ANL-04/15

Metal Waste Form Corrosion Release Data from Immersion Tests

Chemical Engineering Division
Argonne National Laboratory

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ANL-04/15

METAL WASTE FORM CORROSION
RELEASE DATA FROM IMMERSION TESTS

by

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

ACL	Analytical Chemistry Laboratory
AJ13	Acidified J13 (well water) (solution)
ANL	Argonne National Laboratory-East
ANL-W	Argonne National Laboratory-West
CJ13	Concentrated J13 (well water) (solution)
CMT	Chemical Technology Division
HLWG	High level waste glass
ICP-AES	Inductively coupled plasma-atomic emission spectroscopy
ICP-MS	Inductively coupled plasma-mass spectrometry
ID	Identification
MCC-1	Materials Characterization Center-Protocol #1
MWF	Metal waste form
NIST	National Institute of Standards and Technology
NL	Normalized elemental mass loss
RSD	Relative standard deviation
SJ13	Simulated J13 (well water) (solution)
SS	Stainless steel
TRU	Transuranic
WASRD	Waste Acceptance System Requirements Document
1KCl	1,000 parts per million of chlorine (solution)
10KCl	10,000 parts per million of chlorine (solution)

ACKNOWLEDGMENTS

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EXECUTIVE SUMMARY

Purpose and Scope

The compilation of Metal Waste Form (MWF) immersion test data in this document is part of the effort initiated to qualify the stainless steel-15% zirconium (SS-15Zr) alloy for repository disposal. The SS-15Zr alloy was developed as part of the waste stream from the Argonne National Laboratory (ANL) electrometallurgical process for spent nuclear fuel. There were four areas of significant relevance concerning MWF performance in a long-term repository setting addressed in the test model. The areas encompassed the study of the effects of (1) the solution aggressiveness [simulated by concentrated J13 solution (CJ13)], (2) high-chloride content of the solution [simulated by 10,000 ppm chloride solution (10KCl)], (3) solution pH [simulated by acidified J13 solution (AJ13)], and (4) the state of the metal surface—polished vs. oxidized on the releases. The simulated J-13 solution was intended to replicate the groundwater in the J-13 well at the Yucca Mountain geologic repository. A fifth area of interest was to determine if the releases were limited by iron saturation of the solution. The data obtained from the entire study will be compared with the data from the High Level Waste Glass (HLWG) form previously qualified for repository disposal.

Methods

Immersion corrosion tests were initiated on nonradioactive samples of polished and oxidized SS-15Zr-1Nb-1Ru-1Pd-1Rh metal waste form at 90ºC and ambient temperature (25ºC) in May and October, 2000. The tests were based on Materials Characterization Center Protocol #1 (MCC-1) (ASTM C 1220), a static leach test procedure initially developed to evaluate glass-based waste forms. The procedure measured selective leaching of elements from the waste form into representative test solutions, and provided chemical durability and corrosion resistance information.

After each sampling interval, the total release of the metal waste form major elements (Fe, Zr, Cr, and Ni), the fission product elements (Nb, Pd, Ru, Rh, and Mo) and the minor elements (Mn, Cu, Co, and V) was determined from the release to the solution, the release to the walls (obtained from the acid strip wash), and the detected residue. The control data provided useful information regarding the uncertainties in the tests.

Due to contamination problems for Mo, Cu, and V, and the lack of interest in the low released minor element, Mn, releases of these elements will not be discussed. All elemental release and control blank concentrations were converted to normalized loss.

Comparison of the data with high level waste glass data, a waste form previously qualified for repository disposal, was possible when in this form.

Results and Conclusions

Even though the MWF samples used in these tests contained no actinides and no Tc, conclusions can be made with respect to the releases of the noble metal fission products and the stainless steel constituents.

- Fe releases are an order of magnitude or higher than the releases of the noble metal fission-product elements in all solutions.
- Releases of noble metal fission products and Cr and Ni in SJ13 and CJ13 solutions at 90ºC are close to the limits of detection.
- Solution concentration increased the Zr release. Zr releases from CJ13 were about a factor of 2 lower than the Fe release. In CJ13, Zr releases from oxidized samples were higher than from polished samples.
- Releases of all elements increased in the AJ13, pH=2 solution. Total cumulative releases as a function of time continued to increase for the 308 days of tests unlike the behavior in other test solutions. Tests in solutions with pH between 2 and 8 are needed to understand the different behavior.
- Except for high chloride solutions, (10KCl), release rates of stainless steel elements and noble metal fission products from the MWF samples are lower than release rates from HLWG.

I. INTRODUCTION

A. Background

The June 1999 Metal Waste Form Handbook [1] provided data on the Metal Waste Form

1. Processing,
2. Compositions and Microstructure,
3. Mechanical and Thermophysical Properties, and
4. Corrosion Behavior.

Corrosion behavior studies included vapor hydration tests, galvanic corrosion tests, pulsed-flow immersion tests, static immersion tests, and electrochemical corrosion tests.

The immersion tests were done using deionized water and simulated J-13 well water. Simulated J-13 well water is water similar in composition to water from well J-13, which is located near the Yucca Mountain Repository. The composition of the water in well J-13 and the composition of water from nearby wells vary considerably. Table I-1 shows a comparison of the composition of the simulated J-13 well water used in the metal waste form (MWF) tests with one of the many analyses of the water from well J-13 [2]. The main difference between the simulated J-13 solution and the analysis of the water from the J-13 well is the presence of 2.2 mg/L of fluoride in the J-13 well water that has not been included in the simulated solution. Static immersion tests consisted of immersion of different alloys and slag in deionized water and simulated J-13 well-water at 90ºC for 90-days or 365-days. No measurable mass loss or gain or corrosion could be determined from these tests.

Table I-1. Comparison of One Representative Composition of J-13 Well Water with the Composition of Simulated J-13 Water Used in Immersion Tests.

Species	Typical J-13 water (mg/L)	Simulated J-13 water (mg/L)
Nitrate, NO_3^-	9.6	10.1
Sulfate, SO_4^{2-}	18.7	18
Chloride, Cl^-	6.9	4.31
Fluoride, F^-	2.2	---
Calcium, Ca^{2+}	12.5	10.2
Magnesium, Mg^{2+}	1.9	2.09
Sodium, Na^+	44	50.9
Potassium, K^+	5.1	5.21
Silica, SiO_2	58	33.8
Bicarbonate, HCO_3^-	125	109
pH	7.6	9

1. Electrochemical Corrosion

The electrochemical corrosion behavior of metal waste form samples with a range of alloy compositions was measured using the polarization resistance method (also known as linear polarization) based on ASTM G-59 [3]. Polarization resistance is the resistance of a metal or alloy to oxidation during the application of an external potential. The measurement technique and the equations relating the corrosion rate to the polarization resistance of the corroding species are given in the 1999 Metal Waste Form Handbook [1], which contains figures and tables of the corrosion rates determined from polarization resistance measurements on radioactive and nonradioactive samples at 20ºC in solutions with pH= 2, 4, 9 (simulated J-13), and 10.

Additional polarization resistance measurements on polished nonradioactive samples have been completed at 20ºC, 60ºC and 90ºC. Solutions used in these additional tests and previous tests at 20ºC are given in Table I-2 in order of decreasing pH. Solutions used in the tests at 60ºC and 90ºC are given, respectively, in Tables I-3 and I-4. Compositions of alloys tested at 20°C are listed in Table I-5. Alloys listed in Table I-5 in bold print, (ingots SS15ZR17, SS5ZR18, SS20ZR19, and SS15ZR25) were also tested at 60ºC and 90ºC. More extensive data on the electrochemical corrosion tests using the polarization resistance method are provided in Appendix A.

Table I-2. Typical Composition of 20ºC Electrochemical Testing Solutions.

Solution	pH	Solution Composition (mg/L or ppm)								
		Na	K	Ca	Mg	Si	SO_4^{-2}	Cl^{-1}	NO_3^{-1}	HCO_3^{-1}
pH=12	~12	396	57	1.07	0.99	36.4	18.2	3.93	10.9	89
pH=10	~10	65.2	5.32	10.4	2.18	37.9	18	4.33	9.5	88
Sim. J-13	~9	50.9	5.21	10.2	2.09	33.8	18	4.31	10.1	109
Conc. J-13	~8.2	5300	510	6	1.9	30	22	727	11	12700
10000 ppm Cl	~6.3	6270	-	-	-	-	-	10000	-	-
1000 ppm Cl	~5.8	607	-	-	-	-	-	1000	-	-
pH=2	~2	49.1	5.1	10.9	2.12	35.1	17.8	443	10.5	4.4

Table I-3. Typical Composition of 60ºC Electrochemical Testing Solution.

Solution	pH	Solution Composition (mg/L or ppm)								
		Na	K	Ca	Mg	Si	SO_4^{-2}	Cl^{-1}	NO_3^{-1}	HCO_3^{-1}
pH=10	~10	65.2	5.32	10.4	2.18	37.9	18	4.33	9.5	88
Conc. J-13	~8.2	5300	510	6	1.9	30	22	727	11	12700
1000 ppm Cl	~5.8	607	-	-	-	-	-	1000	-	-
10000 ppm Cl	~6.3	6270	-	-	-	-	-	10000	-	-
pH= 2	2	49.1	5.1	10.9	2.12	35.1	17.8	443	10.5	4.4

Table I-4. Typical Composition of 90ºC Electrochemical Testing Solutions.

Solution	pH	Solution Composition (mg/L or ppm)								
		Na	K	Ca	Mg	Si	SO_4^{-2}	Cl^{-1}	NO_3^{-1}	HCO_3^{-1}
pH=10	~10	65.2	5.32	10.4	2.18	37.9	18	4.33	9.5	88
Sim. J-13	~9	50.9	5.21	10.2	2.09	33.8	18	4.31	10.1	109
Conc. J-13	~8.2	5300	510	6	1.9	30	22	727	11	12700
10000 ppm Cl	~6.3	6270	-	-	-	-	-	10000	-	-
1000 ppm Cl	~5.8	607	-	-	-	-	-	1000	-	-
pH=2	~2	49.1	5.1	10.9	2.12	35.1	17.8	443	10.5	4.4

Table I-5. Composition, Density, and Equivalent Weight of Alloys Tested by the Polarization Resistance Method.[a]

Ingot	Alloy Description	Density (g/mL)
SS316	SS316	8
SS15ZR12	SS-15Zr-2Ru-1Pd-1Ag	7.8
SS15ZR14	SS-15Zr (annealed)	7.65
SS15ZR15	SS-15Zr-2Ru-1Nb-0.5Pd-0.5Ag	7.8
SS15ZR17	**SS-15Zr (as-cast)**	7.65
SS05ZR18	**SS-5Zr-2Nb-1Ru-1Pd**	7.8
SS20ZR19	**SS-20Zr-2Nb-1Ru-1Pd**	7.7
SS05ZR20	SS-5Zr-1Nb-0.5Ru-0.5Pd	7.8
SS05ZR21	SS-5Zr	7.9
SS15ZR23	SS-15Zr (cooled at 10°C/min)	7.65
SS15ZR24	SS-15Zr (cooled at 5°C/min)	7.65
SS15ZR25	**SS-15Zr-1Nb-1Ru-1Pd-1Rh**	7.8
SS15ZR26	SS-15Zr-1Nb-1Ru-1Pd-1Rh	7.8
SS15ZR27	SS-15Zr (cooled at 1°C/min)	7.65
SS00ZR28	SS-2Nb-1Ru-1Pd-1Ag	8
Zr	Zr	6.5
ZR08SS02	Zr-8SS-1Ag-1Nb-1Pd-1Ru	6.7
ZR08SS04	Zr-8SS	6.6
Copper	Pure Copper	8.9
C-22	C-22	8.7
AISI 1018	Mild Steel	7.9

[a] Bold Print Indicates Tests at 60 and 90°C.

Corrosion rates of the alloys listed in Table I-5 determined at 20ºC in pH=12 solution, concentrated J-13 solution and the high chloride solutions (1,000 ppm Cl^- and 10,000 ppm Cl^-) using the polarization resistance method are shown in Figures I-1 through I-4 as a function of alloy. Three measurements were made on each alloy except for the pH=12 solution. Results of each measurement, the average of three measurements, and the standard deviations (when appropriate) are given in Tables A-3 through A-6 of Appendix A. Although these data show considerable scatter, they are consistent with the previously reported observations. For pH=12, corrosion rates for the metal waste form samples are above and below that of stainless steel and most are higher than the rate for Alloy C-22. In concentrated J-13 solution, pH ~8.2, the corrosion rates of the metal waste form alloys are comparable with the rate for 316 stainless steel and Alloy C22. In the high chloride tests (1,000 ppm Cl^- and 10,000 ppm Cl^-), the metal waste form alloys have better corrosion resistance than stainless steel and are comparable to Alloy C22.

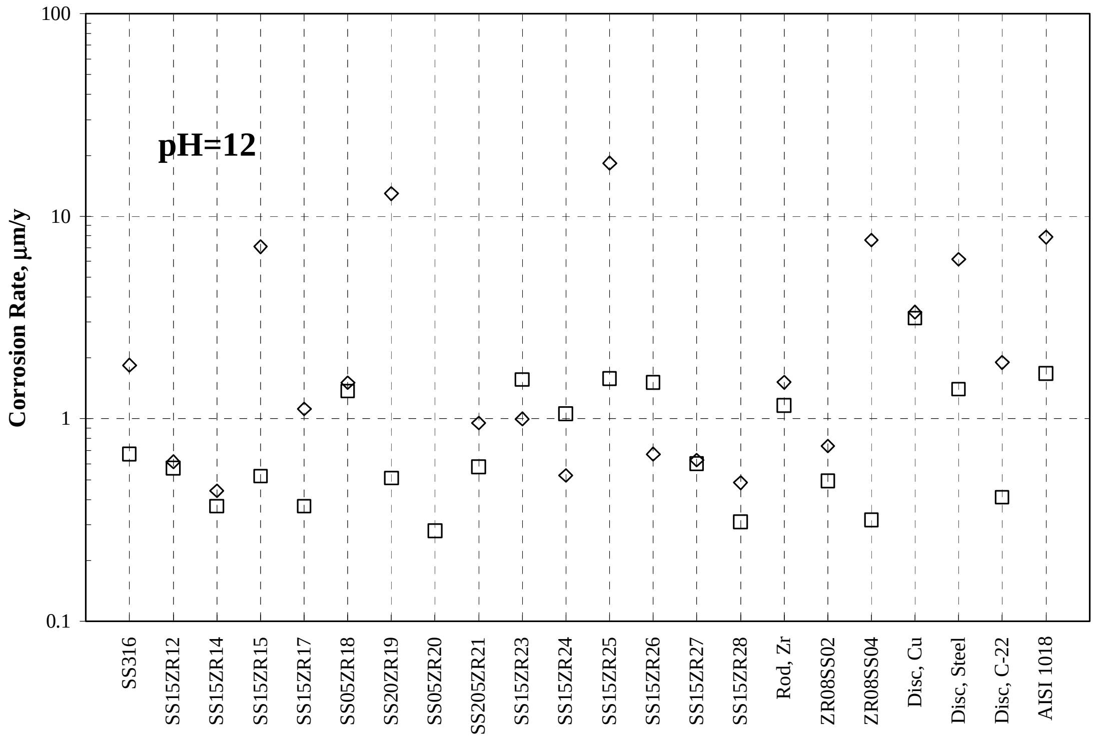

Figure I-1. Corrosion Rates Measured in pH=12 Solution at 20ºC.

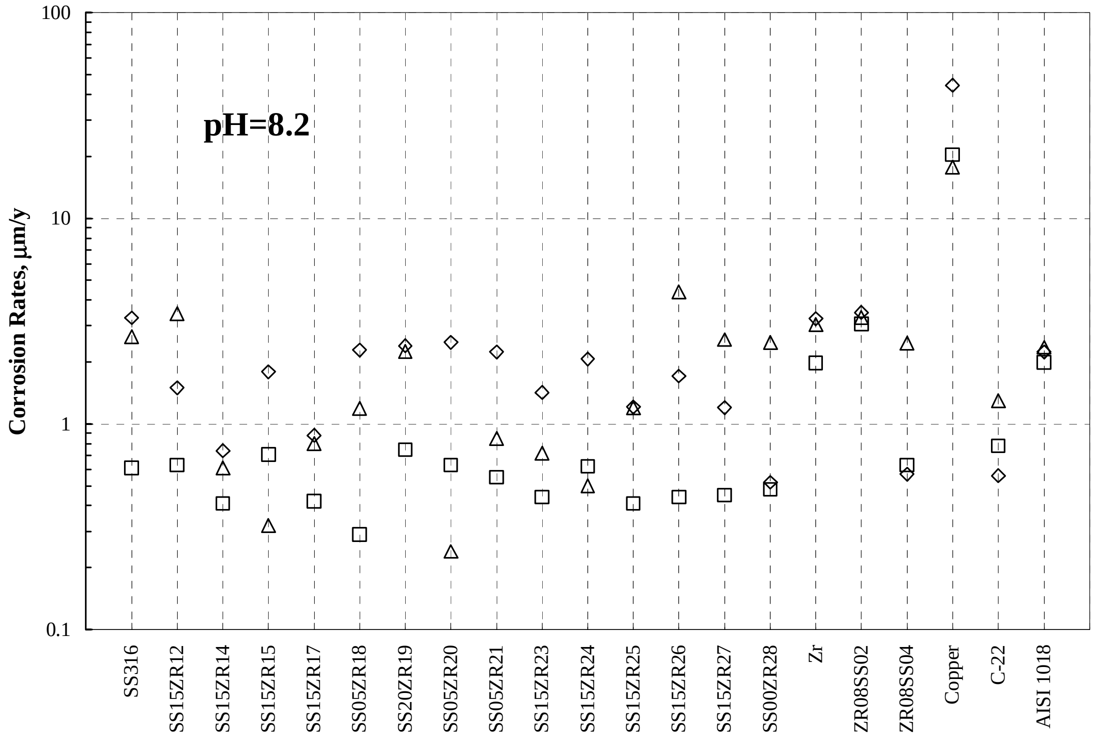

Figure I-2. Corrosion Rates Measured in Concentrated J-13 (pH=8.2) Solution at 20ºC.

