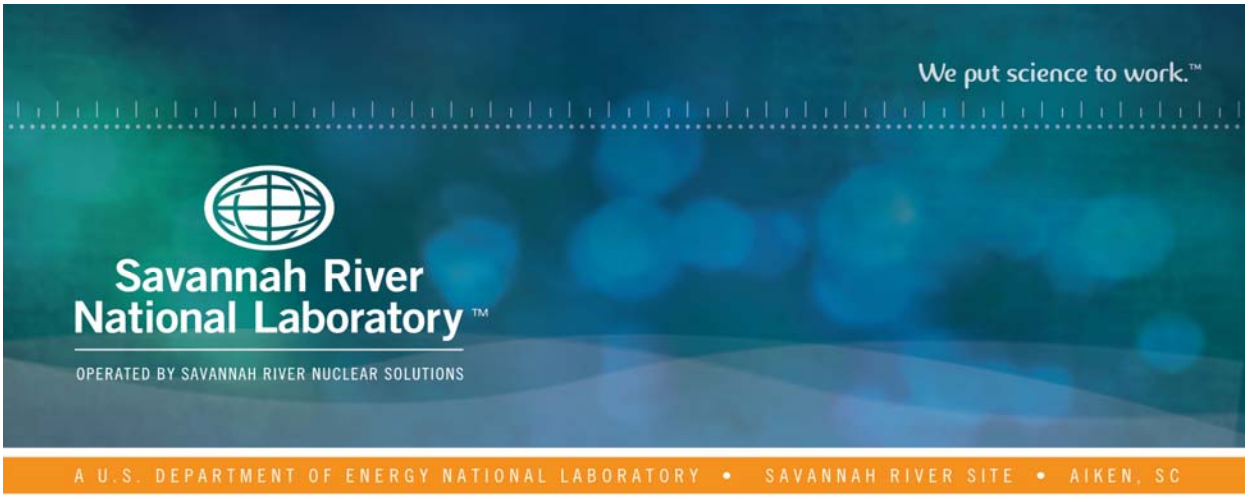

Actual Waste Testing of Glycolate Impacts on the SRS Tank Farm

C.J. Martino

May 2014

SRNL-STI-2013-00322, Revision 0

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Printed in the United States of America

Prepared for
U.S. Department of Energy

SRNL-STI-2013-00322
Revision 0

Keywords: *2H Evaporator, DWPF Alternate Reductant, Uranium, Plutonium, Sodium Aluminosilicate*

Retention: *Permanent*

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Prepared for the U.S. Department of Energy under contract number DE-AC09-08SR22470.

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ACKNOWLEDGEMENTS

The success of this task was due in large part by the thorough planning initiated by Kofi Adu-Wusu. Michael Stone and Terri Fellinger were instrumental in helping to refine the scope of this task to cover the applicable down-stream impacts fully, yet efficiently. I wish to thank the technicians who performed the actual waste testing: Dee Wheeler, Nan Stanley, and Phyllis Burkhalter; and the supply preparation: Betty Mealer. Many chemists and technicians within the SRNL Analytical Development section were essential in providing the analytical data for this study.

EXECUTIVE SUMMARY

Glycolic acid is being studied as a replacement for formic acid in the Defense Waste Processing Facility (DWPF) feed preparation process. After implementation, the recycle stream from DWPF back to the high-level waste Tank Farm will contain soluble sodium glycolate. Most of the potential impacts of glycolate in the Tank Farm were addressed via a literature review and simulant testing, but several outstanding issues remained.

This report documents the actual-waste tests to determine the impacts of glycolate on storage and evaporation of Savannah River Site high-level waste. The objectives of this study are to address the following:

- Determine the extent to which sludge constituents (Pu, U, Fe, etc.) dissolve (the solubility of sludge constituents) in the glycolate-containing 2H-evaporator feed.

- Determine the impact of glycolate on the sorption of fissile (Pu, U, etc.) components onto sodium aluminosilicate solids.

The first objective was accomplished through actual-waste testing using Tank 43H and 38H supernatant and Tank 51H sludge at Tank Farm storage conditions. The second objective was accomplished by contacting actual 2H-evaporator scale with the products from the testing for the first objective.

There is no anticipated impact of up to 10 g/L of glycolate in DWPF recycle to the Tank Farm on tank waste component solubilities as investigated in this test.

Most components were not influenced by glycolate during solubility tests, including major components such as aluminum, sodium, and most salt anions. There was potentially a slight increase in soluble iron with added glycolate, but the soluble iron concentration remained so low (on the order of 10 mg/L) as to not impact the iron to fissile ratio in sludge.

Uranium and plutonium appear to have been supersaturated in 2H-evaporator feed solution mixture used for this testing. As a result, there was a reduction of soluble uranium and plutonium as a function of time. The change in soluble uranium concentration was independent of added glycolate concentration. The change in soluble plutonium content was dependent on the added glycolate concentration, with higher levels of glycolate (5 g/L and 10 g/L) appearing to suppress the plutonium solubility.

The inclusion of glycolate did not change the dissolution of or sorption onto actual-waste 2H-evaporator pot scale to an extent that will impact Tank Farm storage and concentration. The effects that were noted involved dissolution of components from evaporator scale and precipitation of components onto evaporator scale that were independent of the level of added glycolate.

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LIST OF ABBREVIATIONS

AD	Analytical Development
CVAA	Cold Vapor Atomic Absorption
DWPF	Defense Waste Processing Facility
ETF	Effluent Treatment Facility
IC	Ion Chromatography
ICP-ES	Inductively Coupled Plasma – Emission Spectroscopy
ICP-MS	Inductively Coupled Plasma – Mass Spectroscopy
n/a	not applicable
PSAL	Process Science Analytical Laboratory
PuTTA	Plutonium separation by thenoyltrifluoracetone
RSD	Relative Standard Deviation
SRNL	Savannah River National Laboratory
SRR	Savannah River Remediation
SRS	Savannah River Site
TIC/TOC	Total Inorganic Carbon / Total Organic Carbon
TTQAP	Task Technical and Quality Assurance Plan
VDS	Variable Depth Sample

1.0 Introduction

Savannah River Remediation (SRR) is evaluating changes to its current Defense Waste Processing Facility (DWPF) flowsheet to reduce facility hazards and improve processing cycle times. As a result, glycolic acid is being studied as an alternate reductant in DWPF as a replacement for formic acid that is currently used.[1,2] Due to glycolic acid in the Chemical Processing Cell condensate and Melter off-gas, the DWPF process flowsheet with glycolic acid as the reductant may result in as much as 10 g/L of glycolate in the DWPF recycle stream sent to the Savannah River Site (SRS) Tank Farm. [3]

A literature review was conducted on the impact of glycolate on several post-DWPF downstream systems: storage in the Tank Farm, evaporation in the 2H Evaporator system, and evaporator condensate processing through the Effluent Treatment Facility (ETF).[3] The literature search emphasized that glycolic acid, and to a lesser extent glycolate ion, has the ability to complex many multivalent metals and increase their solubility. The complexing ability of glycolate at high pH has been shown for the lanthanides and several actinides. This complexing or solubilizing ability of glycolate may be a potential criticality concern for Tank Farm storage of the DWPF recycle stream and subsequent processing in the 2H-evaporator system.

This report documents actual-waste tests on the storage and evaporator impacts of glycolate in the Tank Farm, where glycolate will be in contact with radioactive components of the tank sludge and the evaporator scale. These tasks are derived from the scope outlined in the Technical Task Request and further detailed in the Task Technical and Quality Assurance Plan (TTQAP).[4,5]

A previous report documented non-radioactive simulant tests for glycolate partitioning during Tank Farm waste evaporation (i.e., into evaporator concentrate versus evaporator condensate) and the impacts of glycolate on cation solubility in Tank Farm waste.[6] Because the majority of the glycolate stays with the evaporator concentrate, studies have also investigated the impacts of glycolate on downstream salt processing facilities.[7,8]

This report addresses tests with actual-waste material to represent the 2H-evaporator system storage tanks. The objectives of this study are to perform tests to address the following:

- Determine the extent to which sludge constituents (Pu, U, Fe, etc.) dissolve (the solubility of sludge constituents) in the glycolate-containing 2H-evaporator feed.

- Determine the impact of glycolate on the sorption of fissile (Pu, U, etc.) components onto sodium aluminosilicate solids.

The first objective was accomplished through actual waste testing using Tank 43H and 38H supernatant and Tank 51H sludge at Tank Farm storage conditions. The second objective was accomplished by contacting actual 2H-evaporator pot scale with the products from the testing for the first objective. The data generated will be used in the OLI modeling task as appropriate.[9]

2.0 Experimental

Two types of testing with actual waste were performed. The testing used a combination of previously obtained actual SRS waste materials from characterization and qualification programs. Table 2-1 contains a listing of the samples that were used in both types of testing. The first type of testing, to evaluate the impact of glycolate on the solubility of sludge components in the Tank Farm, was conducted using a mixture of supernate samples from Tank 43H and 38H and sludge from Tank 51H at Tank Farm storage conditions. The second type of testing, to evaluate the impact of glycolate on the components sorbed onto the 2H-evaporator pot scale, used the soluble portion (equilibrated and filtered) of the product from the first type of testing and a sample of 2H-evaporator pot scale.

Table 2-1. Actual-waste materials used for the sodium glycolate Tank Farm impacts testing

Source	Sample Names	Sample Mass	Analysis
Tank 38H	HTF-38-11-137 and 138 HTF-38-11-51 HTF-38-12-103 and 104	427.17 g	Refs. 10, 11, and 12
Tank 43H	HTF-43-12-53 and 54 HTF-43-12-105 and 106	317.56 g	Refs. 11 and 12
Tank 51H	HTF-51-12-80	17.14 g	Refs. 13 and 14
2H-evaporator pot scale	HTF-13-11 (28H)	4.26 g	Ref. 15

The previous characterization of the materials used in this testing are contained in the references listed in Table 2-1. The Tank 38H and 43H feed solutions are typically 2.5 to 3 M sodium hydroxide, 1.5 to 2 M sodium nitrite and about 1 M sodium nitrate with smaller amounts of other salts. The Tank 38H and 43H solutions typically contain around 60 mg/L of uranium and 20,000 dpm/mL of Pu-238. The Tank 51H material used in these tests was washed Sludge Batch 8 slurry (identified as "SRAT Receipt" in Reference 13). Tank 51H has received a variety of materials, but the majority of the Sludge Batch 8 material in Tank 51H was Tank 12H sludge from which a large portion of the aluminum had been previously dissolved. The Tank 51H washed Sludge Batch 8 material contained 17.2 wt% iron, 5.5 wt% aluminum, 2.6 wt% uranium and 3.84×10^8 dpm/g plutonium-238 on a total solids basis. The 2H-evaporator pot scale was primarily nitrated cancrinite (sodium aluminosilicate) with 12 wt% mercury and 7 wt% uranium.

2.1 Tank Farm Solubility Tests

A stock mixture was made containing tank supernate and sludge solids. This Tank 38H / 51H stock mixture contained 17.14 grams of Tank 51H slurry and 126.23 grams of Tank 38H supernate sample composite. Individual 15 mL bottles were prepared for each solubility test, containing nominally 12 grams of Tank 43H supernate sample composite, 4 grams of the Tank 38H / 51H stock mixture, and the corresponding quantity of sodium glycolate salt to achieve the target glycolate concentration. The slurries prepared for the equilibration tests included 0.4 wt% of Tank 51H sludge solids. Sufficient sludge was

present to be able to raise the solution levels by 1460 mg/L iron, 470 mg/L aluminum, 220 mg/L uranium and 3.27×10^6 dpm/g plutonium-238 if complete dissolution or complexation occurred.

The targeted glycolate concentrations for inclusion were 0 g/L, 5g/L and 10 g/L. Because it is doubtful that such large quantities of glycolate (5 and 10 g/L) would be sent to the Tank Farm, solubilities in a more realistic 0.2 g/L of glycolate was checked for a subset of the equilibration times.

Initial feed analysis was performed on 15 mL samples processed after sitting at room temperature for about an hour. For the other time periods, these individual sample bottles were placed in a nominally 50 ºC shaker oven for periods of 7, 14, 21, and 35 days. Several extra 15 mL sample bottles were prepared and placed in the oven in case that repeated sampling was necessary. Duplicate bottles were prepared and processed for most of the 35 day conditions. A second thermocouple that was placed into the main chamber of the shaker oven read 52 ºC, indicating that the equilibration temperature may have been biased slightly high.

After the target time at temperature had been reached, samples were removed from the oven and prepared for analysis of soluble components. Portions of the slurries were filtered through 0.45 µm nylon filters, and the filtrate was used to prepare two acid diluted aliquots and one water diluted aliquot (nominal ten-fold dilutions). Acidic dilutions were analyzed by Inductively Coupled Plasma – Emission Spectroscopy (ICP-ES), Inductively Coupled Plasma – Mass Spectroscopy (ICP-MS), and plutonium analysis by thenoyltrifluoracetone separation (PuTTA) and alpha counting. Water dilutions were analyzed by titration for free hydroxide, Ion Chromatography (IC) for anions, and Total Inorganic Carbon/Total Organic Carbon (TIC/TOC) for carbonate and organic carbon.

2.2 Evaporator Scale Contact Tests

Materials analogous to the equilibrated end products from the Tank Farm solubility tests were needed for the evaporator scale contact tests. Additional salt solution and sludge mixtures with 0 g/L and 10 g/L of added glycolate were prepared by the method described in the previous section, equilibrated for 48 days in a shaker oven at 50 ºC, and filtered with 0.45 µm nylon filters. The main difference from the previous testing is that Tank 38H sample material diluted with de-ionized water was substituted for Tank 43H sample material.

Individual 15 mL bottles were prepared containing nominally 0.7 grams of 2H-evaporator pot scale and 11 grams of equilibrated and filtered product from the sludge contact test. Four bottles each were prepared for 0 g/L and 10 g/L of added glycolate. One bottle for each level of added glycolate was processed as the initial feed analysis. The other three bottles for each level of added glycolate were placed in a nominally 80 ºC shaker oven for a period of 19 or 20 days. A second thermocouple that was placed into the main chamber of the shaker oven read 82 ºC, indicating that the equilibration temperature may have been biased slightly high.

After the target time at temperature had been reached, samples were removed from the oven and prepared for analysis of soluble components. Portions of the slurries were filtered through 0.45 µm nylon filters, and the filtrate was used to prepare one acid diluted aliquot and one water diluted aliquot (nominal ten-fold dilutions). Acidic dilutions were analyzed by ICP-ES, ICP-MS, plutonium analysis, and Cold Vapor Atomic Absorption (CVAA) analysis for mercury. Water dilutions were analyzed by titration, IC, and TIC/TOC.

3.0 Tank Farm Solubility Evaluation

The densities of Tank 43H and Tank 38H sample composites were measured at 15 ºC as 1.23 g/mL and 1.34 g/mL, respectively. The individual Tank 43H / 38H / 51H mixtures used throughout this testing has a calculated density of 1.25 g/mL at 15 ºC.

Table 3-1, Table 3-2 and Table 3-3 contain the results of the analysis of samples taken during testing, including the averages and relative standard deviations (RSD) of duplicate or quadruplicate analyses. Results are organized for each individual analyte with columns representing each time interval (0, 7, 14, 21, and 35 days) and rows representing added glycolate level (0, 0.2, 5, and 10 g/L). Values preceded by "<" are below the detectible level. Where an RSD is not provided, a single analysis was performed and is listed as the average. Where average results are not reported for a specific combination of analyte, glycolate level, and time interval, no analysis was performed. A reduced set of time intervals were investigated at the glycolate level of 0.2 g/L. A reduced set of analyses were performed for the 21 day analyses. Quadruplicate analyses were performed by ICP-ES, ICP-MS and PuTTA for the 14 day and 35 day time intervals for glycolate levels of 0 and 10 g/L. Appendix A contains results for the individual samples, including results for analytes not reported in the summary tables.

Due to an error in sample preparation, the IC anion, TIC/TOC, and free hydroxide were not usable for the 21 day and 35 day time intervals. The 35 day sample for IC anions, TIC/TOC and free hydroxide was replaced by an alternate sample that did not have precisely the same history as the other 35 day samples. These analyses were taken for samples that were held at 50 ºC for approximately 50 days and at 80 ºC for approximately 7 days, and are reported in the column labeled "35 days*".

The IC analysis for anions in the initial "0 days" sample for the 10 g/L glycolate case appears to be biased high by approximately 30% for all analytes with the exception of oxalate (includes glycolate, formate, nitrite, nitrate, sulfate and phosphate).

The time interval of 0 days can be considered as an initial measurement for each test condition. The 0 day contact times for the Tank 43H salt solution, the mixture of the Tank 38H salt solution and Tank 51H sludge, and the added glycolate (where applicable) was on the order of an hour or less at room temperature prior to filtration. Subsequent time intervals are used to track the concentration of each species at a given glycolate addition level.

A series of figures outline the soluble concentration of select species as a function of time and added glycolate concentration. Figure 3-1 contains the observed behavior of soluble aluminum, Figure 3-2 of iron, Figure 3-3 of uranium, and Figure 3-5 and Figure 3-6 of plutonium. The error bars included on the concentration and activity measurements are the reported 1σ method uncertainties combined with the RSD. Although no error bars are included for the x-axis (time in days), the approximate uncertainty in timing is ±0.25 days.

Table 3-1. Elemental composition analysis of the soluble portion of 2H Evaporator feed solution held in contact with sludge at 50 °C: ICP-ES results

analyte	glycolate (g/L)	0 days		7 days		14 days		21 days		35 days	
		average	RSD	average	RSD	average	RSD	average	RSD	average	RSD
Al (mg/L)	0	9.21E+02	0.5%	9.12E+02	0.5%	9.11E+02	0.3%	9.25E+02	0.7%	9.57E+02	0.5%
	0.2	--		--		9.22E+02	0.1%	--		9.61E+02	0.5%
	5	9.18E+02	0.2%	9.29E+02	1.5%	9.05E+02	0.6%	9.22E+02	0.2%	9.43E+02	0.4%
	10	9.24E+02	0.3%	9.15E+02	0.4%	9.04E+02	0.6%	9.15E+02	1.2%	9.31E+02	0.7%
B (mg/L)	0	1.17E+02	0.2%	1.21E+02	0.1%	1.24E+02	0.6%	1.23E+02	1.3%	1.20E+02	1.2%
	0.2	--		--		1.25E+02	0.5%	--		1.18E+02	1.0%
	5	1.18E+02	0.1%	1.20E+02	0.1%	1.22E+02	0.2%	1.22E+02	0.7%	1.19E+02	1.9%
	10	1.19E+02	1.1%	1.19E+02	0.4%	1.22E+02	0.7%	1.23E+02	0.2%	1.18E+02	1.8%
Ca (mg/L)	0	3.73E+00	17%	1.61E+00	14%	1.54E+00	15%	1.82E+00	2.9%	1.81E+00	15%
	0.2	--		--		1.91E+00	0.8%	--		1.82E+00	15%
	5	1.97E+00	3.1%	1.88E+00	3.0%	1.46E+00	4.0%	1.96E+00	0.7%	2.24E+00	15%
	10	2.47E+00	0.3%	2.39E+00	15%	1.83E+00	2.8%	2.51E+00	1.5%	3.51E+00	73%
Cr (mg/L)	0	4.51E+01	0.2%	4.67E+01	0.7%	4.56E+01	0.5%	4.65E+01	0.5%	4.53E+01	2.0%
	0.2	--		--		4.64E+01	0.0%	--		4.44E+01	0.5%
	5	4.53E+01	0.3%	4.72E+01	0.1%	4.59E+01	0.2%	4.71E+01	0.0%	4.57E+01	2.7%
	10	4.57E+01	1.0%	4.73E+01	0.1%	4.61E+01	0.0%	4.74E+01	1.1%	4.59E+01	2.4%
Fe (mg/L)	0	3.08E+01	15%	3.23E+00	25%	3.04E+00	27%	2.93E+00	34.7%	2.06E+00	20%
	0.2	--		--		2.23E+00	7.1%	--		2.33E+00	37%
	5	4.52E+00	8.6%	6.26E+00	31%	5.60E+00	0.5%	7.02E+00	26%	4.94E+00	5.9%
	10	5.95E+00	30%	9.03E+00	26%	9.16E+00	7.7%	7.93E+00	3.3%	6.45E+00	8.5%
K (mg/L)	0	2.42E+02	1.4%	2.47E+02	3.3%	2.58E+02	2.4%	2.48E+02	0.05%	2.60E+02	3.9%
	0.2	--		--		3.02E+02	1.2%	--		2.65E+02	0.1%
	5	2.65E+02	4.0%	2.64E+02	4.3%	2.88E+02	3.4%	2.75E+02	2.5%	2.74E+02	1.4%
	10	2.77E+02	0.4%	2.90E+02	1.5%	3.11E+02	0.5%	2.74E+02	1.9%	2.68E+02	2.1%
Li (mg/L)	0	5.07E+01	0.5%	5.10E+01	0.3%	5.07E+01	0.02%	5.05E+01	0.7%	5.19E+01	0.4%
	0.2	--		--		5.09E+01	0.4%	--		5.25E+01	0.7%
	5	4.99E+01	0.4%	5.08E+01	0.05%	5.07E+01	0.4%	5.00E+01	0.3%	5.17E+01	0.5%
	10	5.02E+01	0.2%	5.08E+01	0.4%	4.98E+01	0.1%	5.01E+01	0.9%	5.13E+01	0.4%
Na (mg/L)	0	1.34E+05	0.7%	1.34E+05	0.1%	1.34E+05	0.2%	1.36E+05	0.3%	1.34E+05	0.4%
	0.2	--		--		1.36E+05	0.05%	--		1.36E+05	0.02%
	5	1.34E+05	0.3%	1.35E+05	0.6%	1.35E+05	1.3%	1.36E+05	0.7%	1.35E+05	0.9%
	10	1.36E+05	0.03%	1.35E+05	1.6%	1.36E+05	0.2%	1.39E+05	0.7%	1.36E+05	0.9%
P (mg/L)	0	1.18E+02	0.4%	1.28E+02	2.8%	1.28E+02	0.6%	1.33E+02	1.4%	1.16E+02	6.2%
	0.2	--		--		1.34E+02	2.2%	--		1.12E+02	0.6%
	5	1.19E+02	2.6%	1.32E+02	1.1%	1.32E+02	0.2%	1.36E+02	1.7%	1.16E+02	3.9%
	10	1.22E+02	1.9%	1.33E+02	0.8%	1.31E+02	0.02%	1.29E+02	0.6%	1.13E+02	3.7%
S (mg/L)	0	8.76E+02	2.9%	9.82E+02	1.6%	1.05E+03	7.2%	1.04E+03	2.8%	1.17E+03	5.8%
	0.2	--		--		1.05E+03	5.4%	--		1.18E+03	20%
	5	9.16E+02	6.1%	1.00E+03	0.2%	1.07E+03	0.9%	1.07E+03	18%	1.10E+03	21%
	10	9.46E+02	1.1%	1.00E+03	0.5%	1.07E+03	0.00%	1.09E+03	9.6%	1.06E+03	15%
Si (mg/L)	0	1.97E+02	0.8%	9.08E+01	1.0%	7.68E+01	2.1%	7.02E+01	1.9%	5.50E+01	0.9%
	0.2	--		--		7.75E+01	0.9%	--		5.47E+01	1.1%
	5	1.99E+02	0.4%	9.15E+01	1.1%	7.90E+01	3.2%	6.92E+01	0.3%	5.35E+01	2.6%
	10	2.18E+02	2.9%	8.98E+01	0.3%	8.67E+01	16%	6.71E+01	1.5%	5.29E+01	2.6%
Zn (mg/L)	0	6.46E+00	3.6%	5.15E+00	1.8%	5.48E+00	0.2%	5.11E+00	2.7%	4.95E+00	4.4%
	0.2	--		--		5.78E+00	3.3%	--		4.71E+00	0.7%
	5	4.98E+00	1.4%	5.49E+00	2.7%	5.57E+00	1.7%	5.33E+00	2.6%	5.36E+00	23%
	10	5.05E+00	0.8%	5.63E+00	1.3%	5.62E+00	0.9%	5.35E+00	2.4%	5.20E+00	13%

