

40-7102



SHIELDALLOY METALLURGICAL CORPORATION

C. SCOTT EVES
VICE PRESIDENT - ENVIRONMENTAL SERVICES

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October 31, 1994

Mr. Tracy A. Ikenberry, CHP
Senior Research Scientist
Health Physics Department
Pacific Northwest Laboratories
Battelle Boulevard
Richland, Washington 99352

RE: Request for Information for Environmental Assessment
for Shieldalloy Metallurgical Corporation, Newfield, NJ Site

Dear Mr. Ikenberry,

During your visit here on September 13, you requested a copy of the results from the leachability test that was performed on the ferrocolumbium slag from the Newfield operation. Attached is a copy of these results. We will also send you copies of the results of the radon testing that will be done on the slag piles and at the fence line. Please let me know if any additional information is required for you to complete the Environmental Assessment.

Cordially,

C. Scott Eves

CSE:lms

CC: Gary Comfort, USNRC
David R. Smith
Lidia M. Stasiuk

9411090399 941031
PDR ADOCK 04007102
C PDR

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ATTACHMENT A

FERROCOLUMBIUM SLAG LEACHABILITY REPORT

JANUARY 1992

for

SHIELDALLOY METALLURGICAL CORPORATION
Newfield, New Jersey

Prepared by

TELEDYNE ISOTOPES, Inc.
Westwood, New Jersey

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Introduction

Shieldalloy Metallurgical Corporation (SMC) in Newfield, New Jersey is a specialty metals production facility. In one operation, columbium is extracted from ore containing naturally occurring uranium and thorium. During the process uranium, thorium and decay products remain in the form of a hard slag. The slag piles are segregated from other materials based on the origin of the ore (ferro columbium, ferro vanadium) which is related to their residual radioactivity. The material is stored on-site as uncovered piles.

The leachability data of radioactive material in the FeCb slag was requested by the NRC. SMC contracted with Teledyne Isotopes to determine the leachable fraction of radionuclides in slag following American National Standards Institute/American Nuclear Society Standard 16.1 - 1986. "measurement of the leachability of solidified low-level radioactive wastes by a short-term test procedure".

Sample Collection and Analysis

The slag at SMC is generated at a furnace in Building D-111. Various ores are mixed together and placed in a large furnace which is heated by electric arc to temperatures of 2,000° C., for several hours. When the reaction is complete, the furnace is then tilted allowing the slag to cascade down to two successive cast iron pots. The slag cascades from the first pot to the second, the metal or metal and slag remain in the first pot. To obtain samples four six inch by three quarters of an inch metal pipes were constructed and capped on one end. An eight foot length of reinforcing bar was welded to the middle of each pipe. During a "melt" on 7/12/91 each of the four sampling pipes was briefly placed under the liquid metal stream to collect the slag and then allowed to harden. The following day the pipes were packaged and shipped to Teledyne Isotopes' Westwood laboratory.

Because there was some spillage of the molten slag, final slag samples were 13 cm long and 1.9 cm in diameter. This gives a length to diameter ratio of 6.8, slightly greater than the maximum ratio of 5 specified in the standard. This deviation was necessary for several reasons. First, the time frame involved a three month leach test with an additional six week period at the end for preparation and alpha spectroscopy on the final leachate sample. The metal pipes used were readily available on-site. Once the samples were obtained and cooled, it was impossible to cut them to size without fracturing the entire sample. In addition, there were constraints on the leachate container size relative to the sample size which limited the choices available. The deviation in length to diameter ratio should have no effect on the results.

The slag samples were removed from the collection pipes by passing a thin router bit down the length of the pipe on both sides in 1/16" depth increments. The pipe halves were then pried apart, leaving 3 of the 4 slag samples intact. Two samples were chosen for the leachability test. Both the samples and the pipe halves were rinsed with demineralized water, which constitutes the first sample required by the ANSI 16.1 standard. Each of the samples were then suspended in a one liter graduated cylinder using stainless steel wire. The surface area of each sample was 83.9 cm² so, per the ANSI standard, 840 ml of leachate was used. The opening was covered with a polyethylene film and the leachate changed at the specified frequency for the duration of the three month procedure.

