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Measurements of Mercury Released from Amalgams and Sulfide Compounds

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LOCKHEED MARTIN ENERGY RESEARCH CORPORATION
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

ORNL-27 (3-96)

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ORNL/TM-13728

Chemical Technology Division

MEASUREMENTS OF MERCURY RELEASED FROM AMALGAMS AND SULFIDE COMPOUNDS

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Date Published: April 1999

Prepared for the
U.S. DEPARTMENT OF ENERGY
OFFICE OF TECHNOLOGY DEVELOPMENT
Washington, D.C. 20585

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for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-96OR22464

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ACRONYMS

ADA	ADA Technologies
AMLGM	Amalgamation
ASTM	American Society for Testing and Materials
CAA	Clean Air Act
CVAA	Cold vapor atomic absorption
DI	Deionized water
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FERN	Fernald
ICP-AES	Inductively Coupled Argon Plasma–Atomic Emission Spectroscopy
INEEL	Idaho National Engineering and Environmental Laboratory
LANL	Los Alamos National Laboratory
LDR	Land Disposal Restrictions
MLLW	Mixed Low Level Waste
MWFA	Mixed Waste Focus Area
NFS	Nuclear Fuel Services
ORNL	Oak Ridge National Laboratory
ppb	Parts per billion
ppm	Parts per million
RCRA	Resource Conservation and Recovery Act
TCLP	Toxicity Characteristic Leaching Procedure
TLV	Threshold Limiting Value
UTS	Universal Treatment Standard

EXECUTIVE SUMMARY

This report covers work performed during FY 1998 in support of treatment demonstrations conducted for the Mercury Working Group. In order to comply with the requirements of the Resource Conservation and Recovery Act, as implemented by the U.S. Environmental Protection Agency (EPA), the U.S. Department of Energy (DOE) must apply amalgamation, the treatment standard for radioactively contaminated mercury, before disposing of these wastes. The Mercury Working Group under the Mixed Waste Focus Area sponsored a demonstration in which two commercial vendors demonstrated their technologies for the treatment of radioactive mercury from various DOE sites. The project, described in this report, addresses the need for data on the vapor pressure and degradation occurring in amalgamated mercury mixed low-level wastes generated during these demonstrations under a variety of conditions.

A set of experiments studied the release of mercury above the headspace of amalgams as a function of temperature. Three temperatures were selected: 4°C, ambient, and 60°C. Results showed that compounds made with sulfur do not release mercury while those amalgams made with metals release mercury at a level comparable to that of pure mercury.

Another set of experiments studied the degradation of the amalgams as a function of the pH of the leachant in which they were immersed. Four pH values were selected: (1) pH ~3—constituted by EPA fluid #2 from the Toxicity Characteristic Leaching Procedure (TCLP) test, (2) pH ~5—constituted by EPA fluid #1 from the TCLP test, (3) pH ~7—using deionized water, and (4) pH ~12.5—using a saturated solution of $Ca(OH)_2$. The leachates were analyzed after 2 weeks, 1 month, 2 months, and 3 months for mercury and trace metals.

Even though the leach test conditions selected were unlikely to reflect those of a disposal site, the goal was to submit the amalgams to extreme conditions where the mechanisms of degradation, if any, would prevail. Analytical results indicated that amalgams prepared with metals did not perform well at low (acidic) and neutral pH, releasing mercury and metals into the leachate solutions. These amalgams tended to perform better in alkaline solution. Additionally, the sulfur-based amalgams appeared to fare better over the entire pH range evaluated.

1. BACKGROUND

Significant quantities of radioactive mercury waste [mixed low-level waste (MLLW)] are currently stored at the U.S. Department of Energy (DOE) facilities. In order to meet the U.S. Environmental Protection Agency (EPA) Land Disposal Restrictions (LDR), the treatment standard for this type of waste under the Resource Conservation and Recovery Act (RCRA), as set forth by the EPA (40 CFR 268.40), is amalgamation (AMLGM). The EPA defines the term as "amalgamation of liquid, elemental mercury contaminated with radioactive materials utilizing inorganic reagents such as copper, zinc, nickel, gold, and sulfur that result in a nonliquid, semisolid amalgam and thereby reducing potential emissions of elemental mercury vapors to the air." The adherence to a defined technology-based treatment standard qualifies the treated waste as LDR compliant.

As stated in the EPA definition, the purpose of the treatment is to reduce the emission of elemental mercury vapor in the environment. Different metals can form an amalgam with mercury (e.g., tin, cadmium, zinc, and copper), while sulfur forms mercury sulfide compounds. The EPA has accepted sulfur as a possible reagent for meeting the treatment standard. It has to be noted that even though sulfur fits the treatment standard for amalgamation, this material does not amalgamate mercury; it forms low-solubility mercury compounds. An amalgam is an alloy containing mercury, and sulfur is a nonmetallic element; however, after making this distinction, the terminology of sulfur-amalgam may be used throughout the report.

Previous bench-scale work performed at the Oak Ridge Y-12 Plant indicated that amalgams of mercury made with metals released almost as much mercury vapor as pure mercury itself, while amalgams made with sulfur released only small amounts of mercury.[1]

The Mercury Working Group sponsored a demonstration in which two vendors—Nuclear Fuel Services, Inc. (NFS), and ADA Technologies (ADA)—applied their technologies to amalgamate radioactive mercury originating from different DOE sites. NFS treated contaminated mercury from the Oak Ridge Reservation (referred to as OR in the sample numbering) and Idaho National Engineering and Environmental Laboratory (INEEL, referred to as ID). The proprietary process of NFS relies upon the use of metals. ADA treated contaminated mercury from Los Alamos National Laboratory (referred to as LANL in the sample numbering) and Fernald (referred to as FERN) by applying a proprietary process based upon the use of sulfur.

2. INTRODUCTION

One of the primary performance requirements specified in the Mixed Waste Focus Area (MWFA) Technology Development Requirements Document — *Mercury Amalgamation*[2] — is related to vapor emissions: "The process must not release mercury vapors into the environment above the limits established by the applicable air permit [in accordance with Clean Air Act (CAA) requirements]. In addition, the process should not expose operators to mercury vapors above the established Threshold Limiting Value (TLV) of 0.05 mg/m^3." Another part states: "The final waste form must exhibit insignificant decomposition in a temperature range of 40° to 140°F and in environments of all pH ranges, especially alkaline environments. The temperature range provided correlates to environments common to DOE mixed waste storage facilities. Using the TLV as a basis, the final waste form must have a vapor pressure of less than 10^{-6} torr at 140°F."

"Vapor pressure" is defined as the pressure at which a liquid or solid is in equilibrium with its vapor at a given temperature. The property of vapor pressure depends only upon the temperature and the composition of the material considered. For a typical liquid, a constant and reproducible vapor pressure exists, which will increase only with a temperature increase.[3]

The description given by the MWFA defines the scope of the study: (a) measuring mercury vapor pressure as a function of temperature — over the range of 4 to 60°C — and (b) evaluating the effect of pH on the possible degradation of the amalgam and then correlating this degradation with the mercury vapor pressure in the headspace above the sample and solution.

Two experimental methods are provided by the EPA[4] and the American Society for Testing and Materials (ASTM)[5] for measuring mercury vapor pressure: the isoteniscope procedure and the gas saturation procedure. The latter appeared to be well suited for the work described in this document. The modified test procedure used in this study was very similar to the static headspace analysis method used by Kriger and Turner.[6] In this technique, the mercury vapor pressure is allowed to reach equilibrium in a static headspace, and the mercury concentration (mass/volume) in the headspace is subsequently measured using a commercial mercury vapor analyzer. They demonstrated that a portable commercial mercury analyzer can provide fast and reliable measurement of the mercury content in a sample and performed comparative tests of their technique and approved EPA methods (Method 245.1). Satisfactory correlations — from 75% (in the worst case) to 103% — were obtained.

3. EQUIPMENT DESIGN

3.1 MERCURY VAPOR ANALYZER

The instrument used for measurement of the vapor pressure of mercury was a Jerome 431 gold-film mercury vapor analyzer from Arizona Instruments (Phoenix, Arizona). This instrument has a 13-s response time, is battery operated, and can run for 6 h before being recharged. The digital display can provide results in either milligrams per cubic meter or nanograms. The range of detection is 0.000 to 0.999 mg per cubic meter of mercury. The sensitivity of the instrument is 0.003 mg/m^3, which corresponds to 0.3 ng of mercury, considering that the volume of air analyzed is 87.5 mL. This sensitivity is well below the TLV value of 0.05 mg/m^3. The air sampling is made with the aid of an internal pump that operates at a rate of 750 cm^3/min. The air flows through a guard column packed with soda lime for removing moisture and acid gases. The resulting dry vapor is deposited onto a gold film, which forms an amalgam with mercury, thus increasing the electrical resistance of the film. This specific instrument is stable and selective for mercury, and unlike other ultraviolet analyzers, is not prone to interferences such as from water vapor and hydrocarbons. When the sensor approaches its saturation limit, the instrument provides a warning. The regeneration of the sensor takes about 30 min.

3.2 COLD VAPOR ATOMIC ABSORPTION

The instrument used for determination of mercury content in solution during the pH tests was a PS 200 automated mercury analyzer, from Lehman Labs. Its detection limit is ~5 μg/L. EPA protocols (SW846) were followed during use of this instrument.

3.3 INDUCTIVELY COUPLED ARGON PLASMA – ATOMIC EMISSION SPECTROSCOPY (ICP-AES)

The solution in which the amalgam samples were immersed was analyzed for total metals by ICP-AES. The instrument used was a Thermo-Jarrell Ash model 61E-trace. EPA protocols (SW846) were followed for use of this instrument.

4. MERCURY RELEASE AS A FUNCTION OF TEMPERATURE

The objective of this first set of experiments was to study the effect of temperature on the mercury vapors released from the various amalgams and compounds. The Technology Development

Requirements Document (2) indicates that the range of temperature usually found in DOE MLLW storage varies from 4 to 60°C. Consequently, measurements were made at the following temperatures: 4°C, ambient (~20°C), and 60°C.

A weighed sample of amalgam was placed in a Kapak® pouch, which was then closed by heat sealing. The pouch was not completely filled with air to permit volume changes during the experiment. The use of the pouch facilitated sampling. The bag collapsed on itself when the air was withdrawn for analysis and was easily punctured with the needle of the syringe used for sampling. After completion of the sampling, performed in triplicate, the bag was resealed. The same protocol was followed for each temperature studied.

Preliminary tests were performed to determine the need for dilution of the headspace samples. It was found that some of the amalgams, as well as the mercury standard, saturated the sensor of the analyzer when an undiluted analysis was performed. Volumes of 0.1 to 3 mL of the headspace sample diluted to a total of 87.5 mL by clean room air were found to be appropriate for use in this set of experiments. Measurements were made at various time intervals to verify that the data obtained were representative of an equilibrium condition.

The objectives of these tests were to measure the release of elemental mercury vapor over a given set of conditions for each candidate waste form and to compare the results with pure elemental mercury vapor of untreated waste. The literature does not provide tables of vapor concentration of pure mercury as a function of the temperature but rather expressed the vapor pressure as a function of the temperature. However, by using the ideal gas law presented in Eq.(1), such a table was generated, as seen in Table 1 and illustrated in Fig.1.

$$p = (w/M)(RT/v) \quad , \qquad (1)$$

where p = vapor pressure of the sample (Pa),

w = mass of vaporized material (g),

M = molecular weight of mercury,

R = gas constant (8.31 Pa $\cdot m^2 \cdot mol^{-1} \cdot K^{-1}$),

Table 1. Vapor concentration of pure mercury over the temperature range investigated[a]

T (°C)	[Hg] (mg/m³)	T (°C)	[Hg] (mg/m³)	T (°C)	[Hg] (mg/m³)	T (°C)	[Hg] (mg/m³)	T (°C)	[Hg] (mg/m³)	T (°C)	[Hg] (mg/m³)	T (°C)	[Hg] (mg/m³)
1	2.42	11	6.10	21	14.37	31	31.93	41	67.32	51	135.28	61	260.30
2	2.67	12	6.63	22	15.54	32	34.38	42	72.15	52	144.37	62	276.76
3	2.94	13	7.27	23	16.93	33	37.22	43	77.68	53	154.68	63	295.27
4	3.20	14	7.91	24	18.31	34	40.04	44	83.18	54	164.92	64	313.67
5	3.53	15	8.66	25	19.91	35	43.30	45	89.48	55	176.58	65	334.29
6	3.86	16	9.41	26	21.51	36	46.53	46	95.74	56	188.16	66	354.79
7	4.25	17	10.28	27	23.36	37	50.26	47	102.89	57	201.28	67	377.92
8	4.65	18	11.15	28	25.20	38	53.96	48	110.00	58	214.33	68	400.91
9	5.11	19	12.17	29	27.34	39	58.22	49	118.10	59	229.08	69	426.72
10	5.57	20	13.18	30	29.47	40	62.46	50	126.14	60	243.75	70	452.39

[a]Calculations based on standard values obtained from *CRC Handbook of Chemistry and Physics*, CRC Press, Boca Raton, Fla., 47th edition, pp. D-108.

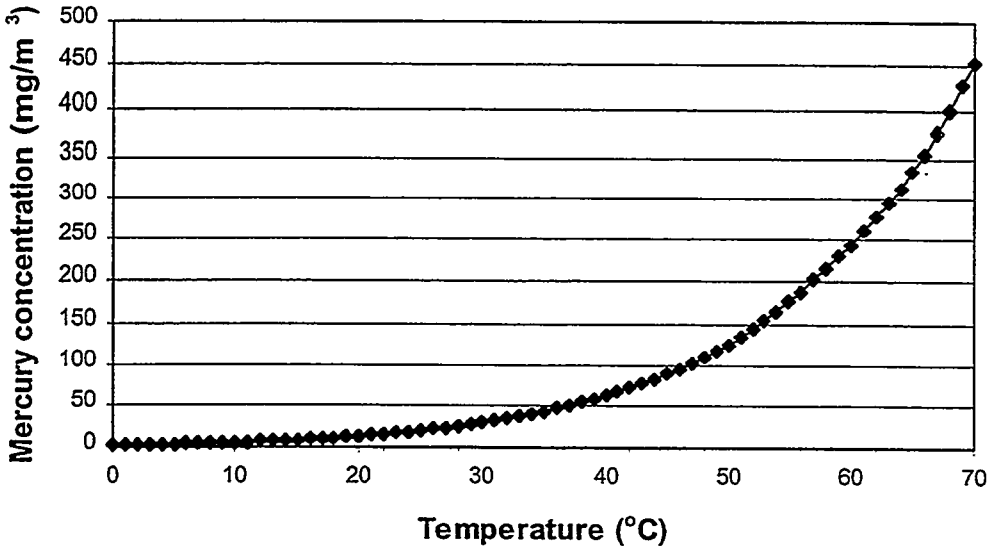

Fig. 1. Vapor-concentration curve of pure mercury as a function of temperature.

T = temperature (K),

v = volume analyzed (m^3).

5. AMALGAM DEGRADATION AS A FUNCTION OF pH

The objective of the second set of experiments was to study the effect of pH on the release of mercury as well as on waste-form degradation. Four solutions representing different pH values were selected for that test:

1. a pH of ~12.5 (the pH of cementitious pore water), prepared from a saturated solution of $Ca(OH)_2$ in deionized (DI) water;
2. a near-neutral pH (6 to 8) made with DI water;
3. an acidic pH (~5) made with the recipe for fluid #1 from the EPA TCLP test (5.7 mL of glacial acetic acid plus 64.3 mL of 1 *N* NaOH solution in 1 L of DI water); and
4. an acidic pH (~3) made with the recipe for fluid #2 (5.7 mL of glacial acetic acid in 1 L of DI water) from the EPA TCLP test.

The same experimental design described in Sect. 4 was also employed in these tests; however, this series was performed at ambient temperature. A known amount of amalgam was introduced into the pouch followed by 100 mL of the chosen leachant. The bag was sealed, placed in a secondary container, and allowed to cure at room temperature. After equilibration for a selected period of time, the leachate was removed from the pouch using a 60-mL syringe. It was then filtered using a 0.45-μm syringe filter and finally preserved with 1 mL of concentrated ultrapure nitric acid. The solutions were subsequently analyzed for metals and mercury content. The samples did not undergo a digestion preparation step.

For each time interval selected (2 weeks, 1 month, 2 months, and 3 months), a blank and mercury standard were prepared in triplicate for each pH value studied. The four types of amalgam were also prepared in triplicate for each period of time and pH value.

6. RESULTS OF MERCURY RELEASE AS A FUNCTION OF TEMPERATURE

As shown in Fig.1 for pure mercury, the concentration of the mercury in the vapor phase is very sensitive to temperature. In these tests, the results obtained at ambient temperature were quite constant because of the small temperature fluctuation existing in the room; however, for the samples maintained in the refrigerator or in the oven, large fluctuations were observed as a result of changes in the temperature of the chamber. Once the door was opened to permit sampling of the first bag, the temperature changed; consequently, the data obtained no longer reflected the targeted temperature.

Some variation is reflected in the data presented in Tables 2, 3, and 4. It must be noted that the mercury used as the standard for our tests had been used for previous experiments; therefore, the data obtained might differ from the theoretical values because of the contamination present in this sample.

6.1 TESTS PERFORMED AT 4°C

These samples were placed in a refrigerator set for 4°C. After 3 days, a first set of measurements was taken. A 3-mL syringe was used for sampling the headspace in each bag and injecting the sample into the septum of the mercury analyzer. The tests were run in triplicate and then averaged. Data found in the literature indicate that the mercury concentration in the headspace should be 3.20 mg/m^3 at 4°C. However, because of the rise in temperature caused by opening the refrigerator door, some of the data were not collected at a temperature of 4°C. The data obtained at three different times (after 3, 11, and 13 days) are provided in Table 2. Figure 2 illustrates the average results obtained for each series of amalgam studied as well as a blank and a mercury standard. The theoretical values for pure mercury at 4, 7, and 10°C are also presented in the plot.

Table 2. Summary of data for the samples maintained at 4°C[a]

	[Hg] in the headspace (mg/m^3)		
Sample	3 days	11 days	13 days
BLK 8	0.000 ± 0.000	0.000 ± 0.000	0.004 ± 0.000
BLK 9	0.000 ± 0.000	0.000 ± 0.000	0.004 ± 0.000
BLK 10	nr	0.000 ± 0.000	0.000 ± 0.000
Average	0.000 ± 0.000	0.000 ± 0.000	0.002 ± 0.000
Hg-6	4.05 ± 0.20	2.25 ± 0.11	1.95 ± 0.10
Hg-9	4.29 ± 0.21	2.43 ± 0.11	2.04 ± 0.10
Hg-10	4.26 ± 0.21	2.78 ± 0.12	3.31 ± 0.05
Average	4.17 ± 0.21	2.34 ± 0.12	2.00 ± 0.08
FERN-2	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
FERN-4	0.000 ± 0.000	0.000 ± 0.000	0.005 ± 0.000
FERN-9	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
Average	0.000 ± 0.000	0.000 ± 0.000	0.002 ± 0.000
LANL-C	0.029 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
LANL-D	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
LANL-G	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
Average	0.010 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
OR-3	4.72 ± 0.23	4.30 ± 0.21	2.15 ± 0.11
OR-6	5.48 ± 0.27	5.46 ± 0.21	3.44 ± 0.17
OR-10	5.30 ± 0.26	5.49 ± 0.27	4.35 ± 0.07
Average	5.17 ± 0.26	5.09 ± 0.23	3.31 ± 0.12
ID-3	4.52 ± 0.23	5.49 ± 0.28	3.94 ± 0.07
ID-6	4.93 ± 0.24	4.20 ± 0.28	2.68 ± 0.14
ID-8	4.29 ± 0.21	3.81 ± 0.21	4.02 ± 0.10
Average	4.58 ± 0.23	4.50 ± 0.25	3.55 ± 0.10

[a]BLK 8, BLK 9 and BLK 10 were the sample names of the blanks used for this experiment. Similarly, Hg-6, Hg-9 and Hg-10 were the sample names of the pure mercury used as control.

Table 3. Summary of data for samples maintained at 21°C[a]

	[Hg] in the headspace (mg/m^3)			
Sample	2 days	5 days	13 days	14 days
BLK 1	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
BLK 2	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
BLK 3	nr	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
Average	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
Hg-1	11.29 ± 0.56	9.74 ± 0.49	10.41 ± 0.52	9.95 ± 0.50
Hg-8	11.26 ± 0.56	10.44 ± 0.52	10.09 ± 0.50	11.00 ± 0.55
Hg-12	nr	10.62 ± 0.53	11.32 ± 0.56	11.55 ± 0.58
Average	11.27 ± 0.56	10.27 ± 0.51	10.61 ± 0.53	10.83 ± 0.54
FERN-1	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
FERN-3	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.020 ± 0.000
FERN-8	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
Average	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.007 ± 0.000
LANL-I	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
LANL-B	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
LANL-E	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
Average	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
OR-2	10.30 ± 0.52	9.77 ± 0.49	10.12 ± 0.51	9.36 ± 0.47
OR-7	10.06 ± 0.50	10.41 ± 0.52	10.65 ± 0.53	10.85 ± 0.54
OR-9	10.27 ± 0.51	10.47 ± 0.52	11.11 ± 0.56	9.63 ± 0.48
Average	10.21 ± 0.51	10.22 ± 0.51	10.63 ± 0.53	9.95 ± 0.50
ID-1	9.89 ± 0.49	10.62 ± 0.53	10.53 ± 0.52	11.67 ± 0.58
ID-5	10.21 ± 0.51	10.35 ± 0.52	10.33 ± 0.52	11.75 ± 0.57
ID-7	10.03 ± 0.50	10.24 ± 0.51	10.12 ± 0.51	11.93 ± 0.59
Average	10.04 ± 0.50	10.40 ± 0.52	10.33 ± 0.52	11.78 ± 0.59

[a]BLK 1, BLK 2 and BLK 3 were the sample names of the blanks used for this experiment. Similarly, Hg-1, Hg-8 and Hg-12 were the sample names of the pure mercury used as control.