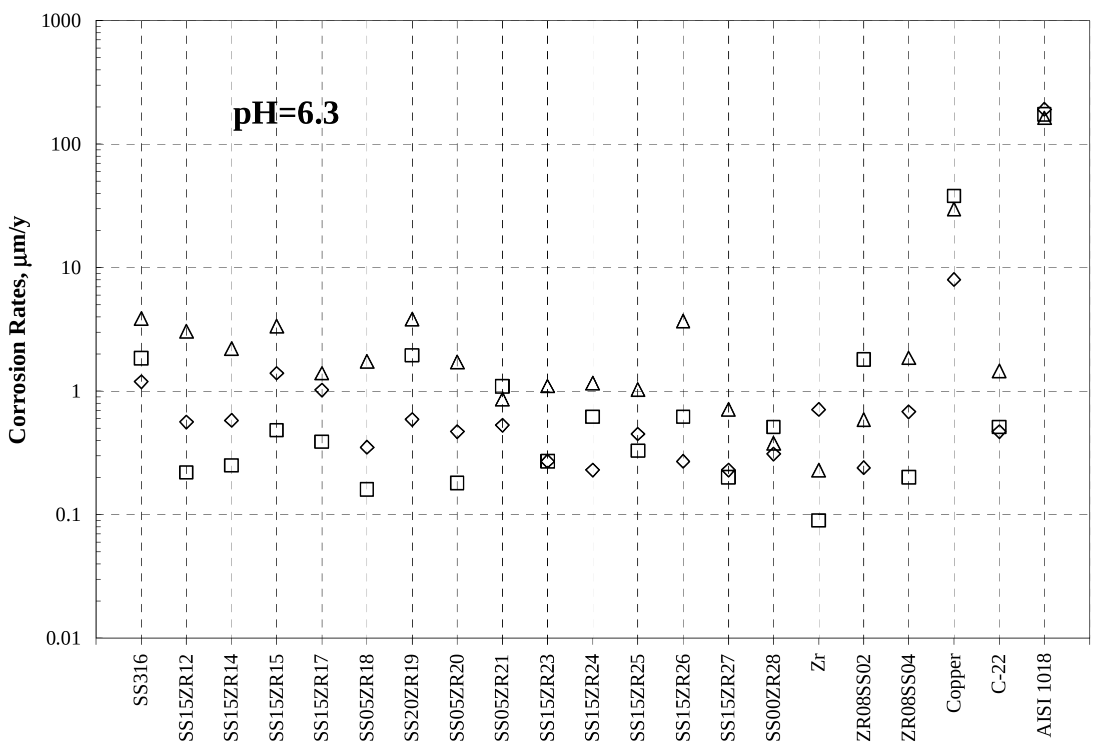

Figure I-3. Corrosion Rates Measured in 10,000 ppm Chloride (pH=6.3) Solution at 20ºC.

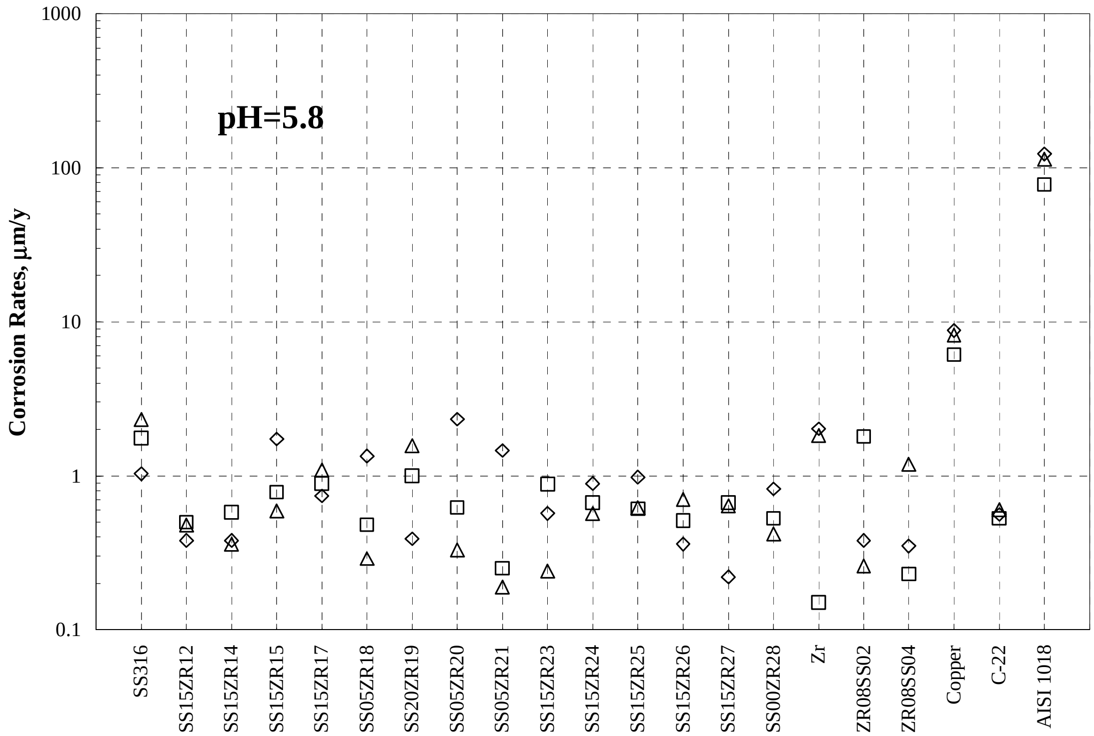

Figure I-4. Corrosion Rates Measured in 1,000 ppm Chloride (pH=5.8) Solution at 20ºC.

Results of polarization resistance measurements at 60ºC and 90ºC on 316 stainless steel and four metal waste form alloys are shown in Figures I-5 through I-15. The data graphed in these figures, the averages from three measurements, and the standard deviations are given in Appendix A: Tables A-7 through A-12 for 60ºC tests and Tables A-13 through A-19 for 90ºC tests. Corrosion results for metal waste form alloys at both 60ºC and 90ºC are similar to results for 316 stainless steel. In some cases, the metal waste form alloys give higher corrosion rates than those for 316 stainless steel. Corrosion rate data at 60 and 90ºC are above those given from analysis of 304 and 316 stainless steel corrosion data [4]. The scatter in the data is sufficient that no obvious difference is discernable between the different compositions of the metal waste form alloys.

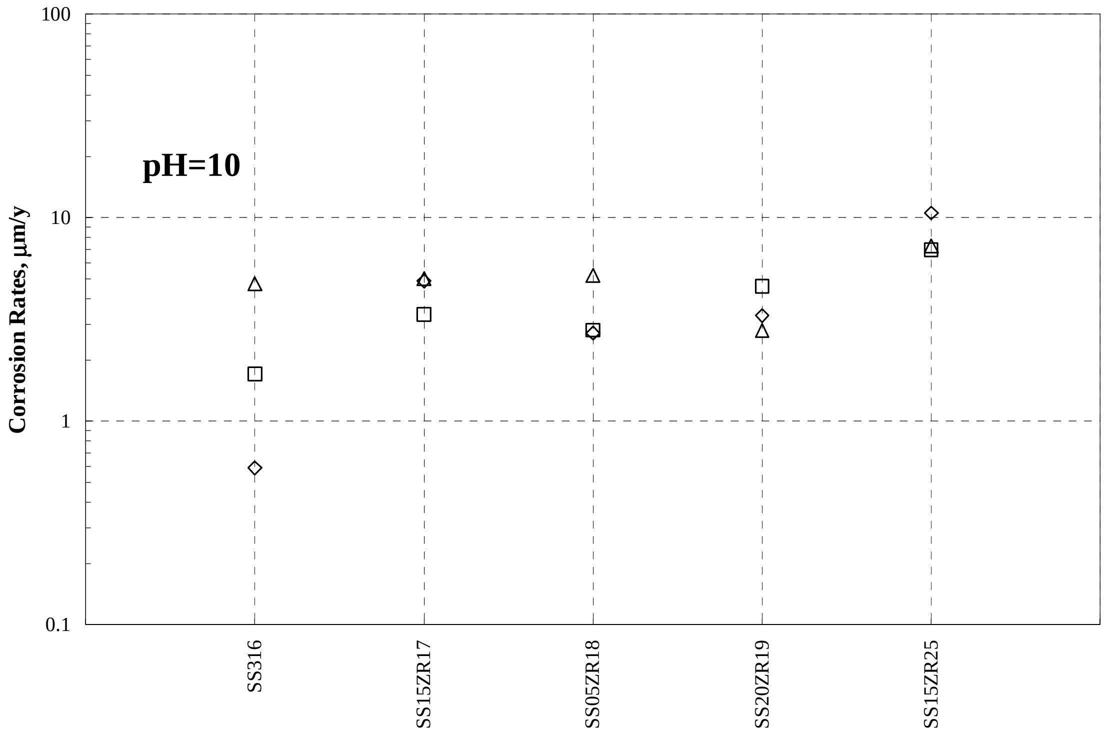

Figure I-5. Corrosion Rates Measured in pH=10 Solution at 60ºC.

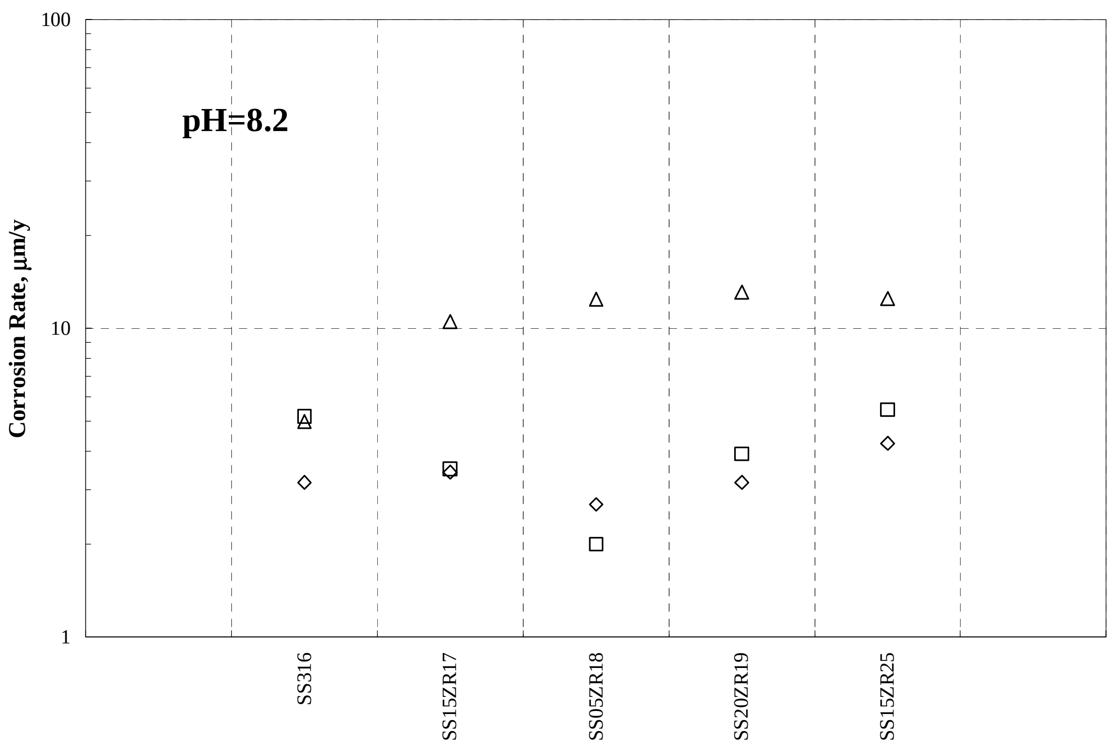

Figure I-6. Corrosion Rates Measured in Concentrated J-13 (pH=8.2) Solution at 60ºC.

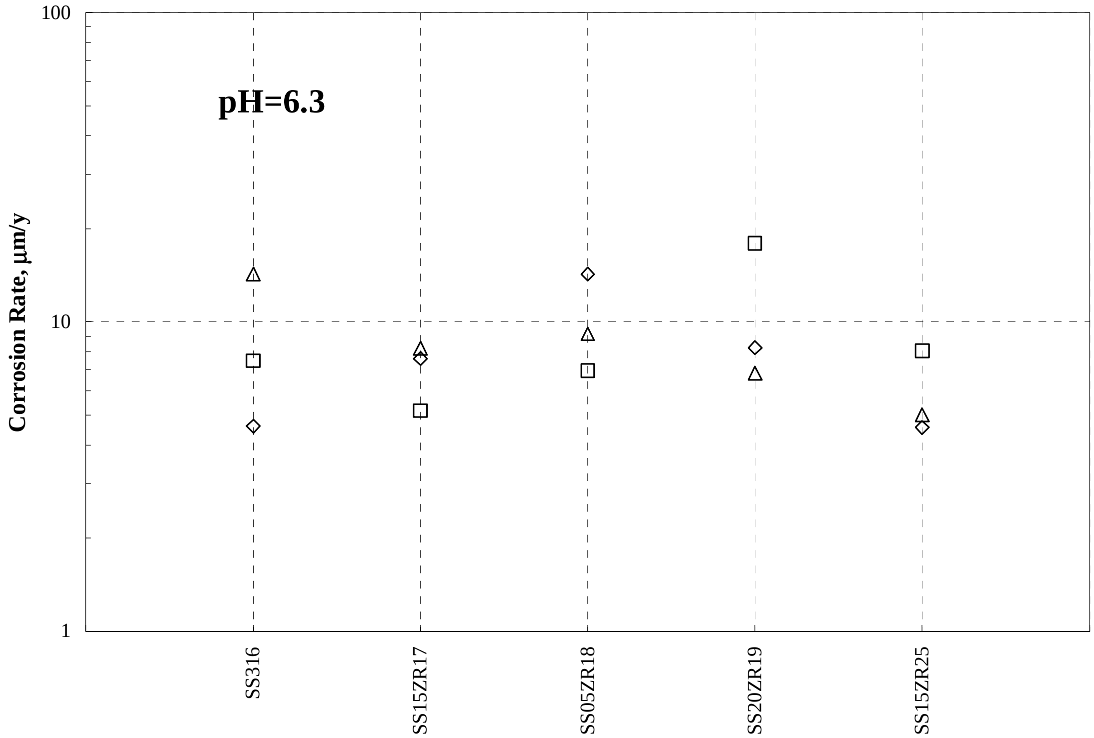

Figure I-7. Corrosion Rates Measured in 10,000 ppm Chloride (pH=6.3) Solution at 60ºC.

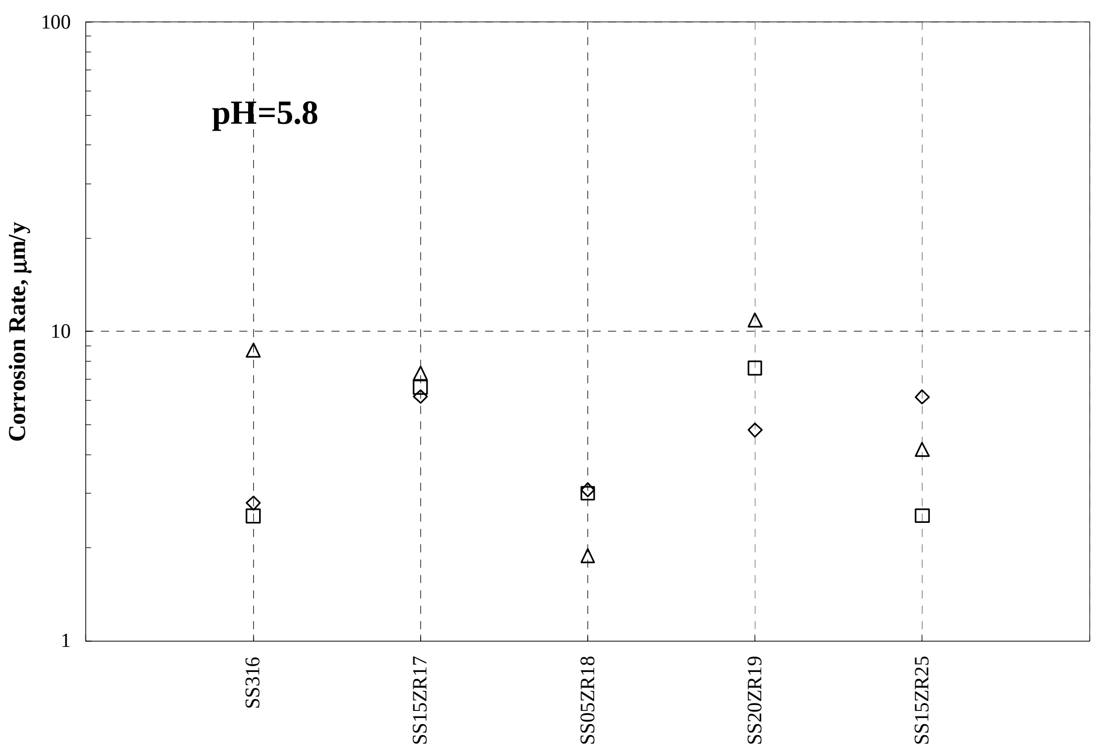

Figure I-8. Corrosion Rates Measured in 1,000 ppm Chloride (pH=5.8) Solution at 60ºC.

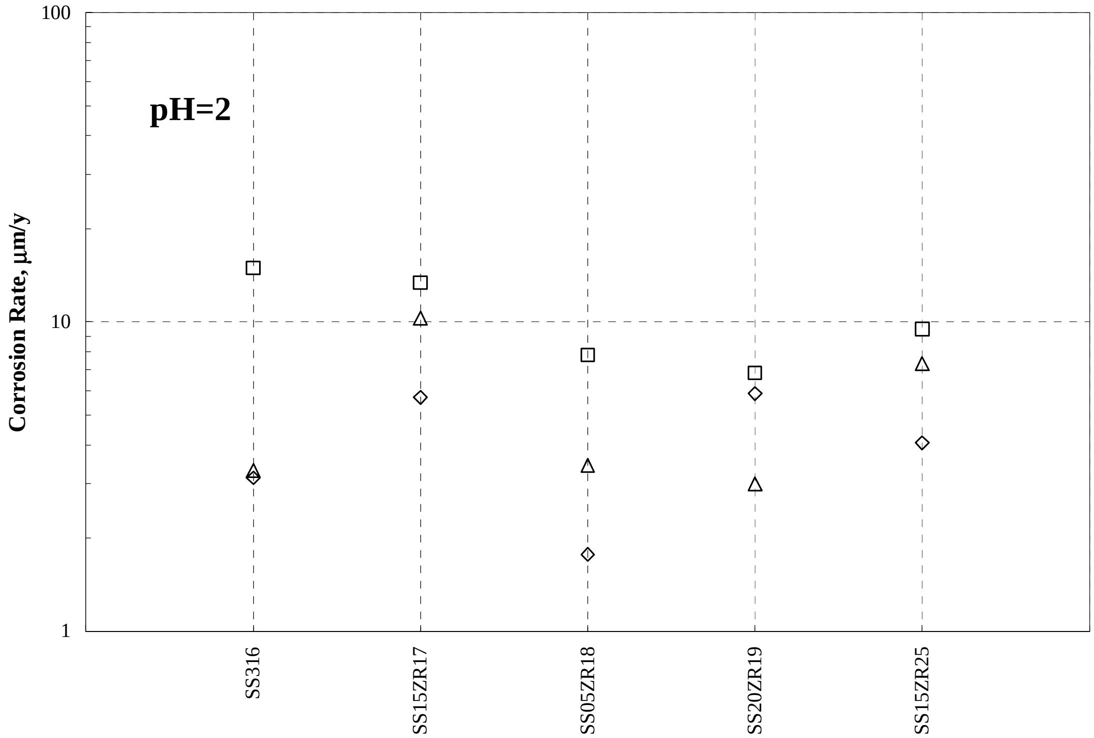

Figure I-9. Corrosion Rates Measured in pH=2 Solution at 60ºC.