During each leachate change out, the temperature and conductivity of the leachate was measured. The temperature ranged from 20°C to 25°C. The electrical conductivity of the deionized water was 0.1 µmho. The leachate was transferred to a one liter plastic bottle and submitted to the radiochemistry lab at Teledyne Isotopes' Westwood, New Jersey laboratory for analysis of uranium and thorium by alpha spectroscopy and Ra-226 by emanation.

The third slag sample was crushed at SMC, to a 100 mesh grade and then returned to Teledyne Isotopes for the same analysis as the leachate. The values obtained from this analysis were used as A_0 , the "initial" activity. This is a departure from the ANSI standard which assumes the activity of the waste stream is known prior to solidification. However, the sample volumes were small compared to the total volume for the "melt" and they were collected in rapid succession. Therefore, the activities between samples should be comparable.

Results

The results of the leachability test are provided in Appendix I. Radium-226, Uranium-234, 235, 238 and thorium-228, 230 and 232 were analyzed in the leachate from two slag samples. A description of each column will be provided in this section. The importance of each of the three parameters, total leachability index, confidence range, and correlation coefficient will be detailed in the discussion section.

Column one specifies the leach interval. The full leach test was performed rather than the 5 day abbreviated test.

Column two shows the leaching time in seconds as required for calculations. The leaching times were, consecutively, 2 hours, 7 hours, 17 hours then four 24 hour periods, 336 hours, 672 hours and 1,032 hours.

The third column gives the mean time of the leaching interval. Mathematically this is derived by Equation 2 in the ANSI standard. It is the midpoint of the cumulative leach time for a given interval. This parameter is used in the calculation of the diffusivity.

The fourth column is the activity leached from the slag sample in the given time interval. The laboratory results in pCi/l are provided in Appendix II. The results in column four have been adjusted from the lab report by 0.84 because the volume of leachate was 840 ml.

The initial activity, in column five, is the result of analysis on a slag sample obtained at the same time as the two slag samples in the leaching study. The laboratory results in Appendix II which are in pCi/g, were multiplied by the weight of the slag sample to give the total activity available for leaching.

Column six is the initial activity divided by the activity leached for each time interval as a percent. The release rate in column seven is the fraction of activity released per second of leach time. This column is important because it normalizes the different leaching times and indicates trends in the release rate of radioactivity.

The diffusivity appearing in column eight is calculated using Equation 1 in the ANSI standard. It is based on the incremental fraction of radioactivity leached. It is a two-dimensional variable because it assumes that the leaching of radioactivity is controlled solely by diffusion, and the sample is a semi-infinite medium, i.e., there is no volume to the sample, only surface area.

The final column lists the leachability index for each time interval, which will be averaged over all intervals for the total leachability index. This is a dimensionless number which must be compared to leachability indices from tests on different materials and isotopes in order to have any relevance.

ANSI/ANS-16.1 Leachability Test for Sheldalloy Metallurgical Corp. Slag

Leach Interval (n)	Leaching Time (sec) (t)	Mean Time of Leaching Interval (T)	Activity Leached (pCi) (An)	Initial Activity (pCi) (Ao)	Fraction Released During Interval	Release Rate (fraction/sec)	Diffusivity (cm sq/sec)	Leachability Index (Ln)
1	7.2 E+03	1.8 E+03	29.4	2.04E+04	0.14%	2.00 E-07	4.49 E-11	10.348
2	1.8 E+04	1.5 E+04	58.8	2.04E+04	0.29%	1.60 E-07	2.36 E-10	9.627
3	6.1 E+04	5.1 E+04	142	2.04E+04	0.70%	1.14 E-07	4.15 E-10	9.382
4	8.6 E+04	1.3 E+05	252	2.04E+04	1.24%	1.44 E-07	1.62 E-09	8.791
5	8.6 E+04	2.1 E+05	142	2.04E+04	0.70%	8.09 E-08	8.72 E-10	9.059
6	8.6 E+04	3.0 E+05	69.8	2.04E+04	0.34%	3.98 E-08	2.96 E-10	9.528
7	8.6 E+04	3.9 E+05	60.5	2.04E+04	0.30%	3.45 E-08	2.87 E-10	9.542
8	1.2 E+06	9.4 E+05	151	2.04E+04	0.74%	6.17 E-09	2.22 E-11	10.653
9	2.4 E+06	2.7 E+06	118	2.04E+04	0.58%	2.41 E-09	9.83 E-12	11.008
10	3.7 E+06	5.8 E+06	200	2.04E+04	0.98%	2.65 E-09	2.52 E-11	10.599