Table 4. Summary of data for the samples maintained at 60°C[a]

	[Hg] in the headspace (mg/m^3)			
Sample	1 day	4 days	12 days	13 days
BLK 4	0.000 ± 0.000	0.204 ± 0.003	0.117 ± 0.002	0.244 ± 0.000
BLK 5	0.000 ± 0.000	0.146 ± 0.002	0.117 ± 0.002	0.241 ± 0.000
Average	0.000 ± 0.000	0.175 ± 0.003	0.117 ± 0.002	0.243 ± 0.000
Hg-4	183.8 ± 91.9	108.9 ± 27.3	113.3 ± 28.3	232.3 ± 58.1
Hg-5	249.4 ± 124.7	83.1 ± 20.8	120.3 ± 30.1	120.3 ± 30.1
Hg-11	306.3 ± 153.1	77.0 ± 19.3	97.6 ± 24.4	151.9 ± 15.2
Average	216.6 ± 123.2	89.7 ± 22.4	110.4 ± 27.6	168.2 ± 34.4
FERN-5	0.000 ± 0.000	0.263 ± 0.004	0.000 ± 0.000	0.003 ± 0.000
FERN-6	0.000 ± 0.000	0.642 ± 0.011	0.292 ± 0.005	0.003 ± 0.000
FERN-7	0.000 ± 0.000	0.175 ± 0.003	0.000 ± 0.000	0.000 ± 0.000
Average	0.000 ± 0.000	0.360 ± 0.006	0.097 ± 0.002	0.002 ± 0.000
LANL-A	0.000 ± 0.000	0.146 ± 0.002	0.088 ± 0.002	0.006 ± 0.000
LANL-F	0.000 ± 0.000	0.000 ± 0.000	0.204 ± 0.003	0.004 ± 0.000
LANL-H	0.000 ± 0.000	0.000 ± 0.000	0.175 ± 0.003	0.004 ± 0.000
Average	0.000 ± 0.000	0.049 ± 0.001	0.156 ± 0.003	0.005 ± 0.000
OR-1	107.2 ± 26.8	104.6 ± 26.1	132.1 ± 33.0	167.1 ± 41.8
OR-5	nr	143.9 ± 36.0	88.8 ± 22.2	259.0 ± 64.8
OR-8	133.9 ± 33.5	129.5 ± 32.4	140.9 ± 35.2	132.1 ± 33.0
Average	120.5 ± 30.1	126.0 ± 31.5	120.6 ± 30.2	186.1 ± 46.5
ID-2	69.1 ± 17.3	90.6 ± 22.6	179.8 ± 45.0	154.0 ± 15.4
ID-4	115.5 ± 27.7	101.1 ± 25.3	118.6 ± 29.6	129.5 ± 13.0
ID-9	74.4 ± 18.6	140.0 ± 35.0	323.8 ± 80.9	164.1 ± 41.0
Average	86.3 ± 31.2	110.5 ± 27.6	207.4 ± 51.8	149.2 ± 23.1

[a]BLK 4 and BLK 5 were the sample names of the blanks used for this experiment. Similarly, Hg-4, Hg-5 and Hg-11 were the sample names of the pure mercury used as control.

The mercury concentrations are not completely accurate because the temperature was not constant over the series measurement. However, comparison with the values obtained for the blank and the pure mercury shows the trend developed by each amalgam. The amalgams made with sulfur (LANL and FERN series) appear to behave like the blank, while those made with metals (OR and ID series) appear to behave like pure mercury.

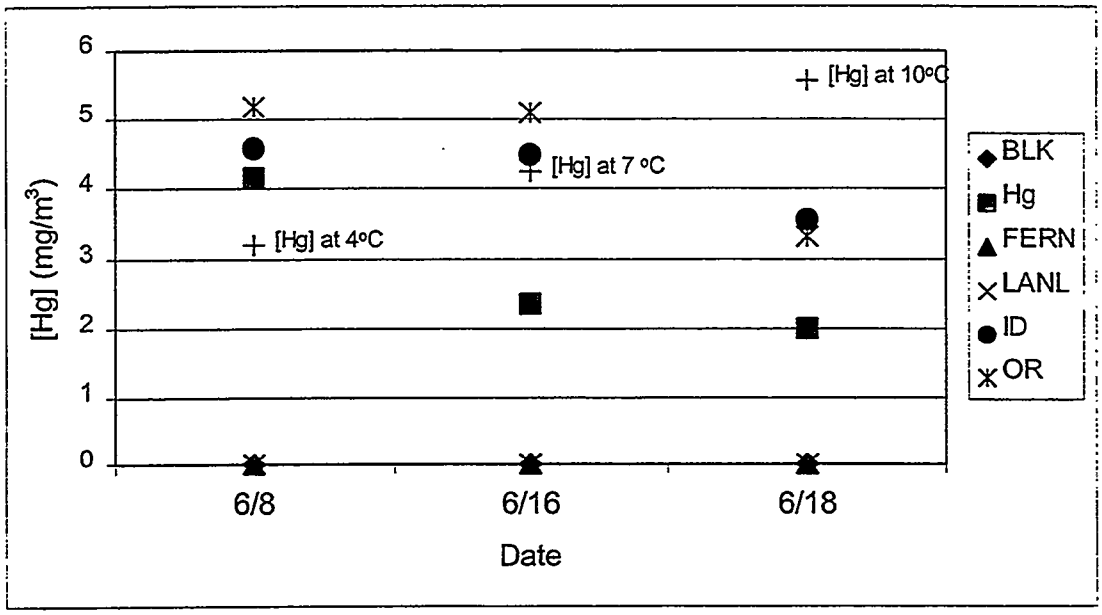

Fig. 2. Mercury concentration in headspace at 4°C.

6.2 TESTS PERFORMED AT AMBIENT TEMPERATURE

The temperature inside the laboratory was quite constant (between 20 and 21°C) when the measurements were performed on four different days. The mercury concentration found in the headspace at 21°C should be 14.5 mg/m^3. The temperature fluctuations observed in the other experiments did not occur in this set, and more reliable values were obtained. The data are summarized in Table 3. Figure 3 plots the average values obtained for each series; the theoretical values for pure mercury at 17 and 19°C are also provided. The same trend observed at 4°C was noted at room temperature: the amalgams made with sulfur behave like the blank, and the amalgams made with metals behave like pure mercury.

6.3 TESTS PERFORMED AT 60°C

For this series of tests, the data showed much fluctuation with the temperature drop that occurred when the oven was opened to obtain the sample for measurement. The theoretical mercury concentration at 60°C is 243.8 mg/m^3. As with the samples maintained at 4°C, no absolute data are generated, only comparative data with the blank and the pure mercury samples. The same trend observed with the other temperatures was also noted. The data obtained on four different days are compiled in Table 4 and illustrated in Fig. 4, where theoretical values for pure mercury at 45, 50, 55, and 60°C are also presented.

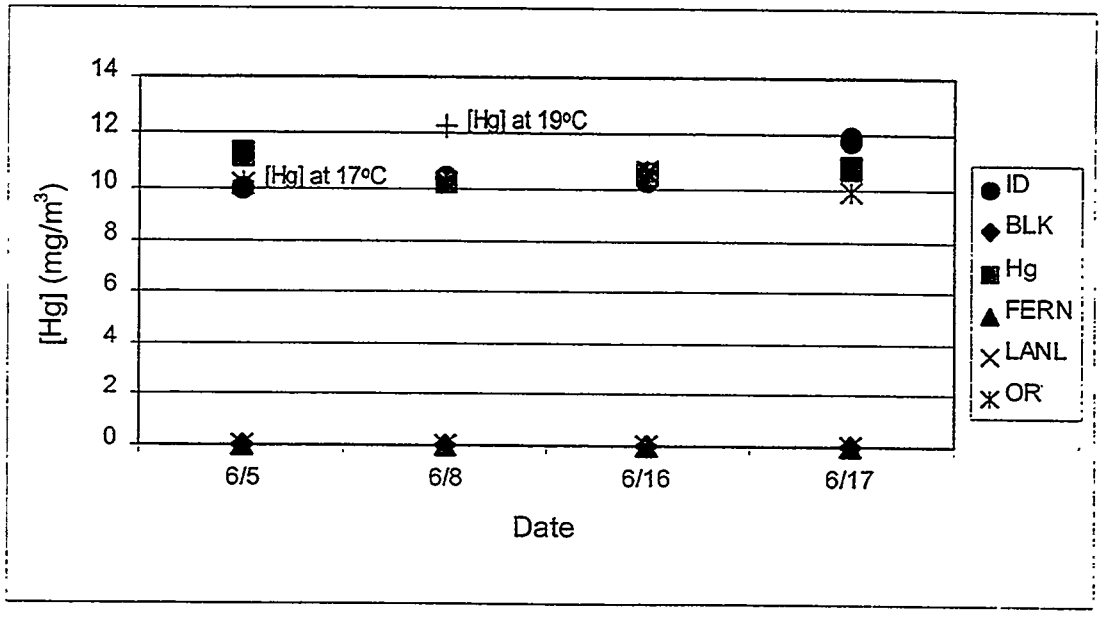

Fig. 3. Mercury concentration in headspace at 21°C.

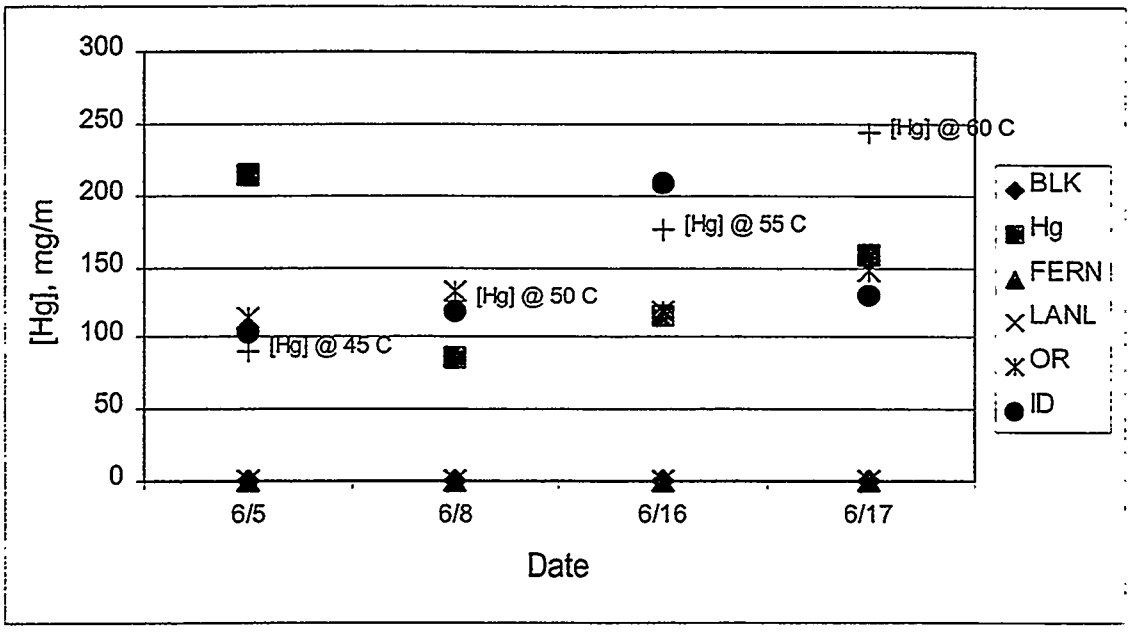

Fig. 4. Mercury concentration in headspace at 60°C.

7. RESULTS OF MERCURY DEGRADATION AS A FUNCTION OF pH

In this set of experiments, triplicate analyses were performed for each time interval and pH evaluated. The metal concentrations, expressed in milligrams per liter, were determined by ICP, while the mercury concentrations, expressed in micrograms per liter, were measured by cold vapor atomic absorption (CVAA). The data generated after 2 weeks, 1 month, 2 months, and 3 months of cure are presented in Tables A.1–A.16 located in Appendix A. A compilation of the average data obtained for each series is provided in Appendix B, Tables B.1–B.6. The weight of the amalgam used as well as the pH of the initial solution and the pH after cure are provided.

It is interesting to note that heterogeneity is observed in the mercury data obtained for some samples prepared in triplicate. Many of the samples presenting these differences were rerun to

confirm the results, and the analyses confirm the heterogeneity in many cases. This may be explained by the presence of mercury that had not completely reacted with the amalgamating material. This hypothesis is very likely to be the case for the FERN samples. During the sample preparation, small spheres of shiny metallic mercury were observed in the black material, providing evidence that some mercury did not react completely. For the FERN and LANL series, with the black mercury sulfide material, this observation was readily made; however, for the gray OR and ID amalgams, it was difficult to note. A second hypothesis would be the presence in the leachate of small particulates of HgS that were not captured by the 0.45-μm filter used. This observation was noted especially for the ID series, followed, to a lesser degree, by the OR series and then by the FERN and LANL series.

7.1 CHANGES IN THE FINAL pH OF THE LEACHATES

Except for the blank and mercury standard series, changes in the final pH values of the solutions were observed. At pH 3, all the solutions containing the various amalgams exhibited a final increase in pH with time. The amalgam made with the ID series appears to be the one for which the pH increased the most. At pH 5, the FERN amalgams appear to produce the highest pH increase. At higher pH values, the two types of waste form are diverging: for the sulfur amalgams, the final pH of the solution decreases slightly at pH 7 and severely at pH 12.5, while the metal-based amalgams show an increase for pH 7 and a small decrease for pH 12.5. These changes are illustrated in Figs. 5–8. The reasons for this are discussed in Sect. 8.1.

7.2 MERCURY LEACHING RESULTS

The average mercury leaching results are compiled for easy comparison in Table 5. The results are expressed in micrograms per liter. All the amalgams show a decrease in the leachability of mercury compared with the pure mercury standard; however, the scale of the reduction is different. It is also interesting to remember that the Universal Treatment Standard (UTS) limit for

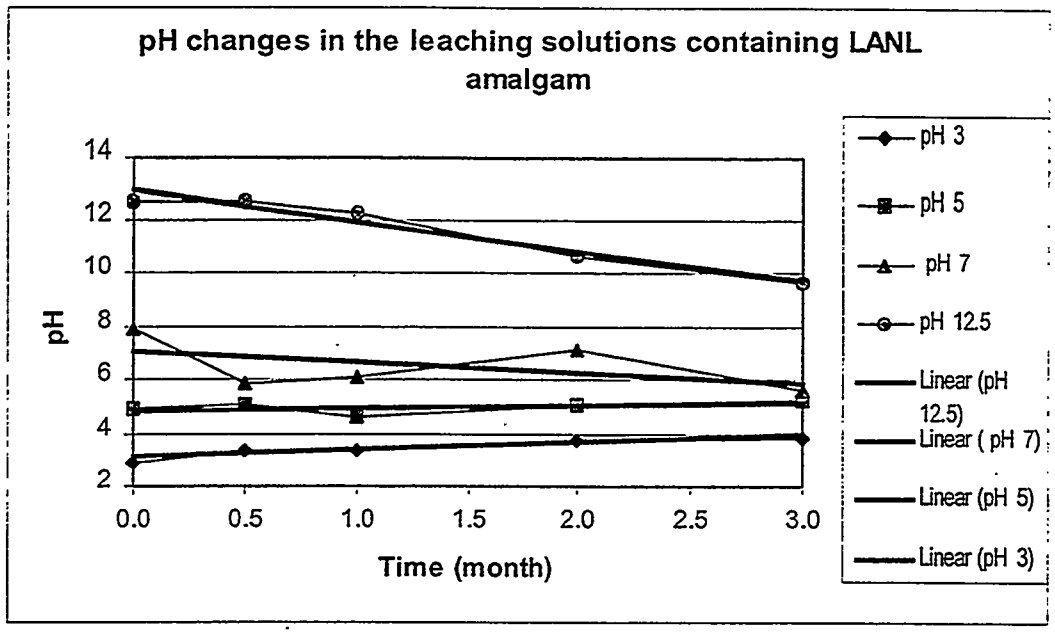

Fig. 5. Change in pH for the LANL amalgam series.

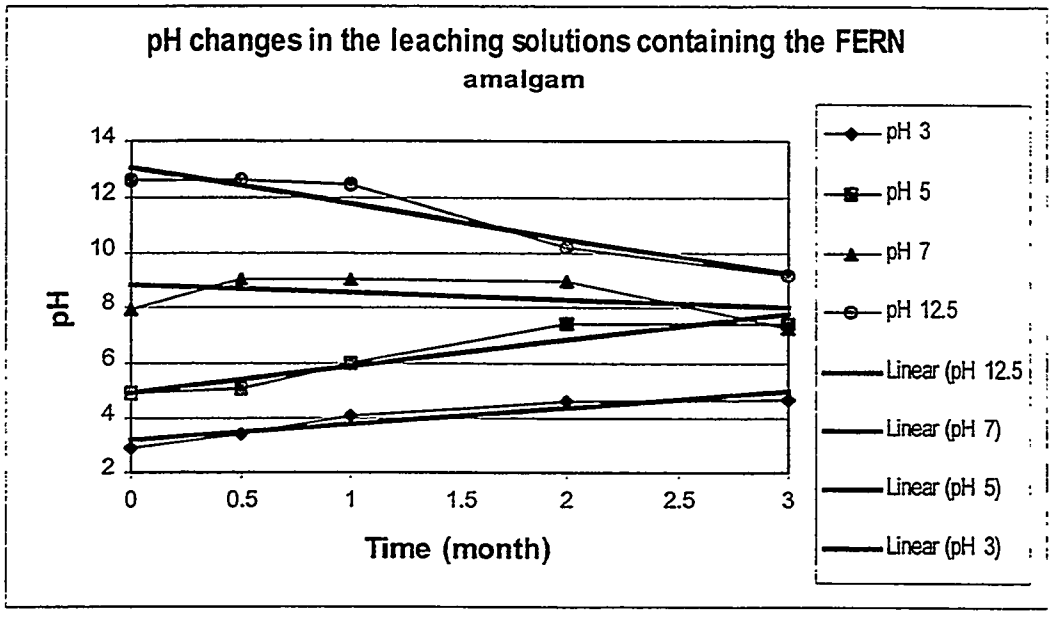

Fig. 6. Change in pH for the FERN amalgam series.

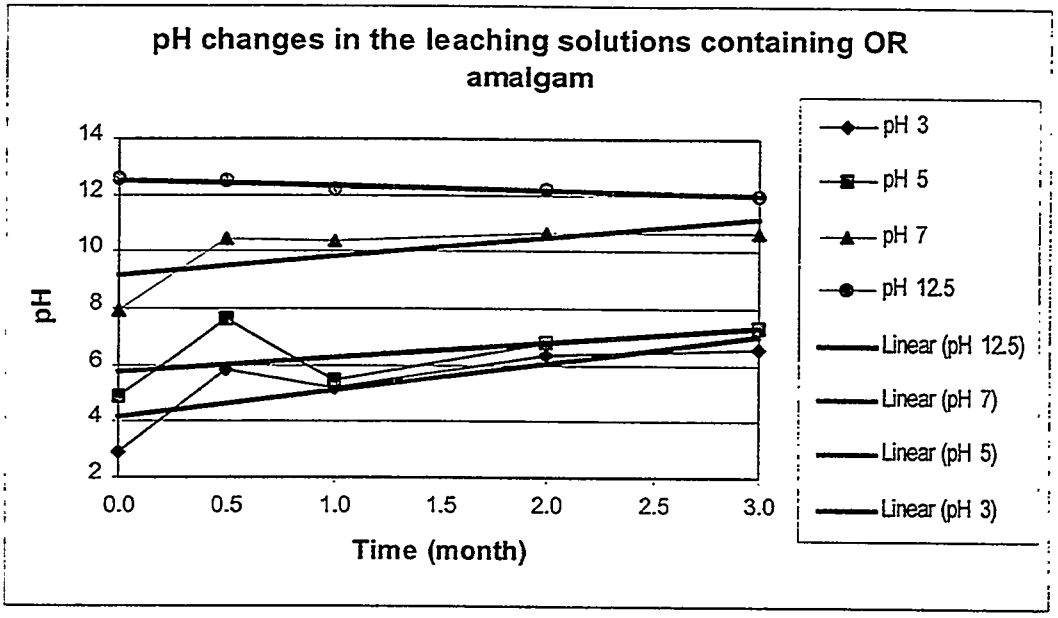

Fig. 7. Change in pH for the OR amalgam series.

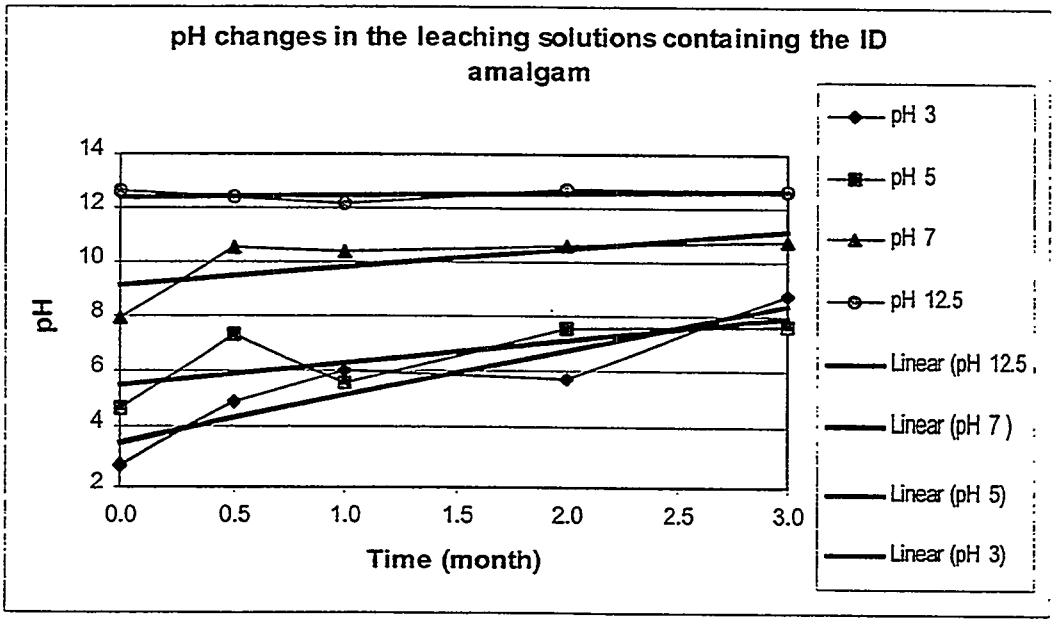

Fig. 8. Change in pH for the ID amalgam series.

mercury is 25 ppb; results for a few amalgams were found to be above this value, but nearly all the results obtained for mercury far exceeded this limit. Table 6 presents normalized data (in percent) of the leachability for each series relative to the leachability for the pure mercury standard at the same time interval. These changes are illustrated in Figs. 9–12.

The two processes behave very differently depending upon pH. Acidic solutions appear to have a lesser deleterious effect upon the sulfur-based amalgams than the metal-based ones, which can release significant amounts of mercury (especially the ID series). Comparatively, the more basic solutions appear to be less aggressive on the metal-based amalgams than those solutions made with sulfur.