Table 3-2. Analysis of the soluble portion of 2H Evaporator feed solution held in contact with sludge at 50 °C: ICP-MS and plutonium results

analyte	glycolate (g/L)	0 days		7 days		14 days		21 days		35 days	
		average	RSD	average	RSD	average	RSD	average	RSD	average	RSD
Pb (mg/L)	0	1.81E+00	2.3%	2.76E-01	11%	2.40E-01	3.4%	2.86E-01	13%	2.77E-01	8.2%
	0.2	--		--		3.11E-01	19%	--		2.98E-01	1.50%
	5	1.5E+00	64%	2.40E-01	1.4%	2.03E-01	1.8%	2.47E-01	0.7%	1.4E+00	160%
	10	6.37E-01	2.1%	2.80E-01	3.8%	1.90E-01	11%	2.68E-01	3.0%	4.88E-01	92%
W (mg/L)	0	1.09E+00	4.5%	8.62E-01	0.4%	9.24E-01	5.6%	9.96E-01	11%	9.82E-01	5.8%
	0.2	--		--		8.85E-01	1.9%	--		9.14E-01	4.6%
	5	9.89E-01	8.7%	8.33E-01	2.9%	9.82E-01	6.2%	9.32E-01	3.1%	9.60E-01	5.2%
	10	9.72E-01	5.9%	8.29E-01	0.2%	8.95E-01	4.8%	9.22E-01	3.5%	1.00E+00	12%
Rb (mg/L)	0	1.29E+00	7.1%	6.29E-01	8.0%	5.88E-01	1.7%	6.65E-01	8.1%	6.19E-01	5.4%
	0.2	--		--		6.08E-01	3.7%	--		6.29E-01	1.5%
	5	1.2E+00	44%	5.99E-01	10%	5.79E-01	1.9%	6.08E-01	2.6%	6.37E-01	6.7%
	10	9.21E-01	15%	6.81E-01	12%	5.84E-01	2.1%	6.60E-01	0.4%	6.19E-01	2.7%
Tc-99 (mg/L)	0	9.08E-01	12%	8.75E-01	8.4%	9.02E-01	0.8%	9.41E-01	1.3%	9.69E-01	2.0%
	0.2	--		--		8.46E-01	2.4%	--		9.03E-01	0.7%
	5	1.07E+00	8.8%	9.43E-01	2.8%	9.18E-01	2.2%	9.26E-01	3.4%	9.54E-01	8.3%
	10	1.10E+00	19%	9.43E-01	1.6%	9.66E-01	4.9%	1.02E+00	1.8%	9.78E-01	5.3%
U (mg/L)	0	5.49E+01	2.4%	2.60E+01	0.4%	1.98E+01	1.1%	1.70E+01	0.2%	1.28E+01	2.2%
	0.2	--		--		2.09E+01	0.1%	--		1.26E+01	1.9%
	5	5.52E+01	0.4%	3.16E+01	0.1%	2.37E+01	0.5%	1.97E+01	2.3%	1.44E+01	1.9%
	10	5.31E+01	2.0%	3.23E+01	0.04%	2.27E+01	0.8%	1.89E+01	1.0%	1.40E+01	1.8%
Pu-238 (dpm/mL)	0	2.16E+04	4.8%	9.19E+03	1.8%	7.49E+03	10%	7.27E+03	1.3%	6.88E+03	15%
	0.2	--		--		6.87E+03	5.8%	--		6.03E+03	14%
	5	2.12E+04	0.3%	5.74E+03	7.9%	1.64E+03	21%	1.12E+03	8.2%	1.28E+03	41%
	10	2.14E+04	8.7%	4.04E+03	22.3%	1.59E+03	6.6%	1.53E+03	4.6%	1.62E+03	22%

Table 3-3. Analysis of the soluble portion of 2H Evaporator feed solution held in contact with sludge at 50 °C: IC anions, OH^- and TIC/TOC results

analyte	glycolate (g/L)	0 days		7 days		14 days		21 days		35 days*	
		average	RSD	average	RSD	average	RSD	average	RSD	average	RSD
$C_2H_3O_3^-$ (mg/L)	0	< 5.14E+02		< 1.13E+03		< 9.64E+02		--		< 5.46E+02	
	5	5.75E+03		4.41E+03		4.23E+03		--		--	
	10	1.55E+04		8.75E+03		8.45E+03		--		6.59E+03	
CHO_2^- (mg/L)	0	1.54E+03		1.48E+03		1.47E+03		--		1.18E+03	
	5	1.45E+03		1.63E+03		1.73E+03		--		--	
	10	2.00E+03		1.78E+03		1.87E+03		--		3.80E+03	
$C_2O_4^{2-}$ (mg/L)	0	2.37E+02		2.59E+02		2.51E+02		--		4.04E+02	
	5	1.91E+02		3.33E+02		3.58E+02		--		--	
	10	1.78E+02		3.73E+02		3.51E+02		--		1.48E+03	
NO_2^- (mg/L)	0	7.21E+04		7.58E+04		7.07E+04		--		7.30E+04	
	5	6.72E+04		7.02E+04		6.97E+04		--		--	
	10	9.07E+04		7.05E+04		6.95E+04		--		7.17E+04	
NO_3^- (mg/L)	0	5.75E+04		5.47E+04		5.52E+04		--		5.42E+04	
	5	5.47E+04		5.50E+04		5.43E+04		--		--	
	10	7.20E+04		5.50E+04		5.44E+04		--		5.45E+04	
SO_4^{2-} (mg/L)	0	1.90E+03		2.07E+03		2.03E+03		--		1.99E+03	
	5	1.88E+03		1.93E+03		2.00E+03		--		--	
	10	2.50E+03		2.03E+03		1.99E+03		--		2.01E+03	
PO_4^{3-} (mg/L)	0	2.88E+02		3.04E+02		2.89E+02		--		2.95E+02	
	5	2.98E+02		2.91E+02		2.84E+02		--		--	
	10	3.78E+02		2.89E+02		2.77E+02		--		2.83E+02	
OH^- (M)	0	2.50E+00		--		--		--		2.51E+00	
	5	2.39E+00		--		--		--		--	
	10	3.19E+00		--		--		--		2.46E+00	
CO_3^{2-} (mg/L)	0	2.11E+04		--		--		--		2.47E+04	
	5	2.11E+04		--		--		--		--	
	10	2.77E+04		--		--		--		2.51E+04	
TOC (mg/L)	0	4.62E+02		--		--		--		5.90E+02	
	5	1.97E+03		--		--		--		--	
	10	4.74E+03		--		--		--		3.27E+03	

* See the report text for an explanation of the 35 day sample for IC anions, TIC/TOC and free hydroxide.

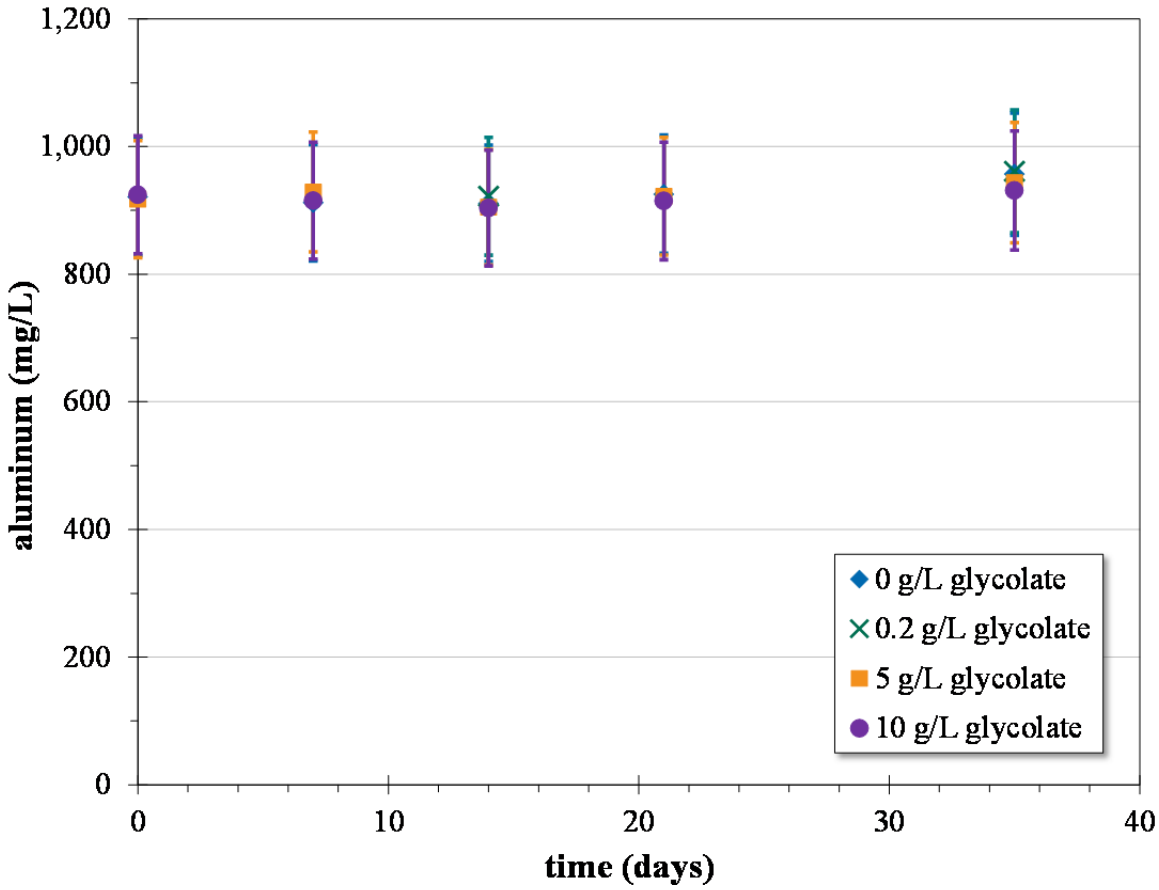

Figure 3-1. Influence of glycolate on soluble aluminum concentration in SRS Tank Farm actual-waste salt solution in contact with sludge at 50 °C

The most common outcome for the testing is that the soluble concentration of an analyte is stable with respect to time and does not show a dependence on the addition of glycolate. Figure 3-1 shows that the soluble aluminum concentration held steady within analytical uncertainty at approximately 920 mg/L for the 5-week period of equilibration at 50 ºC. In addition, the soluble aluminum concentration was the same within analytical uncertainty for all four levels of glycolate addition. A sufficient amount of aluminum was contained in the sludge included in the equilibrating mixture so that an effect could be seen if aluminum dissolution was occurring. No significant aluminum dissolution or precipitation was noted from the supernate analysis, indicating that the mixture was likely already at its equilibrium solubility concentration of aluminum. From Table 3-1 through Table 3-3, the same trend represented by Figure 3-1 for aluminum can be noted for the soluble concentrations of boron, calcium, chromium, potassium, lithium, sodium, zinc, tungsten, technetium-99, and most of the inorganic ions. As discussed later, results for soluble calcium may not be reliable due to the appearance of a significant concentration of calcium in the reference solution analyzed along with the actual samples.

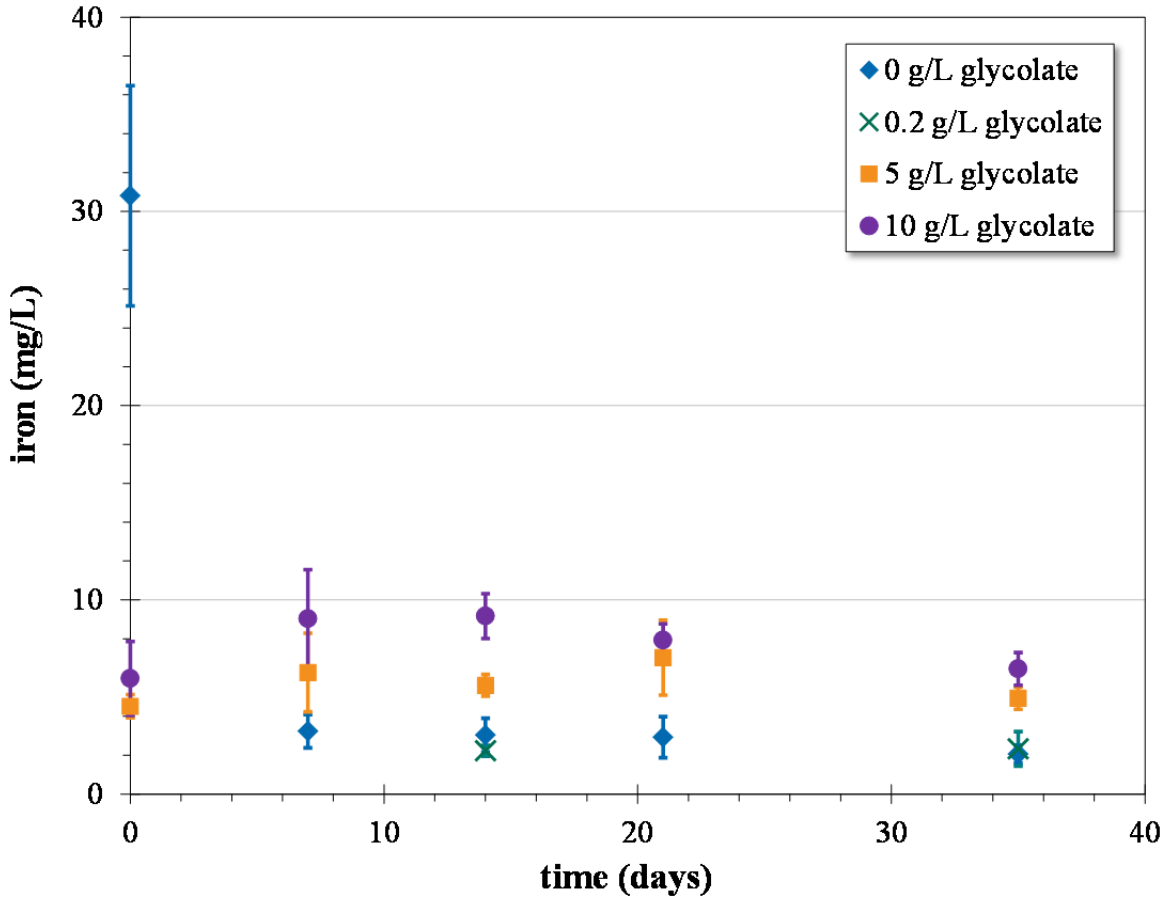

Figure 3-2. Influence of glycolate on soluble iron concentration in SRS Tank Farm actual-waste salt solution in contact with sludge at 50 °C

Iron is the only sludge component that may have exhibited a higher solubility with the addition of glycolate. Figure 3-2 shows the soluble iron as functions of time and added glycolate concentration. With the exception of the initial sample analysis for 0 g/L added glycolate, the iron solubility remained very low (<10 mg/L) throughout the testing. Throughout the equilibration period, the soluble iron concentrations remained about three-times higher in the salt solutions with 10 g/L of added glycolate when compared to the solutions with 0 g/L added glycolate. The 5 g/L level of added glycolate exhibited soluble iron concentrations intermediate to those for the 0 g/L and 10 g/L levels of added glycolate.

There is considerable scatter in the iron data. Some of this may be due to a small fraction of the iron in the sludge passing through the 0.45 micron nylon filter and causing a significant impact on these trace measurements. Another factor is that many of the data are near the method detection limit of approximately 1.6 mg/L. As will be discussed later, reference solutions analyzed with some sample sets had some results that measured iron in the rage of 2.3 to 3.4 mg/L even though those solutions should not have contained iron at those levels.

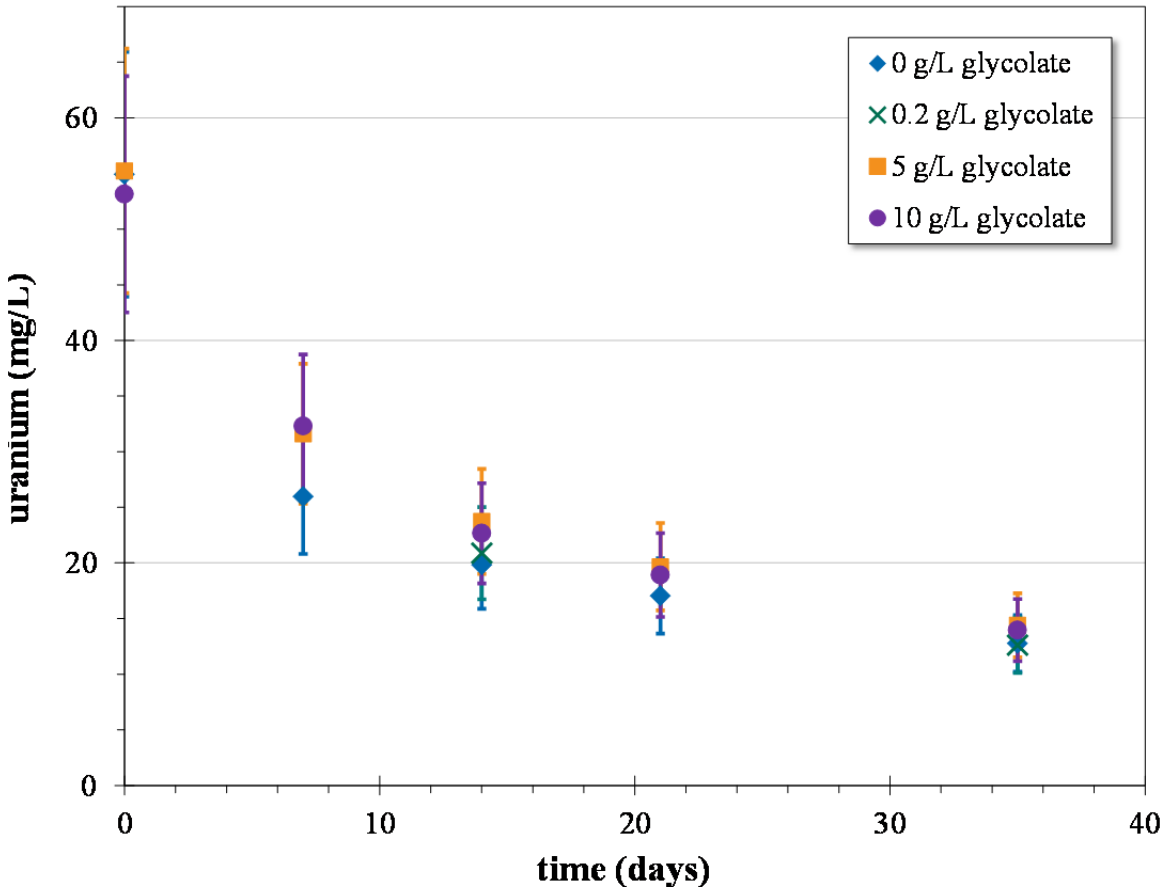

Figure 3-3. Influence of glycolate on soluble uranium concentration in SRS Tank Farm actual-waste salt solution in contact with sludge at 50 °C

The uranium concentrations in the unfiltered dip samples and VDS samples combined for this testing was 58 to 64 mg/L for Tank 43H and 58 to 93 mg/L for Tank 38H.[10,11,12] The initial filtered sample analysis showed a uranium concentration of approximately 54 mg/L.

Figure 3-3 contains the trends for soluble uranium concentration with time and added glycolate concentration. Uranium concentration steadily decreases with time from approximately 54 mg/L in the initial samples (0 days) to approximately 13 mg/L after 35 days of contact with sludge at 50 °C. This indicates that the original Tank 43H and 38H samples were supersaturated with respect to uranium at 50 °C. In these tests, the added sludge and continuous agitation provided good mixing and particulate surface area for nucleation in excess of the typical conditions in Tanks 43H and 38H, allowing for uranium to approach its equilibrium solubility faster than it does in the Tank Farm. The level of glycolate added to the samples did not influence the uranium solubility to an extent beyond the experimental uncertainty. Similar trends are noted for lead, silicon, and rubidium.

The equilibrium soluble concentration of uranium and the equilibrium supernate activity of Pu-238 were examined by plotting the measured values versus the inverse of the time. Because this analysis uses the inverse of the time, the data from the initial samples (0 days) cannot be not used.

Figure 3-4 shows the soluble uranium concentration as a function of inverse time held in contact with sludge at 50 °C. Data for all glycolate concentrations are included and grouped together for this analysis. The y-intercept represents the value that the soluble uranium concentration asymptotically approaches at infinite time, which is the equilibrium concentration. Regardless of the presence of glycolate, the data show that the equilibrium solubility of uranium in contact with sludge at 50 °C is approximately 6.6 mg/L. For comparison, using the salt solution data in Table 3-3 in the uranium solubility models for solutions equilibrated for six months, the predicted uranium solubility is 6.7 mg/L.[16] This actual waste result matches the previously developed model much better than expected when considering the experimental uncertainties.

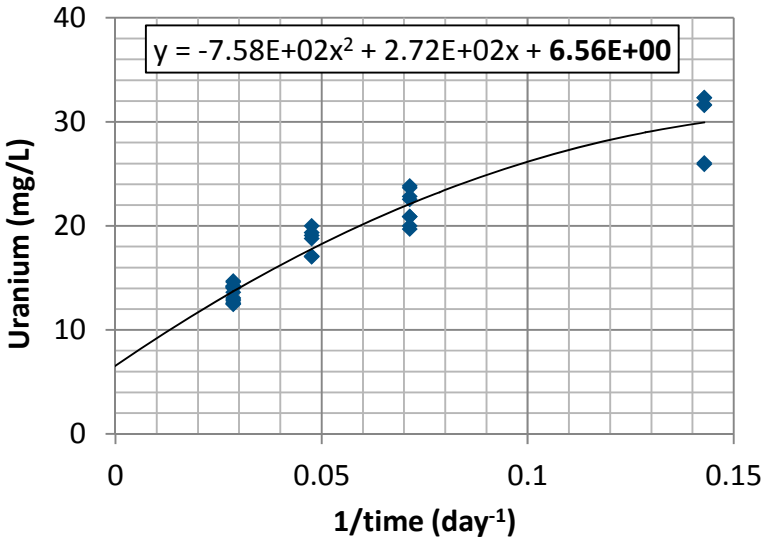

Figure 3-4. Evaluation of the equilibrium solubility of uranium in 2H Evaporator salt solution testing at 50 °C

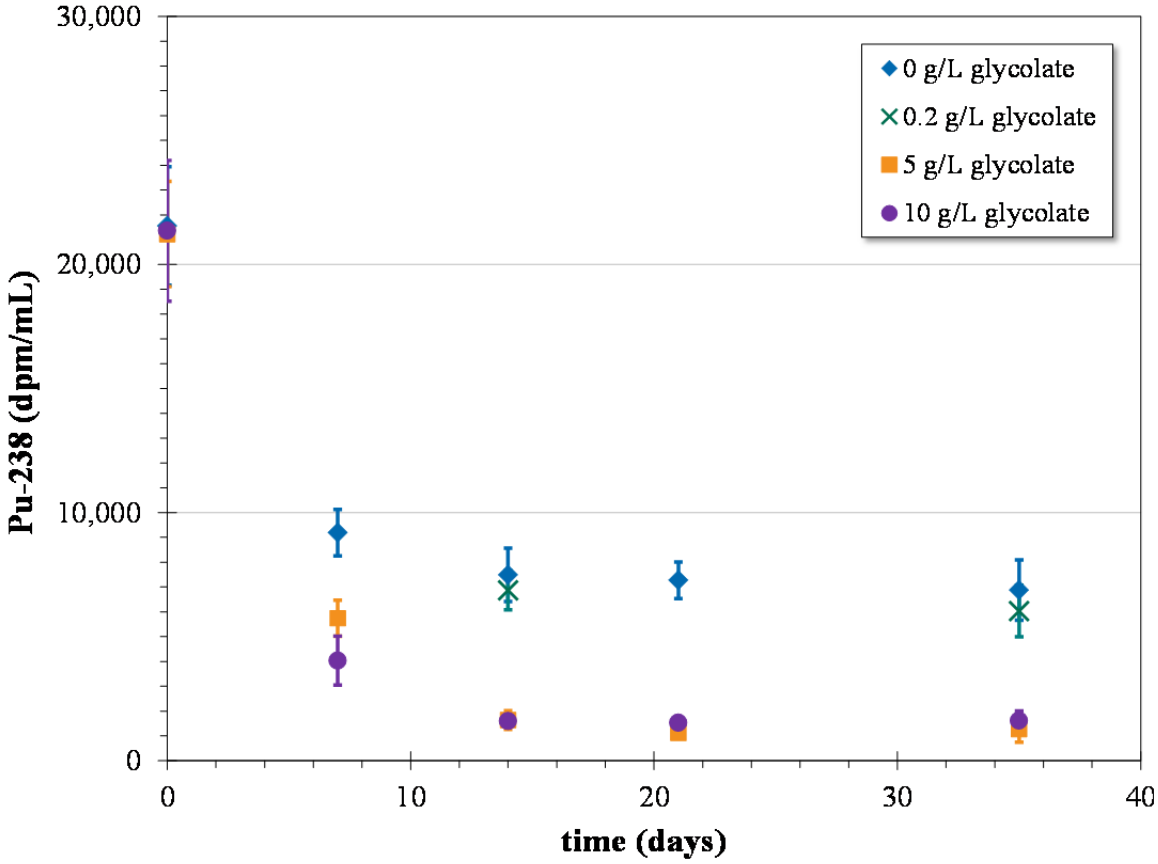

Figure 3-5. Influence of glycolate on soluble Pu-238 activity in SRS Tank Farm actual-waste salt solution in contact with sludge at 50 °C

From Figure 3-5, it is clear that plutonium was also supersaturated at 50 °C in the Tank 43H and 38H material. Within the first seven days of testing, the soluble plutonium-238 activity dropped from around 21,000 dpm/mL to levels below 10,000 dpm/mL. In contrast to the observed solubility for uranium, however, the soluble activity of plutonium-238 exhibited a relationship to the added glycolate concentration. Glycolate appeared to suppress the solubility of plutonium at these conditions, with the plutonium-238 activity over four-times lower for the 5 g/L and 10 g/L added glycolate levels than for the 0 g/L and 0.2 g/L added glycolate levels at equilibration times of 14 days and greater.

The equilibrium plutionium-238 activity for 0 g/L and 0.2 g/L are roughly in the range of 5000 to 7000 dpm/mL. With the inclusion of 5 g/L and 10 g/L glycolate, the soluble plutonium-238 activity seems to stabilize around approximately 1500 dpm/mL during the timeframe of this experiment.