Sample #: 001

Nuclide: Ra-226

Weight: 113.3
Leachability: 9.85

Confidence Range: 8.73 to 10.98
Correlation Coefficient: 0.44

ANSI/ANS-16.1 Leachability Test for Shieldalloy Metallurgical Corp. Slag

Leach Interval (n)	Leaching Time (sec) (t)	Mean Time of Leaching Interval (T)	Activity Leached (pCi) (An)	Initial Activity (pCi) (Ao)	Fraction Released During Interval	Release Rate (fraction/sec)	Diffusivity (cm sq/sec)	Leachability Index (Ln)
1	7.2 E+03	1.8 E+03	0.14	1.59E+03	0.01%	1.22 E-08	1.67 E-13	12.776
2	1.8 E+04	1.5 E+04	3.53	1.59E+03	0.22%	1.23 E-07	1.40 E-10	9.854
3	6.1 E+04	5.1 E+04	0.92	1.59E+03	0.06%	9.49 E-09	2.87 E-12	11.543
4	8.6 E+04	1.3 E+05	0.67	1.59E+03	0.04%	4.90 E-09	1.88 E-12	11.725
5	8.6 E+04	2.1 E+05	0.29	1.59E+03	0.02%	2.12 E-09	5.99 E-13	12.223
6	8.6 E+04	3.0 E+05	0.34	1.59E+03	0.02%	2.49 E-09	1.16 E-12	11.936
7	8.6 E+04	3.9 E+05	0.08	1.59E+03	0.01%	5.85 E-10	8.26 E-14	13.083
8	1.2 E+06	9.4 E+05	0.59	1.59E+03	0.04%	3.09 E-10	5.59 E-14	13.253
9	2.4 E+06	2.7 E+06	0.14	1.59E+03	0.01%	3.67 E-11	2.28 E-15	14.643
10	3.7 E+06	5.8 E+06	0.67	1.59E+03	0.04%	1.14 E-10	4.66 E-14	13.332

Sample #: 001

Nuclide: U-234

Weight: 113.3
Leachability: 12.44

Confidence Range: 10.48 to 14.40
Correlation Coefficient: 0.76

ANSI/ANS-16.1 Leachability Test for Shieldalloy Metallurgical Corp. Slag

Leach Interval (n)	Leaching Time (sec) (t)	Mean Time of Leaching Interval (T)	Activity Leached (pCi) (An)	Initial Activity (pCi) (Ao)	Fraction Released During Interval	Release Rate (fraction/sec)	Diffusivity (cm sq/sec)	Leachability Index (Ln)
1	7.2 E+03	1.8 E+03	0.17	2.04E+02	0.08%	1.16 E-07	1.50 E-11	10.824
2	1.8 E+04	1.5 E+04	0.08	2.04E+02	0.04%	2.18 E-08	4.37 E-12	11.360
3	6.1 E+04	5.1 E+04	0.17	2.04E+02	0.08%	1.37 E-08	5.94 E-12	11.226
4	8.6 E+04	1.3 E+05	0.08	2.04E+02	0.04%	4.56 E-09	1.63 E-12	11.788
5	8.6 E+04	2.1 E+05	0.07	2.04E+02	0.03%	3.99 E-09	2.12 E-12	11.674
6	8.6 E+04	3.0 E+05	0.06	2.04E+02	0.03%	3.42 E-09	2.19 E-12	11.660
7	8.6 E+04	3.9 E+05	0.06	2.04E+02	0.03%	3.42 E-09	2.82 E-12	11.549
8	1.2 E+06	9.4 E+05	0.25	2.04E+02	0.12%	1.02 E-09	6.09 E-13	12.215
9	2.4 E+06	2.7 E+06	0.06	2.04E+02	0.03%	1.23 E-10	2.54 E-14	13.595
10	3.7 E+06	5.8 E+06	7.56	2.04E+02	3.71%	1.00 E-08	3.60 E-10	9.444

