000150		%WATER	Percent water	%	103	n/a	88.2	n/a	n/a	n/a	n/a	0.0100	n/a	
S11R000150		16984-48-8	Fluoride	ug/mL	102	<1.61E-03	2.95E+03	n/a	n/a	n/a	n/a	8.05	n/a	
S11R000150		666-14-8	Glycolate	ug/mL	99.2	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000150		71-50-1	Acetate	ug/mL	102	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000150		12311-97-6	Formate	ug/mL	101	<4.67E-03	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000150		16887-00-6	Chloride	ug/mL	100	<9.98E-03	2.47	n/a	n/a	n/a	n/a	0.998	n/a	J
S11R000150		14797-65-0	Nitrite	ug/mL	99.2	<0.0192	64.2	n/a	n/a	n/a	n/a	1.92	n/a	
S11R000150		14808-79-8	Sulfate	ug/mL	102	<0.0187	134	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000150		338-70-5	Oxalate	ug/mL	99.5	<0.0231	<2.31	n/a	n/a	n/a	n/a	2.31	n/a	U
S11R000150		24959-67-9	Bromide	ug/mL	101	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000150		14797-55-8	Nitrate	ug/mL	99.4	<0.0208	136	n/a	n/a	n/a	n/a	2.08	n/a	
S11R000150		14265-44-2	Phosphate	ug/mL	100	<0.0167	2.27E+04	n/a	n/a	n/a	n/a	83.5	n/a	
S11R000150		7429-90-5	Aluminum	ug/mL	98.1	<0.0300	268	n/a	n/a	n/a	n/a	60.0	n/a	J
S11R000150		7440-42-8	Boron	ug/mL	97.9	<0.0300	<60.0	n/a	n/a	n/a	n/a	60.0	n/a	U
S11R000150		7440-39-3	Barium	ug/mL	99.5	<3.00E-03	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000150		7440-41-7	Beryllium	ug/mL	94.6	<1.00E-03	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000150		7440-69-9	Bismuth	ug/mL	96.3	<0.100	<200	n/a	n/a	n/a	n/a	200	n/a	U
S11R000150		7440-70-2	Calcium	ug/mL	94.5	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000150		7440-45-1	Cerium	ug/mL	104	<0.0300	<60.0	n/a	n/a	n/a	n/a	60.0	n/a	U
S11R000150		7440-47-3	Chromium	ug/mL	97.6	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000150		7440-50-8	Copper	ug/mL	99.7	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000150		7440-53-1	Europium	ug/mL	98.0	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000150		7439-89-6	Iron	ug/mL	97.5	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000150		7440-09-7	Potassium	ug/mL	104	<0.500	<1.00E+03	n/a	n/a	n/a	n/a	1000	n/a	U
S11R000150		7439-91-0	Lanthanum	ug/mL	97.2	<3.00E-03	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000150		7439-93-2	Lithium	ug/mL	107	<3.00E-03	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000150		7439-95-4	Magnesium	ug/mL	100	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000150		7439-98-7	Molybdenum	ug/mL	94.8	<0.0200	<40.0	n/a	n/a	n/a	n/a	40.0	n/a	U
S11R000150		7440-23-5	Sodium	ug/mL	106	<0.100	2.14E+04	n/a	n/a	n/a	n/a	200	n/a	
S11R000150		7723-14-0	Phosphorus	ug/mL	98.6	<0.0500	7.37E+03	n/a	n/a	n/a	n/a	100	n/a	

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 3 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000150		7439-92-1	Lead	ug/mL	101	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000150		7704-34-9	Sulfur	ug/mL	98.8	<0.100	<200	n/a	n/a	n/a	n/a	200	n/a	U
S11R000150		7440-36-0	Antimony	ug/mL	94.5	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000150		7782-49-2	Selenium	ug/mL	97.7	<0.100	<200	n/a	n/a	n/a	n/a	200	n/a	U
S11R000150		7440-21-3	Silicon	ug/mL	90.4	<0.0300	<60.0	n/a	n/a	n/a	n/a	60.0	n/a	U
S11R000150		7440-19-9	Samarium	ug/mL	102	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000150		7440-24-6	Strontium	ug/mL	98.8	<3.00E-03	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000150		7440-29-1	Thorium	ug/mL	102	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000150		7440-32-6	Titanium	ug/mL	97.2	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000150		7440-62-2	Vanadium	ug/mL	98.4	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000150		7440-65-5	Yttrium	ug/mL	99.0	<2.00E-03	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000150		7440-66-6	Zinc	ug/mL	96.1	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000150		7440-67-7	Zirconium	ug/mL	94.9	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000150		SPECGRAVITY	Specific gravity	unitless	100.3	n/a	1.047	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000150		TOC	Total organic carbon	ug/mL	96.1	<20.0	112	n/a	n/a	n/a	n/a	20.0	n/a	J
S11R000150		TIC	Total inorganic carbon	ug/mL	96.1	<7.00	28.0	n/a	n/a	n/a	n/a	7.00	n/a	J
S11R000150		PH	pH	unitless	n/a	n/a	12.0	n/a	n/a	n/a	n/a	0.0100	n/a	

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 4 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000151		%WATER	Percent water	%	103	n/a	99.9	n/a	n/a	n/a	n/a	0.0100	n/a	
S11R000151		16984-48-8	Fluoride	ug/mL	102	<1.61E-03	2.86E+03	n/a	n/a	n/a	n/a	8.05	n/a	
S11R000151		666-14-8	Glycolate	ug/mL	99.2	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000151		71-50-1	Acetate	ug/mL	102	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000151		12311-97-6	Formate	ug/mL	101	<4.67E-03	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000151		16887-00-6	Chloride	ug/mL	100	<9.98E-03	<0.998	n/a	n/a	n/a	n/a	0.998	n/a	U
S11R000151		14797-65-0	Nitrite	ug/mL	99.2	<0.0192	12.1	n/a	n/a	n/a	n/a	1.92	n/a	J
S11R000151		14808-79-8	Sulfate	ug/mL	102	<0.0187	123	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000151		338-70-5	Oxalate	ug/mL	99.5	<0.0231	<2.31	n/a	n/a	n/a	n/a	2.31	n/a	U
S11R000151		24959-67-9	Bromide	ug/mL	101	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000151		14797-55-8	Nitrate	ug/mL	99.4	<0.0208	31.3	n/a	n/a	n/a	n/a	2.08	n/a	
S11R000151		14265-44-2	Phosphate	ug/mL	100	<0.0167	2.24E+04	n/a	n/a	n/a	n/a	83.5	n/a	
S11R000151		7429-90-5	Aluminum	ug/mL	98.1	<0.0300	241	n/a	n/a	n/a	n/a	60.0	n/a	J
S11R000151		7440-42-8	Boron	ug/mL	97.9	<0.0300	<60.0	n/a	n/a	n/a	n/a	60.0	n/a	U
S11R000151		7440-39-3	Barium	ug/mL	99.5	<3.00E-03	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000151		7440-41-7	Beryllium	ug/mL	94.6	<1.00E-03	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000151		7440-69-9	Bismuth	ug/mL	96.3	<0.100	<200	n/a	n/a	n/a	n/a	200	n/a	U
S11R000151		7440-70-2	Calcium	ug/mL	94.5	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000151		7440-45-1	Cerium	ug/mL	104	<0.0300	<60.0	n/a	n/a	n/a	n/a	60.0	n/a	U
S11R000151		7440-47-3	Chromium	ug/mL	97.6	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000151		7440-50-8	Copper	ug/mL	99.7	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000151		7439-89-6	Iron	ug/mL	97.5	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000151		7440-09-7	Potassium	ug/mL	104	<0.500	<1.00E+03	n/a	n/a	n/a	n/a	1000	n/a	U
S11R000151		7439-91-0	Lanthanum	ug/mL	97.2	<3.00E-03	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000151		7439-93-2	Lithium	ug/mL	107	<3.00E-03	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000151		7439-95-4	Magnesium	ug/mL	100	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000151		7439-98-7	Molybdenum	ug/mL	94.8	<0.0200	<40.0	n/a	n/a	n/a	n/a	40.0	n/a	U
S11R000151		7440-23-5	Sodium	ug/mL	106	<0.100	1.86E+04	n/a	n/a	n/a	n/a	200	n/a	
S11R000151		7723-14-0	Phosphorus	ug/mL	98.6	<0.0500	7.27E+03	n/a	n/a	n/a	n/a	100	n/a	
S11R000151		7439-92-1	Lead	ug/mL	101	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 4 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000151		7704-34-9	Sulfur	ug/mL	98.8	<0.100	<200	n/a	n/a	n/a	n/a	200	n/a	U
S11R000151		7440-36-0	Antimony	ug/mL	94.5	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000151		7782-49-2	Selenium	ug/mL	97.7	<0.100	<200	n/a	n/a	n/a	n/a	200	n/a	U
S11R000151		7440-21-3	Silicon	ug/mL	90.4	<0.0300	<60.0	n/a	n/a	n/a	n/a	60.0	n/a	U
S11R000151		7440-19-9	Samarium	ug/mL	102	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000151		7440-24-6	Strontium	ug/mL	98.8	<3.00E-03	<6.00	n/a	n/a	n/a	n/a	6.00	n/a	U
S11R000151		7440-29-1	Thorium	ug/mL	102	<0.0500	<100	n/a	n/a	n/a	n/a	100	n/a	U
S11R000151		7440-32-6	Titanium	ug/mL	97.2	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000151		7440-62-2	Vanadium	ug/mL	98.4	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000151		7440-65-5	Yttrium	ug/mL	99.0	<2.00E-03	<4.00	n/a	n/a	n/a	n/a	4.00	n/a	U
S11R000151		7440-66-6	Zinc	ug/mL	96.1	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000151		7440-67-7	Zirconium	ug/mL	94.9	<5.00E-03	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000151		SPECGRAVITY	Specific gravity	unitless	100.3	n/a	1.038	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000151		TOC	Total organic carbon	ug/mL	96.1	<20.0	17.2	n/a	n/a	n/a	n/a	6.67	n/a	J
S11R000151		TIC	Total inorganic carbon	ug/mL	96.1	<7.00	24.4	n/a	n/a	n/a	n/a	2.33	n/a	
S11R000151		PH	pH	unitless	n/a	n/a	12.0	n/a	n/a	n/a	n/a	0.0100	n/a	

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 5 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000152		%WATER	Percent water	%	101	n/a	93.5	n/a	n/a	n/a	n/a	0.0100	n/a	
S11R000152		16984-48-8	Fluoride	ug/mL	97.4	<1.61E-03	2.57E+03	2.58E+03	2.57E+03	0.314	103	16.1	n/a	
S11R000152		666-14-8	Glycolate	ug/mL	92.9	<9.37E-03	<0.937	<0.937	n/a	n/a	83.3	0.937	n/a	U
S11R000152		71-50-1	Acetate	ug/mL	99.2	<6.04E-03	<0.604	<0.604	n/a	n/a	85.9	0.604	n/a	U
S11R000152		12311-97-6	Formate	ug/mL	95.5	<4.67E-03	<0.467	<0.467	n/a	n/a	95.5	0.467	n/a	U
S11R000152		16887-00-6	Chloride	ug/mL	100	<9.98E-03	2.32	<0.998	n/a	n/a	100	0.998	n/a	J
S11R000152		14797-65-0	Nitrite	ug/mL	99.0	<0.0192	5.91	6.06	5.98	2.46	99.7	1.92	n/a	J
S11R000152		14808-79-8	Sulfate	ug/mL	101	<0.0187	120	120	120	0.185	102	1.87	n/a	
S11R000152		338-70-5	Oxalate	ug/mL	97.5	<0.0231	<2.31	<2.31	n/a	n/a	98.4	2.31	n/a	U
S11R000152		24959-67-9	Bromide	ug/mL	101	<0.0580	<5.80	<5.80	n/a	n/a	102	5.80	n/a	U
S11R000152		14797-55-8	Nitrate	ug/mL	97.3	<0.0208	18.7	19.3	19.0	3.10	100	2.08	n/a	J
S11R000152		14265-44-2	Phosphate	ug/mL	99.5	<0.0167	2.41E+04	2.24E+04	2.32E+04	7.42	97.8	167	n/a	
S11R000152		7440-22-4	Silver	ug/mL	98.3	<5.00E-03	<0.500	<0.500	n/a	n/a	96.3	0.500	n/a	U
S11R000152		7429-90-5	Aluminum	ug/mL	98.6	<0.0300	194	196	195	0.840	99.2	3.00	n/a	
S11R000152		7440-38-2	Arsenic	ug/mL	97.1	<0.0500	<5.00	<5.00	n/a	n/a	101	5.00	n/a	UY
S11R000152		7440-42-8	Boron	ug/mL	100	<0.0300	3.67	4.04	3.86	9.41	98.4	3.00	n/a	J
S11R000152		7440-39-3	Barium	ug/mL	99.7	<3.00E-03	<0.300	<0.300	n/a	n/a	98.1	0.300	n/a	U
S11R000152		7440-41-7	Beryllium	ug/mL	96.1	<1.00E-03	<0.100	<0.100	n/a	n/a	95.4	0.100	n/a	U
S11R000152		7440-69-9	Bismuth	ug/mL	100	<0.100	<10.0	<10.0	n/a	n/a	101	10.0	n/a	UY
S11R000152		7440-70-2	Calcium	ug/mL	98.8	<0.0500	<5.00	<5.00	n/a	n/a	96.4	5.00	n/a	U
S11R000152		7440-43-9	Cadmium	ug/mL	99.9	<5.00E-03	<0.500	<0.500	n/a	n/a	97.1	0.500	n/a	UY
S11R000152		7440-45-1	Cerium	ug/mL	103	<0.0300	<3.00	<3.00	n/a	n/a	96.5	3.00	n/a	U
S11R000152		7440-48-4	Cobalt	ug/mL	99.3	<0.0100	<1.00	<1.00	n/a	n/a	97.7	1.00	n/a	U
S11R000152		7440-47-3	Chromium	ug/mL	100	<5.00E-03	0.808	0.811	0.810	0.458	97.6	0.500	n/a	J
S11R000152		7440-50-8	Copper	ug/mL	98.8	<5.00E-03	<0.500	<0.500	n/a	n/a	99.9	0.500	n/a	U
S11R000152		7440-53-1	Europium	ug/mL	101	<5.00E-03	<0.500	<0.500	n/a	n/a	107	0.500	n/a	UY
S11R000152		7439-89-6	Iron	ug/mL	99.1	<5.00E-03	0.919	1.10	1.01	17.8	96.8	0.500	n/a	J
S11R000152		7440-09-7	Potassium	ug/mL	93.5	<0.500	<50.0	<50.0	n/a	n/a	87.0	50.0	n/a	U
S11R000152		7439-91-0	Lanthanum	ug/mL	97.7	<3.00E-03	<0.300	<0.300	n/a	n/a	95.0	0.300	n/a	U
S11R000152		7439-93-2	Lithium	ug/mL	103	<3.00E-03	<0.300	<0.300	n/a	n/a	97.3	0.300	n/a	U

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 5 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000152		7439-95-4	Magnesium	ug/mL	99.0	<0.0500	<5.00	<5.00	n/a	n/a	96.1	5.00	n/a	U
S11R000152		7439-96-5	Manganese	ug/mL	98.9	<3.00E-03	<0.300	<0.300	n/a	n/a	97.8	0.300	n/a	UY
S11R000152		7439-98-7	Molybdenum	ug/mL	99.4	<0.0200	<2.00	<2.00	n/a	n/a	98.4	2.00	n/a	U
S11R000152		7440-23-5	Sodium	ug/mL	101	<0.100	1.75E+04	1.79E+04	1.77E+04	2.71	78.8	10.0	n/a	
S11R000152		7440-00-8	Neodymium	ug/mL	102	<0.0100	<1.00	<1.00	n/a	n/a	97.3	1.00	n/a	U
S11R000152		7440-02-0	Nickel	ug/mL	99.4	<0.0200	<2.00	<2.00	n/a	n/a	97.2	2.00	n/a	U
S11R000152		7723-14-0	Phosphorus	ug/mL	102	<0.0500	7.64E+03	7.70E+03	7.67E+03	0.820	80.1	5.00	n/a	
S11R000152		7439-92-1	Lead	ug/mL	103	<0.0500	<5.00	<5.00	n/a	n/a	101	5.00	n/a	U
S11R000152		7704-34-9	Sulfur	ug/mL	102	<0.100	38.1	41.8	39.9	9.21	101	10.0	n/a	J
S11R000152		7440-36-0	Antimony	ug/mL	97.4	<0.0500	<5.00	<5.00	n/a	n/a	98.3	5.00	n/a	U
S11R000152		7782-49-2	Selenium	ug/mL	100	<0.100	<10.0	<10.0	n/a	n/a	101	10.0	n/a	U
S11R000152		7440-21-3	Silicon	ug/mL	93.6	<0.0300	10.2	10.1	10.2	0.309	93.5	3.00	n/a	J
S11R000152		7440-19-9	Samarium	ug/mL	101	<0.0500	<5.00	<5.00	n/a	n/a	95.4	5.00	n/a	U
S11R000152		7440-24-6	Strontium	ug/mL	98.9	<3.00E-03	<0.300	<0.300	n/a	n/a	96.5	0.300	n/a	U
S11R000152		7440-29-1	Thorium	ug/mL	99.9	<0.0500	<5.00	<5.00	n/a	n/a	97.8	5.00	n/a	U
S11R000152		7440-32-6	Titanium	ug/mL	101	<5.00E-03	<0.500	<0.500	n/a	n/a	97.6	0.500	n/a	U
S11R000152		7440-28-0	Thallium	ug/mL	108	<0.100	<10.0	<10.0	n/a	n/a	98.5	10.0	n/a	U
S11R000152		7440-61-1	Uranium	ug/mL	103	<0.100	<10.0	<10.0	n/a	n/a	95.5	10.0	n/a	U
S11R000152		7440-62-2	Vanadium	ug/mL	100	<5.00E-03	<0.500	<0.500	n/a	n/a	98.1	0.500	n/a	U
S11R000152		7440-65-5	Yttrium	ug/mL	101	<2.00E-03	<0.200	<0.200	n/a	n/a	107	0.200	n/a	U
S11R000152		7440-66-6	Zinc	ug/mL	98.2	<5.00E-03	<0.500	<0.500	n/a	n/a	98.5	0.500	n/a	U
S11R000152		7440-67-7	Zirconium	ug/mL	97.6	<5.00E-03	<0.500	<0.500	n/a	n/a	99.3	0.500	n/a	U
S11R000152		SPECGRAVITY	Specific gravity	unitless	99.83	n/a	1.053	1.042	1.048	1.050	n/a	1.000E-03	n/a	
S11R000152		TOC	Total organic carbon	ug/mL	96.8	<20.0	<6.67	n/a	n/a	n/a	n/a	6.67	n/a	U
S11R000152		TIC	Total inorganic carbon	ug/mL	105	<7.00	47.1	n/a	n/a	n/a	n/a	2.33	n/a	
S11R000152		PH	pH	unitless	n/a	n/a	12.1	12.1	12.1	0.330	n/a	0.0100	n/a	

Comment for samples S11R000152, S11R000153, S11R000154, S11R000155, S11R000156, and S11R000157: "As, Eu, Mn and Cd detected >MDL in the ICBA standards. The beginning LLS was at 64% for Bi. Bi was detected in sample S11R000157. Otherwise, none of these analytes were detected in any of the samples. All of these analytes were "Y' flagged for all samples. SDB 4/22/11"

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 6 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000153		%WATER	Percent water	%	101	n/a	95.6	n/a	n/a	n/a	n/a	0.0100	n/a	
S11R000153		16984-48-8	Fluoride	ug/mL	97.4	<1.61E-03	2.66E+03	n/a	n/a	n/a	n/a	16.1	n/a	
S11R000153		666-14-8	Glycolate	ug/mL	92.9	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000153		71-50-1	Acetate	ug/mL	99.2	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000153		12311-97-6	Formate	ug/mL	95.5	<4.67E-03	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000153		16887-00-6	Chloride	ug/mL	100	<9.98E-03	<0.998	n/a	n/a	n/a	n/a	0.998	n/a	U
S11R000153		14797-65-0	Nitrite	ug/mL	99.0	<0.0192	2.61	n/a	n/a	n/a	n/a	1.92	n/a	J
S11R000153		14808-79-8	Sulfate	ug/mL	101	<0.0187	145	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000153		338-70-5	Oxalate	ug/mL	97.5	<0.0231	<2.31	n/a	n/a	n/a	n/a	2.31	n/a	U
S11R000153		24959-67-9	Bromide	ug/mL	101	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000153		14797-55-8	Nitrate	ug/mL	97.3	<0.0208	10.5	n/a	n/a	n/a	n/a	2.08	n/a	J
S11R000153		14265-44-2	Phosphate	ug/mL	99.5	<0.0167	2.36E+04	n/a	n/a	n/a	n/a	167	n/a	
S11R000153		7440-22-4	Silver	ug/mL	98.3	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000153		7429-90-5	Aluminum	ug/mL	98.6	<0.0300	305	n/a	n/a	n/a	n/a	3.00	n/a	
S11R000153		7440-38-2	Arsenic	ug/mL	97.1	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	UY
S11R000153		7440-42-8	Boron	ug/mL	100	<0.0300	<3.00	n/a	n/a	n/a	n/a	3.00	n/a	U
S11R000153		7440-39-3	Barium	ug/mL	99.7	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	U
S11R000153		7440-41-7	Beryllium	ug/mL	96.1	<1.00E-03	<0.100	n/a	n/a	n/a	n/a	0.100	n/a	U
S11R000153		7440-69-9	Bismuth	ug/mL	100	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	UY
S11R000153		7440-70-2	Calcium	ug/mL	98.8	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000153		7440-43-9	Cadmium	ug/mL	99.9	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	UY
S11R000153		7440-45-1	Cerium	ug/mL	103	<0.0300	<3.00	n/a	n/a	n/a	n/a	3.00	n/a	U
S11R000153		7440-48-4	Cobalt	ug/mL	99.3	<0.0100	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000153		7440-47-3	Chromium	ug/mL	100	<5.00E-03	0.856	n/a	n/a	n/a	n/a	0.500	n/a	J
S11R000153		7440-50-8	Copper	ug/mL	98.8	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000153		7440-53-1	Europium	ug/mL	101	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	UY
S11R000153		7439-89-6	Iron	ug/mL	99.1	<5.00E-03	2.44	n/a	n/a	n/a	n/a	0.500	n/a	J
S11R000153		7440-09-7	Potassium	ug/mL	93.5	<0.500	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000153		7439-91-0	Lanthanum	ug/mL	97.7	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	U
S11R000153		7439-93-2	Lithium	ug/mL	103	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	U