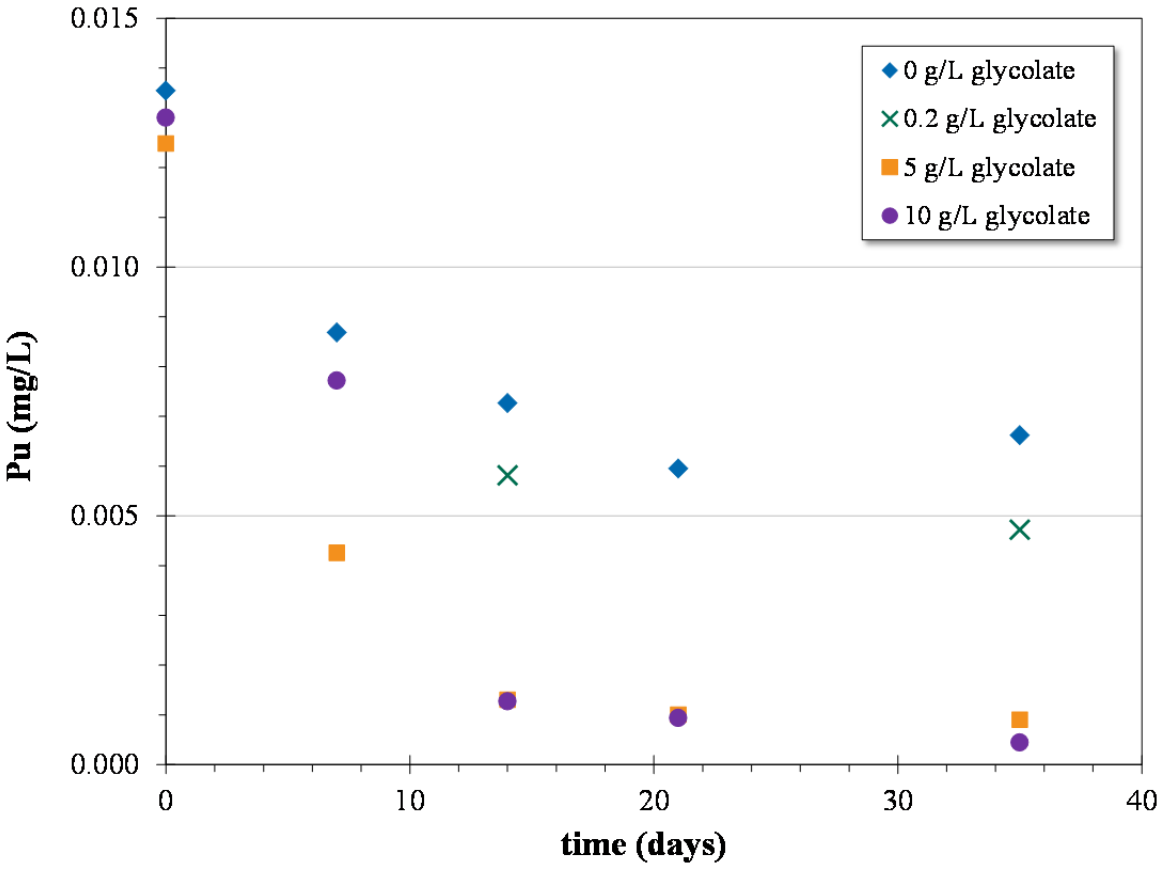

Figure 3-6. Influence of glycolate on soluble plutonium concentration in SRS Tank Farm actual-waste salt solution in contact with sludge at 50 °C

The plutionium-238 activity in Figure 3-5 is not a true solubility because the other isotopes of plutonium (i.e., plutionium-239 and plutionium-240) have a major impact on the concentration of plutonium on a mass basis. Making the assumption that the isotopic ratio of plutionium-239 to plutionium-240 are the same in the supernatant solution as they are in the Tank 51H sludge, the plutonium concentration was calculated on a mass basis and plotted in Figure 3-6. The same trends are evident when looking at the total plutonium mass that were noted for the Pu-238 activity: plutonium appeared to be supersaturated in the initial salt solution and the addition of sodium glycolate appeared to suppress the solubility of plutonium. Because the Pu-239/240 results had greater uncertainty than the Pu-238 results, the uncertainty of the data in Figure 3-6 is greater than that for the data in Figure 3-5.

Table 3-4. Analysis of reference solutions run with 0 day, 14 day and 35 day sample sets

analyte	0 g/L glycolate (reference soluiton 1)					10 g/L glycolate (reference solution 2)				
	recipe	previous[a]	0 days	14 days	35 days	recipe	previous[a]	0 days	14 days	35 days
Na^+	**1.51E+05**	1.31E+05	1.49E+05	1.50E+05	1.50E+05	**1.51E+05**	1.34E+05	1.50E+05	1.53E+05	1.53E+05
K^+	**0**	6.18E+00	*< 3.05E+01*	*< 3.05E+01*	3.37E+01	**0**	6.37E+00	5.30E+01	5.82E+01	*< 3.06E+01*
OH^-	**4.61E+04**	4.29E+04	4.06E+04	--	--	**4.61E+04**	4.47E+04	3.53E+04	--	--
NO_2^-	**8.19E+04**	8.60E+04	8.03E+04	8.16E+04	--	**7.58E+04**	8.04E+04	6.40E+04	6.40E+04	--
NO_3^-	**6.57E+04**	6.73E+04	6.54E+04	6.35E+04	--	**6.57E+04**	6.80E+04	5.36E+04	5.33E+04	--
CO_3^{2-}	**2.72E+04**	2.34E+04	2.78E+04	--	3.00E+04	**2.72E+04**	2.36E+04	2.35E+04	--	2.51E+04
AlO_2^-	**2.24E+03**	2.22E+03	2.31E+03	2.34E+03	2.30E+03	**2.24E+03**	2.19E+03	2.34E+03	2.36E+03	2.31E+03
CHO_2^-	**1.59E+03**	1.63E+03	1.65E+03	1.61E+03	--	**1.59E+03**	1.85E+03	1.37E+03	1.37E+03	--
SO_4^{2-}	**6.16E+02**	5.73E+02	1.68E+03	1.67E+03	--	**6.16E+02**	5.72E+02	1.37E+03	1.50E+03	--
PO_4^{3-}	**1.30E+02**	1.67E+02	3.82E+02	3.41E+02	--	**1.30E+02**	1.60E+02	3.01E+02	2.74E+02	--
$C_2O_4^{2-}$	**1.67E+02**	*< 1.00E+03*	1.36E+02	1.36E+02	--	**1.67E+02**	*< 1.00E+03*	1.50E+02	1.50E+02	--
$C_2H_3O^{3-}$	**0**	*< 1.00E+03*	*< 6.82E+02*	*< 1.36E+03*	*< 1.36E+03*	**1.00E+04**	9.88E+03	8.86E+03	7.44E+03	7.77E+03
TOC	**n/a**	5.22E+02	3.92E+02	--	4.26E+02	**n/a**	3.01E+03	2.82E+03	--	2.98E+03
Ca	**0**	1.63E+00	4.10E+00	3.32E+00	3.63E+00	**0**	1.81E+00	4.88E+00	4.11E+00	4.34E+00
Fe	**0**	*< 1.00E-01*	*< 1.58E+00*	*< 1.58E+00*	*< 1.58E+00*	**0**	3.60E-01	2.30E+00	3.37E+00	*< 1.58E+00*
Li	**0**	n/a	*< 8.84E-01*	9.48E-01	*< 8.84E-01*	**0**	n/a	1.39E+00	1.77E+00	*< 8.87E-01*
Mg	**0**	n/a	6.34E-01	6.47E-01	6.22E-01	**0**	n/a	1.13E+00	1.20E+00	1.11E+00
Mn	**0**	*< 1.00E-01*	*< 9.87E-01*	*< 9.87E-01*	*< 9.87E-01*	**0**	*< 1.00E-01*	*< 9.90E-01*	*< 9.90E-01*	*< 9.90E-01*
Si	**0**	2.93E+00	*< 5.10E+00*	*< 5.10E+00*	*< 5.10E+00*	**0**	2.38E+00	1.01E+01	5.32E+00	*< 5.12E+00*

[a] analysis performed by Process Science Analytical Laboratory (PSAL) and reported in Table 4 of Reference 6

Two reference solutions were submitted for ICP-ES, ICP-MS, IC, titration, and TIC/TOC analysis along with the 0 day, 14 day, and 35 day sample sets. These samples were submitted in an identical manner to the actual samples so that their identity was blind to the analysts. Table 3-4 contains the results for the reference solutions. The 0 g/L and 10 g/L glycolate reference solutions (1 and 2) are the 0 g/L and 10 g/L glycolate Nominal Salt solutions for which the recipes and analysis are reported in Tables 1 and 4, respectively, of Reference 6. The results in the columns labeled “0 days”, “14 days” and “35 days” are the results obtained by SRNL Analytical Development for the same material submitted along with the corresponding sample set.

The results for sodium and aluminum in the reference solutions match the recipe concentrations. The results for most anions were low by comparison to the reference solution recipes. This low bias is more prominent for the 10 g/L glycolate reference material than for the 0 g/L material. Glycolate and oxalate are included in the lower than expected analytical results. One possible factor contributing to a lower measured concentration of glycolate and oxalate is that 4 to 6 months had passed from the time the reference solutions were mixed to the time they were used in this analysis. In contrast, two anions, sulfate and phosphate, were typically measured at more than double their recipe and PSAL analysis concentrations.

Several analytes were measured in the reference samples even though they were not included in the original recipe. Potential causes for these observed analytes are 1) impurities in the chemicals used to make up the reference solutions, 2) impurities in the chemicals used for sample preparation and dilution,

and 3) spurious analytical results. Causes 2 and 3 are of the most concern because they can be considered to apply to the actual samples and reference solutions equally. Of the additional analytes observed in the reference solutions, only calcium and iron were observed on the order of the measurements for the actual samples. Thus, calcium and iron results included in this report may be influenced by sample preparation impurities or otherwise spurious results. Levels of potassium, lithium and silicon measured in the actual samples were sufficiently high as to not be greatly influenced by any implication of the lower results for the reference solutions.

In summary, there is no anticipated impact of up to 10 g/L of glycolate in DWPF recycle to the Tank Farm on tank waste component solubilities as investigated in this test. Uranium and plutonium appear to have been supersaturated in 2H evaporator feed solution mixture used for this testing. As a result, there was a reduction of soluble uranium and plutonium as a function of time. The change in soluble uranium concentration was independent of added glycolate concentration. The change in soluble plutonium content was dependent on the added glycolate concentration, with higher levels of glycolate (5 g/L and 10g/L) appearing to suppress the plutonium solubility.

Most components were not influenced by glycolate during solubility tests. There was potentially a slight increase in soluble iron with added glycolate, but the soluble iron concentration remained so low (on the order of 10 mg/L) as to not be able to impact the iron to fissile ratio in sludge. Prior to this testing, the hypothesized effect of added glycolate on plutonium was that the complexing nature of glycolate would increase the plutonium concentration in the supernate and provide a mechanism to separate plutonium from poisons in the sludge such as iron. However, the observed effect of glycolate on the soluble plutonium is the opposite of the hypothesized effect. Suppression of the already low soluble plutonium concentration in the supernate when glycolate is added is too insignificant to have a credible impact on the iron to fissile ratio in sludge.

4.0 Evaporator Scale Contact Tests

The sodium aluminosilicate contact tests used material analogous to the soluble portions that resulted from the Tank Farm solubility tests and adds actual-waste 2H-evaporator scale to simulate contact in the 2H-evaporator system.

Table 4-1 contains results from the sodium aluminosilicate contact tests. The two major divisions of the 2H-evaporator scale contact tests are tests that included 0 g/L glycolate and tests that included 10 g/L glycolate. The columns labeled "pre-contact" contains the results for a single analysis of the feed to the 2H-evaporator scale contact tests. These feed materials had already been in contact with sludge and held at 50 °C for the desired amount of time. The pre-contact feed materials had yet to contact the 2H-evaporator scale. The columns labeled "post-contact" contain the result averages and RSDs for the characterization of soluble components from triplicate contact tests. The post-contact material resulted from contact with 2H-evaporator scale at 80 °C for a total of either 19 or 20 days. For the 10 g/L level of added glycolate, the glycolate measured in the pre- and post-contact samples were both approximately 6.4 g/L.

Three main types of effects were observed for all components other than plutonium-238. These three effects are 1) no change, 2) an increase in soluble concentration, and 3) a decrease in soluble concentration, and are all independent of the level of added glycolate.

The majority of components did not have a significant change in pre-contact and post-contact concentrations for both 0 g/L and 10 g/L of added glycolate. This was seen for aluminum, boron, chromium, lithium, sodium, sulfur, zinc, sulfate, and hydroxide.

For a significant fraction of the components, there was an increase in the concentration of the component between the pre-contact and post-contact measurements for both 0 g/L and 10 g/L of added glycolate. This corresponds to the dissolution or leaching of components from the 2H-evaporator pot scale. This effect, however, was the same for both 0 g/L and 10 g/L of added glycolate and thus is independent of glycolate content. This was seen for calcium, mercury, potassium, magnesium, phosphorous, uranium, formate, oxalate, nitrate, nitrite, phosphate, carbonate, and TOC.

For some components, there was a decrease in the concentration of the component between the pre-contact and post-contact measurements for both 0 g/L and 10 g/L of added glycolate. This corresponds to the sorption or precipitation of components onto the 2H-evaporator pot scale. This effect, however, was the same for both 0 g/L and 10 g/L of added glycolate and thus is independent of glycolate content. This was typically a very minor effect and was seen for iron, silicon, and technetium-99.

For plutonium-238, the pre-contact starting conditions differed for the 0 g/L and 10 g/L added glycolate levels. This difference is expected based on the tests from the previous section. The post contact levels of soluble plutonium-238 were decreased for both the 0 g/L and 10 g/L added glycolate levels, indicating that sorption or precipitation of plutonium is taking place. The final soluble activity of plutonium-238 differ slightly between the two levels of added glycolate.

In summary, the inclusion of glycolate did not change the dissolution of or sorption onto actual-waste 2H-evaporator pot scale to an extent that will impact Tank Farm storage and concentration. The effects that were noted involved dissolution of components from evaporator scale and precipitation of components onto evaporator scale that were independent of the level of added glycolate.

Table 4-1. Results from testing of sodium aluminosilicate evaporator scale contact with solutions that have contacted sludge, where 0 and 10 g/L glycolate ion are present

Glycolate:		0 g/L			10 g/L		
analyte	units	pre-contact	post-contact average	post-contact RSD	pre-contact	post-contact average	post-contact RSD
Al	mg/L	1.33E+03	1.29E+03	6.6%	1.26E+03	1.35E+03	11.9%
B	mg/L	1.16E+02	1.18E+02	3.0%	1.12E+02	1.23E+02	6.1%
Ca	mg/L	9.78E+00	1.41E+01	25.8%	1.24E+01	1.72E+01	10.7%
Cr	mg/L	4.78E+01	4.66E+01	4.5%	4.78E+01	5.03E+01	2.8%
Fe	mg/L	6.71E+00	≤1.41E+00 [a]	--	3.17E+00	≤2.48E+00 [a]	--
Hg	mg/L	2.19E+02	3.47E+02	4.2%	1.52E+02	2.48E+02	7.9%
K	mg/L	2.74E+02	3.39E+02	9.8%	2.71E+02	3.86E+02	10.5%
Li	mg/L	4.55E+01	4.49E+01	2.6%	4.36E+01	4.63E+01	5.9%
Mg	mg/L	2.62E-01	3.48E-01	11.9%	3.66E-01	5.67E-01	33.0%
Na	mg/L	1.33E+05	1.30E+05	3.0%	1.30E+05	1.39E+05	6.0%
P	mg/L	1.22E+02	1.36E+02	4.0%	1.13E+02	1.41E+02	10.6%
S	mg/L	*< 1.12E+03*	1.12E+03	14.0%	*< 1.10E+03*	1.05E+03	23.0%
Si	mg/L	4.08E+01	3.46E+01	1.6%	4.08E+01	3.45E+01	2.4%
Zn	mg/L	5.23E+00	5.42E+00	1.2%	5.05E+00	5.37E+00	5.1%
Tc-99	mg/L	1.09E+00	9.94E-01	10.0%	1.12E+00	8.67E-01	6.5%
U-238	mg/L	2.59E+00	6.39E+00	9.4%	5.84E+00	6.90E+00	3.9%
Pu-238	dpm/mL	4.05E+03	4.38E+02 [b]	23.2%	7.27E+02	2.84E+02 [c]	44.9%
$C_2H_3O_3^-$	mg/L	*< 7.90E+02*	*< 5.73E+02*	--	6.36E+03	6.39E+03	6.6%
CHO_2^-	mg/L	1.42E+03	1.48E+03	1.6%	3.71E+03	4.50E+03	6.6%
$C_2O_4^{2-}$	mg/L	3.64E+02	5.54E+02	1.4%	7.52E+02	1.37E+03	9.7%
NO_2^-	mg/L	6.76E+04	7.10E+04	2.0%	6.71E+04	7.42E+04	6.5%
NO_3^-	mg/L	5.17E+04	5.65E+04	6.9%	5.14E+04	5.72E+04	6.3%
SO_4^{2-}	mg/L	2.02E+03	1.99E+03	2.6%	1.96E+03	2.03E+03	5.6%
PO_4^{3-}	mg/L	2.69E+02	2.94E+02	2.5%	2.66E+02	3.13E+02	6.1%
OH^-	M	2.17E+00	2.12E+00	3.1%	2.07E+00	2.08E+00	6.7%
CO_3^{2-}	mg/L	2.23E+04	2.37E+04	2.2%	2.48E+04	2.89E+04	7.7%
TOC	mg/L	6.64E+02	1.16E+03	10.4%	3.51E+03	4.54E+03	9.7%

[a] Fe values combine measurements just above the detection limit with below detection limit values and thus have a high level of uncertainty.
[b] post contact Pu-238 values are near the detection limit and have a high level of uncertainty.
[c] post contact Pu-238 values are near the detection limit and have a high level of uncertainty and include one measurement that is an "upper limit" value due to potential interferences.

5.0 Conclusions

There is no anticipated impact of up to 10 g/L of glycolate in DWPF recycle to the Tank Farm on tank waste component solubilities as investigated in this test.

Most components were not influenced by glycolate during solubility tests, including major components such as aluminum, sodium, and most salt anions. There was potentially a slight increase in soluble iron with added glycolate, but the soluble iron concentration remained so low (on the order of 10 mg/L) as to not impact the iron to fissile ratio in sludge.

Uranium and plutonium appear to have been supersaturated in 2H-evaporator feed solution mixture used for this testing. As a result, there was a reduction of soluble uranium and plutonium as a function of time. The change in soluble uranium concentration was independent of added glycolate concentration. The change in soluble plutonium content was dependent on the added glycolate concentration, with higher levels of glycolate (5 g/L and 10 g/L) appearing to suppress the plutonium solubility.

The inclusion of glycolate did not change the dissolution of or sorption onto actual-waste 2H-evaporator pot scale to an extent that will impact Tank Farm storage and concentration. The effects that were noted involved dissolution of components from evaporator scale and precipitation of components onto evaporator scale that were independent of the level of added glycolate.

6.0 Quality Assurance

Data are recorded in the SRNL electronic laboratory notebook system as experiments A6583-00032-12, A6583-00032-15 and A6583-00032-16. This report received a technical review by means of Design Verification by Document Review. Requirements for performing reviews of technical reports and the extent of review are established in manual E7 2.60. SRNL documents the extent and type of review using the SRNL Technical Report Design Checklist contained in WSRC-IM-2002-00011, Rev. 2.

7.0 Recommendations

Results from other portions of glycolic acid flowsheet testing should be monitored to determine if they challenge any of the assumptions in this study. The major assumptions are that the maximum glycolate concentration sent to the Tank Farm will be 10 g/L and that there are no major new organics beyond what is typical in SRS waste sent to the Tank Farm as a result of the breakdown or polymerization of glycolic acid. If it is confirmed through experimentation that a large amount of glycolate is contained in the DWPF recycle stream to the Tank Farm (i.e., 10 g/L), collecting further information on the decomposition of sodium glycolate within the SRS Tank Farm may be warranted (i.e., additional tests or waste sampling).

8.0 References

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Appendix A. Results for Replicate Analyses

Table A-1. Analysis results of acid dilutions of sludge contact tests

hold time (days)	0	0	Standard 1	0	0	0	0	Standard 2	7	7	7	7	7	7
glycolate (g/L)	0	0	0	5	5	10	10	10	0	0	5	5	10	10
DF (mL/mL)	10.11	10.32	12.70	10.90	10.44	10.95	12.13	12.70	10.75	10.73	9.49	9.55	8.83	9.22
LIMS numbers	300303312	300303313	300303314	300303315	300303316	300303317	300303318	300303319	300303297	300303298	300303299	300303300	300303301	300303302
	300303320	300303321		300303322	300303323	300303324	300303325		300303303	300303304	300303305	300303306	300303307	300303308
ICP-ES (mg/L) - nominal uncertanty = 10%														
Ag	< 1.13E+00	< 1.16E+00	< 1.42E+00	< 1.22E+00	< 1.17E+00	< 1.23E+00	< 1.36E+00	< 1.42E+00	< 1.20E+00	< 1.20E+00	< 1.06E+00	< 1.07E+00	< 9.89E-01	< 1.03E+00
Al	9.18E+02	9.24E+02	1.04E+03	9.19E+02	9.16E+02	9.22E+02	9.27E+02	1.06E+03	9.09E+02	9.15E+02	9.19E+02	9.39E+02	9.18E+02	9.13E+02
B	1.17E+02	1.18E+02	< 2.53E+00	1.18E+02	1.18E+02	1.18E+02	1.20E+02	< 2.53E+00	1.21E+02	1.21E+02	1.21E+02	1.20E+02	1.19E+02	1.20E+02
Ba	< 5.36E-01	< 5.47E-01	< 6.73E-01	< 5.78E-01	< 5.53E-01	< 5.80E-01	< 6.43E-01	< 6.73E-01	< 5.70E-01	< 5.69E-01	< 5.03E-01	< 5.06E-01	< 4.68E-01	< 4.89E-01
Be	< 1.21E-01	< 1.24E-01	< 1.52E-01	< 1.31E-01	< 1.25E-01	< 1.31E-01	< 1.46E-01	< 1.52E-01	< 1.29E-01	< 1.29E-01	< 1.14E-01	< 1.15E-01	< 1.06E-01	< 1.11E-01
Ca	3.29E+00	4.18E+00	4.06E+00	2.02E+00	1.93E+00	2.46E+00	2.47E+00	4.82E+00	1.45E+00	1.77E+00	1.84E+00	1.92E+00	2.13E+00	2.65E+00
Cd	< 1.45E+00	< 1.48E+00	< 1.82E+00	< 1.56E+00	< 1.49E+00	< 1.57E+00	< 1.73E+00	< 1.82E+00	< 1.54E+00	< 1.53E+00	< 1.36E+00	< 1.37E+00	< 1.26E+00	< 1.32E+00
Ce	< 8.28E+00	< 8.45E+00	< 1.04E+01	< 8.93E+00	< 8.55E+00	< 8.97E+00	< 9.93E+00	< 1.04E+01	< 8.81E+00	< 8.79E+00	< 7.77E+00	< 7.82E+00	< 7.23E+00	< 7.55E+00
Co	< 1.87E+00	< 1.91E+00	< 2.35E+00	< 2.02E+00	< 1.93E+00	< 2.03E+00	< 2.24E+00	< 2.35E+00	< 1.99E+00	< 1.99E+00	< 1.76E+00	< 1.77E+00	< 1.63E+00	< 1.71E+00
Cr	4.51E+01	4.52E+01	< 2.83E+00	4.54E+01	4.52E+01	4.53E+01	4.60E+01	< 2.83E+00	4.64E+01	4.69E+01	4.73E+01	4.72E+01	4.73E+01	4.74E+01
Cu	< 3.00E+00	< 3.06E+00	< 3.77E+00	< 3.24E+00	< 3.10E+00	< 3.25E+00	< 3.60E+00	< 3.77E+00	< 3.19E+00	< 3.19E+00	< 2.82E+00	< 2.84E+00	< 2.62E+00	< 2.74E+00
Fe	3.42E+01	2.74E+01	< 1.56E+00	4.24E+00	4.79E+00	4.68E+00	7.23E+00	2.27E+00	3.80E+00	2.67E+00	4.90E+00	7.61E+00	7.36E+00	1.07E+01
Gd	< 2.40E+00	< 2.45E+00	< 3.01E+00	< 2.58E+00	< 2.47E+00	< 2.60E+00	< 2.87E+00	< 3.01E+00	< 2.55E+00	< 2.54E+00	< 2.25E+00	< 2.26E+00	< 2.09E+00	< 2.18E+00
K	2.40E+02	2.45E+02	< 3.02E+01	2.57E+02	2.72E+02	2.78E+02	2.77E+02	5.23E+01	2.41E+02	2.52E+02	2.56E+02	2.72E+02	2.87E+02	2.93E+02
La	< 1.27E+00	< 1.30E+00	< 1.60E+00	< 1.37E+00	< 1.32E+00	< 1.38E+00	< 1.53E+00	< 1.60E+00	< 1.35E+00	< 1.35E+00	< 1.20E+00	< 1.20E+00	< 1.11E+00	< 1.16E+00
Li	5.09E+01	5.06E+01	< 8.76E-01	4.97E+01	5.00E+01	5.03E+01	5.01E+01	1.37E+00	5.11E+01	5.09E+01	5.08E+01	5.08E+01	5.07E+01	5.10E+01
Mg	1.42E-01	1.96E-01	6.28E-01	< 1.09E-01	< 1.04E-01	1.64E-01	< 1.21E-01	1.12E+00	1.02E-01	1.13E-01	9.49E-02	2.48E-01	1.06E-01	1.61E-01
Mn	< 7.78E-01	< 7.94E-01	< 9.78E-01	< 8.40E-01	< 8.04E-01	< 8.43E-01	< 9.34E-01	< 9.78E-01	< 1.72E-01	< 1.72E-01	1.99E-01	2.96E-01	7.68E-01	1.00E+00
Mo	< 9.94E+00	< 1.01E+01	< 1.25E+01	< 1.07E+01	< 1.03E+01	< 1.08E+01	< 1.19E+01	< 1.25E+01	< 1.06E+01	< 1.05E+01	< 9.33E+00	< 9.39E+00	< 8.68E+00	< 9.06E+00
Na	1.34E+05	1.33E+05	1.47E+05	1.34E+05	1.35E+05	1.36E+05	1.36E+05	1.49E+05	1.34E+05	1.34E+05	1.36E+05	1.35E+05	1.33E+05	1.36E+05
Ni	< 2.09E+00	< 2.14E+00	< 2.63E+00	< 2.26E+00	< 2.16E+00	< 2.27E+00	< 2.51E+00	< 2.63E+00	< 2.23E+00	< 2.22E+00	< 1.97E+00	< 1.98E+00	< 1.83E+00	< 1.91E+00
P	1.18E+02	1.18E+02	1.40E+02	1.17E+02	1.21E+02	1.20E+02	1.24E+02	1.38E+02	1.26E+02	1.31E+02	1.33E+02	1.31E+02	1.34E+02	1.33E+02
Pb	< 8.27E+00	< 8.44E+00	< 1.04E+01	< 8.92E+00	< 8.54E+00	< 8.96E+00	< 9.92E+00	< 1.04E+01	< 4.96E+01	< 4.95E+01	< 4.38E+01	< 4.40E+01	< 4.07E+01	< 4.25E+01
S	8.95E+02	8.58E+02	< 7.62E+02	9.56E+02	8.77E+02	9.38E+02	9.53E+02	< 7.62E+02	9.71E+02	9.93E+02	1.01E+03	1.00E+03	9.97E+02	1.00E+03
Sb	< 3.49E+01	< 3.56E+01	< 4.38E+01	< 3.76E+01	< 3.60E+01	< 3.78E+01	< 4.18E+01	< 4.38E+01	< 3.71E+01	< 3.70E+01	< 3.28E+01	< 3.30E+01	< 3.05E+01	< 3.18E+01
Si	1.98E+02	1.96E+02	< 5.05E+00	2.00E+02	1.98E+02	2.22E+02	2.13E+02	9.94E+00	9.14E+01	9.01E+01	9.22E+01	9.08E+01	9.00E+01	8.96E+01
Sn	< 1.19E+01	< 1.22E+01	< 1.50E+01	< 1.29E+01	< 1.23E+01	< 1.29E+01	< 1.43E+01	< 1.50E+01	< 1.59E+01	< 1.59E+01	< 1.40E+01	< 1.41E+01	< 1.31E+01	< 1.36E+01
Sr	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 5.38E-02	< 5.37E-02	< 4.75E-02	< 4.78E-02	< 4.41E-02	< 4.61E-02
Th	< 5.18E+00	< 5.28E+00	< 6.50E+00	< 5.58E+00	< 5.34E+00	< 5.61E+00	< 6.21E+00	< 6.50E+00	< 5.50E+00	< 5.49E+00	< 4.86E+00	< 4.89E+00	< 4.52E+00	< 4.72E+00
Ti	< 5.86E-01	< 5.98E-01	< 7.36E-01	< 6.32E-01	< 6.05E-01	< 6.35E-01	< 7.03E-01	< 7.36E-01	< 6.24E-01	< 6.22E-01	< 5.51E-01	< 5.54E-01	< 5.12E-01	< 5.35E-01
U	5.21E+01	5.16E+01	< 4.09E+01	6.00E+01	5.58E+01	5.60E+01	5.87E+01	< 4.09E+01	3.86E+01	5.43E+01	4.59E+01	4.69E+01	4.14E+01	5.31E+01
V	< 6.37E-01	< 6.50E-01	< 8.00E-01	< 6.87E-01	< 6.58E-01	< 6.90E-01	< 7.64E-01	< 8.00E-01	< 6.77E-01	< 6.76E-01	< 5.98E-01	< 6.02E-01	< 5.56E-01	< 5.81E-01
Zn	6.30E+00	6.62E+00	< 9.52E-01	5.03E+00	4.93E+00	5.08E+00	5.02E+00	< 9.52E-01	5.09E+00	5.22E+00	5.38E+00	5.59E+00	5.58E+00	5.68E+00
Zr	< 4.95E-01	< 5.06E-01	< 6.22E-01	< 5.34E-01	< 5.11E-01	< 5.37E-01	< 5.94E-01	< 6.22E-01	< 5.27E-01	< 5.26E-01	< 4.65E-01	< 4.68E-01	< 4.32E-01	< 4.52E-01
PuTTA - nominal counting uncertanty ~ 7% for Pu-238, ~ 20% for Pu239/240														
Pu-238	2.08E+04	2.23E+04		2.13E+04	2.12E+04	2.00E+04	2.27E+04		9.31E+03	9.08E+03	5.42E+03	6.07E+03	3.40E+03	4.67E+03
Pu-239/240	2.00E+03	2.46E+03		2.06E+03	2.04E+03	2.11E+03	2.16E+03		1.41E+03	1.49E+03	4.89E+02	9.21E+02	1.91E+03	7.08E+02