Sample #: 001

Nuclide: U-235

Weight: 113.3
Leachability: 11.53

Confidence Range: 9.96 to 13.11
Correlation Coefficient: 0.61

ANSI/ANS-16.1 Leachability Test for Shieldalloy Metallurgical Corp. Slag

Leach Interval (n)	Leaching Time (t)	Mean Time of Leaching Interval (T)	Activity Leached (pCi) (An)	Initial Activity (pCi) (Ao)	Fraction Released During Interval	Release Rate (fraction/sec)	Diffusivity (cm sq/sec)	Leachability Index (Ln)
1	7.2 E+03	1.8 E+03	0.08	1.36E+03	0.01%	8.17 E-09	7.47 E-14	13.126
2	1.8 E+04	1.5 E+04	1.18	1.36E+03	0.09%	4.82 E-08	2.14 E-11	10.670
3	6.1 E+04	5.1 E+04	0.81	1.36E+03	0.06%	9.76 E-09	3.04 E-12	11.518
4	8.6 E+04	1.3 E+05	0.48	1.36E+03	0.04%	4.10 E-09	1.32 E-12	11.879
5	8.6 E+04	2.1 E+05	0.16	1.36E+03	0.01%	1.37 E-09	2.49 E-13	12.604
6	8.6 E+04	3.0 E+05	0.17	1.36E+03	0.01%	1.45 E-09	3.96 E-13	12.403
7	8.6 E+04	3.9 E+05	0.17	1.36E+03	0.01%	1.45 E-09	5.10 E-13	12.293
8	1.2 E+06	9.4 E+05	0.69	1.36E+03	0.05%	4.23 E-10	1.04 E-13	12.981
9	2.4 E+06	2.7 E+06	0.19	1.36E+03	0.01%	5.82 E-11	5.73 E-15	14.242
10	3.7 E+06	5.8 E+06	16.8	1.36E+03	1.24%	3.34 E-09	4.00 E-11	10.398

Sample #: 001

Nuclide: U-238

Weight: 113.3
Leachability: 12.21

Confidence Range: 10.47 to 13.96
Correlation Coefficient: 0.68

ANSI/ANS-16.1 Leachability Test for Shieldalloy Metallurgical Corp. Slag

Leach Interval (n)	Leaching Time (sec) (t)	Mean Time of Leaching Interval (T)	Activity Leached (pCi) (An)	Initial Activity (pCi) (Ao)	Fraction Released During Interval	Release Rate (fraction/sec)	Diffusivity (cm sq/sec)	Leachability Index (Ln)
1	7.2 E+03	1.8 E+03	1.85	7.59E+02	0.24%	3.39 E-07	1.28 E-10	9.892
2	1.8 E+04	1.5 E+04	1.68	7.59E+02	0.22%	1.23 E-07	1.39 E-10	9.856
3	6.1 E+04	5.1 E+04	2.52	7.59E+02	0.33%	5.44 E-08	9.44 E-11	10.025
4	8.6 E+04	1.3 E+05	1.51	7.59E+02	0.20%	2.31 E-08	4.19 E-11	10.377
5	8.6 E+04	2.1 E+05	2.27	7.59E+02	0.30%	3.48 E-08	1.61 E-10	9.793
6	8.6 E+04	3.0 E+05	3.53	7.59E+02	0.47%	5.41 E-08	5.48 E-10	9.262
7	8.6 E+04	3.9 E+05	2.52	7.59E+02	0.33%	3.86 E-08	3.60 E-10	9.444
8	1.2 E+06	9.4 E+05	12.6	7.59E+02	1.66%	1.38 E-08	1.12 E-10	9.952
9	2.4 E+06	2.7 E+06	8.23	7.59E+02	1.08%	4.52 E-09	3.45 E-11	10.462
10	3.7 E+06	5.8 E+06	2.52	7.59E+02	0.33%	8.97 E-10	2.89 E-12	11.539