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 6 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000153		7439-95-4	Magnesium	ug/mL	99.0	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000153		7439-96-5	Manganese	ug/mL	98.9	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	UY
S11R000153		7439-98-7	Molybdenum	ug/mL	99.4	<0.0200	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000153		7440-23-5	Sodium	ug/mL	101	<0.100	1.90E+04	n/a	n/a	n/a	n/a	10.0	n/a	
S11R000153		7440-00-8	Neodymium	ug/mL	102	<0.0100	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000153		7440-02-0	Nickel	ug/mL	99.4	<0.0200	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000153		7723-14-0	Phosphorus	ug/mL	102	<0.0500	8.20E+03	n/a	n/a	n/a	n/a	5.00	n/a	
S11R000153		7439-92-1	Lead	ug/mL	103	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000153		7704-34-9	Sulfur	ug/mL	102	<0.100	48.1	n/a	n/a	n/a	n/a	10.0	n/a	J
S11R000153		7440-36-0	Antimony	ug/mL	97.4	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000153		7782-49-2	Selenium	ug/mL	100	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000153		7440-21-3	Silicon	ug/mL	93.6	<0.0300	7.48	n/a	n/a	n/a	n/a	3.00	n/a	J
S11R000153		7440-19-9	Samarium	ug/mL	101	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000153		7440-24-6	Strontium	ug/mL	98.9	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	U
S11R000153		7440-29-1	Thorium	ug/mL	99.9	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000153		7440-32-6	Titanium	ug/mL	101	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000153		7440-28-0	Thallium	ug/mL	108	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000153		7440-61-1	Uranium	ug/mL	103	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000153		7440-62-2	Vanadium	ug/mL	100	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000153		7440-65-5	Yttrium	ug/mL	101	<2.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S11R000153		7440-66-6	Zinc	ug/mL	98.2	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000153		7440-67-7	Zirconium	ug/mL	97.6	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000153		SPECGRAVITY	Specific gravity	unitless	99.83	n/a	1.057	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000153		TOC	Total organic carbon	ug/mL	96.8	<20.0	<6.67	n/a	n/a	n/a	n/a	6.67	n/a	U
S11R000153		TIC	Total inorganic carbon	ug/mL	105	<7.00	23.2	n/a	n/a	n/a	n/a	2.33	n/a	J
S11R000153		PH	pH	unitless	n/a	n/a	12.1	n/a	n/a	n/a	n/a	0.0100	n/a	

Comment for samples S11R000152, S11R000153, S11R000154, S11R000155, S11R000156, and S11R000157: "As, Eu, Mn and Cd detected >MDL in the ICBA standards. The beginning LLS was at 64% for Bi. Bi was detected in sample S11R000157. Otherwise, none of these analytes were detected in any of the samples. All of these analytes were "Y' flagged for all samples. SDB 4/22/11"

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 7 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000154		%WATER	Percent water	%	101	n/a	100	n/a	n/a	n/a	n/a	0.0100	n/a	
S11R000154		16984-48-8	Fluoride	ug/mL	97.4	<1.61E-03	2.52E+03	n/a	n/a	n/a	n/a	16.1	n/a	
S11R000154		666-14-8	Glycolate	ug/mL	92.9	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000154		71-50-1	Acetate	ug/mL	99.2	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000154		12311-97-6	Formate	ug/mL	95.5	<4.67E-03	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000154		16887-00-6	Chloride	ug/mL	100	<9.98E-03	<0.998	n/a	n/a	n/a	n/a	0.998	n/a	U
S11R000154		14797-65-0	Nitrite	ug/mL	99.0	<0.0192	2.18	n/a	n/a	n/a	n/a	1.92	n/a	J
S11R000154		14808-79-8	Sulfate	ug/mL	101	<0.0187	136	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000154		338-70-5	Oxalate	ug/mL	97.5	<0.0231	<2.31	n/a	n/a	n/a	n/a	2.31	n/a	U
S11R000154		24959-67-9	Bromide	ug/mL	101	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000154		14797-55-8	Nitrate	ug/mL	97.3	<0.0208	10.1	n/a	n/a	n/a	n/a	2.08	n/a	J
S11R000154		14265-44-2	Phosphate	ug/mL	99.5	<0.0167	2.48E+04	n/a	n/a	n/a	n/a	167	n/a	
S11R000154		7440-22-4	Silver	ug/mL	98.3	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000154		7429-90-5	Aluminum	ug/mL	98.6	<0.0300	267	n/a	n/a	n/a	n/a	3.00	n/a	
S11R000154		7440-38-2	Arsenic	ug/mL	97.1	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	UY
S11R000154		7440-42-8	Boron	ug/mL	100	<0.0300	<3.00	n/a	n/a	n/a	n/a	3.00	n/a	U
S11R000154		7440-39-3	Barium	ug/mL	99.7	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	U
S11R000154		7440-41-7	Beryllium	ug/mL	96.1	<1.00E-03	<0.100	n/a	n/a	n/a	n/a	0.100	n/a	U
S11R000154		7440-69-9	Bismuth	ug/mL	100	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	UY
S11R000154		7440-70-2	Calcium	ug/mL	98.8	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000154		7440-43-9	Cadmium	ug/mL	99.9	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	UY
S11R000154		7440-45-1	Cerium	ug/mL	103	<0.0300	<3.00	n/a	n/a	n/a	n/a	3.00	n/a	U
S11R000154		7440-48-4	Cobalt	ug/mL	99.3	<0.0100	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000154		7440-47-3	Chromium	ug/mL	100	<5.00E-03	0.562	n/a	n/a	n/a	n/a	0.500	n/a	J
S11R000154		7440-50-8	Copper	ug/mL	98.8	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000154		7440-53-1	Europium	ug/mL	101	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	UY
S11R000154		7439-89-6	Iron	ug/mL	99.1	<5.00E-03	0.748	n/a	n/a	n/a	n/a	0.500	n/a	J
S11R000154		7440-09-7	Potassium	ug/mL	93.5	<0.500	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000154		7439-91-0	Lanthanum	ug/mL	97.7	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	U
S11R000154		7439-93-2	Lithium	ug/mL	103	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	U

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 7 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000154		7439-95-4	Magnesium	ug/mL	99.0	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000154		7439-96-5	Manganese	ug/mL	98.9	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	UY
S11R000154		7439-98-7	Molybdenum	ug/mL	99.4	<0.0200	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000154		7440-23-5	Sodium	ug/mL	101	<0.100	1.96E+04	n/a	n/a	n/a	n/a	10.0	n/a	
S11R000154		7440-00-8	Neodymium	ug/mL	102	<0.0100	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000154		7440-02-0	Nickel	ug/mL	99.4	<0.0200	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000154		7723-14-0	Phosphorus	ug/mL	102	<0.0500	8.46E+03	n/a	n/a	n/a	n/a	5.00	n/a	
S11R000154		7439-92-1	Lead	ug/mL	103	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000154		7704-34-9	Sulfur	ug/mL	102	<0.100	46.3	n/a	n/a	n/a	n/a	10.0	n/a	J
S11R000154		7440-36-0	Antimony	ug/mL	97.4	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000154		7782-49-2	Selenium	ug/mL	100	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000154		7440-21-3	Silicon	ug/mL	93.6	<0.0300	7.71	n/a	n/a	n/a	n/a	3.00	n/a	J
S11R000154		7440-19-9	Samarium	ug/mL	101	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000154		7440-24-6	Strontium	ug/mL	98.9	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	U
S11R000154		7440-29-1	Thorium	ug/mL	99.9	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000154		7440-32-6	Titanium	ug/mL	101	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000154		7440-28-0	Thallium	ug/mL	108	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000154		7440-61-1	Uranium	ug/mL	103	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000154		7440-62-2	Vanadium	ug/mL	100	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000154		7440-65-5	Yttrium	ug/mL	101	<2.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S11R000154		7440-66-6	Zinc	ug/mL	98.2	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000154		7440-67-7	Zirconium	ug/mL	97.6	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000154		SPECGRAVITY	Specific gravity	unitless	99.83	n/a	1.055	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000154		TOC	Total organic carbon	ug/mL	96.8	<20.0	<6.67	n/a	n/a	n/a	n/a	6.67	n/a	U
S11R000154		TIC	Total inorganic carbon	ug/mL	105	<7.00	22.4	n/a	n/a	n/a	n/a	2.33	n/a	J
S11R000154		PH	pH	unitless	n/a	n/a	12.2	n/a	n/a	n/a	n/a	0.0100	n/a	

Comment for samples S11R000152, S11R000153, S11R000154, S11R000155, S11R000156, and S11R000157: "As, Eu, Mn and Cd detected >MDL in the ICBA standards. The beginning LLS was at 64% for Bi. Bi was detected in sample S11R000157. Otherwise, none of these analytes were detected in any of the samples. All of these analytes were "Y' flagged for all samples. SDB 4/22/11"

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 8 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000155		%WATER	Percent water	%	101	n/a	89.5	n/a	n/a	n/a	n/a	0.0100	n/a	
S11R000155		16984-48-8	Fluoride	ug/mL	97.4	<1.61E-03	2.44E+03	n/a	n/a	n/a	n/a	16.1	n/a	
S11R000155		666-14-8	Glycolate	ug/mL	92.9	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000155		71-50-1	Acetate	ug/mL	99.2	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000155		12311-97-6	Formate	ug/mL	95.5	<4.67E-03	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000155		16887-00-6	Chloride	ug/mL	100	<9.98E-03	<0.998	n/a	n/a	n/a	n/a	0.998	n/a	U
S11R000155		14797-65-0	Nitrite	ug/mL	99.0	<0.0192	3.50	n/a	n/a	n/a	n/a	1.92	n/a	J
S11R000155		14808-79-8	Sulfate	ug/mL	101	<0.0187	108	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000155		338-70-5	Oxalate	ug/mL	97.5	<0.0231	<2.31	n/a	n/a	n/a	n/a	2.31	n/a	U
S11R000155		24959-67-9	Bromide	ug/mL	101	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000155		14797-55-8	Nitrate	ug/mL	97.3	<0.0208	14.6	n/a	n/a	n/a	n/a	2.08	n/a	J
S11R000155		14265-44-2	Phosphate	ug/mL	99.5	<0.0167	2.44E+04	n/a	n/a	n/a	n/a	167	n/a	
S11R000155		7440-22-4	Silver	ug/mL	98.3	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000155		7429-90-5	Aluminum	ug/mL	98.6	<0.0300	260	n/a	n/a	n/a	n/a	3.00	n/a	
S11R000155		7440-38-2	Arsenic	ug/mL	97.1	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	UY
S11R000155		7440-42-8	Boron	ug/mL	100	<0.0300	<3.00	n/a	n/a	n/a	n/a	3.00	n/a	U
S11R000155		7440-39-3	Barium	ug/mL	99.7	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	U
S11R000155		7440-41-7	Beryllium	ug/mL	96.1	<1.00E-03	<0.100	n/a	n/a	n/a	n/a	0.100	n/a	U
S11R000155		7440-69-9	Bismuth	ug/mL	100	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	UY
S11R000155		7440-70-2	Calcium	ug/mL	98.8	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000155		7440-43-9	Cadmium	ug/mL	99.9	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	UY
S11R000155		7440-45-1	Cerium	ug/mL	103	<0.0300	<3.00	n/a	n/a	n/a	n/a	3.00	n/a	U
S11R000155		7440-48-4	Cobalt	ug/mL	99.3	<0.0100	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000155		7440-47-3	Chromium	ug/mL	100	<5.00E-03	0.649	n/a	n/a	n/a	n/a	0.500	n/a	J
S11R000155		7440-50-8	Copper	ug/mL	98.8	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000155		7440-53-1	Europium	ug/mL	101	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	UY
S11R000155		7439-89-6	Iron	ug/mL	99.1	<5.00E-03	0.599	n/a	n/a	n/a	n/a	0.500	n/a	J
S11R000155		7440-09-7	Potassium	ug/mL	93.5	<0.500	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000155		7439-91-0	Lanthanum	ug/mL	97.7	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	U
S11R000155		7439-93-2	Lithium	ug/mL	103	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	U

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 8 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000155		7439-95-4	Magnesium	ug/mL	99.0	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000155		7439-96-5	Manganese	ug/mL	98.9	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	UY
S11R000155		7439-98-7	Molybdenum	ug/mL	99.4	<0.0200	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000155		7440-23-5	Sodium	ug/mL	101	<0.100	1.84E+04	n/a	n/a	n/a	n/a	10.0	n/a	
S11R000155		7440-00-8	Neodymium	ug/mL	102	<0.0100	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000155		7440-02-0	Nickel	ug/mL	99.4	<0.0200	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000155		7723-14-0	Phosphorus	ug/mL	102	<0.0500	8.34E+03	n/a	n/a	n/a	n/a	5.00	n/a	
S11R000155		7439-92-1	Lead	ug/mL	103	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000155		7704-34-9	Sulfur	ug/mL	102	<0.100	36.5	n/a	n/a	n/a	n/a	10.0	n/a	J
S11R000155		7440-36-0	Antimony	ug/mL	97.4	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000155		7782-49-2	Selenium	ug/mL	100	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000155		7440-21-3	Silicon	ug/mL	93.6	<0.0300	7.16	n/a	n/a	n/a	n/a	3.00	n/a	J
S11R000155		7440-19-9	Samarium	ug/mL	101	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000155		7440-24-6	Strontium	ug/mL	98.9	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	U
S11R000155		7440-29-1	Thorium	ug/mL	99.9	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000155		7440-32-6	Titanium	ug/mL	101	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000155		7440-28-0	Thallium	ug/mL	108	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000155		7440-61-1	Uranium	ug/mL	103	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000155		7440-62-2	Vanadium	ug/mL	100	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000155		7440-65-5	Yttrium	ug/mL	101	<2.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S11R000155		7440-66-6	Zinc	ug/mL	98.2	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000155		7440-67-7	Zirconium	ug/mL	97.6	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000155		SPECGRAVITY	Specific gravity	unitless	99.83	n/a	1.058	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000155		TOC	Total organic carbon	ug/mL	96.8	<20.0	<20.0	<20.0	n/a	n/a	101	20.0	n/a	U
S11R000155		TIC	Total inorganic carbon	ug/mL	105	<7.00	21.5	20.3	20.9	5.74	94.2	7.00	n/a	J
S11R000155		PH	pH	unitless	n/a	n/a	12.3	n/a	n/a	n/a	n/a	0.0100	n/a	

Comment for samples S11R000152, S11R000153, S11R000154, S11R000155, S11R000156, and S11R000157: "As, Eu, Mn and Cd detected >MDL in the ICBA standards. The beginning LLS was at 64% for Bi. Bi was detected in sample S11R000157. Otherwise, none of these analytes were detected in any of the samples. All of these analytes were "Y' flagged for all samples. SDB 4/22/11"

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 9 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000156		%WATER	Percent water	%	101	n/a	96.7	n/a	n/a	n/a	n/a	0.0100	n/a	
S11R000156		16984-48-8	Fluoride	ug/mL	97.4	<1.61E-03	2.09E+03	n/a	n/a	n/a	n/a	16.1	n/a	
S11R000156		666-14-8	Glycolate	ug/mL	92.9	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000156		71-50-1	Acetate	ug/mL	99.2	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000156		12311-97-6	Formate	ug/mL	95.5	<4.67E-03	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000156		16887-00-6	Chloride	ug/mL	100	<9.98E-03	<0.998	n/a	n/a	n/a	n/a	0.998	n/a	U
S11R000156		14797-65-0	Nitrite	ug/mL	99.0	<0.0192	2.18	n/a	n/a	n/a	n/a	1.92	n/a	J
S11R000156		14808-79-8	Sulfate	ug/mL	101	<0.0187	66.4	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000156		338-70-5	Oxalate	ug/mL	97.5	<0.0231	<2.31	n/a	n/a	n/a	n/a	2.31	n/a	U
S11R000156		24959-67-9	Bromide	ug/mL	101	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000156		14797-55-8	Nitrate	ug/mL	97.3	<0.0208	22.7	n/a	n/a	n/a	n/a	2.08	n/a	J
S11R000156		14265-44-2	Phosphate	ug/mL	99.5	<0.0167	2.10E+04	n/a	n/a	n/a	n/a	167	n/a	
S11R000156		7440-22-4	Silver	ug/mL	98.3	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000156		7429-90-5	Aluminum	ug/mL	98.6	<0.0300	204	n/a	n/a	n/a	n/a	3.00	n/a	
S11R000156		7440-38-2	Arsenic	ug/mL	97.1	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	UY
S11R000156		7440-42-8	Boron	ug/mL	100	<0.0300	<3.00	n/a	n/a	n/a	n/a	3.00	n/a	U
S11R000156		7440-39-3	Barium	ug/mL	99.7	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	U
S11R000156		7440-41-7	Beryllium	ug/mL	96.1	<1.00E-03	<0.100	n/a	n/a	n/a	n/a	0.100	n/a	U
S11R000156		7440-69-9	Bismuth	ug/mL	100	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	UY
S11R000156		7440-70-2	Calcium	ug/mL	98.8	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000156		7440-43-9	Cadmium	ug/mL	99.9	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	UY
S11R000156		7440-45-1	Cerium	ug/mL	103	<0.0300	<3.00	n/a	n/a	n/a	n/a	3.00	n/a	U
S11R000156		7440-48-4	Cobalt	ug/mL	99.3	<0.0100	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000156		7440-47-3	Chromium	ug/mL	100	<5.00E-03	0.608	n/a	n/a	n/a	n/a	0.500	n/a	J
S11R000156		7440-50-8	Copper	ug/mL	98.8	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000156		7440-53-1	Europium	ug/mL	101	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	UY
S11R000156		7439-89-6	Iron	ug/mL	99.1	<5.00E-03	0.658	n/a	n/a	n/a	n/a	0.500	n/a	J
S11R000156		7440-09-7	Potassium	ug/mL	93.5	<0.500	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000156		7439-91-0	Lanthanum	ug/mL	97.7	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	U
S11R000156		7439-93-2	Lithium	ug/mL	103	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	U

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 9 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000156		7439-95-4	Magnesium	ug/mL	99.0	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000156		7439-96-5	Manganese	ug/mL	98.9	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	UY
S11R000156		7439-98-7	Molybdenum	ug/mL	99.4	<0.0200	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000156		7440-23-5	Sodium	ug/mL	101	<0.100	1.66E+04	n/a	n/a	n/a	n/a	10.0	n/a	
S11R000156		7440-00-8	Neodymium	ug/mL	102	<0.0100	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000156		7440-02-0	Nickel	ug/mL	99.4	<0.0200	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000156		7723-14-0	Phosphorus	ug/mL	102	<0.0500	7.17E+03	n/a	n/a	n/a	n/a	5.00	n/a	
S11R000156		7439-92-1	Lead	ug/mL	103	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000156		7704-34-9	Sulfur	ug/mL	102	<0.100	22.1	n/a	n/a	n/a	n/a	10.0	n/a	J
S11R000156		7440-36-0	Antimony	ug/mL	97.4	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000156		7782-49-2	Selenium	ug/mL	100	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000156		7440-21-3	Silicon	ug/mL	93.6	<0.0300	8.70	n/a	n/a	n/a	n/a	3.00	n/a	J
S11R000156		7440-19-9	Samarium	ug/mL	101	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000156		7440-24-6	Strontium	ug/mL	98.9	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	U
S11R000156		7440-29-1	Thorium	ug/mL	99.9	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000156		7440-32-6	Titanium	ug/mL	101	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000156		7440-28-0	Thallium	ug/mL	108	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000156		7440-61-1	Uranium	ug/mL	103	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000156		7440-62-2	Vanadium	ug/mL	100	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000156		7440-65-5	Yttrium	ug/mL	101	<2.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S11R000156		7440-66-6	Zinc	ug/mL	98.2	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000156		7440-67-7	Zirconium	ug/mL	97.6	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000156		SPECGRAVITY	Specific gravity	unitless	99.83	n/a	1.044	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000156		TOC	Total organic carbon	ug/mL	96.8	<20.0	<40.0	n/a	n/a	n/a	n/a	40.0	n/a	U
S11R000156		TIC	Total inorganic carbon	ug/mL	105	<7.00	28.2	n/a	n/a	n/a	n/a	14.0	n/a	J
S11R000156		PH	pH	unitless	n/a	n/a	12.3	n/a	n/a	n/a	n/a	0.0100	n/a	

Comment for samples S11R000152, S11R000153, S11R000154, S11R000155, S11R000156, and S11R000157: "As, Eu, Mn and Cd detected >MDL in the ICBA standards. The beginning LLS was at 64% for Bi. Bi was detected in sample S11R000157. Otherwise, none of these analytes were detected in any of the samples. All of these analytes were "Y' flagged for all samples. SDB 4/22/11"

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 10 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000157		%WATER	Percent water	%	101	n/a	95.8	97.8	96.8	2.12	n/a	0.0100	n/a	
S11R000157		16984-48-8	Fluoride	ug/mL	97.4	<1.61E-03	188	n/a	n/a	n/a	n/a	0.161	n/a	
S11R000157		666-14-8	Glycolate	ug/mL	92.9	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000157		71-50-1	Acetate	ug/mL	99.2	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000157		12311-97-6	Formate	ug/mL	95.5	<4.67E-03	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000157		16887-00-6	Chloride	ug/mL	100	<9.98E-03	<0.998	n/a	n/a	n/a	n/a	0.998	n/a	U
S11R000157		14797-65-0	Nitrite	ug/mL	99.0	<0.0192	8.50	n/a	n/a	n/a	n/a	1.92	n/a	J
S11R000157		14808-79-8	Sulfate	ug/mL	101	<0.0187	3.43	n/a	n/a	n/a	n/a	1.87	n/a	J
S11R000157		338-70-5	Oxalate	ug/mL	97.5	<0.0231	<2.31	n/a	n/a	n/a	n/a	2.31	n/a	U
S11R000157		24959-67-9	Bromide	ug/mL	101	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000157		14797-55-8	Nitrate	ug/mL	97.3	<0.0208	2.15	n/a	n/a	n/a	n/a	2.08	n/a	J
S11R000157		14265-44-2	Phosphate	ug/mL	99.5	<0.0167	1.82E+03	n/a	n/a	n/a	n/a	1.67	n/a	
S11R000157		7440-22-4	Silver	ug/mL	98.3	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000157		7429-90-5	Aluminum	ug/mL	98.6	<0.0300	99.6	n/a	n/a	n/a	n/a	3.00	n/a	
S11R000157		7440-38-2	Arsenic	ug/mL	97.1	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	UY
S11R000157		7440-42-8	Boron	ug/mL	100	<0.0300	<3.00	n/a	n/a	n/a	n/a	3.00	n/a	U
S11R000157		7440-39-3	Barium	ug/mL	99.7	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	U
S11R000157		7440-41-7	Beryllium	ug/mL	96.1	<1.00E-03	<0.100	n/a	n/a	n/a	n/a	0.100	n/a	U
S11R000157		7440-69-9	Bismuth	ug/mL	100	<0.100	41.1	n/a	n/a	n/a	n/a	10.0	n/a	JY
S11R000157		7440-70-2	Calcium	ug/mL	98.8	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000157		7440-43-9	Cadmium	ug/mL	99.9	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	UY
S11R000157		7440-45-1	Cerium	ug/mL	103	<0.0300	<3.00	n/a	n/a	n/a	n/a	3.00	n/a	U
S11R000157		7440-48-4	Cobalt	ug/mL	99.3	<0.0100	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000157		7440-47-3	Chromium	ug/mL	100	<5.00E-03	0.644	n/a	n/a	n/a	n/a	0.500	n/a	J
S11R000157		7440-50-8	Copper	ug/mL	98.8	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000157		7440-53-1	Europium	ug/mL	101	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	UY
S11R000157		7439-89-6	Iron	ug/mL	99.1	<5.00E-03	34.6	n/a	n/a	n/a	n/a	0.500	n/a	
S11R000157		7440-09-7	Potassium	ug/mL	93.5	<0.500	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000157		7439-91-0	Lanthanum	ug/mL	97.7	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	U
S11R000157		7439-93-2	Lithium	ug/mL	103	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	U