Table 5. Mercury leachability (micrograms per liter) measured for different amalgams

pH	pH 3				pH 5				pH 7				pH 12.5			
Time	2 w	1 m	2 m	3 m	2 w	1 m	2 m	3 m	2 w	1 m	2 m	3 m	2 w	1 m	2 m	3 m
Hg	723	1337	537	4257	1368	3986	3111	7745	641	2739	1371	3666	5231	6594	4534	11259
LANL	8.5	41	ND	5.9	38	54	20	10	8.2	7.4	52.	21	8.6	5.9	12.8	12
FERN	12	4.5	5.0	80	10	28	125	184	16	73	200	108	15	42	1223	264
OR	16	76	4.5	62	13	109	34	213	4.5	21	ND	7.2	52	81	14.2	24
ID	210	192	293	8.2	65	133	80	288	13	11	ND	9.4	33	70	406	110

Table 6. Normalized (percent) mercury leachability for different amalgams

pH	pH 3				pH 5				pH 7				pH 12.5			
Time	2w	1m	2 m	3 m	2 w	1 m	2 m	3 m	2 w	1 m	2 m	3 m	2 w	1 m	2 m	3 m
Hg	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
LANL	1.2	3.1	0	0.1	2.8	1.4	0.6	0.1	1.3	0.3	3.8	0.6	0.2	0.1	0.3	0.1
FERN	1.7	0.4	0.9	1.9	0.7	0.7	4.0	2.4	2.5	2.7	14.6	2.9	0.3	0.6	27.0	2.3
OR	2.2	5.7	0.8	1.5	1.0	2.7	1.1	2.8	0.7	0.8	0	0.2	1.0	1.2	0.3	0.2
ID	29	14.4	54.5	0.2	4.7	3.3	2.6	3.7	2.0	0.4	0	0.2	0.6	1.1	9.0	1.0

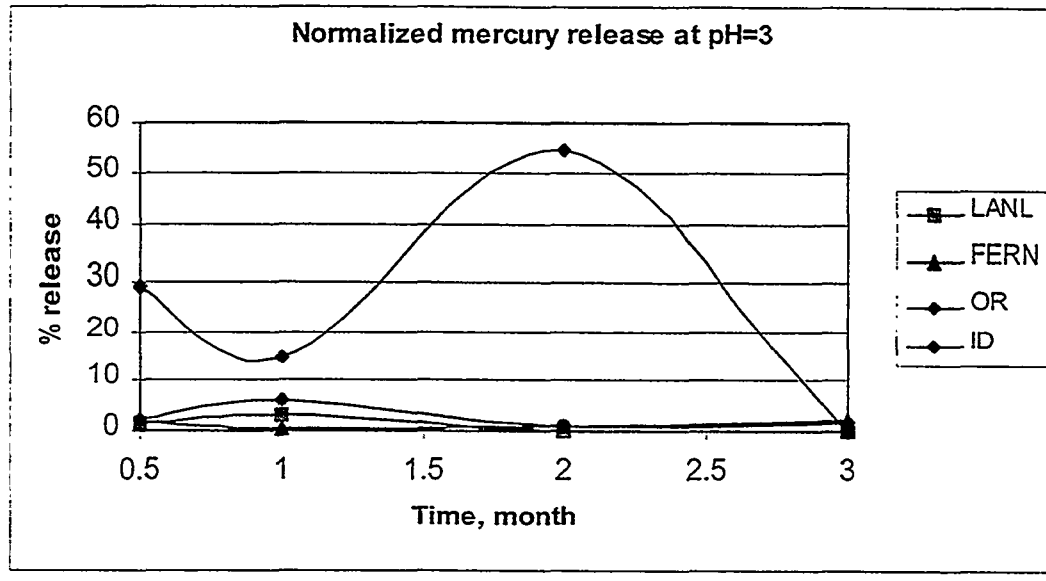

Fig. 9. Normalized mercury leachability for each type of amalgam at pH=3.

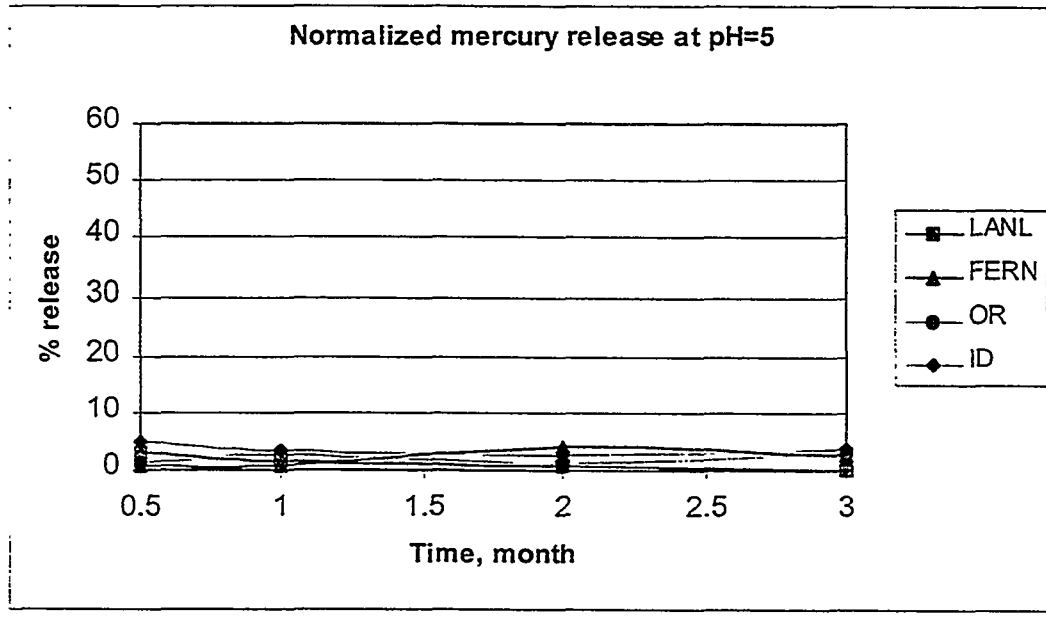

Fig. 10. Normalized mercury leachability for each type of amalgam at pH=5.

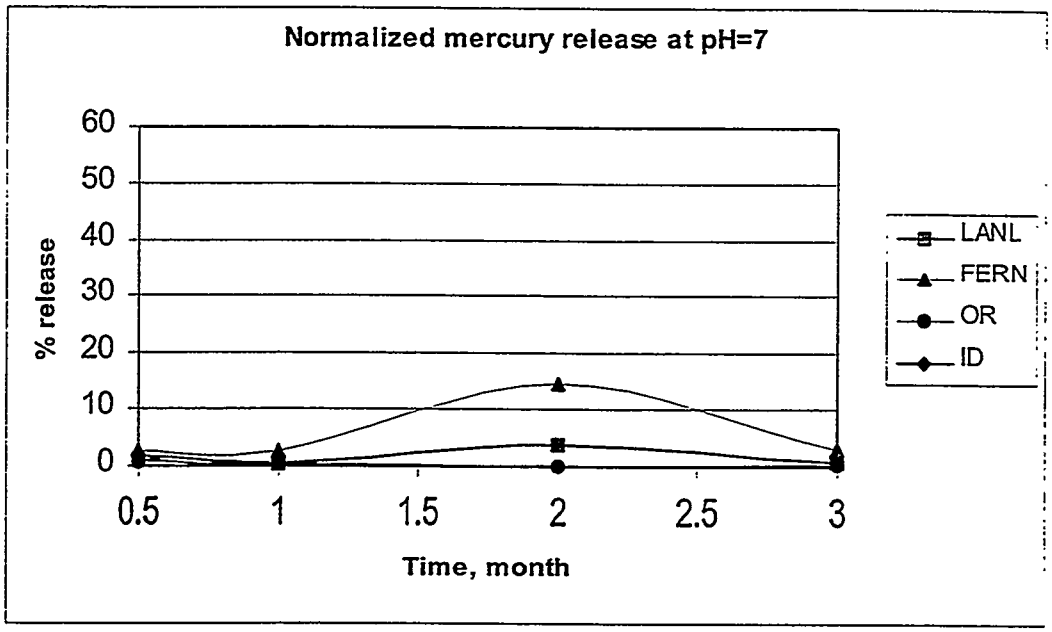

Fig. 11. Normalized mercury leachability for each type of amalgam at pH=7.

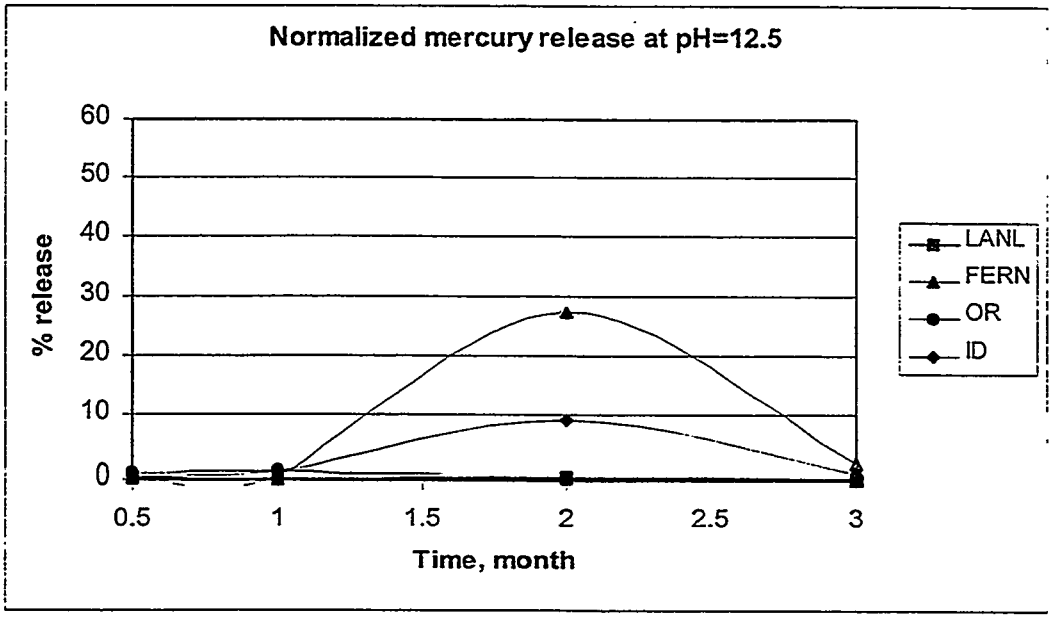

Fig. 12. Normalized mercury leachability for each type of amalgam at pH=12.5.

7.3 METAL LEACHING RESULTS

The leachates were also analyzed for trace metals by ICP-AES. Results obtained from the blank series are illustrated in Fig. 13 and provide an estimate of the contamination inherent in the experimental protocol followed — the high level of sodium found for a pH of 5 is caused by the presence of NaOH in TCLP fluid # 2; at a pH of 12.5, the calcium hydroxide added for the preparation of the saturated $Ca(OH)_2$ explains the high calcium content. Low concentrations of potassium, sodium, silicon, and zinc were found in this series. The mercury series (Fig. 14) shows that trace copper, silicon, and aluminum were present as contaminants in the mercury used for the experiments.

Data from the FERN series (Fig. 15) show that the following metals were found at low concentrations in the leaching solutions: aluminum, iron, magnesium, and strontium. The concentrations of metals leached were higher at low pH values than at higher ones. The concentration of calcium found in the leachate was high, around 2000 mg/L. From the same process, the LANL series (Fig. 16) also presented higher concentrations of calcium than those in the blank; however, these concentrations were not as high as those observed in the FERN series. The concentrations of aluminum, iron, magnesium, potassium, sodium, and silicon present in the amalgams were higher than those found in the blank series.

Data from the OR series (Fig. 17) showed that small concentrations of aluminum, boron, iron, potassium, and silicon are also present in the leachates. At low pH values, high concentrations of zinc and magnesium were found in the leachates but were absent at neutral values or basic pHs. It is interesting to observe that in contrast to the sulfur-based amalgams, the metal-based type appears to consume calcium at high pH. The ID amalgams (Fig. 18) released aluminum, boron, iron, potassium, and silicon. As in the OR series, magnesium and zinc were released at acidic pHs. The calcium release follows the same pattern as the OR series; concentrations at pH values of 12.5 were lower than those for the blank series. The sodium concentrations appear to be higher than those for the other series.

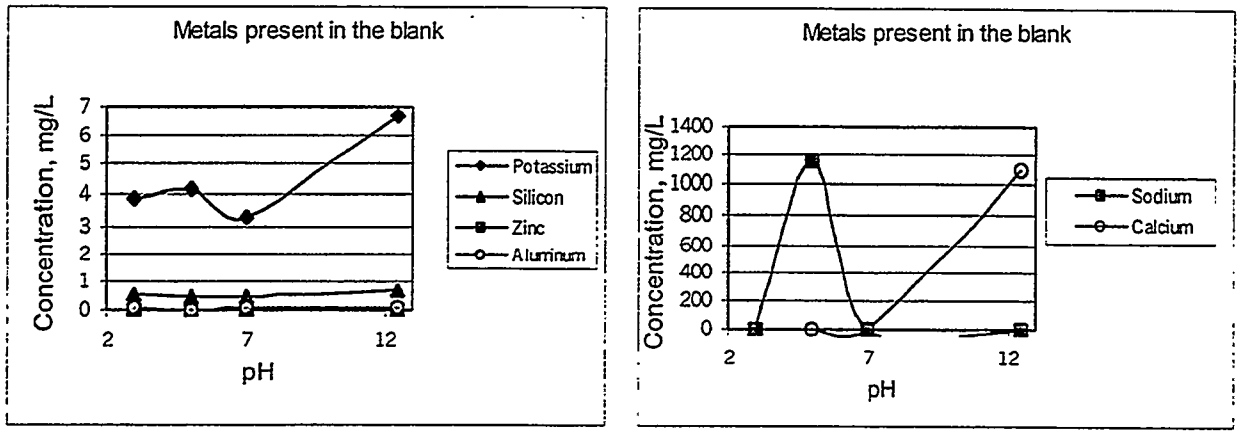

Fig. 13. Metals present in the blank.

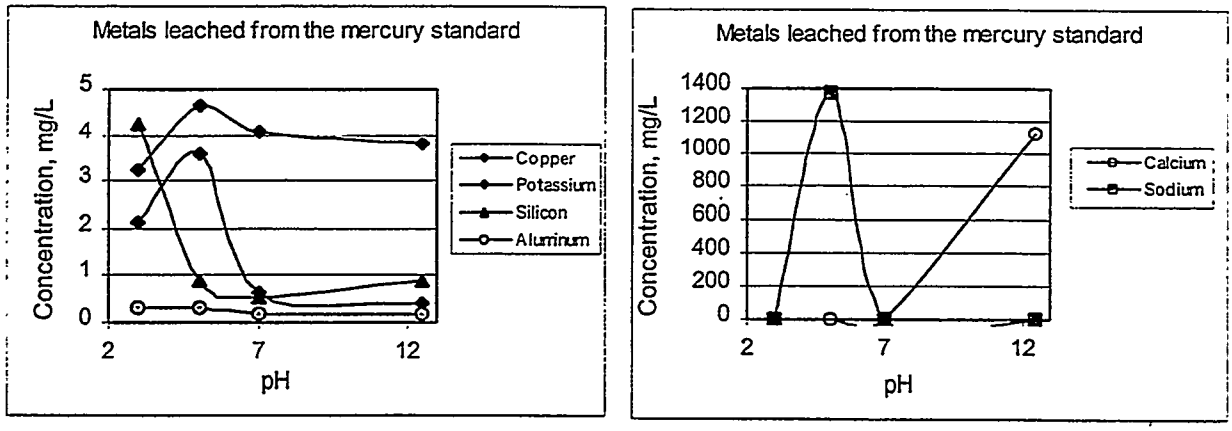

Fig. 14. Metals present in the leachates of the mercury standard.

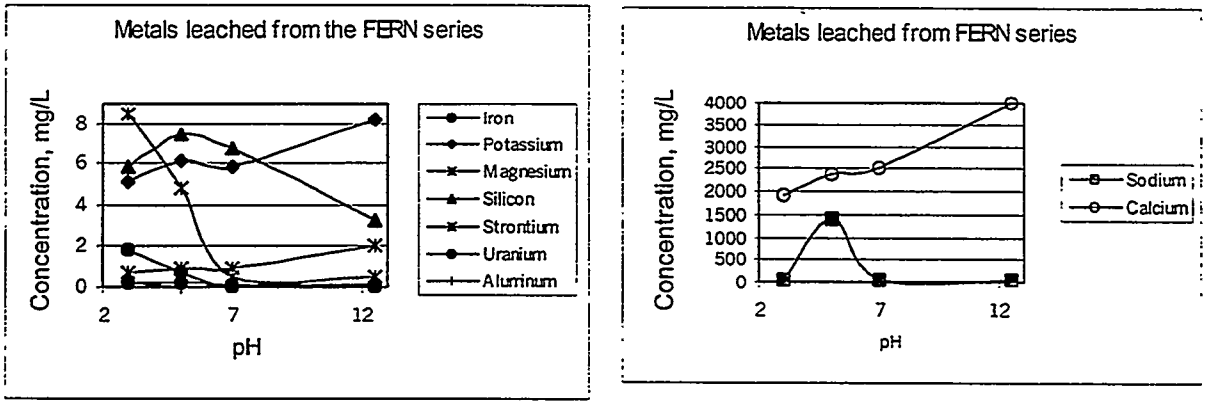

Fig. 15. Metals present in the leachates of the FERN amalgam.

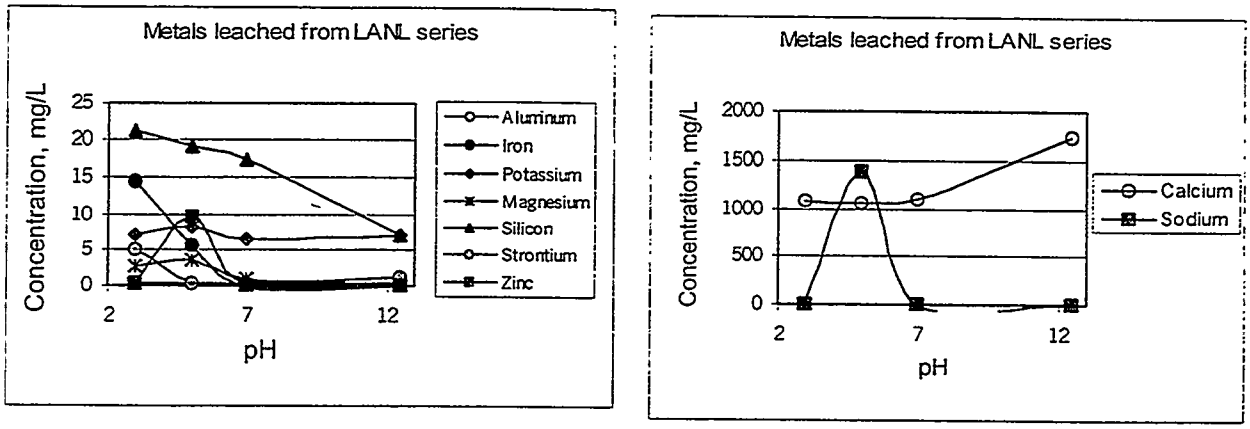

Fig. 16. Metals present in the leachates of the LANL amalgam.

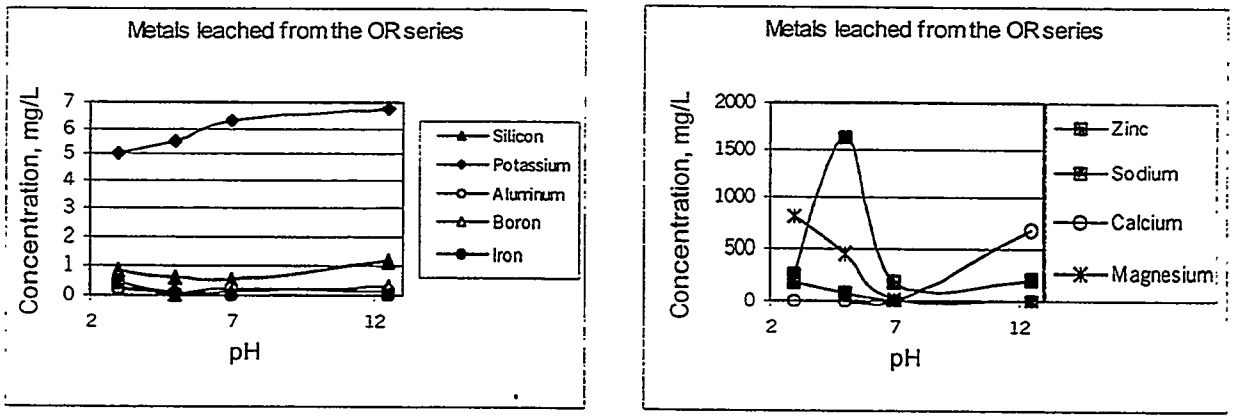

Fig. 17. Metals present in the leachates of the OR amalgam.

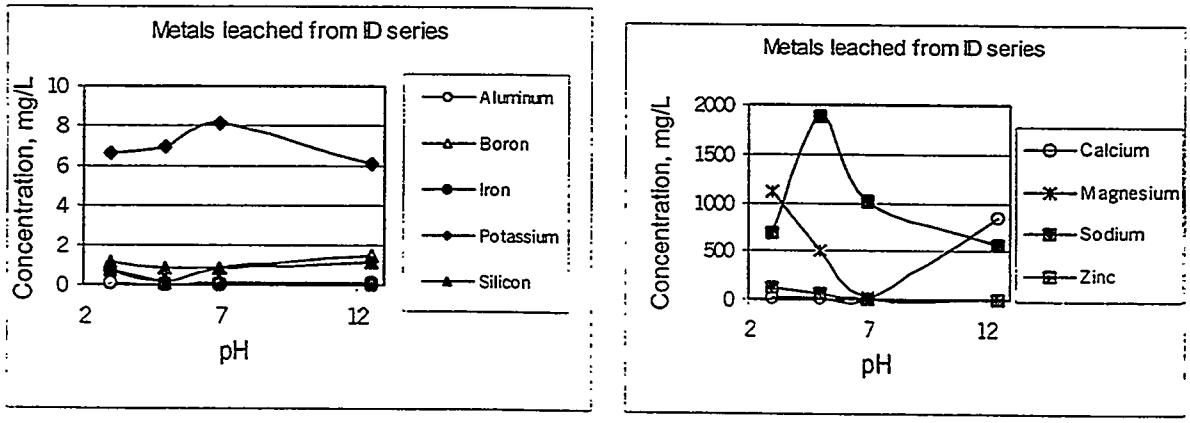

Fig. 18. Metals present in the leachates of the ID amalgam.

8. DISCUSSION OF RESULTS

8.1 AMALGAMATED MERCURY

The acidic pH values were expected to have a more deleterious effect upon the amalgam when made with acid-reactive metals (zinc, aluminum, cadmium, copper) because of the generation of hydrogen that occurs at lower pH values. At higher pH values, hydrated oxides of mercury tend to form and are therefore expected to fare better. Amalgamated mercury did not perform as well as the sulfur-based mercuric sulfide. This may be explained by the well-known fact that mercury, once amalgamated with another metal such as zinc, copper, or aluminum, causes the metal to become very reactive in water and especially in acidic solutions. These metals will even slowly react with pure water, liberating hydrogen, and enter solution as the metal cation. This process is slow kinetically; however, when mercury amalgamates with the metal, the hydrogen potential of the metal reacting with water or acid is lowered considerably and becomes more reactive as a result.[7] After all the metal dissolves, the elemental mercury remains behind. This reactivity with either acid or water is depicted in the following equations:

$$\mathrm{Hg\text{-}M^{*} + 2H^{+} \rightarrow M^{2+} + Hg^{0} + H_2(g)\uparrow} \qquad (2)$$

$$\mathrm{Hg\text{-}M + 2H_2O \rightarrow M^{2+} + Hg^{0} + H_2(g)\uparrow + 2OH^{-}} \qquad (3)$$

Both reactions produce a rise in pH, as illustrated by Figs. 7 and 8. From the ICP data, it appears that zinc was likely used as an amalgamating metal. Because of the enhancement in reactivity of the metal toward water or acidic solutions, mercury amalgamation using such metals will result in the re-formation of free elemental mercury released to the environment over time, if the waste form is exposed to such conditions.

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* Hg-M denotes a metal amalgam.