Sample #: 001

Nuclide: Th-228

Weight: 113.3
Leachability: 10.06

Confidence Range: 9.10 to 11.02
Correlation Coefficient: 0.37

ANSI/ANS-16.1 Leachability Test for Shieldalloy Metallurgical Corp. Slag

Leach Interval (n)	Leaching Time (t)	Mean Time of Leaching Interval (T)	Activity Leached (pCi) (An)	Initial Activity (pCi) (Ao)	Fraction Released During Interval	Release Rate (fraction/sec)	Diffusivity (cm sq/sec)	Leachability Index (Ln)
1	7.2 E+03	1.8 E+03	2.69	2.15E+02	1.25%	1.74 E-06	3.38 E-09	8.471
2	1.8 E+04	1.5 E+04	0.92	2.15E+02	0.43%	2.38 E-07	5.20 E-10	9.284
3	6.1 E+04	5.1 E+04	0.59	2.15E+02	0.27%	4.50 E-08	6.45 E-11	10.191
4	8.6 E+04	1.3 E+05	0.44	2.15E+02	0.20%	2.38 E-08	4.44 E-11	10.353
5	8.6 E+04	2.1 E+05	0.71	2.15E+02	0.33%	3.84 E-08	1.96 E-10	9.707
6	8.6 E+04	3.0 E+05	11.8	2.15E+02	5.49%	6.38 E-07	7.63 E-08	7.118
7	8.6 E+04	3.9 E+05	0.84	2.15E+02	0.39%	4.54 E-08	4.98 E-10	9.303
8	1.2 E+06	9.4 E+05	0.84	2.15E+02	0.39%	3.26 E-09	6.19 E-12	11.208
9	2.4 E+06	2.7 E+06	0.25	2.15E+02	0.12%	4.84 E-10	3.97 E-13	12.401
10	3.7 E+06	5.8 E+06	0.76	2.15E+02	0.35%	9.55 E-10	3.28 E-12	11.485

Sample #: 001

Nuclide: Th-230

Weight: 113.3
Leachability: 9.95

Confidence Range: 7.63 to 12.27
Correlation Coefficient: 0.90

ANSI/ANS-16.1 Leachability Test for Shieldalloy Metallurgical Corp. Slag

Leach Interval (n)	Leaching Time (t)	Mean Time of Leaching Interval (T)	Activity Leached (pCi) (An)	Initial Activity (pCi) (Ao)	Fraction Released During Interval	Release Rate (fraction/sec)	Diffusivity (cm sq/sec)	Leachability Index (Ln)
1	7.2 E+03	1.8 E+03	0.76	3.51E+02	0.22%	3.01 E-07	1.01 E-10	9.995
2	1.8 E+04	1.5 E+04	0.25	3.51E+02	0.07%	3.96 E-08	1.44 E-11	10.841
3	6.1 E+04	5.1 E+04	0.42	3.51E+02	0.12%	1.96 E-08	1.23 E-11	10.912
4	8.6 E+04	1.3 E+05	0.34	3.51E+02	0.10%	1.13 E-08	9.94 E-12	11.002
5	8.6 E+04	2.1 E+05	0.17	3.51E+02	0.05%	5.63 E-09	4.22 E-12	11.374
6	8.6 E+04	3.0 E+05	1.6	3.51E+02	0.46%	5.30 E-08	5.26 E-10	9.279
7	8.6 E+04	3.9 E+05	0.5	3.51E+02	0.14%	1.66 E-08	6.62 E-11	10.179
8	1.2 E+06	9.4 E+05	0.76	3.51E+02	0.22%	1.80 E-09	1.90 E-12	11.721
9	2.4 E+06	2.7 E+06	0.25	3.51E+02	0.07%	2.97 E-10	1.49 E-13	12.827
10	3.7 E+06	5.8 E+06	0.84	3.51E+02	0.24%	6.47 E-10	1.50 E-12	11.823