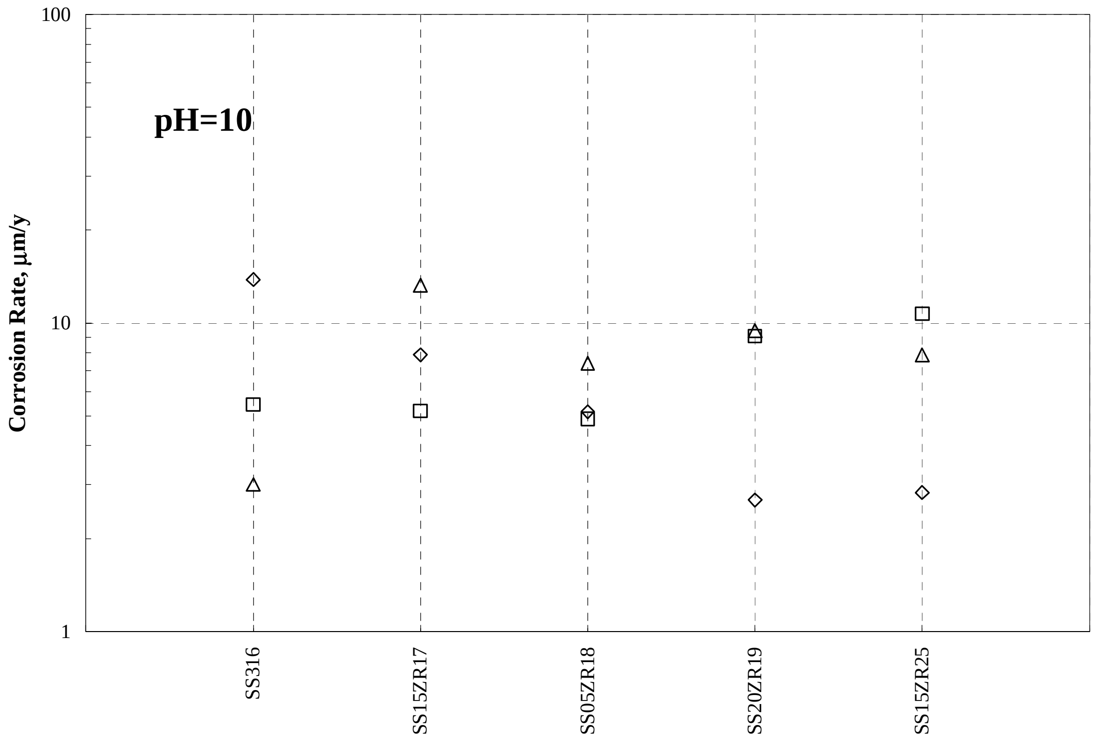

Figure I-10. Corrosion Rates Measured in pH=10 Solution at 90ºC.

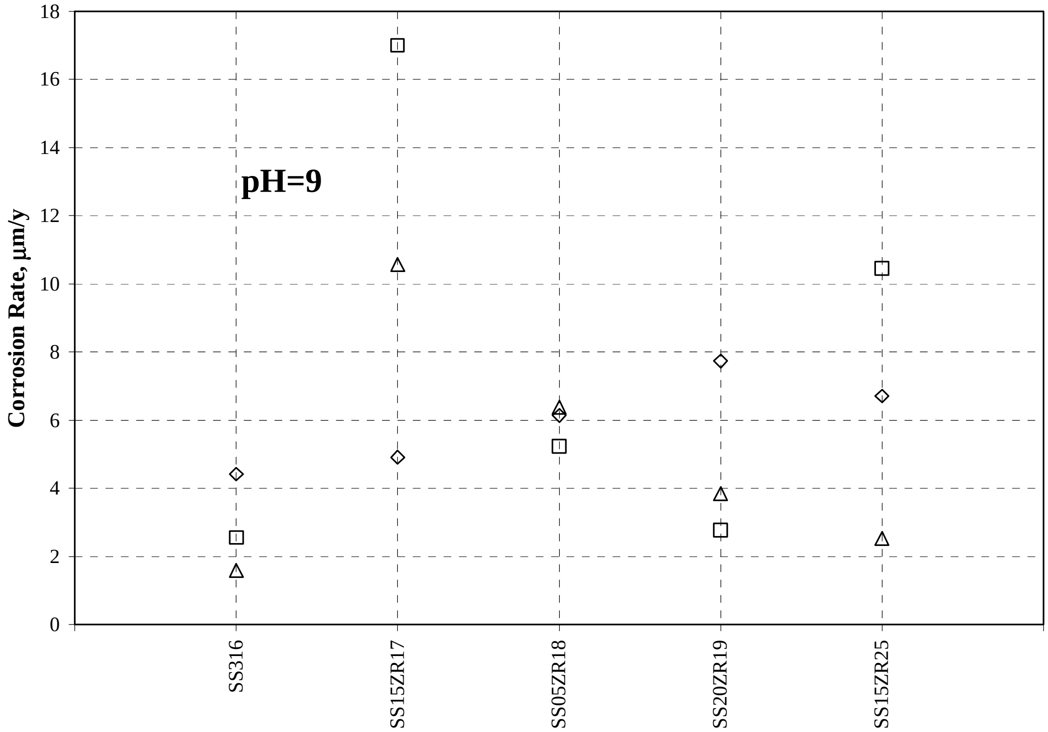

Figure I-11. Corrosion Rates Measured in SJ13 (pH=9) Solution at 90ºC.

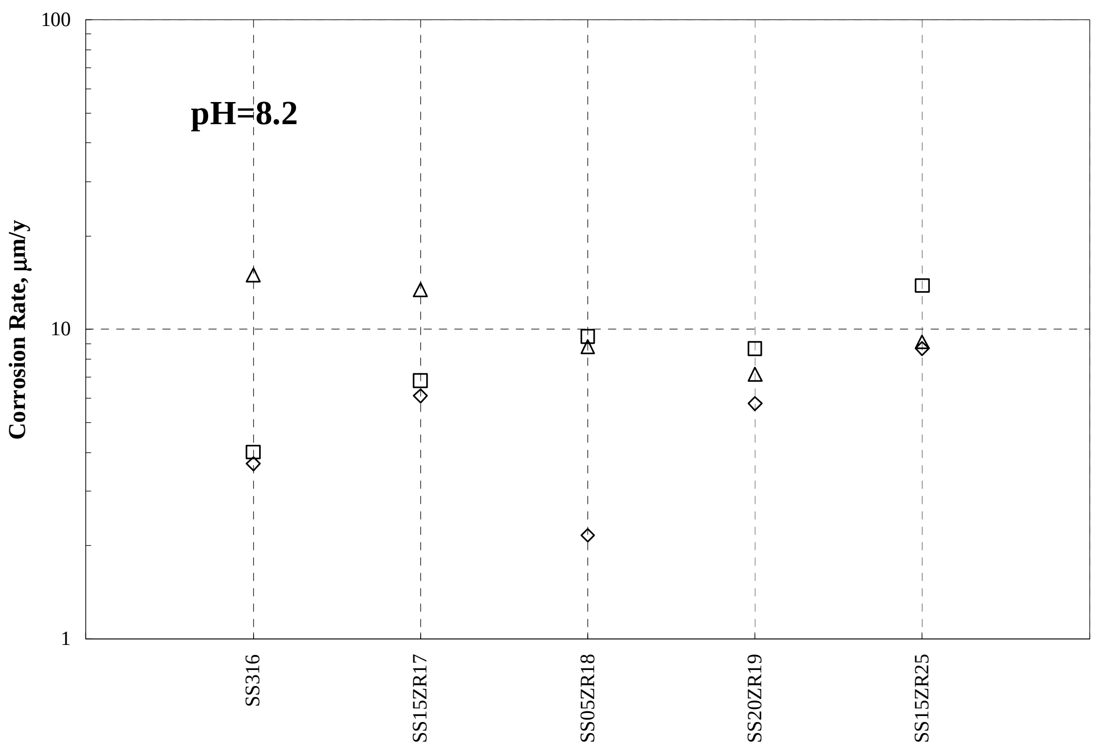

Figure I-12. Corrosion Rates Measured in CJ13 (pH=8.2) Solution at 90ºC.

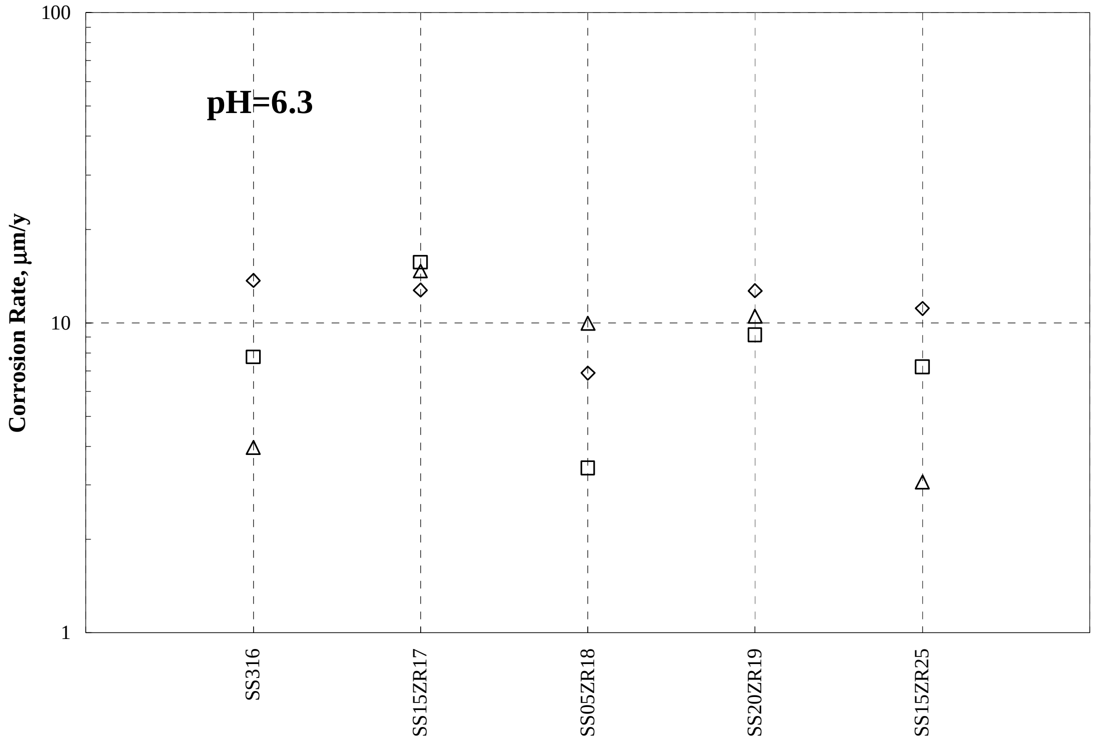

Figure I-13. Corrosion Rates Measured in 10,000 ppm Chloride (pH=6.3) Solution at 90ºC.

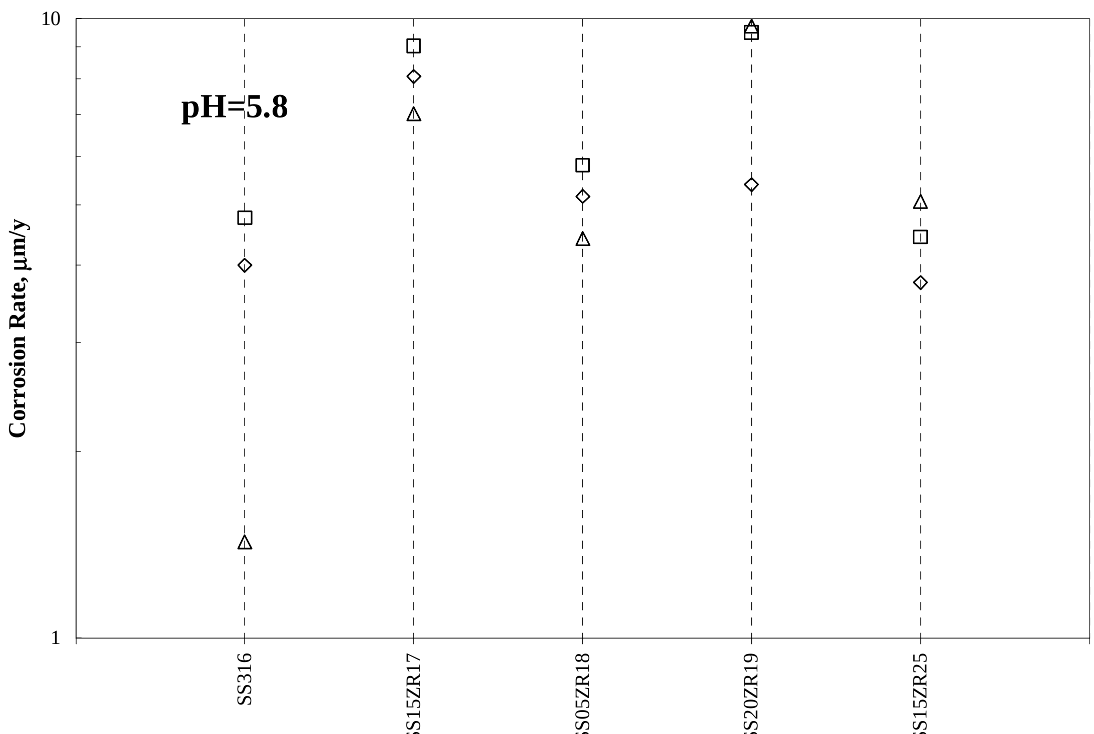

Figure I-14. Corrosion Rates Measured in 1,000 ppm Chloride (pH=5.8) Solution at 90ºC.

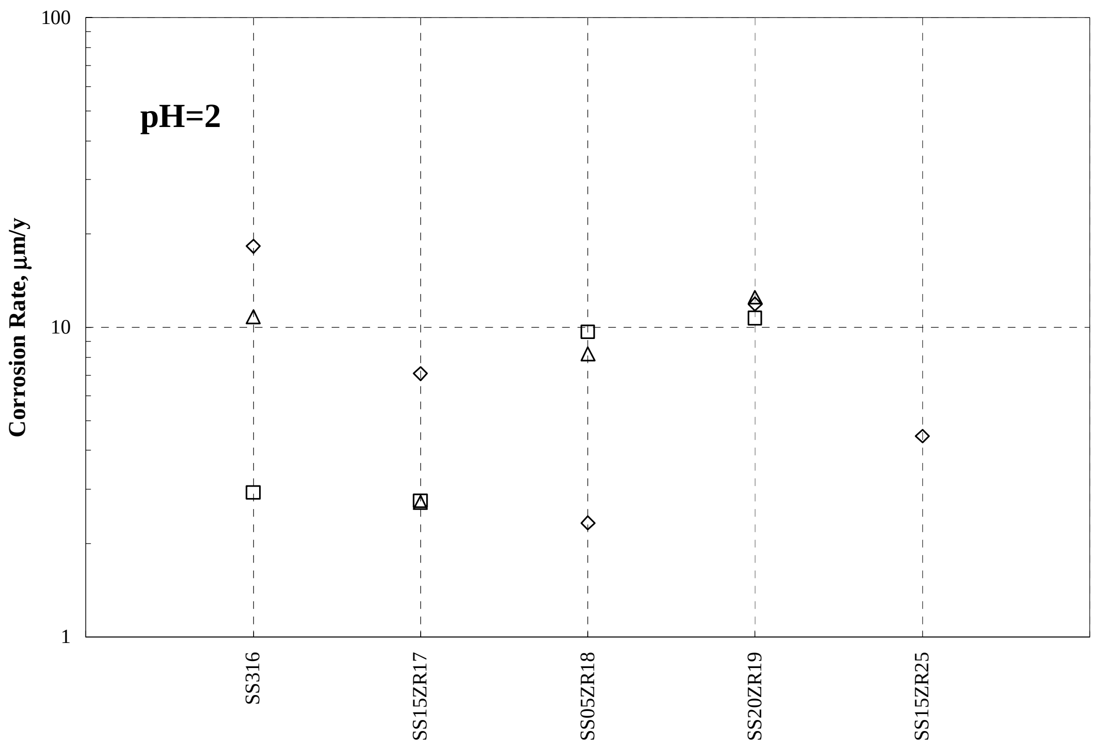

Figure I-15. Corrosion Rates Measured in pH=2 Solution at 90ºC.

Comparisons of the average corrosion rates as a function of temperature for 20, 60, and 90ºC are shown in Figures I-16 through I-20 for each solution. In these figures, the standard deviations (1σ) have been included for the 60ºC data to indicate the extent of data scatter. Standard deviations for 20ºC and 90ºC have not been included in the figures because they are so large that these standard deviations intersect. The average values shown in these graphs with the standard deviations for each temperature are tabulated in Appendix A Tables A-20 through A-24. Although for most pH values and most metal waste form alloy samples, the average corrosion rate increases with temperature, this is not true for all cases. For example, Figure I-20 for pH=2 shows this expected behavior only for the SS20ZR19 and 316 stainless steel. This departure for the average corrosion rate from the expected trend of increase in corrosion with temperature may arise from the large scatter in the data, which in some cases is as high as 50%. The source of the large scatter in the data is not known. A factor of two uncertainty has been introduced by assuming the Tafel slopes to be 0.5 volts. The polarization current uncertainty arising from the Tafel slope uncertainty and data scatter is a factor of four. Other sources of error associated with using the polarization method to determine corrosion rate have been reported by Mansfeld [5].