Table A-1. (contd.)

hold time (days)	14	14	Standard 1	14	14	14	14	Standard 2	14	14	21	21	21	21	21	21
glycolate (g/L)	0	0	0	5	5	10	10	10	0.2	0.2	0	0	5	5	10	10
DF (mL/mL)	10.44	10.89	12.70	9.77	9.80	9.31	10.10	12.70	11.77	10.41	11.26	10.68	9.35	10.07	11.21	11.60
LIMS numbers	300303331	300303332	300303333	300303334	300303335	300303336	300303337	300303338	300303339	300303340	300303355	300303356	300303357	300303358	300303359	300303360
	300303341	300303342		300303343	300303344	300303345	300303346		300303347	300303348	300303361	300303362	300303363	300303364	300303365	300303366
ICP-ES (mg/L) - nominal uncertanty = 10%																
Ag	< 1.17E+00	< 1.22E+00	< 1.42E+00	< 1.09E+00	< 1.10E+00	< 1.04E+00	< 1.13E+00	< 1.42E+00	< 1.32E+00	< 1.17E+00	< 1.26E+00	< 1.20E+00	< 1.05E+00	< 1.13E+00	< 1.26E+00	< 1.30E+00
Al	9.09E+02	9.13E+02	1.06E+03	9.02E+02	9.09E+02	9.00E+02	9.07E+02	1.07E+03	9.21E+02	9.23E+02	9.21E+02	9.30E+02	9.21E+02	9.23E+02	9.22E+02	9.07E+02
B	1.23E+02	1.24E+02	< 2.53E+00	1.22E+02	1.23E+02	1.21E+02	1.22E+02	< 2.53E+00	1.26E+02	1.25E+02	1.22E+02	1.24E+02	1.22E+02	1.23E+02	1.23E+02	1.23E+02
Ba	< 5.53E-01	< 5.77E-01	< 6.73E-01	< 5.18E-01	< 5.20E-01	< 4.94E-01	< 5.36E-01	< 6.73E-01	< 6.24E-01	< 5.52E-01	< 5.97E-01	< 5.66E-01	< 4.96E-01	< 5.34E-01	< 5.94E-01	< 6.15E-01
Be	< 1.25E-01	< 1.31E-01	< 1.52E-01	< 1.17E-01	< 1.18E-01	< 1.12E-01	< 1.21E-01	< 1.52E-01	< 1.41E-01	< 1.25E-01	< 1.35E-01	< 1.28E-01	< 1.12E-01	< 1.21E-01	< 1.34E-01	< 1.39E-01
Ca	1.70E+00	1.37E+00	3.29E+00	1.50E+00	1.42E+00	1.80E+00	1.87E+00	4.06E+00	1.89E+00	1.92E+00	1.86E+00	1.78E+00	1.97E+00	1.95E+00	2.49E+00	2.54E+00
Cd	< 8.45E-01	< 8.82E-01	< 1.03E+00	< 7.91E-01	< 7.94E-01	< 7.54E-01	< 8.18E-01	< 1.03E+00	< 9.53E-01	< 8.44E-01	< 1.61E+00	< 1.53E+00	< 1.34E+00	< 1.44E+00	< 1.60E+00	< 1.66E+00
Ce	< 8.55E+00	< 8.92E+00	< 1.04E+01	< 8.00E+00	< 8.03E+00	< 7.63E+00	< 8.28E+00	< 1.04E+01	< 9.64E+00	< 8.53E+00	< 9.22E+00	< 8.75E+00	< 7.66E+00	< 8.25E+00	< 9.18E+00	< 9.50E+00
Co	< 1.93E+00	< 2.01E+00	< 2.35E+00	< 1.81E+00	< 1.81E+00	< 1.72E+00	< 1.87E+00	< 2.35E+00	< 2.18E+00	< 1.93E+00	< 2.08E+00	< 1.98E+00	< 1.73E+00	< 1.86E+00	< 2.07E+00	< 2.15E+00
Cr	4.54E+01	4.57E+01	< 2.83E+00	4.58E+01	4.60E+01	4.61E+01	4.61E+01	< 2.83E+00	4.64E+01	4.63E+01	4.64E+01	4.67E+01	4.71E+01	4.71E+01	4.77E+01	4.70E+01
Cu	1.18E+00	1.14E+00	< 1.24E+00	1.38E+00	1.43E+00	1.61E+00	1.43E+00	< 1.24E+00	1.20E+00	1.11E+00	< 3.34E+00	< 3.17E+00	< 2.78E+00	< 2.99E+00	< 3.33E+00	< 3.45E+00
Fe	3.61E+00	2.46E+00	< 1.56E+00	5.58E+00	5.62E+00	8.66E+00	9.66E+00	3.33E+00	2.12E+00	2.34E+00	2.21E+00	3.64E+00	8.29E+00	5.75E+00	8.11E+00	7.74E+00
Gd	< 2.47E+00	< 2.58E+00	< 3.01E+00	< 2.32E+00	< 2.32E+00	< 2.21E+00	< 2.39E+00	< 3.01E+00	< 2.79E+00	< 2.47E+00	< 2.67E+00	< 2.53E+00	< 2.22E+00	< 2.39E+00	< 2.66E+00	< 2.75E+00
K	2.54E+02	2.62E+02	< 3.02E+01	2.81E+02	2.95E+02	3.10E+02	3.12E+02	5.75E+01	2.99E+02	3.04E+02	2.48E+02	2.48E+02	2.70E+02	2.80E+02	2.70E+02	2.77E+02
La	< 1.31E+00	< 1.37E+00	< 1.60E+00	< 1.23E+00	< 1.24E+00	< 1.17E+00	< 1.27E+00	< 1.60E+00	< 1.48E+00	< 1.31E+00	< 1.42E+00	< 1.35E+00	< 1.18E+00	< 1.27E+00	< 1.41E+00	< 1.46E+00
Li	5.07E+01	5.07E+01	9.39E-01	5.06E+01	5.09E+01	4.97E+01	4.98E+01	1.75E+00	5.11E+01	5.08E+01	5.02E+01	5.08E+01	5.01E+01	4.99E+01	5.04E+01	4.98E+01
Mg	1.46E-01	< 1.09E-01	6.41E-01	< 9.77E-02	< 9.80E-02	< 9.31E-02	< 1.01E-01	1.18E+00	1.94E-01	1.56E-01	< 1.13E-01	< 1.07E-01	< 9.35E-02	< 1.01E-01	< 1.12E-01	< 1.16E-01
Mn	< 8.04E-01	< 8.38E-01	< 9.78E-01	< 7.52E-01	< 7.55E-01	< 7.17E-01	< 7.78E-01	< 9.78E-01	< 9.06E-01	< 8.02E-01	< 8.67E-01	< 8.23E-01	< 7.20E-01	< 7.75E-01	< 8.63E-01	< 8.93E-01
Mo	< 1.03E+01	< 1.07E+01	< 1.25E+01	< 9.60E+00	< 9.64E+00	< 9.16E+00	< 9.93E+00	< 1.25E+01	< 1.16E+01	< 1.02E+01	< 1.11E+01	< 1.05E+01	< 9.19E+00	< 9.90E+00	< 1.10E+01	< 1.14E+01
Na	1.34E+05	1.34E+05	1.49E+05	1.36E+05	1.33E+05	1.36E+05	1.36E+05	1.51E+05	1.37E+05	1.36E+05	1.36E+05	1.36E+05	1.36E+05	1.37E+05	1.38E+05	1.39E+05
Ni	< 2.16E+00	< 2.25E+00	< 2.63E+00	< 2.02E+00	< 2.03E+00	< 1.93E+00	< 2.09E+00	< 2.63E+00	< 2.44E+00	< 2.16E+00	< 2.33E+00	< 2.21E+00	< 1.94E+00	< 2.08E+00	< 2.32E+00	< 2.40E+00
P	1.27E+02	1.28E+02	1.59E+02	1.32E+02	1.32E+02	1.31E+02	1.31E+02	1.60E+02	1.37E+02	1.32E+02	1.34E+02	1.31E+02	1.35E+02	1.38E+02	1.29E+02	1.30E+02
Pb	< 8.54E+00	< 8.91E+00	< 1.04E+01	< 7.99E+00	< 8.02E+00	< 7.62E+00	< 8.27E+00	< 1.04E+01	< 9.63E+00	< 8.52E+00	< 9.21E+00	< 8.74E+00	< 7.65E+00	< 8.24E+00	< 9.17E+00	< 9.49E+00
S	9.93E+02	1.10E+03	< 7.62E+02	1.06E+03	1.08E+03	1.07E+03	1.07E+03	< 7.62E+02	1.01E+03	1.09E+03	1.06E+03	1.02E+03	1.21E+03	9.35E+02	1.01E+03	1.16E+03
Sb	< 3.60E+01	< 3.76E+01	< 4.38E+01	< 3.37E+01	< 3.38E+01	< 3.21E+01	< 3.49E+01	< 4.38E+01	< 4.06E+01	< 3.59E+01	< 3.88E+01	< 3.69E+01	< 3.23E+01	< 3.47E+01	< 3.87E+01	< 4.00E+01
Si	7.57E+01	7.79E+01	< 5.05E+00	7.72E+01	8.08E+01	7.71E+01	9.62E+01	5.26E+00	7.80E+01	7.71E+01	6.92E+01	7.12E+01	6.94E+01	6.91E+01	6.78E+01	6.64E+01
Sn	< 1.54E+01	< 1.61E+01	< 1.88E+01	< 1.45E+01	< 1.45E+01	< 1.38E+01	< 1.50E+01	< 1.88E+01	< 1.74E+01	< 1.54E+01	< 1.67E+01	< 1.58E+01	< 1.38E+01	< 1.49E+01	< 1.66E+01	< 1.72E+01
Sr	< 5.22E-02	< 5.44E-02	< 6.35E-02	< 4.88E-02	< 4.90E-02	< 4.66E-02	< 5.05E-02	< 6.35E-02	< 5.88E-02	< 5.21E-02	< 5.63E-02	< 5.34E-02	< 4.68E-02	< 5.03E-02	< 5.60E-02	< 5.80E-02
Th	< 5.34E+00	< 5.57E+00	< 6.50E+00	< 5.00E+00	< 5.02E+00	< 4.77E+00	< 5.17E+00	< 6.50E+00	< 6.03E+00	< 5.33E+00	< 5.76E+00	< 5.47E+00	< 4.79E+00	< 5.15E+00	< 5.74E+00	< 5.94E+00
Ti	< 6.05E-01	< 6.31E-01	< 7.36E-01	< 5.67E-01	< 5.69E-01	< 5.40E-01	< 5.86E-01	< 7.36E-01	< 6.83E-01	< 6.04E-01	< 6.53E-01	< 6.20E-01	< 5.42E-01	< 5.84E-01	< 6.50E-01	< 6.73E-01
U	< 6.32E+01	< 6.60E+01	< 7.69E+01	< 5.92E+01	< 5.94E+01	< 5.64E+01	< 6.12E+01	< 7.69E+01	< 7.13E+01	< 6.31E+01	< 6.82E+01	< 6.47E+01	< 5.67E+01	< 6.10E+01	< 6.79E+01	< 7.03E+01
V	< 6.57E-01	< 6.86E-01	< 8.00E-01	< 6.15E-01	< 6.18E-01	< 5.87E-01	< 6.37E-01	< 8.00E-01	< 7.41E-01	< 6.56E-01	< 7.09E-01	< 6.73E-01	< 5.89E-01	< 6.34E-01	< 7.06E-01	< 7.31E-01
Zn	5.47E+00	5.49E+00	< 9.52E-01	5.50E+00	5.64E+00	5.59E+00	5.66E+00	< 9.52E-01	5.65E+00	5.92E+00	5.01E+00	5.20E+00	5.43E+00	5.24E+00	5.43E+00	5.26E+00
Zr	< 5.11E-01	< 5.33E-01	< 6.22E-01	< 4.79E-01	< 4.80E-01	< 4.56E-01	< 4.95E-01	< 6.22E-01	< 5.77E-01	< 5.10E-01	< 5.52E-01	< 5.24E-01	< 4.58E-01	< 4.93E-01	< 5.49E-01	< 5.69E-01
PuTTA - nominal counting uncertanty ~ 7% for Pu-238, ~ 20% for Pu239/240																
Pu-238	8.04E+03	6.95E+03		1.40E+03	1.88E+03	1.52E+03	1.67E+03		6.59E+03	7.15E+03	7.21E+03	7.34E+03	1.19E+03	1.06E+03	1.48E+03	1.58E+03
Pu-239/240	1.24E+03	1.19E+03		2.01E+02	2.32E+02	1.87E+02	2.35E+02		9.43E+02	9.93E+02	8.67E+02	1.11E+03	1.65E+02	1.70E+02	1.43E+02	1.65E+02

Table A-1. Analysis results of acid dilutions of sludge contact tests (contd.)

hold time (days)	35	35	Standard 1	35	35	35	35	Standard 2	35	35	35	35	35	35	35	35	56	56
glycolate (g/L)	0	0	0	5	5	10	10	10	0.2	0.2	0	0	5	5	10	10	0	10
DF (mL/mL)	10.74	9.26	12.70	11.78	10.95	12.04	10.23	12.70	9.45	12.27	10.65	10.91	11.65	10.58	10.65	12.28	8.99	10.87
LIMS numbers	300303385	300303386	300303387	300303388	300303389	300303390	300303391	300303392	300303393	300303394	300303395	300303396	300303397	300303398	300303399	300303400		
	300303401	300303402		300303403	300303404	300303405	300303406		300303407	300303408	300303409	300303410	300303411	300303412	300303413	300303414	300303380	300303381
	300308381	300308382									300308383	300308384						
ICP-ES (mg/L) - nominal uncertanty = 10%																		
Ag	< 1.20E+00	< 1.04E+00	< 1.42E+00	< 1.32E+00	< 1.23E+00	< 1.35E+00	< 1.15E+00	< 1.42E+00	< 1.06E+00	< 1.37E+00	< 1.19E+00	< 1.22E+00	< 1.31E+00	< 1.19E+00	< 1.19E+00	< 1.37E+00		
Al	9.53E+02	9.54E+02	1.04E+03	9.45E+02	9.47E+02	9.25E+02	9.27E+02	1.04E+03	9.64E+02	9.58E+02	9.63E+02	9.58E+02	9.44E+02	9.38E+02	9.40E+02	9.33E+02		
B	1.19E+02	1.19E+02	< 2.53E+00	1.16E+02	1.17E+02	1.17E+02	1.16E+02	< 2.53E+00	1.17E+02	1.19E+02	1.21E+02	1.21E+02	1.21E+02	1.20E+02	1.19E+02	1.20E+02		
Ba	< 5.69E-01	< 4.91E-01	< 6.73E-01	< 6.24E-01	< 5.80E-01	< 6.38E-01	< 5.42E-01	< 6.73E-01	< 5.01E-01	< 6.50E-01	< 5.64E-01	< 5.78E-01	< 6.18E-01	< 5.61E-01	< 5.64E-01	< 6.51E-01		
Be	< 1.29E-01	< 1.11E-01	< 1.52E-01	< 1.41E-01	< 1.31E-01	< 1.44E-01	< 1.23E-01	< 1.52E-01	< 1.13E-01	< 1.47E-01	< 1.28E-01	< 1.31E-01	< 1.40E-01	< 1.27E-01	< 1.28E-01	< 1.47E-01		
Ca	1.80E+00	1.44E+00	3.59E+00	1.99E+00	1.92E+00	2.22E+00	1.99E+00	4.29E+00	1.63E+00	2.01E+00	2.11E+00	1.88E+00	2.55E+00	2.51E+00	7.31E+00	2.50E+00		
Cd	< 1.54E+00	< 1.32E+00	< 1.82E+00	< 1.68E+00	< 1.57E+00	< 1.72E+00	< 1.46E+00	< 1.82E+00	< 1.35E+00	< 1.75E+00	< 1.52E+00	< 1.56E+00	< 1.67E+00	< 1.51E+00	< 1.52E+00	< 1.76E+00		
Ce	< 8.80E+00	< 7.58E+00	< 1.04E+01	< 9.65E+00	< 8.97E+00	< 9.86E+00	< 8.38E+00	< 1.04E+01	< 7.74E+00	< 1.00E+01	< 8.72E+00	< 8.93E+00	< 9.54E+00	< 8.67E+00	< 8.72E+00	< 1.01E+01		
Co	< 1.99E+00	< 1.71E+00	< 2.35E+00	< 2.18E+00	< 2.03E+00	< 2.23E+00	< 1.89E+00	< 2.35E+00	< 1.75E+00	< 2.27E+00	< 1.97E+00	< 2.02E+00	< 2.16E+00	< 1.96E+00	< 1.97E+00	< 2.27E+00		
Cr	4.48E+01	4.44E+01	< 2.83E+00	4.45E+01	4.48E+01	4.50E+01	4.48E+01	< 2.83E+00	4.42E+01	4.45E+01	4.62E+01	4.60E+01	4.68E+01	4.67E+01	4.66E+01	4.70E+01		
Cu	< 3.19E+00	< 2.75E+00	< 3.77E+00	< 3.50E+00	< 3.25E+00	< 3.58E+00	< 3.04E+00	< 3.77E+00	< 2.81E+00	< 3.64E+00	< 3.16E+00	< 3.24E+00	5.01E+00	< 3.14E+00	< 3.16E+00	< 3.65E+00		
Fe	2.59E+00	1.58E+00	< 1.56E+00	4.57E+00	5.25E+00	6.33E+00	6.06E+00	< 1.56E+00	2.94E+00	1.72E+00	1.94E+00	2.12E+00	4.86E+00	5.07E+00	7.25E+00	6.15E+00		
Gd	< 2.55E+00	< 2.19E+00	< 3.01E+00	< 2.79E+00	< 2.60E+00	< 2.85E+00	< 2.42E+00	< 3.01E+00	< 2.24E+00	< 2.91E+00	< 2.52E+00	< 2.59E+00	< 2.76E+00	< 2.51E+00	< 2.52E+00	< 2.91E+00		
K	2.59E+02	2.75E+02	3.34E+01	2.74E+02	2.74E+02	2.64E+02	2.73E+02	< 3.02E+01	2.65E+02	2.65E+02	2.53E+02	2.54E+02	2.79E+02	2.69E+02	2.73E+02	2.63E+02		
La	< 1.35E+00	< 1.17E+00	< 1.60E+00	< 1.48E+00	< 1.38E+00	< 1.52E+00	< 1.29E+00	< 1.60E+00	< 1.19E+00	< 1.55E+00	< 1.34E+00	< 1.37E+00	< 1.47E+00	< 1.33E+00	< 1.34E+00	< 1.55E+00		
Li	5.20E+01	5.20E+01	< 8.76E-01	5.17E+01	5.20E+01	5.15E+01	5.11E+01	< 8.76E-01	5.27E+01	5.23E+01	5.21E+01	5.16E+01	5.17E+01	5.13E+01	5.11E+01	5.14E+01		
Mg	< 1.07E-01	< 9.26E-02	6.16E-01	< 1.18E-01	< 1.10E-01	< 1.20E-01	< 1.02E-01	1.10E+00	< 9.45E-02	< 1.23E-01	< 1.06E-01	< 1.09E-01	< 1.17E-01	< 1.06E-01	< 1.18E+00	< 1.23E-01		
Mn	< 8.27E-01	< 7.13E-01	< 9.78E-01	< 9.07E-01	< 8.43E-01	< 9.27E-01	< 7.88E-01	< 9.78E-01	< 7.28E-01	< 9.45E-01	< 8.20E-01	< 8.40E-01	< 8.97E-01	< 8.15E-01	< 8.20E-01	< 9.45E-01		
Mo	< 1.06E+01	< 9.10E+00	< 1.25E+01	< 1.16E+01	< 1.08E+01	< 1.18E+01	< 1.01E+01	< 1.25E+01	< 9.29E+00	< 1.21E+01	< 1.05E+01	< 1.07E+01	< 1.15E+01	< 1.04E+01	< 1.05E+01	< 1.21E+01		
Na	1.34E+05	1.34E+05	1.49E+05	1.35E+05	1.36E+05	1.37E+05	1.37E+05	1.51E+05	1.36E+05	1.36E+05	1.34E+05	1.33E+05	1.34E+05	1.33E+05	1.35E+05	1.35E+05		
Ni	< 2.22E+00	< 1.92E+00	< 2.63E+00	< 2.44E+00	< 2.27E+00	< 2.49E+00	< 2.12E+00	< 2.63E+00	< 1.96E+00	< 2.54E+00	< 2.20E+00	< 2.26E+00	< 2.41E+00	< 2.19E+00	< 2.20E+00	< 2.54E+00		
P	1.13E+02	1.08E+02	1.31E+02	1.12E+02	1.14E+02	1.08E+02	1.11E+02	1.28E+02	1.12E+02	1.12E+02	1.20E+02	1.24E+02	1.22E+02	1.17E+02	1.16E+02	1.18E+02		
Pb	< 8.78E+00	< 7.58E+00	< 1.04E+01	< 9.63E+00	< 8.96E+00	< 9.85E+00	< 8.37E+00	< 1.04E+01	< 7.73E+00	< 1.00E+01	< 8.71E+00	< 8.92E+00	< 9.53E+00	< 8.66E+00	< 8.71E+00	< 1.00E+01		
S	1.25E+03	1.11E+03	9.50E+02	1.34E+03	1.22E+03	1.26E+03	1.13E+03	8.98E+02	1.35E+03	1.02E+03	1.11E+03	1.20E+03	1.01E+03	8.32E+02	9.15E+02	9.49E+02		
Sb	< 3.71E+01	< 3.20E+01	< 4.38E+01	< 4.06E+01	< 3.78E+01	< 4.15E+01	< 3.53E+01	< 4.38E+01	< 3.26E+01	< 4.23E+01	< 3.67E+01	< 3.76E+01	< 4.02E+01	< 3.65E+01	< 3.67E+01	< 4.24E+01		
Si	5.54E+01	5.45E+01	< 5.05E+00	5.18E+01	5.30E+01	5.13E+01	5.23E+01	< 5.05E+00	5.43E+01	5.51E+01	5.46E+01	5.55E+01	5.49E+01	5.44E+01	5.42E+01	5.39E+01		
Sn	< 1.27E+01	< 1.09E+01	< 1.50E+01	< 1.39E+01	< 1.29E+01	< 1.42E+01	< 1.21E+01	< 1.50E+01	< 1.12E+01	< 1.45E+01	< 1.26E+01	< 1.29E+01	< 1.38E+01	< 1.25E+01	< 1.26E+01	< 1.45E+01		
Sr	< 5.37E-02	< 4.63E-02	< 6.35E-02	< 5.89E-02	< 5.48E-02	< 6.02E-02	< 5.11E-02	< 6.35E-02	< 4.73E-02	< 6.13E-02	< 5.32E-02	< 5.45E-02	< 5.83E-02	< 5.29E-02	< 5.32E-02	< 6.14E-02		
Th	< 5.50E+00	< 4.74E+00	< 6.50E+00	< 6.03E+00	< 5.61E+00	< 6.17E+00	< 5.24E+00	< 6.50E+00	< 4.84E+00	< 6.28E+00	< 5.45E+00	< 5.58E+00	< 5.97E+00	< 5.42E+00	< 5.45E+00	< 6.29E+00		
Ti	< 6.23E-01	< 5.37E-01	< 7.36E-01	< 6.83E-01	< 6.35E-01	< 6.98E-01	< 5.93E-01	< 7.36E-01	< 5.48E-01	< 7.12E-01	< 6.18E-01	< 6.33E-01	< 6.76E-01	< 6.14E-01	< 6.17E-01	< 7.12E-01		
U	< 3.46E+01	< 2.98E+01	< 4.09E+01	< 3.79E+01	< 3.53E+01	< 3.88E+01	< 3.29E+01	< 4.09E+01	< 3.04E+01	< 3.95E+01	< 3.43E+01	< 3.51E+01	< 3.75E+01	< 3.41E+01	< 3.43E+01	< 3.95E+01		
V	< 6.77E-01	< 5.83E-01	< 8.00E-01	< 7.42E-01	< 6.90E-01	< 7.59E-01	< 6.44E-01	< 8.00E-01	< 5.96E-01	< 7.73E-01	< 6.71E-01	< 6.87E-01	< 7.34E-01	< 6.67E-01	< 6.71E-01	< 7.73E-01		
Zn	4.80E+00	4.72E+00	< 9.52E-01	4.71E+00	4.57E+00	4.93E+00	4.71E+00	< 9.52E-01	4.74E+00	4.69E+00	5.13E+00	5.14E+00	7.15E+00	5.00E+00	6.16E+00	5.02E+00		
Zr	< 5.26E-01	< 4.54E-01	< 6.22E-01	< 5.77E-01	< 5.37E-01	< 5.90E-01	< 5.01E-01	< 6.22E-01	< 4.63E-01	< 6.01E-01	< 5.22E-01	< 5.34E-01	< 5.71E-01	< 5.19E-01	< 5.22E-01	< 6.02E-01		
PuTTA - nominal counting uncertanty ~ 7% for Pu-238, ~ 20% for Pu239/240																		
Pu-238	6.02E+03	8.30E+03		1.80E+03	1.64E+03	1.95E+03	1.87E+03		6.63E+03	5.43E+03	6.38E+03	6.82E+03	9.65E+02	7.11E+02	1.18E+03	1.46E+03	9.80E+03	1.39E+03
Pu-239/240	9.47E+02	1.35E+03		1.96E+02	2.81E+02	7.89E+01	1.16E+02		8.56E+02	7.12E+02	1.08E+03	1.07E+03	4.73E+01	7.19E+01	3.49E+01	4.44E+01	1.32E+03	1.13E+02
Pu-238	7.06E+03	1.14E+03									7.72E+03	7.45E+03						
Pu-239/240	9.43E+02	1.64E+02									9.11E+02	8.06E+02						