C-110 Heel Solids: Large-scale 15 °C Dissolution Test — Contact 10 Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000157		7439-95-4	Magnesium	ug/mL	99.0	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000157		7439-96-5	Manganese	ug/mL	98.9	<3.00E-03	<0.300	n/a	n/a	n/a	n/a	0.300	n/a	UY
S11R000157		7439-98-7	Molybdenum	ug/mL	99.4	<0.0200	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000157		7440-23-5	Sodium	ug/mL	101	<0.100	1.46E+03	n/a	n/a	n/a	n/a	10.0	n/a	
S11R000157		7440-00-8	Neodymium	ug/mL	102	<0.0100	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000157		7440-02-0	Nickel	ug/mL	99.4	<0.0200	<2.00	n/a	n/a	n/a	n/a	2.00	n/a	U
S11R000157		7723-14-0	Phosphorus	ug/mL	102	<0.0500	595	n/a	n/a	n/a	n/a	5.00	n/a	
S11R000157		7439-92-1	Lead	ug/mL	103	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000157		7704-34-9	Sulfur	ug/mL	102	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000157		7440-36-0	Antimony	ug/mL	97.4	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000157		7782-49-2	Selenium	ug/mL	100	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000157		7440-21-3	Silicon	ug/mL	93.6	<0.0300	12.0	n/a	n/a	n/a	n/a	3.00	n/a	J
S11R000157		7440-19-9	Samarium	ug/mL	101	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000157		7440-24-6	Strontium	ug/mL	98.9	<3.00E-03	0.960	n/a	n/a	n/a	n/a	0.300	n/a	J
S11R000157		7440-29-1	Thorium	ug/mL	99.9	<0.0500	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000157		7440-32-6	Titanium	ug/mL	101	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000157		7440-28-0	Thallium	ug/mL	108	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000157		7440-61-1	Uranium	ug/mL	103	<0.100	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000157		7440-62-2	Vanadium	ug/mL	100	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000157		7440-65-5	Yttrium	ug/mL	101	<2.00E-03	<0.200	n/a	n/a	n/a	n/a	0.200	n/a	U
S11R000157		7440-66-6	Zinc	ug/mL	98.2	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000157		7440-67-7	Zirconium	ug/mL	97.6	<5.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000157		SPECGRAVITY	Specific gravity	unitless	99.83	n/a	1.009	n/a	n/a	n/a	n/a	1.000E-03	n/a	
S11R000157		TOC	Total organic carbon	ug/mL	96.8	<20.0	<40.0	n/a	n/a	n/a	n/a	40.0	n/a	U
S11R000157		TIC	Total inorganic carbon	ug/mL	105	<7.00	32.2	n/a	n/a	n/a	n/a	14.0	n/a	J
S11R000157		PH	pH	unitless	n/a	n/a	11.3	n/a	n/a	n/a	n/a	0.0100	n/a	

Comment for samples S11R000152, S11R000153, S11R000154, S11R000155, S11R000156, and S11R000157: "As, Eu, Mn and Cd detected >MDL in the ICBA standards. The beginning LLS was at 64% for Bi. Bi was detected in sample S11R000157. Otherwise, none of these analytes were detected in any of the samples. All of these analytes were "Y' flagged for all samples. SDB 4/22/11"

C-110 Heel Solids: Large-scale 45 °C Dissolution Test — Bulk Density Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000178		16984-48-8	Fluoride	ug/mL	96.7	<1.61E-03	1.66E+03	1.59E+03	1.62E+03	4.23	90.7	1.61	n/a	
S11R000178		666-14-8	Glycolate	ug/mL	96.3	<9.37E-03	<0.937	<0.937	n/a	n/a	88.8	0.937	n/a	U
S11R000178		71-50-1	Acetate	ug/mL	99.9	<6.04E-03	47.1	48.4	47.8	2.76	93.1	0.604	n/a	
S11R000178		12311-97-6	Formate	ug/mL	98.8	0.0181	18.1	18.9	18.5	4.65	97.2	0.467	n/a	B
S11R000178		16887-00-6	Chloride	ug/mL	98.2	<9.98E-03	120	122	121	2.00	101	0.998	n/a	
S11R000178		14797-65-0	Nitrite	ug/mL	97.5	<0.0192	5.62E+03	5.35E+03	5.49E+03	4.98	94.3	19.2	n/a	
S11R000178		14808-79-8	Sulfate	ug/mL	99.3	<0.0187	1.39E+03	1.41E+03	1.40E+03	1.54	94.8	1.87	n/a	
S11R000178		338-70-5	Oxalate	ug/mL	96.7	<0.0231	369	372	371	0.812	88.1	2.31	n/a	
S11R000178		24959-67-9	Bromide	ug/mL	103	<0.0580	<5.80	<5.80	n/a	n/a	91.4	5.80	n/a	U
S11R000178		14797-55-8	Nitrate	ug/mL	97.4	<0.0208	1.09E+04	1.04E+04	1.07E+04	4.27	94.5	20.8	n/a	
S11R000178		14265-44-2	Phosphate	ug/mL	98.2	<0.0167	1.58E+04	1.51E+04	1.54E+04	4.16	92.1	16.7	n/a	
S11R000178		7440-22-4	Silver	ug/mL	99.4	<5.00E-03	<2.50	<2.50	n/a	n/a	97.1	2.50	n/a	U
S11R000178		7429-90-5	Aluminum	ug/mL	100	<0.0300	112	113	112	0.615	97.6	15.0	n/a	
S11R000178		7440-38-2	Arsenic	ug/mL	99.6	<0.0500	<25.0	<25.0	n/a	n/a	100	25.0	n/a	U
S11R000178		7440-42-8	Boron	ug/mL	101	<0.0300	<15.0	<15.0	n/a	n/a	98.2	15.0	n/a	U
S11R000178		7440-39-3	Barium	ug/mL	102	<3.00E-03	<1.50	<1.50	n/a	n/a	101	1.50	n/a	U
S11R000178		7440-41-7	Beryllium	ug/mL	100	<1.00E-03	<0.500	<0.500	n/a	n/a	96.5	0.500	n/a	U
S11R000178		7440-69-9	Bismuth	ug/mL	103	<0.100	<50.0	<50.0	n/a	n/a	104	50.0	n/a	U
S11R000178		7440-70-2	Calcium	ug/mL	99.7	<0.0500	<25.0	<25.0	n/a	n/a	96.0	25.0	n/a	U
S11R000178		7440-43-9	Cadmium	ug/mL	103	<5.00E-03	<2.50	<2.50	n/a	n/a	98.9	2.50	n/a	U
S11R000178		7440-45-1	Cerium	ug/mL	105	<0.0300	<15.0	<15.0	n/a	n/a	99.2	15.0	n/a	U
S11R000178		7440-48-4	Cobalt	ug/mL	103	<0.0100	<5.00	<5.00	n/a	n/a	99.3	5.00	n/a	U
S11R000178		7440-47-3	Chromium	ug/mL	103	<5.00E-03	31.1	33.5	32.3	7.32	99.3	2.50	n/a	
S11R000178		7440-50-8	Copper	ug/mL	101	<5.00E-03	<2.50	<2.50	n/a	n/a	100	2.50	n/a	U
S11R000178		7440-53-1	Europium	ug/mL	101	<5.00E-03	<2.50	<2.50	n/a	n/a	101	2.50	n/a	U
S11R000178		7439-89-6	Iron	ug/mL	102	6.42E-03	30.2	29.4	29.8	2.69	99.2	2.50	n/a	
S11R000178		7440-09-7	Potassium	ug/mL	95.2	<0.500	<250	<250	n/a	n/a	89.2	250	n/a	U
S11R000178		7439-91-0	Lanthanum	ug/mL	100	<3.00E-03	<1.50	<1.50	n/a	n/a	97.5	1.50	n/a	U
S11R000178		7439-93-2	Lithium	ug/mL	102	<3.00E-03	<1.50	<1.50	n/a	n/a	94.6	1.50	n/a	U
S11R000178		7439-95-4	Magnesium	ug/mL	102	<0.0500	<25.0	<25.0	n/a	n/a	97.2	25.0	n/a	U

C-110 Heel Solids: Large-scale 45 °C Dissolution Test — Bulk Density Liquid (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000178		7439-96-5	Manganese	ug/mL	102	<3.00E-03	<1.50	<1.50	n/a	n/a	99.6	1.50	n/a	U
S11R000178		7439-98-7	Molybdenum	ug/mL	100	<0.0200	<10.0	<10.0	n/a	n/a	98.6	10.0	n/a	U
S11R000178		7440-23-5	Sodium	ug/mL	100	<0.100	2.71E+04	2.73E+04	2.72E+04	1.01	77.5	50.0	n/a	
S11R000178		7440-00-8	Neodymium	ug/mL	101	<0.0100	<5.00	<5.00	n/a	n/a	97.0	5.00	n/a	U
S11R000178		7440-02-0	Nickel	ug/mL	102	<0.0200	<10.0	<10.0	n/a	n/a	99.1	10.0	n/a	U
S11R000178		7723-14-0	Phosphorus	ug/mL	101	<0.0500	5.21E+03	5.21E+03	5.21E+03	0.0560	95.0	25.0	n/a	
S11R000178		7439-92-1	Lead	ug/mL	100	<0.0500	<25.0	<25.0	n/a	n/a	95.7	25.0	n/a	U
S11R000178		7704-34-9	Sulfur	ug/mL	102	<0.100	498	500	499	0.470	99.1	50.0	n/a	J
S11R000178		7440-36-0	Antimony	ug/mL	98.7	<0.0500	<25.0	<25.0	n/a	n/a	98.3	25.0	n/a	U
S11R000178		7782-49-2	Selenium	ug/mL	104	<0.100	<50.0	<50.0	n/a	n/a	104	50.0	n/a	U
S11R000178		7440-21-3	Silicon	ug/mL	93.3	<0.0300	<15.0	<15.0	n/a	n/a	92.2	15.0	n/a	U
S11R000178		7440-19-9	Samarium	ug/mL	103	<0.0500	<25.0	<25.0	n/a	n/a	100	25.0	n/a	U
S11R000178		7440-24-6	Strontium	ug/mL	101	<3.00E-03	<1.50	<1.50	n/a	n/a	98.9	1.50	n/a	U
S11R000178		7440-29-1	Thorium	ug/mL	102	<0.0500	<25.0	<25.0	n/a	n/a	98.4	25.0	n/a	U
S11R000178		7440-32-6	Titanium	ug/mL	101	<5.00E-03	<2.50	<2.50	n/a	n/a	97.9	2.50	n/a	U
S11R000178		7440-28-0	Thallium	ug/mL	104	<0.100	<50.0	<50.0	n/a	n/a	96.0	50.0	n/a	U
S11R000178		7440-61-1	Uranium	ug/mL	100	<0.100	185	193	189	3.78	95.3	50.0	n/a	J
S11R000178		7440-62-2	Vanadium	ug/mL	103	<5.00E-03	<2.50	<2.50	n/a	n/a	99.9	2.50	n/a	U
S11R000178		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<1.00	<1.00	n/a	n/a	98.9	1.00	n/a	U
S11R000178		7440-66-6	Zinc	ug/mL	101	<5.00E-03	<2.50	<2.50	n/a	n/a	98.7	2.50	n/a	U
S11R000178		7440-67-7	Zirconium	ug/mL	97.6	<5.00E-03	<2.50	<2.50	n/a	n/a	95.4	2.50	n/a	U
S11R000178		TOC	Total organic carbon	ug/mL	99.2	<20.0	183	220	202	18.4	103	40.0	n/a	J
S11R000178		TIC	Total inorganic carbon	ug/mL	92.2	<7.00	1.61E+03	1.79E+03	1.70E+03	10.6	85.5	14.0	n/a	
S11R000178		PH	pH	unitless	n/a	n/a	11.5	11.7	11.6	1.46	n/a	0.0100	n/a	

C-110 Heel Solids: Large-scale 45 °C Dissolution Test — Contact 1 Liquid - diluted [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000179		16984-48-8	Fluoride	ug/mL	96.7	<1.61E-03	2.46E+03	n/a	n/a	n/a	n/a	1.61	n/a	
S11R000179		666-14-8	Glycolate	ug/mL	96.3	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000179		71-50-1	Acetate	ug/mL	99.9	<6.04E-03	11.6	n/a	n/a	n/a	n/a	0.604	n/a	
S11R000179		12311-97-6	Formate	ug/mL	98.8	0.0181	5.83	n/a	n/a	n/a	n/a	0.467	n/a	BJ
S11R000179		16887-00-6	Chloride	ug/mL	98.2	<9.98E-03	38.7	n/a	n/a	n/a	n/a	0.998	n/a	
S11R000179		14797-65-0	Nitrite	ug/mL	97.5	<0.0192	1.70E+03	n/a	n/a	n/a	n/a	1.92	n/a	
S11R000179		14808-79-8	Sulfate	ug/mL	99.3	<0.0187	538	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000179		338-70-5	Oxalate	ug/mL	96.7	<0.0231	117	n/a	n/a	n/a	n/a	2.31	n/a	
S11R000179		24959-67-9	Bromide	ug/mL	103	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000179		14797-55-8	Nitrate	ug/mL	97.4	<0.0208	3.34E+03	n/a	n/a	n/a	n/a	20.8	n/a	
S11R000179		14265-44-2	Phosphate	ug/mL	98.2	<0.0167	2.31E+04	n/a	n/a	n/a	n/a	16.7	n/a	
S11R000179		7440-22-4	Silver	ug/mL	99.4	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000179		7429-90-5	Aluminum	ug/mL	100	<0.0300	379	n/a	n/a	n/a	n/a	15.0	n/a	
S11R000179		7440-38-2	Arsenic	ug/mL	99.6	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000179		7440-42-8	Boron	ug/mL	101	<0.0300	<15.0	n/a	n/a	n/a	n/a	15.0	n/a	U
S11R000179		7440-39-3	Barium	ug/mL	102	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000179		7440-41-7	Beryllium	ug/mL	100	<1.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000179		7440-69-9	Bismuth	ug/mL	103	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000179		7440-70-2	Calcium	ug/mL	99.7	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000179		7440-43-9	Cadmium	ug/mL	103	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000179		7440-45-1	Cerium	ug/mL	105	<0.0300	<15.0	n/a	n/a	n/a	n/a	15.0	n/a	U
S11R000179		7440-48-4	Cobalt	ug/mL	103	<0.0100	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000179		7440-47-3	Chromium	ug/mL	103	<5.00E-03	10.3	n/a	n/a	n/a	n/a	2.50	n/a	
S11R000179		7440-50-8	Copper	ug/mL	101	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000179		7440-53-1	Europium	ug/mL	101	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000179		7439-89-6	Iron	ug/mL	102	6.42E-03	17.5	n/a	n/a	n/a	n/a	2.50	n/a	J
S11R000179		7440-09-7	Potassium	ug/mL	95.2	<0.500	<250	n/a	n/a	n/a	n/a	250	n/a	U
S11R000179		7439-91-0	Lanthanum	ug/mL	100	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000179		7439-93-2	Lithium	ug/mL	102	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000179		7439-95-4	Magnesium	ug/mL	102	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U

C-110 Heel Solids: Large-scale 45 °C Dissolution Test — Contact 1 Liquid - diluted [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000179		7439-96-5	Manganese	ug/mL	102	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000179		7439-98-7	Molybdenum	ug/mL	100	<0.0200	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000179		7440-23-5	Sodium	ug/mL	100	<0.100	2.04E+04	n/a	n/a	n/a	n/a	50.0	n/a	
S11R000179		7440-00-8	Neodymium	ug/mL	101	<0.0100	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000179		7440-02-0	Nickel	ug/mL	102	<0.0200	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000179		7723-14-0	Phosphorus	ug/mL	101	<0.0500	7.18E+03	n/a	n/a	n/a	n/a	25.0	n/a	
S11R000179		7439-92-1	Lead	ug/mL	100	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000179		7704-34-9	Sulfur	ug/mL	102	<0.100	162	n/a	n/a	n/a	n/a	50.0	n/a	J
S11R000179		7440-36-0	Antimony	ug/mL	98.7	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000179		7782-49-2	Selenium	ug/mL	104	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000179		7440-21-3	Silicon	ug/mL	93.3	<0.0300	<15.0	n/a	n/a	n/a	n/a	15.0	n/a	U
S11R000179		7440-19-9	Samarium	ug/mL	103	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000179		7440-24-6	Strontium	ug/mL	101	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000179		7440-29-1	Thorium	ug/mL	102	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000179		7440-32-6	Titanium	ug/mL	101	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000179		7440-28-0	Thallium	ug/mL	104	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000179		7440-61-1	Uranium	ug/mL	100	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000179		7440-62-2	Vanadium	ug/mL	103	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000179		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000179		7440-66-6	Zinc	ug/mL	101	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000179		7440-67-7	Zirconium	ug/mL	97.6	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000179		TOC	Total organic carbon	ug/mL	99.2	<20.0	<40.0	n/a	n/a	n/a	n/a	40.0	n/a	U
S11R000179		TIC	Total inorganic carbon	ug/mL	92.2	<7.00	624	n/a	n/a	n/a	n/a	14.0	n/a	
S11R000179		PH	pH	unitless	n/a	n/a	11.7	n/a	n/a	n/a	n/a	0.0100	n/a	

[a] 45 °C Contact 1 Liquid Sample

	Wt	Vol at 43.2 °C	D_{Liq}
Test Liquid	25.037 g	22.767 mL	1.100 g/mL
H_2O	25.066 g	25.295 mL	0.990955 g/mL

C-110 Heel Solids: Large-scale 45 °C Dissolution Test — Contact 2 Liquid - diluted [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000180		16984-48-8	Fluoride	ug/mL	96.7	<1.61E-03	2.57E+03	n/a	n/a	n/a	n/a	1.61	n/a	
S11R000180		666-14-8	Glycolate	ug/mL	96.3	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000180		71-50-1	Acetate	ug/mL	99.9	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000180		12311-97-6	Formate	ug/mL	98.8	0.0181	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000180		16887-00-6	Chloride	ug/mL	98.2	<9.98E-03	5.41	n/a	n/a	n/a	n/a	0.998	n/a	J
S11R000180		14797-65-0	Nitrite	ug/mL	97.5	<0.0192	235	n/a	n/a	n/a	n/a	1.92	n/a	
S11R000180		14808-79-8	Sulfate	ug/mL	99.3	<0.0187	157	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000180		338-70-5	Oxalate	ug/mL	96.7	<0.0231	10.7	n/a	n/a	n/a	n/a	2.31	n/a	J
S11R000180		24959-67-9	Bromide	ug/mL	103	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000180		14797-55-8	Nitrate	ug/mL	97.4	<0.0208	467	n/a	n/a	n/a	n/a	2.08	n/a	
S11R000180		14265-44-2	Phosphate	ug/mL	98.2	<0.0167	2.35E+04	n/a	n/a	n/a	n/a	16.7	n/a	
S11R000180		7440-22-4	Silver	ug/mL	99.4	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000180		7429-90-5	Aluminum	ug/mL	100	<0.0300	438	n/a	n/a	n/a	n/a	15.0	n/a	
S11R000180		7440-38-2	Arsenic	ug/mL	99.6	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000180		7440-42-8	Boron	ug/mL	101	<0.0300	<15.0	n/a	n/a	n/a	n/a	15.0	n/a	U
S11R000180		7440-39-3	Barium	ug/mL	102	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000180		7440-41-7	Beryllium	ug/mL	100	<1.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000180		7440-69-9	Bismuth	ug/mL	103	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000180		7440-70-2	Calcium	ug/mL	99.7	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000180		7440-43-9	Cadmium	ug/mL	103	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000180		7440-45-1	Cerium	ug/mL	105	<0.0300	<15.0	n/a	n/a	n/a	n/a	15.0	n/a	U
S11R000180		7440-48-4	Cobalt	ug/mL	103	<0.0100	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000180		7440-47-3	Chromium	ug/mL	103	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000180		7440-50-8	Copper	ug/mL	101	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000180		7440-53-1	Europium	ug/mL	101	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000180		7439-89-6	Iron	ug/mL	102	6.42E-03	4.98	n/a	n/a	n/a	n/a	2.50	n/a	J
S11R000180		7440-09-7	Potassium	ug/mL	95.2	<0.500	<250	n/a	n/a	n/a	n/a	250	n/a	U
S11R000180		7439-91-0	Lanthanum	ug/mL	100	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000180		7439-93-2	Lithium	ug/mL	102	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000180		7439-95-4	Magnesium	ug/mL	102	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U

C-110 Heel Solids: Large-scale 45 °C Dissolution Test — Contact 2 Liquid - diluted [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000180		7439-96-5	Manganese	ug/mL	102	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000180		7439-98-7	Molybdenum	ug/mL	100	<0.0200	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000180		7440-23-5	Sodium	ug/mL	100	<0.100	1.98E+04	n/a	n/a	n/a	n/a	50.0	n/a	
S11R000180		7440-00-8	Neodymium	ug/mL	101	<0.0100	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000180		7440-02-0	Nickel	ug/mL	102	<0.0200	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000180		7723-14-0	Phosphorus	ug/mL	101	<0.0500	7.90E+03	n/a	n/a	n/a	n/a	25.0	n/a	
S11R000180		7439-92-1	Lead	ug/mL	100	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000180		7704-34-9	Sulfur	ug/mL	102	<0.100	59.6	n/a	n/a	n/a	n/a	50.0	n/a	J
S11R000180		7440-36-0	Antimony	ug/mL	98.7	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000180		7782-49-2	Selenium	ug/mL	104	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000180		7440-21-3	Silicon	ug/mL	93.3	<0.0300	<15.0	n/a	n/a	n/a	n/a	15.0	n/a	U
S11R000180		7440-19-9	Samarium	ug/mL	103	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000180		7440-24-6	Strontium	ug/mL	101	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000180		7440-29-1	Thorium	ug/mL	102	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000180		7440-32-6	Titanium	ug/mL	101	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000180		7440-28-0	Thallium	ug/mL	104	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000180		7440-61-1	Uranium	ug/mL	100	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000180		7440-62-2	Vanadium	ug/mL	103	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000180		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000180		7440-66-6	Zinc	ug/mL	101	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000180		7440-67-7	Zirconium	ug/mL	97.6	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000180		TOC	Total organic carbon	ug/mL	99.2	<20.0	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000180		TIC	Total inorganic carbon	ug/mL	92.2	<7.00	99.7	n/a	n/a	n/a	n/a	7.00	n/a	
S11R000180		PH	pH	unitless	n/a	n/a	12.0	n/a	n/a	n/a	n/a	0.0100	n/a	