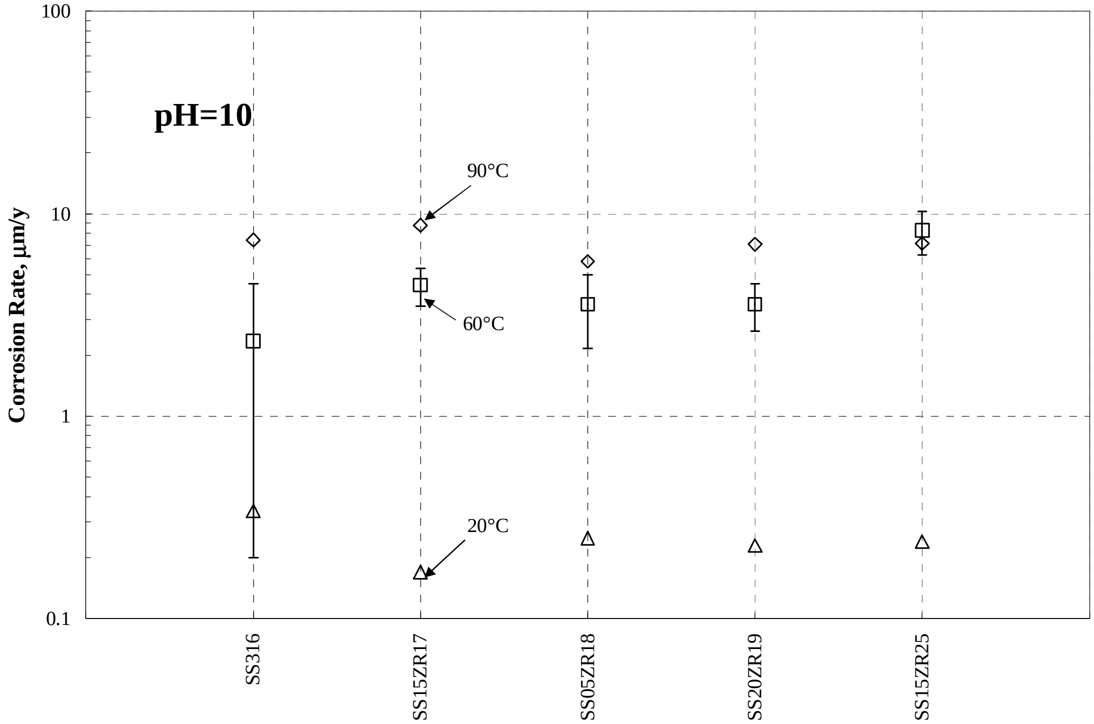

Figure I-16. Average Corrosion Rates Measured in pH=10 Solution.

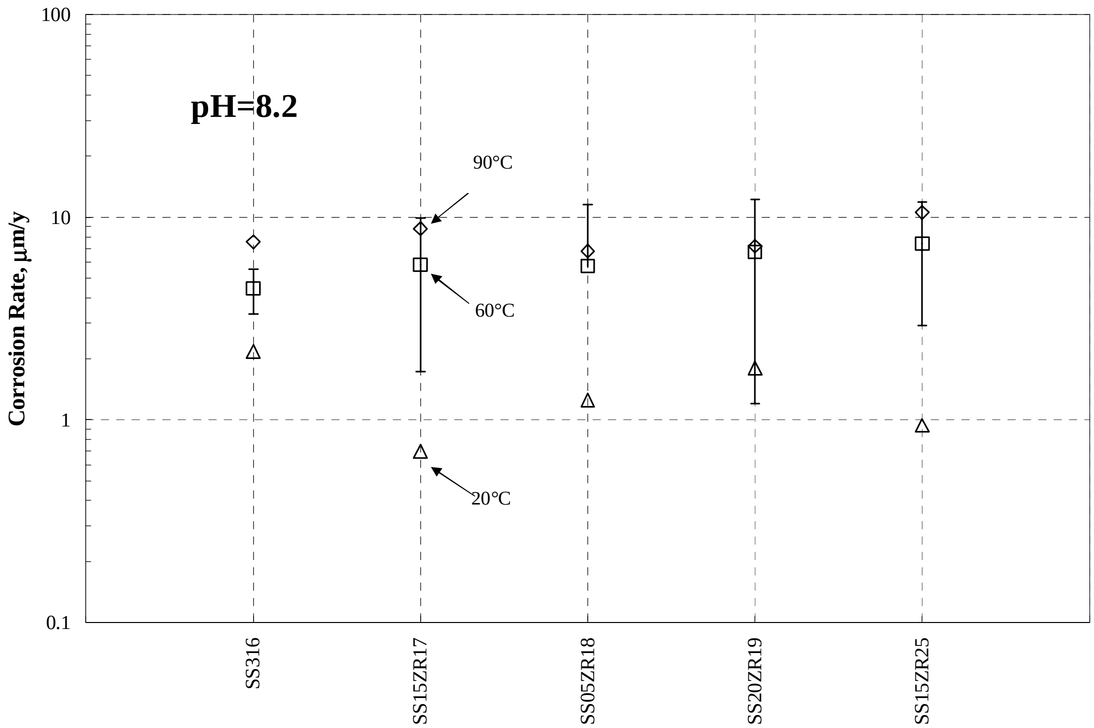

Figure I-17. Average Corrosion Rates Measured in Concentrated J-13 (pH=8.2) Solution.

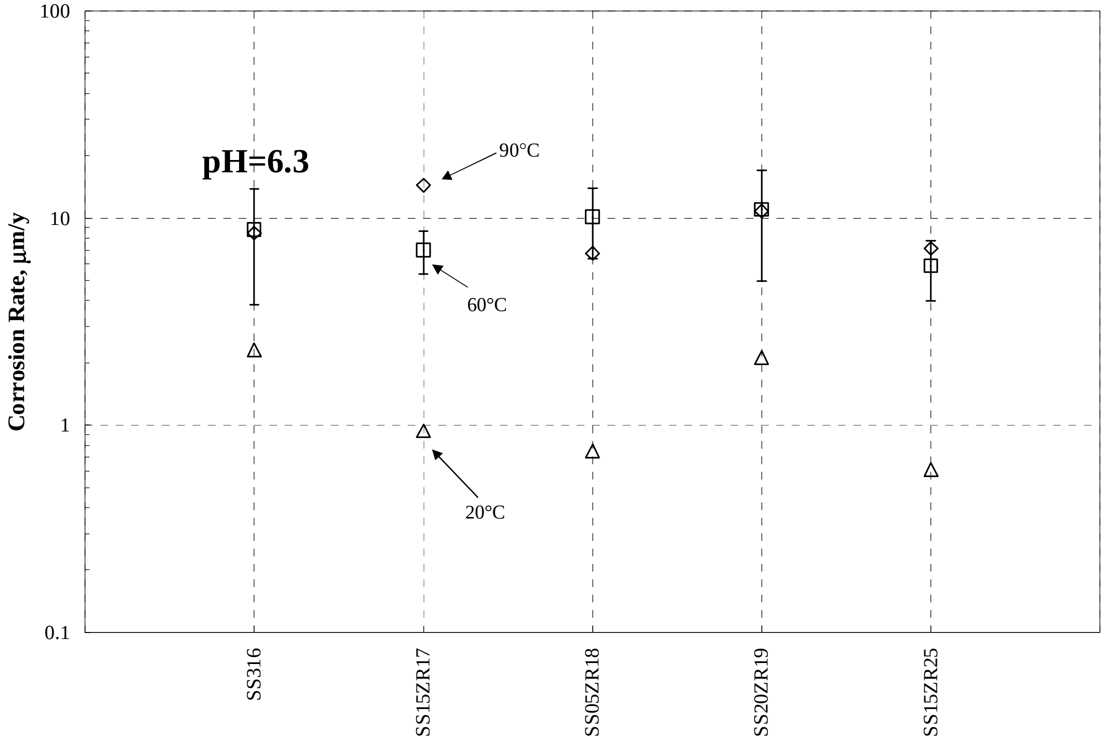

Figure I-18. Average Corrosion Rates Measured in 10,000 ppm Chloride (pH=6.3) Solution.

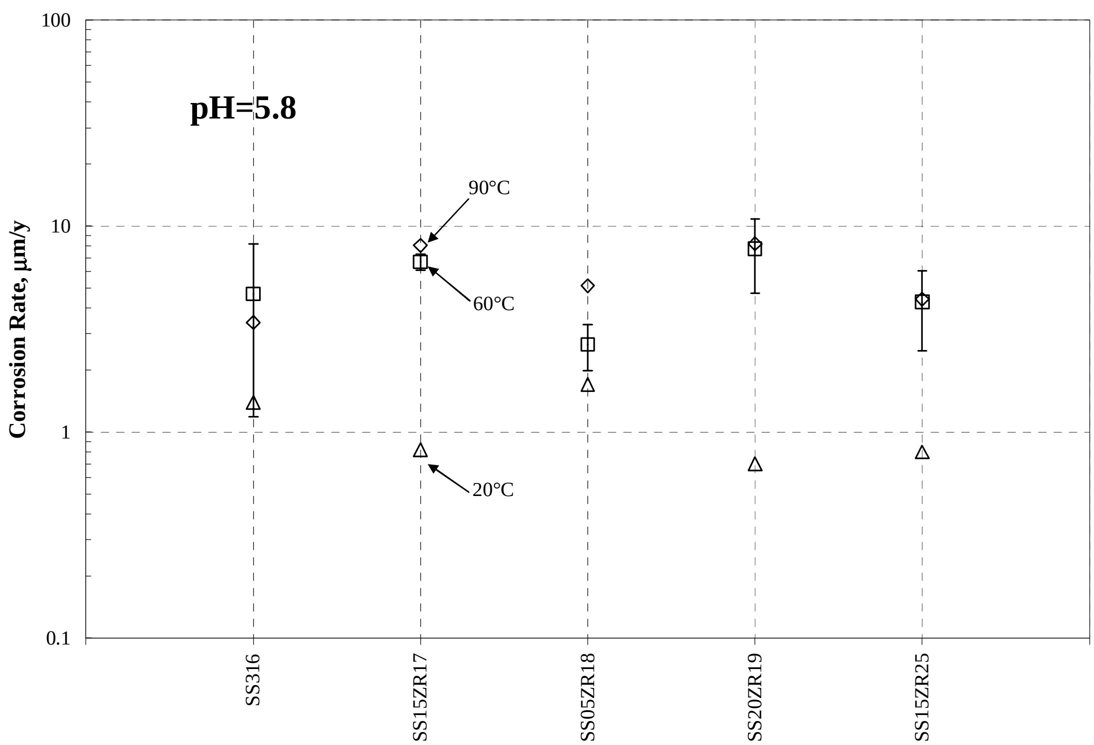

Figure I-19. Average Corrosion Rates Measured in 1,000 ppm Chloride (pH=5.8) Solution.

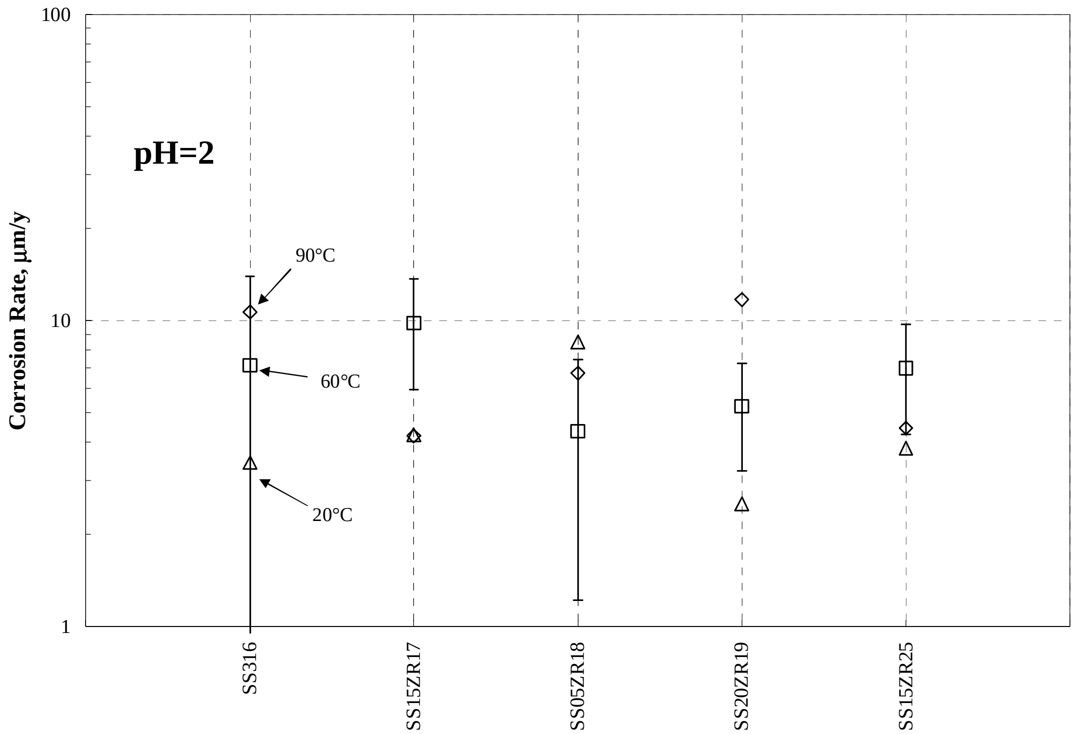

Figure I-20. Average Corrosion Rates Measured in pH=2 Solution.

Fink et al. [4] examined the available metal waste form electrochemical corrosion rate data as a function of Zr content, composition, pH, and temperature. The scatter in the data was sufficiently large that it was not possible to discern any dependence on addition of noble metal fission products, technetium, or uranium or on Zr content. Thus, all the data were analyzed together as a function of pH, temperature, and chloride content. The corrosion rate data were converted from (μm/y) to $g/(m^2y)$ by multiplying by the sample density, which given in Table I-5 for each alloy tested. The data were fit by a least squares minimization method to a number of functional forms consistent with metal corrosion. In calculation of the total variance, the contributions to the variance at each temperature were divided by the number of data at that temperature so that the fit was not biased by the temperature for which the most data were available. The best fit to the logarithm to the base 10 of the corrosion rate was obtained by the equation

$$\log_{10} CR = 1.52 + 2.07x10^{-3}\,T + 4.15x10^{-2}\,pH - 3.35\,pH/T + 1.82x10^{-7}\,Cl^{-}\,T$$

where *CR* = electrochemical uniform corrosion rate in $g/(m^2y)$
T = temperature in ºC (20ºC $\leq$ T $\leq$ 90ºC)
pH = pH of the bulk solution (2 $\leq$ pH $\leq$ 12)
Cl^- = the halide or chloride ion concentration in ppm or mg/L.

The standard deviation for the fit of the $\log_{10}$ CR is 0.36. Corrosion rates as a function of pH determined from the above equation are shown in Figures I-21 through I-23 for temperatures 90, 60, and 20ºC. The data analyzed have been included in each figure.

Note that this analysis gives an increase in corrosion rate with decreasing pH at 20ºC but the pH dependence decreases with increasing temperature. At 90ºC, the scatter in the data is so large that this analysis provided almost no dependence on pH. This lack of dependence on pH with increasing temperature is not expected for releases. Equations for releases from high level waste glass [6] show significant pH dependence at both room temperature and at higher temperatures, with minimums near neutral pH solutions.

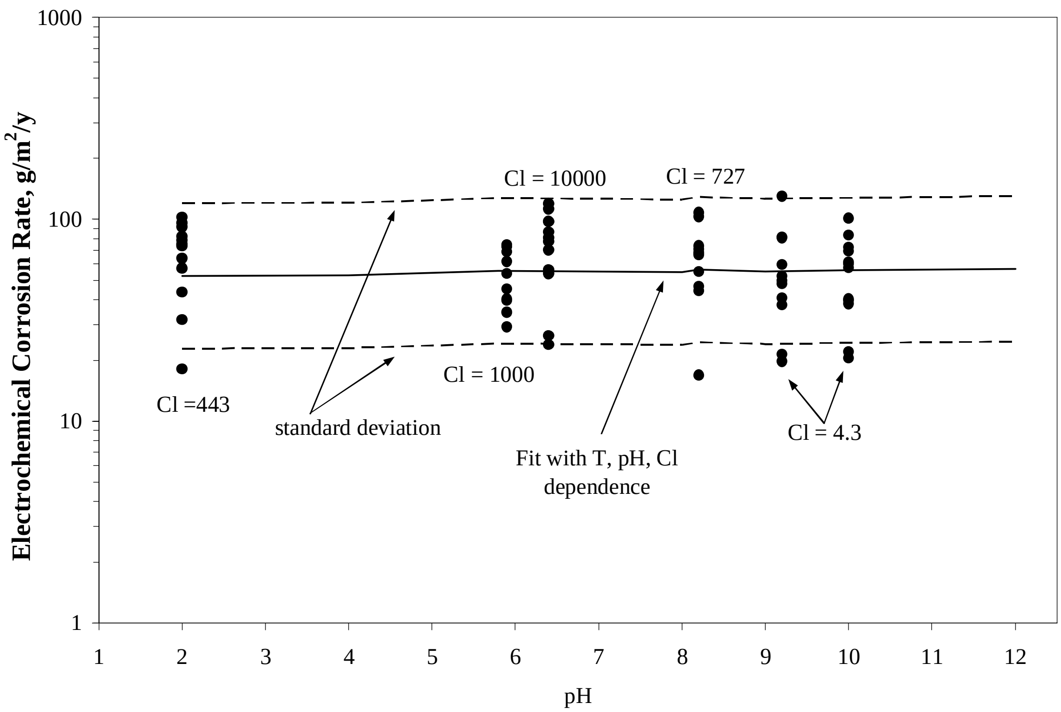

Figure I-21. Fit to Electrochemical Corrosion Data at 90ºC.

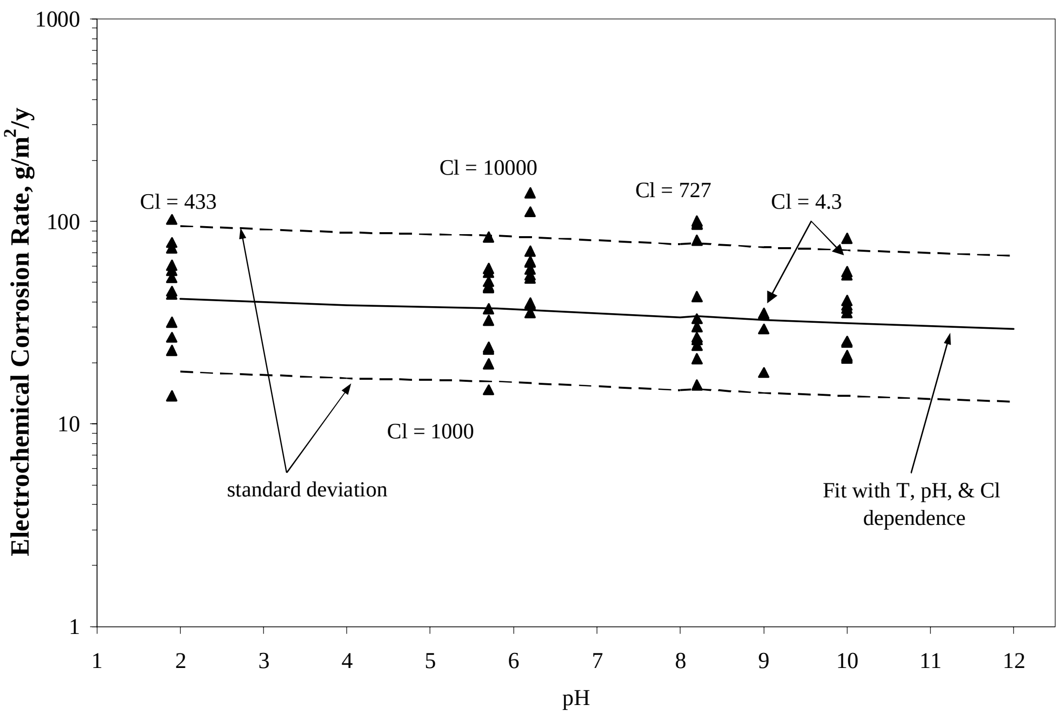

Figure I-22. Fit to Electrochemical Corrosion Data at 60°C.