Table A-2. ICP-MS of acid dilutions of sludge contact tests (mg/L), nominal uncertainty = 20%

hold time (days)	0	0	Standard 1	0	0	0	0	Standard 2	7	7	7	7	7	7
glycolate (g/L)	0	0	0	5	5	10	10	10	0	0	5	5	10	10
DF (mL/mL)	10.11	10.32	12.70	10.90	10.44	10.95	12.13	12.70	10.75	10.73	9.49	9.55	8.83	9.22
LIMS numbers	300303312	300303313	300303314	300303315	300303316	300303317	300303318	300303319	300303297	300303298	300303299	300303300	300303301	300303302
mass (m/z) = 59	< 1.77E-01	< 1.81E-01	< 2.22E-01	< 1.91E-01	< 1.83E-01	< 1.92E-01	< 2.12E-01	< 2.22E-01	< 7.53E-02	< 7.51E-02	< 6.65E-02	< 6.69E-02	< 6.18E-02	< 6.45E-02
82	< 9.73E+00	< 9.93E+00	< 1.22E+01	< 1.05E+01	< 1.00E+01	< 1.05E+01	< 1.17E+01	< 1.22E+01	< 1.04E+00	< 1.04E+00	< 9.21E-01	< 9.27E-01	< 8.56E-01	< 8.94E-01
84	< 7.83E-01	< 8.00E-01	< 9.84E-01	< 8.45E-01	< 8.09E-01	< 8.49E-01	< 9.40E-01	< 9.84E-01	< 6.56E-01	< 6.55E-01	< 5.79E-01	< 5.83E-01	< 5.38E-01	< 5.62E-01
85	5.68E-01	7.31E-01	< 1.59E-01	7.55E-01	3.87E-01	3.32E-01	4.07E-01	2.19E-01	2.40E-01	2.45E-01	2.49E-01	1.84E-01	2.66E-01	2.74E-01
86	< 2.27E-01	< 2.32E-01	< 2.86E-01	< 2.45E-01	< 2.35E-01	< 2.46E-01	< 2.73E-01	< 2.86E-01	< 9.68E-02	< 9.66E-02	< 8.54E-02	< 8.60E-02	< 7.94E-02	< 8.30E-02
87	6.60E-01	6.27E-01	< 1.27E-01	7.90E-01	4.21E-01	4.94E-01	6.10E-01	1.73E-01	3.53E-01	4.20E-01	3.94E-01	3.72E-01	3.56E-01	4.65E-01
88	2.30E-01	< 2.32E-01	< 2.86E-01	2.65E-01	< 2.35E-01	< 2.46E-01	< 2.73E-01	< 2.86E-01	< 3.23E-02	< 3.22E-02	< 2.85E-02	< 2.87E-02	< 2.65E-02	< 2.77E-02
89	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 3.23E-02	< 3.22E-02	< 2.85E-02	< 2.87E-02	< 2.65E-02	< 2.77E-02
90	< 1.01E-01	< 1.03E-01	< 1.27E-01	< 1.09E-01	< 1.04E-01	< 1.10E-01	< 1.21E-01	< 1.27E-01	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
91	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
92	9.23E-01	9.04E-01	7.00E-02	9.44E-01	5.46E-01	4.10E-01	5.93E-01	5.54E-01	3.62E-01	3.09E-01	3.09E-01	3.41E-01	2.93E-01	3.05E-01
93	< 5.05E-02	< 5.16E-02	6.58E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	7.18E-02	< 4.30E-02	< 4.29E-02	< 3.80E-02	< 3.82E-02	< 3.53E-02	< 3.69E-02
94	4.19E-01	6.00E-01	< 1.27E-01	6.41E-01	2.49E-01	2.49E-01	2.58E-01	2.63E-01	2.41E-01	1.17E-01	1.38E-01	1.58E-01	1.71E-01	1.60E-01
95	1.78E+00	1.91E+00	< 1.27E-01	1.96E+00	1.31E+00	1.42E+00	1.32E+00	6.29E-01	1.16E+00	1.14E+00	1.09E+00	1.16E+00	1.14E+00	1.18E+00
96	1.31E+00	9.77E-01	< 6.35E-02	1.13E+00	6.57E-01	4.92E-01	6.57E-01	6.12E-01	2.82E-01	3.14E-01	3.28E-01	3.08E-01	3.43E-01	3.44E-01
97	1.29E+00	1.48E+00	< 6.35E-02	1.42E+00	1.17E+00	1.03E+00	9.96E-01	2.78E-01	8.58E-01	9.82E-01	9.56E-01	9.23E-01	9.91E-01	9.71E-01
98	2.30E+00	2.19E+00	8.70E-02	2.42E+00	1.57E+00	1.44E+00	1.59E+00	7.17E-01	1.24E+00	1.33E+00	1.25E+00	1.30E+00	1.32E+00	1.25E+00
99	9.83E-01	8.32E-01	< 6.35E-02	1.14E+00	1.00E+00	9.52E-01	1.25E+00	< 6.35E-02	8.23E-01	9.28E-01	9.62E-01	9.24E-01	9.33E-01	9.54E-01
100	1.33E+00	1.39E+00	< 6.35E-02	1.75E+00	1.23E+00	1.17E+00	1.26E+00	2.45E-01	1.04E+00	1.07E+00	1.09E+00	1.05E+00	1.05E+00	9.84E-01
101	9.14E-01	1.12E+00	< 9.52E-02	8.95E-01	9.41E-01	8.54E-01	8.85E-01	< 9.52E-02	9.02E-01	8.85E-01	7.89E-01	7.49E-01	8.45E-01	8.05E-01
102	8.90E-01	8.50E-01	< 6.35E-02	8.50E-01	8.45E-01	7.20E-01	8.11E-01	< 6.35E-02	8.46E-01	8.54E-01	7.75E-01	7.45E-01	7.15E-01	7.83E-01
103	1.74E-01	2.18E-01	< 1.59E-01	2.07E-01	1.87E-01	2.02E-01	1.57E-01	< 1.59E-01	1.90E-01	1.83E-01	2.39E-01	2.35E-01	1.99E-01	2.19E-01
104	3.98E-01	4.33E-01	< 6.35E-02	6.33E-01	4.63E-01	3.87E-01	4.31E-01	< 6.35E-02	4.77E-01	4.73E-01	4.45E-01	4.40E-01	4.34E-01	4.54E-01
105	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 8.60E-02	< 8.59E-02	< 7.59E-02	< 7.64E-02	< 7.06E-02	< 7.37E-02
106	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 4.30E-02	< 4.29E-02	< 3.80E-02	< 3.82E-02	< 3.53E-02	< 3.69E-02
107	< 3.79E-01	< 3.87E-01	< 4.76E-01	< 4.09E-01	< 3.91E-01	< 4.11E-01	< 4.55E-01	< 4.76E-01	2.45E-01	< 2.36E-01	< 2.09E-01	< 2.10E-01	< 1.94E-01	< 2.03E-01
108	< 1.01E-01	< 1.03E-01	< 1.27E-01	< 1.09E-01	< 1.04E-01	< 1.10E-01	< 1.21E-01	< 1.27E-01	< 6.45E-02	< 6.44E-02	< 5.70E-02	< 5.73E-02	< 5.30E-02	< 5.53E-02
109	1.07E-01	< 1.03E-01	2.08E-01	1.29E-01	< 1.04E-01	< 1.10E-01	< 1.21E-01	< 1.27E-01	3.07E-01	1.33E-01	< 1.04E-01	< 1.05E-01	< 9.71E-02	< 1.01E-01
110	< 1.01E-01	< 1.03E-01	< 1.27E-01	< 1.09E-01	< 1.04E-01	< 1.10E-01	< 1.21E-01	< 1.27E-01	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
111	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	5.78E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 6.45E-02	< 6.44E-02	< 5.70E-02	< 5.73E-02	< 5.30E-02	< 5.53E-02
112	6.30E-02	7.52E-02	< 6.35E-02	< 5.45E-02	5.88E-02	6.36E-02	8.61E-02	< 6.35E-02	< 5.38E-02	< 5.37E-02	< 4.75E-02	< 4.78E-02	< 4.41E-02	< 4.61E-02
113	< 6.34E+00	< 6.47E+00	< 7.97E+00	< 6.84E+00	< 6.55E+00	< 6.87E+00	< 7.61E+00	< 7.97E+00	< 3.10E+00	< 3.09E+00	< 2.73E+00	< 2.75E+00	< 2.54E+00	< 2.65E+00
114	< 7.58E-02	8.95E-02	< 9.52E-02	9.82E-02	1.07E-01	1.03E-01	< 9.10E-02	< 9.52E-02	5.66E-02	3.56E-02	3.14E-02	4.16E-02	3.91E-02	3.16E-02
116	1.43E-01	1.16E-01	< 6.35E-02	1.40E-01	9.94E-02	8.41E-02	1.26E-01	< 6.35E-02	9.01E-02	9.63E-02	8.85E-02	6.35E-02	9.18E-02	7.05E-02
117	< 7.58E-02	< 7.74E-02	< 9.52E-02	< 8.18E-02	< 7.83E-02	< 8.21E-02	< 9.10E-02	< 9.52E-02	3.39E-02	3.30E-02	3.74E-02	3.86E-02	4.01E-02	3.72E-02
118	1.59E-01	1.69E-01	< 6.35E-02	2.01E-01	1.15E-01	1.38E-01	1.31E-01	< 6.35E-02	1.27E-01	1.49E-01	1.18E-01	1.13E-01	1.33E-01	1.18E-01
119	2.37E-01	2.88E-01	< 9.52E-02	3.71E-01	1.99E-01	1.89E-01	2.25E-01	< 9.52E-02	1.04E-01	1.23E-01	2.40E-01	2.42E-01	1.99E-01	1.82E-01
120	2.26E-01	2.97E-01	< 6.35E-02	2.54E-01	1.82E-01	2.20E-01	1.87E-01	< 6.35E-02	2.22E-01	2.08E-01	1.49E-01	2.33E-01	1.78E-01	1.63E-01
121	9.07E-02	1.02E-01	< 6.35E-02	9.64E-02	5.77E-02	< 5.48E-02	6.63E-02	8.59E-02	< 9.68E-02	< 9.66E-02	< 8.54E-02	< 8.60E-02	< 7.94E-02	< 8.30E-02
122	< 7.58E-02	< 7.74E-02	< 9.52E-02	< 8.18E-02	< 7.83E-02	< 8.21E-02	< 9.10E-02	< 9.52E-02	2.39E-02	3.32E-02	4.11E-02	2.84E-02	3.62E-02	4.41E-02
123	< 1.77E-01	< 1.81E-01	< 2.22E-01	< 1.91E-01	< 1.83E-01	< 1.92E-01	< 2.12E-01	< 2.22E-01	< 7.53E-02	< 7.51E-02	< 6.65E-02	< 6.69E-02	< 6.18E-02	< 6.45E-02
124	5.82E-02	6.98E-02	< 6.35E-02	7.63E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	5.49E-02	4.83E-02	5.83E-02	3.85E-02	4.26E-02	4.36E-02
125	< 1.52E-01	< 1.55E-01	< 1.90E-01	< 1.64E-01	< 1.57E-01	< 1.64E-01	< 1.82E-01	< 1.90E-01	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02

Table A-2. ICP-MS of acid dilutions of sludge contact tests (mg/L), nominal uncertainty = 20% (contd.)

hold time (days)	14	14	Standard 1	14	14	14	14	Standard 2	14	14	21	21	21	21	21	21
glycolate (g/L)	0	0	0	5	5	10	10	10	0.2	0.2	0	0	5	5	10	10
DF (mL/mL)	10.44	10.89	12.70	9.77	9.80	9.31	10.10	12.70	11.77	10.41	11.26	10.68	9.35	10.07	11.21	11.60
LIMS numbers	300303331	300303332	300303333	300303334	300303335	300303336	300303337	300303338	300303339	300303340	300303355	300303356	300303357	300303358	300303359	300303360
mass (m/z) = 59	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
82	< 5.23E+00	< 5.45E+00	< 6.36E+00	< 4.89E+00	< 4.91E+00	< 4.67E+00	< 5.06E+00	< 6.36E+00	< 5.90E+00	< 5.22E+00	< 6.53E+00	< 6.20E+00	< 5.42E+00	< 5.84E+00	< 6.50E+00	< 6.73E+00
84	< 4.17E-02	< 4.35E-02	< 5.08E-02	< 3.91E-02	< 3.92E-02	< 3.73E-02	6.98E-02	< 5.08E-02	< 4.71E-02	< 4.17E-02	< 2.14E-01	< 2.03E-01	< 1.78E-01	< 1.91E-01	< 2.13E-01	< 2.20E-01
85	2.31E-01	2.28E-01	< 8.89E-02	2.15E-01	2.22E-01	2.41E-01	2.41E-01	< 8.89E-02	2.27E-01	2.61E-01	2.39E-01	2.61E-01	2.25E-01	2.40E-01	2.56E-01	2.46E-01
86	< 7.31E-02	< 7.62E-02	< 8.89E-02	< 6.84E-02	< 6.86E-02	< 6.52E-02	< 7.07E-02	< 8.89E-02	< 8.24E-02	< 7.29E-02	< 1.69E-01	< 1.60E-01	< 1.40E-01	< 1.51E-01	< 1.68E-01	< 1.74E-01
87	3.64E-01	3.53E-01	< 2.54E-02	3.56E-01	3.65E-01	3.52E-01	3.34E-01	< 2.54E-02	3.96E-01	3.30E-01	3.88E-01	4.42E-01	3.72E-01	3.79E-01	4.02E-01	4.16E-01
88	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	2.78E-02	< 2.35E-02	< 2.08E-02	< 1.01E-01	< 9.62E-02	< 8.42E-02	< 9.06E-02	< 1.01E-01	< 1.04E-01
89	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 4.50E-02	< 4.27E-02	< 3.74E-02	< 4.03E-02	< 4.48E-02	< 4.64E-02
90	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
91	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
92	2.50E-01	2.97E-01	< 5.08E-02	2.79E-01	2.74E-01	2.54E-01	2.55E-01	< 5.08E-02	2.77E-01	2.69E-01	2.82E-01	3.03E-01	2.77E-01	2.57E-01	2.89E-01	3.24E-01
93	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
94	1.76E-01	1.99E-01	< 2.54E-02	1.95E-01	1.69E-01	1.69E-01	1.80E-01	< 2.54E-02	1.51E-01	2.03E-01	2.04E-01	1.81E-01	1.72E-01	1.67E-01	1.73E-01	1.70E-01
95	1.14E+00	1.04E+00	3.97E-02	1.07E+00	1.00E+00	1.13E+00	1.08E+00	< 2.54E-02	1.06E+00	1.09E+00	1.19E+00	1.12E+00	1.15E+00	1.18E+00	1.31E+00	1.16E+00
96	3.28E-01	3.50E-01	5.80E-02	3.37E-01	3.52E-01	3.60E-01	3.47E-01	< 2.54E-02	3.55E-01	3.46E-01	3.33E-01	3.40E-01	3.39E-01	3.07E-01	3.52E-01	3.22E-01
97	9.05E-01	9.04E-01	< 2.54E-02	9.34E-01	8.10E-01	8.82E-01	8.25E-01	< 2.54E-02	8.97E-01	8.93E-01	8.86E-01	9.70E-01	9.36E-01	9.41E-01	9.31E-01	9.24E-01
98	1.13E+00	1.25E+00	7.72E-02	1.22E+00	1.21E+00	1.15E+00	1.17E+00	< 2.54E-02	1.08E+00	1.14E+00	1.23E+00	1.19E+00	1.24E+00	1.20E+00	1.31E+00	1.28E+00
99	8.97E-01	9.07E-01	< 3.81E-02	9.32E-01	9.04E-01	9.99E-01	9.33E-01	< 3.81E-02	8.31E-01	8.60E-01	9.49E-01	9.33E-01	9.03E-01	9.48E-01	1.03E+00	1.00E+00
100	1.03E+00	1.06E+00	< 2.54E-02	1.05E+00	1.03E+00	1.02E+00	9.72E-01	< 2.54E-02	9.58E-01	9.80E-01	1.08E+00	1.03E+00	1.06E+00	1.07E+00	1.12E+00	1.07E+00
101	8.82E-01	8.24E-01	< 2.54E-02	7.96E-01	8.23E-01	8.97E-01	7.93E-01	< 2.54E-02	8.43E-01	7.95E-01	7.84E-01	8.82E-01	7.80E-01	8.33E-01	9.51E-01	9.12E-01
102	8.06E-01	8.41E-01	< 2.54E-02	7.16E-01	7.37E-01	8.22E-01	7.83E-01	< 2.54E-02	7.10E-01	8.16E-01	8.54E-01	8.29E-01	8.17E-01	7.27E-01	8.61E-01	8.94E-01
103	2.67E-01	2.28E-01	< 2.54E-02	2.34E-01	2.40E-01	3.04E-01	2.99E-01	< 2.54E-02	2.22E-01	2.02E-01	2.31E-01	2.09E-01	2.85E-01	2.78E-01	3.94E-01	3.82E-01
104	4.82E-01	4.00E-01	< 2.54E-02	4.02E-01	4.22E-01	4.06E-01	4.71E-01	< 2.54E-02	3.87E-01	3.88E-01	4.45E-01	4.36E-01	4.06E-01	3.96E-01	5.44E-01	4.52E-01
105	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 4.50E-02	< 4.27E-02	< 3.74E-02	< 4.03E-02	< 4.48E-02	< 4.64E-02
106	< 3.13E-02	< 3.27E-02	< 3.81E-02	< 2.93E-02	< 2.94E-02	< 2.79E-02	< 3.03E-02	< 3.81E-02	< 3.53E-02	< 3.12E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
107	6.96E-02	< 6.53E-02	< 7.62E-02	< 5.86E-02	< 5.88E-02	< 5.59E-02	< 6.06E-02	< 7.62E-02	< 7.06E-02	< 6.25E-02	6.15E-02	9.51E-02	< 4.68E-02	< 5.03E-02	< 5.60E-02	< 5.80E-02
108	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
109	5.92E-02	7.12E-02	< 3.81E-02	< 2.93E-02	< 2.94E-02	< 2.79E-02	< 3.03E-02	< 3.81E-02	4.40E-02	5.09E-02	9.27E-02	9.92E-02	< 5.61E-02	< 6.04E-02	< 6.72E-02	< 6.96E-02
110	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
111	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	2.20E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
112	3.70E-02	2.61E-02	< 2.54E-02	2.23E-02	2.78E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	3.59E-02	3.60E-02	2.63E-02	3.21E-02	2.40E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
113	< 1.62E+00	< 1.69E+00	< 1.97E+00	< 1.51E+00	< 1.52E+00	< 1.44E+00	< 1.57E+00	< 1.97E+00	< 1.82E+00	< 1.61E+00	< 1.31E+00	< 1.24E+00	< 1.08E+00	< 1.17E+00	< 1.30E+00	< 1.35E+00
114	3.35E-02	4.45E-02	< 2.54E-02	4.18E-02	2.97E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	4.17E-02	4.17E-02	3.86E-02	3.93E-02	2.01E-02	2.87E-02	< 2.24E-02	< 2.32E-02
116	8.99E-02	9.87E-02	< 2.54E-02	8.68E-02	7.35E-02	1.15E-01	8.44E-02	< 2.54E-02	8.05E-02	8.72E-02	9.12E-02	8.95E-02	9.01E-02	7.03E-02	7.93E-02	8.50E-02
117	3.20E-02	3.28E-02	< 2.54E-02	3.71E-02	3.40E-02	3.44E-02	3.78E-02	< 2.54E-02	2.40E-02	3.78E-02	3.97E-02	4.23E-02	4.39E-02	3.47E-02	4.36E-02	3.96E-02
118	1.47E-01	1.21E-01	< 2.54E-02	1.27E-01	1.56E-01	1.28E-01	1.29E-01	< 2.54E-02	1.29E-01	1.15E-01	1.14E-01	9.90E-02	1.43E-01	1.30E-01	1.36E-01	1.25E-01
119	1.31E-01	1.71E-01	< 2.54E-02	1.55E-01	1.36E-01	1.66E-01	1.62E-01	< 2.54E-02	1.59E-01	1.46E-01	1.52E-01	1.61E-01	1.63E-01	1.47E-01	1.68E-01	1.77E-01
120	1.90E-01	1.61E-01	< 2.54E-02	1.51E-01	1.71E-01	1.53E-01	1.67E-01	< 2.54E-02	1.70E-01	1.81E-01	1.81E-01	2.01E-01	2.00E-01	1.79E-01	1.56E-01	1.71E-01
121	< 3.13E-02	< 3.27E-02	< 3.81E-02	< 2.93E-02	< 2.94E-02	< 2.79E-02	< 3.03E-02	< 3.81E-02	< 3.53E-02	< 3.12E-02	< 9.01E-02	< 8.55E-02	< 7.48E-02	< 8.05E-02	< 8.96E-02	< 9.28E-02
122	3.33E-02	3.39E-02	< 2.54E-02	4.85E-02	3.24E-02	3.15E-02	3.50E-02	< 2.54E-02	3.65E-02	3.71E-02	2.56E-02	3.83E-02	3.98E-02	2.92E-02	4.04E-02	3.89E-02
123	< 4.17E-02	< 4.35E-02	< 5.08E-02	< 3.91E-02	< 3.92E-02	< 3.73E-02	< 4.04E-02	< 5.08E-02	< 4.71E-02	< 4.17E-02	< 3.38E-02	< 3.21E-02	< 2.81E-02	< 3.02E-02	< 3.36E-02	< 3.48E-02
124	6.23E-02	5.46E-02	< 2.54E-02	4.08E-02	4.66E-02	5.19E-02	5.30E-02	< 2.54E-02	4.62E-02	4.60E-02	4.43E-02	6.22E-02	4.65E-02	5.54E-02	5.08E-02	4.65E-02
125	< 4.17E-02	< 4.35E-02	< 5.08E-02	< 3.91E-02	< 3.92E-02	< 3.73E-02	< 4.04E-02	< 5.08E-02	< 4.71E-02	< 4.17E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02