8.2 MERCURIC SULFIDE IMMOBILIZATION

Mercury is found in nature as the very insoluble mineral cinnabar (HgS) and is also known as mercuric sulfide. The sulfide is not reactive to any appreciable extent in water, with a solubility product (K_{sp}) of only 10^{-15} for the black allotropic form. The sulfide is reactive only in acid and slowly reactive in oxygenated alkaline solution, where it can be oxidized to soluble mercuric sulfate or sometimes $HgOH^+$. These first two reactions of mercuric sulfide can be depicted as follows:

$$Hg\text{–}M^* + 2H^+ \rightarrow M^{2+} + Hg^0 + H_2\,(g)\uparrow \qquad (4)$$

and

$$HgS + OH^- + 2O_2(g) \rightarrow Hg(OH)^+ + SO_4^{2-} \qquad (5)$$

In Eq.(4), acid is consumed as mercury enters solution and the pH can be expected to rise, as shown in Figs. 5 and 6. Eventually, the mercury(II) cation can react with hydroxyl anion, when the pH rises sufficiently, and form moderately insoluble hydrates of mercury(II) oxide (HgO).

In an alkaline solution, with air present above the solution, as was found in the experimental setup, the highly insoluble HgS can slowly be oxidized to more soluble mercuric sulfate. In Eq. (5), the hydroxyl anion is consumed, therefore causing a drop in pH, as shown in Figs. 5 and 6. The reactions of HgS in an acid or base are numerous; therefore, the reactions shown in Eqs. (4) and (5) are probable but not the only ones possible. Eventually, mercury in neutral and alkaline solution will precipitate as oxide, as shown in Eq. (6):

$$Hg(OH)^+ + OH^- \rightarrow HgO\downarrow + H_2O \quad . \qquad (6)$$

Since the reactivity of HgS in neutral water is far too slow to consider and the oxidation to soluble sulfate in alkaline solution is slow, sulfide is a good form to bind elemental mercury.

9. CONCLUSIONS

Two different processes for treatment of radioactively contaminated mercury were evaluated: one process relied upon amalgamation with metals and the other depended on the formation of mercuric compounds with sulfur. In the set of experiments that evaluated the release of mercury vapor in the headspace as a function of temperature, the amalgams made with metals released as much mercury as the standard pure mercury added as a control. This observation was made at all three temperatures investigated, that is, 4, 20, and 60°C. On the contrary, the compounds of mercury sulfide did not release mercury in the headspace. Even at 60°C, the concentration of mercury present in the headspace of sulfide compounds did not exceed 1 mg/m^3, while the metal-based amalgams could be as high as 260 mg/m^3. This finding corroborates the results obtained by Gorin et al. (1) in their experimental work as well as those found in the literature[7].

When leached in various solutions, the metal-based amalgams appeared to degrade more than the sulfur-based compounds, even though the duration of the tests was short (3 months). Some variability was found in the mercury leaching results. This could be caused by heterogeneity of the samples themselves; that is, all the mercury may not have reacted during the treatment. This was corroborated by the observation of a few tiny droplets of shiny mercury in the black FERN sulfur-based mercury compound. Another cause could be the presence in the leachate of small insoluble particulates of mercuric sulfide or compounds that were not captured by the filtration step—the 0.45-μm filter—and were analyzed as ionic mercury from the leachate.

10. REFERENCES

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2. *Mercury Amalgamation*, Mixed Waste Focus Area, Technology Development Requirements Document, INEL/EXT-97-00314, Rev. 0, March 1997.

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APPENDIX A

LEACHING TEST DATA

Table A.1. Leaching results (milligrams per liter) obtained at 2 weeks — pH 3

	Blk-	Blk-K	Blk-L	HG-B	HG-C	HG-11	LANL-F	LANL-5	LANL-6	Fern-D	Fern-E	Fern-F	OR-A	OR-B	OR-8	ID-A	ID-B	ID-C
Weight(g)				15.84	14.32	6.64	7.63	9.80	6.49	6.63	7.90	11.44	20.36	25.53	26.87	7.37	7.17	6.46
Initial pH	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96
Final pH	2.87	2.85	2.89	2.87	2.88	2.86	3.28	3.45	3.38	3.38	3.42	3.44	5.22	5.30	6.96	5.00	4.74	4.78
Silver	< 0.00	< 0.003	< 0.003	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Aluminum	0.07	0.070	0.084	0.407	0.372	0.167	1.608	1.981	2.399	0.288	0.305	0.335	0.212	0.251	0.146	0.174	0.164	0.217
Arsenic	< 0.01	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Boron	< 0.02	< 0.020	< 0.020	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	0.148	0.270	0.357	0.349	0.300	0.481
Barium	< 0.00	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	0.008	0.014	0.012	0.004	0.005	0.010	< 0.002	< 0.002	< 0.002	0.019	0.014	0.019
Beryllium	0.00	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.003	0.003	0.004	0.004	0.004	0.004	0.003	0.003	0.003
Calcium	0.04	< 0.040	< 0.040	0.204	< 0.080	< 0.080	541	832	658	974	1217	1591	8.59	7.50	8.99	15.69	8.03	16.21
Cadmium	< 0.00	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Chromium	< 0.00	< 0.005	< 0.005	< 0.010	< 0.010	< 0.010	< 0.010	0.019	0.019	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Copper	< 0.00	< 0.004	< 0.004	4.164	3.695	1.362	< 0.008	< 0.008	< 0.008	0.014	< 0.008	0.015	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Iron	< 0.05	< 0.050	< 0.050	< 0.100	< 0.100	< 0.100	6.111	10.292	6.675	1.115	1.528	1.873	0.843	1.294	1.481	0.797	0.404	0.654
Potassium	4.28	5.368	11.178	3.998	4.807	1.974	10.211	6.598	3.747	4.135	4.040	14.264	6.794	6.443	6.700	4.104	6.276	15.45
Magnesium	< 0.02	< 0.020	< 0.020	< 0.040	< 0.040	< 0.040	0.978	1.709	1.383	4.083	4.811	6.805	823	968	1357	849	653	796
Manganese	< 0.00	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	0.052	0.129	0.082	0.018	0.025	0.029	0.052	0.068	0.058	0.028	0.025	0.024
Sodium	0.69	0.077	0.073	< 0.120	< 0.120	0.398	4.165	5.857	4.107	13.699	15.415	23.137	416	512	521	847	770	866
Nickel	< 0.00	< 0.004	< 0.004	< 0.008	< 0.008	< 0.008	0.020	0.017	0.013	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Lead	< 0.00	< 0.007	< 0.007	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014
Selenium	0.02	0.020	0.021	0.033	0.037	0.039	< 0.020	< 0.020	< 0.020	< 0.020	0.027	0.025	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Antimony	< 0.01	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Silicon	0.52	0.507	0.568	0.514	0.602	0.681	3.404	5.783	5.156	2.580	3.172	3.915	1.401	1.394	0.999	1.306	1.214	1.730
Strontium	< 0.00	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	0.190	0.321	0.222	0.310	0.393	0.589	0.024	0.021	0.023	0.070	0.046	0.066
Thorium	< 0.13	< 0.130	< 0.130	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260
Titanium	0.00	0.001	0.001	< 0.002	< 0.002	< 0.002	0.004	0.005	0.004	0.005	0.007	0.009	< 0.002	< 0.002	< 0.002	0.002	< 0.002	0.003
Thallium	< 0.00	< 0.008	< 0.008	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
Uranium	0.09	0.074	0.070	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Vanadium	< 0.01	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	0.035	0.024	< 0.020	< 0.020	0.021	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Zinc	0.01	0.009	0.011	0.012	0.015	0.012	0.036	0.043	0.046	0.024	0.020	0.026	116.1	242.9	107.6	104.0	104.5	190.4
Zirconium	< 0.01	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	0.021	0.026	0.036	< 0.020	0.022	0.105	0.205	0.110	0.093	0.111	0.160
Mercury[a]	0.20	0.121	0.136	555	665	949	9.12	8.28	8.24	8.7	10.8	17.5	17.8	20.4	9.940	318.0	173.0	139.0

[a]Results in micrograms per liter.

Table A.2. Leaching results (milligrams per liter) obtained at 2 weeks – pH 5

	Blk-	Blk-H	Blk-I	HG-D	HG-E	HG-8	LANL-	Lanl-	Lanl-2	Fern-	Fern-	Fern-I	OR-4	OR-5	OR-9	ID-G	ID-H	ID-10
Weight(g)				19.15	18.64	8.22	11.12	14.41	9.76	5.99	8.67	16.76	17.40	37.46	37.18	7.11	7.43	6.85
Initial pH	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Final pH	5.06	5.06	5.05	5.01	5.02	5.02	5.09	5.07	5.01	5.06	5.00	5.06	6.85	8.00	7.93	7.61	7.74	6.61
Silver	< 0.003	< 0.003	< 0.003	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Aluminum	< 0.030	< 0.030	< 0.030	0.335	0.279	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060
Arsenic	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.020	0.026	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Boron	< 0.020	< 0.020	< 0.020	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040
Barium	0.001	0.001	< 0.001	< 0.002	< 0.002	< 0.002	0.022	0.027	0.016	0.009	0.010	0.014	0.003	0.003	0.006	0.018	0.015	0.018
Beryllium	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.004
Calcium	< 0.040	< 0.040	< 0.040	< 0.080	< 0.080	0.644	939	1249	744	1266	1283	2238	6.716	12.007	10.653	12.091	9.221	10.094
Cadmium	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Chromium	< 0.005	< 0.005	< 0.005	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Copper	< 0.004	< 0.004	< 0.004	4.863	4.776	1.707	< 0.008	< 0.008	< 0.008	0.017	< 0.008	0.017	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Iron	< 0.050	< 0.050	< 0.050	< 0.100	< 0.100	< 0.100	3.719	4.144	2.583	0.895	1.168	3.526	< 0.100	0.334	0.123	< 0.100	< 0.100	< 0.100
Potassium	4.967	5.735	5.700	6.025	5.733	6.581	8.075	7.988	12.239	4.200	3.480	6.009	3.816	12.164	11.774	5.762	9.999	21.232
Magnesium	< 0.020	< 0.020	< 0.020	< 0.040	< 0.040	< 0.040	1.514	1.903	0.961	3.813	5.639	10.729	324	615	465	380	377	386
Manganese	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	0.141	0.074	0.051	0.017	0.013	0.038	0.008	0.004	< 0.002	0.008	0.008	0.009
Sodium	1243	1234	1229	1399	1405	1385	1373	1366	1397	1441	1507	1500	1932	1998	1932	2070	2032	1826
Nickel	< 0.004	< 0.004	< 0.004	< 0.008	< 0.008	< 0.008	0.014	0.019	0.013	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Lead	< 0.007	< 0.007	< 0.007	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014
Selenium	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Antimony	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Silicon	0.602	0.571	0.486	0.497	0.501	0.680	10.844	13.852	6.934	3.026	2.377	3.988	0.912	0.875	0.893	1.222	1.041	1.150
Strontium	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	0.333	0.494	0.257	0.353	0.481	0.940	0.017	0.036	0.033	0.057	0.047	0.041
Thorium	< 0.130	< 0.130	< 0.130	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260
Titanium	0.001	0.001	0.001	< 0.002	< 0.002	< 0.002	0.006	0.007	0.005	0.008	0.007	0.011	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Thallium	< 0.008	< 0.008	< 0.008	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
Uranium	0.067	0.067	0.056	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Vanadium	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	0.021	0.035	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Zinc	0.008	0.007	0.007	0.017	0.016	0.031	0.074	0.047	0.071	0.020	0.013	0.010	167.2	25.92	32.32	74.390	67.054	75.826
Zirconium	0.011	< 0.010	0.014	< 0.020	< 0.020	< 0.020	0.036	0.037	< 0.020	0.025	< 0.020	0.029	0.164	0.051	0.051	0.074	0.074	0.087
Mercury[a]	0.14	0.104	0.108	1423	1271	1411	50.8	54.6	9.1	10.7	11.4	8.1	13.1	19.90	5.790	8.100	10.90	176.0

[a]Results in micrograms per liter.

Table A.3. Leaching results (milligrams per liter) obtained at 2 weeks – pH 7

	Blk-D	Blk-E	Blk-F	HG-F	HG-G	HG-H	Lanl-	Lanl-4	Lanl-E1	Fern-J	Fern-K	Fern-L	OR-C	OR-7	OR-17	ID-E	ID-F	ID-1
Weight(g)				22.99	23.32	16.35	10.61	5.95		8.16	11.8	12.05	20.77	26.3	5.66	5.16	5.26	5.80
Initial pH	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87
Final pH	7.54	6.70	6.34	7.35	7.40	7.08	6.35	4.80	6.35	8.66	8.80	9.77	10.45	10.3	10.70	10.49	10.4	10.59
Silver	< 0.003	< 0.003	< 0.003	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Aluminum	0.068	0.080	0.070	0.144	0.154	0.158	0.124	0.126	0.129	0.215	0.168	0.219	0.119	0.145	0.201	0.109	0.099	0.123
Arsenic	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Boron	< 0.020	< 0.020	< 0.020	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	0.143	0.107	0.097	0.400	0.308	0.382
Barium	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	0.015	0.009	0.011	0.006	0.007	0.010	< 0.002	< 0.002	< 0.002	0.011	0.010	0.009
Beryllium	0.002	0.001	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.004
Calcium	0.479	0.047	0.053	< 0.080	< 0.080	< 0.080	860	511	565	1244	1588	1811	2.830	5.883	0.990	4.521	5.565	3.072
Cadmium	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Chromium	< 0.005	< 0.005	< 0.005	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Copper	< 0.004	0.017	< 0.004	0.268	0.426	0.655	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	0.021	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Iron	< 0.050	< 0.050	< 0.050	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Potassium	4.238	4.309	3.825	5.419	4.208	4.625	5.516	10.726	5.646	5.484	4.010	3.659	5.277	6.232	4.101	6.72	10.66	7.34
Magnesium	< 0.020	< 0.020	< 0.020	< 0.040	< 0.040	< 0.040	0.710	0.479	0.535	0.166	0.288	0.218	45.31	89.89	20.89	25.62	32.05	19.08
Manganese	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	0.005	0.002	0.003	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Sodium	< 0.060	0.069	< 0.060	0.457	< 0.120	< 0.120	5.743	3.878	3.877	19.34	26.12	27.02	400	464	103	530	711	696
Nickel	< 0.004	< 0.004	< 0.004	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Lead	< 0.007	< 0.007	< 0.007	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014
Selenium	< 0.010	0.012	< 0.010	0.025	0.026	0.022	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.029	< 0.020	< 0.020	< 0.020
Antimony	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Silicon	0.461	0.449	0.474	0.511	0.498	0.561	9.671	7.151	9.513	3.543	4.934	4.885	0.881	0.878	0.484	0.890	0.898	0.974
Strontium	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	0.325	0.166	0.188	0.430	0.580	0.682	0.006	0.015	0.003	0.024	0.030	0.021
Thorium	< 0.130	< 0.130	< 0.130	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260
Titanium	0.001	< 0.001	0.001	< 0.002	< 0.002	< 0.002	0.005	0.003	0.004	0.006	0.009	0.010	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Thallium	< 0.008	< 0.008	< 0.008	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
Uranium	0.094	< 0.050	0.080	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Vanadium	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Zinc	0.014	0.007	< 0.005	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.011	< 0.010	< 0.010	< 0.010	0.077	0.104	0.167	0.056	0.054	0.078
Zirconium	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	0.031	0.021	0.021	0.034	< 0.020	0.023	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Mercury[a]	0.081	0.05	0.141	630	343	950	9.05	7.86	7.68	12.7	2.24	18.6	9.03	1.60	2.760	19.0	13.3	7.860

[a]Results in micrograms per liter.

Table A.4. Leaching results (milligrams per liter) obtained at 2 weeks — pH 12.5

	Blk-A	Blk-B	Blk-C	HG-	HG-1	HG-12	Lanl-A	Lanl-H	Lanl-7	Fern-A	Fern-B	Fern-C	OR-1	OR-2	OR-18	ID-D	ID-	ID-
Weight(g)				11.7	4.92	5.54	11.06	7.51	8.66	7.90	8.68	6.59	21.0	22.52	5.39	4.33	6.85	5.33
Initial pH	12.53	12.53	12.53	12.5	12.53	12.5	12.53	12.53	12.53	12.53	12.53	12.53	12.5	12.53	12.53	12.5	12.53	12.53
Final pH	12.78	12.78	12.74	12.7	12.73	12.7	12.67	12.48	12.65	12.59	12.55	12.61	12.4	12.37	12.71	12.4	12.34	12.48
Silver	< 0.003	< 0.003	< 0.003	0.024	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Aluminum	0.070	0.084	0.081	0.249	0.171	0.194	0.128	0.141	0.127	0.175	0.176	0.158	0.163	0.170	0.210	0.111	0.141	0.113
Arsenic	< 0.010	< 0.010	< 0.010	< 0.020	0.021	< 0.020	< 0.020	< 0.020	< 0.020	0.022	0.022	0.022	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Boron	< 0.020	< 0.020	< 0.020	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	0.425	0.613	0.185	1.298	1.378	1.709
Barium	0.016	0.016	0.016	0.016	0.032	0.016	0.041	0.032	0.037	0.021	0.024	0.020	0.015	0.016	0.016	0.026	0.030	0.026
Beryllium	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.003	0.004	0.004	0.004	0.003	0.004	0.004
Calcium	1031	1024	1020	968	2024	986	1946	1402	1611	2105	2149	1801	1031	803	1132	707	656	765
Cadmium	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Chromium	0.032	0.030	0.030	0.027	0.060	0.028	< 0.010	< 0.010	0.018	< 0.010	< 0.010	0.011	< 0.010	< 0.010	0.011	< 0.010	< 0.010	0.011
Copper	< 0.004	< 0.004	< 0.004	1.093	0.856	0.450	< 0.008	< 0.008	< 0.008	0.042	0.018	0.021	0.008	< 0.008	< 0.008	< 0.008	0.018	0.086
Iron	< 0.050	< 0.050	< 0.050	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Potassium	4.687	22.813	6.959	4.305	12.560	4.579	6.176	5.830	6.470	6.403	8.186	3.864	10.89	6.601	4.777	4.177	11.684	9.100
Magnesium	< 0.020	< 0.020	< 0.020	< 0.040	< 0.040	< 0.040	0.045	< 0.040	< 0.040	0.057	0.055	< 0.040	0.072	< 0.040	< 0.040	0.169	0.074	< 0.040
Manganese	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Sodium	0.938	0.945	0.930	0.869	2.051	1.087	6.647	5.497	6.024	16.18	19.56	13.92	361	461	113	638	629	652
Nickel	< 0.004	< 0.004	< 0.004	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Lead	< 0.007	< 0.007	< 0.007	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014
Selenium	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Antimony	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Silicon	1.266	0.988	1.107	0.889	2.019	0.541	1.268	1.092	1.122	1.089	1.228	1.002	2.604	1.909	1.745	0.938	1.361	1.097
Strontium	0.864	0.870	0.870	0.763	1.729	0.772	1.295	1.037	1.171	1.273	1.355	1.161	0.776	0.697	0.916	0.603	0.732	0.770
Thorium	< 0.130	< 0.130	< 0.130	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260
Titanium	0.006	0.006	0.006	0.005	0.011	0.005	0.010	0.008	0.009	0.011	0.011	0.009	0.005	0.004	0.006	0.004	0.004	0.004
Thallium	< 0.008	< 0.008	< 0.008	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
Uranium	0.092	0.069	0.093	< 0.100	0.102	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Vanadium	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Zinc	< 0.005	< 0.005	0.006	< 0.010	0.021	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	2.564	2.619	3.130	4.144	4.904	3.035
Zirconium	< 0.010	0.010	< 0.010	< 0.020	< 0.020	< 0.020	0.033	0.032	0.030	< 0.020	< 0.020	< 0.020	< 0.020	0.023	< 0.020	< 0.020	< 0.020	< 0.020
Mercury[a]	0.155	0.112	0.779	5503	4297	5893	7.38	10.42	8.05	15.3	14.2	15.9	30.5	12.0	115.0	41.10	3.260	55.0

[a]Results in micrograms per liter.

Table A.5. Leaching results (milligrams per liter) obtained at 1 month — pH 3

	Blk-1	Blk-2	Blk-3	HG-1	HG-2	HG-3	LANL-	LANL-	LANL-12	Fern-19	Fern-20	Fern-21	OR-11	OR-12	OR-16	ID-24	ID-24A	ID-28
Weight(g)	-	-	-	10	8	7	11.49	9.93	15.12	16.32	11.62	18.14	4.58	4.47	4.92	6.50	3.65	5.96
Initial pH	nr	nr	2.96	2.96	2.96	2.96	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.96
Final pH	nr	nr	2.88	2.52	2.58	2.65	3.42	3.28	3.29	3.96	4.18	4.26	5.28	5.43	4.89	5.87	5.60	6.60
Silver	< 0.003	< 0.003	< 0.003	0.013	0.004	0.004	< 0.013	< 0.013	< 0.013	< 0.005	< 0.005	< 0.005	< 0.013	< 0.013	< 0.013	< 0.005	< 0.005	< 0.005
Aluminum	0.048	< 0.030	0.039	0.422	0.357	0.321	4.941	4.242	4.563	0.271	0.180	0.210	0.670	0.524	0.368	0.102	0.159	0.061
Arsenic	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020
Boron	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.100	< 0.100	< 0.100	< 0.040	< 0.040	< 0.040	0.166	0.187	0.210	1.258	0.784	0.657
Barium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.031	0.024	0.033	0.020	0.018	0.035	< 0.005	< 0.005	< 0.005	0.026	0.029	0.022
Beryllium	0.001	0.001	0.001	0.001	0.001	0.001	0.009	0.008	0.008	0.003	0.002	0.003	0.006	0.006	0.006	0.003	0.003	0.003
Calcium	0.053	< 0.040	< 0.040	< 0.040	0.042	< 0.040	1085	872	1234	1907	2130	2639	4.034	2.887	2.858	19.024	11.675	18.767
Cadmium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.005	< 0.005	< 0.005	< 0.002	< 0.002	< 0.002	< 0.005	< 0.005	< 0.005	< 0.002	< 0.002	< 0.002
Chromium	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.035	0.029	0.033	0.013	0.025	0.017	0.068	< 0.025	< 0.025	< 0.010	< 0.010	< 0.010
Copper	< 0.004	0.004	< 0.004	3.141	2.626	2.349	< 0.020	< 0.020	< 0.020	< 0.008	< 0.008	< 0.008	< 0.020	< 0.020	< 0.020	< 0.008	< 0.008	< 0.008
Iron	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	15.184	10.551	12.977	2.683	1.801	2.559	< 0.250	< 0.250	< 0.250	1.558	1.075	1.213
Potassium	0.051	0.052	1.789	1.706	0.789	6.623	3.826	3.492	4.375	3.863	2.999	2.977	1.977	1.787	1.654	4.743	4.628	3.079
Magnesium	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	2.911	2.040	2.629	10.241	7.131	11.396	419	407	417	1394	1096	1198
Manganese	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.152	0.120	0.144	0.054	0.028	0.047	0.054	0.060	0.068	0.050	0.064	0.035
Sodium	0.086	0.063	< 0.060	0.871	0.221	0.127	8.177	6.596	9.190	29.271	18.861	31.319	164.8	158.3	90.87	811	478	758
Nickel	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	0.021	0.023	0.024	< 0.008	< 0.008	0.008	< 0.020	< 0.020	< 0.020	< 0.008	< 0.008	< 0.008
Lead	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.035	< 0.035	< 0.035	< 0.014	< 0.014	< 0.014	< 0.035	< 0.035	< 0.035	< 0.014	< 0.014	< 0.014
Selenium	0.016	0.016	0.013	0.018	0.017	0.019	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020
Antimony	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020
Silicon	0.623	0.558	0.586	0.622	0.605	0.560	20.244	13.846	17.400	6.349	4.525	7.090	1.207	1.001	1.045	2.383	1.463	1.416
Strontium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.352	0.266	0.419	0.813	0.713	1.096	0.009	0.008	0.008	0.079	0.047	0.076
Thorium	< 0.130	< 0.130	< 0.130	< 0.130	< 0.130	< 0.130	< 0.650	< 0.650	< 0.650	< 0.260	< 0.260	< 0.260	< 0.650	< 0.650	< 0.650	< 0.260	< 0.260	< 0.260
Titanium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.007	0.007	0.008	0.011	0.013	0.014	< 0.005	< 0.005	< 0.005	0.002	0.003	< 0.002
Thallium	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.040	< 0.040	< 0.040	< 0.016	< 0.016	< 0.016	< 0.040	< 0.040	< 0.040	< 0.016	< 0.016	< 0.016
Uranium	< 0.050	0.060	< 0.050	0.085	0.081	0.059	< 0.250	< 0.250	< 0.250	< 0.100	0.139	< 0.100	< 0.250	< 0.250	< 0.250	< 0.100	< 0.100	< 0.100
Vanadium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	0.031	< 0.020	0.031	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020
Zinc	0.011	0.008	0.008	0.011	0.012	0.011	0.142	0.153	0.105	< 0.010	0.015	0.010	280.1	274.6	271.9	102.1	108.7	94.16
Zirconium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	0.048	0.024	0.053	0.251	0.276	0.213	0.112	0.118	0.107
Mercury[a]	< 0.050	< 0.050	0.109	1397	1303	1311	30.0	48.1	45.7	5.02	3.70	4.70	60.4	115.1	53.8	412	82.7	81.3

[a]Results in micrograms per liter.