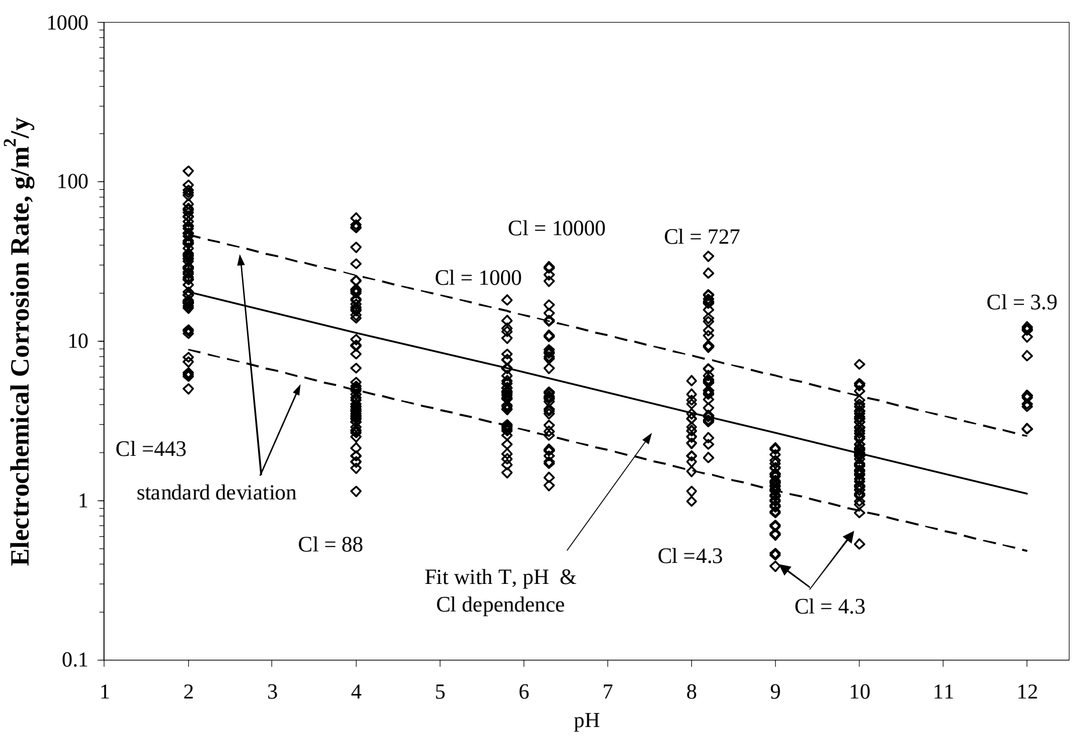

Figure I-23. Fit to Electrochemical Corrosion Data at 20°C.

The electrochemical corrosion data for the metal waste form alloys are useful for ranking the corrosion of the metal waste form relative to the corrosion of other alloys. However, it is not clear if these data are appropriate for determination of a long-term corrosion rate or for modeling releases. From his literature review and analysis of stainless steel corrosion data, Petri [7] found that long term corrosion rates for stainless steel obtained from immersion data are consistently lower than rates obtained from electrochemical measurements. At room temperature, the rates differ by about a factor of five. Both stainless steel and the metal waste form develop a passive oxide film that protects these alloys from aqueous corrosion. Because the linear polarization measurements have been made on highly polished samples, they give the initial corrosion rate during the formation of the passive oxide film not the rate after the passive oxide layer has been established.

2. Role of Passive Oxide Layer

The metal waste form, like stainless steel, develops a passive oxide layer over the iron-solid solution and intermetallic phases that limits corrosion. The long-term goal of the corrosion studies is development of a mechanistic model of aqueous corrosion and releases that includes

1. development of a passive oxide layer from reaction of metal cations with oxide ions
2. diffusion through the passive layer
3. releases from dissolution of the outer passive layer in the aqueous solution.

The point-defect model of Macdonald [8], which models the growth and breakdown of the passive oxide film of a metal has been considered by Fink et al. [4] for development of a mechanistic model for the corrosion and releases from the metal waste form. The Macdonald point-defect model is appropriate because it relates the rate of formation of the passive oxide layer to the rate of dissolution to the barrier layer-outer layer interface. The status of model development has been reported in Section V of Reference 4. A large effort is required to develop this mechanistic model, which requires identification of the corrosion products in the passive oxide layer and understanding the processes for movement of alloy elements through the passive oxide layer to react with the aqueous phase. Information required for this model development include:

1. understanding the structure of the metal waste form and the oxide layers over each alloy phase to identify the compositions of the barrier and outer oxide layer;
2. release data as a function of time under a range of conditions.

The structure of the oxide layers must be understood so that the limiting process can be identified. At present, it is not known if the limiting process is (a) diffusion of the oxide to the metal interface or (b) diffusion of elements from the metal to the oxide layer. The metal waste form and the oxide layers have been characterized from examinations using Auger electron spectroscopy, transmission electron microscopy, and X-ray diffraction. The Metal Waste Form Handbook [1] provides information on the structure of the metal waste form and characterizes the two main phases (iron solid solution and intermetallic phase) and minor phases from examinations on a number of samples. Because most fission products and the actinides are located in the $ZrFe_2$-type intermetallic phase, most examinations of the oxide layers have concentrated on the oxide over the intermetallic phase. Results of studies of the oxide layers formed on samples immersed for two years in deionized water and samples exposed to 200ºC saturated steam are summarized by Fink et al. [4]. Additional details on the examinations have been reported in a number of papers. Appendix B contains a bibliography of relevant publications by D. Abraham on characterization of the oxide layers, microstructure and phase stability of the metal waste form, and model development.

Release data as a function of time under a range of conditions are required in order to formulate the dissolution term in the MacDonald model as a function of pH, chloride and/or fluoride concentration, and temperature. Such a dissolution term may be needed for each element of interest in the metal waste form in order to develop a mechanistic model of corrosion and release.

3. Review of Releases from Existing Immersion Tests

Initial immersion tests in simulated J13 solution and deionized water for 90 and 365 days, which were reported in the Metal Waste Handbook [1], provided little data on releases because releases were so small that they were often below limits of detectability. In accord with the recommendations of the National Research Council [9], new immersion tests were done at 90ºC for periods of 7 to 365 days using more aggressive solutions (a high-chloride solution and a concentrated J-13 solution (CJ13), which contained 100 to 150 times the chloride and bicarbonate concentrations of J13 well water). Separate polished SS-15wt%Zr samples containing noble metal fission products were immersed in these solutions for 7, 14, 28, 60, 95, 182 and 365 days. The immersion tests were done in Teflon vessels. The composition of the SS-15 wt% Zr samples is given in Table I-6. Compositions of the solutions are given in Table I-7.

Table I-6. Composition (wt %) of SS15ZR25 Alloy Samples[a]

Major Elements				Noble Metal Fission Products					Minor Elements				
Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V	Si
56.5	14.1	8.65	14.2	0.8	0.98	0.93	0.92	1.66	1.13	0.19	0.4	0.09	0.32

[a]Sample composition was determined by ACL-CMT using ICPMS and ICPAES.

Table I-7. Composition of Solutions used for Immersion Tests[a]

Solution	pH	Solution Composition (mg/L or ppm)								
		Na	K	Ca	Mg	Si	SO_4^{-2}	Cl^{-1}	NO_3^{-1}	HCO_3^{-1}
1000 ppm Cl	~58	607	-	-	-	-	-	1000	-	-
Conc. J-13	~8.2	5300	510	6	1.9	30	22	727	11	12700

[a]Solutions were prepared and analyzed by ACL-CMT.

Following immersion of each sample for 7 to 365 days, the sample was examined visually for any changes and weighed. The leaching solution was analyzed. The vessel was filled with an acid wash to remove any material that had migrated to the vessel walls. Then this acid solution was analyzed. Data obtained from these examinations and analyses are summarized in tables in Appendix C. Tabulated data given in Appendix C include: mass changes and observations of the condition of the samples, concentrations of each element in the leachate and in the acid wash, the total mass released during each test, and normalized losses of each element in the leachate and acid wash. The equation used to calculate the normalized losses has been included in Appendix C.

Figure I-24 shows the total mass released during each test in the 1,000 ppm Cl^- at 90ºC. The detected masses in the solution and on the walls at the end of each test have also been included in the figure. Data from the tests lasting from 7 to 95 days show no consistency. Total releases from the 14 day test are the highest and releases from the 95 day test are the lowest. However, releases from the 365 day test are higher than those of the 182 day test, as expected. It is not known if the unusual results are from sample variability and lack of statistics or from other test variables. No conclusions regarding releases can be drawn from these data.

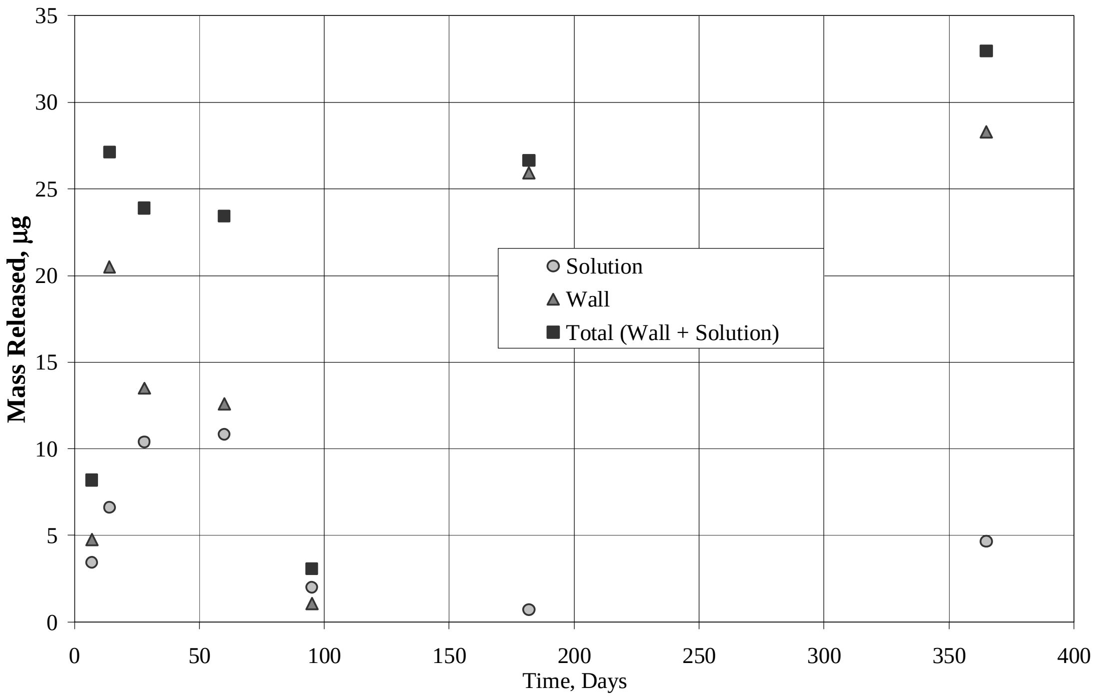

Figure I-24. Mass Releases in 1KCl Solution Tests at 90ºC.

The total mass released and masses in solution and on the walls for each of the tests in CJ13 solution at 90ºC are shown in Figure I-25. The total mass released from these tests increases with test duration for tests less than 60 days. However, for longer tests, the mass in solution does not increase with test duration but appears to reach a constant level. The total mass of the wall deposit appears to increase with length of the immersion test. The comparison of the Fe releases and Fe wall deposits with total releases and wall deposits in Figure I-26 shows that the Fe behavior is similar to that of the total releases and that Fe makes up most of the mass released and the mass deposited on the walls. It is possible that after immersion for approximately 60 days, the test solution becomes saturated in Fe and that element is then deposited on the walls.

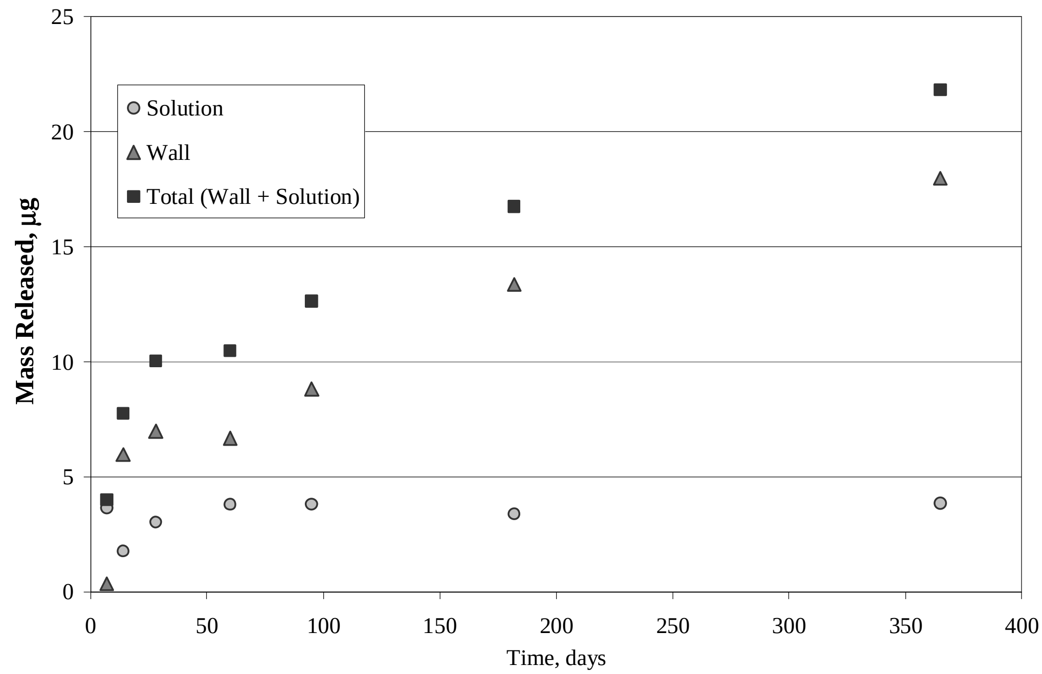

Figure I-25. Mass released in CJ13 Tests at 90ºC.

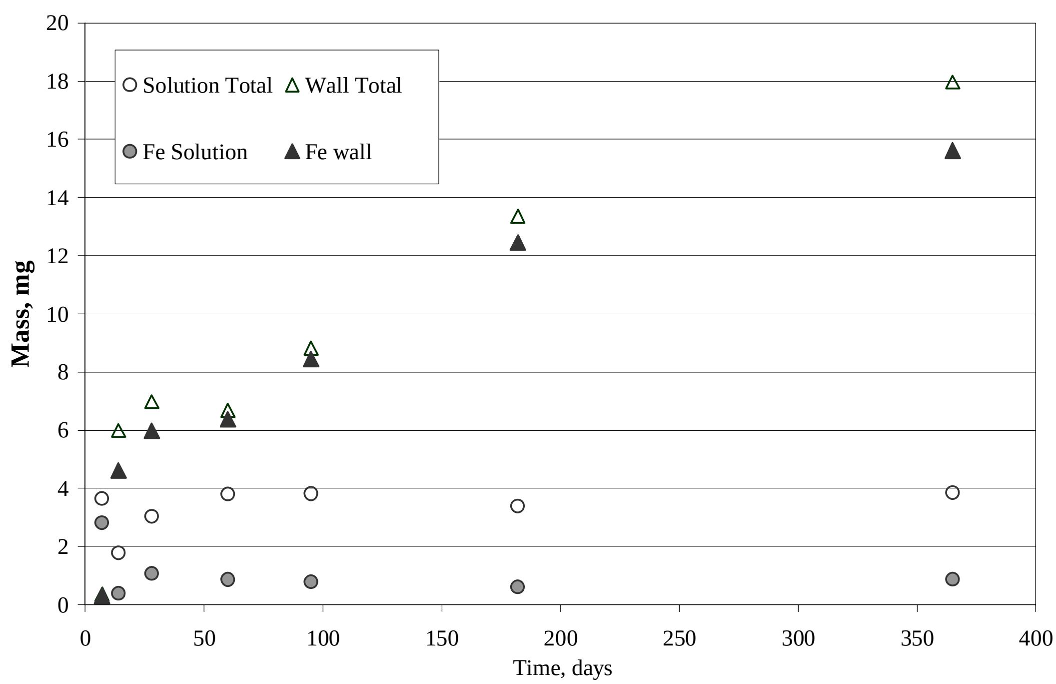

Figure I-26. Comparison of Fe Release with Total Release in CJ13 at 90ºC.

Although the release data from the tests in CJ13 solution at 90ºC (Figure I-25), appear to show more consistency than the data from the high chloride tests (Figure I-24), both sets of data have large uncertainties because (1) each test was done on a different waste form sample, (2) only one sample was immersed for each time period so no statistics exist for each datum, and (3) except for Fe in the CJ13 tests, large scatter exists in releases of a given element as a function of time in both test series.

Rates of release as a function of time calculated from the total releases and Fe and Mo normalized losses for the tests in CJ13 at 90ºC are compared in Figure I-27 with the corrosion rates from the three electrochemical corrosion tests in CJ13 at 90ºC. The corrosion rates are shown as constants because data are available only for measurements on polished samples. No data are available on how the corrosion rate changes as a function of time during which the passive oxide film is developed. Comparison of the 7 day immersion test with the electrochemical corrosion data shows that the release rates are two orders of magnitude below the electrochemical corrosion rates. For the 365 day test, the rates differ by three orders of magnitude.