Table A-2. ICP-MS of acid dilutions of sludge contact tests (mg/L), nominal uncertainty = 20% (contd.)

hold time (days)	35	35	Standard 1	35	35	35	35	Standard 2	35	35	35	35	35	35	35	35
glycolate (g/L)	0	0	0	5	5	10	10	10	0.2	0.2	0	0	5	5	10	10
DF (mL/mL)	10.74	9.26	12.70	11.78	10.95	12.04	10.23	12.70	9.45	12.27	10.65	10.91	11.65	10.58	10.65	12.28
LIMS numbers	300303385	300303386	300303387	300303388	300303389	300303390	300303391	300303392	300303393	300303394	300303395	300303396	300303397	300303398	300303399	300303400
mass (m/z) = 59	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 3.19E-02	< 3.27E-02	< 3.50E-02	< 3.18E-02	< 3.19E-02	< 3.68E-02
82	< 4.02E+00	< 3.46E+00	< 4.75E+00	< 4.41E+00	< 4.10E+00	< 4.50E+00	< 3.83E+00	< 4.75E+00	< 3.54E+00	< 4.59E+00	< 2.04E+00	< 2.09E+00	< 2.24E+00	< 2.03E+00	< 2.04E+00	< 2.36E+00
84	< 2.26E-01	< 1.94E-01	< 2.67E-01	< 2.47E-01	< 2.30E-01	< 2.53E-01	< 2.15E-01	< 2.67E-01	< 1.99E-01	< 2.58E-01	< 3.73E-01	< 3.82E-01	< 4.08E-01	< 3.70E-01	< 3.73E-01	< 4.30E-01
85	2.61E-01	2.27E-01	< 3.81E-02	2.30E-01	2.45E-01	2.42E-01	2.27E-01	< 3.81E-02	2.29E-01	2.59E-01	2.40E-01	2.54E-01	2.31E-01	2.63E-01	2.48E-01	2.93E-01
86	< 4.30E-01	< 3.70E-01	< 5.08E-01	< 4.71E-01	< 4.38E-01	< 4.82E-01	< 4.09E-01	< 5.08E-01	< 3.78E-01	< 4.91E-01	< 1.06E-01	< 1.09E-01	< 1.17E-01	< 1.06E-01	< 1.06E-01	< 1.23E-01
87	3.98E-01	3.68E-01	< 2.54E-02	4.06E-01	3.93E-01	3.75E-01	3.75E-01	< 2.54E-02	3.93E-01	3.77E-01	3.47E-01	3.82E-01	3.54E-01	4.26E-01	3.67E-01	3.49E-01
88	< 2.15E-02	< 1.85E-02	3.44E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	3.44E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 4.00E-02	< 2.46E-02
89	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
90	< 2.15E-02	< 1.85E-02	3.25E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 3.19E-02	< 3.27E-02	< 3.50E-02	< 3.18E-02	< 3.19E-02	< 3.68E-02
91	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
92	2.58E-01	2.71E-01	< 7.62E-02	2.97E-01	2.88E-01	3.18E-01	2.86E-01	< 7.62E-02	2.90E-01	3.47E-01	3.46E-01	3.41E-01	2.88E-01	3.61E-01	3.22E-01	3.09E-01
93	< 5.37E-02	< 4.63E-02	< 6.35E-02	< 5.89E-02	< 5.48E-02	< 6.02E-02	< 5.11E-02	< 6.35E-02	< 4.73E-02	< 6.13E-02	< 3.19E-02	< 3.27E-02	< 3.50E-02	< 3.18E-02	< 3.19E-02	< 3.68E-02
94	1.98E-01	1.75E-01	5.29E-02	1.61E-01	1.92E-01	2.27E-01	1.71E-01	< 3.81E-02	1.83E-01	1.89E-01	1.72E-01	1.88E-01	2.57E-01	2.25E-01	2.07E-01	1.99E-01
95	1.14E+00	1.23E+00	5.89E-02	1.18E+00	1.11E+00	1.11E+00	1.18E+00	< 3.81E-02	1.18E+00	1.17E+00	1.06E+00	1.14E+00	1.15E+00	1.19E+00	1.12E+00	1.16E+00
96	3.47E-01	3.60E-01	6.00E-02	3.45E-01	3.28E-01	3.49E-01	3.52E-01	< 3.81E-02	3.15E-01	3.23E-01	3.27E-01	3.24E-01	3.41E-01	3.45E-01	3.75E-01	3.18E-01
97	9.72E-01	8.86E-01	< 3.81E-02	9.32E-01	1.01E+00	1.02E+00	9.76E-01	< 3.81E-02	9.76E-01	1.04E+00	8.80E-01	9.90E-01	9.37E-01	9.56E-01	9.23E-01	9.73E-01
98	1.31E+00	1.19E+00	7.81E-02	1.28E+00	1.28E+00	1.32E+00	1.21E+00	< 3.81E-02	1.23E+00	1.29E+00	1.25E+00	1.24E+00	1.22E+00	1.19E+00	1.24E+00	1.22E+00
99	9.54E-01	9.94E-01	< 2.54E-02	8.40E-01	9.67E-01	9.24E-01	1.01E+00	< 2.54E-02	8.98E-01	9.08E-01	9.54E-01	9.72E-01	1.02E+00	9.87E-01	1.03E+00	9.43E-01
100	1.02E+00	9.83E-01	3.98E-02	1.10E+00	1.01E+00	1.03E+00	1.04E+00	< 2.54E-02	1.06E+00	1.11E+00	1.09E+00	1.11E+00	1.05E+00	1.16E+00	1.03E+00	1.06E+00
101	9.02E-01	8.50E-01	< 2.54E-02	8.78E-01	8.49E-01	9.68E-01	9.78E-01	< 2.54E-02	8.07E-01	8.39E-01	8.56E-01	8.78E-01	8.77E-01	9.29E-01	1.04E+00	1.08E+00
102	8.49E-01	8.31E-01	< 3.81E-02	7.54E-01	7.98E-01	1.19E+00	9.50E-01	< 3.81E-02	7.59E-01	8.09E-01	8.43E-01	8.24E-01	7.88E-01	8.82E-01	1.03E+00	9.64E-01
103	2.31E-01	2.42E-01	< 3.81E-02	2.88E-01	2.87E-01	3.77E-01	3.87E-01	< 3.81E-02	2.12E-01	2.74E-01	2.22E-01	2.28E-01	3.67E-01	3.46E-01	4.87E-01	4.89E-01
104	4.46E-01	4.80E-01	< 2.54E-02	4.63E-01	4.48E-01	5.08E-01	5.31E-01	< 2.54E-02	4.59E-01	4.55E-01	4.76E-01	4.74E-01	4.88E-01	4.80E-01	5.96E-01	5.54E-01
105	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 3.97E-02	< 2.46E-02
106	< 4.30E-02	< 3.70E-02	< 5.08E-02	< 4.71E-02	< 4.38E-02	< 4.82E-02	< 4.09E-02	< 5.08E-02	< 3.78E-02	< 4.91E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.82E-02	< 2.46E-02
107	1.31E-01	1.07E-01	< 7.62E-02	< 7.07E-02	< 6.57E-02	< 7.22E-02	< 6.14E-02	< 7.62E-02	1.22E-01	8.05E-02	1.15E-01	8.74E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
108	< 3.22E-02	< 2.78E-02	< 3.81E-02	< 3.53E-02	< 3.29E-02	< 3.61E-02	< 3.07E-02	< 3.81E-02	< 2.84E-02	< 3.68E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
109	1.40E-01	1.66E-01	3.98E-02	< 3.53E-02	< 3.29E-02	< 3.61E-02	< 3.07E-02	< 3.81E-02	9.42E-02	9.26E-02	1.50E-01	9.23E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
110	< 2.15E-02	1.89E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	2.69E-02	< 2.46E-02
111	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	3.39E-02	< 2.46E-02
112	2.88E-02	4.45E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	3.87E-02	3.01E-02	3.90E-02	3.45E-02	2.53E-02	2.44E-02	7.87E-02	< 2.46E-02
113	< 1.01E+00	< 8.71E-01	< 1.19E+00	< 1.11E+00	< 1.03E+00	< 1.13E+00	< 9.61E-01	< 1.19E+00	< 8.89E-01	< 1.15E+00	< 1.70E+00	< 1.75E+00	< 1.86E+00	< 1.69E+00	< 1.70E+00	< 1.96E+00
114	3.74E-02	4.84E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	2.55E-02	< 2.05E-02	< 2.54E-02	4.43E-02	3.02E-02	4.19E-02	4.24E-02	2.75E-02	2.27E-02	8.82E-02	< 2.46E-02
116	8.45E-02	1.05E-01	< 2.54E-02	8.40E-02	7.62E-02	1.05E-01	8.47E-02	< 2.54E-02	7.66E-02	8.84E-02	1.07E-01	8.47E-02	1.27E-01	9.03E-02	1.46E-01	6.68E-02
117	4.26E-02	5.78E-02	< 2.54E-02	3.83E-02	3.38E-02	5.18E-02	4.00E-02	< 2.54E-02	3.83E-02	4.00E-02	3.88E-02	3.91E-02	4.68E-02	4.04E-02	8.07E-02	3.73E-02
118	1.47E-01	1.23E-01	< 2.54E-02	1.36E-01	1.40E-01	1.31E-01	1.34E-01	< 2.54E-02	1.33E-01	1.52E-01	1.43E-01	1.49E-01	1.93E-01	1.39E-01	2.37E-01	1.22E-01
119	1.26E-01	1.50E-01	< 2.54E-02	1.37E-01	1.29E-01	1.84E-01	1.29E-01	< 2.54E-02	1.26E-01	1.38E-01	1.36E-01	1.21E-01	1.29E-01	1.24E-01	1.51E-01	1.22E-01
120	2.14E-01	1.95E-01	< 2.54E-02	1.95E-01	1.56E-01	1.82E-01	1.57E-01	< 2.54E-02	1.79E-01	2.02E-01	1.78E-01	1.72E-01	1.97E-01	2.11E-01	2.94E-01	1.48E-01
121	< 4.30E-02	< 3.70E-02	< 5.08E-02	< 4.71E-02	< 4.38E-02	< 4.82E-02	< 4.09E-02	< 5.08E-02	< 3.78E-02	< 4.91E-02	< 5.32E-02	< 5.45E-02	< 5.83E-02	< 5.29E-02	< 5.32E-02	< 6.14E-02
122	3.71E-02	3.53E-02	< 2.54E-02	4.42E-02	2.92E-02	3.87E-02	5.18E-02	< 2.54E-02	4.66E-02	3.01E-02	< 4.26E-02	< 4.36E-02	< 4.66E-02	< 4.23E-02	4.56E-02	< 4.91E-02
123	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 4.26E-02	< 4.36E-02	< 4.66E-02	< 4.23E-02	< 4.26E-02	< 4.91E-02
124	5.63E-02	5.74E-02	< 2.54E-02	3.99E-02	5.63E-02	4.80E-02	4.75E-02	< 2.54E-02	4.21E-02	5.62E-02	< 5.32E-02	< 5.45E-02	< 5.88E-02	< 5.29E-02	6.75E-02	< 6.14E-02
125	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 8.52E-02	< 8.73E-02	< 9.32E-02	< 8.47E-02	< 8.52E-02	< 9.82E-02

Table A-2. ICP-MS of acid dilutions of sludge contact tests (mg/L), nominal uncertainty = 20% (contd.)

hold time (days)	0	0	Standard 1	0	0	0	0	Standard 2	7	7	7	7	7	7
glycolate (g/L)	0	0	0	5	5	10	10	10	0	0	5	5	10	10
DF (mL/mL)	10.11	10.32	12.70	10.90	10.44	10.95	12.13	12.70	10.75	10.73	9.49	9.55	8.83	9.22
LIMS numbers	300303312	300303313	300303314	300303315	300303316	300303317	300303318	300303319	300303297	300303298	300303299	300303300	300303301	300303302
mass(m/z)= 126	< 1.52E-01	< 1.55E-01	< 1.90E-01	< 1.64E-01	< 1.57E-01	< 1.64E-01	< 1.82E-01	< 1.90E-01	< 1.18E-01	< 1.18E-01	< 1.04E-01	< 1.05E-01	< 9.71E-02	< 1.01E-01
128	< 6.06E-01	< 6.19E-01	< 7.62E-01	< 6.54E-01	< 6.26E-01	< 6.57E-01	< 7.28E-01	< 7.62E-01	< 3.87E-01	< 3.86E-01	< 3.42E-01	< 3.44E-01	< 3.18E-01	< 3.32E-01
130	< 1.49E+00	< 1.52E+00	< 1.87E+00	< 1.61E+00	< 1.54E+00	< 1.62E+00	< 1.79E+00	< 1.87E+00	< 8.06E-01	< 8.05E-01	< 7.12E-01	< 7.16E-01	< 6.62E-01	< 6.91E-01
133	1.43E+00	1.54E+00	< 9.52E-02	1.48E+00	1.55E+00	1.50E+00	1.55E+00	< 9.52E-02	1.62E+00	1.55E+00	1.54E+00	1.38E+00	1.55E+00	1.67E+00
134	< 5.05E-01	< 5.16E-01	< 6.35E-01	< 5.45E-01	< 5.22E-01	< 5.48E-01	< 6.06E-01	< 6.35E-01	< 3.23E-02	< 3.22E-02	< 2.85E-02	< 2.87E-02	< 2.65E-02	< 2.77E-02
135	1.98E-01	2.83E-01	< 6.35E-02	2.30E-01	1.83E-01	1.79E-01	2.08E-01	< 6.35E-02	1.91E-01	1.86E-01	1.87E-01	2.20E-01	2.07E-01	2.10E-01
136	< 5.56E-01	< 5.67E-01	< 6.98E-01	< 6.00E-01	< 5.74E-01	< 6.02E-01	< 6.67E-01	< 6.98E-01	< 2.26E-01	< 2.25E-01	< 1.99E-01	< 2.01E-01	< 1.85E-01	< 1.94E-01
137	4.57E-01	4.98E-01	< 9.52E-02	5.08E-01	4.54E-01	5.28E-01	4.15E-01	1.28E-01	4.24E-01	4.36E-01	4.17E-01	4.35E-01	4.73E-01	4.30E-01
138	4.71E-01	7.18E-01	< 1.90E-01	4.61E-01	2.71E-01	3.66E-01	3.86E-01	4.52E-01	< 5.38E-02	< 5.37E-02	< 4.75E-02	1.01E-01	< 4.41E-02	< 4.61E-02
139	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
140	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
141	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
142	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
143	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
144	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
145	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
146	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
147	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
148	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
149	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
150	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
151	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
152	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
153	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
154	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
155	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
156	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
157	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
158	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
159	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
160	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
161	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
162	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
163	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
164	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
165	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
166	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
167	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
168	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
169	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 3.23E-02	< 3.22E-02	< 2.85E-02	< 2.87E-02	< 2.65E-02	< 2.77E-02
170	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
171	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
172	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02

Table A-2. ICP-MS of acid dilutions of sludge contact tests (mg/L), nominal uncertainty = 20% (contd.)

hold time (days)	14	14	Standard 1	14	14	14	14	Standard 2	14	14	21	21	21	21	21	21
glycolate (g/L)	0	0	0	5	5	10	10	10	0.2	0.2	0	0	5	5	10	10
DF (mL/mL)	10.44	10.89	12.70	9.77	9.80	9.31	10.10	12.70	11.77	10.41	11.26	10.68	9.35	10.07	11.21	11.60
LIMS numbers	300303331	300303332	300303333	300303334	300303335	300303336	300303337	300303338	300303339	300303340	300303355	300303356	300303357	300303358	300303359	300303360
mass(m/z)= 126	< 8.35E-02	< 8.71E-02	< 1.02E-01	< 7.81E-02	< 7.84E-02	< 7.45E-02	< 8.08E-02	< 1.02E-01	< 9.42E-02	< 8.33E-02	< 6.76E-02	< 6.41E-02	< 5.61E-02	< 6.04E-02	< 6.72E-02	< 6.96E-02
128	< 2.50E-01	< 2.61E-01	< 3.05E-01	< 2.34E-01	< 2.35E-01	< 2.24E-01	< 2.43E-01	< 3.05E-01	< 2.82E-01	< 2.50E-01	< 3.60E-01	< 3.42E-01	< 2.99E-01	< 3.22E-01	< 3.59E-01	< 3.71E-01
130	< 4.49E-01	< 4.68E-01	< 5.46E-01	< 4.20E-01	< 4.22E-01	< 4.01E-01	< 4.34E-01	< 5.46E-01	< 5.06E-01	< 4.48E-01	< 5.18E-01	< 4.91E-01	< 4.30E-01	< 4.63E-01	< 5.15E-01	< 5.34E-01
133	1.51E+00	1.53E+00	< 2.54E-02	1.43E+00	1.44E+00	1.56E+00	1.53E+00	< 2.54E-02	1.44E+00	1.52E+00	1.49E+00	1.49E+00	1.49E+00	1.52E+00	1.62E+00	1.55E+00
134	< 3.34E-01	< 3.48E-01	< 4.06E-01	< 3.13E-01	< 3.14E-01	< 2.98E-01	< 3.23E-01	< 4.06E-01	< 3.77E-01	< 3.33E-01	< 2.93E-01	< 2.78E-01	< 2.43E-01	< 2.62E-01	< 2.91E-01	< 3.02E-01
135	1.87E-01	2.03E-01	< 2.54E-02	1.74E-01	1.88E-01	1.85E-01	1.86E-01	< 2.54E-02	1.89E-01	2.00E-01	1.88E-01	2.05E-01	1.85E-01	2.05E-01	2.83E-01	2.25E-01
136	< 5.22E-02	< 5.44E-02	< 6.35E-02	< 4.88E-02	< 4.90E-02	< 4.66E-02	< 5.05E-02	< 6.35E-02	< 5.88E-02	< 5.21E-02	< 2.36E-01	< 2.24E-01	< 1.96E-01	< 2.11E-01	< 2.35E-01	< 2.44E-01
137	4.41E-01	4.41E-01	< 2.54E-02	4.58E-01	4.71E-01	4.49E-01	4.29E-01	< 2.54E-02	4.38E-01	4.48E-01	4.58E-01	4.66E-01	4.27E-01	4.60E-01	4.85E-01	4.64E-01
138	< 8.35E-02	< 8.71E-02	1.12E-01	< 7.81E-02	< 7.84E-02	< 7.45E-02	< 8.08E-02	1.19E-01	< 9.42E-02	< 8.33E-02	< 3.38E-02	< 3.21E-02	< 2.81E-02	< 3.02E-02	< 3.36E-02	< 3.48E-02
139	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
140	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
141	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
142	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
143	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
144	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
145	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
146	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
147	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
148	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
149	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
150	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
151	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
152	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
153	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
154	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
155	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
156	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
157	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
158	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
159	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
160	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
161	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
162	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
163	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
164	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
165	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
166	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
167	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
168	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
169	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
170	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
171	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
172	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02

Table A-2. ICP-MS of acid dilutions of sludge contact tests (mg/L), nominal uncertainty = 20% (contd.)

hold time (days)	35	35	Standard 1	35	35	35	35	Standard 2	35	35	35	35	35	35	35	35
glycolate (g/L)	0	0	0	5	5	10	10	10	0.2	0.2	0	0	5	5	10	10
DF (mL/mL)	10.74	9.26	12.70	11.78	10.95	12.04	10.23	12.70	9.45	12.27	10.65	10.91	11.65	10.58	10.65	12.28
LIMS numbers	300303385	300303386	300303387	300303388	300303389	300303390	300303391	300303392	300303393	300303394	300303395	300303396	300303397	300303398	300303399	300303400
mass(m/z)= 126	< 9.67E-02	< 8.34E-02	< 1.14E-01	< 1.06E-01	< 9.86E-02	< 1.08E-01	< 9.21E-02	< 1.14E-01	< 8.51E-02	< 1.10E-01	4.62E-02	6.20E-02	< 4.66E-02	< 4.23E-02	6.17E-02	< 4.91E-02
128	< 2.15E-01	< 1.85E-01	< 2.54E-01	< 2.36E-01	< 2.19E-01	< 2.41E-01	< 2.05E-01	< 2.54E-01	< 1.89E-01	< 2.45E-01	< 1.70E-01	< 1.75E-01	< 1.86E-01	< 1.69E-01	< 1.70E-01	< 1.96E-01
130	< 5.37E-01	< 4.63E-01	< 6.35E-01	< 5.89E-01	< 5.48E-01	< 6.02E-01	< 5.11E-01	< 6.35E-01	< 4.73E-01	< 6.13E-01	< 5.75E-01	< 5.89E-01	< 6.29E-01	< 5.72E-01	< 5.75E-01	< 6.63E-01
133	1.48E+00	1.51E+00	< 2.54E-02	1.54E+00	1.45E+00	1.61E+00	1.52E+00	< 2.54E-02	1.52E+00	1.46E+00	1.53E+00	1.59E+00	1.53E+00	1.50E+00	1.59E+00	1.51E+00
134	< 1.61E-01	< 1.39E-01	< 1.90E-01	< 1.77E-01	< 1.64E-01	< 1.81E-01	< 1.53E-01	< 1.90E-01	< 1.42E-01	< 1.84E-01	< 3.51E-01	< 3.60E-01	< 3.85E-01	< 3.49E-01	< 3.51E-01	< 4.05E-01
135	2.07E-01	1.73E-01	< 2.54E-02	2.22E-01	1.91E-01	1.69E-01	1.86E-01	< 2.54E-02	1.98E-01	1.92E-01	1.89E-01	1.83E-01	2.09E-01	2.09E-01	2.05E-01	2.21E-01
136	< 4.30E-02	< 3.70E-02	< 5.08E-02	< 4.71E-02	< 4.38E-02	< 4.82E-02	< 4.09E-02	< 5.08E-02	< 3.78E-02	< 4.91E-02	< 7.45E-02	< 7.64E-02	< 8.16E-02	< 7.41E-02	< 7.45E-02	< 8.59E-02
137	4.55E-01	4.61E-01	< 2.54E-02	5.26E-01	4.47E-01	4.55E-01	4.61E-01	< 2.54E-02	4.61E-01	4.89E-01	4.98E-01	4.73E-01	5.51E-01	5.09E-01	4.78E-01	4.53E-01
138	< 3.22E-02	< 2.78E-02	1.54E-01	< 3.53E-02	< 3.29E-02	< 3.61E-02	< 3.07E-02	1.03E-01	< 2.84E-02	< 3.68E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	3.53E-02	< 2.46E-02
139	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
140	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
141	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
142	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
143	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
144	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
145	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
146	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
147	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
148	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
149	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
150	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
151	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
152	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
153	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
154	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
155	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
156	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
157	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
158	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
159	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
160	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
161	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
162	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
163	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
164	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
165	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
166	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
167	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
168	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
169	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
170	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
171	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
172	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02

Table A-2. ICP-MS of acid dilutions of sludge contact tests (mg/L), nominal uncertainty = 20% (contd.)