[a] 45 °C Contact 2 Liquid Sample

	Wt	Vol at 37.2 °C	D_{Liq}
Test Liquid	25.012 g	22.888 mL	1.093 g/mL
H_2O	25.062 g	25.232 mL	0.993256 g/mL

C-110 Heel Solids: Large-scale 45 °C Dissolution Test — Contact 3 Liquid - diluted [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000181		16984-48-8	Fluoride	ug/mL	96.7	<1.61E-03	2.64E+03	n/a	n/a	n/a	n/a	1.61	n/a	
S11R000181		666-14-8	Glycolate	ug/mL	96.3	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000181		71-50-1	Acetate	ug/mL	99.9	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000181		12311-97-6	Formate	ug/mL	98.8	0.0181	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000181		16887-00-6	Chloride	ug/mL	98.2	<9.98E-03	1.25	n/a	n/a	n/a	n/a	0.998	n/a	J
S11R000181		14797-65-0	Nitrite	ug/mL	97.5	<0.0192	29.1	n/a	n/a	n/a	n/a	1.92	n/a	
S11R000181		14808-79-8	Sulfate	ug/mL	99.3	<0.0187	149	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000181		338-70-5	Oxalate	ug/mL	96.7	<0.0231	<2.31	n/a	n/a	n/a	n/a	2.31	n/a	U
S11R000181		24959-67-9	Bromide	ug/mL	103	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000181		14797-55-8	Nitrate	ug/mL	97.4	<0.0208	67.0	n/a	n/a	n/a	n/a	2.08	n/a	
S11R000181		14265-44-2	Phosphate	ug/mL	98.2	<0.0167	2.35E+04	n/a	n/a	n/a	n/a	16.7	n/a	
S11R000181		7440-22-4	Silver	ug/mL	99.4	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000181		7429-90-5	Aluminum	ug/mL	100	<0.0300	580	n/a	n/a	n/a	n/a	15.0	n/a	
S11R000181		7440-38-2	Arsenic	ug/mL	99.6	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000181		7440-42-8	Boron	ug/mL	101	<0.0300	<15.0	n/a	n/a	n/a	n/a	15.0	n/a	U
S11R000181		7440-39-3	Barium	ug/mL	102	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000181		7440-41-7	Beryllium	ug/mL	100	<1.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000181		7440-69-9	Bismuth	ug/mL	103	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000181		7440-70-2	Calcium	ug/mL	99.7	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000181		7440-43-9	Cadmium	ug/mL	103	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000181		7440-45-1	Cerium	ug/mL	105	<0.0300	<15.0	n/a	n/a	n/a	n/a	15.0	n/a	U
S11R000181		7440-48-4	Cobalt	ug/mL	103	<0.0100	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000181		7440-47-3	Chromium	ug/mL	103	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000181		7440-50-8	Copper	ug/mL	101	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000181		7440-53-1	Europium	ug/mL	101	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000181		7439-89-6	Iron	ug/mL	102	6.42E-03	3.32	n/a	n/a	n/a	n/a	2.50	n/a	J
S11R000181		7440-09-7	Potassium	ug/mL	95.2	<0.500	<250	n/a	n/a	n/a	n/a	250	n/a	U
S11R000181		7439-91-0	Lanthanum	ug/mL	100	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000181		7439-93-2	Lithium	ug/mL	102	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000181		7439-95-4	Magnesium	ug/mL	102	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U

C-110 Heel Solids: Large-scale 45 °C Dissolution Test — Contact 3 Liquid - diluted [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000181		7439-96-5	Manganese	ug/mL	102	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000181		7439-98-7	Molybdenum	ug/mL	100	<0.0200	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000181		7440-23-5	Sodium	ug/mL	100	<0.100	1.94E+04	n/a	n/a	n/a	n/a	50.0	n/a	
S11R000181		7440-00-8	Neodymium	ug/mL	101	<0.0100	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000181		7440-02-0	Nickel	ug/mL	102	<0.0200	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000181		7723-14-0	Phosphorus	ug/mL	101	<0.0500	7.89E+03	n/a	n/a	n/a	n/a	25.0	n/a	
S11R000181		7439-92-1	Lead	ug/mL	100	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000181		7704-34-9	Sulfur	ug/mL	102	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000181		7440-36-0	Antimony	ug/mL	98.7	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000181		7782-49-2	Selenium	ug/mL	104	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000181		7440-21-3	Silicon	ug/mL	93.3	<0.0300	<15.0	n/a	n/a	n/a	n/a	15.0	n/a	U
S11R000181		7440-19-9	Samarium	ug/mL	103	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000181		7440-24-6	Strontium	ug/mL	101	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000181		7440-29-1	Thorium	ug/mL	102	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000181		7440-32-6	Titanium	ug/mL	101	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000181		7440-28-0	Thallium	ug/mL	104	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000181		7440-61-1	Uranium	ug/mL	100	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000181		7440-62-2	Vanadium	ug/mL	103	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000181		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000181		7440-66-6	Zinc	ug/mL	101	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000181		7440-67-7	Zirconium	ug/mL	97.6	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000181		TOC	Total organic carbon	ug/mL	99.2	<20.0	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000181		TIC	Total inorganic carbon	ug/mL	92.2	<7.00	30.1	n/a	n/a	n/a	n/a	7.00	n/a	J
S11R000181		PH	pH	unitless	n/a	n/a	11.9	n/a	n/a	n/a	n/a	0.0100	n/a	

[a] 45 °C Contact 3 Liquid Sample	Wt	Vol at 42.8 °C	D_{Liq}
Test Liquid	25.012 g	22.959 mL	1.089 g/mL
H_2O	24.986 g	25.210 mL	0.991116 g/mL

C-110 Heel Solids: Large-scale 45 °C Dissolution Test — Contact 4 Liquid - diluted [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000182		16984-48-8	Fluoride	ug/mL	96.7	<1.61E-03	2.53E+03	n/a	n/a	n/a	n/a	16.1	n/a	
S11R000182		666-14-8	Glycolate	ug/mL	96.3	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000182		71-50-1	Acetate	ug/mL	99.9	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000182		12311-97-6	Formate	ug/mL	98.8	0.0181	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000182		16887-00-6	Chloride	ug/mL	98.2	<9.98E-03	<0.998	n/a	n/a	n/a	n/a	0.998	n/a	U
S11R000182		14797-65-0	Nitrite	ug/mL	97.5	<0.0192	5.50	n/a	n/a	n/a	n/a	1.92	n/a	J
S11R000182		14808-79-8	Sulfate	ug/mL	99.3	<0.0187	113	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000182		338-70-5	Oxalate	ug/mL	96.7	<0.0231	<2.31	n/a	n/a	n/a	n/a	2.31	n/a	U
S11R000182		24959-67-9	Bromide	ug/mL	103	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000182		14797-55-8	Nitrate	ug/mL	97.4	<0.0208	18.8	n/a	n/a	n/a	n/a	2.08	n/a	J
S11R000182		14265-44-2	Phosphate	ug/mL	98.2	<0.0167	2.27E+04	n/a	n/a	n/a	n/a	167	n/a	
S11R000182		7440-22-4	Silver	ug/mL	99.4	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000182		7429-90-5	Aluminum	ug/mL	100	<0.0300	421	n/a	n/a	n/a	n/a	15.0	n/a	
S11R000182		7440-38-2	Arsenic	ug/mL	99.6	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000182		7440-42-8	Boron	ug/mL	101	<0.0300	<15.0	n/a	n/a	n/a	n/a	15.0	n/a	U
S11R000182		7440-39-3	Barium	ug/mL	102	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000182		7440-41-7	Beryllium	ug/mL	100	<1.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000182		7440-69-9	Bismuth	ug/mL	103	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000182		7440-70-2	Calcium	ug/mL	99.7	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000182		7440-43-9	Cadmium	ug/mL	103	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000182		7440-45-1	Cerium	ug/mL	105	<0.0300	<15.0	n/a	n/a	n/a	n/a	15.0	n/a	U
S11R000182		7440-48-4	Cobalt	ug/mL	103	<0.0100	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000182		7440-47-3	Chromium	ug/mL	103	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000182		7440-50-8	Copper	ug/mL	101	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000182		7440-53-1	Europium	ug/mL	101	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000182		7439-89-6	Iron	ug/mL	102	6.42E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000182		7440-09-7	Potassium	ug/mL	95.2	<0.500	<250	n/a	n/a	n/a	n/a	250	n/a	U
S11R000182		7439-91-0	Lanthanum	ug/mL	100	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000182		7439-93-2	Lithium	ug/mL	102	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000182		7439-95-4	Magnesium	ug/mL	102	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U

C-110 Heel Solids: Large-scale 45 °C Dissolution Test — Contact 4 Liquid - diluted [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000182		7439-96-5	Manganese	ug/mL	102	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000182		7439-98-7	Molybdenum	ug/mL	100	<0.0200	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000182		7440-23-5	Sodium	ug/mL	100	<0.100	1.86E+04	n/a	n/a	n/a	n/a	50.0	n/a	
S11R000182		7440-00-8	Neodymium	ug/mL	101	<0.0100	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000182		7440-02-0	Nickel	ug/mL	102	<0.0200	<10.0	n/a	n/a	n/a	n/a	10.0	n/a	U
S11R000182		7723-14-0	Phosphorus	ug/mL	101	<0.0500	7.58E+03	n/a	n/a	n/a	n/a	25.0	n/a	
S11R000182		7439-92-1	Lead	ug/mL	100	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000182		7704-34-9	Sulfur	ug/mL	102	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000182		7440-36-0	Antimony	ug/mL	98.7	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000182		7782-49-2	Selenium	ug/mL	104	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000182		7440-21-3	Silicon	ug/mL	93.3	<0.0300	<15.0	n/a	n/a	n/a	n/a	15.0	n/a	U
S11R000182		7440-19-9	Samarium	ug/mL	103	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000182		7440-24-6	Strontium	ug/mL	101	<3.00E-03	<1.50	n/a	n/a	n/a	n/a	1.50	n/a	U
S11R000182		7440-29-1	Thorium	ug/mL	102	<0.0500	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000182		7440-32-6	Titanium	ug/mL	101	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000182		7440-28-0	Thallium	ug/mL	104	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000182		7440-61-1	Uranium	ug/mL	100	<0.100	<50.0	n/a	n/a	n/a	n/a	50.0	n/a	U
S11R000182		7440-62-2	Vanadium	ug/mL	103	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000182		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<1.00	n/a	n/a	n/a	n/a	1.00	n/a	U
S11R000182		7440-66-6	Zinc	ug/mL	101	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000182		7440-67-7	Zirconium	ug/mL	97.6	<5.00E-03	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000182		TOC	Total organic carbon	ug/mL	99.2	<20.0	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000182		TIC	Total inorganic carbon	ug/mL	92.2	<7.00	17.4	n/a	n/a	n/a	n/a	7.00	n/a	J
S11R000182		PH	pH	unitless	n/a	n/a	12.1	n/a	n/a	n/a	n/a	0.0100	n/a	

[a] 45 °C Contact 4 Liquid Sample	Wt	Vol at 41.8 °C	D_{Liq}
Test Liquid	25.067 g	23.099 mL	1.085 g/mL
H_2O	25.005 g	25.219 mL	0.991515 g/mL

C-110 Heel Solids: Large-scale 45 °C Dissolution Test — Contact 5 Liquid - diluted [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000183		16984-48-8	Fluoride	ug/mL	96.7	<1.61E-03	1.14E+03	n/a	n/a	n/a	n/a	16.1	n/a	
S11R000183		666-14-8	Glycolate	ug/mL	96.3	<9.37E-03	<0.937	n/a	n/a	n/a	n/a	0.937	n/a	U
S11R000183		71-50-1	Acetate	ug/mL	99.9	<6.04E-03	<0.604	n/a	n/a	n/a	n/a	0.604	n/a	U
S11R000183		12311-97-6	Formate	ug/mL	98.8	0.0181	<0.467	n/a	n/a	n/a	n/a	0.467	n/a	U
S11R000183		16887-00-6	Chloride	ug/mL	98.2	<9.98E-03	<0.998	n/a	n/a	n/a	n/a	0.998	n/a	U
S11R000183		14797-65-0	Nitrite	ug/mL	97.5	<0.0192	<1.92	n/a	n/a	n/a	n/a	1.92	n/a	U
S11R000183		14808-79-8	Sulfate	ug/mL	99.3	<0.0187	33.5	n/a	n/a	n/a	n/a	1.87	n/a	
S11R000183		338-70-5	Oxalate	ug/mL	96.7	<0.0231	<2.31	n/a	n/a	n/a	n/a	2.31	n/a	U
S11R000183		24959-67-9	Bromide	ug/mL	103	<0.0580	<5.80	n/a	n/a	n/a	n/a	5.80	n/a	U
S11R000183		14797-55-8	Nitrate	ug/mL	97.4	<0.0208	9.48	n/a	n/a	n/a	n/a	2.08	n/a	J
S11R000183		14265-44-2	Phosphate	ug/mL	98.2	<0.0167	1.08E+04	n/a	n/a	n/a	n/a	167	n/a	
S11R000183		7440-22-4	Silver	ug/mL	99.4	<5.00E-03	<1.25	n/a	n/a	n/a	n/a	1.25	n/a	U
S11R000183		7429-90-5	Aluminum	ug/mL	100	<0.0300	136	n/a	n/a	n/a	n/a	7.50	n/a	
S11R000183		7440-38-2	Arsenic	ug/mL	99.6	<0.0500	<12.5	n/a	n/a	n/a	n/a	12.5	n/a	U
S11R000183		7440-42-8	Boron	ug/mL	101	<0.0300	<7.50	n/a	n/a	n/a	n/a	7.50	n/a	U
S11R000183		7440-39-3	Barium	ug/mL	102	<3.00E-03	<0.750	n/a	n/a	n/a	n/a	0.750	n/a	U
S11R000183		7440-41-7	Beryllium	ug/mL	100	<1.00E-03	<0.250	n/a	n/a	n/a	n/a	0.250	n/a	U
S11R000183		7440-69-9	Bismuth	ug/mL	103	<0.100	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000183		7440-70-2	Calcium	ug/mL	99.7	<0.0500	<12.5	n/a	n/a	n/a	n/a	12.5	n/a	U
S11R000183		7440-43-9	Cadmium	ug/mL	103	<5.00E-03	<1.25	n/a	n/a	n/a	n/a	1.25	n/a	U
S11R000183		7440-45-1	Cerium	ug/mL	105	<0.0300	<7.50	n/a	n/a	n/a	n/a	7.50	n/a	U
S11R000183		7440-48-4	Cobalt	ug/mL	103	<0.0100	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000183		7440-47-3	Chromium	ug/mL	103	<5.00E-03	<1.25	n/a	n/a	n/a	n/a	1.25	n/a	U
S11R000183		7440-50-8	Copper	ug/mL	101	<5.00E-03	<1.25	n/a	n/a	n/a	n/a	1.25	n/a	U
S11R000183		7440-53-1	Europium	ug/mL	101	<5.00E-03	<1.25	n/a	n/a	n/a	n/a	1.25	n/a	U
S11R000183		7439-89-6	Iron	ug/mL	102	6.42E-03	<1.25	n/a	n/a	n/a	n/a	1.25	n/a	U
S11R000183		7440-09-7	Potassium	ug/mL	95.2	<0.500	<125	n/a	n/a	n/a	n/a	125	n/a	U
S11R000183		7439-91-0	Lanthanum	ug/mL	100	<3.00E-03	<0.750	n/a	n/a	n/a	n/a	0.750	n/a	U
S11R000183		7439-93-2	Lithium	ug/mL	102	<3.00E-03	<0.750	n/a	n/a	n/a	n/a	0.750	n/a	U
S11R000183		7439-95-4	Magnesium	ug/mL	102	<0.0500	<12.5	n/a	n/a	n/a	n/a	12.5	n/a	U

C-110 Heel Solids: Large-scale 45 °C Dissolution Test — Contact 5 Liquid - diluted [a] (2 sheets) **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000183		7439-96-5	Manganese	ug/mL	102	<3.00E-03	<0.750	n/a	n/a	n/a	n/a	0.750	n/a	U
S11R000183		7439-98-7	Molybdenum	ug/mL	100	<0.0200	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000183		7440-23-5	Sodium	ug/mL	100	<0.100	9.64E+03	n/a	n/a	n/a	n/a	25.0	n/a	
S11R000183		7440-00-8	Neodymium	ug/mL	101	<0.0100	<2.50	n/a	n/a	n/a	n/a	2.50	n/a	U
S11R000183		7440-02-0	Nickel	ug/mL	102	<0.0200	<5.00	n/a	n/a	n/a	n/a	5.00	n/a	U
S11R000183		7723-14-0	Phosphorus	ug/mL	101	<0.0500	3.72E+03	n/a	n/a	n/a	n/a	12.5	n/a	
S11R000183		7439-92-1	Lead	ug/mL	100	<0.0500	<12.5	n/a	n/a	n/a	n/a	12.5	n/a	U
S11R000183		7704-34-9	Sulfur	ug/mL	102	<0.100	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000183		7440-36-0	Antimony	ug/mL	98.7	<0.0500	<12.5	n/a	n/a	n/a	n/a	12.5	n/a	U
S11R000183		7782-49-2	Selenium	ug/mL	104	<0.100	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000183		7440-21-3	Silicon	ug/mL	93.3	<0.0300	10.7	n/a	n/a	n/a	n/a	7.50	n/a	J
S11R000183		7440-19-9	Samarium	ug/mL	103	<0.0500	<12.5	n/a	n/a	n/a	n/a	12.5	n/a	U
S11R000183		7440-24-6	Strontium	ug/mL	101	<3.00E-03	<0.750	n/a	n/a	n/a	n/a	0.750	n/a	U
S11R000183		7440-29-1	Thorium	ug/mL	102	<0.0500	<12.5	n/a	n/a	n/a	n/a	12.5	n/a	U
S11R000183		7440-32-6	Titanium	ug/mL	101	<5.00E-03	<1.25	n/a	n/a	n/a	n/a	1.25	n/a	U
S11R000183		7440-28-0	Thallium	ug/mL	104	<0.100	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000183		7440-61-1	Uranium	ug/mL	100	<0.100	<25.0	n/a	n/a	n/a	n/a	25.0	n/a	U
S11R000183		7440-62-2	Vanadium	ug/mL	103	<5.00E-03	<1.25	n/a	n/a	n/a	n/a	1.25	n/a	U
S11R000183		7440-65-5	Yttrium	ug/mL	102	<2.00E-03	<0.500	n/a	n/a	n/a	n/a	0.500	n/a	U
S11R000183		7440-66-6	Zinc	ug/mL	101	<5.00E-03	<1.25	n/a	n/a	n/a	n/a	1.25	n/a	U
S11R000183		7440-67-7	Zirconium	ug/mL	97.6	<5.00E-03	<1.25	n/a	n/a	n/a	n/a	1.25	n/a	U
S11R000183		TOC	Total organic carbon	ug/mL	99.2	<20.0	<20.0	n/a	n/a	n/a	n/a	20.0	n/a	U
S11R000183		TIC	Total inorganic carbon	ug/mL	92.2	<7.00	18.3	n/a	n/a	n/a	n/a	7.00	n/a	J
S11R000183		PH	pH	unitless	n/a	n/a	12.2	n/a	n/a	n/a	n/a	0.0100	n/a	

[a] 45 °C Contact 5 Liquid Sample	Wt	Vol at 40.3 °C	D_{Liq}
Test Liquid	25.020 g	24.102 mL	1.038 g/mL
H_2O	25.031 g	25.230 mL	0.992100 g/mL