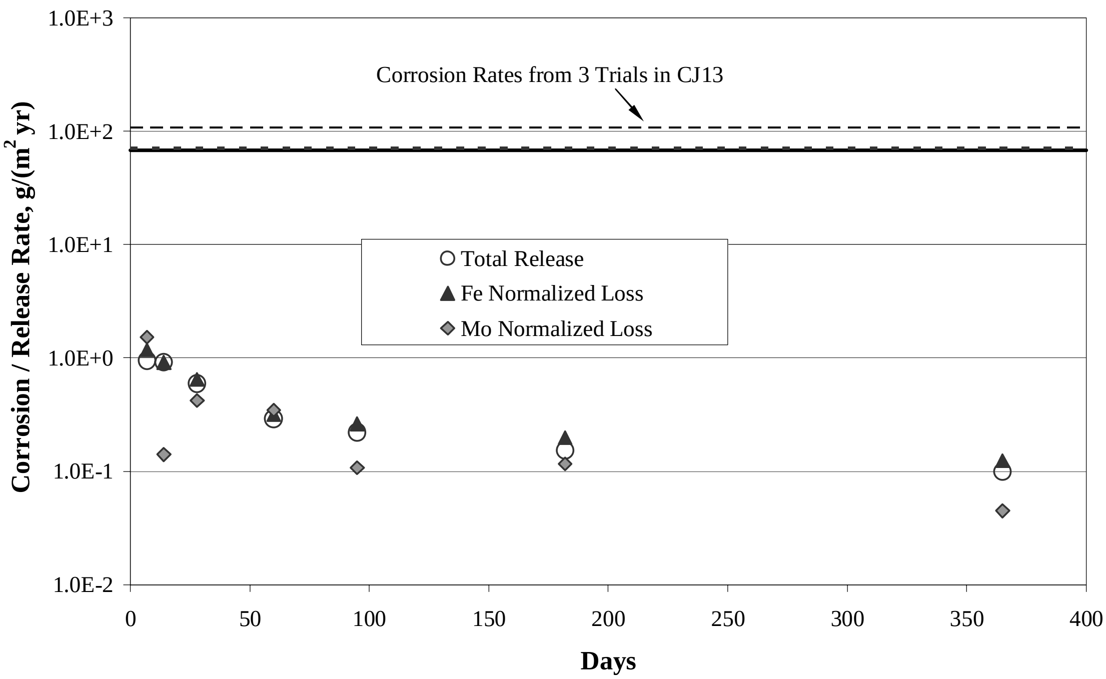

Figure I-27. Comparison of Corrosion and Release Rates from 90ºC CJ13 Tests.

B. Need for Additional Immersion Tests

The available data discussed above are not adequate for development of a mechanistic corrosion and release model, such as the point defect model of Macdonald [8]. The initial immersion tests in simulated J13 solution and deionized water for 90 and 365 days [1] were done under such benign conditions that meaningful release rates could not be determined from the data. The total release data as a function of time on samples immersed for different times at 90ºC in CJ13 solution and in 1000 ppm Cl^- solution are inadequate for model development because these data do not provide release as a function of time for one sample, lack statistical information to estimate uncertainties, and raise some questions regarding the tests such as the possibility of Fe saturation of the solution for tests longer than 60 days.

New immersion tests are needed to answer a number of questions, which are discussed below.

1. In the Yucca Mountain repository, the metal waste form would be oxidized by air for a number of years prior to any aqueous corrosion. During this time, a passive oxide layer would be formed on the sample. Immersion tests on both polished and oxidized samples under the same conditions are needed to determine if pre-oxidation prior to contact with water makes any difference on the releases.

2. Consideration has been given to co-packaging the metal waste form with the ceramic waste. This could result in water high in chloride contacting the metal waste form. Thus tests on multiple samples in high chloride solutions are needed to provide release data with good statistics to determine the effect of chloride on releases.

3. The effect of pH on releases is not known because all immersion tests have been done at pH levels very close to 8 (the pH of simulated J13 solution). Electrochemical tests showed little pH dependence at 90ºC but significant pH dependence at room temperature. Electrochemical tests do not measure releases and the relation between electrochemical tests and releases (if any) is not known. Thus, tests at 90ºC in an aggressive solution with a very low pH (pH=2) where any effect on releases from the change in pH will be evident are needed. If these tests indicate pH dependence, then additional tests are required to determine the pH dependence of releases.

4. Comparison of Fe releases from tests of samples immersed in CJ13 at 90ºC for different times showed that the Fe release increased with exposure time for short times of exposure but reached a maximum for longer exposures. It is not clear if this apparent leveling off, which was observed in the longer tests, is due to limitation of Fe release from Fe saturation of the water or if the reduction in the Fe release rate with time is from formation of protective passive oxide layers on the two phases. To determine if Fe saturation limited the Fe releases for longer exposure times, tests are needed in which the samples are put in new solutions after weekly terminations so that the solutions do not become saturated. Analysis of the solutions from these weekly terminations will determine if the Fe release rate decreases with immersion time.

II. EXPERIMENTAL

Immersion corrosion tests were initiated on nonradioactive samples of the metal waste form in May and October, 2000. The tests were based on Materials Characterization Center Protocol #1 (MCC-1) (ASTM C 1220) [10], a static leach test procedure initially developed to evaluate glass-based waste forms. It measures selective leaching of elements from the waste form into representative test solutions, and provides chemical durability and corrosion resistance information.

This procedure describes the steps needed for the time-dependent study of elemental releases into solution of the metal waste form, SS-15Zr-1Nb-1Ru-1Pd-1Rh. The results of this study will be incorporated into a database in order to develop a mechanistic model for the corrosion of metal waste form alloys. The corrosion model is being developed as part of the Yucca Mountain Performance Assessment Studies for SS-15Zr waste forms.

Immersion tests at 90°C in four solutions were initiated May 2, 2000. Additional tests were initiated October 17, 2000, consisting of 90°C and ambient room temperature. Solution identification and test vessel information can be found in Table D-1. The SJ13 solution is intended to replicate the groundwater in the J-13 well at the Yucca Mountain geologic repository. However, the J-13 solution prepared for these immersion tests did not contain fluoride, which has been reported at a level of 2.2 mg/L in samples of J-13 well-water [11] (see Table 1 in the Introduction). The other solutions represented stringent conditions that may be encountered by the waste form during the lifetime of the geologic repository [12]. The immersion tests started in May were conducted on 3 samples polished to 0.5 µm and 2 samples polished to 0.5 µm and pre-oxidized at 500ºC for 2 hours. The immersion tests started in October were conducted on 1 sample polished to 1 µm. Each sample was machined by the CMT machine shop from ingots SS15Zr25 and SS15Zr26 cast with a nominal composition of SS15Zr1Nb1Pd1Rh. Each round coupon had a sample area of 219.9 mm^2. When placed into the Teflon vessel, each sample rested on a Teflon support surrounded by the designated solution. The test vessels were contained in a secondary container filled with deionized water, and were placed into an oven set at 90°C or placed in a designated area of the countertop in laboratory H-126. At certain time intervals, each sample was removed from the Teflon vessel, examined visually, and placed into a cleaned Teflon vessel filled with fresh solution. The acidified test solution, any residue present, and an overnight "acid strip" solution from the terminated Teflon vessel was weighed and analyzed by the Analytical Chemistry Laboratory. The samples were analyzed by Inductively Coupled Plasma—Mass Spectrometry (ICP-MS) and Inductively Coupled Plasma—Atomic Emission Spectrometry (ICP-AES). Each test termination yielded 2x30-mL high-density polyethylene sample bottles for each Teflon test vessel, and dried residue from any solutions in which one may be present. The first sample bottle contained the leachate from the vessel. This solution along with the dried residues measured the elemental constituents of the alloy that dissolved in the solution. The second bottle contained the acid-strip solution that measured the elemental constituents of the alloy that deposited on the walls of the vessels. The combined data from the three analyses provided a measure of the alloy dissolution during the experiment. The as-polished samples were expected to provide information on elemental release during the buildup of the passive layer, and the pre-oxidized samples are expected to yield information on the steady state release from the alloy samples.

Sample analysis data was received and incorporated into a database along with all sample parameters. All elemental release and control blank concentrations were converted to normalized loss (NL_i) according to the following equation:

Normalized Loss Formula with No Correction for Blanks

Used for Comparing Fe Normalized Loss with High Level Glass Waste

$$NL_i = \frac{\left[\frac{(C_i d_i V_i) + (C_i V_i)_{AS}}{V_i} + C_R\right] * V_i * 0.001}{A * f_i}$$

NL_i = Normalized Loss (g/m^2)
C_i = Concentration of i^{th} element in solution (μg/L)
d_i = dilution factor for test solution containing i^{th} element (because solution is acidified)
V_i = Volume of test solution containing i^{th} element (mL)
AS= Acid Strip (refers to elemental concentration and volume of acid strip solutions)
A = area of specimen (mm^2)
f_i = fraction of i^{th} element in specimen
C_R = Concentration of i^{th} element in residue (μg/L)

Notes:

1. The 1st term in the equation gives the elemental content in the test and acid strip solutions.

2. The multiplication factor 0.001 is used to convert the normalized loss value to g/m^2.

Converting release concentration data to normalized loss provides an indication of the quantity of a given element released into solution based on the weight fraction of the element in the alloy, and the surface area of the sample coupon in contact with the immersion test solution. Comparison of the data with high level waste glass data is possible when in this form.

III. RESULTS

A. Initial Tests

1. Releases of Elements from Each Test

After each sampling interval, the total release of each element was determined from the release to the solution, the release to the walls (obtained from the acid strip wash), and the detected residue. The releases detected in the test solution, in the acid strip from the walls, and the residues for each element are shown as bar graphs in Appendix E. Tabulated values are in Appendix F. Average detection limits for the leachate and acid strip have been included on the bar graphs. The detection limits of each element as a function of time are given in Appendix G. Detection limits varied from day to day, depending on the instrument calibration. This variation of detection limits led to spurious results when the element released was so low that it was not detected except on the days when the detection limit was lower than usual.

Appendix H contains graphs of the total releases of each element from the five metal waste form samples (3 polished, and 2 pre-oxidized) in the 90ºC tests in four solutions (SJ13, CJ13, 10KCl, and AJ13) for each sampling interval, as a function of sampling interval. The amount of each element detected in the control vial solution has been included as a bar graph for comparison. The control data provide useful information regarding the uncertainties in the tests. These uncertainties are discussed below for the metal waste form major elements (Fe, Zr, Cr, and Ni), the fission product elements (Nb, Pd, Ru, Rh, and Mo) and the minor elements (Mn, Cu, Co, and V).

Appendices J-M contains results from room temperature tests and from the 1KCl test at 90ºC.

a) Effect of Reuse of Teflon Vials on Releases of Major Elements

These tests showed that the Teflon vials should not be reused. The standard cleaning procedure for the first 22 weeks (154 days) of the 90ºC tests was to thoroughly rinse the vessels and boil for 1 hour in deionized water, then clean the vessels according to the 1996 ASTM "Standard Test Method for Static Leaching of Monolithic Waste Forms for Disposal of Radioactive Waste" [10]. After the initial boiling step, the cleaning procedure consisted of filling each vial with 1wt% HNO_3 and placing it into the oven at 110ºC for 24 hours. After removal from the oven, the vials were emptied, rinsed, and boiled again for 1 hour in deionized water. The vessels were refilled with deionized water and placed back into the oven for 16 hours. Upon removal from the oven and cooling, the pH of every vessel was checked to ensure it was in the pH range of 5-7. The vials were dried in the oven overnight, allowed to cool, then reused immediately for immersion testing or placed in a sealed plastic bag for storage. Then the vials were reused.

Later tests of second acid washes on vials showed that the cleaning procedure did not always remove all the material that had migrated into the wall, particularly when the vial had been used for the high chloride solution or the pH=2, AJ13 solution. Although the masses removed from the wall with the second acid wash are small relative to the releases in AJ13 and 10KCl and did not affect those test results, they are not always small compared to releases in SJ13 and CJ13. Reuse of vials from aggressive solutions (AJ13 and 10KCl) for the less aggressive solutions (SJ13 and CJ13) could give a higher release from the acid wash of the wall, which removes elements that are in the wall. Figures III-1 and III-2, which show the Fe release in SJ13 and CJ13, illustrate the problem of contamination from the Fe that remained in the Teflon wall. According to Appendix D, which gives the order of vial reuse, the vial for the SJ13 control sample analyzed on day 98 had been previously used for a metal waste form sample for the first week test in 10KCl. The large Fe release in the blank is most likely Fe that was not removed from the Teflon walls in the acid wash. Samples P7, P8, and P9 in CJ13 for day 98 were also in Teflon vials that had been previously used for the first week 10KCl test. These samples had much higher releases than the day 98 CJ13 Samples O10 and O11, which were in Teflon vials that had previously been used for a blank and for an AJ13 test, respectively.

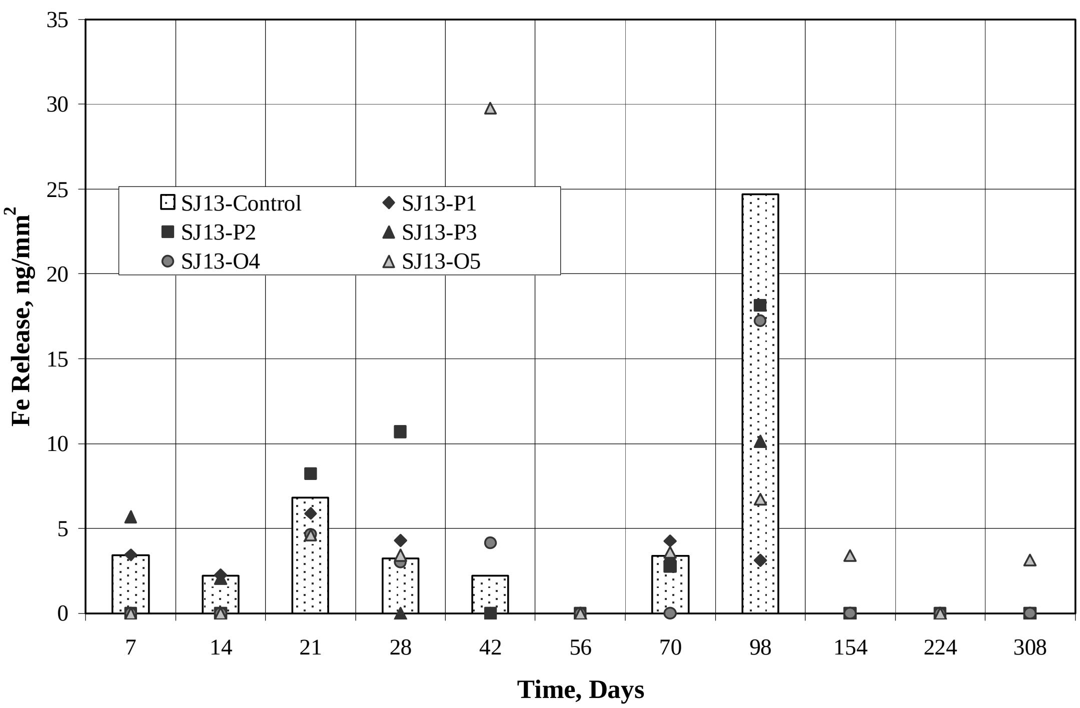

Figure III-1. Iron releases in SJ13 at 90°C.

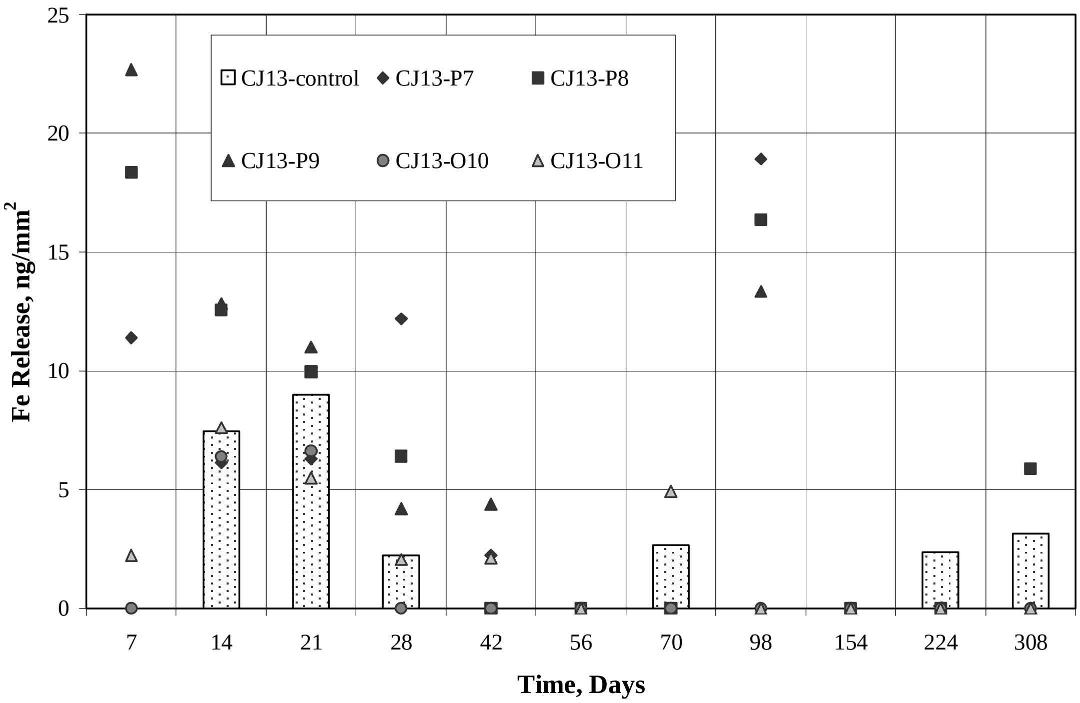

Figure III-2. Iron releases in CJ13 at 90ºC.

These figures also illustrate that the releases in SJ13 and CJ13 were so low even for the major elements released, that the detected releases were near the amount of element detected in the blank samples—even for the tests after week 22 (154 days) when new vials were used for each test.

b) Effect of Variation of Detection Limits on Reported Releases

Some fission-product elements and minor elements had releases that were near the detection limits—particularly in solutions SJ13 and CJ13. For elements released near the limit of detection, the variation in the detection limit determined whether or not any element was detected. An example of this is the release of Pd in SJ13, shown in Figure III-3. The solution detection limits for Pd in SJ13 ranged from a low of 0.0030 ng/mm^2 on day 14 (week 2) to a high of 0.037 ng/mm^2 on day 21 (week 3). The acid strip detection limits for Pd in SJ13 ranged from a low of 0.003 ng/mm^2 on week 2 (day 14) to a high of 0.044 ng/mm^2 on week 3 (day 21). Thus, if Pd was released during the time from week 2 (day 14) to week 3 (day 21) at the same rate as the previous week, it would not have been detected in either the solution or the acid strip from week 3 (day 21). Another example, shown in Figure III-4, is the detection of 0.069 ng/mm^2 of Ru from sample 2 immersed in SJ13. Ru was detected in the acid strip of the walls on week 22 (day 154), which had a detection limit of 0.03 ng/mm^2 for that day. The detection limit from the acid strip ranged from a low of 0.007 ng/mm^2 to 0.27 ng/mm^2. No other Ru was detected from any sample immersed in SJ13 for the entire test series.