Sample #: 001

Nuclide: Th-232

Weight: 113.3
Leachability: 11.00

Confidence Range: 9.46 to 12.53
Correlation Coefficient: 0.60

ANSI/ANS-16.1 Leachability Test for Shieldalloy Metallurgical Corp. Slag

Leach Interval (n)	Leaching Time (sec) (t)	Mean Time of Leaching Interval (T)	Activity Leached (pCi) (An)	Initial Activity (pCi) (Ao)	Fraction Released During Interval	Release Rate (fraction/sec)	Diffusivity (cm sq/sec)	Leachability Index (Ln)
1	7.2 E+03	1.8 E+03	17.6	2.01E+04	0.09%	1.22 E-07	1.66 E-11	10.781
2	1.8 E+04	1.5 E+04	40.3	2.01E+04	0.20%	1.11 E-07	1.14 E-10	9.942
3	6.1 E+04	5.1 E+04	109	2.01E+04	0.54%	8.89 E-08	2.52 E-10	9.599
4	8.6 E+04	1.3 E+05	134	2.01E+04	0.67%	7.75 E-08	4.71 E-10	9.327
5	8.6 E+04	2.1 E+05	160	2.01E+04	0.80%	9.26 E-08	1.14 E-09	8.943
6	8.6 E+04	3.0 E+05	168	2.01E+04	0.84%	9.72 E-08	1.77 E-09	8.752
7	8.6 E+04	3.9 E+05	92.4	2.01E+04	0.46%	5.35 E-08	6.90 E-10	9.161
8	1.2 E+06	0.4 E+05	227	2.01E+04	1.13%	9.41 E-09	5.17 E-11	10.286
9	2.4 E+06	2.7 E+06	104	2.01E+04	0.52%	2.16 E-09	7.86 E-12	11.104
10	3.7 E+06	5.8 E+06	200	2.01E+04	1.00%	2.69 E-09	2.60 E-11	10.586

Sample #: 002

Nuclide: Ra-226

Weight: 111.6
Leachability: 9.85

Confidence Range: 8.61 to 11.08
Correlation Coefficient: 0.48

ANSI/ANS-16.1 Leachability Test for Shieldalloy Metallurgical Corp. Slag

Leach Interval (n)	Leaching Time (sec) (t)	Mean Time of Leaching Interval (T)	Activity Leached (pCi) (An)	Initial Activity (pCi) (Ao)	Fraction Released During Interval	Release Rate (fraction/sec)	Diffusivity (cm sq/sec)	Leachability Index (Ln)
1	7.2 E+03	1.8 E+03	0.08	1.56E+03	0.01%	7.12 E-09	5.68 E-14	13.246
2	1.8 E+04	1.5 E+04	0.28	1.56E+03	0.02%	9.97 E-09	9.15 E-13	12.038
3	6.1 E+04	5.1 E+04	0.5	1.56E+03	0.03%	5.25 E-09	8.79 E-13	12.056
4	8.6 E+04	1.3 E+05	0.25	1.56E+03	0.02%	1.86 E-09	2.72 E-13	12.565
5	8.6 E+04	2.1 E+05	0.84	1.56E+03	0.05%	6.26 E-09	5.22 E-12	11.282
6	8.6 E+04	3.0 E+05	0.42	1.56E+03	0.03%	3.13 E-09	1.83 E-12	11.736
7	8.6 E+04	3.9 E+05	0.17	1.56E+03	0.01%	1.27 E-09	3.88 E-13	12.412
8	1.2 E+06	9.4 E+05	0.17	1.56E+03	0.01%	9.08 E-11	4.82 E-15	14.317
9	2.4 E+06	2.7 E+06	0.5	1.56E+03	0.03%	1.34 E-10	3.02 E-14	13.520
10	3.7 E+06	5.8 E+06	0.67	1.56E+03	0.04%	1.16 E-10	4.84 E-14	13.316

Sample #: 002

Nuclide: U-234

Weight: 111.6
Leachability: 12.65

Confidence Range: 11.24 to 14.06
Correlation Coefficient: 0.55

ANSI/ANS-16.1 Leachability Test for Shieldalloy Metallurgical Corp. Slag

Leach Interval (n)	Leaching Time (sec) (t)	Mean Time of Leaching Interval (T)	Activity Leached (pCi) (An)	Initial Activity (pCi) (Ao)	Fraction Released During Interval	Release Rate (fraction/sec)	Diffusivity (cm sq/sec)	Leachability Index (Ln)
1	7.2 E+03	1.8 E+03	0.05	2.01E+02	0.02%	3.45 E-08	1.34 E-12	11.874
2	1.8 E+04	1.5 E+04	0.03	2.01E+02	0.01%	8.29 E-09	6.33 E-13	12.199
3	6.1 E+04	5.1 E+04	0.25	2.01E+02	0.12%	2.04 E-08	1.32 E-11	10.878
4	8.6 E+04	1.3 E+05	0.17	2.01E+02	0.08%	9.83 E-09	7.58 E-12	11.120
5	8.6 E+04	2.1 E+05	0.42	2.01E+02	0.21%	2.43 E-08	7.86 E-11	10.105
6	8.6 E+04	3.0 E+05	0.25	2.01E+02	0.12%	1.45 E-08	3.92 E-11	10.407
7	8.6 E+04	3.9 E+05	0.06	2.01E+02	0.03%	3.47 E-09	2.91 E-12	11.536
8	1.2 E+06	9.4 E+05	0.17	2.01E+02	0.08%	7.05 E-10	2.90 E-13	12.537
9	2.4 E+06	2.7 E+06	0.25	2.01E+02	0.12%	5.18 E-10	4.54 E-13	12.343
10	3.7 E+06	5.8 E+06	0.67	2.01E+02	0.33%	9.01 E-10	2.91 E-12	11.536