C-110 Heel Solids: Large-scale H_2O Dissolution Tests — Combined Residual Solids [a] (9 sheets) **Group: 20111097** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000436	A	7440-22-4	Silver	ug/g	85.9	<5.00E-03	<17.0	<18.0	n/a	n/a	97.7	17.0	n/a	U
S11R000436	A	7429-90-5	Aluminum	ug/g	89.7	<0.0300	1.75E+05	1.75E+05	1.75E+05	3.14E-03	-765	102	n/a	
S11R000436	A	7440-38-2	Arsenic	ug/g	92.3	<0.0500	<204	<216	n/a	n/a	68.4	204	n/a	Ub
S11R000436	A	7440-42-8	Boron	ug/g	91.2	<0.0300	<102	<108	n/a	n/a	107	102	n/a	U
S11R000436	A	7440-39-3	Barium	ug/g	96.6	<3.00E-03	140	143	141	2.10	105	10.2	n/a	
S11R000436	A	7440-41-7	Beryllium	ug/g	101	<1.00E-03	<3.40	<3.59	n/a	n/a	106	3.40	n/a	U
S11R000436	A	7440-69-9	Bismuth	ug/g	91.1	<0.100	3.94E+04	4.04E+04	3.99E+04	2.63	288	340	n/a	b
S11R000436	A	7440-70-2	Calcium	ug/g	87.8	<0.0500	1.69E+03	1.76E+03	1.72E+03	3.68	113	170	n/a	J
S11R000436	A	7440-43-9	Cadmium	ug/g	93.7	<5.00E-03	<17.0	<18.0	n/a	n/a	107	17.0	n/a	U
S11R000436	A	7440-45-1	Cerium	ug/g	99.2	<0.0300	462	459	461	0.652	103	102	n/a	J
S11R000436	A	7440-48-4	Cobalt	ug/g	92.4	<0.0100	<34.0	<35.9	n/a	n/a	109	34.0	n/a	U
S11R000436	A	7440-47-3	Chromium	ug/g	93.4	<5.00E-03	9.88E+02	1.02E+03	1.00E+03	2.90	118	17.0	n/a	
S11R000436	A	7440-50-8	Copper	ug/g	97.5	<5.00E-03	122	121	122	0.560	103	17.0	n/a	J
S11R000436	A	7440-53-1	Europium	ug/g	94.6	<5.00E-03	<17.0	<18.0	n/a	n/a	98.9	17.0	n/a	U
S11R000436	A	7439-89-6	Iron	ug/g	94.0	0.0116	7.82E+04	8.31E+04	8.07E+04	6.05	267	17.0	n/a	
S11R000436	A	7439-91-0	Lanthanum	ug/g	96.1	<3.00E-03	<10.2	<10.8	n/a	n/a	104	10.2	n/a	U
S11R000436	A	7439-93-2	Lithium	ug/g	97.3	<3.00E-03	22.4	25.9	24.1	14.4	103	10.2	n/a	J
S11R000436	A	7439-95-4	Magnesium	ug/g	88.0	<0.0500	3.49E+03	3.65E+03	3.57E+03	4.35	121	170	n/a	
S11R000436	A	7439-96-5	Manganese	ug/g	92.2	<3.00E-03	304	331	318	8.33	109	10.2	n/a	
S11R000436	A	7439-98-7	Molybdenum	ug/g	93.4	<0.0200	<68.0	<71.8	n/a	n/a	108	68.0	n/a	U
S11R000436	A	7440-23-5	Sodium	ug/g	95.8	<0.100	5.25E+04	5.43E+04	5.34E+04	3.37	99.1	340	n/a	
S11R000436	A	7440-00-8	Neodymium	ug/g	98.4	<0.0100	64.6	66.4	65.5	2.70	102	34.0	n/a	J
S11R000436	A	7440-02-0	Nickel	ug/g	92.0	<0.0200	158	179	168	12.5	113	68.0	n/a	J
S11R000436	A	7723-14-0	Phosphorus	ug/g	94.1	<0.0500	4.69E+04	4.81E+04	4.75E+04	2.49	119	170	n/a	
S11R000436	A	7439-92-1	Lead	ug/g	91.8	<0.0500	3.99E+03	4.05E+03	4.02E+03	1.50	112	170	n/a	
S11R000436	A	7440-05-3	Palladium	ug/g	92.8	<0.100	<340	<359	n/a	n/a	121	340	n/a	U
S11R000436	A	7440-10-0	Praseodymium	ug/g	98.8	<0.0100	<34.0	<35.9	n/a	n/a	103	34.0	n/a	U
S11R000436	A	7440-16-6	Rhodium	ug/g	96.2	<0.0500	<170	<180	n/a	n/a	102	170	n/a	U
S11R000436	A	7440-18-8	Ruthenium	ug/g	91.0	<0.0300	<102	<108	n/a	n/a	93.9	102	n/a	U
S11R000436	A	7704-34-9	Sulfur	ug/g	92.4	<0.100	<340	<359	n/a	n/a	133	340	n/a	Ub
S11R000436	A	7440-36-0	Antimony	ug/g	91.2	<0.0500	<170	<180	n/a	n/a	84.8	170	n/a	U

C-110 Heel Solids: Large-scale H_2O Dissolution Tests — Combined Residual Solids [a] (9 sheets) **Group: 20111097** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000436	A	7782-49-2	Selenium	ug/g	95.7	<0.100	<340	<359	n/a	n/a	101	340	n/a	U
S11R000436	A	7440-21-3	Silicon	ug/g	74.4	<0.0300	1.34E+03	1.62E+03	1.48E+03	18.5	15.9	102	n/a	ab
S11R000436	A	7440-19-9	Samarium	ug/g	103	<0.0200	<68.0	<71.8	n/a	n/a	101	68.0	n/a	U
S11R000436	A	7440-24-6	Strontium	ug/g	96.0	<3.00E-03	9.85E+03	9.90E+03	9.87E+03	0.499	106	10.2	n/a	
S11R000436	A	13494-80-9	Tellurium	ug/g	92.1	<0.100	<340	<359	n/a	n/a	86.5	340	n/a	U
S11R000436	A	7440-29-1	Thorium	ug/g	94.4	<0.0500	<170	<180	n/a	n/a	99.6	170	n/a	U
S11R000436	A	7440-32-6	Titanium	ug/g	93.5	<5.00E-03	24.6	27.3	26.0	10.4	103	17.0	n/a	J
S11R000436	A	7440-28-0	Thallium	ug/g	94.8	<0.100	<340	<359	n/a	n/a	99.5	340	n/a	U
S11R000436	A	7440-61-1	Uranium	ug/g	100	<0.100	1.38E+03	1.40E+03	1.39E+03	1.54	96.9	340	n/a	J
S11R000436	A	7440-62-2	Vanadium	ug/g	94.8	<5.00E-03	<17.0	<18.0	n/a	n/a	109	17.0	n/a	U
S11R000436	A	7440-65-5	Yttrium	ug/g	92.1	<2.00E-03	<6.80	<7.18	n/a	n/a	101	6.80	n/a	U
S11R000436	A	7440-66-6	Zinc	ug/g	92.2	<5.00E-03	604	610	607	0.994	107	17.0	n/a	
S11R000436	A	7440-67-7	Zirconium	ug/g	92.3	<5.00E-03	<17.0	<18.0	n/a	n/a	2.46	17.0	n/a	Ub
S11R000433	F	7440-22-4	Silver	ug/g	100	<293	<293	<194	n/a	n/a	96.0	293	n/a	U
S11R000433	F	7429-90-5	Aluminum	ug/g	100	<1.76E+03	1.78E+05	2.29E+05	2.03E+05	25.3	101	1.76E+03	n/a	
S11R000433	F	7440-38-2	Arsenic	ug/g	98.3	<3.52E+03	<3.52E+03	<1.76E+03	n/a	n/a	102	3.52E+03	n/a	U
S11R000433	F	7440-42-8	Boron	ug/g	99.6	<1.76E+03	<1.76E+03	<3.70E+02	n/a	n/a	103	1.76E+03	n/a	U
S11R000433	F	7440-39-3	Barium	ug/g	99.5	<176	<176	176	n/a	n/a	101	176	n/a	U
S11R000433	F	7440-41-7	Beryllium	ug/g	97.6	<58.6	<58.6	<72.8	n/a	n/a	97.5	58.6	n/a	U
S11R000433	F	7440-69-9	Bismuth	ug/g	99.7	<5.86E+03	3.50E+04	4.62E+04	4.06E+04	27.7	103	5.86E+03	n/a	J
S11R000433	F	7440-70-2	Calcium	ug/g	101	<2.93E+03	<2.93E+03	3.07E+03	n/a	n/a	102	2.93E+03	n/a	U
S11R000433	F	7440-45-1	Cerium	ug/g	103	<1.76E+03	<1.76E+03	<1.32E+03	n/a	n/a	99.6	1.76E+03	n/a	U
S11R000433	F	7440-48-4	Cobalt	ug/g	99.9	<586	<586	<285	n/a	n/a	101	586	n/a	U
S11R000433	F	7440-47-3	Chromium	ug/g	101	<293	1.04E+03	1.11E+03	1.08E+03	6.45	101	293	n/a	J
S11R000433	F	7440-50-8	Copper	ug/g	99.4	<293	<293	202	n/a	n/a	102	293	n/a	U
S11R000433	F	7440-53-1	Europium	ug/g	97.2	<293	<293	<121	n/a	n/a	99.8	293	n/a	U
S11R000433	F	7439-89-6	Iron	ug/g	99.4	<293	7.24E+04	9.23E+04	8.23E+04	24.2	99.2	293	n/a	
S11R000433	F	7439-91-0	Lanthanum	ug/g	97.5	<176	<176	<212	n/a	n/a	97.9	176	n/a	U
S11R000433	F	7439-93-2	Lithium	ug/g	105	<176	<176	<255	n/a	n/a	101	176	n/a	U
S11R000433	F	7439-95-4	Magnesium	ug/g	101	<2.93E+03	<2.93E+03	4.41E+03	n/a	n/a	98.9	2.93E+03	n/a	U
S11R000433	F	7439-96-5	Manganese	ug/g	99.3	<176	275	368	322	29.1	101	176	n/a	J

C-110 Heel Solids: Large-scale H_2O Dissolution Tests — Combined Residual Solids [a] (9 sheets) **Group: 20111097** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000433	F	7439-98-7	Molybdenum	ug/g	98.9	<1.17E+03	<1.17E+03	<2.79E+02	n/a	n/a	100	1.17E+03	n/a	U
S11R000433	F	7440-23-5	Sodium	ug/g	105	<5.86E+03	5.94E+04	7.76E+04	6.85E+04	26.6	101	5.86E+03	n/a	
S11R000433	F	7440-00-8	Neodymium	ug/g	101	<586	<586	<540	n/a	n/a	98.1	586	n/a	U
S11R000433	F	7723-14-0	Phosphorus	ug/g	100	<2.93E+03	4.50E+04	5.85E+04	5.17E+04	26.0	101	2.93E+03	n/a	
S11R000433	F	7439-92-1	Lead	ug/g	104	<2.93E+03	4.59E+03	3.84E+03	4.21E+03	17.8	103	2.93E+03	n/a	J
S11R000433	F	7440-10-0	Praseodymium	ug/g	99.4	<586	<586	<825	n/a	n/a	99.1	586	n/a	U
S11R000433	F	7440-17-7	Rubidium	ug/g	93.6	<5.86E+04	<5.86E+04	<3.37E+04	n/a	n/a	85.8	5.86E+04	n/a	U
S11R000433	F	7440-16-6	Rhodium	ug/g	96.8	<2.93E+03	<2.93E+03	<1.79E+03	n/a	n/a	98.9	2.93E+03	n/a	U
S11R000433	F	7440-18-8	Ruthenium	ug/g	101	<1.76E+03	<1.76E+03	<1.02E+03	n/a	n/a	102	1.76E+03	n/a	U
S11R000433	F	7704-34-9	Sulfur	ug/g	101	<5.86E+03	<5.86E+03	<1.81E+03	n/a	n/a	102	5.86E+03	n/a	U
S11R000433	F	7440-36-0	Antimony	ug/g	98.0	<2.93E+03	<2.93E+03	1.50E+03	n/a	n/a	101	2.93E+03	n/a	U
S11R000433	F	7782-49-2	Selenium	ug/g	99.6	<5.86E+03	<5.86E+03	4.07E+03	n/a	n/a	103	5.86E+03	n/a	U
S11R000433	F	7440-21-3	Silicon	ug/g	92.6	<1.76E+03	1.43E+04	1.89E+04	1.66E+04	28.0	95.4	1.76E+03	n/a	J
S11R000433	F	7440-19-9	Samarium	ug/g	103	<1.17E+03	<1.17E+03	<7.94E+02	n/a	n/a	98.6	1.17E+03	n/a	U
S11R000433	F	7440-31-5	Tin	ug/g	103	<1.76E+03	<1.76E+03	<7.40E+02	n/a	n/a	106	1.76E+03	n/a	U
S11R000433	F	7440-24-6	Strontium	ug/g	99.0	<176	9.74E+03	1.24E+04	1.11E+04	23.8	99.4	176	n/a	
S11R000433	F	7440-25-7	Tantalum	ug/g	101	<2.93E+03	<2.93E+03	<1.26E+03	n/a	n/a	104	2.93E+03	n/a	U
S11R000433	F	13494-80-9	Tellurium	ug/g	100	<5.86E+03	<5.86E+03	<2.58E+03	n/a	n/a	103	5.86E+03	n/a	U
S11R000433	F	7440-29-1	Thorium	ug/g	104	<2.93E+03	<2.93E+03	<8.19E+02	n/a	n/a	104	2.93E+03	n/a	U
S11R000433	F	7440-32-6	Titanium	ug/g	99.0	<293	<293	75.6	n/a	n/a	98.8	293	n/a	U
S11R000433	F	7440-28-0	Thallium	ug/g	106	<5.86E+03	<5.86E+03	<2.50E+03	n/a	n/a	102	5.86E+03	n/a	U
S11R000433	F	7440-61-1	Uranium	ug/g	101	<5.86E+03	<5.86E+03	<3.18E+03	n/a	n/a	95.7	5.86E+03	n/a	U
S11R000433	F	7440-62-2	Vanadium	ug/g	100	<293	<293	<267	n/a	n/a	102	293	n/a	U
S11R000433	F	7440-65-5	Yttrium	ug/g	99.6	<117	<117	<66.7	n/a	n/a	101	117	n/a	U
S11R000433	F	7440-66-6	Zinc	ug/g	98.4	<293	480	775	627	47.0	101	293	n/a	J
S11R000433	F	7440-67-7	Zirconium	ug/g	98.5	<293	386	<352	n/a	n/a	98.7	293	n/a	J
S11R000434	W	16984-48-8	Fluoride	ug/g	95.2	<1.61E-03	1.50E+03	1.69E+03	1.59E+03	12.4	4.39	2.55	n/a	
S11R000434	W	666-14-8	Glycolate	ug/g	97.0	<9.37E-03	<14.8	<16.7	n/a	n/a	72.8	14.8	n/a	Ub
S11R000434	W	71-50-1	Acetate	ug/g	104	<6.04E-03	<9.56	<10.8	n/a	n/a	87.8	9.56	n/a	U
S11R000434	W	12311-97-6	Formate	ug/g	100	0.0584	<7.39	<8.34	n/a	n/a	89.2	7.39	n/a	U
S11R000434	W	16887-00-6	Chloride	ug/g	99.5	<9.98E-03	23.3	24.1	23.7	3.39	91.1	15.8	n/a	J

C-110 Heel Solids: Large-scale H_2O Dissolution Tests — Combined Residual Solids [a] (9 sheets) **Group: 20111097** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000434	W	14797-65-0	Nitrite	ug/g	97.9	0.0569	35.2	40.2	37.7	13.2	94.2	30.4	n/a	J
S11R000434	W	14808-79-8	Sulfate	ug/g	101	<0.0187	37.3	40.0	38.6	6.94	97.2	29.6	n/a	J
S11R000434	W	338-70-5	Oxalate	ug/g	98.1	<0.0231	<36.6	<41.2	n/a	n/a	100	36.6	n/a	U
S11R000434	W	24959-67-9	Bromide	ug/g	101	<0.0580	<91.8	<104	n/a	n/a	111	91.8	n/a	U
S11R000434	W	14797-55-8	Nitrate	ug/g	98.6	<0.0208	151	153	152	1.18	102	32.9	n/a	J
S11R000434	W	14265-44-2	Phosphate	ug/g	99.0	<0.0167	2.46E+04	2.79E+04	2.62E+04	12.5	-157	26.4	n/a	
S11R000678	Z	7440-22-4	Silver	ug/g	99.3	<298	<298	<292	n/a	n/a	56.4	298	n/a	Ub
S11R000678	Z	7429-90-5	Aluminum	ug/g	101	<1.79E+03	1.73E+05	1.74E+05	1.73E+05	0.426	99.4	1.79E+03	n/a	
S11R000678	Z	7440-38-2	Arsenic	ug/g	98.5	<3.58E+03	<3.58E+03	<3.50E+03	n/a	n/a	98.5	3.58E+03	n/a	U
S11R000678	Z	7440-42-8	Boron	ug/g	100	<1.79E+03	<1.79E+03	<1.75E+03	n/a	n/a	100	1.79E+03	n/a	U
S11R000678	Z	7440-39-3	Barium	ug/g	101	<179	<179	<175	n/a	n/a	99.0	179	n/a	U
S11R000678	Z	7440-41-7	Beryllium	ug/g	99.2	<59.6	<59.6	<58.4	n/a	n/a	95.8	59.6	n/a	U
S11R000678	Z	7440-69-9	Bismuth	ug/g	102	<5.96E+03	3.91E+04	3.77E+04	3.84E+04	3.58	102	5.96E+03	n/a	J
S11R000678	Z	7440-70-2	Calcium	ug/g	99.7	<2.98E+03	<2.98E+03	<2.92E+03	n/a	n/a	97.0	2.98E+03	n/a	U
S11R000678	Z	7440-43-9	Cadmium	ug/g	102	<298	<298	<292	n/a	n/a	98.8	298	n/a	U
S11R000678	Z	7440-45-1	Cerium	ug/g	1.0430E+02	<1.79E+03	<1.79E+03	<1.75E+03	n/a	n/a	101	1.79E+03	n/a	U
S11R000678	Z	7440-48-4	Cobalt	ug/g	102	<596	<596	<584	n/a	n/a	99.6	596	n/a	U
S11R000678	Z	7440-47-3	Chromium	ug/g	102	<298	7.98E+02	1.07E+03	9.33E+02	29.0	100	298	n/a	J
S11R000678	Z	7440-50-8	Copper	ug/g	100	<298	<298	<292	n/a	n/a	99.6	298	n/a	U
S11R000678	Z	7440-53-1	Europium	ug/g	9.7723E+01	<298	<298	<292	n/a	n/a	97.1	298	n/a	U
S11R000678	Z	7439-89-6	Iron	ug/g	102	<298	7.42E+04	7.35E+04	7.39E+04	0.953	98.4	298	n/a	
S11R000678	Z	7439-91-0	Lanthanum	ug/g	99.5	194	<179	<175	n/a	n/a	96.8	179	n/a	U
S11R000678	Z	7439-93-2	Lithium	ug/g	103	<179	<179	<175	n/a	n/a	97.1	179	n/a	U
S11R000678	Z	7439-95-4	Magnesium	ug/g	102	<2.98E+03	<2.98E+03	<2.92E+03	n/a	n/a	97.0	2.98E+03	n/a	U
S11R000678	Z	7439-96-5	Manganese	ug/g	101	<179	323	325	324	0.379	99.9	179	n/a	J
S11R000678	Z	7439-98-7	Molybdenum	ug/g	99.9	<1.19E+03	<1.19E+03	<1.17E+03	n/a	n/a	98.1	1.19E+03	n/a	U
S11R000678	Z	7440-23-5	Sodium	ug/g	104	<5.96E+03	5.38E+04	5.58E+04	5.48E+04	3.63	98.5	5.96E+03	n/a	J
S11R000678	Z	7440-00-8	Neodymium	ug/g	1.0008E+02	<596	<596	<584	n/a	n/a	97.0	596	n/a	U
S11R000678	Z	7440-02-0	Nickel	ug/g	101	<1.19E+03	<1.19E+03	<1.17E+03	n/a	n/a	98.8	1.19E+03	n/a	U
S11R000678	Z	7440-30-1	Niobium	ug/g	9.9471E+01	<1.79E+03	<1.79E+03	<1.75E+03	n/a	n/a	98.5	1.79E+03	n/a	U
S11R000678	Z	7723-14-0	Phosphorus	ug/g	101	<2.98E+03	3.98E+04	4.18E+04	4.08E+04	4.86	95.8	2.98E+03	n/a	

C-110 Heel Solids: Large-scale H_2O Dissolution Tests — Combined Residual Solids [a] (9 sheets) **Group: 20111097** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000678	Z	7439-92-1	Lead	ug/g	104	<2.98E+03	<2.98E+03	3.51E+03	n/a	n/a	102	2.98E+03	n/a	U
S11R000678	Z	7440-05-3	Palladium	ug/g	9.8380E+01	<5.96E+03	<5.96E+03	<5.84E+03	n/a	n/a	98.7	5.96E+03	n/a	U
S11R000678	Z	7440-10-0	Praseodymium	ug/g	9.8967E+01	<596	<596	<584	n/a	n/a	96.3	596	n/a	U
S11R000678	Z	7440-17-7	Rubidium	ug/g	9.3181E+01	<5.96E+04	<5.96E+04	<5.84E+04	n/a	n/a	95.5	5.96E+04	n/a	U
S11R000678	Z	7440-16-6	Rhodium	ug/g	9.8934E+01	<2.98E+03	<2.98E+03	<2.92E+03	n/a	n/a	98.2	2.98E+03	n/a	U
S11R000678	Z	7440-18-8	Ruthenium	ug/g	9.9348E+01	<1.79E+03	<1.79E+03	<1.75E+03	n/a	n/a	97.9	1.79E+03	n/a	U
S11R000678	Z	7704-34-9	Sulfur	ug/g	103	<5.96E+03	<5.96E+03	<5.84E+03	n/a	n/a	98.6	5.96E+03	n/a	U
S11R000678	Z	7440-36-0	Antimony	ug/g	98.9	<2.98E+03	<2.98E+03	<2.92E+03	n/a	n/a	99.0	2.98E+03	n/a	U
S11R000678	Z	7782-49-2	Selenium	ug/g	104	<5.96E+03	<5.96E+03	<5.84E+03	n/a	n/a	101	5.96E+03	n/a	U
S11R000678	Z	7440-21-3	Silicon	ug/g	92.0	<1.79E+03	1.33E+04	1.39E+04	1.36E+04	4.36	91.5	1.79E+03	n/a	J
S11R000678	Z	7440-19-9	Samarium	ug/g	1.0350E+02	<1.19E+03	<1.19E+03	<1.17E+03	n/a	n/a	100	1.19E+03	n/a	U
S11R000678	Z	7440-31-5	Tin	ug/g	1.0095E+02	<1.79E+03	<1.79E+03	<1.75E+03	n/a	n/a	101	1.79E+03	n/a	U
S11R000678	Z	7440-24-6	Strontium	ug/g	101	<179	8.63E+03	9.22E+03	8.92E+03	6.62	97.9	179	n/a	
S11R000678	Z	7440-25-7	Tantalum	ug/g	9.4928E+01	<2.98E+03	<2.98E+03	<2.92E+03	n/a	n/a	96.7	2.98E+03	n/a	U
S11R000678	Z	13494-80-9	Tellurium	ug/g	9.9059E+01	<5.96E+03	<5.96E+03	<5.84E+03	n/a	n/a	96.8	5.96E+03	n/a	U
S11R000678	Z	7440-29-1	Thorium	ug/g	1.0040E+02	<2.98E+03	<2.98E+03	<2.92E+03	n/a	n/a	99.6	2.98E+03	n/a	U
S11R000678	Z	7440-32-6	Titanium	ug/g	101	<298	<298	<292	n/a	n/a	97.2	298	n/a	U
S11R000678	Z	7440-28-0	Thallium	ug/g	1.0733E+02	<5.96E+03	<5.96E+03	<5.84E+03	n/a	n/a	99.1	5.96E+03	n/a	U
S11R000678	Z	7440-61-1	Uranium	ug/g	1.0144E+02	<5.96E+03	<5.96E+03	<5.84E+03	n/a	n/a	98.8	5.96E+03	n/a	U
S11R000678	Z	7440-62-2	Vanadium	ug/g	102	<298	<298	<292	n/a	n/a	101	298	n/a	U
S11R000678	Z	7440-33-7	Tungsten	ug/g	9.6428E+01	<1.19E+04	<1.19E+04	<1.17E+04	n/a	n/a	98.5	1.19E+04	n/a	U
S11R000678	Z	7440-65-5	Yttrium	ug/g	9.9205E+01	<119	<119	<117	n/a	n/a	98.2	119	n/a	U
S11R000678	Z	7440-66-6	Zinc	ug/g	99.5	<298	589	604	597	2.62	98.6	298	n/a	J