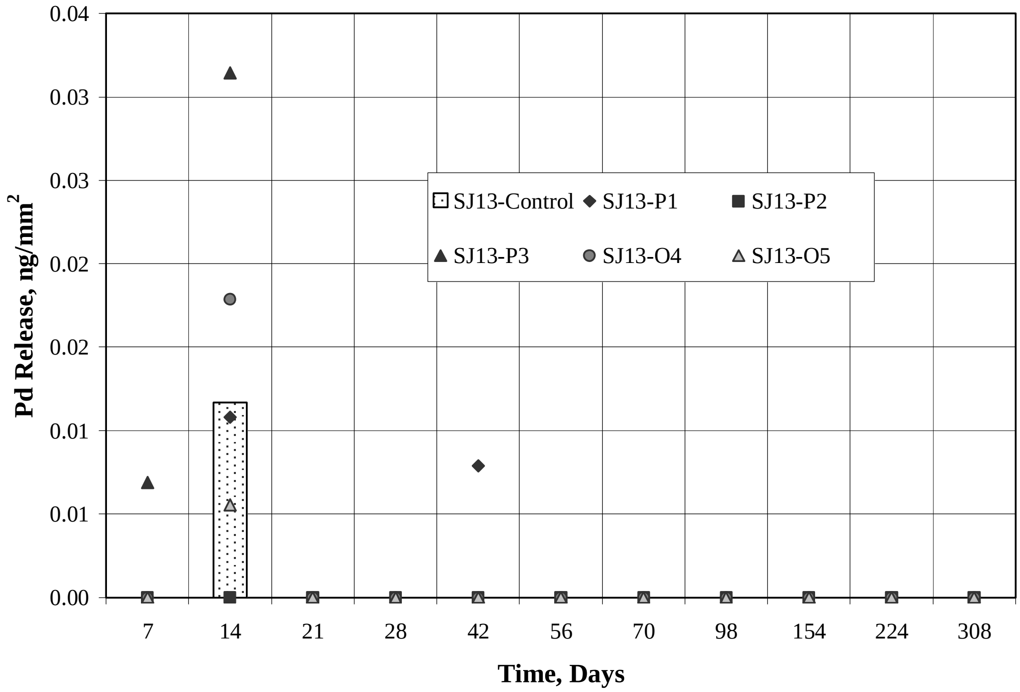

Figure III-3. Palladium releases in SJ13 at 90ºC.

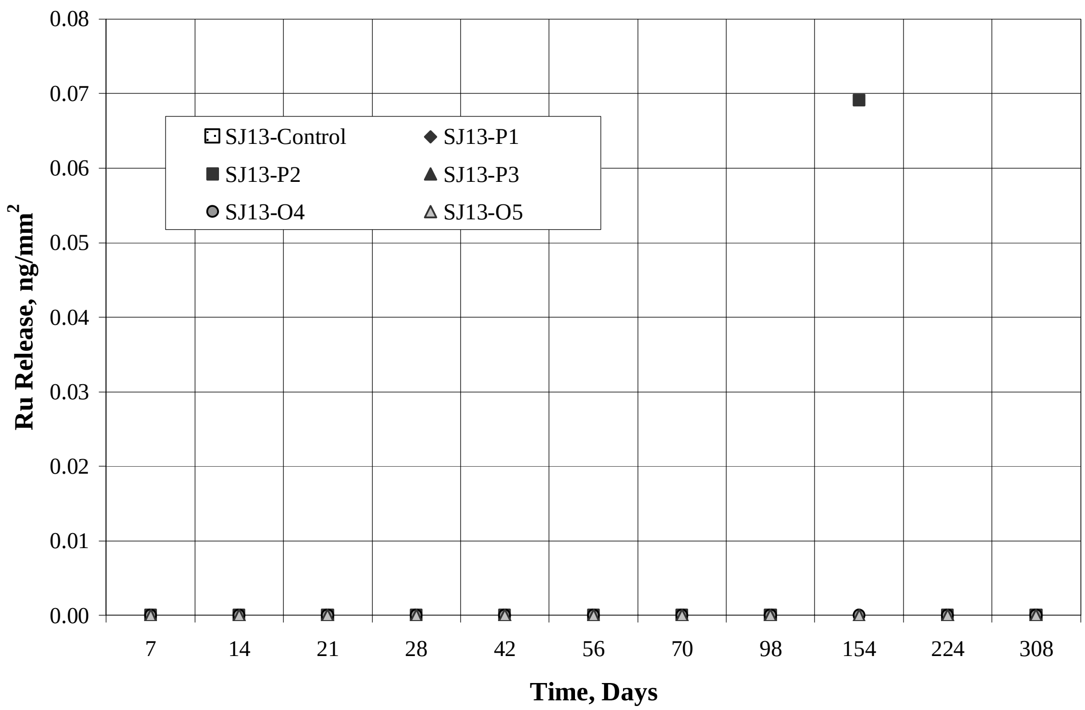

Figure III-4. Ruthenium releases in SJ13 at 90ºC.

c) Sample Contamination of Minor Elements & Mo

Examination of releases of Mo, Cu, and V showed unusual fluctuations that could not be attributed to changes in detection limits or previous use of vials. Upon checking the history of laboratory use during the test time of high releases, it was found that experimenters not related to the Metal Waste Form Project were using the laboratory balance to measure powders containing Mo, Cu, and V. It is believed that the test samples were contaminated from airborne powders of these elements. Thus, reported releases of these three elements are not reliable. Figure III-5 shows unusually high Mo from residue on week 4 (day 28) in the 10KCl test. Examination of the test data for the other samples shows similar high Mo from residue. It is believed this is from sample contamination.

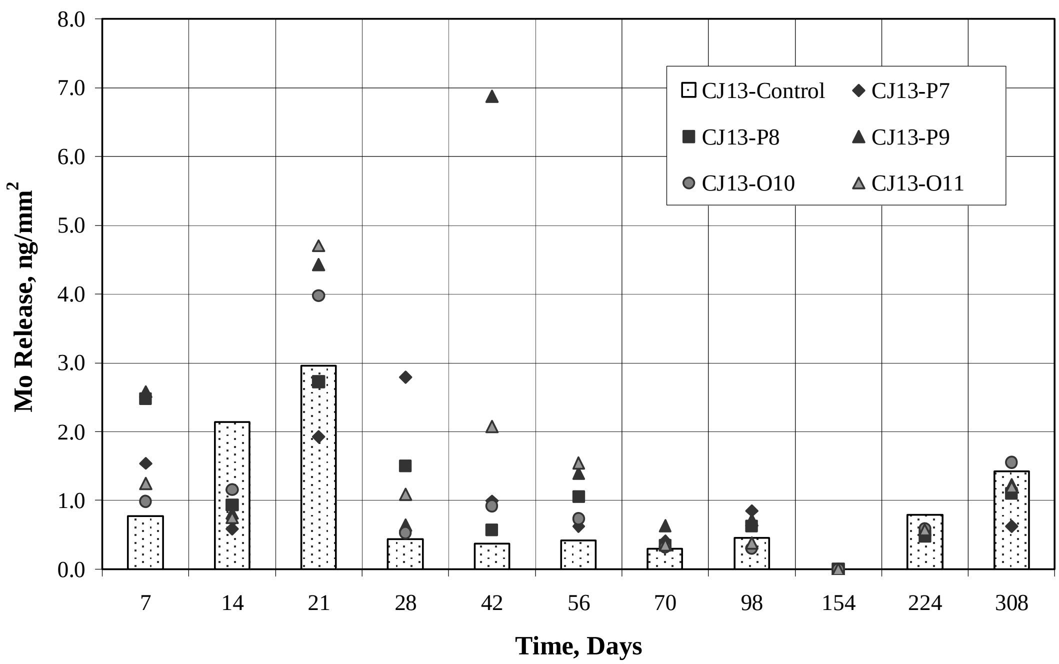

Figure III-5. Molybdenum releases in CJ13 at 90ºC.

The Cu and V release data in Appendix E show random high releases. Although some could be from changes in detection limits, others are most likely related to contamination from other work with powdered Cu and V in the laboratory.

d) Mo and Minor Elements (Mn, Co, Cu, and V)

Because of contamination problems for Mo, Cu, and V and the lack of interest in the low released minor elements, releases of these elements will not be discussed. These elements have not been included in the reported total release. Inclusion or not inclusion of the minor elements, Mn and Co, make no difference in the total release. However, inclusion of the elements for which the solutions were sometimes contaminated (Mo, Cu, and V) in the sum of the total release may produce occasional increases from the contamination in SJ13 tests when the releases of the major elements were small. Because the data for Mo, Cu, and V lack validity because of contamination, they have not been included in the total release.

2. Cumulative Releases at 90ºC for Each Solution

a) SJ13:

Except for the releases of Fe and Zr, few elements were detected from the immersion tests in SJ13. Cr and Rh were not detected in any of the examinations. The small amounts of Ni and fission-product elements detected were near the limits of detection. The total cumulative releases, which is defined as the sum of the major elements (Fe, Zr, Cr, Ni) and the fission product elements (Pd, Nb, Ru, Rh), are shown in Figure III-6 from five samples in SJ13. The higher releases for sample SJ13-O5 relative to the other samples arises from the combined higher releases of Zr and Fe for that sample.

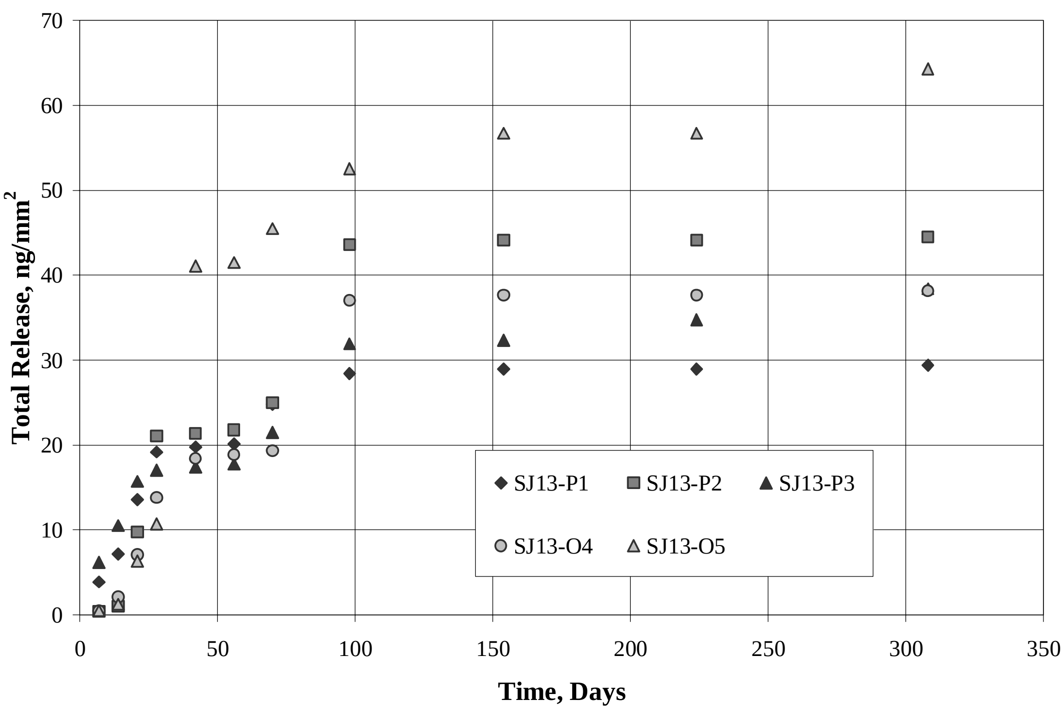

Figure III-6. Total cumulative releases in SJ13 at 90ºC.

Release of Major Elements

The amounts of Fe detected in SJ13 solutions were low compared to the Fe detected in the more aggressive solutions, AJ13 and 10KCl. Thus, removal of Fe from walls of Teflon vials reused from the high chloride and pH=2, AJ13 solutions adds uncertainty to the cumulative Fe release in SJ13, as discussed above. The cumulative release of Fe in SJ13 at 90ºC is shown in Figure III-7. The large scatter and jumps in the data are related to vial reuse and indicate the uncertainty in the reported results. The cumulative release data for Zr in SJ13 at 90ºC is shown in Figure III-8. The large scatter between the different immersion samples arises because the releases are so small. In fact, amounts of

Zr detected in the control vials from SJ13 tests were almost as high as that from vials that contained Metal Waste Form samples. Figure III-9 indicates that Ni was only detected in two samples at two times. No Cr was detected in any samples immersed in SJ13 at 90ºC.

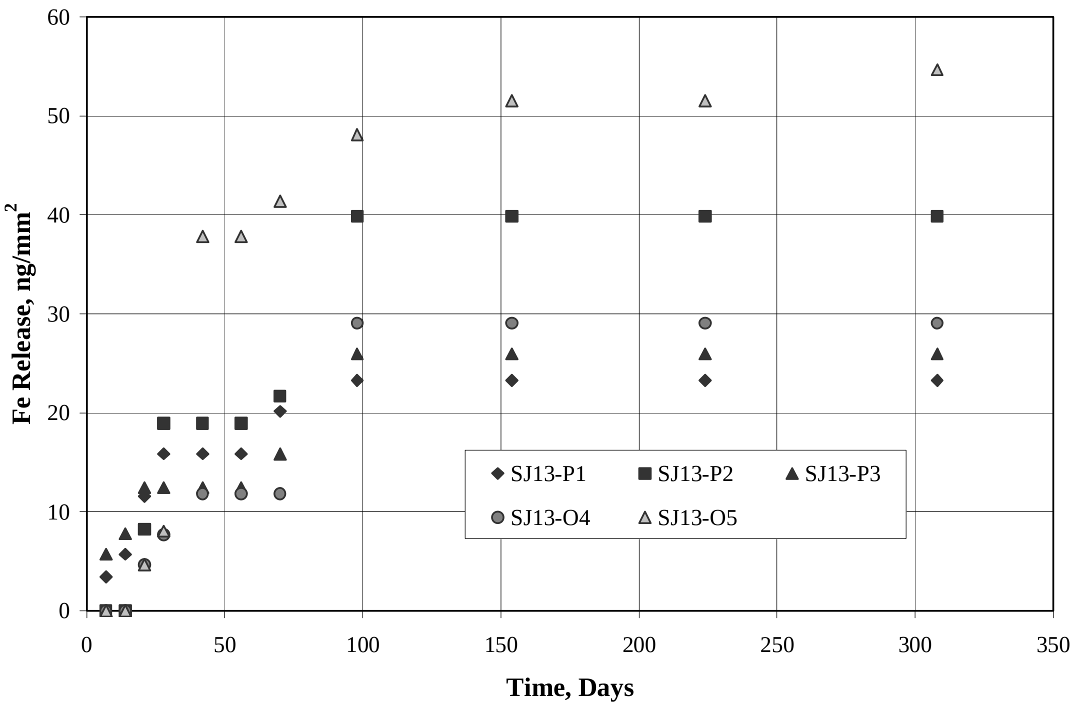

Figure III-7. Cumulative Iron releases in SJ13 at 90ºC.

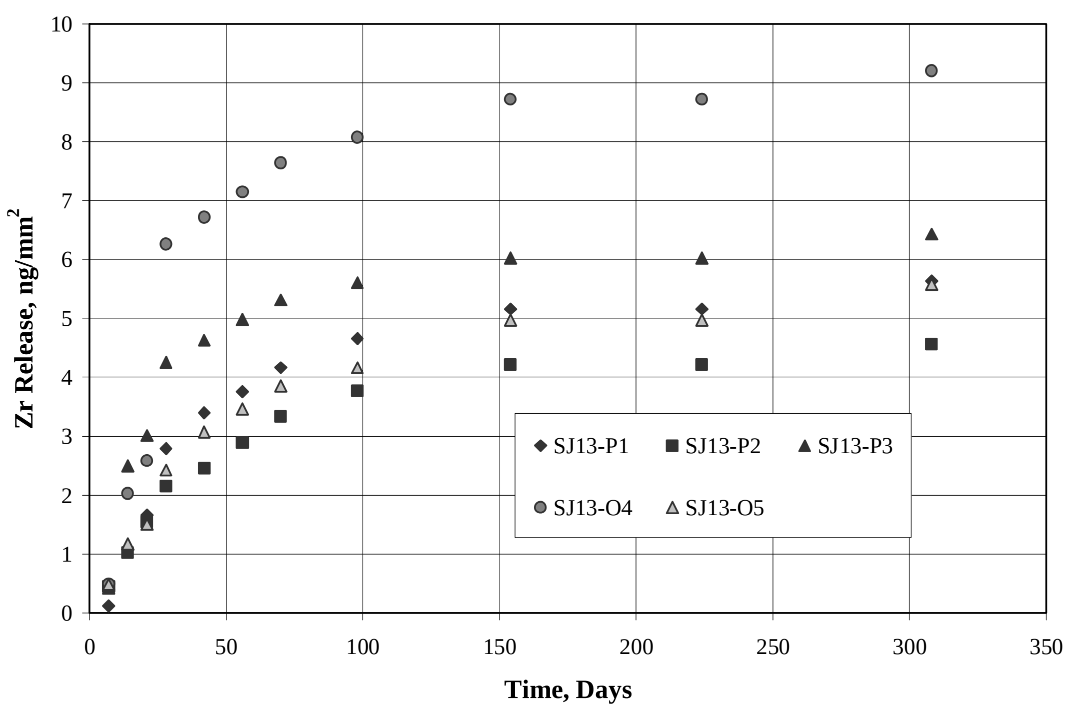

Figure III-8. Cumulative Zirconium releases in SJ13 at 90ºC.

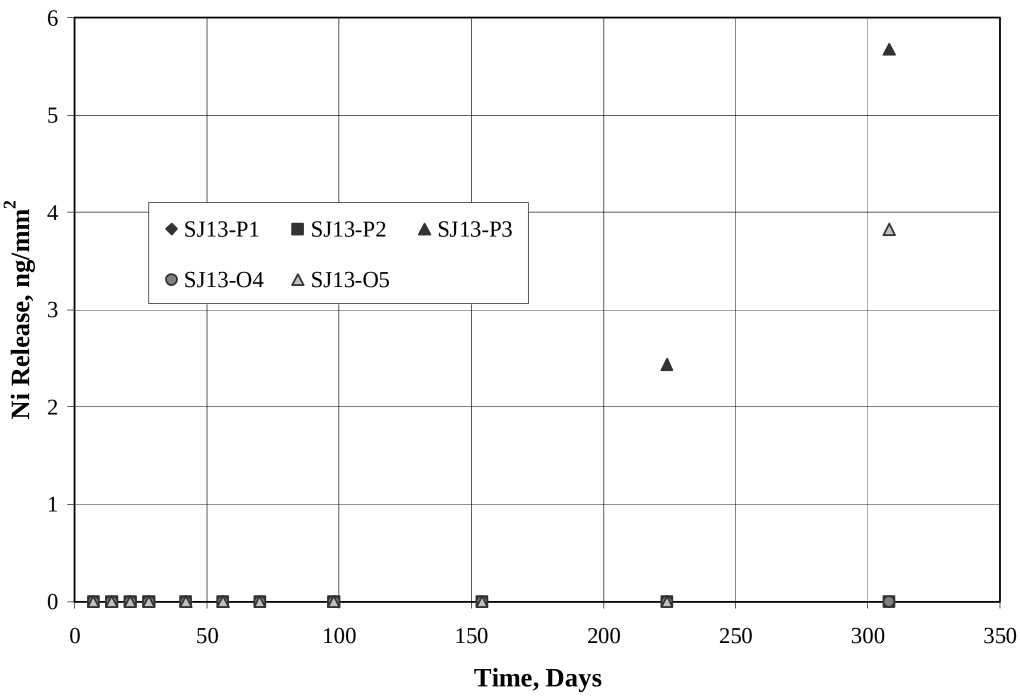

Figure III-9. Cumulative Nickel releases in SJ13 at 90ºC.