Sample #: 002

Nuclide: U-235

Weight: 111.6
Leachability: 11.45

Confidence Range: 10.21 to 12.69
Correlation Coefficient: 0.48

ANSI/ANS-16.1 Leachability Test for Shieldalloy Metallurgical Corp. Slag

Leach Interval (n)	Leaching Time (t)	Mean Time of Leaching Interval (T)	Activity Leached (pCi) (An)	Initial Activity (pCi) (Ao)	Fraction Released During Interval	Release Rate (fraction/sec)	Diffusivity (cm sq/sec)	Leachability Index (Ln)
1	7.2 E+03	1.8 E+03	0.35	1.34E+03	0.03%	3.63 E-08	1.47 E-12	11.832
2	1.8 E+04	1.5 E+04	0.29	1.34E+03	0.02%	1.20 E-08	1.33 E-12	11.876
3	6.1 E+04	5.1 E+04	0.34	1.34E+03	0.03%	4.16 E-09	5.51 E-13	12.259
4	8.6 E+04	1.3 E+05	0.34	1.34E+03	0.03%	2.95 E-09	6.82 E-13	12.166
5	8.6 E+04	2.1 E+05	0.76	1.34E+03	0.06%	6.59 E-09	5.79 E-12	11.237
6	8.6 E+04	3.0 E+05	0.42	1.34E+03	0.03%	3.64 E-09	2.49 E-12	11.604
7	8.6 E+04	3.9 E+05	0.26	1.34E+03	0.02%	2.26 E-09	1.23 E-12	11.911
8	1.2 E+06	9.4 E+05	0.17	1.34E+03	0.01%	1.06 E-10	6.53 E-15	14.185
9	2.4 E+06	2.7 E+06	0.34	1.34E+03	0.03%	1.06 E-10	1.89 E-14	13.723
10	3.7 E+06	5.8 E+06	1.68	1.34E+03	0.13%	3.39 E-10	4.12 E-13	12.385

Sample #: 002

Nuclide: U-238

Weight: 111.6
Leachability: 12.32

Confidence Range: 10.92 to 13.72
Correlation Coefficient: 0.54

ANSI/ANS-16.1 Leachability Test for Shieldalloy Metallurgical Corp. Slag

Leach Interval (n)	Leaching Time (t)	Mean Time of Leaching Interval (T)	Activity Leached (pCi) (An)	Initial Activity (pCi) (Ao)	Fraction Released During Interval	Release Rate (fraction/sec)	Diffusivity (cm sq/sec)	Leachability Index (Ln)
1	7.2 E+03	1.8 E+03	0.83	7.48E+02	0.11%	1.54 E-07	2.66 E-11	10.575
2	1.8 E+04	1.5 E+04	4.2	7.48E+02	0.56%	3.12 E-07	8.96 E-10	9.048
3	6.1 E+04	5.1 E+04	3.53	7.48E+02	0.47%	7.74 E-08	1.91 E-10	9.720
4	8.6 E+04	1.3 E+05	2.1	7.48E+02	0.28%	3.26 E-08	8.35 E-11	10.078
5	8.6 E+04	2.1 E+05	2.52	7.48E+02	0.34%	3.92 E-08	2.04 E-10	9.690
6	8.6 E+04	3.0 E+05	1.43	7.48E+02	0.19%	2.22 E-08	9.25 E-11	10.034
7	8.6 E+04	3.9 E+05	3.28	7.48E+02	0.44%	5.10 E-08	6.27 E-10	9.202
8	1.2 E+06	9.4 E+05	7.56	7.48E+02	1.01%	8.42 E-09	4.14 E-11	10.383
9	2.4 E+06	2.7 E+06	10.1	7.48E+02	1.35%	5.63 E-09	5.36 E-11	10.271
10	3.7 E+06	5.8 E+06	6.72	7.48E+02	0.90%	2.43 E-09	2.12 E-11	10.674