C-110 Heel Solids: Large-scale H_2O Dissolution Tests — Combined Residual Solids [a] (9 sheets) **Group: 20111097** **DSR: 05-Sep-2013**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000435	A	14133-76-7	Technetium-99	ug/g	112	<6.00E-05	0.400	0.408	0.404	2.02	47.7	2.33E-03	n/a	
S11R000433	F	CM-243/244	Curium-243/244	uCi/g	n/a	<3.66E-05	<2.99E-05	<3.34E-05	n/a	n/a	n/a	2.99E-05	n/a	U
S11R000433	F	14596-10-2	Americium-241	uCi/g	94.5	1.10E-04	0.0286	0.0262	0.0274	8.74	n/a	2.36E-05	2.54	
S11R000433	F	15510-73-3	Curium-242	uCi/g	n/a	<1.90E-05	<1.88E-05	<1.80E-05	n/a	n/a	n/a	1.88E-05	n/a	U
S11R000433	F	13966-02-4	Beryllium-7	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13966-32-0	Sodium-22	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	16759-28-7	Sodium-24	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14999-04-3	Aluminum-28	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14158-34-0	Chlorine-38	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13966-00-2	Potassium-40	uCi/g	n/a	<2.65	<2.66	<2.75	n/a	n/a	n/a	2.66	n/a	U
S11R000433	F	14163-25-8	Argon-41	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13967-63-0	Scandium-46	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14392-02-0	Chromium-51	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	MN-54	Manganese-54	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14093-03-9	Cobalt-56	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14681-52-8	Manganese-56	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13981-50-5	Cobalt-57	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13981-38-9	Cobalt-58	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14596-12-4	Iron-59	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	10198-40-0	Cobalt-60	uCi/g	100	<0.0898	<0.0996	<0.0993	n/a	n/a	n/a	0.0996	n/a	U
S11R000433	F	13981-25-4	Copper-64	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13982-39-3	Zinc-65	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14391-73-2	Copper-66	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14265-71-5	Selenium-75	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	15758-45-9	Selenium-79	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13983-27-2	Krypton-85	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13967-73-2	Strontium-85	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13982-36-0	Yttrium-88	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14234-24-3	Yttrium-91	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14681-63-1	Niobium-94	uCi/g	n/a	<0.0796	<0.0572	<0.0687	n/a	n/a	n/a	0.0572	n/a	U

C-110 Heel Solids: Large-scale H_2O Dissolution Tests — Combined Residual Solids [a] (9 sheets) **Group: 20111097** **DSR: 05-Sep-2013**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000433	F	Zr/Nb-95	Zirconium/Niobium-95	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13968-53-1	Ruthenium-103	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	RU/RH-106	Ruthenium/Rhodium-106	uCi/g	n/a	<0.670	<1.04	<1.04	n/a	n/a	n/a	1.04	n/a	U
S11R000433	F	14391-65-2	Silver-108	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14109-32-1	Cadmium-109	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	AG-110M	Silver-110	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13966-06-8	Tin-113	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14304-80-4	Tellurium-123	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14683-10-4	Antimony-124	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14234-35-6	Antimony-125	uCi/g	n/a	<0.163	<0.302	<0.244	n/a	n/a	n/a	0.302	n/a	U
S11R000433	F	14390-73-9	Tellurium-125	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	15756-32-8	Antimony-126	uCi/g	n/a	<0.0734	<0.0921	<0.0909	n/a	n/a	n/a	0.0921	n/a	U
S11R000433	F	15832-50-5	Tin-126	uCi/g	n/a	<0.0746	<0.167	<0.172	n/a	n/a	n/a	0.167	n/a	U
S11R000433	F	15046-84-1	Iodine-129	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	24267-56-9	Iodine-131	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14683-11-5	Xenon-131	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13981-41-4	Barium-133	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13967-70-9	Cesium-134	uCi/g	n/a	<0.448	<0.615	<0.632	n/a	n/a	n/a	0.615	n/a	U
S11R000433	F	14234-29-8	Cesium-136	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	10045-97-3	Cesium-137	uCi/g	101	<0.0848	6.54	6.66	6.60	1.80	n/a	0.120	1.15	
S11R000433	F	15758-29-9	Cesium-138	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13982-30-4	Cerium-139	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14798-08-4	Barium-140	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13981-28-7	Lanthanum-140	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13967-74-3	Cerium-141	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14762-78-8	Cerium-144	uCi/g	n/a	<0.408	<0.724	<0.796	n/a	n/a	n/a	0.724	n/a	U
S11R000433	F	CE/PR-144	Cerium/Praseodymium-144	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14683-23-9	Europium-152	uCi/g	n/a	<0.226	<0.297	<0.321	n/a	n/a	n/a	0.297	n/a	U
S11R000433	F	15585-10-1	Europium-154	uCi/g	n/a	<0.235	<0.256	<0.231	n/a	n/a	n/a	0.256	n/a	U
S11R000433	F	14391-16-3	Europium-155	uCi/g	n/a	<0.193	<0.341	<0.336	n/a	n/a	n/a	0.341	n/a	U

C-110 Heel Solids: Large-scale H_2O Dissolution Tests — Combined Residual Solids [a] (9 sheets) **Group: 20111097** **DSR: 05-Sep-2013**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000433	F	13982-00-8	Tantalum-182	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	10043-49-9	Gold-198	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13982-78-0	Mercury-203	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13982-38-2	Bismuth-207	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14913-50-9	Thallium-208	uCi/g	n/a	0.427	<0.0885	<0.109	n/a	n/a	n/a	0.0885	n/a	U
S11R000433	F	14255-04-0	Lead-210	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14913-49-6	Bismuth-212	uCi/g	n/a	<0.977	<1.33	<1.30	n/a	n/a	n/a	1.33	n/a	U
S11R000433	F	15092-94-1	Lead-212	uCi/g	n/a	<0.126	<0.166	<0.214	n/a	n/a	n/a	0.166	n/a	U
S11R000433	F	14733-03-0	Bismuth-214	uCi/g	n/a	<0.198	<0.232	<0.232	n/a	n/a	n/a	0.232	n/a	U
S11R000433	F	15067-28-4	Lead-214	uCi/g	n/a	<0.178	<0.199	<0.258	n/a	n/a	n/a	0.199	n/a	U
S11R000433	F	13233-32-4	Radium-224	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13982-63-3	Radium-226	uCi/g	n/a	<1.25	<1.68	<1.73	n/a	n/a	n/a	1.68	n/a	U
S11R000433	F	14331-83-0	Actinium-228	uCi/g	n/a	<0.347	<0.449	<0.458	n/a	n/a	n/a	0.449	n/a	U
S11R000433	F	14274-82-9	Thorium-228	uCi/g	n/a	<29.3	<56.6	<60.5	n/a	n/a	n/a	56.6	n/a	U
S11R000433	F	15594-54-4	Thorium-229	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14158-29-3	Uranium-232	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13981-14-1	Protactinium-233	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	U/Th-233	Uranium/Thorium-233	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	15100-28-4	Protactinium-234	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	15065-10-8	Thorium-234	uCi/g	n/a	<0.970	<24.2	<25.4	n/a	n/a	n/a	24.2	n/a	U
S11R000433	F	15117-96-1	Uranium-235	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13994-20-2	Neptunium-237	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14269-75-1	Uranium-237	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	15766-25-3	Neptunium-238	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	13968-59-7	Neptunium-239	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	15117-48-3	Plutonium-239	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U
S11R000433	F	14596-10-2	Americium-241	uCi/g	n/a	<0.103	<0.253	<0.236	n/a	n/a	n/a	0.253	n/a	U
S11R000433	F	14993-75-0	Americium-243	uCi/g	n/a	<5.85E+05	<5.85E+05	<6.06E+05	n/a	n/a	n/a	5.85E+05	n/a	U

C-110 Heel Solids: Large-scale H_2O Dissolution Tests — Combined Residual Solids [a] (9 sheets) **Group: 20111097** **DSR: 05-Sep-2013**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000433	F	13968-55-3	Uranium-233	ug/g	101	<0.234	<0.234	<0.243	n/a	n/a	86.0	0.234	n/a	U
S11R000433	F	13966-29-5	Uranium-234	ug/g	n/a	<5.86E-03	0.0648	0.0655	0.0652	1.21	n/a	5.86E-03	n/a	
S11R000433	F	15117-96-1	Uranium-235	ug/g	105	<0.0117	8.86	8.47	8.67	4.50	87.5	0.0117	n/a	
S11R000433	F	13982-70-2	Uranium-236	ug/g	n/a	<4.69E-03	0.0662	0.0655	0.0659	0.935	n/a	4.69E-03	n/a	
S11R000433	F	13994-20-2	Neptunium-237	ug/g	104	<0.117	0.322	0.354	0.338	9.32	86.0	0.117	n/a	J
S11R000433	F	U-238	Uranium-238	ug/g	104	<0.586	1.28E+03	1.22E+03	1.25E+03	4.55	87.1	0.586	n/a	
S11R000433	F	PU-239/240	Plutonium-239/240	uCi/g	103	1.62E-04	0.781	0.751	0.766	3.96	n/a	4.87E-05	0.53	
S11R000433	F	13981-16-3	Plutonium-238	uCi/g	n/a	<7.28E-05	4.66E-03	4.58E-03	4.62E-03	1.80	n/a	4.37E-05	6.88	
S11R000433	F	SR-89/90	Strontium-89/90	uCi/g	93.9	<1.62E-04	572	554	563	3.14	n/a	0.0938	0.665	

[a] The sample for which the results reported in the data summary report apply contained 16.13 wt% H_2O when submitted for analysis.

C-110 Heel Solids: Large-scale H_2O Dissolution Tests — Combined Residual Solids [a] **Group: 20100764** **DSR: 05-Nov-2012**

Sample Number	A	CAS Number	Analyte	Units	Std %-Rec	Blank	Result	Duplicate	Average	RPD	Spk %-Rec	Det Limit	Count %-Error	Qual Flag
S11R000161		TOC	Total organic carbon	ug/g	96.8	<20.0	541	597	569	9.84	99.5	162	n/a	J
S11R000161		TIC	Total inorganic carbon	ug/g	98.0	<7.00	853	979	916	13.8	93.2	56.5	n/a	
S11R000161		15046-84-1	Iodine-129	uCi/g	124	<5.71E-05	<3.07E-05	<4.27E-05	n/a	n/a	n/a	3.07E-05	n/a	Ua
S11R000161		7553-56-2C	Iodine-C	%	n/a	52.5	72.5	56.1	n/a	n/a	n/a	1.00	n/a	

[a] The sample for which the results reported in the data summary report apply contained 16.13 wt% H_2O when submitted for analysis.

ATTACHMENT B

PARTICLE SIZE DISTRIBUTION ANALYSIS

ATTACHMENT B — Particle Size Distribution Analysis

1.0 INTRODUCTION

Measurement of the particle size distribution (PSD) in the solids remaining after completion of large-scale dissolution testing on a composite sample of tank 241-C-110 (C-110) heel solids was specified in a client-approved test plan (LAB-PLN-10-00011, *Test Plan for Tank 241-C-110 Heel Solids Characterization and Dissolution Testing*). The measurement was made in two steps. First, the residual solids from the large-scale dissolution tests were separated into >710-µm and <710-µm fractions by wet sieving. A subsample of the <710-µm solids (sample S11R000163) was collected for PSD measurement using laser light scattering. The light-scattering-based PSD measurements and results are the subject of this attachment.

2.0 SAMPLE

All measurements described in this attachment were made on portions of the <710-µm sieve size fraction of the solids remaining after completion of large-scale dissolution tests on a composite prepared from C-110 heel solids samples. The parent sample for all analytical specimens was S11R000163. The multiple sampling and measurement steps leading to the parent sample are described in detail in the main body of this report.

3.0 PARTICLE SIZE DISTRIBUTION ANALYSIS

3.1 INSTRUMENTATION

PSD measurements were performed using the Horiba®[8] LA-910 Laser Scattering Particle Size Distribution Analyzer in hood 2 in room 1F of the 222-S Laboratory (222-S). The LA-910 is an ensemble type, light-scattering-based PSD analyzer; it is not a sensing-zone or image-analysis type of instrument where measurements or observations of individual particles are made. The measurement actually performed defines the light-scattering pattern created when a large number of sample particles scatter the light in the focused beam(s) of the analytical probe(s). Analyzer software, using iterative algorithms based on Mie Scattering Theory, creates a virtual population of optically isotropic and homogeneous, spherical particles with a distribution of diameters that would, given the same experimental parameters, generate a similar light-scattering pattern. The frequencies of occurrence of particles of various sizes in these populations are weighted according to the volumes of the virtual spherical particles. The reported particle sizes are the diameters of these virtual spherical particles, i.e., equivalent spherical diameters.

[8] Horiba is a registered trademark of Horiba, Ltd. Corporation Japan, Kyoto, Japan.

The LA-910 analyzer uses dual light sources: a helium-neon laser (λ = 632.8 nm) and a 40-W, tungsten-halogen, blue-filtered lamp (λ = 450 nm). The dual light sources and physical design of the detector array allow measurement of PSDs for samples with particles ranging from 0.02 μm to 1020 μm in equivalent spherical diameter.

The LA-910 analyzer was operated in flow cell mode for the PSD measurements. In this mode, a dilute slurry of sample solids is continuously circulated through the analyzer-measuring loop during PSD measurements. Key components in the loop include the following.

Sample Tank: Sample solids and suspension liquid are introduced into a stainless-steel sample tank (maximum volume ≈280 mL). Specimen suspensions are generally limited to ≈210 mL to minimize both contamination within the sample tank compartment and the volume of analytical waste generated. Suspensions enter the measurement loop from the bottom of the tank.

Stirrer: A three-bladed, impeller-type, mechanical stirrer (≈1-in. diameter) in the sample tank assists in suspending the sample solids in the suspension liquid and is critical in introducing a uniform sample suspension into the flow loop. The stirrer speed is adjustable in seven step settings, S1 through S7. In distilled water, a stirrer speed setting of S6 represents a stirring speed of ≈1000 rpm.

A maximum stirrer speed setting of S3 is used when the total sample volumes are ≈210 ml of aqueous slurry. A greater speed risks drawing the bottom of the liquid vortex created down to the stirrer blades resulting in entrainment of air into the slurry and splattering in the sample tank compartment. Tests have shown that the stirrer speed at the S2 setting is the minimum required to effectively sample spherical particles with density ≈2.5 g/mL and with diameters up to 350 μm in aqueous suspensions.

Ultrasonic Generator: The sample tank is also the chamber of a low-power (40 W, 39 kHz), standing-wave-type ultrasonic bath. The ultrasonic bath is provided to facilitate dispersion of sample particulates in the suspension liquid. The power of the bath is fixed. The operator may select whether or not to activate the ultrasonic generator. If activated, the operator may adjust the time the bath operates before the light-scattering measurement begins and the length of any delay period between termination of the ultrasonic treatment and initiation of the light-scattering measurement. The operator may also elect to continue ultrasonic treatment during the PSD measurement. For brevity, ultrasonic treatment of samples hereafter is referred to as "sonication."

Circulation Pump: Located immediately downstream from the sample tank, a variable-occlusion peristaltic pump circulates the sample slurry through the analyzer measurement loop. The pump speed is adjustable in seven step settings, P1 through P7. Pump speed settings of P3 and P5 were used in these measurements. The discharge volume at the P5 setting is ≈10.6 mL/s using Tygon®[9] tubing with an internal diameter of 4.8 mm.

[9] Tygon is a registered trademark of Norton Company, Worcester, Massachusetts.

The occlusion of the Masterflex®[10] peristaltic pump head is adjusted so that the pump tubing is not totally compressed (occluded) at any point of the rotor rotation. Performance tests using this occlusion setting and various pump and stirrer speed combinations have shown that a stirrer speed setting of P2 combined with a pump speed setting of S4 is the minimum combination required to satisfactorily reproduce the PSD of a certified standard containing soda-lime glass microspheres (density of 2.4–2.5 g/mL) with diameters ranging from 50-350 µm—Whitehouse Scientific[11] standard PS223.

Measurement Cell: The flow cell is located immediately downstream from the circulation pump. The two optical windows of the cell are Tempax®[12] glass (with a nonreflective coating on the exterior surfaces). The dimensions of the interior specimen cavity of the flow cell are 70 mm × 45 mm × 3.5 mm (H × W × D). The analytical light probes traverse paths through the depth of the cell perpendicular to the cell windows. The sample suspension enters at the bottom of the measurement cell, exits at the top of the cell, and returns to the sample tank.

3.2 ANALYSIS SPECIMENS

Each PSD specimen analyzed was ≈210 mL of a dilute slurry of the <710-µm C-110 residual solids in reagent water. The optimum volumetric concentration of solids in a specimen is approximately proportional to particle size: about 0.002% for particles with diameters of 0.5 µm and about 1% for particles with diameters of 500 µm (ISO-13320-1, *Particle Size Analysis – Laser Diffraction Methods – Part 1: General Principles*). In practice, an attempt was made to add an amount of sample solids that resulted in obscuration of the analyzer light beams by at least 5% but not more than 30%.

Subsampling of the <710-µm residual solids was performed using a technique recommended in ISO-13320-1. When the PSD sample (S11R000163) was collected on June 20, 2011, 1-2 mL of reagent water was added to mitigate any possibility of drying of the test solids prior to PSD measurements. On May 1, 2012, 2-3 mL of clear supernatant liquid was pipetted from the sample vial. The sample vial was also left uncapped for several hours prior to initiation of the PSD measurements on the afternoon of May 2 so additional water could evaporate from the sample. The sample solids were then gently but thoroughly mixed in the vial by stirring with a microspatula. As noted in ISO-13320-1, the ideal consistency of the samples, which minimizes segregation errors, is one like "honey or toothpaste." The final consistency of the <710-µm C-110 residual solids sample was within the low end of this viscosity range.

[10] Masterflex is a registered trademark of the Cole-Parmer Instrument Company, Vernon Hills, Illinois.
[11] Whitehouse Scientific, Waverton, Chester, England.
[12] Tempax is a registered trademark of Schott Glaswerkes, Mainz, Germany.

At the beginning of each of the triplicate PSD measurements, a 210-mL charge of reagent water was added to the analyzer sample tank, and stirring and pumping were initiated. Immediately prior to each PSD measurement, the contents of the sample vial were remixed by stirring with a small spatula. A small portion of the sample paste was then transferred to the water in the sample tank of the PSD analyzer using the spatula.

3.3 MEASUREMENTS

3.3.1 Procedure

Particle size distribution measurements were made on three specimens (primary, duplicate, and triplicate portions) of the <710-µm C-110 residual solids. The PSD measurement on each specimen was actually a set of three sequential PSD runs.

The sequence for completing a set of three PSD runs for a single specimen was as follows:

1. Approximately 210 mL of reagent water was added to the analyzer sample tank.
2. The pump speed was set to P5, the stirrer speed to S3, and the water charge was sonicated for 2 min. (This treatment helps to degas the liquid and ensures the measurement loop is free from particulate contamination and bubbles.)
3. A blank measurement was completed.
4. The pump speed was set to P3 and the stirrer speed was set to S1.
5. Portion(s) of the sample were transferred to the sample tank until transmission of light through the measurement cell was reduced by 5-30% (i.e., %-transmission values were between 70% and 95%).
6. Run 1 analyzer settings were established, and the Run 1 measurement sequence was started.
7. When Run 1 was complete and the presence of a saved data file was verified, Run 2 analyzer settings were established, and the Run 2 measurement sequence was started.
8. When Run 2 was complete and the presence of a saved data file was verified, Run 3 analyzer settings were established, and the Run 3 measurement sequence was started.
9. When Run 3 was complete, the presence of a saved data file was verified.
10. The specimen suspension was drained from the analyzer sample loop.
11. The analyzer sample loop was flushed with reagent water until the light-scattering pattern returned to a particulate-free profile.

The analyzer settings and sequence times that were used in each PSD run are presented in Table B-1.

Table B-1. Particle Size Distribution Analysis Run Settings.

	PSD Run			
	Load-In[a]	**1**	**2**	**3**
Specimen Circulation	—	—		—
Pump (circulation) speed setting[b]	P3	P5	P5	P5
Stirrer (agitation) speed setting[b]	S1	S3	S3	S3
Premeasurement	—	—	—	—
Work time (s)	As needed	6	120	120
Ultrasonics ON[c]	No	No	No	Yes
Premeasurement wait (s)[d]	N/A	0	0	6[d]
Measurement	—	—	—	—
Measure cycles (laser/lamp)[e]	N/A	36/36	36/36	36/36
Sonication during measure	N/A	No	No	No

[a] Settings established while specimen solids were being transferred to the sample tank of the PSD analyzer.

[b] Speed settings for the peristaltic pump (P) used to circulate specimen slurry through the analyzer flow loop and the impeller type stirrer (S) used to maintain homogeneity of the specimen slurry. Selectable pump speeds range from 1-7; selectable stirrer speeds range from 0-7.

[c] 'Ultrasonics' or 'sonication' refers to treatment of specimen suspension in a low-power (40 W) standing-wave-type ultrasonic bath incorporated in the analyzer flow loop.

[d] When the specimen slurry is sonicated before but not during measurement, a short delay is commonly inserted between termination of the sonication and initiation of the light-scattering measurement.

[e] A composite measurement combining 36 readouts of detectors while illuminating specimen with a He-Ne laser and 36 readouts while illuminating the sample with a blue-filtered lamp. Total measurement time is ≈60 s.

3.3.2 Specimen Load-In

The set of analyzer settings identified as "Load-In" were used while each PSD specimen was being transferred to the analyzer sample tank. The time required to transfer each of the triplicate specimens to the analyzer tank averaged 1 min.

3.3.3 Refractive Indexes

Conversion of the light-scattering patterns measured by the analyzer to PSDs requires input of a relative refractive index—

RRI = Refractive index of ***p***articles / Refractive index of liquid ***m***edium

The accuracy of this input becomes increasingly important as the diameters of the particles become smaller than ≈25 μm (ISO 13320-1).

The complex refractive index (N) of a substance is defined as

$$N = n - ki,$$

where the real part of the index, n, represents the degree of refraction of light in the material. The complex (or imaginary) part of the index, ki, is directly proportional to the degree of attenuation (primarily by absorption) of the probe light beam(s) by a material. Transparent

materials have small extinction coefficients (k); opaque and/or highly colored materials have larger coefficients.

In practice, it is assumed that a suspension liquid that strongly absorbs at the wavelength(s) of the analytical probes will not be used and that minor absorption by the liquid will be accounted for by blank measurements. The RRI value actually input is

$$\text{RRI} = (n_{\text{particles}}/n_{\text{medium}}) - (k_{\text{particles}})\ \text{i}.$$

As previously noted, the liquid medium used in these measurements was pure water. The real refractive index of water is 1.333 at $\lambda = 589.3$ nm.

Solid phase characterization of the <710-µm C-110 residual solids indicated that gibbsite was the major solid phase present. The real refractive index for gibbsite is 1.575.