hold time (days)	0	0	Standard 1	0	0	0	0	Standard 2	7	7	7	7	7	7
glycolate (g/L)	0	0	0	5	5	10	10	10	0	0	5	5	10	10
DF (mL/mL)	10.11	10.32	12.70	10.90	10.44	10.95	12.13	12.70	10.75	10.73	9.49	9.55	8.83	9.22
LIMS numbers	300303312	300303313	300303314	300303315	300303316	300303317	300303318	300303319	300303297	300303298	300303299	300303300	300303301	300303302
mass(m/z)= 173	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
174	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
175	< 7.58E-02	< 7.74E-02	< 9.52E-02	< 8.18E-02	< 7.83E-02	< 8.21E-02	< 9.10E-02	< 9.52E-02	< 3.23E-02	< 3.22E-02	< 2.85E-02	< 2.87E-02	< 2.65E-02	< 2.77E-02
176	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
177	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
178	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
179	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
180	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
181	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 5.38E-02	< 5.37E-02	< 4.75E-02	< 4.78E-02	< 4.41E-02	< 4.61E-02
182	2.85E-01	2.81E-01	< 1.27E-01	2.22E-01	2.64E-01	2.23E-01	2.23E-01	< 1.27E-01	2.33E-01	2.23E-01	2.07E-01	2.13E-01	2.26E-01	2.24E-01
183	1.26E-01	1.46E-01	< 6.35E-02	1.41E-01	1.28E-01	1.12E-01	1.32E-01	< 6.35E-02	1.07E-01	1.26E-01	1.39E-01	1.08E-01	1.14E-01	1.57E-01
184	3.25E-01	3.43E-01	< 1.90E-01	3.01E-01	3.35E-01	3.05E-01	2.49E-01	< 1.90E-01	2.58E-01	2.52E-01	2.28E-01	2.56E-01	2.52E-01	2.42E-01
185	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
186	3.16E-01	3.51E-01	< 2.54E-01	2.63E-01	3.23E-01	2.91E-01	4.08E-01	< 2.54E-01	2.63E-01	2.63E-01	2.42E-01	2.73E-01	2.37E-01	2.08E-01
187	< 2.27E-01	< 2.32E-01	< 2.86E-01	< 2.45E-01	< 2.35E-01	< 2.46E-01	< 2.73E-01	< 2.86E-01	< 3.23E-02	< 3.22E-02	< 2.85E-02	< 2.87E-02	< 2.65E-02	< 2.77E-02
191	5.90E-01	3.45E-01	7.21E-02	3.06E-01	5.82E-02	< 5.48E-02	< 6.06E-02	1.16E+00	< 8.60E-02	< 8.59E-02	< 7.59E-02	< 7.64E-02	< 7.06E-02	< 7.37E-02
193	1.18E+00	6.80E-01	< 2.22E-01	4.74E-01	< 1.83E-01	< 1.92E-01	< 2.12E-01	1.88E+00	< 8.60E-02	< 8.59E-02	< 7.59E-02	< 7.64E-02	< 7.06E-02	< 7.37E-02
194	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
195	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 3.23E-02	< 3.22E-02	< 2.85E-02	< 2.87E-02	< 2.65E-02	< 2.77E-02
196	1.92E-01	2.64E-01	< 1.90E-01	1.88E-01	2.27E-01	2.38E-01	2.07E-01	< 1.90E-01	2.08E-01	1.94E-01	2.02E-01	2.41E-01	1.80E-01	2.39E-01
197	< 9.60E-01	< 9.80E-01	1.35E+00	1.22E+00	< 9.92E-01	< 1.04E+00	< 1.15E+00	< 1.21E+00	< 9.14E-01	< 9.12E-01	< 8.07E-01	< 8.12E-01	< 7.50E-01	< 7.83E-01
198	1.23E+01	1.30E+01	< 4.44E-01	1.32E+01	1.22E+01	1.26E+01	1.20E+01	< 4.44E-01	1.20E+01	1.20E+01	1.10E+01	1.10E+01	1.12E+01	1.09E+01
203	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 3.23E-02	< 3.22E-02	< 2.85E-02	< 2.87E-02	< 2.65E-02	< 2.77E-02
204	5.70E+00	6.14E+00	< 1.59E-01	6.27E+00	5.96E+00	5.84E+00	5.98E+00	< 1.59E-01	5.25E+00	5.57E+00	5.23E+00	4.96E+00	4.99E+00	5.09E+00
205	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 3.23E-02	< 3.22E-02	< 2.85E-02	< 2.87E-02	< 2.65E-02	< 2.77E-02
206	4.08E-01	4.97E-01	< 9.52E-02	6.40E-01	2.13E-01	9.19E-02	1.92E-01	3.29E-01	7.07E-02	8.62E-02	5.95E-02	6.16E-02	6.06E-02	7.22E-02
207	4.12E-01	3.93E-01	< 1.90E-01	4.41E-01	1.60E-01	< 1.64E-01	< 1.82E-01	< 1.90E-01	5.51E-02	5.29E-02	6.38E-02	5.33E-02	4.86E-02	6.43E-02
208	1.02E+00	8.92E-01	< 6.35E-02	1.09E+00	4.48E-01	3.71E-01	2.72E-01	6.83E-01	< 1.29E-01	1.58E-01	< 1.14E-01	1.27E-01	1.79E-01	1.36E-01
230	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
232	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 1.61E-01	< 1.61E-01	< 1.42E-01	< 1.43E-01	< 1.32E-01	< 1.38E-01
233	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
234	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
235	3.42E-01	3.84E-01	< 9.52E-02	3.20E-01	4.13E-01	3.88E-01	3.01E-01	< 9.52E-02	1.49E-01	1.72E-01	1.71E-01	1.90E-01	1.68E-01	1.99E-01
236	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
237	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 3.23E-02	< 3.22E-02	< 2.85E-02	< 2.87E-02	< 2.65E-02	< 2.77E-02
238	5.36E+01	5.55E+01	< 1.27E-01	5.51E+01	5.47E+01	5.20E+01	5.36E+01	< 1.27E-01	2.58E+01	2.59E+01	3.14E+01	3.14E+01	3.22E+01	3.21E+01
239	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	8.05E-02	1.02E-01	1.03E-01	9.07E-02	8.81E-02	8.43E-02
240	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 3.23E-02	< 3.22E-02	< 2.85E-02	< 2.87E-02	< 2.65E-02	< 2.77E-02
241	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
242	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
243	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 2.15E-02	< 2.15E-02	< 1.90E-02	< 1.91E-02	< 1.77E-02	< 1.84E-02
244	< 5.05E-02	< 5.16E-02	< 6.35E-02	< 5.45E-02	< 5.22E-02	< 5.48E-02	< 6.06E-02	< 6.35E-02	< 4.30E-02	< 4.29E-02	< 3.80E-02	< 3.82E-02	< 3.53E-02	< 3.69E-02

Table A-2. ICP-MS of acid dilutions of sludge contact tests (mg/L), nominal uncertainty = 20% (contd.)

hold time (days)	14	14	Standard 1	14	14	14	14	Standard 2	14	14	21	21	21	21	21	21
glycolate (g/L)	0	0	0	5	5	10	10	10	0.2	0.2	0	0	5	5	10	10
DF (mL/mL)	10.44	10.89	12.70	9.77	9.80	9.31	10.10	12.70	11.77	10.41	11.26	10.68	9.35	10.07	11.21	11.60
LIMS numbers	300303331	300303332	300303333	300303334	300303335	300303336	300303337	300303338	300303339	300303340	300303355	300303356	300303357	300303358	300303359	300303360
mass(m/z)= 173	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
174	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
175	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
176	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
177	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
178	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
179	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
180	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
181	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
182	2.62E-01	2.49E-01	5.89E-02	2.54E-01	2.77E-01	2.31E-01	2.21E-01	3.16E-02	2.61E-01	2.39E-01	2.57E-01	2.19E-01	2.68E-01	2.10E-01	2.28E-01	2.11E-01
183	1.23E-01	1.34E-01	< 6.35E-02	1.29E-01	1.50E-01	1.45E-01	1.33E-01	< 6.35E-02	9.44E-02	1.37E-01	1.93E-01	1.41E-01	1.34E-01	1.32E-01	1.49E-01	1.44E-01
184	2.99E-01	2.71E-01	< 8.89E-02	2.72E-01	3.31E-01	2.87E-01	2.61E-01	< 8.89E-02	2.75E-01	2.80E-01	2.95E-01	2.60E-01	2.76E-01	2.85E-01	2.65E-01	3.01E-01
185	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 4.50E-02	< 4.27E-02	< 3.74E-02	< 4.03E-02	< 4.48E-02	< 4.64E-02
186	2.77E-01	2.34E-01	5.56E-02	2.85E-01	2.68E-01	2.63E-01	2.50E-01	5.17E-02	2.43E-01	2.42E-01	3.28E-01	2.99E-01	2.74E-01	2.83E-01	2.58E-01	2.89E-01
187	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 4.50E-02	< 4.27E-02	< 3.74E-02	< 4.03E-02	< 4.48E-02	< 4.64E-02
191	< 3.13E-02	< 3.27E-02	4.07E-02	< 2.93E-02	< 2.94E-02	< 2.79E-02	< 3.03E-02	4.34E-02	< 3.53E-02	< 3.12E-02	< 7.88E-02	< 7.48E-02	< 6.55E-02	< 7.05E-02	< 7.84E-02	< 8.12E-02
193	< 4.17E-02	< 4.35E-02	8.68E-02	< 3.91E-02	< 3.92E-02	< 3.73E-02	< 4.04E-02	6.03E-02	< 4.71E-02	< 4.17E-02	< 7.88E-02	< 7.48E-02	< 6.55E-02	< 7.05E-02	< 7.84E-02	< 8.12E-02
194	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
195	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 3.38E-02	< 3.21E-02	< 2.81E-02	< 3.02E-02	< 3.36E-02	< 3.48E-02
196	1.91E-01	1.69E-01	< 2.54E-02	1.75E-01	1.58E-01	1.84E-01	1.86E-01	< 2.54E-02	2.24E-01	1.87E-01	1.68E-01	1.78E-01	2.06E-01	1.72E-01	1.80E-01	1.58E-01
197	< 1.77E-01	< 1.85E-01	< 2.16E-01	< 1.66E-01	< 1.67E-01	< 1.58E-01	< 1.72E-01	< 2.16E-01	< 2.00E-01	< 1.77E-01	< 4.28E-01	< 4.06E-01	< 3.55E-01	< 3.83E-01	< 4.26E-01	< 4.41E-01
198	1.02E+01	1.05E+01	< 1.14E-01	9.54E+00	9.99E+00	9.93E+00	9.80E+00	< 1.14E-01	1.13E+01	1.13E+01	1.04E+01	1.04E+01	1.03E+01	1.02E+01	9.89E+00	9.90E+00
203	< 3.13E-02	< 3.27E-02	< 3.81E-02	< 2.93E-02	< 2.94E-02	< 2.79E-02	< 3.03E-02	< 3.81E-02	< 3.53E-02	< 3.12E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
204	4.37E+00	4.63E+00	< 8.89E-02	4.28E+00	4.61E+00	4.31E+00	4.57E+00	< 8.89E-02	4.88E+00	5.05E+00	5.11E+00	5.12E+00	5.07E+00	5.04E+00	4.82E+00	4.70E+00
205	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
206	6.28E-02	6.28E-02	3.93E-02	4.87E-02	6.23E-02	4.05E-02	4.20E-02	< 2.54E-02	8.01E-02	7.93E-02	8.90E-02	6.66E-02	6.00E-02	5.39E-02	6.73E-02	4.82E-02
207	5.43E-02	6.25E-02	< 3.81E-02	4.33E-02	3.41E-02	3.86E-02	4.16E-02	< 3.81E-02	5.48E-02	6.50E-02	< 7.88E-02	< 7.48E-02	< 6.55E-02	< 7.05E-02	< 7.84E-02	< 8.12E-02
208	1.17E-01	1.21E-01	9.19E-02	1.08E-01	1.09E-01	9.60E-02	1.21E-01	< 5.08E-02	2.17E-01	1.26E-01	1.45E-01	1.18E-01	1.20E-01	1.24E-01	1.28E-01	1.33E-01
230	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
232	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	2.27E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
233	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
234	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
235	1.42E-01	1.52E-01	< 2.54E-02	1.77E-01	1.40E-01	1.80E-01	1.63E-01	< 2.54E-02	1.21E-01	1.51E-01	1.12E-01	9.95E-02	1.85E-01	1.45E-01	1.31E-01	1.20E-01
236	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
237	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
238	1.98E+01	1.95E+01	< 2.54E-02	2.35E+01	2.37E+01	2.24E+01	2.26E+01	< 2.54E-02	2.08E+01	2.07E+01	1.69E+01	1.70E+01	1.98E+01	1.92E+01	1.89E+01	1.87E+01
239	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
240	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
241	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
242	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
243	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02
244	< 2.09E-02	< 2.18E-02	< 2.54E-02	< 1.95E-02	< 1.96E-02	< 1.86E-02	< 2.02E-02	< 2.54E-02	< 2.35E-02	< 2.08E-02	< 2.25E-02	< 2.14E-02	< 1.87E-02	< 2.01E-02	< 2.24E-02	< 2.32E-02

Table A-2. ICP-MS of acid dilutions of sludge contact tests (mg/L), nominal uncertainty = 20% (contd.)

hold time (days)	35	35	Standard 1	35	35	35	35	Standard 2	35	35	35	35	35	35	35	35
glycolate (g/L)	0	0	0	5	5	10	10	10	0.2	0.2	0	0	5	5	10	10
DF (mL/mL)	10.74	9.26	12.70	11.78	10.95	12.04	10.23	12.70	9.45	12.27	10.65	10.91	11.65	10.58	10.65	12.28
LIMS numbers	300303385	300303386	300303387	300303388	300303389	300303390	300303391	300303392	300303393	300303394	300303395	300303396	300303397	300303398	300303399	300303400
mass(m/z)= 173	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
174	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
175	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
176	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
177	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
178	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 5.32E-02	< 5.45E-02	< 5.83E-02	< 5.29E-02	< 5.32E-02	< 6.14E-02
179	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
180	< 4.30E-02	< 3.70E-02	< 5.08E-02	< 4.71E-02	< 4.38E-02	< 4.82E-02	< 4.09E-02	< 5.08E-02	< 3.78E-02	< 4.91E-02	2.70E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
181	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 4.26E-02	< 4.36E-02	< 4.66E-02	< 4.23E-02	< 4.26E-02	< 4.91E-02
182	2.51E-01	2.50E-01	< 1.27E-01	2.58E-01	2.58E-01	2.63E-01	2.94E-01	< 1.27E-01	2.44E-01	2.29E-01	2.78E-01	2.91E-01	2.85E-01	2.50E-01	3.05E-01	2.28E-01
183	1.34E-01	1.42E-01	4.15E-02	1.18E-01	1.47E-01	1.35E-01	1.26E-01	4.01E-02	1.35E-01	1.29E-01	1.58E-01	1.85E-01	1.34E-01	1.95E-01	1.82E-01	1.45E-01
184	2.99E-01	2.83E-01	1.13E-01	2.66E-01	2.78E-01	2.79E-01	2.93E-01	6.87E-02	2.80E-01	3.41E-01	2.78E-01	3.15E-01	2.87E-01	2.79E-01	3.42E-01	2.64E-01
185	< 3.22E-02	< 2.78E-02	< 3.81E-02	< 3.53E-02	< 3.29E-02	< 3.61E-02	< 3.07E-02	< 3.81E-02	< 2.84E-02	< 3.68E-02	< 3.19E-02	< 3.27E-02	< 3.50E-02	< 3.18E-02	< 3.19E-02	< 3.68E-02
186	2.76E-01	2.44E-01	1.10E-01	2.81E-01	2.39E-01	2.93E-01	2.57E-01	4.59E-02	2.25E-01	2.45E-01	2.83E-01	2.60E-01	2.61E-01	3.04E-01	3.49E-01	2.50E-01
187	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
191	< 6.44E-02	< 5.56E-02	< 7.62E-02	< 7.07E-02	< 6.57E-02	< 7.22E-02	< 6.14E-02	< 7.62E-02	< 5.67E-02	< 7.36E-02	2.47E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
193	< 6.44E-02	< 5.56E-02	< 7.62E-02	< 7.07E-02	< 6.57E-02	< 7.22E-02	< 6.14E-02	< 7.62E-02	< 5.67E-02	< 7.36E-02	3.64E-02	4.04E-02	3.69E-02	2.45E-02	< 2.13E-02	< 2.46E-02
194	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 4.26E-02	< 4.36E-02	< 4.66E-02	< 4.23E-02	< 4.26E-02	< 4.91E-02
195	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
196	2.06E-01	1.88E-01	< 2.54E-02	1.47E-01	1.43E-01	1.51E-01	2.07E-01	< 2.54E-02	2.45E-01	2.02E-01	1.47E-01	1.62E-01	1.55E-01	1.98E-01	2.08E-01	1.19E-01
197	< 2.79E-01	< 2.41E-01	3.61E-01	< 3.06E-01	< 2.85E-01	< 3.13E-01	< 2.66E-01	< 3.30E-01	< 2.46E-01	< 3.19E-01	< 4.58E-01	< 4.69E-01	< 5.01E-01	< 4.55E-01	< 4.58E-01	< 5.28E-01
198	9.72E+00	9.49E+00	< 5.08E-02	8.98E+00	9.41E+00	8.50E+00	8.47E+00	< 5.08E-02	9.35E+00	9.52E+00	9.89E+00	9.86E+00	9.52E+00	9.64E+00	8.89E+00	8.76E+00
203	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
204	4.64E+00	4.54E+00	< 1.02E-01	4.23E+00	4.29E+00	4.07E+00	4.14E+00	< 1.02E-01	4.53E+00	4.22E+00	4.48E+00	4.51E+00	4.43E+00	4.52E+00	4.16E+00	4.16E+00
205	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
206	6.79E-02	6.76E-02	2.84E-02	6.85E-02	6.72E-02	6.25E-02	4.22E-02	4.69E-02	9.01E-02	6.34E-02	7.49E-02	6.76E-02	6.66E-02	1.26E+00	3.44E-01	8.77E-02
207	6.73E-02	5.70E-02	< 3.81E-02	4.31E-02	4.95E-02	4.81E-02	5.45E-02	4.71E-02	6.23E-02	6.37E-02	5.58E-02	6.45E-02	7.22E-02	9.10E-01	2.27E-01	6.56E-02
208	1.44E-01	1.46E-01	6.50E-02	1.34E-01	1.38E-01	1.76E-01	1.30E-01	1.35E-01	1.48E-01	1.67E-01	1.76E-01	1.20E-01	1.96E-01	2.54E+00	5.89E-01	1.23E-01
230	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
232	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
233	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
234	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
235	1.06E-01	9.18E-02	< 2.54E-02	9.55E-02	1.03E-01	1.01E-01	9.71E-02	< 2.54E-02	1.02E-01	9.60E-02	9.45E-02	8.06E-02	1.05E-01	7.78E-02	7.74E-02	9.02E-02
236	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
237	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
238	1.25E+01	1.24E+01	< 2.54E-02	1.40E+01	1.41E+01	1.40E+01	1.41E+01	< 2.54E-02	1.27E+01	1.24E+01	1.30E+01	1.28E+01	1.46E+01	1.45E+01	1.39E+01	1.35E+01
239	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
240	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
241	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
242	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
243	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02
244	< 2.15E-02	< 1.85E-02	< 2.54E-02	< 2.36E-02	< 2.19E-02	< 2.41E-02	< 2.05E-02	< 2.54E-02	< 1.89E-02	< 2.45E-02	< 2.13E-02	< 2.18E-02	< 2.33E-02	< 2.12E-02	< 2.13E-02	< 2.46E-02

Table A-3. Analysis of water dilutions for sludge contact testing

hold time (days)	0	Standard 1	0	0	Standard 2	7	7	7	14	Standard 1	14	14	Standard 2	14
glycolate (g/L)	0	0	5	10	10	0	5	10	0	0	5	10	10	0.2
DF (mL/mL)	10.29	13.52	10.63	10.50	13.51	11.26	10.41	12.04	9.64	13.52	10.53	9.24	13.51	8.94
LIMS number	300303326	300303327	300303328	300303329	300303330	300303309	300303310	300303311	300303349	300303353	300303350	300303351	300303354	300303352
IC Anions (mg/L)														
Glycolate	< 5.14E+02	< 6.76E+02	5.75E+03	1.55E+04	8.75E+03	< 1.13E+03	4.41E+03	8.75E+03	< 9.64E+02	< 1.35E+03	4.23E+03	8.45E+03	7.35E+03	< 8.94E+02
Fluoride	< 1.03E+02	< 1.35E+02	< 1.06E+02	< 1.05E+02	< 1.35E+02	< 1.13E+03	< 1.04E+03	< 1.20E+03	< 9.64E+02	< 1.35E+03	< 1.05E+03	< 9.24E+02	< 1.35E+03	< 8.94E+02
Formate	1.54E+03	1.64E+03	1.45E+03	2.00E+03	1.35E+03	1.48E+03	1.63E+03	1.78E+03	1.47E+03	1.60E+03	1.73E+03	1.87E+03	1.35E+03	1.53E+03
Chloride	1.23E+02	< 1.35E+02	1.28E+02	1.57E+02	< 1.35E+02	< 1.13E+03	< 1.04E+03	< 1.20E+03	< 9.64E+02	< 1.35E+03	< 1.05E+03	< 9.24E+02	< 1.35E+03	< 8.94E+02
Nitrite	7.21E+04	7.95E+04	6.72E+04	9.07E+04	6.32E+04	7.58E+04	7.02E+04	7.05E+04	7.07E+04	8.08E+04	6.97E+04	6.95E+04	6.32E+04	7.01E+04
Bromide	< 1.03E+03	< 1.35E+03	< 1.06E+03	< 1.05E+03	< 1.35E+03	< 1.13E+03	< 1.04E+03	< 1.20E+03	< 9.64E+02	< 1.35E+03	< 1.05E+03	< 9.24E+02	< 1.35E+03	< 8.94E+02
Nitrate	5.75E+04	6.48E+04	5.47E+04	7.20E+04	5.30E+04	5.47E+04	5.50E+04	5.50E+04	5.52E+04	6.29E+04	5.43E+04	5.44E+04	5.27E+04	5.47E+04
Phosphate	2.88E+02	3.79E+02	2.98E+02	3.78E+02	2.97E+02	3.04E+02	2.91E+02	2.89E+02	2.89E+02	3.38E+02	2.84E+02	2.77E+02	2.70E+02	2.86E+02
Sulfate	1.90E+03	1.66E+03	1.88E+03	2.50E+03	1.35E+03	2.07E+03	1.93E+03	2.03E+03	2.03E+03	1.65E+03	2.00E+03	1.99E+03	1.49E+03	1.99E+03
Oxalate	2.37E+02	< 1.35E+02	1.91E+02	1.78E+02	1.49E+02	2.59E+02	3.33E+02	3.73E+02	2.51E+02	< 1.35E+02	3.58E+02	3.51E+02	1.49E+02	2.50E+02
TIC/TOC (mg C/L)														
Total Carbon	4.68E+03	5.91E+03	7.25E+03	1.03E+04	7.42E+03	--	--	--	--	--	--	--	--	--
Inorganic Carbon	4.22E+03	5.52E+03	4.22E+03	5.54E+03	4.63E+03	--	--	--	--	--	--	--	--	--
Organic Carbon	4.62E+02	3.88E+02	1.97E+03	4.74E+03	2.78E+03	--	--	--	--	--	--	--	--	--
Titration (M)														
Total Base	3.51E+00	3.62E+00	3.49E+00	4.52E+00	3.15E+00	--	--	--	--	--	--	--	--	--
Free Hydroxide	2.50E+00	2.37E+00	2.39E+00	3.19E+00	2.05E+00	--	--	--	--	--	--	--	--	--
Other Base*	3.91E-01	7.30E-01	3.61E-01	5.35E-01	5.54E-01	--	--	--	--	--	--	--	--	--

* Other Base excluding carbonate

Table A-3. Analysis of water dilutions for sludge contact testing (contd.)

hold time (days)	21	21	21	35	Standard 1	35	35	Standard 2	35	35	35	35	56	56
glycolate (g/L)	0	5	10	0	0	5	10	10	0.2	0	5	10	0	10
DF (mL/mL)	9.68	10.97	10.71	13.50	13.52	9.85	9.53	13.51	9.70	9.47	8.47	9.46	10.92	8.57
LIMS number	300303367	300303368	300303369	300303415	300303416	300303417	300303418	300303419	300303420	300303421	300303422	300303423	300303382	300303384
IC Anions (mg/L)														
Glycolate	--	--	--	< 1.35E+03	< 1.35E+03	< 3.79E+03	< 8.38E+03	7.67E+03	< 9.70E+02	< 9.47E+02	< 3.86E+03	< 8.16E+03	< 5.46E+02	6.59E+03
Fluoride	--	--	--	--	--	--	--	--	--	--	--	--	< 5.46E+02	< 4.29E+02
Formate	--	--	--	--	--	--	--	--	--	--	--	--	1.18E+03	3.80E+03
Chloride	--	--	--	--	--	--	--	--	--	--	--	--	< 5.46E+02	< 4.29E+02
Nitrite	--	--	--	--	--	--	--	--	--	--	--	--	7.30E+04	7.17E+04
Bromide	--	--	--	--	--	--	--	--	--	--	--	--	< 5.46E+03	< 4.29E+03
Nitrate	--	--	--	--	--	--	--	--	--	--	--	--	5.42E+04	5.45E+04
Phosphate	--	--	--	--	--	--	--	--	--	--	--	--	2.95E+02	2.83E+02
Sulfate	--	--	--	--	--	--	--	--	--	--	--	--	1.99E+03	2.01E+03
Oxalate	--	--	--	--	--	--	--	--	--	--	--	--	4.04E+02	1.48E+03
TIC/TOC (mg C/L)														
Total Carbon	--	--	--	4.79E+02	6.37E+03	1.70E+03	3.29E+03	7.90E+03	4.69E+02	4.11E+02	1.72E+03	3.26E+03	5.52E+03	8.29E+03
Inorganic Carbon	--	--	--	1.97E+02	5.95E+03	1.41E+02	1.44E+02	4.96E+03	1.20E+02	1.57E+02	1.62E+02	1.67E+02	4.94E+03	5.01E+03
Organic Carbon	--	--	--	2.82E+02	4.22E+02	1.57E+03	3.14E+03	2.94E+03	3.48E+02	2.54E+02	1.56E+03	3.09E+03	5.90E+02	3.27E+03
Titration (M)														
Total Base	--	--	--	--	--	--	--	--	--	--	--	--	2.95E+00	2.80E+00
Free Hydroxide	--	--	--	--	--	--	--	--	--	--	--	--	2.51E+00	2.46E+00
Other Base*	--	--	--	--	--	--	--	--	--	--	--	--	< 5.46E-01	< 4.29E-01