Table A.6. Leaching results (milligrams per liter) obtained at 1 month – pH 5

	Blk-	Blk-	Blk-12	HG-10	HG-11	HG-12	Lanl-4	Lanl-5	Lanl-7	Fern-13	Fern-14	Fern-	OR-	OR-	OR-	ID-	ID-	ID-
Weight(g)	-	-	-	10	16	7	12.22	9.80	11.06	26.92	36.77	19.6	6.90	10.86	8.51	7.85	3.80	5.29
Initial pH	4.63	nr	nr	5.00	5.00	5.00	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	5.00
Final pH	4.65	nr	nr	4.69	4.60	4.77	4.60	4.60	4.62	5.09	7.63	5.21	5.49	5.57	5.41	5.78	5.11	5.74
Silver	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.013	< 0.013	< 0.013	< 0.005	< 0.005	< 0.005	< 0.013	< 0.013	< 0.013	< 0.005	< 0.005	< 0.005
Aluminum	< 0.030	< 0.030	< 0.030	0.223	0.252	0.199	0.639	0.539	0.764	< 0.060	< 0.060	< 0.060	0.200	0.208	0.248	< 0.060	< 0.060	< 0.060
Arsenic	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	0.027	0.031	< 0.020	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020
Boron	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.100	< 0.100	< 0.100	< 0.040	< 0.040	< 0.040	< 0.100	< 0.100	< 0.100	0.087	< 0.040	< 0.040
Barium	< 0.001	< 0.001	0.001	0.001	0.001	< 0.001	0.033	0.024	0.029	0.052	0.074	0.038	< 0.005	< 0.005	< 0.005	0.024	0.021	0.017
Beryllium	0.001	0.001	0.001	0.001	0.001	0.001	0.009	0.009	0.009	0.003	0.004	0.004	0.007	0.007	0.007	0.003	0.003	0.003
Calcium	< 0.040	< 0.040	< 0.040	0.688	0.147	0.093	1109	842	1006	3061	4447	2431	4.433	5.722	5.961	18.96	9.77	14.79
Cadmium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.005	< 0.005	< 0.005	< 0.002	< 0.002	< 0.002	< 0.005	< 0.005	< 0.005	< 0.002	< 0.002	< 0.002
Chromium	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.025	< 0.025	< 0.025	< 0.010	< 0.010	< 0.010	< 0.025	< 0.025	< 0.025	< 0.010	< 0.010	< 0.010
Copper	< 0.004	< 0.004	< 0.004	2.954	4.382	2.646	< 0.020	< 0.020	< 0.020	< 0.008	0.011	< 0.008	< 0.020	< 0.020	< 0.020	< 0.008	< 0.008	< 0.008
Iron	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	7.680	7.202	8.123	1.313	< 0.100	1.527	< 0.250	< 0.250	< 0.250	0.451	0.222	< 0.100
Potassium	1.529	0.304	1.490	1.167	2.346	1.045	4.716	4.209	4.212	5.121	8.423	4.270	2.068	1.867	2.973	4.279	5.658	2.735
Magnesium	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	2.462	1.805	1.968	13.379	1.471	9.981	459	568	501	727	534	345
Manganese	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.192	0.107	0.128	0.031	< 0.002	0.019	0.024	0.030	0.022	0.002	0.015	0.006
Sodium	1178	1156	1214	1214	1209	1206	1525	1516	1505	1380	1394	1373	1549	1625	1594	2035	1680	1820
Nickel	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.020	< 0.020	< 0.020	< 0.008	< 0.008	< 0.008	< 0.020	< 0.020	< 0.020	< 0.008	< 0.008	< 0.008
Lead	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.035	< 0.035	< 0.035	< 0.014	< 0.014	< 0.014	< 0.035	< 0.035	< 0.035	< 0.014	< 0.014	< 0.014
Selenium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020
Antimony	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020
Silicon	0.589	0.557	0.554	0.608	0.558	0.554	19.302	14.075	17.133	11.606	13.906	8.045	0.824	0.785	0.773	1.053	1.093	1.318
Strontium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.335	0.232	0.293	1.449	2.094	1.048	0.011	0.016	0.015	0.081	0.040	0.059
Thorium	< 0.130	< 0.130	< 0.130	< 0.130	< 0.130	< 0.130	< 0.650	< 0.650	< 0.650	< 0.260	< 0.260	< 0.260	< 0.650	< 0.650	< 0.650	< 0.260	< 0.260	< 0.260
Titanium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.006	< 0.005	0.006	0.016	0.023	0.014	< 0.005	< 0.005	< 0.005	< 0.002	0.002	< 0.002
Thallium	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.040	< 0.040	< 0.040	< 0.016	< 0.016	< 0.016	< 0.040	< 0.040	< 0.040	< 0.016	< 0.016	< 0.016
Uranium	< 0.050	0.057	0.079	0.077	< 0.050	< 0.050	< 0.250	< 0.250	< 0.250	0.105	0.119	0.140	< 0.250	< 0.250	< 0.250	< 0.100	< 0.100	< 0.100
Vanadium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020
Zinc	0.009	0.011	0.018	0.012	0.014	0.011	0.472	0.585	0.340	< 0.010	< 0.010	< 0.010	187.9	158.8	158.0	61.20	87.57	62.67
Zirconium	0.015	< 0.010	< 0.010	< 0.010	0.014	< 0.010	0.055	< 0.050	< 0.050	0.043	0.046	0.032	0.167	0.178	0.158	0.086	0.098	0.070
Mercury[a]	0.838	< 0.050	0.489	3393	4584	3980	47.5	60.0	54.5	32.2	10.30	42.4	97.5	102.9	125.1	124.	138.8	135.3

[a]Results in micrograms per liter.

Table A.7. Leaching results (milligrams per liter) obtained at 1 month — pH 7

	Blk-7	Blk-8	Blk-9	HG-4	HG-5	HG-6	Lanl-6	Lanl-8	Lanl-9	Fern-16	Fern-17	Fern-18	OR-13	OR-	OR-15	ID-11	ID-	ID-
Weight(g)	-	-	-	18	10	14	11.06	12.36	11.27	16.59	24.74	24.88	5.93	3.94	6.51	6.16	4.19	4.50
Initial pH	nr	nr	7.55	7.87	7.87	7.87	7.55	7.55	7.55	7.55	7.55	7.55	7.55	7.55	7.55	7.55	7.55	7.55
Final pH	nr	nr	5.63	6.23	6.08	6.35	6.57	5.86	5.80	8.83	9.10	9.14	10.20	10.60	10.28	10.35	10.49	10.20
Silver	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.013	< 0.013	< 0.013	< 0.005	< 0.005	0.029	< 0.013	< 0.013	< 0.013	< 0.005	< 0.005	< 0.005
Aluminum	0.053	0.044	0.047	0.060	0.058	0.049	0.243	0.210	0.168	0.100	0.062	0.319	0.369	0.339	0.378	< 0.060	0.093	0.086
Arsenic	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020
Boron	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.100	< 0.100	< 0.100	< 0.040	< 0.040	< 0.040	< 0.100	< 0.100	0.114	1.215	0.517	0.425
Barium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.020	0.021	0.026	0.021	0.029	0.015	< 0.005	< 0.005	< 0.005	0.014	0.011	0.011
Beryllium	0.001	0.001	0.001	0.001	0.001	0.001	0.009	0.009	0.008	0.003	0.003	0.004	0.006	0.007	0.007	0.003	0.003	0.003
Calcium	0.526	< 0.040	< 0.040	< 0.040	0.083	< 0.040	885	970	923	2141	2973	5004	1.376	1.063	1.431	5.805	3.826	4.503
Cadmium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.005	< 0.005	< 0.005	< 0.002	< 0.002	< 0.002	< 0.005	< 0.005	< 0.005	< 0.002	< 0.002	< 0.002
Chromium	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.025	< 0.025	< 0.025	< 0.010	< 0.010	< 0.010	< 0.025	< 0.025	< 0.025	< 0.010	< 0.010	< 0.010
Copper	< 0.004	0.005	< 0.004	0.719	0.713	0.694	< 0.020	< 0.020	< 0.020	0.008	< 0.008	0.132	< 0.020	< 0.020	< 0.020	< 0.008	< 0.008	< 0.008
Iron	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.250	< 0.250	< 0.250	< 0.100	< 0.100	< 0.100	< 0.250	< 0.250	< 0.250	< 0.100	< 0.100	< 0.100
Potassium	0.114	0.067	3.115	1.021	0.874	1.393	3.641	2.943	2.848	3.803	4.098	6.155	1.308	1.299	1.284	3.458	1.978	3.171
Magnesium	0.029	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.776	0.842	0.828	0.225	0.294	1.152	33.306	8.777	23.382	24.675	15.410	23.754
Manganese	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.007	< 0.006	0.008	< 0.002	< 0.002	0.011	< 0.006	< 0.006	< 0.006	< 0.002	< 0.002	< 0.002
Sodium	0.144	< 0.060	< 0.060	0.102	0.117	0.071	7.03	7.72	6.93	28.4	43.4	60.8	111.6	70.9	117.5	689	444	550
Nickel	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.020	< 0.020	< 0.020	< 0.008	< 0.008	0.073	< 0.020	< 0.020	< 0.020	< 0.008	< 0.008	< 0.008
Lead	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.035	< 0.035	< 0.035	< 0.014	< 0.014	< 0.014	< 0.035	< 0.035	< 0.035	< 0.014	< 0.014	< 0.014
Selenium	< 0.010	< 0.010	< 0.010	0.012	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020
Antimony	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	0.132	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020
Silicon	0.491	0.506	0.480	0.454	0.473	0.496	14.047	16.149	14.243	4.865	6.164	6.092	0.745	0.709	0.729	1.008	0.762	0.847
Strontium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.263	0.297	0.286	0.815	1.302	1.948	< 0.005	< 0.005	< 0.005	0.031	0.022	0.024
Thorium	< 0.130	< 0.130	< 0.130	< 0.130	< 0.130	< 0.130	< 0.650	< 0.650	< 0.650	< 0.260	< 0.260	< 0.260	< 0.650	< 0.650	< 0.650	< 0.260	< 0.260	< 0.260
Titanium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.005	0.006	0.006	0.011	0.016	0.012	< 0.005	< 0.005	< 0.005	< 0.002	< 0.002	< 0.002
Thallium	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.040	< 0.040	< 0.040	< 0.016	< 0.016	< 0.016	< 0.040	< 0.040	< 0.040	< 0.016	< 0.016	< 0.016
Uranium	< 0.050	0.065	< 0.050	< 0.050	0.069	0.070	< 0.250	< 0.250	< 0.250	< 0.100	< 0.100	< 0.100	< 0.250	< 0.250	< 0.250	< 0.100	< 0.100	< 0.100
Vanadium	< 0.010	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	0.030	0.022	0.462	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020
Zinc	0.018	0.006	< 0.005	0.008	0.011	0.011	< 0.025	< 0.025	< 0.025	< 0.010	< 0.010	< 0.010	0.701	0.227	0.107	0.111	0.073	0.152
Zirconium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	0.051	0.055	0.554	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020
Mercury[a]	< 0.05	< 0.05	0.10	3290	1947	2979	10.00	7.46	4.85	79.72	79.72	59.70	35.70	12.00	16.80	6.22	6.38	19.33

[a]Results in micrograms per liter.

Table A.8. Leaching results (milligrams per liter) obtained at 1 month — pH 12.5

	Blk-4	Blk-5	Blk-6	HG-7	HG-8	HG-9	Lanl-1	Lanl-2	Lanl-3	Fern-10	Fern-11	Fern-12	OR-	OR-20	OR-	ID-13	ID-14	ID-14A
Weight(g)	-	-	-	7	9	9	7.51	9.79	9.96	14.74	18.54	19.30	5.62	6.44	7.85	5.34	5.50	4.80
Initial pH	nr	nr	12.53	12.53	12.53	12.53	12.68	12.68	12.68	12.68	12.68	12.68	12.53	12.53	12.53	12.53	12.53	12.53
Final pH	nr	nr	12.72	12.06	12.39	12.35	12.55	12.17	11.89	12.40	12.43	12.34	12.27	12.19	12.20	12.15	12.22	12.20
Silver	<0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.015	< 0.013	< 0.013	0.029	< 0.005	< 0.005	< 0.013	< 0.013	< 0.013	< 0.005	< 0.005	< 0.005
Aluminum	0.047	0.053	0.049	0.057	0.060	0.059	< 0.150	0.285	0.272	0.212	0.154	0.118	0.383	0.341	0.374	< 0.060	0.069	< 0.060
Arsenic	<0.010	< 0.010	< 0.010	0.011	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.020	0.021	0.022	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020
Boron	<0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.100	< 0.100	< 0.100	< 0.040	< 0.040	< 0.040	0.178	0.201	0.235	1.402	1.239	1.337
Barium	0.012	0.012	0.012	0.013	0.014	0.015	0.053	0.069	0.064	0.024	0.042	0.042	0.011	0.010	0.010	0.033	0.037	0.033
Beryllium	0.001	0.001	0.001	0.001	0.001	0.001	0.007	0.009	0.009	0.003	0.004	0.003	0.007	0.007	0.007	0.003	0.003	0.003
Calcium	1192	1175	1179	1223	1237	1244	1886	1588	1437	6343	4248	4621	525	588	591	643	498	479
Cadmium	<0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.005	< 0.005	< 0.005	< 0.002	< 0.002	< 0.002	< 0.005	< 0.005	< 0.005	< 0.002	< 0.002	< 0.002
Chromium	0.012	0.013	0.014	0.014	0.015	0.018	< 0.025	< 0.025	< 0.025	< 0.010	< 0.010	< 0.010	< 0.025	< 0.025	< 0.025	< 0.010	< 0.010	< 0.010
Copper	0.013	0.010	0.011	0.405	0.415	0.320	< 0.020	0.076	0.023	0.128	0.021	0.023	< 0.020	< 0.020	< 0.020	< 0.008	< 0.008	< 0.008
Iron	<0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.250	< 0.250	< 0.250	< 0.100	< 0.100	< 0.100	< 0.250	< 0.250	< 0.250	< 0.100	< 0.100	< 0.100
Potassium	0.139	0.160	1.314	1.087	1.096	1.221	3.001	4.368	4.379	6.419	3.635	3.560	2.362	2.607	1.994	4.220	5.913	3.101
Magnesium	<0.020	0.026	< 0.020	< 0.020	< 0.020	< 0.020	< 0.100	< 0.100	< 0.100	0.736	0.115	0.114	0.122	< 0.100	< 0.100	0.169	0.111	< 0.040
Manganese	<0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.008	< 0.006	< 0.006	0.009	< 0.002	< 0.002	< 0.006	< 0.006	< 0.006	< 0.002	< 0.002	< 0.002
Sodium	0.550	0.553	0.555	0.611	0.612	0.649	5.727	7.622	7.884	37.38	32.152	35.783	106.6	114.2	147.2	512	523	438
Nickel	<0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.020	< 0.020	< 0.020	0.057	< 0.008	< 0.008	< 0.020	< 0.020	< 0.020	< 0.008	< 0.008	< 0.008
Lead	<0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.035	< 0.035	< 0.035	< 0.014	< 0.014	< 0.014	< 0.035	< 0.035	< 0.035	< 0.014	< 0.014	< 0.014
Selenium	<0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020
Antimony	<0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	0.101	< 0.020	< 0.020	< 0.050	< 0.050	< 0.050	< 0.020	< 0.020	< 0.020
Silicon	0.607	0.566	0.904	0.897	0.927	0.902	1.763	1.170	1.429	2.692	2.133	2.151	1.118	1.142	1.383	1.052	0.965	1.319
Strontium	0.719	0.718	0.744	0.776	0.825	0.855	1.234	1.178	1.138	3.030	2.462	2.570	0.469	0.441	0.449	0.588	0.574	0.552
Thorium	<0.130	< 0.130	< 0.130	< 0.130	< 0.130	< 0.130	< 0.650	< 0.650	< 0.650	< 0.260	< 0.260	< 0.260	< 0.650	< 0.650	< 0.650	< 0.260	< 0.260	< 0.260
Titanium	0.005	0.005	0.005	0.005	0.005	0.005	0.013	0.009	0.008	0.026	0.021	0.024	< 0.005	< 0.005	0.005	0.004	0.003	0.003
Thallium	<0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.040	< 0.040	< 0.040	< 0.016	< 0.016	< 0.016	< 0.040	< 0.040	< 0.040	< 0.016	< 0.016	< 0.016
Uranium	0.073	0.057	< 0.050	0.067	0.069	0.071	< 0.250	< 0.250	< 0.250	< 0.100	< 0.100	< 0.100	< 0.250	< 0.250	< 0.250	< 0.100	< 0.100	< 0.100
Vanadium	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	0.354	0.028	0.035	< 0.050	< 0.050	< 0.050	0.024	< 0.020	< 0.020
Zinc	0.007	0.007	0.009	0.006	0.006	0.008	< 0.025	< 0.025	< 0.025	< 0.010	< 0.010	< 0.010	1.782	1.756	1.574	1.302	1.121	1.605
Zirconium	<0.010	< 0.010	0.011	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	0.353	0.054	0.055	< 0.050	< 0.050	< 0.050	0.033	0.032	< 0.020
Mercury[a]	<0.05	< 0.05	0.32	6398	6989	6396	4.6	4.8	8.2	25	43.7	57.5	47.0	102.3	94.3	65.5	131.2	13.9

[a]Results in micrograms per liter.

Table A.9. Leaching results (milligrams per liter) obtained at 2 months — pH 3

	Blk-M	Blk-N	Blk-O	HG-14	HG-17	HG-18	LANL-	LANL-	LANL-	Fern-37	Fern-38	Fern-39	OR-28	OR-29	OR-30	ID-	ID-	ID-
Weight(g)				4.91	5.92	5.04	14.44	12.94	14.00	14.37	13.26	17.41	8.28	9.26	16.63	5.44	6.38	4.32
Initial pH	2.85	3.05	3.05	3.05	2.85	2.85	3.05	3.05	3.05	3.05	3.05	3.05	3.05	3.05	3.05	3.05	2.85	2.85
Final pH	2.81	2.87	2.88	2.94	2.89	2.81	3.79	3.76	3.74	4.50	4.56	4.89	5.72	5.80	7.42	5.56	6.05	5.44
Silver	<0.003	<0.003	<0.003	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013
Aluminum	0.040	0.073	0.068	0.506	0.484	0.423	7.709	6.011	7.035	0.211	<0.150	0.238	0.309	0.273	0.229	0.212	<0.150	0.236
Arsenic	<0.010	<0.010	<0.010	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Boron	<0.020	<0.020	<0.020	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	0.348	0.282	0.248	0.585	0.747	0.733
Barium	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	0.041	0.037	0.039	0.024	0.022	0.036	<0.005	<0.005	<0.005	0.023	0.028	0.028
Beryllium	0.001	0.002	0.002	0.012	0.012	0.011	0.014	0.014	0.014	<0.003	<0.003	0.003	0.007	0.007	0.007	0.004	0.004	0.005
Calcium	<0.040	0.170	<0.040	0.397	<0.200	<0.200	1330	1160	1258	2036	1896	2251	3.95	5.11	7.84	15.80	15.67	13.12
Cadmium	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	<0.005	<0.005	<0.005	<0.025	<0.025	<0.025	0.035	0.025	0.026	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Copper	<0.004	<0.004	<0.004	1.075	1.276	1.108	<0.020	<0.020	<0.020	0.028	<0.020	0.027	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Iron	<0.050	<0.050	<0.050	<0.250	<0.250	<0.250	19.95	16.06	23.40	1.607	1.369	1.885	<0.250	<0.250	<0.250	<0.250	0.549	0.299
Potassium	5.617	5.072	4.81	4.831	4.676	4.268	9.32	8.888	11.19	6.717	7.219	6.88	5.669	5.642	9.714	8.137	6.868	10.248
Magnesium	<0.020	<0.020	<0.020	<0.100	<0.100	<0.100	3.499	2.988	3.181	8.741	8.280	10.87	700	751	1000	925	1255	1070
Manganese	<0.001	<0.001	<0.001	<0.006	<0.006	<0.006	0.212	0.198	0.477	0.030	0.026	0.031	0.186	0.175	0.159	0.148	0.149	0.160
Sodium	0.070	0.073	<0.060	0.303	<0.300	<0.300	10.99	9.167	10.48	23.55	23.25	29.94	155	183	331	644	746	514
Nickel	<0.004	<0.004	<0.004	<0.020	<0.020	<0.020	0.028	0.026	0.028	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Lead	<0.007	<0.007	<0.007	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035
Selenium	0.023	0.029	0.028	0.101	0.093	0.082	0.071	0.078	0.086	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Antimony	<0.010	<0.010	<0.010	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Silicon	0.539	0.537	0.563	0.461	0.449	0.468	31.23	27.07	28.81	6.737	6.114	8.195	0.887	0.799	0.391	1.264	0.568	1.171
Strontium	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	0.423	0.351	0.400	0.579	0.544	0.722	0.012	0.015	0.022	0.064	0.063	0.055
Thorium	<0.130	<0.130	<0.130	<0.650	<0.650	<0.650	<0.650	<0.650	<0.650	<0.650	<0.650	<0.650	<0.650	<0.650	<0.650	<0.650	<0.650	<0.650
Titanium	<0.001	0.001	<0.001	<0.005	<0.005	<0.005	0.007	0.007	0.007	0.014	0.013	0.015	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium	<0.008	<0.008	<0.008	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Uranium	<0.050	0.054	<0.050	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	0.322	0.326	0.361	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250
Vanadium	<0.010	<0.010	<0.010	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Zinc	0.008	0.005	0.007	<0.025	<0.025	<0.025	0.116	0.280	0.112	0.070	0.187	0.523	245.9	241.3	113.7	179.0	224.3	233.6
Zirconium	<0.010	<0.010	<0.010	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.229	0.209	0.121	0.149	0.198	0.219
Mercury[a]	<0.050	<0.050	<0.050	113	729	769	<0.050	<0.050	<0.050	1.800	6.300	7.000	2.100	9.800	1.500	818.0	49.5	11.0

[a]Results in micrograms per liter.