Within the PSD analyzer software (except for specialized, well-defined applications), spherical particles of transparent materials are assigned an extinction coefficient of 0.00. Opaque and highly colored materials, particularly those of unknown composition, are generally assigned extinction coefficients ranging from 0.10 to 1.00. The <710-µm C-110 residual solids were (visually) a light tan to moderate reddish-brown in color. Microscopic examination also suggested that the surfaces of most of the solid particles were moderately to highly textured (surface texture can contribute to $k_{\text{particles}}$). In the absence of other sample specific input, an intermediate value of $k_{\text{particles}} = 0.10$ was assigned.

Based on the preceding discussion, the RRI value used in the PSD calculations for the <710-µm C-110 residual solids was

$$\text{RRI} = (1.575/1.333) - (0.1)\ \text{i} = 1.18 - 0.10\ \text{i}$$

If the client has input suggesting that an alternate RRI value would be more appropriate or desirable, PSDs can be recalculated using revised value(s) without reanalysis of physical specimens.

3.4 DEVIATIONS FROM TEST PLAN

No deviations from the PSD measurements specified in test plan LAB-PLN-10-00011 occurred.

4.0 PARTICLE SIZE DISTRIBUTION RESULTS

The results of the light-scattering-based PSD measurements on the <710-µm C-110 heel solids dissolution test residues are presented in this section. As previously noted, these measurements were made on three specimens taken from sample vial S11R000163. The data files for corresponding PSD runs on the primary, duplicate, and triplicate specimens were subsequently combined numerically to produce the ‘average’ data presented in this report.

The scattered-light patterns measured by the LA-910 analyzer are directly related to the volumes of small particles and the cross-sectional areas of larger particles. Default analyzer output is a PSD with frequencies of occurrence weighted according to the volumes of the scattering particles. (Recall that all numerical PSD data is based on a virtual population of optically homogenous spherical particles created by the analyzer software.) The analyzer software allows these primary distributions to be recalculated as area-, length-, or number-based distributions. These converted distributions are obtained by re-weighting the original, partially processed, volume-based data using the appropriate power of the particle diameters (d) and then renormalizing the resulting distributions. For example, number-based PSDs are obtained by applying weighting factors proportional to $1/d^3$ to the original volume-based PSD data. All numerical PSD results presented in this report are derived from the volume-based PSDs. The histograms and %-undersize curves derived from the recalculated number-based PSDs are presented in this attachment for comparison.

All the PSD data presented for the <710-µm C-110 residual solids are based on 'standard-form' distributions. Standard-form distributions are generated when the analyzer calculation algorithms proceed through 30 iterations as opposed to the 150 iterations used to calculate 'sharp-form' distributions. Standard-form distributions are broader with poor resolution of distinct features. However, unless specific knowledge of the PSD of a sample is available, a large number of calculation iterations can cause the results of the deconvolution/inversion function to diverge rather than converge to a reasonable result and create distinct features in the reported PSD when only small discontinuities in the light-scattering patterns were actually measured.

All the PSD data presented are calculated using a value of $1.18 - 0.10\,i$ for the RRI.

4.1 TRANSCRIPTS OF RAW DATA FILES

The default data sets generated by the Horiba® LA-910 analyzer consist of 80 logarithmically spaced particle-diameter bins that are populated with occurrence frequency data. Transcripts of these "raw" data files for the volume-based distributions for the <710-µm C-110 residual solids are provided on the following 3 pages. Each data sheet presents the averaged results for one of the three PSD runs on the primary, duplicate, and triplicate analysis specimens. The Diameter vs. Frequency % and Diameter vs. Undersize % data tables can be provided as Excel spreadsheets if requested. Data files for the recalculated number-based PSDs can also be provided on request.

The span values associated with the reported PSD median diameters are a measure of the breadth of the PSDs. The span is calculated as

(90%-undersize diameter – 10%-undersize diameter) / median diameter

SAMPLE MATERIAL:	241-C-110 Heel Solids: <710 µm Large-scale Dissolution Test Residues
SAMPLE #:	S11R000163 — Average of Run 1 on three specimens
MEASUREMENT ID:	05/02/2012 — (Runs 067, 070, and 073)
FILENAME:	S11R163R1Avg

INSTRUMENT:	Horiba LA-910
SUSPENSION LIQUID	Water
DISPERSANT:	None
DISPERSION METHOD:	Stirring and pumping in analyzer during load-in and Run 1 measurement
FLOW REGIME:	Flow Cell Measurement

RRI:	1.18 – 0.10i
DISTRIBUTION BASE:	Volume
DISTRIBUTION FORM:	Standard

STIR SET: 3 PUMP SET: 5 SONIC: OFF DELAY: 0 s SONIC DURING MEAS: NO

MEASURE (Laser/Lamp Cycles): 36/36 Σ WORK TIME: 2.3 min Σ SONIC: 0 min

MEAN (µm): 108.7 MEDIAN (µm): 12.1 MODE (µm): 321.7 S.P. Area (cm^2/cm^3): 22,601
σ (µm): 175.3 SPAN: 32.1

Diameter (µm)	Frequency (%)	Undersize (%)	Diameter (µm)	Frequency (%)	Undersize (%)	Diameter (µm)	Frequency (%)	Undersize (%)
0.020	0.00	0.00	0.766	1.24	8.60	29.91	1.47	61.63
0.023	0.00	0.00	0.877	1.64	10.23	34.25	1.36	63.00
0.026	0.00	0.00	1.005	2.07	12.30	39.23	1.25	64.25
0.030	0.00	0.00	1.151	2.21	14.51	44.94	1.13	65.38
0.034	0.00	0.00	1.318	2.21	16.72	51.47	1.01	66.39
0.039	0.00	0.00	1.510	1.72	18.44	58.95	0.92	67.31
0.044	0.00	0.00	1.729	1.54	19.98	67.52	0.86	68.17
0.051	0.00	0.00	1.981	1.72	21.70	77.34	0.85	69.02
0.058	0.00	0.00	2.269	2.04	23.74	88.58	0.89	69.91
0.067	0.00	0.00	2.599	1.95	25.69	101.5	0.94	70.85
0.076	0.00	0.00	2.976	1.98	27.67	116.2	1.06	71.91
0.087	0.00	0.00	3.409	1.98	29.65	133.1	1.20	73.11
0.100	0.00	0.00	3.905	1.95	31.60	152.5	1.34	74.45
0.115	0.00	0.00	4.472	1.97	33.57	174.6	1.53	75.98
0.131	0.00	0.00	5.122	2.10	35.67	200.0	1.72	77.70
0.150	0.00	0.00	5.867	2.19	37.85	229.1	1.96	79.65
0.172	0.00	0.00	6.720	2.30	40.15	262.4	2.30	81.95
0.197	0.00	0.00	7.697	2.37	42.52	300.5	2.69	84.65
0.226	0.06	0.06	8.816	2.37	44.88	344.2	2.90	87.54
0.259	0.20	0.26	10.10	2.28	47.17	394.2	2.70	90.25
0.296	0.37	0.63	11.56	2.16	49.33	451.6	2.66	92.90
0.339	0.65	1.28	13.25	2.05	51.37	517.2	2.34	95.24
0.389	1.03	2.31	15.17	1.94	53.31	592.4	1.96	97.20
0.445	1.31	3.62	17.38	1.84	55.15	678.5	1.61	98.80
0.510	1.35	4.97	19.90	1.76	56.91	777.1	0.87	99.67
0.584	1.24	6.21	22.80	1.67	58.58	890.1	0.33	100.00
0.669	1.14	7.35	26.11	1.58	60.16	1019.5	0.00	100.00

SAMPLE MATERIAL:	241-C-110 Heel Solids: <710 µm Large-scale Dissolution Test Residues
SAMPLE #:	S11R000163 — Average of Run 2 on three specimens
MEASUREMENT ID:	05/02/2012 — (Runs 068, 071, and 074)
FILENAME:	S11R163R2R2Avg

INSTRUMENT:	Horiba LA-910
SUSPENSION LIQUID	Water
DISPERSANT:	None
DISPERSION METHOD:	Stirring and pumping for 2.0 minutes before measurement
FLOW REGIME:	Flow Cell Measurement

RRI:	1.18 – 0.10i
DISTRIBUTION BASE:	Volume
DISTRIBUTION FORM:	Standard

STIR SET: 3 PUMP SET: 5 SONIC: OFF DELAY: 0 s SONIC DURING MEAS: NO

MEASURE (Laser/Lamp Cycles): 36/36 Σ WORK TIME: 5.4 min Σ SONIC: 0 min

MEAN (µm): 124.3 MEDIAN (µm): 15.9 MODE (µm): 367.1 S.P. Area (cm^2/cm^3): 20,996

σ (µm): 182.4 SPAN: 26.0

Diameter (µm)	Frequency (%)	Undersize (%)	Diameter (µm)	Frequency (%)	Undersize (%)	Diameter (µm)	Frequency (%)	Undersize (%)
0.020	0.00	0.00	0.766	1.15	8.00	29.91	1.39	57.24
0.023	0.00	0.00	0.877	1.52	9.53	34.25	1.29	58.53
0.026	0.00	0.00	1.005	1.92	11.44	39.23	1.19	59.71
0.030	0.00	0.00	1.151	2.04	13.48	44.94	1.08	60.80
0.034	0.00	0.00	1.318	2.04	15.52	51.47	0.99	61.78
0.039	0.00	0.00	1.510	1.58	17.10	58.95	0.92	62.70
0.044	0.00	0.00	1.729	1.41	18.51	67.52	0.89	63.59
0.051	0.00	0.00	1.981	1.58	20.08	77.34	0.87	64.46
0.058	0.00	0.00	2.269	1.88	21.96	88.58	0.93	65.39
0.067	0.00	0.00	2.599	1.79	23.75	101.5	1.00	66.39
0.076	0.00	0.00	2.976	1.82	25.56	116.2	1.10	67.49
0.087	0.00	0.00	3.409	1.82	27.38	133.1	1.21	68.70
0.100	0.00	0.00	3.905	1.79	29.17	152.5	1.33	70.03
0.115	0.00	0.00	4.472	1.81	30.98	174.6	1.51	71.53
0.131	0.00	0.00	5.122	1.93	32.91	200.0	1.82	73.36
0.150	0.00	0.00	5.867	2.03	34.94	229.1	2.26	75.62
0.172	0.00	0.00	6.720	2.14	37.07	262.4	2.82	78.44
0.197	0.00	0.00	7.697	2.21	39.29	300.5	3.35	81.79
0.226	0.08	0.08	8.816	2.21	41.50	344.2	3.50	85.29
0.259	0.18	0.26	10.10	2.14	43.63	394.2	3.51	88.81
0.296	0.34	0.59	11.56	2.02	45.66	451.6	3.32	92.12
0.339	0.60	1.19	13.25	1.92	47.57	517.2	2.81	94.93
0.389	0.95	2.14	15.17	1.82	49.39	592.4	2.22	97.15
0.445	1.22	3.37	17.38	1.73	51.12	678.5	1.57	98.71
0.510	1.26	4.63	19.90	1.66	52.78	777.1	0.90	99.61
0.584	1.16	5.78	22.80	1.58	54.36	890.1	0.39	100.00
0.669	1.07	6.85	26.11	1.49	55.85	1019.5	0.00	100.00

SAMPLE MATERIAL:	241-C-110 Heel Solids: <710 µm Large-scale Dissolution Test Residues
SAMPLE #:	S11R000163 — Average of Run 3 on three specimens
MEASUREMENT ID:	05/02/2012 — (Runs 069, 072, and 075)
FILENAME:	S11R163R3Avg

INSTRUMENT:	Horiba LA-910
SUSPENSION LIQUID	Water
DISPERSANT:	None
DISPERSION METHOD:	Stirring, pumping and sonication for 2.0 minutes before measurement
FLOW REGIME:	Flow Cell Measurement

RRI:	1.18 – 0.10i
DISTRIBUTION BASE:	Volume
DISTRIBUTION FORM:	Standard

STIR SET: 3 PUMP SET: 5 SONIC: ON DELAY: 6 s SONIC DURING MEAS: NO

MEASURE (Laser/Lamp Cycles): 36/36 Σ WORK TIME: 8.7 min Σ SONIC: 2.0 min

MEAN (µm): 8.26 MEDIAN (µm): 2.41 MODE (µm): 1.21 S.P. Area (cm^2/cm^3): 46,230

σ (µm): 29.08 SPAN: 4.84

Diameter (µm)	Frequency (%)	Undersize (%)	Diameter (µm)	Frequency (%)	Undersize (%)	Diameter (µm)	Frequency (%)	Undersize (%)
0.020	0.00	0.00	0.766	2.55	18.51	29.91	0.34	97.52
0.023	0.00	0.00	0.877	3.36	21.87	34.25	0.19	97.72
0.026	0.00	0.00	1.005	4.13	26.00	39.23	0.12	97.83
0.030	0.00	0.00	1.151	4.36	30.36	44.94	0.09	97.92
0.034	0.00	0.00	1.318	4.37	34.73	51.47	0.07	97.98
0.039	0.00	0.00	1.510	3.43	38.16	58.95	0.05	98.03
0.044	0.00	0.00	1.729	3.05	41.21	67.52	0.04	98.07
0.051	0.00	0.00	1.981	3.36	44.57	77.34	0.04	98.11
0.058	0.00	0.00	2.269	3.86	48.43	88.58	0.03	98.14
0.067	0.00	0.00	2.599	3.62	52.04	101.5	0.04	98.18
0.076	0.00	0.00	2.976	3.57	55.61	116.2	0.05	98.23
0.087	0.00	0.00	3.409	3.47	59.08	133.1	0.08	98.32
0.100	0.00	0.00	3.905	3.36	62.45	152.5	0.14	98.45
0.115	0.00	0.00	4.472	3.33	65.77	174.6	0.24	98.69
0.131	0.00	0.00	5.122	3.46	69.23	200.0	0.35	99.04
0.150	0.00	0.00	5.867	3.53	72.76	229.1	0.39	99.43
0.172	0.07	0.07	6.720	3.62	76.37	262.4	0.28	99.71
0.197	0.16	0.23	7.697	3.61	79.98	300.5	0.16	99.87
0.226	0.29	0.51	8.816	3.43	83.41	344.2	0.09	99.95
0.259	0.54	1.05	10.10	3.10	86.51	394.2	0.05	100.00
0.296	0.98	2.03	11.56	2.69	89.20	451.6	0.00	100.00
0.339	1.61	3.64	13.25	2.28	91.48	517.2	0.00	100.00
0.389	2.28	5.92	15.17	1.86	93.34	592.4	0.00	100.00
0.445	2.67	8.58	17.38	1.46	94.80	678.5	0.00	100.00
0.510	2.63	11.22	19.90	1.09	95.89	777.1	0.00	100.00
0.584	2.44	13.65	22.80	0.77	96.66	890.1	0.00	100.00
0.669	2.30	15.96	26.11	0.52	97.18	1019.5	0.00	100.00

4.2 HISTOGRAMS AND PERCENT-UNDERSIZE CURVES

Volume-based histograms and %-undersize curves depicting the results of the averaged PSD Run data on the three specimens of sample S11R000163 are presented in Figure B-1.

Recalculated number-based histograms and %-undersize curves for the averaged PSD Run data are presented in Figure B-2 for comparison. The number-based histograms and curves emphasize the degree to which volume-based data can be influenced by the presence of relatively small populations of larger particles.

The header for each PSD run displays the stirrer speed setting, the circulation pump speed setting, whether the specimen slurry was sonicated for 2 min, and the average duration of the run (in minutes). For Run 1, the average duration includes the approximate time required to introduce the PSD specimen into the analyzer sample tank.

Figure B-1. Averaged, Volume-based Histograms and%-Undersize Curves for C-110, <710-µm, Residual Solids.

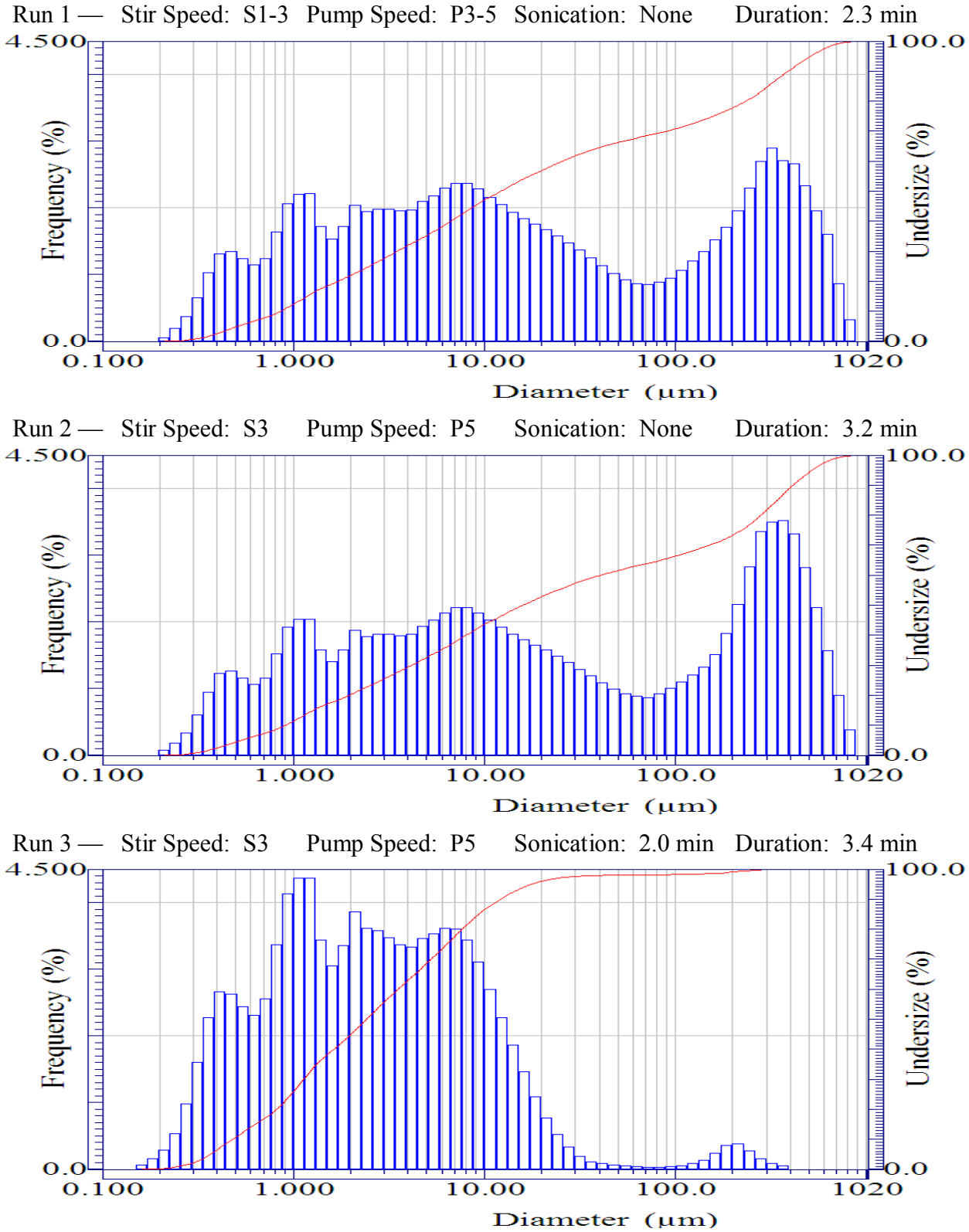
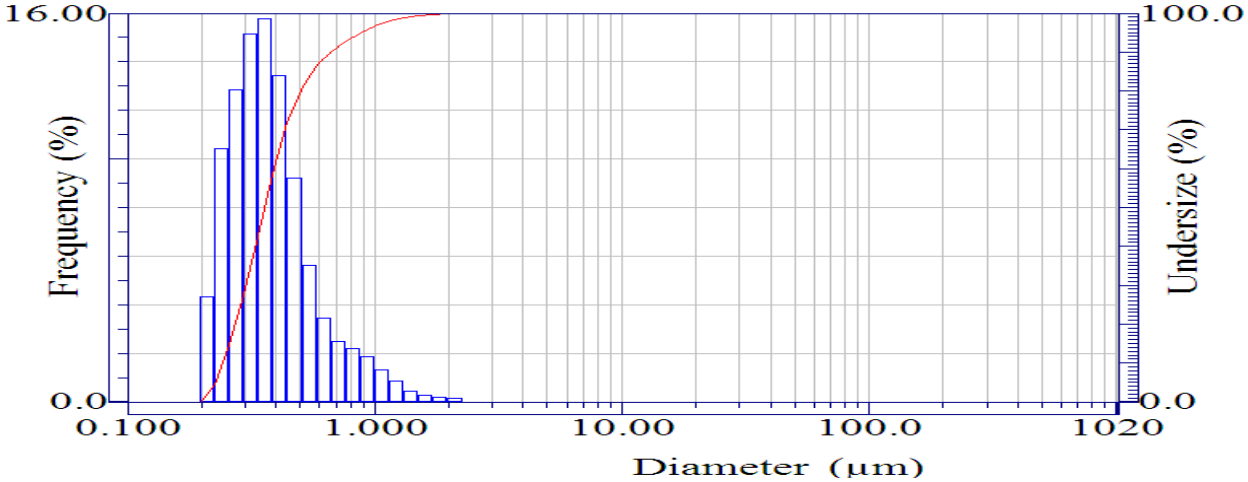
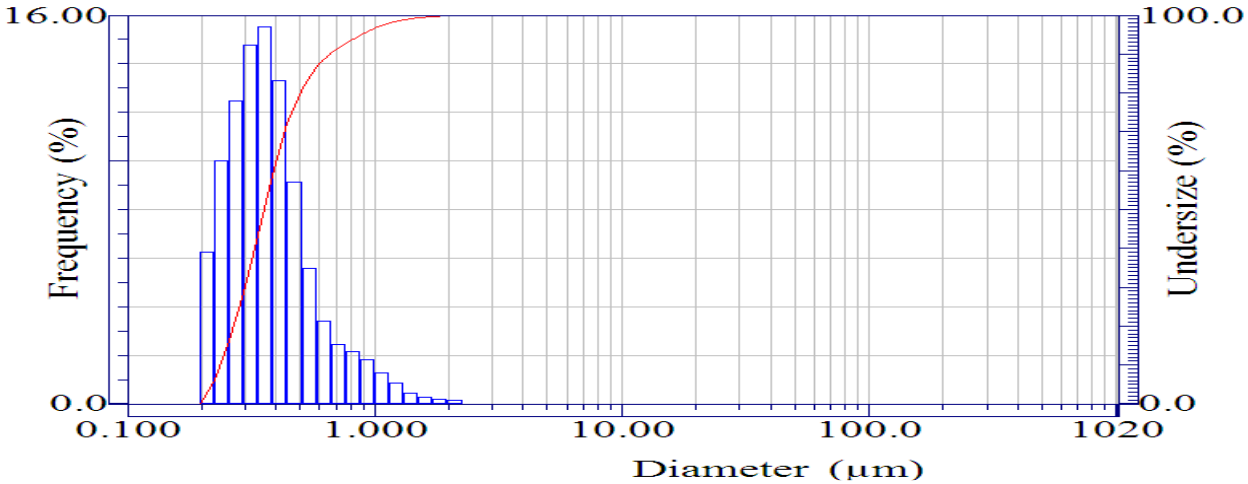


Figure B-2. Averaged, Number-based Histograms and %-Undersize Curves for C-110, <710-µm, Residual Solids.