Sample #: 002

Nuclide: Th-228

Weight: 111.6
Leachability: 9.97

Confidence Range: 9.14 to 10.80
Correlation Coefficient: 0.32

ANSI/ANS-16.1 Leachability Test for Shieldalloy Metallurgical Corp. Slag

Leach Interval (n)	Leaching Time (sec) (t)	Mean Time of Leaching Interval (T)	Activity Leached (pCi) (An)	Initial Activity (pCi) (Ao)	Fraction Released During Interval	Release Rate (fraction/sec)	Diffusivity (cm sq/sec)	Leachability Index (Ln)
1	7.2 E+03	1.8 E+03	1.09	2.12E+02	0.51%	7.14 E-07	5.71 E-10	9.243
2	1.8 E+04	1.5 E+04	0.84	2.12E+02	0.40%	2.20 E-07	4.46 E-10	9.351
3	6.1 E+04	5.1 E+04	0.5	2.12E+02	0.24%	3.87 E-08	4.76 E-11	10.322
4	8.6 E+04	1.3 E+05	0.42	2.12E+02	0.20%	2.30 E-08	4.16 E-11	10.381
5	8.6 E+04	2.1 E+05	0.45	2.12E+02	0.21%	2.47 E-08	8.11 E-11	10.091
6	8.6 E+04	3.0 E+05	0.17	2.12E+02	0.08%	9.32 E-09	1.63 E-11	10.788
7	8.6 E+04	3.9 E+05	0.07	2.12E+02	0.03%	3.84 E-09	3.56 E-12	11.449
8	1.2 E+06	9.4 E+05	1.68	2.12E+02	0.79%	6.60 E-09	2.55 E-11	10.594
9	2.4 E+06	2.7 E+06	0.17	2.12E+02	0.08%	3.34 E-10	1.89 E-13	12.724
10	3.7 E+06	5.8 E+06	0.84	2.12E+02	0.40%	1.07 E-09	4.12 E-12	11.386

Sample #: 002

Nuclide: Th-230

Weight: 111.6
Leachability: 10.63

Confidence Range: 9.07 to 12.20
Correlation Coefficient: 0.61

ANSI/ANS-16.1 Leachability Test for Shieldalloy Metallurgical Corp. Slag

Leach Interval (n)	Leaching Time (sec) (t)	Mean Time of Leaching Interval (T)	Activity Leached (pCi) (An)	Initial Activity (pCi) (Ao)	Fraction Released During Interval	Release Rate (fraction/sec)	Diffusivity (cm sq/sec)	Leachability Index (Ln)
1	7.2 E+03	1.8 E+03	0.08	3.46E+02	0.02%	3.21 E-08	1.15 E-12	11.938
2	1.8 E+04	1.5 E+04	0.5	3.46E+02	0.14%	8.03 E-08	5.93 E-11	10.227
3	6.1 E+04	5.1 E+04	0.25	3.46E+02	0.07%	1.18 E-08	4.47 E-12	11.350
4	8.6 E+04	1.3 E+05	0.34	3.46E+02	0.10%	1.14 E-08	1.02 E-11	10.990
5	8.6 E+04	2.1 E+05	0.34	3.46E+02	0.10%	1.14 E-08	1.74 E-11	10.760
6	8.6 E+04	3.0 E+05	0.25	3.46E+02	0.07%	8.40 E-09	1.32 E-11	10.879
7	8.6 E+04	3.9 E+05	0.17	3.46E+02	0.05%	5.71 E-09	7.08 E-12	11.104
8	1.2 E+06	9.4 E+05	0.76	3.46E+02	0.22%	1.83 E-09	1.96 E-12	11.708
9	2.4 E+06	2.7 E+06	1.68	3.46E+02	0.49%	2.02 E-09	6.93 E-12	11.160
10	3.7 E+06	5.8 E+06	0.84	3.46E+02	0.24%	6.56 E-10	1.55 E-12	11.811

Sample #: 002

Nuclide: Th-232

Weight: 111.6
Leachability: 11.19

Confidence Range: 10.40 to 11.99
Correlation Coefficient: 0.31