Table A.10. Leaching results (milligrams per liter) obtained at 2 months — pH 5

	Blk-S	Blk-T	Blk-U	HG-M	HG-N	HG-O	Lanl-19	Lanl-20	Lanl-21	Fern-28	Fern-29	Fern-30	OR-	OR-38	OR-39	ID-17	ID-18	ID-19A
Weight(g)				14.00	11.00	8.00	13.15	11.17	13.84	19.75	20.58	17.67	9.12	7.15	9.15	6.37	6.26	6.02
Initial pH	4.63	4.89	4.89	4.63	4.63	4.63	4.89	4.89	4.89	4.89	4.89	4.89	4.89	4.89	4.89	4.89	4.63	4.63
Final pH	4.78	4.97	5.00	4.75	4.77	4.77	5.00	5.07	5.12	7.28	8.58	6.43	6.86	6.03	7.50	10.06	6.68	5.95
Silver	< 0.003	< 0.003	< 0.003	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013
Aluminum	< 0.030	< 0.030	< 0.030	0.752	0.628	0.597	0.744	0.847	0.678	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150
Arsenic	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Boron	< 0.020	< 0.020	< 0.020	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	0.171	0.229	< 0.100
Barium	0.001	< 0.001	< 0.001	< 0.005	< 0.005	< 0.005	0.037	0.029	0.039	0.036	0.044	0.031	< 0.005	< 0.005	< 0.005	0.025	0.027	0.025
Beryllium	0.002	0.002	0.002	0.012	0.012	0.012	0.013	0.013	0.013	< 0.003	< 0.003	< 0.003	0.008	0.008	0.008	0.003	0.003	0.003
Calcium	0.081	< 0.040	< 0.040	0.268	< 0.200	< 0.200	1194	994	1277	2360	2514	2157	5.882	3.39	4.811	14.04	16.21	15.50
Cadmium	< 0.001	< 0.001	< 0.001	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Chromium	< 0.005	< 0.005	< 0.005	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
Copper	< 0.004	< 0.004	< 0.004	4.399	3.614	2.815	< 0.020	< 0.020	< 0.020	0.032	0.036	0.023	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Iron	< 0.050	< 0.050	< 0.050	< 0.250	< 0.250	< 0.250	5.706	4.704	6.270	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250
Potassium	5.698	5.427	5.859	4.496	4.390	12.65	12.06	10.87	11.57	13.99	7.44	7.56	8.04	8.75	5.80	6.41	7.18	7.84
Magnesium	< 0.020	< 0.020	< 0.020	< 0.100	< 0.100	< 0.100	2.485	1.949	3.031	1.790	0.633	6.93	411	339	421	420	718	623
Manganese	< 0.001	< 0.001	< 0.001	< 0.006	< 0.006	< 0.006	0.143	0.107	0.181	0.053	< 0.006	0.012	0.119	0.123	0.121	0.109	0.118	0.120
Sodium	1226	1125	1116	1500	1468	1479	1323	1360	1340	1488	1476	1445	1501	1449	1481	1957	2164	2117
Nickel	< 0.004	< 0.004	< 0.004	< 0.020	< 0.020	< 0.020	0.021	< 0.020	0.023	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Lead	< 0.007	< 0.007	< 0.007	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035
Selenium	< 0.010	< 0.010	< 0.010	0.051	< 0.050	0.056	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Antimony	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Silicon	0.560	0.488	0.507	0.449	0.434	0.418	22.57	19.72	27.49	8.577	8.726	7.892	0.428	0.413	0.496	0.489	1.075	0.672
Strontium	< 0.001	< 0.001	< 0.001	< 0.005	< 0.005	< 0.005	0.339	0.254	0.368	0.786	0.847	0.719	0.018	0.011	0.015	0.064	0.073	0.074
Thorium	< 0.130	< 0.130	< 0.130	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650
Titanium	0.001	< 0.001	< 0.001	< 0.005	< 0.005	< 0.005	0.006	0.005	0.007	0.014	0.014	0.013	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Thallium	< 0.008	< 0.008	< 0.008	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	0.042	0.064	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040
Uranium	< 0.050	0.054	< 0.050	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	0.277	< 0.250	0.304	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250
Vanadium	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Zinc	0.011	0.006	0.005	< 0.025	< 0.025	< 0.025	0.250	1.478	2.178	< 0.025	0.050	0.103	44.67	105.6	50.96	0.09	75.69	98.29
Zirconium	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	0.067	< 0.050	0.060	0.089	0.066	< 0.050	0.079	0.106
Mercury[a]	0.145	0.104	0.072	3876	2985	2473	58.0	63.20	89.60	205	13	157	50.50	46.30	6.00	34.5	136	104

[a]Results in micrograms per liter.

Table A.11. Leaching results (milligrams per liter) obtained at 2 months — pH 7

	Blk-P	Blk-Q	Blk-R	HG-P	HG-Q	HG-R	Lanl-32	Lanl-33	Lanl-34	Fern-40	Fern-41	Fern-42	OR-40	OR-41	OR-42	ID-26	ID-27	ID-30
Weight(g)				13.00	6.00	8.00	19.31	14.65	23.92	14.84	19.31	27.06	8.83	7.14	8.34	12.15	12.33	21.36
Initial pH	7.55	7.55	8.06	7.55	7.55	7.55	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06
Final pH	7.60	5.78	5.94	7.13	6.83	6.89	7.44	7.25	6.51	7.90	9.35	9.77	10.73	10.70	10.71	10.74	10.66	10.53
Silver	< 0.003	< 0.003	< 0.003	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	0.022	< 0.013	< 0.013	<0.013	< 0.013	< 0.013	< 0.013
Aluminum	0.074	0.085	0.066	0.481	0.446	0.466	0.319	0.256	0.536	< 0.150	0.266	0.151	0.289	0.270	0.256	< 0.150	< 0.150	< 0.150
Arsenic	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	0.069	< 0.050	< 0.050	< 0.050	<0.050	< 0.050	< 0.050	< 0.050
Boron	< 0.020	< 0.020	< 0.020	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	0.156	0.155	0.136	1.027	1.100	0.973
Barium	< 0.001	< 0.001	< 0.001	< 0.005	< 0.005	< 0.005	0.040	0.023	0.040	0.025	0.030	0.043	< 0.005	< 0.005	<0.005	0.013	0.015	0.017
Beryllium	0.002	0.002	0.002	0.012	0.012	0.012	0.006	0.006	0.013	0.003	0.004	0.005	0.008	0.009	0.009	0.005	0.005	0.006
Calcium	< 0.040	< 0.040	< 0.040	< 0.200	< 0.200	< 0.200	1628	1044	1770	1970	2647	4010	1.670	1.143	1.396	6.907	6.772	9.372
Cadmium	< 0.001	< 0.001	< 0.001	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	<0.005	< 0.005	< 0.005	< 0.005
Chromium	< 0.005	< 0.005	< 0.005	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	<0.025	< 0.025	< 0.025	< 0.025
Copper	< 0.004	< 0.004	< 0.004	0.638	0.469	0.549	< 0.020	< 0.020	0.026	0.037	0.050	0.075	< 0.020	< 0.020	<0.020	< 0.020	< 0.020	< 0.020
Iron	< 0.050	< 0.050	< 0.050	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	<0.250	< 0.250	< 0.250	< 0.250
Potassium	4.612	5.204	6.054	11.93	6.782	4.190	9.380	7.49	10.44	9.318	12.31	7.298	7.131	5.508	13.70	8.091	9.21	11.52
Magnesium	< 0.020	< 0.020	< 0.020	< 0.100	< 0.100	< 0.100	1.643	0.879	1.545	0.517	0.347	0.803	17.01	16.44	16.03	22.98	29.71	52.55
Manganese	< 0.001	< 0.001	< 0.001	< 0.006	< 0.006	< 0.006	0.122	0.129	0.011	< 0.006	< 0.006	< 0.006	0.118	0.117	0.116	0.111	0.111	0.106
Sodium	< 0.060	< 0.060	< 0.060	0.641	< 0.300	< 0.300	13.45	8.15	14.8	28.34	38.18	53.53	178	124	163	1545	1430	2621
Nickel	< 0.004	< 0.004	< 0.004	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.025	< 0.020	< 0.020	<0.020	< 0.020	< 0.020	< 0.020
Lead	< 0.007	< 0.007	< 0.007	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	<0.035	< 0.035	< 0.035	< 0.035
Selenium	0.020	0.018	0.016	0.079	0.066	0.073	< 0.050	< 0.050	0.065	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	<0.050	< 0.050	< 0.050	< 0.050
Antimony	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	<0.050	< 0.050	< 0.050	< 0.050
Silicon	0.507	0.498	0.467	0.437	0.444	0.446	29.38	14.05	22.69	6.853	9.210	10.60	0.389	0.363	0.438	0.834	0.889	0.964
Strontium	< 0.001	< 0.001	< 0.001	< 0.005	< 0.005	< 0.005	0.572	0.320	0.608	0.572	0.833	1.353	0.005	< 0.005	<0.005	0.051	0.047	0.076
Thorium	< 0.130	< 0.130	< 0.130	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	<0.650	< 0.650	< 0.650	< 0.650
Titanium	< 0.001	< 0.001	< 0.001	< 0.005	< 0.005	< 0.005	0.007	< 0.005	0.009	0.011	0.014	0.017	< 0.005	< 0.005	<0.005	< 0.005	< 0.005	< 0.005
Thallium	< 0.008	< 0.008	< 0.008	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	0.114	0.071	0.159	< 0.040	< 0.040	<0.040	< 0.040	< 0.040	< 0.040
Uranium	0.055	< 0.050	0.059	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	<0.250	< 0.250	< 0.250	< 0.250
Vanadium	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	0.066	0.056	0.154	< 0.050	< 0.050	<0.050	< 0.050	< 0.050	< 0.050
Zinc	< 0.005	< 0.005	0.005	< 0.025	< 0.025	< 0.025	< 0.025	0.227	< 0.025	0.053	0.026	0.061	0.167	0.144	0.244	0.241	0.088	0.060
Zirconium	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	0.062	0.064	0.118	< 0.050	< 0.050	<0.050	< 0.050	< 0.050	< 0.050
Mercury[a]	< 0.050	< 0.050	< 0.050	3107	203	803	0.930	1.900	153.0	48.7	95.2	599	< 0.050	< 0.050	<0.050	13.70	8.43	10.40

[a]Results in micrograms per liter.

Table A.12. Leaching results (milligrams per liter) obtained at 2 months – pH 12.5

	Blk-V	Blk-W	Blk-X	HG-13	HG-19	HG-21	Lanl-16	Lanl-17	Lanl-18	Fern-25	Fern-26	Fern-27	OR-23	OR-24	OR-25	ID-15	ID-15A	ID-20A
Weight(g)				6.10	4.24	13.40	11.20	11.32	17.50	19.51	23.31	19.99	7.30	8.93	8.73	3.78	6.64	3.89
Initial pH	12.68	12.48	12.48	12.68	12.68	12.68	12.48	12.48	12.48	12.48	12.48	12.48	12.48	12.48	12.48	12.68	12.68	12.48
Final pH	12.73	12.75	12.74	12.74	12.74	12.71	11.77	9.90	10.32	10.30	10.22	10.29	12.12	12.42	12.21	12.74	12.70	12.72
Silver	< 0.003	< 0.003	< 0.003	0.022	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	0.051	0.017	< 0.013	< 0.013	< 0.013	0.058	< 0.013	< 0.013
Aluminum	0.083	0.094	0.089	0.498	0.482	0.505	0.566	0.512	0.550	0.410	0.281	< 0.150	0.271	0.213	0.213	< 0.150	< 0.150	0.156
Arsenic	0.015	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Boron	< 0.020	< 0.020	< 0.020	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	0.244	0.301	0.295	1.200	2.115	1.439
Barium	0.013	0.016	0.016	0.012	0.011	0.013	0.074	0.078	0.109	0.039	0.040	0.037	0.016	0.016	0.015	0.059	0.053	0.048
Beryllium	0.002	0.002	0.002	0.012	0.012	0.012	0.012	0.012	0.013	0.008	< 0.003	< 0.003	0.007	0.007	0.007	0.003	0.003	0.004
Calcium	974	965	981	970	974	968	1461	1529	1839	4544	4821	4477	446	709	610	1060	1031	1080
Cadmium	< 0.001	< 0.001	< 0.001	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Chromium	0.018	0.024	0.022	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	0.048	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
Copper	0.012	0.016	0.015	0.238	0.128	0.339	0.062	0.025	0.024	0.077	0.108	0.102	< 0.020	0.024	< 0.020	< 0.020	< 0.020	< 0.020
Iron	< 0.050	< 0.050	< 0.050	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250
Potassium	3.705	19.013	2.722	3.610	3.885	4.338	9.258	9.974	10.39	27.96	8.375	6.875	10.02	20.92	7.70	6.324	10.258	5.890
Magnesium	< 0.020	< 0.020	< 0.020	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	0.135	0.738	1.154	0.659	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	0.151
Manganese	< 0.001	< 0.001	< 0.001	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	0.117	0.116	0.115	0.113	0.111	0.113
Sodium	1.009	0.654	0.564	0.629	0.462	0.458	8.287	8.046	11.80	42.90	46.86	38.39	151	169	185	395	698	480
Nickel	< 0.004	< 0.004	< 0.004	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.033	0.036	0.026	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Lead	< 0.007	< 0.007	< 0.007	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035
Selenium	< 0.010	< 0.010	0.011	0.095	0.079	0.073	0.069	0.069	0.081	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Antimony	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	0.061	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Silicon	0.682	0.779	0.822	0.850	0.554	0.655	1.925	3.923	7.914	4.220	5.617	3.552	1.194	0.822	0.882	1.547	1.763	1.600
Strontium	0.731	0.848	0.854	0.487	0.496	0.513	1.010	1.021	1.224	2.019	2.208	2.001	0.668	0.659	0.669	0.750	0.836	0.845
Thorium	< 0.130	< 0.130	< 0.130	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650	< 0.650
Titanium	0.005	0.005	0.005	0.006	0.006	< 0.005	0.008	0.008	0.009	0.018	0.021	0.017	< 0.005	< 0.005	< 0.005	0.005	0.005	< 0.005
Thallium	< 0.008	< 0.008	< 0.008	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	0.134	0.145	0.104	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040
Uranium	0.056	0.050	0.065	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250
Vanadium	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	0.163	0.241	0.176	< 0.050	0.062	< 0.050	< 0.050	< 0.050	< 0.050
Zinc	< 0.005	< 0.005	< 0.005	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	0.037	0.047	0.031	1.052	2.404	1.310	2.271	2.187	2.486
Zirconium	< 0.010	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	0.224	0.194	0.193	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	0.056
Mercury[a]	1.354	< 0.050	< 0.050	6791	6499	311	8.00	15.00	15.50	1027	1630	1011	8.50	22.60	11.60	839	214	166

[a]Results in micrograms per liter.

Table A.13. Leaching results (milligrams per liter) obtained at 3 months — pH 3

	Blk-G	Blk-H	Blk-I	HG-2	HG-7	HG-3	LANL-28	LANL-29	LANL-30	Fern-34	Fern-35	Fern-36	OR-46	OR-47	OR-48	ID-21	ID-23	ID-23A
Weight(g)				4.52	6.81	7.70	19.15	12.92	12.29	14.71	19.52	14.09	10.20	7.30	11.15	7.59	6.10	4.53
Initial pH	2.85	3.05	3.05	2.85	2.85	2.85	3.05	3.05	3.05	3.05	3.05	3.05	3.05	3.05	3.05	3.05	2.85	2.85
Final pH	2.77	2.81	2.89	2.90	2.92	2.92	3.92	3.77	3.80	4.84	4.80	4.49	6.17	6.13	7.31	9.68	8.70	7.86
Silver	< 0.003	< 0.003	< 0.003	< 0.005	< 0.005	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Aluminum	< 0.030	< 0.030	< 0.030	0.060	< 0.060	0.064	6.599	6.077	7.285	0.158	0.146	0.131	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060
Arsenic	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.023	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Boron	< 0.020	< 0.020	< 0.020	1.168	0.172	2.167	0.180	0.146	0.134	0.164	0.162	0.148	0.465	0.399	0.433	0.909	0.966	1.038
Barium	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	0.002	0.041	0.030	0.034	0.026	0.028	0.018	0.003	0.003	0.005	0.027	0.036	0.044
Beryllium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Calcium	< 0.040	< 0.040	< 0.040	< 0.080	0.398	0.145	1624	1204	1174	2262	2550	1642	4.82	3.59	6.32	14.32	13.44	11.88
Cadmium	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Chromium	< 0.005	< 0.005	< 0.005	< 0.010	< 0.010	< 0.010	0.035	0.033	0.028	0.014	0.018	0.014	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Copper	0.005	< 0.004	< 0.004	1.129	1.587	1.872	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Iron	< 0.050	< 0.050	< 0.050	< 0.100	< 0.100	< 0.100	23.16	15.09	14.47	1.617	2.398	1.918	0.678	0.404	0.824	0.623	0.644	0.598
Potassium	3.826	3.206	1.61	1.333	1.615	2.240	6.90	5.017	9.232	2.695	2.671	2.68	7.133	3.205	4.137	4.535	7.578	4.094
Magnesium	< 0.020	< 0.020	< 0.020	< 0.040	< 0.040	< 0.040	4.447	4.058	3.178	8.993	11.98	8.814	960	716	1069	1229	1430	1380
Manganese	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	0.252	0.178	0.658	0.026	0.040	0.030	0.067	0.063	0.076	< 0.002	< 0.002	0.008
Sodium	1.106	0.363	0.143	< 0.120	< 0.120	< 0.120	12.73	8.283	8.347	26.96	34.66	25.72	248	228	236	659	654	530
Nickel	< 0.004	0.005	< 0.004	< 0.008	< 0.008	< 0.008	0.043	0.030	0.030	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Lead	< 0.007	< 0.007	< 0.007	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014
Selenium	< 0.010	0.011	< 0.010	0.022	< 0.020	0.027	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.021	0.023	< 0.020	< 0.020	< 0.020	0.022
Antimony	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.022	< 0.020	< 0.020	0.027	< 0.020
Silicon	0.506	0.047	0.402	8.907	0.549	36.31	40.62	28.99	33.37	6.652	8.438	6.501	0.297	0.068	0.516	0.552	0.723	0.073
Strontium	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	0.726	0.479	0.480	0.844	1.080	0.683	0.014	0.011	0.017	0.049	0.046	0.041
Thorium	< 0.130	< 0.130	< 0.130	< 0.260	0.340	< 0.260	< 0.260	< 0.260	< 0.260	0.448	0.516	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260
Titanium	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Thallium	< 0.008	< 0.008	< 0.008	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
Uranium	< 0.050	0.062	0.080	< 0.100	0.138	< 0.100	< 0.100	< 0.100	< 0.100	0.295	0.336	0.165	< 0.100	< 0.100	0.105	< 0.100	< 0.100	< 0.100
Vanadium	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	0.042	0.032	0.039	< 0.020	0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.040	< 0.020
Zinc	< 0.005	0.009	< 0.005	0.013	0.023	0.025	0.804	0.200	0.260	0.040	0.031	0.038	107.9	125.9	96.7	0.1	2.3	35.3
Zirconium	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.031	0.061	0.071
Mercury[a]	0.426	0.130	0.139	3929	4230	4611	3.950	3.890	9.750	77.6	91.0	72.0	42.1	23.9	121.5	3.03	12..6	8.9

[a]Results in micrograms per liter.

Table A.14. Leaching results (milligrams per liter) obtained at 3 months – pH 5

	Blk-D	Blk-E	Blk-F	HG-D	HG-E	HG-F	Lanl-22	Lanl-23	Lanl-24	Fern-31	Fern-32	Fern-33	OR-34	OR-35	OR-	ID-	ID-18A	ID-19
Weight(g)				11.00	10.00	13.00	9.74	14.65	11.90	23.17	18.48	14.75	11.10	10.45	7.66	4.78	4.63	5.28
Initial pH	4.63	4.89	4.89	4.63	4.63	4.63	4.89	4.89	4.89	4.89	4.89	4.89	4.89	4.89	4.89	4.89	4.89	4.63
Final pH	4.65	4.91	4.91	4.79	4.80	4.79	5.17	5.23	5.19	7.63	7.24	7.26	9.10	6.45	6.36	6.71	9.91	6.14
Silver	< 0.003	< 0.003	< 0.003	< 0.005	< 0.005	< 0.005	0.024	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Aluminum	< 0.030	< 0.030	< 0.030	0.207	0.154	0.253	0.083	0.121	0.279	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060
Arsenic	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	0.056	< 0.020	< 0.020	0.026	< 0.020	0.023	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Boron	< 0.020	< 0.020	< 0.020	< 0.040	< 0.040	0.194	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	0.283	0.226
Barium	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	0.056	0.044	0.031	0.036	0.030	0.026	0.004	0.004	0.003	0.022	0.028	0.028
Beryllium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Calcium	< 0.040	< 0.040	< 0.040	< 0.080	0.105	0.136	927	1373	1107	2627	2146	1848	4.591	5.07	3.765	11.24	12.60	14.35
Cadmium	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	0.004	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Chromium	< 0.005	< 0.005	< 0.005	< 0.010	< 0.010	< 0.010	0.027	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Copper	< 0.004	< 0.004	< 0.004	3.622	3.229	4.210	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Iron	< 0.050	< 0.050	< 0.050	< 0.100	< 0.100	< 0.100	6.093	5.440	6.204	< 0.100	< 0.100	< 0.100	0.142	0.126	< 0.100	< 0.100	< 0.100	0.122
Potassium	5.476	2.961	4.771	2.602	6.235	2.500	6.631	8.300	7.56	4.487	5.338	3.888	3.542	2.87	2.73	3.028	5.064	4.62
Magnesium	< 0.020	< 0.020	< 0.020	< 0.040	< 0.040	< 0.040	2.280	20.16	2.204	0.660	1.853	1.23	499	466	449	400	424	747
Manganese	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	0.122	0.243	0.135	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.003	< 0.002	< 0.002	< 0.002
Sodium	1072	1003	1003	1413	1435	1428	1297	1318	1318	1337	1327	1284	1458	1483	1451	1536	1609	1673
Nickel	< 0.004	< 0.004	< 0.004	< 0.008	< 0.008	< 0.008	0.031	0.026	0.020	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Lead	< 0.007	< 0.007	< 0.007	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014
Selenium	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Antimony	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	0.055	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Silicon	0.504	0.053	0.043	0.610	1.804	3.528	23.70	29.71	25.21	8.536	6.992	5.731	0.427	0.410	0.431	0.159	0.103	0.763
Strontium	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	1.013	0.576	0.439	1.166	0.889	0.683	0.014	0.015	0.010	0.045	0.052	0.057
Thorium	< 0.130	< 0.130	< 0.130	< 0.260	< 0.260	< 0.260	4.157	< 0.260	< 0.260	0.314	0.269	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260
Titanium	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Thallium	< 0.008	< 0.008	< 0.008	< 0.016	< 0.016	< 0.016	0.059	< 0.016	0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
Uranium	< 0.050	< 0.050	< 0.050	< 0.100	< 0.100	< 0.100	1.504	0.106	< 0.100	0.304	0.285	0.274	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Vanadium	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	0.120	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Zinc	0.008	< 0.005	0.008	0.020	0.014	0.034	35.08	73.91	0.242	< 0.010	0.013	< 0.010	0.44	38.90	60.91	45.71	0.16	63.34
Zirconium	0.015	0.019	0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.038	0.034	0.044
Mercury[a]	0.225	0.126	0.139	12000	4865	6371	10.6	9.61	11.1	183	227	142	7.48	60.3	570	56.0	6.7	800

[a]Results in micrograms per liter.