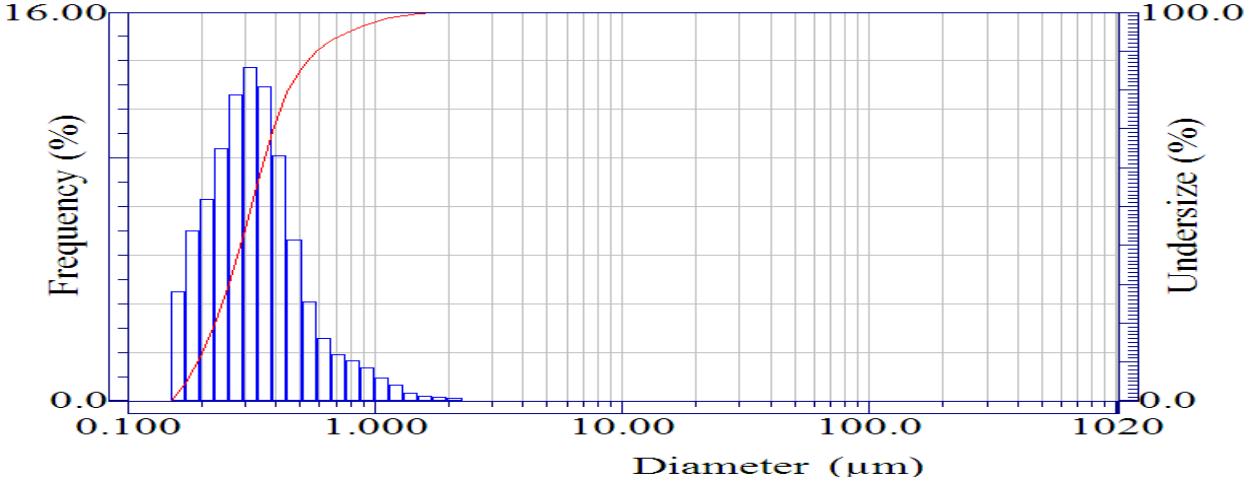
Run 1 — Stir Speed: S1-3 Pump Speed: P3-5 Sonication: None Duration: 2.3 min



Run 2 — Stir Speed: S3 Pump Speed: P5 Sonication: None Duration: 3.2 min



Run 3 — Stir Speed: S3 Pump Speed: P5 Sonication: 2.0 min Duration: 3.4 min



4.3 CUMULATIVE %-UNDERSIZE DATA

The particle diameters associated with five pre-selected points on the cumulative %-undersize curves describing the volume-based PSDs for the <710-µm C-110 residual solids are presented in Table B-2. The particle diameters associated with 10-, 25-, 50-, 75-, and 90 %-undersize cut points are tabulated. (These values are commonly reported as d10, d25, d50, d75, and d90 particle diameters, respectively.) The 50 %-undersize values are, by definition, the median particle diameters of the PSDs.

Table B-2. Diameter versus %-Undersize for <710-µm Residual Solids.

Specimen	PSD Run	Diameters of Particles (µm) at Volume-based %-Undersize Cut Points				
		10%	25%	50%	75%	90%
Primary	1	1.3	6.1	62	186	300
	2	1.2	5.4	50	166	277
	3	0.51	1.0	2.8	7.7	19
Duplicate	1	0.92	2.9	17	384	563
	2	0.85	2.5	12	354	531
	3	0.47	0.94	2.2	5.8	10.3
Triplicate	1	0.62	1.4	4.8	14	40
	2	0.79	2.1	9.5	221	389
	3	0.47	0.94	2.3	5.9	10.7

The cumulative %-undersize data for the averaged PSD Run files is presented in the main body of this report.

5.0 DISCUSSION OF MEASUREMENT RESULTS

Discussion of the results of these PSD measurements in relation to the characterization of the C-110 heel residual solids is included in the main body of this report. Discussion pertinent to evaluating the limitations on the accuracy or applicability of the light-scattering-based measurements is presented in this attachment.

5.1 PARTICLE SIZE DISTRIBUTION MEASUREMENT CAVEATS

Light-scattering-based PSD measurements are based on several assumptions:

a. All sample particles are spherical.
b. All particles with diameters less than ≈25 μm are compositionally and/or optically identical.
c. The optical properties of both the particles and the suspending medium are well known when samples contain particles with diameters less than ≈25 μm.
d. There is no interaction between light scattered from different particles (i.e., no multiple scattering phenomena).

Deviations from these assumptions will introduce some degree of error in the PSD measurements due to the inability of the deconvolution and inversion algorithms to account for the deviations.

It is reemphasized that the Horiba® LA-910 is an ensemble type, light-scattering-based PSD analyzer, not a sensing-zone or image-analysis type of instrument. Direct observation and/or measurement of individual particles are not made. The calculated PSDs are based, in part, on assumptions regarding the shapes and statistical properties of distributions that may not apply to the samples being measured.

5.1.1 Range

The results reported for the PSD analyses apply only to particles with diameters within the 0.02-1020 μm measuring range of the analyzer. The calculated PSDs are normalized so that the sum of the occurrence frequencies of particles within this range is always 100%. This should not be taken to represent that particles with diameters <0.02 μm or >1020 μm were determined, by measurement, to be absent from the samples.

Since the analyzed sample solids had passed through a 710-μm sieve, the absence of any significant quantity of particulates >710 μm in diameter was as expected. Visual observation and tactile evaluation during mixing and transfer of PSD specimens to the analyzer also supported this expectation.

The presence of particles with diameters <0.02 μm cannot be ruled out by these PSD measurements.

5.1.2 Nonspherical Particles

All light-scattering-based PSD data are presented in terms of an equivalent spherical diameter—the diameter of a spherical particle having the same light-scattering function as that assigned to the sample particle. By design, a nonlaminar, quasi-turbulent flow regime is maintained in the LA-910 flow cell. Under "ideal" conditions, the equivalent spherical diameter reported for any nonspherical particle would be derived from a combination of all cross-sectional diameters that a rapidly and randomly rotating particle could present to the probe light beams. The degree to which measurements on any significantly nonspherical component of a real, non-uniform sample actually achieves this ideal cannot be determined without undertaking an extensive study including both light-scattering-based and direct measurements of particle dimensions. This type of developmental program was not performed as part of these PSD measurements.

The degree to which PSD measurements on nonspherical components in the <710-µm C-110 residual solids have yielded meaningful, averaged spherical diameters or the effect their presence might have on the overall measured distributions is not known. The degree to which (even given ideal performance of the analyzer and its software package) averaged particle dimensions address actual project requirements should also be carefully considered.

5.1.3 Dispersion of Sample Particles

Laser diffraction instruments cannot distinguish between scattering by single particles and scattering by clusters of primary particles forming an agglomerate or aggregate. Usually the measured particle size for agglomerates or aggregates is related to the cluster size, but sometimes the size of the primary particles is reflected in the PSD as well[13] (ISO 13320-1). Furthermore, no technique not based on direct observation of sample solids can distinguish between agglomerates that may exist in a sample in its native state and agglomerates that may form as a result of the measurement process (e.g., by introduction of the sample solids into a different liquid medium with different electrostatic properties). As a result, ensuring a good degree of dispersion prior to sample analysis is generally considered to be an important step to ensure reliable and reproducible size analysis (NIST 960-1, *NIST Recommended Practice Guide: Particle Size Characterization*).

In the current PSD measurements, Run 1 on each specimen was made under conditions where dispersive forces and the time of their application were purposefully minimized. In Run 2 the intensity of the dispersive forces was not changed but the duration of their action on the sample solids was extended to 2 min. In Run 3, low-energy sonication of the specimen suspensions, a standard dispersive technique in PSD analysis, was employed.

[13] In some cases the light-scattering pattern produced by agglomerates or aggregates can be interpreted as multiple scattering resulting from localized high concentrations of discrete particles. In extreme cases, the calculated diameters may not only be unrelated to the cluster size but also may underestimate the diameters of the primary particles.

The results of the Run 1 and Run 2 measurements were very similar indicating that additional dissolution of sample solids, precipitation of new solids, or dispersal of weakly bound agglomerates was occurring slowly, if at all, under the low-shear conditions applied.

In the Run 3 distributions, most of the particulate population with diameters >20 μm was lost while the population with diameters <20 μm was essentially the same as in Runs 1 and 2. The changes in the Run 3 PSDs are probably due to the break-up of weakly bound aggregates of <20-μm particles during the 2 min of low-energy sonication. The scattering of blue light (λ = 450 nm) by and the calculated specific surface area (cm^2/cm^3) of the particulates increased significantly in Run 3 as compared to Run 1 and Run 2 for each specimen. Both increases indicate a significant increase in the number of small diameter particles in the PSD specimens in Run 3.

5.1.4 Refractive Indexes

In numerous cases, the results of a particle size analysis are only as good as the optical model chosen to interpret and convert the measured pattern of scattered light into a PSD (NIST 960-1). In particular, input of accurate refractive indexes of the sample solids and suspension liquid to the algorithms can be of critical importance.

When particle diameters are much larger than the wavelength of the light probe(s), scattering is effectively described as Fraunhofer diffraction and is independent of the optical properties of the sample material. To describe the scattering of light by smaller particles (down to diameters somewhat smaller than the light wavelength), use of Mie Scattering Theory is required. Application of Mie Theory requires that the complex refractive indexes of both the (assumed optically isotropic and spherical) particulate phase (N_p) and the suspension liquid (N_m) be known. This requirement is of increasing importance as the (a) particle diameters approach or become smaller than the wavelength(s) of the light scattered, (b) particles become increasingly transparent to the light probe(s), (c) particulates significantly absorb at the wavelength(s) of the light probe(s), and/or (d) refractive indexes of the liquid and solid phases approach one another.

The minimum particle size at which the Fraunhofer approximation holds varies depending on the actual solid-liquid system being measured. As a general rule (ISO 13320-1), the accuracy of the optical model data is not a significant concern for particles with diameters >50 μm and has only minor impact for particles with diameters as small as 18 μm to 25 μm for the 450-nm and 632-nm light sources employed in the LA-910 analyzer. The input of accurate optical data is of increasing importance as the diameters of sample particles become smaller than 25 μm and is critical when particles diameters are less than 1 μm-2 μm.

A small change in the assigned RRI may cause a significant change in calculated PSDs. Also, the effect of the RRI on PSDs calculated for samples containing particles of diverse composition and morphology is, generally, quite complicated. Unfortunately, it is sometimes difficult, even for a single well-defined phase, to obtain an accurate value for the real index of refraction (n_p). It is often very difficult to obtain an accurate value for the imaginary component (k_pi) of the refractive index: absorption is often strongly dependent on wavelength, and the extinction

coefficient can also be affected by surface structure of the particles (e.g., surface roughness) and intraparticle density heterogeneity. Indeed, it is common practice to determine appropriate values for the imaginary part (and often the real part also) of the refractive index using trial-and-error procedures of size determination using a microscopy-based technique, a light-scattering-based instrument, and samples of the solids to be measured.

For the <710-µm C-110 residual solids, the light-scattering-based PSD measurements indicated that the majority of the particulate volume (and presumably mass) resides in particles with diameters smaller than 18-25 µm. This is generally supported by the observed settling behavior of the solids. Use of appropriate values of N for the specimen solid and liquid phases for these measurements was, therefore, of some importance.

Gibbsite was identified as a major component of the <710-µm C-110 residual solids and the reference value of n_p for gibbsite, 1.575, was assigned for the specimen solids. The value of k_pi for gibbsite is not known but should be relatively small since gibbsite is transparent at the wavelengths used in the PSD measurements. The values of N_p for the other solids present in significant quantities in the <710-µm residual solids are unknown. The impact of the assignment of the single value $N_p = 1.575 – 0.10i$ for the particulate solids on the PSD measurements is unknown.

The real index of refraction of pure water, 1.333, should be a reasonably accurate value for the suspension liquid used in the PSD measurements.

If the RRI of (1.575/1.333) – 0.10i = 1.18 – 0.10i applies, with moderate tolerance, to the majority of the <710-µm C-110 residual solids in the aqueous specimen slurries, the calculated PSDs should reasonably characterize those present in the sample. If large and small diameter particulates are comprised of different solid phases with significantly different indexes of refraction, the calculated PSDs may differ significantly from those actually present in the sample.

5.1.5 Specimen Size

Volume-based PSD measurements can be very sensitive to the presence of small numbers of large-diameter particles that can nevertheless represent a very large fraction of the sample particulate volume. For example, in a population of 10^6 particles, 1 particle with a diameter 100 times larger than the diameter of the remaining 999,999 particles would have a number-based occurrence frequency of 0.0001%. However, in a volume-based distribution the single large particle would represent 50% of the particulate volume. Clearly, in samples containing a broad range of particle sizes, obtaining an analytical specimen in which the relative proportions of large and small particles are accurately represented is of importance. This requirement can, however, create a dilemma.

Particle concentration in specimen suspensions (by volume) should be above a minimum level required to produce an acceptable signal-to-noise ratio. In the LA-910 analyzer this concentration corresponds to a reduction in %-transmission to about 95% (reduction in

transmission of the probe light beam(s) through the suspension by 5% relative to the particle-free suspension liquid). To avoid multiple scattering, the solids concentration should be below a level that corresponds to about 65%-transmission for particles larger than 20 µm and about 85%-transmission for smaller particles (ISO 13320-1). In general, the multiple scattering that results when the specimen suspensions are significantly overconcentrated redistributes scattered light intensity to larger scattering angles resulting in calculation of minimum particle diameters that are smaller than the true values.

The dilemma arises when analyzing samples containing a broad range of particle sizes including some with relatively large diameters. Statistics indicate that a specimen that will accurately and reproducibly represent the proportion of both the large and small particles in the parent sample must be of a minimum weight or volume [*Particle Size Measurement: Volume 1 − Powder Sampling and Particle Size Measurement* (Allen 1997)]. However, if specimens of this size are analyzed, the target %-transmission limits for the PSD suspensions are often exceeded; indeed, the target values for the small diameter particles are very often exceeded. If smaller specimen sizes are used, the accuracy in representation of the relative amounts of larger particles present is potentially sacrificed in order to limit the effects of multiple scattering by the smaller particles.

It was relatively easy to achieve the desired levels of light obscuration when loading the <710-µm C-110 residual solids into the PSD analyzer, and the target levels were maintained during the Run 1 and Run 2 measurements. The generation of significantly larger numbers of relatively small particulates in the Run 3 measurements caused the %-transmission of the 450-nm probe beam to drop to ≈60%-transmission; a level significantly lower than the 85%-transmission target. However, nearly all of the remaining particulates were 0.5 to 18 µm in diameter. While the quantitative accuracy of the PSD results may be somewhat compromised due to underrepresentation of larger particulates, the bias is not believed to be large. Also, while artifacts caused by multiple scattering are almost certainly present, their impact should not be large.

5.2 REPRESENTATIVENESS

Particle size analysis is carried out on samples extracted from the bulk, which, irrespective of the precautions taken, never represent the bulk exactly. The degree to which the samples withdrawn from tank C-110 represented the bulk of the heel solids is unknown. The heel solids samples were then subjected to an extended series of test operations to produce the <710-µm residual solids analyzed. Finally, two additional subsampling steps were required to complete the transfer of each specimen into the PSD analyzer. Clearly, the degree to which the measured PSDs can or should be taken to represent the PSD of solids that might remain in tank C-110 after an actual retrieval operation should be carefully considered.

6.0 QUALITY CONTROL

6.1 REPEAT MEASUREMENTS

As previously noted, PSD measurements were performed on triplicate portions (specimens) withdrawn from sample S11R000163 of the <710-µm solids remaining after the large-scale dissolution tests on the C-110 heel solids. There was greater difference between the Run 1 (and Run 2) PSDs for the triplicate samples than normal, particularly in the portions of the PSDs for particulates with diameters >20 µm. The triplicate Run 3 PSDs were much more similar. Samples containing a small quantity of relatively large, weakly bound aggregates might be expected to be difficult to sample representatively and to yield PSDs that change over the three runs in the observed manner. However, the averaged data suggests that the protocols followed in the preparation and transfer of specimens to the PSD analyzer and in the execution of the measurements themselves resulted in PSD analyses with a level of precision (repeatability) meeting project requirements.

6.2 STANDARD MEASUREMENTS

A measurement of the PSD of a certified particle size standard was performed before sample measurements began and after they were completed. The standards measured were selected from a set of samples of monodisperse, polystyrene microspheres acquired from Thermo Scientific.[14] The 222-S Standards Laboratory acquired the standards and maintains files of the original standard certificates. These standards have mean diameter(s) certified with linear dimensions transferred from the National Institute of Standards and Technology. The results of the standard measurements are tabulated in Table B-3. The calculated mean particle diameters were within ±10% relative percent difference (RPD) of the certified values for both standard measurements.

Table B-3. Results of Particle Size Distribution Measurements on Certified Standards.

Standard	Mean Diameter		PSD Run File
	Certified	Measured	
Thermo Scientific #4010A (Lot 37781) Polystyrene microspheres	1.034 ± 0.021 µm	1.024 ± 0.075 µm (–1.0 % RPD)	201205011343057 PS-1um-050112a
Thermo Scientific #4314A (Lot 39966) Polystyrene microspheres	138 ± 2.2 µm	141 ± 14 µm (+2.2 % RPD)	201205030846076 PS-140um-050312a

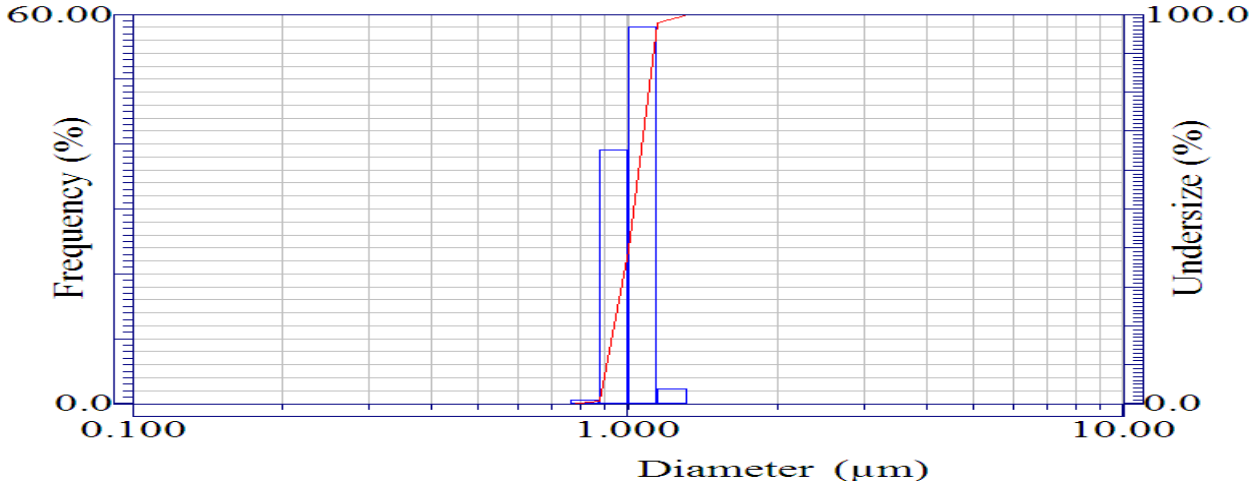
The measured PSDs for the standards are presented in Figure B-3. The sharp-form distributions presented are appropriate for these uniformly sized (i.e., monodisperse) standards.

[14] Thermo Fisher Scientific Inc., Waltham, Massachusetts.

Figure B-3. Volume-based Histograms and %-Undersize Curves for Particle Size Distribution Standards.

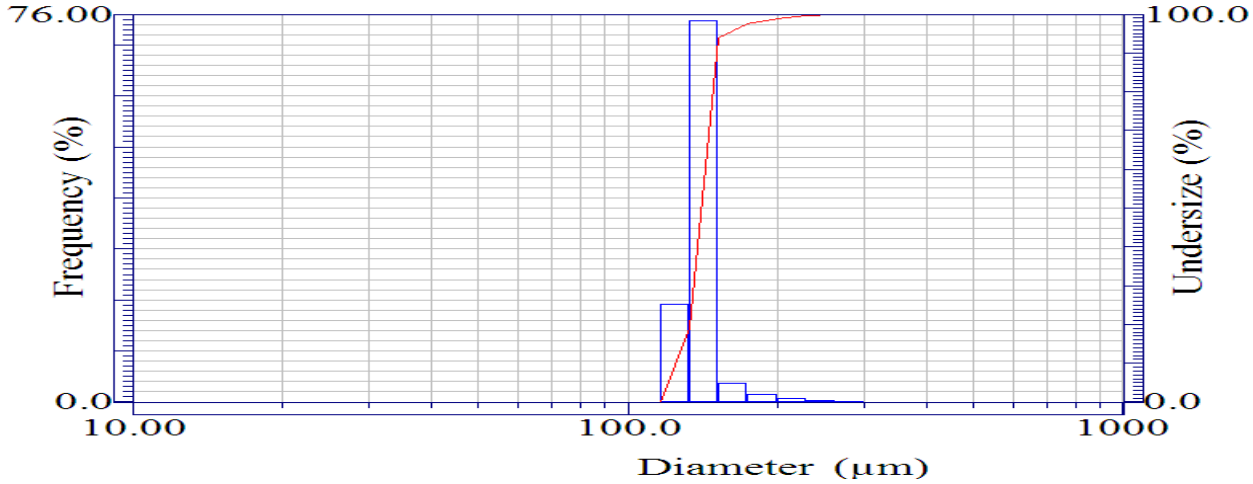
(a) Thermo Scientific 4010A (Lot 37781)
Polystyrene spheres
Distribution form: Sharp

Run Date: May 1, 2012—03:43
Certified Mean Diameter: 1.034 ± 0.021 µm
Calculated Mean Diameter: 1.02 ± 0.07 µm



(b) Thermo Scientific 4314A (Lot 39966)
Polystyrene spheres
Distribution form: Sharp

Run Date: May 3, 2012—08:46
Certified Mean Diameter: 138 ± 2.2 µm
Calculated Mean Diameter: 141 ± 14 µm



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