* Other Base excluding carbonate

Table A-4. Analysis results for acid dilutions of evaporator scale contact tests

hold time (days)	0	0	19	19	20	19	20	20
glycolate (g/L)	0	10	0	0	0	10	10	10
DF (mL/mL)	18.73	18.31	10.96	10.59	10.91	11.07	10.83	11.29
LIMS numbers	300304639	300304641	300304643	300304645	300304647	300304644	300304646	300304648
	300304649	300304651	300304653	300304655	300304657	300304654	300304656	300304658
ICP-ES (mg/L)								
Ag	< 2.10E+00	< 2.05E+00	< 1.23E+00	< 1.19E+00	< 1.22E+00	< 1.24E+00	< 1.21E+00	< 1.26E+00
Al	1.33E+03	1.26E+03	1.24E+03	1.39E+03	1.24E+03	1.33E+03	1.52E+03	1.20E+03
B	1.16E+02	1.12E+02	1.15E+02	1.22E+02	1.17E+02	1.25E+02	1.30E+02	1.15E+02
Ba	< 9.93E-01	< 9.70E-01	< 5.81E-01	< 5.61E-01	< 5.78E-01	< 5.87E-01	< 5.74E-01	< 5.98E-01
Be	< 2.25E-01	< 2.20E-01	< 1.31E-01	< 1.27E-01	< 1.31E-01	< 1.33E-01	< 1.30E-01	< 1.35E-01
Ca	9.78E+00	1.24E+01	1.83E+01	1.15E+01	1.25E+01	1.93E+01	1.65E+01	1.58E+01
Cd	< 2.68E+00	< 2.62E+00	< 1.57E+00	< 1.51E+00	< 1.56E+00	< 1.58E+00	< 1.55E+00	< 1.61E+00
Ce	< 1.53E+01	< 1.50E+01	< 8.97E+00	< 8.67E+00	< 8.93E+00	< 9.07E+00	< 8.87E+00	< 9.25E+00
Co	< 3.47E+00	< 3.39E+00	< 2.03E+00	< 1.96E+00	< 2.02E+00	< 2.05E+00	< 2.00E+00	< 2.09E+00
Cr	4.78E+01	4.78E+01	4.66E+01	4.45E+01	4.87E+01	5.14E+01	5.09E+01	4.88E+01
Cu	< 1.84E+00	< 1.79E+00	< 1.07E+00	< 1.04E+00	< 1.07E+00	< 1.09E+00	< 1.34E+00	< 1.11E+00
Fe	6.71E+00	3.17E+00	< 1.35E+00	< 1.30E+00	1.57E+00	4.71E+00	< 1.33E+00	1.39E+00
Gd	< 8.88E+00	< 8.68E+00	< 5.19E+00	< 5.02E+00	< 5.17E+00	< 5.25E+00	< 5.13E+00	< 5.35E+00
K	2.74E+02	2.71E+02	3.00E+02	3.59E+02	3.57E+02	3.64E+02	4.33E+02	3.61E+02
La	< 2.36E+00	< 2.31E+00	< 1.38E+00	< 1.33E+00	< 1.37E+00	< 1.40E+00	< 1.36E+00	< 1.42E+00
Li	4.55E+01	4.36E+01	4.38E+01	4.62E+01	4.48E+01	4.66E+01	4.89E+01	4.35E+01
Mg	2.62E-01	3.66E-01	3.62E-01	3.02E-01	3.82E-01	7.81E-01	4.93E-01	4.29E-01
Mn	< 1.44E+00	< 1.41E+00	< 8.44E-01	< 8.16E-01	< 8.40E-01	< 8.53E-01	< 8.34E-01	< 8.69E-01
Mo	< 1.84E+01	< 1.80E+01	< 1.08E+01	< 1.04E+01	< 1.07E+01	< 1.09E+01	< 1.06E+01	< 1.11E+01
Na	1.33E+05	1.30E+05	1.27E+05	1.35E+05	1.29E+05	1.41E+05	1.46E+05	1.30E+05
Ni	< 3.88E+00	< 3.79E+00	< 2.27E+00	< 2.19E+00	< 2.26E+00	< 2.29E+00	< 2.24E+00	< 2.34E+00
P	1.22E+02	1.13E+02	1.29E+02	1.39E+02	1.39E+02	1.49E+02	1.51E+02	1.24E+02
Pb	< 8.64E+01	< 8.44E+01	< 5.05E+01	< 4.88E+01	< 5.03E+01	< 5.10E+01	< 4.99E+01	< 5.20E+01
S	< 1.12E+03	< 1.10E+03	1.16E+03	1.26E+03	9.51E+02	8.04E+02	1.07E+03	1.29E+03
Sb	< 6.46E+01	< 6.32E+01	< 3.78E+01	< 3.65E+01	< 3.76E+01	< 3.82E+01	< 3.74E+01	< 3.89E+01
Si	4.08E+01	4.08E+01	3.40E+01	3.48E+01	3.50E+01	3.44E+01	3.54E+01	3.38E+01
Sn	< 6.78E+01	< 6.63E+01	< 3.97E+01	< 3.83E+01	< 3.95E+01	< 4.01E+01	< 3.92E+01	< 4.09E+01
Sr	< 9.37E-01	< 9.15E-01	< 5.48E-01	< 5.30E-01	< 5.45E-01	< 5.54E-01	< 5.41E-01	< 5.64E-01
Th	< 9.59E+00	< 9.37E+00	< 5.61E+00	< 5.42E+00	< 5.59E+00	< 5.67E+00	< 5.54E+00	< 5.78E+00
Ti	< 1.09E+00	< 1.06E+00	< 6.35E-01	< 6.14E-01	< 6.33E-01	< 6.42E-01	< 6.28E-01	< 6.55E-01
U	< 5.28E+01	< 5.16E+01	< 3.09E+01	< 2.99E+01	< 3.08E+01	< 3.12E+01	< 3.05E+01	< 3.18E+01
V	< 1.18E+00	< 1.15E+00	< 6.90E-01	< 6.67E-01	< 6.87E-01	< 6.98E-01	< 6.82E-01	< 7.11E-01
Zn	5.23E+00	5.05E+00	5.35E+00	5.48E+00	5.43E+00	5.49E+00	5.57E+00	5.06E+00
Zr	< 9.18E-01	< 8.97E-01	< 5.37E-01	< 5.19E-01	< 5.35E-01	< 5.43E-01	< 5.31E-01	< 5.53E-01
CVAA Hg (mg/L)								
Hg	2.19E+02	1.52E+02	3.57E+02	3.30E+02	3.53E+02	2.31E+02	2.70E+02	2.43E+02
PuTTA (dpm/mL)								
Pu-238	4.05E+03	7.27E+02	3.80E+02	5.55E+02	3.77E+02	3.79E+02	3.35E+02	<1.39E+02 [a]
Pu-239/240	4.76E+02	<1.25E+02 [a]	<7.29E+01 [a]	<6.77E+01 [a]	<1.31E+02 [a]	<6.06E+01 [a]	<3.68E+01 [a]	< 6.12E+01

[a] some Pu-238 measurements are reported as "upper limit" values due to potential interferences.

Table A-5. ICP-MS results for acid dilutions of evaporator scale contact tests

hold time (days)	0	0	19	19	20	19	20	20
glycolate (g/L)	0	10	0	0	0	10	10	10
DF (mL/mL)	18.73	18.31	10.96	10.59	10.91	11.07	10.83	11.29
LIMS numbers	300304639	300304641	300304643	300304645	300304647	300304644	300304646	300304648
mass (m/z) = 59	< 7.49E-02	< 7.32E-02	< 4.38E-02	< 4.24E-02	< 4.36E-02	< 4.43E-02	< 4.33E-02	< 4.52E-02
82	< 1.95E+00	< 1.90E+00	< 1.14E+00	< 1.10E+00	< 1.13E+00	< 1.15E+00	< 1.13E+00	< 1.17E+00
84	< 1.12E+00	< 1.10E+00	< 6.57E-01	< 6.36E-01	< 6.55E-01	< 6.64E-01	< 6.50E-01	< 6.77E-01
85	2.57E-01	2.59E-01	2.75E-01	2.56E-01	2.34E-01	2.74E-01	2.73E-01	2.60E-01
86	< 9.93E-01	< 9.70E-01	< 5.81E-01	< 5.61E-01	< 5.78E-01	< 5.87E-01	< 5.74E-01	< 5.98E-01
87	3.70E-01	4.49E-01	4.22E-01	4.39E-01	4.67E-01	4.87E-01	4.68E-01	4.64E-01
88	< 7.49E-02	< 7.32E-02	8.38E-02	< 4.24E-02	6.31E-02	6.88E-02	6.47E-02	7.40E-02
89	< 1.12E-01	< 1.10E-01	< 6.57E-02	< 6.36E-02	< 6.55E-02	< 6.64E-02	< 6.50E-02	< 6.77E-02
90	< 1.87E-01	< 1.83E-01	< 1.10E-01	< 1.06E-01	< 1.09E-01	< 1.11E-01	< 1.08E-01	< 1.13E-01
91	< 5.62E-02	< 5.49E-02	< 3.29E-02	< 3.18E-02	< 3.27E-02	< 3.32E-02	< 3.25E-02	< 3.39E-02
92	3.08E-01	3.31E-01	3.16E-01	3.13E-01	2.93E-01	3.57E-01	3.66E-01	3.28E-01
93	< 5.62E-02	< 5.49E-02	< 3.29E-02	< 3.18E-02	< 3.27E-02	< 3.32E-02	< 3.25E-02	< 3.39E-02
94	2.48E-01	2.21E-01	2.34E-01	2.16E-01	2.19E-01	2.31E-01	2.58E-01	2.57E-01
95	1.27E+00	1.25E+00	1.34E+00	1.21E+00	1.43E+00	1.39E+00	1.34E+00	1.39E+00
96	4.50E-01	3.86E-01	4.24E-01	4.41E-01	4.59E-01	4.77E-01	4.82E-01	4.65E-01
97	1.08E+00	1.08E+00	1.05E+00	1.08E+00	1.13E+00	1.26E+00	1.27E+00	1.14E+00
98	1.50E+00	1.33E+00	1.51E+00	1.37E+00	1.42E+00	1.55E+00	1.43E+00	1.56E+00
99	1.09E+00	1.12E+00	1.06E+00	8.80E-01	1.05E+00	9.30E-01	8.22E-01	8.50E-01
100	1.16E+00	1.25E+00	1.14E+00	1.16E+00	1.14E+00	1.32E+00	1.35E+00	1.21E+00
101	7.70E-01	1.02E+00	8.14E-01	8.26E-01	8.58E-01	1.38E+00	1.21E+00	1.10E+00
102	7.21E-01	9.51E-01	7.45E-01	7.83E-01	7.57E-01	1.08E+00	1.16E+00	1.05E+00
103	2.81E-01	7.67E-01	2.63E-01	2.94E-01	3.26E-01	8.39E-01	8.15E-01	7.07E-01
104	4.54E-01	5.81E-01	4.47E-01	3.73E-01	3.83E-01	5.53E-01	5.87E-01	5.06E-01
105	< 1.12E-01	< 1.10E-01	< 6.57E-02	< 6.36E-02	< 6.55E-02	< 8.19E-02	< 7.39E-02	< 7.35E-02
106	1.23E-01	9.72E-02	8.89E-02	7.66E-02	8.15E-02	7.42E-02	8.21E-02	6.59E-02
107	< 4.87E-01	< 4.76E-01	< 2.85E-01	< 2.75E-01	< 2.84E-01	< 2.88E-01	< 2.82E-01	< 2.94E-01
108	< 1.87E-01	< 1.83E-01	< 1.10E-01	< 1.06E-01	< 1.09E-01	< 1.11E-01	< 1.08E-01	< 1.13E-01
109	2.04E-01	6.81E-02	2.90E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
110	4.34E-02	< 3.66E-02	2.93E-02	2.17E-02	2.61E-02	< 2.21E-02	< 2.17E-02	2.64E-02
111	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	2.19E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
112	< 5.62E-02	< 5.49E-02	< 3.29E-02	< 3.18E-02	< 3.27E-02	< 3.32E-02	< 3.25E-02	< 3.39E-02
113	< 2.27E+00	< 2.22E+00	< 1.33E+00	< 1.28E+00	< 1.32E+00	< 1.34E+00	< 1.31E+00	< 1.37E+00
114	< 1.12E-01	< 1.10E-01	< 6.57E-02	< 6.36E-02	< 6.55E-02	< 6.64E-02	< 6.50E-02	< 6.77E-02
116	1.01E-01	1.14E-01	1.10E-01	9.63E-02	1.11E-01	1.04E-01	1.26E-01	1.09E-01
117	< 3.75E-02	6.81E-02	5.62E-02	7.57E-02	6.16E-02	6.49E-02	7.06E-02	5.59E-02
118	1.38E-01	1.47E-01	1.34E-01	1.49E-01	1.35E-01	1.36E-01	1.50E-01	1.40E-01
119	5.80E-02	1.54E-01	6.13E-02	1.03E-01	7.29E-02	1.07E-01	1.11E-01	7.25E-02
120	1.72E-01	1.92E-01	1.68E-01	1.64E-01	1.81E-01	1.85E-01	1.73E-01	1.73E-01
121	< 3.00E-01	< 2.93E-01	< 1.75E-01	< 1.69E-01	< 1.75E-01	< 1.77E-01	< 1.73E-01	< 1.81E-01
122	5.55E-02	6.43E-02	5.88E-02	4.87E-02	5.51E-02	6.69E-02	6.18E-02	5.05E-02
123	< 1.31E-01	< 1.28E-01	< 7.67E-02	< 7.41E-02	< 7.64E-02	< 7.75E-02	< 7.58E-02	< 7.90E-02
124	7.89E-02	7.68E-02	9.20E-02	9.24E-02	8.42E-02	8.81E-02	5.99E-02	6.58E-02
125	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02

Table A-5. ICP-MS results for acid dilutions of evaporator scale contact tests (contd.)

hold time (days)	0	0	19	19	20	19	20	20
glycolate (g/L)	0	10	0	0	0	10	10	10
DF (mL/mL)	18.73	18.31	10.96	10.59	10.91	11.07	10.83	11.29
LIMS numbers	300304639	300304641	300304643	300304645	300304647	300304644	300304646	300304648
mass (m/z) = 126	< 1.31E-01	1.45E-01	1.00E-01	7.98E-02	9.69E-02	8.11E-02	9.85E-02	9.88E-02
128	< 3.18E-01	< 3.11E-01	< 1.86E-01	< 1.80E-01	< 1.85E-01	< 1.88E-01	< 1.84E-01	< 1.92E-01
130	< 1.76E+00	< 1.72E+00	< 1.03E+00	< 9.96E-01	< 1.03E+00	< 1.04E+00	< 1.02E+00	< 1.06E+00
133	1.64E+00	1.53E+00	1.64E+00	1.75E+00	1.73E+00	1.86E+00	1.93E+00	1.82E+00
134	< 8.99E-01	< 8.79E-01	< 5.26E-01	< 5.08E-01	< 5.24E-01	< 5.32E-01	< 5.20E-01	< 5.42E-01
135	2.36E-01	2.05E-01	2.28E-01	2.14E-01	1.99E-01	2.30E-01	2.44E-01	2.05E-01
136	< 9.37E-02	< 9.15E-02	< 5.48E-02	< 5.30E-02	< 5.45E-02	< 5.54E-02	< 5.41E-02	< 5.64E-02
137	4.87E-01	4.77E-01	6.10E-01	5.40E-01	5.65E-01	5.36E-01	5.94E-01	5.65E-01
138	< 9.37E-02	< 9.15E-02	< 5.48E-02	< 5.30E-02	< 5.45E-02	< 5.54E-02	< 5.41E-02	< 5.64E-02
139	< 7.49E-02	< 7.32E-02	< 4.38E-02	< 4.24E-02	< 4.36E-02	< 4.43E-02	< 4.33E-02	< 4.52E-02
140	< 9.37E-02	< 9.15E-02	< 5.48E-02	< 5.30E-02	< 5.45E-02	< 5.54E-02	< 5.41E-02	< 5.64E-02
141	< 5.62E-02	< 5.49E-02	< 3.29E-02	< 3.18E-02	< 3.27E-02	< 3.32E-02	< 3.25E-02	< 3.39E-02
142	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
143	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
144	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
145	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
146	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
147	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
148	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
149	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
150	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
151	< 5.62E-02	< 5.49E-02	< 3.29E-02	< 3.18E-02	< 3.27E-02	< 3.32E-02	< 3.25E-02	< 3.39E-02
152	< 7.49E-02	< 7.32E-02	< 4.38E-02	< 4.24E-02	< 4.36E-02	< 4.43E-02	< 4.33E-02	< 4.52E-02
153	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
154	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
155	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
156	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
157	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
158	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
159	< 5.62E-02	< 5.49E-02	< 3.29E-02	< 3.18E-02	< 3.27E-02	< 3.32E-02	< 3.25E-02	< 3.39E-02
160	< 5.62E-02	< 5.49E-02	< 3.29E-02	< 3.18E-02	< 3.27E-02	< 3.32E-02	< 3.25E-02	< 3.39E-02
161	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
162	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
163	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
164	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
165	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
166	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
167	< 5.62E-02	< 5.49E-02	< 3.29E-02	< 3.18E-02	< 3.27E-02	< 3.32E-02	< 3.25E-02	< 3.39E-02
168	< 5.62E-02	< 5.49E-02	< 3.29E-02	< 3.18E-02	< 3.27E-02	< 3.32E-02	< 3.25E-02	< 3.39E-02
169	< 5.62E-02	< 5.49E-02	< 3.29E-02	< 3.18E-02	< 3.27E-02	< 3.32E-02	< 3.25E-02	< 3.39E-02
170	< 5.62E-02	< 5.49E-02	< 3.29E-02	< 3.18E-02	< 3.27E-02	< 3.32E-02	< 3.25E-02	< 3.39E-02
171	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
172	< 5.62E-02	< 5.49E-02	< 3.29E-02	< 3.18E-02	< 3.27E-02	< 3.32E-02	< 3.25E-02	< 3.39E-02

Table A-5. ICP-MS results for acid dilutions of evaporator scale contact tests (contd.)

hold time (days)	0	0	19	19	20	19	20	20
glycolate (g/L)	0	10	0	0	0	10	10	10
DF (mL/mL)	18.73	18.31	10.96	10.59	10.91	11.07	10.83	11.29
LIMS numbers	300304639	300304641	300304643	300304645	300304647	300304644	300304646	300304648
mass (m/z) = 173	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
174	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
175	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
176	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
177	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
178	< 7.49E-02	< 7.32E-02	< 4.38E-02	< 4.24E-02	< 4.36E-02	< 4.43E-02	< 4.33E-02	< 4.52E-02
179	< 1.12E-01	< 1.10E-01	< 6.57E-02	< 6.36E-02	< 6.55E-02	< 6.64E-02	< 6.50E-02	< 6.77E-02
180	< 1.50E-01	< 1.46E-01	< 8.77E-02	< 8.47E-02	< 8.73E-02	< 8.86E-02	< 8.66E-02	< 9.03E-02
181	< 3.18E-01	< 3.11E-01	< 1.86E-01	< 1.80E-01	< 1.85E-01	< 1.88E-01	< 1.84E-01	< 1.92E-01
182	2.39E-01	1.78E-01	2.38E-01	1.97E-01	2.16E-01	2.23E-01	2.16E-01	2.16E-01
183	1.38E-01	< 1.28E-01	1.32E-01	1.28E-01	1.29E-01	1.69E-01	1.35E-01	1.29E-01
184	3.36E-01	2.89E-01	2.52E-01	2.65E-01	2.53E-01	3.20E-01	2.92E-01	2.75E-01
185	< 1.31E-01	< 1.28E-01	< 7.67E-02	< 7.41E-02	< 7.64E-02	< 7.75E-02	< 7.58E-02	< 7.90E-02
186	2.45E-01	2.51E-01	2.32E-01	2.71E-01	2.40E-01	2.67E-01	2.36E-01	2.63E-01
187	< 5.62E-02	< 5.49E-02	< 3.29E-02	< 3.18E-02	< 3.27E-02	< 3.32E-02	< 3.25E-02	< 3.39E-02
191	< 9.37E-02	< 9.15E-02	< 5.48E-02	< 5.30E-02	< 5.45E-02	< 5.54E-02	< 5.41E-02	< 5.64E-02
193	< 1.12E-01	< 1.10E-01	< 6.57E-02	< 6.36E-02	< 6.55E-02	< 6.64E-02	< 6.50E-02	< 6.77E-02
194	< 1.50E-01	< 1.46E-01	< 8.77E-02	< 8.47E-02	< 8.73E-02	< 8.86E-02	< 8.66E-02	< 9.03E-02
195	< 1.31E-01	< 1.28E-01	< 7.67E-02	< 7.41E-02	< 7.64E-02	< 7.75E-02	< 7.58E-02	< 7.90E-02
196	3.16E-01	1.54E-01	3.06E-01	3.01E-01	3.11E-01	2.21E-01	2.12E-01	2.48E-01
198	1.08E+01	7.86E+00	1.69E+01	1.69E+01	1.80E+01	1.19E+01	1.34E+01	1.30E+01
203	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
204	4.87E+00	3.71E+00	7.88E+00	7.95E+00	8.33E+00	5.37E+00	6.28E+00	5.75E+00
205	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
206	< 3.75E-02	3.67E-02	2.74E-02	< 2.12E-02	9.27E-02	< 2.21E-02	2.60E-02	< 2.26E-02
207	< 3.75E-02	< 3.66E-02	2.72E-02	2.42E-02	6.92E-02	2.85E-02	2.95E-02	2.52E-02
208	9.91E-02	7.83E-02	6.40E-02	< 4.24E-02	2.39E-01	< 4.43E-02	6.82E-02	4.80E-02
230	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
232	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
233	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
234	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
235	< 3.75E-02	< 3.66E-02	6.26E-02	5.04E-02	3.98E-02	5.33E-02	5.04E-02	6.16E-02
236	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
237	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
238	2.59E+00	5.84E+00	5.88E+00	7.05E+00	6.25E+00	7.12E+00	6.98E+00	6.59E+00
239	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
240	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
241	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
242	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
243	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02
244	< 3.75E-02	< 3.66E-02	< 2.19E-02	< 2.12E-02	< 2.18E-02	< 2.21E-02	< 2.17E-02	< 2.26E-02

Table A-6. Analysis results for water dilutions of evaporator scale contact tests

hold time (days)	0	0	19	19	20	19	20	20
glycolate (g/L)	0	10	0	0	0	10	10	10
DF (mL/mL)	15.81	15.67	11.92	11.36	11.12	11.27	11.05	11.74
LIMS numbers	300304659	300304661	300304663	300304665	300304667	300304664	300304666	300304668
	300304669	300304671	300304673	300304675	300304677	300304674	300304676	300304678
IC Anions (mg/L)								
Glycolate	*< 7.90E+02*	*6.36E+03*	*< 5.96E+02*	*< 5.68E+02*	*< 5.56E+02*	*6.62E+03*	*6.65E+03*	*5.91E+03*
Fluoride	< 7.90E+02	< 7.84E+02	< 5.96E+02	< 5.68E+02	< 5.56E+02	< 5.63E+02	< 5.52E+02	< 5.87E+02
Formate	1.42E+03	3.71E+03	1.45E+03	1.50E+03	1.48E+03	4.56E+03	4.76E+03	4.18E+03
Chloride	< 7.90E+02	< 7.84E+02	< 5.96E+02	< 5.68E+02	< 5.56E+02	< 5.63E+02	< 5.52E+02	< 5.87E+02
Nitrite	6.76E+04	6.71E+04	7.04E+04	7.26E+04	7.00E+04	7.57E+04	7.81E+04	6.88E+04
Bromide	< 7.90E+03	< 7.84E+03	< 5.96E+03	< 5.68E+03	< 5.56E+03	< 5.63E+03	< 5.52E+03	< 5.87E+03
Nitrate	5.17E+04	5.14E+04	5.42E+04	6.10E+04	5.43E+04	5.83E+04	6.02E+04	5.32E+04
Phosphate	2.69E+02	2.66E+02	2.86E+02	2.95E+02	3.00E+02	3.16E+02	3.31E+02	2.94E+02
Sulfate	2.02E+03	1.96E+03	2.04E+03	2.00E+03	1.93E+03	2.11E+03	2.09E+03	1.90E+03
Oxalate	3.64E+02	7.52E+02	5.60E+02	5.46E+02	5.56E+02	1.28E+03	1.52E+03	1.30E+03
TIC/TOC (mg C/L)								
Total Carbon	5.12E+03	8.46E+03	5.98E+03	6.00E+03	5.71E+03	1.06E+04	1.10E+04	9.35E+03
Inorganic Carbon	4.46E+03	4.95E+03	4.70E+03	4.86E+03	4.67E+03	5.86E+03	6.19E+03	5.31E+03
Organic Carbon	6.64E+02	3.51E+03	1.29E+03	1.14E+03	1.05E+03	4.73E+03	4.86E+03	4.04E+03
Titration (M)								
Total Base	2.48E+00	2.37E+00	2.41E+00	2.58E+00	2.39E+00	3.53E+00	2.26E+00	2.03E+00
Free Hydroxide	2.17E+00	2.07E+00	2.16E+00	2.04E+00	2.16E+00	2.23E+00	2.05E+00	1.96E+00
Other Base*	< 3.16E-01	< 3.13E-01	< 2.38E-01	< 2.25E-01	< 2.27E-01	< 2.21E-01	< 2.22E-01	< 2.35E-01

* Other Base excluding carbonate