Table A.15. Leaching results (milligrams per liter) obtained at 3 months — pH 7

	Blk-C	Blk-B	Blk-A	HG-B	HG-A	HG-C	Lanl-31	Lanl-35	Lanl-36	Fern-43	Fern-44	Fern-45	OR-43	OR-44	OR-45	ID-25	ID-25A	ID-29
Weight(g)				6.00	13.00	13.00	13.82	18.09	16.22	13.60	20.89	26.59	7.56	8.14	11.27	6.28	4.13	12.13
Initial pH	7.55	7.55	8.06	7.55	7.55	7.55	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06
Final pH	5.57	5.42	5.62	7.41	7.01	7.74	4.82	6.04	6.01	7.04	7.32	7.50	10.68	10.72	10.68	10.60	11.01	10.61
Silver	< 0.003	< 0.003	< 0.003	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Aluminum	< 0.030	< 0.030	< 0.030	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	0.118	0.099	< 0.060
Arsenic	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.021	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Boron	< 0.020	< 0.020	< 0.020	0.224	0.205	0.248	0.128	0.148	0.141	0.154	0.173	0.206	0.276	0.301	0.297	1.901	0.788	0.995
Barium	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	0.023	0.030	0.026	0.020	0.032	0.039	< 0.002	< 0.002	< 0.002	0.020	0.017	0.014
Beryllium	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Calcium	< 0.040	< 0.040	0.049	< 0.080	< 0.080	< 0.080	1,160	1583	1401	1369	2447	3087	1.280	0.795	1.314	4.399	2.386	5.751
Cadmium	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Chromium	< 0.005	< 0.005	< 0.005	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Copper	0.015	0.124	0.138	0.762	0.916	0.626	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	0.010	0.009	< 0.008	< 0.008	< 0.008	< 0.008
Iron	< 0.050	< 0.050	< 0.050	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Potassium	2.082	1.974	3.895	4.575	1.913	1.990	7.919	5.21	5.232	2.608	4.013	7.215	22.96	3.769	2.651	7.498	19.20	8.493
Magnesium	< 0.020	< 0.020	< 0.020	< 0.040	< 0.040	< 0.040	1.090	1.528	1.333	0.434	0.654	0.774	18.37	8.80	14.47	17.06	3.58	29.06
Manganese	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	0.011	0.012	0.010	< 0.002	< 0.002	0.003	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Sodium	< 0.060	< 0.060	< 0.060	0.159	< 0.120	0.537	8.009	10.53	9.424	24.82	39.50	47.79	144	168	209	833	547	1502
Nickel	< 0.004	< 0.004	< 0.004	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Lead	< 0.007	< 0.007	< 0.007	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014
Selenium	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Antimony	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Silicon	0.358	0.337	0.441	0.747	0.617	0.664	18.51	28.73	23.95	5.407	8.091	10.21	0.358	0.094	0.528	0.929	0.527	0.481
Strontium	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	0.459	0.657	0.569	0.542	1.051	1.375	0.003	0.002	0.003	0.021	0.017	0.042
Thorium	< 0.130	< 0.130	< 0.130	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	0.350	0.302	0.494	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260
Titanium	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Thallium	< 0.008	< 0.008	< 0.008	< 0.016	< 0.016	< 0.016	0.024	< 0.016	< 0.016	0.016	< 0.016	0.018	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
Uranium	0.072	< 0.050	< 0.050	< 0.100	< 0.100	< 0.100	0.186	0.125	0.157	0.256	0.279	0.372	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Vanadium	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	0.024	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.021	0.038	< 0.020
Zinc	< 0.005	< 0.005	0.018	0.013	0.021	0.016	0.018	0.062	0.070	0.012	0.018	0.012	0.145	0.153	0.116	0.117	0.129	0.076
Zirconium	< 0.010	0.011	0.011	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.080	0.032	0.062
Mercury[a]	0.124	0.343	0.110	2904	2981	5114	17.9	26.3	18.8	1.4	36.9	285	10.4	7.4	3.95	8.99	10.70	8.46

[a]Results in micrograms per liter.

Table A.16. Leaching results (milligrams per liter) obtained at 3 months – pH 12.5

	Blk-J	Blk-L	Blk-K	HG-20	HG-15	HG-16	Lanl-13	Lanl-14	Lanl-15	Fern-22	Fern-23	Fern-24	OR-31	OR-32	OR-33	ID-16	ID-16A	ID-20
Weight(g)				6.37	7.40	4.81	19.71	12.53	14.74	21.64	17.61	15.59	10.56	12.30	13.94	5.75	6.59	4.92
Initial pH	12.68	12.48	12.48	12.68	12.68	12.68	12.48	12.48	12.48	12.48	12.48	12.48	12.48	12.48	12.48	12.68	12.68	12.48
Final pH	12.72	12.70	12.71	12.77	12.81	12.80	8.75	10.82	9.19	9.62	8.95	9.13	12.06	12.08	11.94	12.56	12.63	12.74
Silver	< 0.003	< 0.003	< 0.003	< 0.005	< 0.005	< 0.005	0.008	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.009	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Aluminum	< 0.030	< 0.030	< 0.030	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060
Arsenic	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	0.028	< 0.020	< 0.020	0.033	0.023	0.025	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Boron	< 0.020	< 0.020	< 0.020	0.188	0.198	0.188	0.148	0.127	0.116	0.207	0.208	0.196	0.410	0.472	0.522	1.754	1.526	1.398
Barium	0.012	0.015	0.016	0.013	0.011	0.012	0.117	0.079	0.093	0.052	0.049	0.040	0.015	0.014	0.016	0.050	0.054	0.058
Beryllium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Calcium	1226	1189	1225	1033	943	934	2436	1696	1967	4738	4098	3820	455	606	623	867	1023	1255
Cadmium	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	0.004	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Chromium	0.018	0.024	0.028	0.019	0.014	0.017	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Copper	< 0.004	< 0.004	< 0.004	0.172	0.237	0.094	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Iron	< 0.050	< 0.050	< 0.050	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Potassium	10.25	5.162	3.585	3.593	2.525	2.723	8.836	6.558	6.979	6.319	12.86	4.017	2.63	3.834	7.190	4.613	5.087	3.460
Magnesium	< 0.020	< 0.020	< 0.020	< 0.040	< 0.040	< 0.040	1.041	0.099	0.423	0.794	0.943	0.695	0.064	0.052	0.122	< 0.040	< 0.040	0.244
Manganese	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	< 0.002	0.006	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Sodium	0.345	0.364	0.384	0.430	0.408	0.406	14.72	8.582	10.15	42.15	36.04	30.35	196	240	261	645	576	585
Nickel	< 0.004	< 0.004	< 0.004	< 0.008	< 0.008	< 0.008	0.017	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Lead	< 0.007	< 0.007	< 0.007	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014
Selenium	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Antimony	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Silicon	0.632	0.095	0.114	0.874	0.863	0.599	34.85	4.292	22.41	4.301	6.955	4.633	0.507	0.538	0.701	0.553	1.038	0.603
Strontium	0.604	0.713	0.744	0.685	0.590	0.607	1.708	1.269	1.415	2.497	2.181	2.001	0.716	0.722	0.790	0.564	0.624	0.777
Thorium	< 0.130	< 0.130	0.256	0.272	< 0.260	< 0.260	< 0.260	< 0.260	0.298	0.791	0.508	0.588	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260
Titanium	< 0.001	< 0.001	0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Thallium	< 0.008	< 0.008	< 0.008	< 0.016	< 0.016	< 0.016	0.032	< 0.016	0.021	< 0.016	0.043	0.026	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
Uranium	0.116	0.098	0.226	0.171	0.127	0.143	0.249	0.145	0.259	0.546	0.453	0.463	< 0.100	0.120	0.117	< 0.100	< 0.100	< 0.100
Vanadium	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	0.036	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.021
Zinc	< 0.005	< 0.005	0.010	0.016	0.012	0.019	0.200	0.042	0.021	< 0.010	< 0.010	< 0.010	0.946	1.044	0.918	1.931	2.299	2.566
Zirconium	< 0.010	< 0.010	< 0.010	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.024
Mercury[a]	0.179	0.137	0.131	11192	12057	10528	12.50	11.20	11.00	663	20.2	108	17.2	27.8	27.5	80.0	34.0	217.0

[a]Results in micrograms per liter.

APPENDIX B

LEACHING RESULTS SORTED BY SAMPLE TYPE

Table B.1. Leaching results (milligrams per liter) for the blank series

	pH 3				pH 5				pH 7				pH 12.5			
Time	2w	1m	2m	3m	2w	1m	2m	3m	2w	1m	2m	3m	2w	1m	2m	3m
Initial pH	2.96	2.96	2.98	2.98	5.00	4.63	4.80	4.80	7.87	7.55	7.72	7.72	12.53	12.53	12.55	12.55
Final pH	2.87	2.88	2.85	2.82	5.06	4.65	4.92	4.82	6.86	5.63	6.44	5.54	12.77	12.72	12.74	12.71
Silver	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
Aluminum	0.076	0.039	0.060	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	0.073	0.048	0.075	< 0.030	0.078	0.050	0.089	< 0.030
Arsenic	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.012	< 0.010
Boron	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Barium	< 0.001	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.016	0.012	0.015	0.014
Beryllium	0.002	0.001	0.002	< 0.001	0.002	0.001	0.002	< 0.001	0.002	0.001	0.002	0.001	0.002	0.001	0.002	< 0.001
Calcium	0.040	0.044	0.083	< 0.040	< 0.040	< 0.040	0.054	< 0.040	0.193	0.202	< 0.040	0.043	1025	1182	973	1213
Cadmium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Chromium	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.031	0.013	0.021	0.023
Copper	< 0.004	0.004	< 0.004	0.004	< 0.004	< 0.004	< 0.004	< 0.004	0.008	0.004	< 0.004	0.092	< 0.004	0.011	0.014	< 0.004
Iron	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Potassium	6.94	0.631	5.17	2.88	5.47	1.11	5.66	4.40	4.12	1.10	5.29	2.65	11.49	0.54	8.48	6.33
Magnesium	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.023	< 0.020	< 0.020	< 0.020	< 0.022	< 0.020	< 0.020
Manganese	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Sodium	0.282	0.069	0.068	0.537	1235	1183	1156	1026	0.063	0.088	< 0.060	< 0.060	0.938	0.553	0.743	0.364
Nickel	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Lead	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
Selenium	0.021	0.015	0.027	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.011	< 0.010	0.018	< 0.010	< 0.010	< 0.010	0.010	< 0.010
Antimony	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Silicon	0.534	0.589	0.546	0.318	0.553	0.567	0.518	0.200	0.461	0.493	0.491	0.379	1.121	0.693	0.761	0.280
Strontium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.868	0.727	0.811	0.687
Thorium	< 0.130	< 0.130	< 0.130	< 0.130	< 0.130	< 0.130	< 0.130	< 0.130	< 0.130	< 0.130	< 0.130	< 0.130	< 0.130	< 0.130	< 0.130	0.172
Titanium	0.001	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	0.006	0.005	0.005	0.001
Thallium	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Uranium	0.079	0.053	< 0.051	0.064	0.063	0.062	0.051	< 0.050	0.075	0.055	0.055	0.057	0.085	0.060	0.057	0.147
Vanadium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.010	< 0.010	< 0.010
Zinc	0.010	0.009	0.007	0.006	0.007	0.012	0.007	0.007	0.009	0.010	< 0.005	0.009	0.005	0.008	< 0.005	0.007
Zirconium	< 0.010	< 0.010	< 0.010	< 0.010	0.012	0.012	< 0.010	0.015	< 0.010	< 0.010	< 0.010	0.011	0.010	0.010	< 0.010	< 0.010
Mercury[a]	0.153	0.070	< 0.050	0.232	0.119	0.459	0.107	0.163	0.092	0.07	< 0.050	0.192	0.349	0.140	0.485	0.149

[a]Results are in micrograms per liter.

Table B.2. Leaching results (milligrams per liter) for the mercury standard series

	pH 3				pH 5				pH 7				pH 12.5			
Time	2w	1m	2m	3m	2w	1m	2m	3m	2w	1m	2m	3m	2w	1m	2m	3m
Weight(g)	12.27	8.33	5.29	6.34	15.34	11.00	11.00	11.33	20.89	14.00	9.00	10.67				
Initial pH	2.96	2.96	2.92	2.85	5.00	5.00	4.63	4.63	7.87	7.87	7.55	7.55	12.53	12.53	12.68	12.68
Final pH	2.87	2.58	2.88	2.91	5.02	4.69	4.76	4.79	7.28	6.22	6.95	7.39	12.73	12.27	12.73	12.79
Silver	< 0.005	0.007	< 0.013	0.005	< 0.005	< 0.003	< 0.013	< 0.005	< 0.005	< 0.003	< 0.013	< 0.005	0.011	< 0.003	0.016	< 0.005
Aluminum	0.315	0.367	0.471	0.061	0.225	0.225	0.659	0.205	0.152	0.056	0.464	< 0.060	0.205	0.059	0.495	< 0.060
Arsenic	< 0.020	< 0.010	< 0.050	< 0.020	< 0.020	< 0.010	< 0.050	< 0.020	< 0.020	< 0.010	< 0.050	< 0.020	0.020	0.010	< 0.050	< 0.020
Boron	< 0.040	< 0.020	< 0.100	1.169	< 0.040	< 0.020	< 0.100	0.091	< 0.040	< 0.020	< 0.100	0.225	< 0.040	< 0.020	< 0.100	0.191
Barium	< 0.002	< 0.001	< 0.005	0.002	< 0.002	0.001	< 0.005	< 0.002	< 0.002	< 0.001	< 0.005	< 0.002	0.021	0.014	0.012	0.012
Beryllium	0.002	0.001	0.011	< 0.001	0.003	0.001	0.012	< 0.001	0.003	0.001	0.012	< 0.001	0.003	0.001	0.012	< 0.001
Calcium	0.121	< 0.041	0.266	0.208	0.268	0.310	0.223	0.107	< 0.080	0.054	< 0.200	< 0.080	1326	1235	970	970
Cadmium	< 0.002	< 0.001	< 0.005	< 0.002	< 0.002	< 0.001	< 0.005	< 0.002	< 0.002	< 0.001	< 0.005	< 0.002	< 0.002	< 0.001	< 0.005	< 0.002
Chromium	< 0.010	< 0.005	< 0.025	< 0.010	< 0.010	< 0.005	< 0.025	< 0.010	< 0.010	< 0.005	< 0.025	< 0.010	0.039	0.016	< 0.025	0.016
Copper	3.07	2.71	1.15	1.53	3.78	3.33	3.61	3.69	0.450	0.709	0.552	0.768	0.800	0.380	0.235	0.168
Iron	< 0.100	< 0.050	< 0.250	< 0.100	< 0.100	< 0.050	< 0.250	< 0.100	< 0.100	< 0.050	< 0.250	< 0.100	< 0.100	< 0.050	< 0.250	< 0.100
Potassium	3.59	3.04	4.59	1.73	6.11	1.52	7.18	3.78	4.75	1.10	7.63	2.83	7.15	1.13	3.94	2.95
Magnesium	< 0.040	< 0.020	< 0.100	< 0.040	< 0.040	< 0.020	< 0.100	< 0.040	< 0.040	< 0.020	< 0.100	< 0.040	< 0.040	< 0.020	< 0.100	< 0.040
Manganese	< 0.002	< 0.001	< 0.006	< 0.002	< 0.002	< 0.001	< 0.006	< 0.002	< 0.002	< 0.001	< 0.006	< 0.002	< 0.002	< 0.001	< 0.006	< 0.002
Sodium	0.213	0.406	0.301	< 0.120	1396	1210	1482	1425	0.232	0.096	0.414	0.272	1.336	0.624	0.516	0.415
Nickel	< 0.008	< 0.004	< 0.020	< 0.008	< 0.008	< 0.004	< 0.020	< 0.008	< 0.008	< 0.004	< 0.020	< 0.008	< 0.008	< 0.004	< 0.020	< 0.008
Lead	< 0.014	< 0.007	< 0.035	< 0.014	< 0.014	< 0.007	< 0.035	< 0.014	< 0.014	< 0.007	< 0.035	< 0.014	< 0.014	< 0.007	< 0.035	< 0.014
Selenium	0.036	0.018	0.092	0.023	< 0.020	< 0.010	0.052	< 0.020	0.024	0.011	0.073	< 0.020	< 0.020	< 0.010	0.083	< 0.020
Antimony	< 0.020	< 0.010	< 0.050	< 0.020	< 0.020	< 0.010	< 0.050	< 0.020	< 0.020	< 0.010	< 0.050	< 0.020	< 0.020	< 0.010	< 0.050	< 0.020
Silicon	0.599	0.596	0.459	15.26	0.559	0.573	0.433	1.98	0.523	0.474	0.442	0.676	1.149	0.909	0.686	0.779
Strontium	< 0.002	< 0.001	< 0.005	< 0.002	< 0.002	< 0.001	< 0.005	< 0.002	< 0.002	< 0.001	< 0.005	< 0.002	1.088	0.819	0.499	0.627
Thorium	< 0.260	< 0.130	< 0.650	0.287	< 0.260	< 0.130	< 0.650	< 0.260	< 0.260	< 0.130	< 0.650	< 0.260	< 0.260	< 0.130	< 0.650	0.264
Titanium	< 0.002	< 0.001	< 0.005	< 0.002	< 0.002	< 0.001	< 0.005	< 0.002	< 0.002	< 0.001	< 0.005	< 0.002	0.007	0.005	0.006	< 0.002
Thallium	< 0.016	< 0.008	< 0.040	< 0.016	< 0.016	< 0.008	< 0.040	< 0.016	< 0.016	< 0.008	< 0.040	< 0.016	< 0.016	< 0.008	< 0.040	< 0.016
Uranium	< 0.100	0.075	< 0.250	0.113	< 0.100	0.059	< 0.250	< 0.100	< 0.100	0.063	< 0.250	< 0.100	0.101	0.069	< 0.250	0.147
Vanadium	< 0.020	< 0.010	< 0.050	< 0.020	< 0.020	< 0.010	< 0.050	< 0.020	< 0.020	< 0.010	< 0.050	< 0.020	< 0.020	< 0.010	< 0.050	< 0.020
Zinc	0.013	0.011	< 0.025	0.020	0.021	0.012	< 0.025	0.023	< 0.010	0.010	< 0.025	0.017	0.014	0.006	< 0.025	0.016
Zirconium	< 0.020	< 0.010	< 0.050	< 0.020	< 0.020	0.011	< 0.050	< 0.020	< 0.020	< 0.010	< 0.050	< 0.020	< 0.020	< 0.010	< 0.050	< 0.020
Mercury[a]	723	1337	537	4257	1368	3986	3111	7745	641	2739	1371	3666	5231	6594	4534	11259

[a]Results are in micrograms per liter.

Table B.3. Leaching results (milligrams per liter) for the LANL series

	pH 3				pH 5				pH 7				pH 12.5			
Time	2w	1m	2m	3m	2w	1m	2m	3m	2w	1m	2m	3m	2w	1m	2m	3m
Weight(g)	7.97	12.18	13.79	14.79	11.76	11.03	12.72	12.10	8.28	11.56	19.29	16.04	9.08	9.09	13.34	15.66
Initial pH	2.96	2.85	3.05	3.05	5.00	4.63	4.89	4.89	7.87	7.55	8.06	8.06	12.53	12.68	12.48	12.48
Final pH	3.37	3.33	3.76	3.83	5.06	4.61	5.06	5.20	5.83	6.08	7.07	5.62	12.60	12.20	10.66	9.59
Silver	< 0.005	< 0.013	< 0.013	< 0.005	< 0.005	< 0.013	< 0.013	0.011	< 0.005	< 0.013	< 0.013	< 0.005	< 0.005	0.013	< 0.013	0.006
Aluminum	2.00	4.58	6.92	6.65	< 0.060	0.647	0.757	0.161	0.126	0.207	0.371	< 0.060	0.132	0.236	0.543	< 0.060
Arsenic	< 0.020	< 0.050	< 0.050	< 0.020	< 0.020	< 0.050	< 0.050	0.032	< 0.020	< 0.050	< 0.050	< 0.020	< 0.020	< 0.050	< 0.050	0.023
Boron	< 0.040	< 0.100	< 0.100	0.153	< 0.040	< 0.100	< 0.100	< 0.040	< 0.040	< 0.100	< 0.100	0.139	< 0.040	< 0.100	< 0.100	0.130
Barium	0.011	0.029	0.039	0.035	0.021	0.029	0.035	0.044	0.012	0.023	0.034	0.026	0.037	0.062	0.087	0.096
Beryllium	0.003	0.008	0.014	< 0.001	0.003	0.009	0.013	< 0.001	0.003	0.009	0.009	< 0.001	0.003	0.008	0.012	0.002
Calcium	677	1063	1249	1334	977	986	1155	1136	645	926	1481	1382	1653	1637	1610	2033
Cadmium	< 0.002	< 0.005	< 0.005	< 0.002	< 0.002	< 0.005	< 0.005	0.003	< 0.002	< 0.005	< 0.005	< 0.002	< 0.002	< 0.005	< 0.005	0.003
Chromium	0.016	0.033	0.029	0.032	< 0.010	< 0.025	< 0.025	0.016	< 0.010	< 0.025	< 0.025	< 0.010	0.013	< 0.025	< 0.025	< 0.010
Copper	< 0.008	< 0.020	< 0.020	< 0.008	< 0.008	< 0.020	< 0.020	< 0.008	< 0.008	< 0.020	0.022	< 0.008	< 0.008	0.040	0.037	< 0.008
Iron	7.69	12.90	19.80	17.57	3.48	7.67	5.56	5.91	< 0.100	< 0.250	< 0.250	< 0.100	< 0.100	< 0.250	< 0.250	< 0.100
Potassium	6.85	3.90	9.80	7.05	9.43	4.38	11.50	7.50	7.30	3.14	9.10	6.12	6.16	3.92	9.87	7.46
Magnesium	1.36	2.53	3.22	3.89	1.46	2.08	2.49	8.22	0.57	0.82	1.356	1.32	0.042	< 0.100	0.112	0.521
Manganese	0.087	0.139	0.295	0.363	0.089	0.142	0.144	0.167	0.004	0.007	0.087	0.011	< 0.002	0.007	< 0.006	0.004
Sodium	4.71	7.99	10.22	9.79	1379	1515	1341	1311	4.50	7.22	12.12	9.32	6.06	7.08	9.38	11.15
Nickel	0.017	0.023	0.027	0.034	0.015	< 0.020	0.021	0.025	< 0.008	< 0.020	< 0.020	< 0.008	< 0.008	< 0.020	< 0.020	0.011
Lead	< 0.014	< 0.035	< 0.035	< 0.014	< 0.014	< 0.035	< 0.035	< 0.014	< 0.014	< 0.035	< 0.035	< 0.014	< 0.014	< 0.035	< 0.035	< 0.014
Selenium	< 0.020	< 0.050	0.078	< 0.020	< 0.020	< 0.050	< 0.050	< 0.020	< 0.020	< 0.050	0.055	< 0.020	< 0.020	< 0.050	0.073	< 0.020
Antimony	< 0.020	< 0.050	< 0.050	< 0.020	< 0.020	< 0.050	< 0.050	0.032	< 0.020	< 0.050	< 0.050	< 0.020	< 0.020	< 0.050	< 0.050	< 0.020
Silicon	4.78	17.16	29.04	34.33	10.54	16.84	23.26	26.20	8.78	14.81	22.04	23.73	1.16	1.45	4.59	20.52
Strontium	0.244	0.346	0.391	0.562	0.361	0.287	0.320	0.676	0.227	0.282	0.500	0.562	1.17	1.18	1.09	1.46
Thorium	< 0.260	< 0.650	< 0.650	< 0.260	< 0.260	< 0.650	< 0.650	1.559	< 0.260	< 0.650	< 0.650	< 0.260	< 0.260	< 0.650	< 0.650	0.273
Titanium	0.004	0.007	0.007	< 0.002	0.006	0.006	0.006	< 0.002	0.004	0.005	0.007	< 0.002	0.009	0.010	0.009	< 0.002
Thallium	< 0.016	< 0.040	< 0.040	0.016	< 0.016	< 0.040	< 0.040	0.030	< 0.016	< 0.040	< 0.040	0.019	< 0.016	< 0.040	< 0.040	0.023
Uranium	< 0.100	< 0.250	< 0.250	< 0.100	< 0.100	< 0.250	< 0.250	0.570	< 0.100	< 0.250	< 0.250	0.156	< 0.100	< 0.250	< 0.250	0.218
Vanadium	0.026	< 0.050	< 0.050	0.038	0.025	< 0.050	< 0.050	0.053	< 0.020	< 0.050	< 0.050	0.021	< 0.020	< 0.050	< 0.050	0.025
Zinc	0.042	0.133	0.169	0.421	0.06	0.47	1.302	36.41	0.010	< 0.025	0.092	0.050	< 0.010	< 0.025	< 0.025	0.088
Zirconium	0.022	< 0.050	< 0.050	< 0.020	0.031	0.052	< 0.050	< 0.020	0.024	< 0.050	< 0.050	< 0.020	0.032	< 0.050	< 0.050	< 0.020
Mercury[a]	8.55	41.3	< 0.050	5.86	38.16	54.0	20.38	10.44	8.20	7.44	52	21.0	8.62	5.86	12.83	11.57

[a]Results are in micrograms per liter.

Table B.4. Leaching results (milligrams per liter) for the FERN series

Time	pH 3				pH 5				pH 7				pH 12.5			
	2w	1m	2m	3m	2w	1m	2m	3m	2w	1m	2m	3m	2w	1m	2m	3m
Weight(g)	8.66	15.36	15.01	16.11	10.47	27.78	19.33	18.80	10.70	22.07	20.40	20.36	7.72	17.53	20.94	18.28
Initial pH	2.96	2.85	3.05	3.05	5.00	4.63	4.89	4.89	7.87	7.55	8.06	8.06	12.53	12.68	12.48	12.48
Final pH	3.41	4.13	4.65	4.71	5.04	5.98	7.43	7.38	9.08	9.02	9.01	7.29	12.58	12.39	10.27	9.23
Silver	< 0.005	< 0.005	< 0.013	< 0.005	< 0.005	< 0.005	< 0.013	< 0.005	< 0.005	0.013	0.016	< 0.005	< 0.005	0.013	0.027	< 0.005
Aluminum	0.310	0.220	0.200	0.145	< 0.060	< 0.060	< 0.150	< 0.060	0.201	0.160	0.189	< 0.060	0.170	0.161	0.281	< 0.060
Arsenic	< 0.020	< 0.020	< 0.050	0.021	0.022	0.026	< 0.050	0.023	< 0.020	< 0.020	0.056	0.020	0.022	0.021	< 0.050	0.027
Boron	< 0.040	< 0.040	< 0.100	0.158	< 0.040	< 0.040	< 0.100	< 0.040	< 0.040	< 0.040	< 0.100	0.178	< 0.040	< 0.040	< 0.100	0.203
Barium	0.006	0.024	0.027	0.024	0.011	0.055	0.037	0.031	0.008	0.022	0.033	0.030	0.022	0.036	0.039	0.047
Beryllium	0.003	0.003	0.003	< 0.001	0.004	0.003	< 0.003	< 0.001	0.004	0.003	0.004	< 0.001	0.004	0.003	0.004	< 0.001
Calcium	1261	2225	2061	2151	1596	3313	2344	2207	1547	3373	2876	2301	2018	5070	4614	4219
Cadmium	< 0.002	< 0.002	< 0.005	< 0.002	< 0.002	< 0.002	< 0.005	< 0.002	< 0.002	< 0.002	< 0.005	< 0.002	< 0.002	< 0.002	< 0.005	< 0.002
Chromium	< 0.010	0.019	< 0.025	0.015	< 0.010	< 0.010	< 0.025	< 0.010	< 0.010	< 0.010	< 0.025	< 0.010	0.010	< 0.010	0.033	< 0.010
Copper	0.012	< 0.008	0.025	< 0.008	0.014	0.009	0.030	< 0.008	0.012	0.049	0.054	< 0.008	0.027	0.057	0.096	< 0.008
Iron	1.51	2.35	1.62	1.98	1.863	0.980	< 0.250	< 0.100	< 0.100	< 0.100	< 0.250	< 0.100	< 0.100	< 0.100	< 0.250	< 0.100
Potassium	7.48	3.28	6.94	2.68	4.56	5.94	9.66	4.57	4.38	4.69	9.64	4.61	6.15	4.54	14.40	7.73
Magnesium	5.23	9.59	9.30	9.93	6.73	8.28	3.12	1.25	0.22	0.56	0.556	0.621	0.051	0.322	0.850	0.811
Manganese	0.024	0.043	0.029	0.032	0.022	0.018	0.024	< 0.002	< 0.002	0.005	< 0.006	< 0.003	< 0.002	0.005	< 0.006	< 0.002
Sodium	17.42	26.48	25.58	29.11	1483	1382	1470	1316	24.2	44.2	40.0	37.37	16.6	35.1	42.7	36.18
Nickel	< 0.008	0.008	< 0.020	< 0.008	< 0.008	< 0.008	< 0.020	< 0.008	< 0.008	0.030	< 0.022	< 0.008	< 0.008	0.024	0.032	< 0.008
Lead	< 0.014	< 0.014	< 0.035	< 0.014	< 0.014	< 0.014	< 0.035	< 0.014	< 0.014	< 0.014	< 0.035	< 0.014	< 0.014	< 0.014	< 0.035	< 0.014
Selenium	0.024	< 0.020	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.020
Antimony	< 0.020	< 0.020	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.020	< 0.020	0.057	< 0.050	< 0.020	< 0.020	0.047	0.054	< 0.020
Silicon	3.22	5.99	7.02	7.20	3.13	11.19	8.40	7.09	4.45	5.71	8.89	7.90	1.11	2.33	4.46	5.30
Strontium	0.431	0.874	0.615	0.869	0.591	1.531	0.784	0.913	0.564	1.355	0.920	0.989	1.26	2.69	2.08	2.23
Thorium	< 0.260	< 0.260	< 0.650	0.408	< 0.260	< 0.260	< 0.650	0.281	< 0.260	< 0.260	< 0.650	0.382	< 0.260	< 0.260	< 0.650	0.629
Titanium	0.007	0.012	0.014	< 0.002	0.009	0.017	0.014	< 0.002	0.008	0.013	0.014	< 0.002	0.011	0.024	0.019	< 0.002
Thallium	< 0.016	< 0.016	< 0.040	< 0.016	< 0.016	< 0.016	0.049	< 0.016	< 0.016	< 0.016	0.114	0.017	< 0.016	< 0.016	0.127	0.028
Uranium	< 0.100	0.113	0.337	0.265	< 0.100	0.121	0.277	0.288	< 0.100	< 0.100	< 0.250	0.303	< 0.100	< 0.100	< 0.250	0.488
Vanadium	0.020	0.027	< 0.050	0.020	< 0.020	< 0.020	< 0.050	< 0.020	< 0.020	0.172	0.092	< 0.020	< 0.020	0.139	0.193	< 0.020
Zinc	0.023	0.012	0.260	0.036	0.01	< 0.01	0.060	0.011	< 0.010	< 0.010	0.046	0.014	< 0.010	< 0.010	0.038	< 0.010
Zirconium	0.026	0.042	< 0.050	< 0.020	0.025	0.040	0.056	< 0.020	0.026	0.220	0.082	< 0.020	< 0.020	0.154	0.204	< 0.020
Mercury[a]	12.33	4.47	5.03	80.2	10.07	28.3	125	184	15.7	73.0	200	107.8	15.1	42.0	1223	264

[a]Results are in micrograms per liter.

Table B.5. Leaching results (milligrams per liter) for the OR series

	pH 3				pH 5				pH 7				pH 12.5			
Time	2w	1m	2m	3m	2w	1m	2m	3m	2w	1m	2m	3m	2w	1m	2m	3m
Weight(g)	24.25	4.66	11.39	9.55	30.68	8.76	8.47	9.74	17.60	5.46	8.10	8.99	16.32	6.64	8.32	12.27
Initial pH	2.96	2.85	3.05	3.05	5.00	4.63	4.89	4.89	7.87	7.55	8.06	8.06	12.53	12.53	12.48	12.48
Final pH	5.83	5.20	6.31	6.54	7.59	5.49	6.80	7.30	10.50	10.36	10.71	10.69	12.52	12.22	12.25	12.03
Silver	< 0.005	< 0.013	< 0.013	< 0.005	< 0.005	< 0.013	< 0.013	< 0.005	< 0.005	< 0.013	< 0.013	< 0.005	< 0.005	< 0.013	< 0.013	0.006
Aluminum	0.203	0.520	0.270	< 0.060	< 0.060	0.219	< 0.150	< 0.060	0.155	0.362	0.271	< 0.060	0.181	0.366	0.232	< 0.060
Arsenic	< 0.020	< 0.050	< 0.050	< 0.020	< 0.020	< 0.050	< 0.050	< 0.020	< 0.020	< 0.050	< 0.050	< 0.020	< 0.020	< 0.050	< 0.050	< 0.020
Boron	0.258	0.188	0.293	0.432	< 0.040	< 0.100	< 0.100	< 0.040	0.116	0.105	0.149	0.291	0.407	0.205	0.280	0.468
Barium	< 0.002	< 0.005	< 0.005	0.004	0.004	< 0.005	< 0.005	0.004	< 0.002	< 0.005	< 0.005	< 0.002	0.016	0.010	0.016	0.015
Beryllium	0.004	0.006	0.007	< 0.001	0.004	0.007	0.008	< 0.001	0.004	0.007	0.009	< 0.001	0.004	0.007	0.007	< 0.001
Calcium	8.36	3.26	5.63	4.91	9.79	5.37	4.70	4.48	3.23	1.29	1.40	1.13	989	568	588	561
Cadmium	< 0.002	< 0.005	< 0.005	< 0.002	< 0.002	< 0.005	< 0.005	< 0.002	< 0.002	< 0.005	< 0.005	< 0.002	< 0.002	< 0.005	< 0.005	< 0.002
Chromium	< 0.010	0.039	< 0.025	< 0.010	< 0.010	< 0.025	< 0.025	< 0.010	< 0.010	< 0.025	< 0.025	< 0.010	0.010	< 0.025	< 0.025	< 0.010
Copper	< 0.008	< 0.020	< 0.020	< 0.008	< 0.008	< 0.020	< 0.020	< 0.008	< 0.008	< 0.020	< 0.020	0.009	0.008	< 0.020	0.021	< 0.008
Iron	1.206	< 0.250	< 0.250	0.636	0.185	< 0.250	< 0.250	0.123	< 0.100	< 0.250	< 0.250	< 0.100	< 0.100	< 0.250	< 0.250	< 0.100
Potassium	6.65	1.81	7.01	4.83	9.25	2.30	7.53	3.05	5.20	1.30	8.78	9.79	7.42	2.32	12.88	4.55
Magnesium	1049	414	817	915	468	509	391	471	52.03	21.82	16.49	13.88	0.051	0.107	< 0.100	0.079
Manganese	0.060	0.061	0.174	0.069	0.005	0.025	0.121	0.003	< 0.002	< 0.006	0.117	< 0.002	< 0.002	< 0.006	0.116	< 0.002
Sodium	483	138	223	238	1954	1589	1477	1464	323	100	155	173	312	123	168	233
Nickel	< 0.008	< 0.020	< 0.020	< 0.008	< 0.008	< 0.020	< 0.020	< 0.008	< 0.008	< 0.020	< 0.020	< 0.008	< 0.008	< 0.020	< 0.020	< 0.008
Lead	< 0.014	< 0.035	< 0.035	< 0.014	< 0.014	< 0.035	< 0.035	< 0.014	< 0.014	< 0.035	< 0.035	< 0.014	< 0.014	< 0.035	< 0.035	< 0.014
Selenium	< 0.020	< 0.050	< 0.050	0.021	< 0.020	< 0.050	< 0.050	< 0.020	< 0.023	< 0.050	< 0.050	< 0.020	< 0.020	< 0.050	< 0.050	< 0.020
Antimony	< 0.020	< 0.050	< 0.050	0.021	< 0.020	< 0.050	< 0.050	< 0.020	< 0.020	< 0.050	< 0.050	< 0.020	< 0.020	< 0.050	< 0.050	< 0.020
Silicon	1.265	1.084	0.692	0.294	0.893	0.794	0.446	0.423	0.748	0.728	0.397	0.326	2.086	1.214	0.966	0.582
Strontium	0.023	0.008	0.016	0.014	0.029	0.014	0.014	0.013	0.008	< 0.005	0.005	0.003	0.796	0.453	0.665	0.742
Thorium	< 0.260	< 0.650	< 0.650	< 0.260	< 0.260	< 0.650	< 0.650	< 0.260	< 0.260	< 0.650	< 0.650	< 0.260	< 0.260	< 0.650	< 0.650	< 0.260
Titanium	< 0.002	< 0.005	< 0.005	< 0.002	< 0.002	< 0.005	< 0.005	< 0.002	< 0.002	< 0.005	< 0.005	< 0.002	0.005	0.005	< 0.005	< 0.002
Thallium	< 0.016	< 0.040	< 0.040	< 0.016	< 0.016	< 0.040	< 0.040	< 0.016	< 0.016	< 0.040	< 0.040	< 0.016	< 0.016	< 0.040	< 0.040	< 0.016
Uranium	< 0.100	< 0.250	< 0.250	0.102	< 0.100	< 0.250	< 0.250	< 0.100	< 0.100	< 0.250	< 0.250	< 0.100	< 0.100	< 0.250	< 0.250	0.112
Vanadium	< 0.020	< 0.050	< 0.050	< 0.020	< 0.020	< 0.050	< 0.050	< 0.020	< 0.020	< 0.050	< 0.050	< 0.020	< 0.020	< 0.050	< 0.054	< 0.020
Zinc	156	276	200	110	75.1	168.2	67.1	33.4	0.116	0.345	0.185	0.138	2.77	1.70	1.59	0.97
Zirconium	0.140	0.246	0.186	< 0.020	0.089	0.168	0.072	< 0.020	< 0.020	< 0.050	< 0.050	< 0.020	< 0.021	< 0.050	< 0.050	< 0.020
Mercury[a]	16.0	76	4.47	62.5	12.9	108.5	34.3	213	4.46	21.5	< 0.050	7.25	52.5	81.2	14.23	24.2

[a]Results are in micrograms per liter.

Table B.6. Leaching results (milligrams per liter) for the ID series

Time	pH 3				pH 5				pH 7				pH 12.5			
	2w	1m	2m	3m	2w	1m	2m	3m	2w	1m	2m	3m	2w	1m	2m	3m
Weight(g)	7.00	5.37	5.38	6.07	7.13	5.65	6.22	4.90	5.41	4.95	15.28	7.51	5.50	5.21	4.77	5.75
Initial pH	2.96	2.85	2.92	2.92	5.00	4.63	4.72	4.80	7.87	7.55	8.06	8.06	12.53	12.53	12.61	12.61
Final pH	4.84	6.02	5.68	8.75	7.32	5.54	7.56	7.59	10.51	10.35	10.64	10.74	12.41	12.19	12.72	12.64
Silver	< 0.005	< 0.005	< 0.013	< 0.005	< 0.005	< 0.005	< 0.013	< 0.005	< 0.005	< 0.005	< 0.013	< 0.005	< 0.005	< 0.005	0.028	< 0.005
Aluminum	0.185	0.107	0.199	< 0.060	< 0.060	< 0.060	< 0.150	< 0.060	0.110	0.080	< 0.150	0.092	0.122	0.063	0.152	< 0.060
Arsenic	< 0.020	< 0.020	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.020
Boron	0.377	0.900	0.688	0.971	< 0.040	0.056	0.166	0.183	0.363	0.719	1.033	1.228	1.46	1.33	1.58	1.56
Barium	0.017	0.026	0.026	0.035	0.017	0.021	0.026	0.026	0.010	0.012	0.015	0.017	0.027	0.034	0.053	0.054
Beryllium	0.003	0.003	0.004	< 0.001	0.003	0.003	0.003	< 0.001	0.003	0.003	0.005	< 0.001	0.003	0.003	0.003	< 0.001
Calcium	13.31	16.49	14.86	13.21	10.47	14.51	15.25	12.73	4.39	4.71	7.68	4.18	709	540	1057	1048
Cadmium	< 0.002	< 0.002	< 0.005	< 0.002	< 0.002	< 0.002	< 0.005	< 0.002	< 0.002	< 0.002	< 0.005	< 0.002	< 0.002	< 0.002	< 0.005	< 0.002
Chromium	< 0.010	< 0.010	< 0.025	< 0.010	< 0.010	< 0.010	< 0.025	< 0.010	< 0.010	< 0.010	< 0.025	< 0.010	< 0.010	< 0.010	< 0.025	< 0.010
Copper	< 0.008	< 0.008	< 0.020	< 0.008	< 0.008	< 0.008	< 0.020	< 0.008	< 0.008	< 0.008	< 0.020	< 0.008	0.037	< 0.008	< 0.020	< 0.008
Iron	0.618	1.282	0.366	0.622	< 0.100	0.258	< 0.250	0.107	< 0.100	< 0.100	< 0.250	< 0.100	< 0.100	< 0.100	< 0.250	< 0.100
Potassium	8.61	4.15	8.42	5.40	12.33	4.224	7.14	4.24	8.24	2.87	9.61	11.7	8.32	4.41	7.49	4.39
Magnesium	766	1229	1083	1346	381	536	587	524	25.6	21.3	35.1	16.6	0.094	0.107	0.117	0.108
Manganese	0.026	0.050	0.152	0.004	0.008	0.008	0.116	< 0.002	< 0.002	< 0.002	0.109	< 0.002	< 0.002	< 0.002	0.112	< 0.002
Sodium	828	683	634	614	1976	1845	2079	1606	646	561	1866	960	640	491	524	602
Nickel	< 0.008	< 0.008	< 0.020	< 0.008	< 0.008	< 0.008	< 0.020	< 0.008	< 0.008	< 0.008	< 0.020	< 0.008	< 0.008	< 0.008	< 0.020	< 0.008
Lead	< 0.014	< 0.014	< 0.035	< 0.014	< 0.014	< 0.014	< 0.035	< 0.014	< 0.014	< 0.014	< 0.035	< 0.014	< 0.014	< 0.014	< 0.035	< 0.014
Selenium	< 0.020	< 0.020	< 0.050	0.021	< 0.020	< 0.020	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.020
Antimony	< 0.020	< 0.020	< 0.050	0.022	< 0.020	< 0.020	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	< 0.020
Silicon	1.417	1.754	1.001	0.449	1.138	1.155	0.745	0.342	0.921	0.873	0.896	0.646	1.132	1.112	1.637	0.732
Strontium	0.061	0.067	0.061	0.045	0.048	0.060	0.070	0.051	0.025	0.026	0.058	0.027	0.701	0.571	0.810	0.655
Thorium	< 0.260	< 0.260	< 0.650	< 0.260	< 0.260	< 0.260	< 0.650	< 0.260	< 0.260	< 0.260	< 0.650	< 0.260	< 0.260	< 0.260	< 0.650	< 0.260
Titanium	0.002	0.002	< 0.005	< 0.002	< 0.002	< 0.002	< 0.005	< 0.002	< 0.002	< 0.002	< 0.005	< 0.002	0.004	0.003	< 0.005	< 0.002
Thallium	< 0.016	< 0.016	< 0.040	< 0.016	< 0.016	< 0.016	< 0.040	< 0.016	< 0.016	< 0.016	< 0.040	< 0.016	< 0.016	< 0.016	< 0.040	< 0.016
Uranium	< 0.100	< 0.100	< 0.250	< 0.100	< 0.100	< 0.100	< 0.250	< 0.100	< 0.100	< 0.100	< 0.250	< 0.100	< 0.100	< 0.100	< 0.250	< 0.100
Vanadium	< 0.020	< 0.020	< 0.050	< 0.027	< 0.020	< 0.020	< 0.050	< 0.020	< 0.020	< 0.020	< 0.050	0.026	< 0.020	0.021	< 0.050	0.020
Zinc	132.9	101.7	212.3	12.6	72.42	70.48	58.02	36.4	0.063	0.112	0.129	0.107	4.03	1.34	2.31	2.27
Zirconium	0.121	0.112	0.189	0.05	0.078	0.084	0.078	0.039	< 0.020	< 0.020	< 0.050	0.058	< 0.020	0.028	0.052	0.021
Mercury[a]	210	192	293	8.2	65.0	133	80.0	288	13.4	10.6	< 0.050	9.38	33.1	70.2	406	110

[a]Results are in micrograms per liter.

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