Release of Fission-Product Elements

The cumulative release of Ru, shown in Figure III-10, shows a jump at 154 days for one sample and then a constant value because Ru was detected in only one acid strip wash of sample P2 during week 22 analysis, as discussed above. The scatter in the cumulative Pd release, shown in Figure III-11, results from the Pd release being so close to the detection limit, that it is only detected on days when the detection limits were unusually low, as discussed above. The large scatter in the cumulative Nb release, shown in Figure III-12, indicates that these data have significant uncertainty because of the low Nb release.

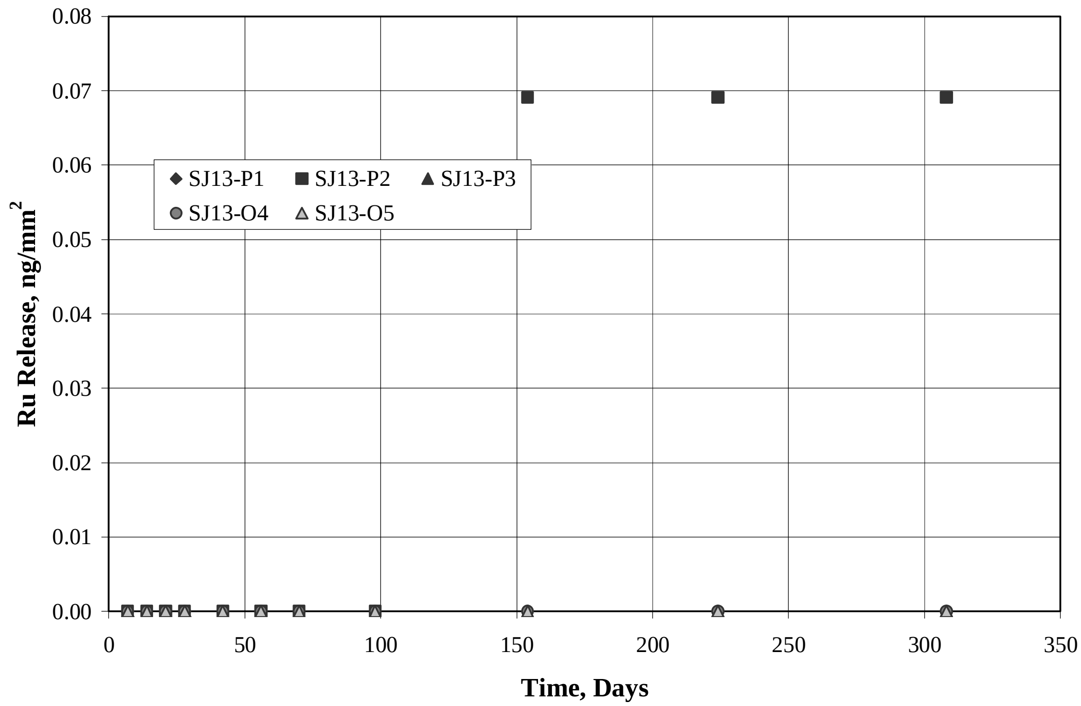

Figure III-10. Cumulative Ruthenium releases in SJ13 at 90ºC.

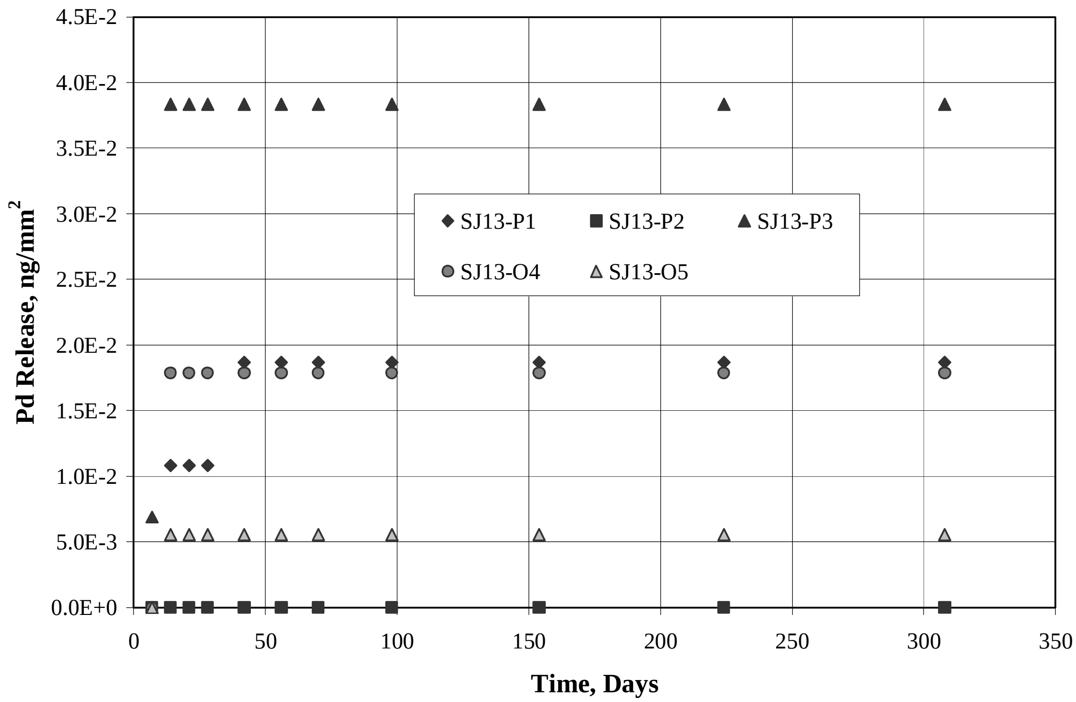

Figure III-11. Cumulative Palladium releases in SJ13 at 90ºC.

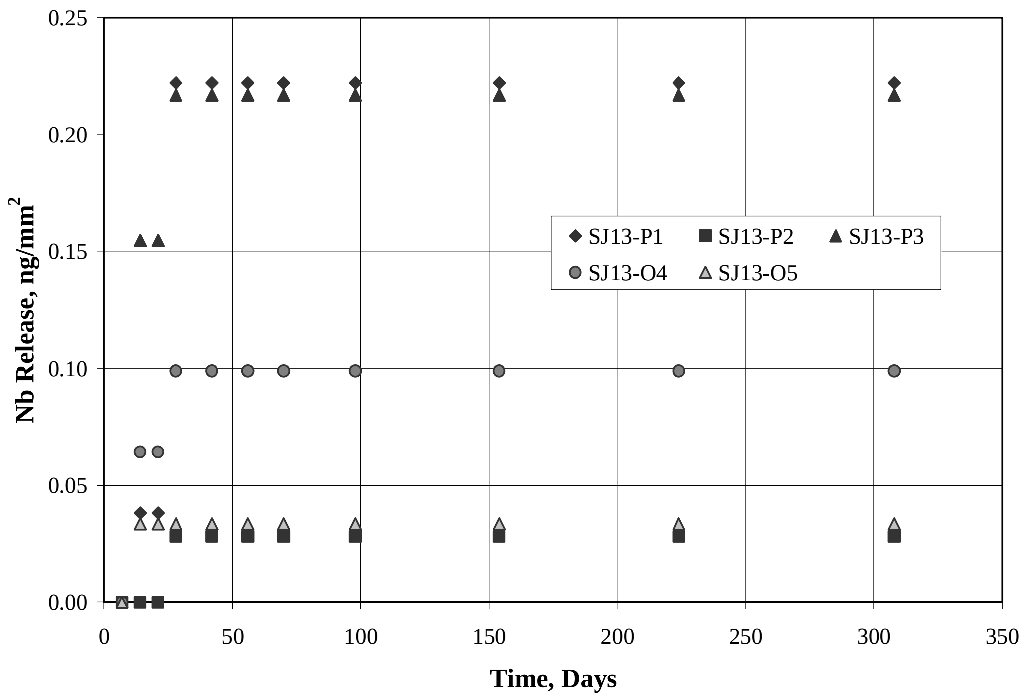

Figure III-12. Cumulative Niobium releases in SJ13 at 90°C.

SJ13 Summary

Figure III-13 compares the averages of the cumulative releases of Fe, Zr, and the fission-product elements with the average total release in SJ13. The average release of Ni, which was released at similar levels as the fission-product elements, has not been shown because inclusion of Ni in the figure would make it more difficult to discern differences of the fission-product elements. Figure III-13 shows that the main contribution to the total cumulative release is the release of Fe. Zr release is about an order of magnitude lower. Fission-product element releases are even lower and are close to their detection limits. In some cases, an element was detected in only one test—a test that had a lower detection limit than other tests. This indicates that longer time intervals between analysis of the solutions are needed. Thus, normalized losses based on these data may not be reliable.

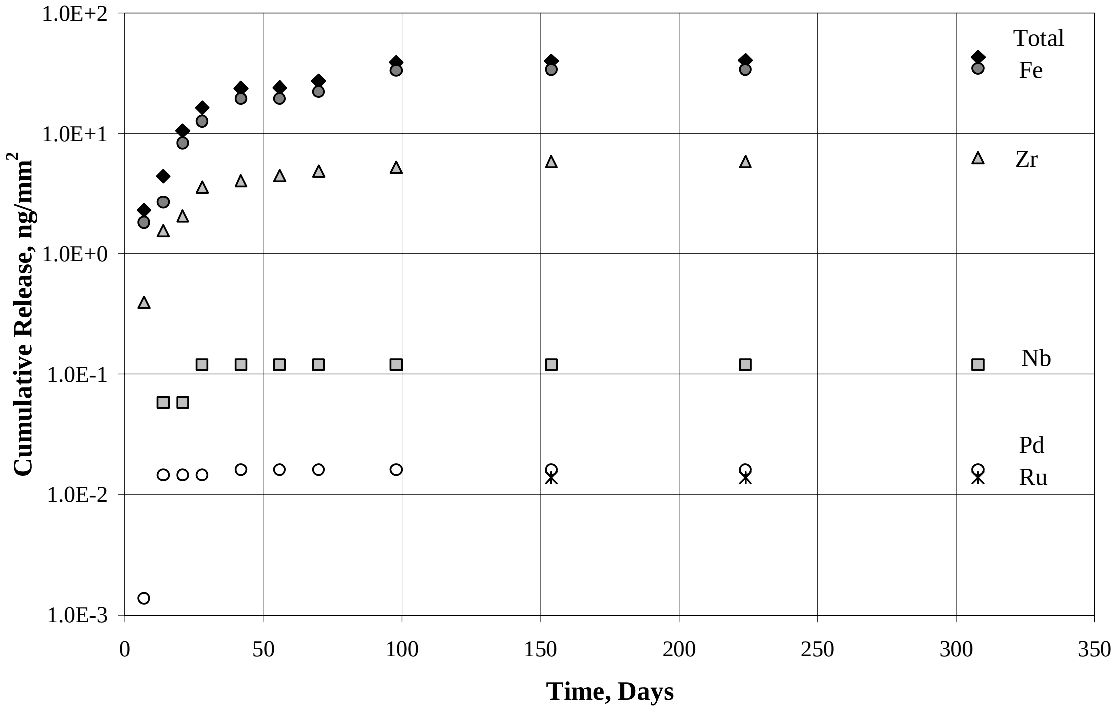

Figure III-13. Average cumulative release in SJ13 at 90°C.

b) CJ13:

The CJ13 solution was selected to have a similar pH to that of SJ13 but to be a little more aggressive, yet not as aggressive as the high chloride and AJ13 solutions. Total releases of the major elements (Fe, Zr, Cr, and Ni) and the fission-product elements (Pd, Nb, Rh, Ru) in CJ13 are shown in Figure III-14. These total releases are only slightly higher than the total releases in SJ13, Figure III-6. This solution appears to differ from SJ13, in that the total releases of the two pre-oxidized samples (O10 and O11) are consistently lower than the releases from the polished samples.

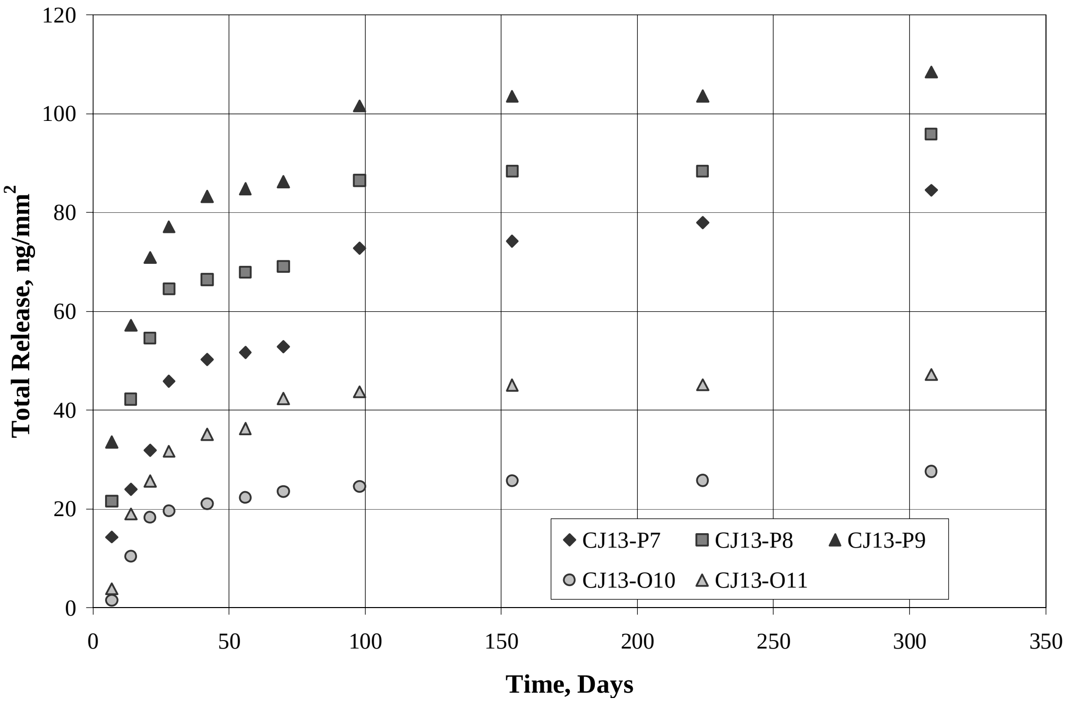

Figure III-14. Total cumulative releases in CJ13 at 90ºC.

Release of Major Elements

The cumulative releases of Fe from samples immersed in CJ13, shown in Figure III-15, show similar behavior to the total releases in CJ13. The differences between the Fe releases from polished and oxidized samples for the first few weeks are more pronounced than for the total releases in CJ13. The jump in the releases from the polished samples at day 98 may be from Fe leaching from the walls because the vials for these three samples were previously used for a test in 10KCl, which aggressively attacks the Fe. The samples that do not show the jump had been previously used as a control and for an AJ13 test. Cumulative releases of Zr in CJ13 are shown in Figure III-16. The large scatter in the data for the first two weeks affected all subsequent cumulative releases. Like the Fe releases, Zr releases from sample O10 are the lowest, but the Zr releases from the polished sample P7 are lower than the releases from the oxidized sample O11, indicating that the oxidation may not affect the Zr releases as much as the Fe releases. Figures III-17 and III-18 indicate that little Ni and Cr were detected in CJ13, just like SJ13 releases of these elements.

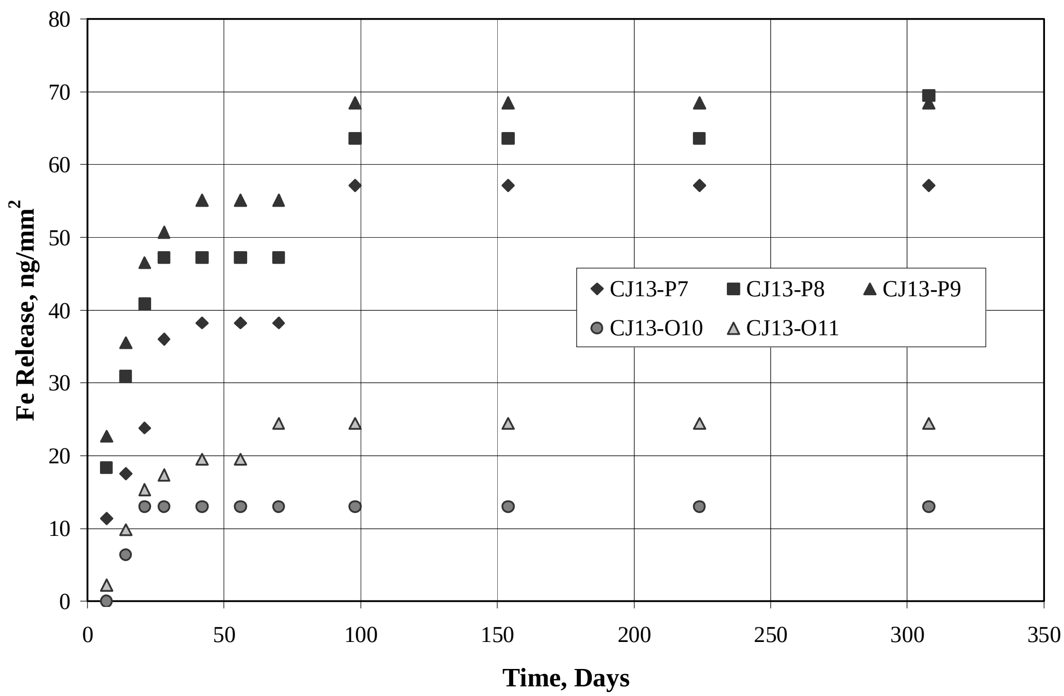

Figure III-15. Cumulative Iron releases in CJ13 at 90°C.

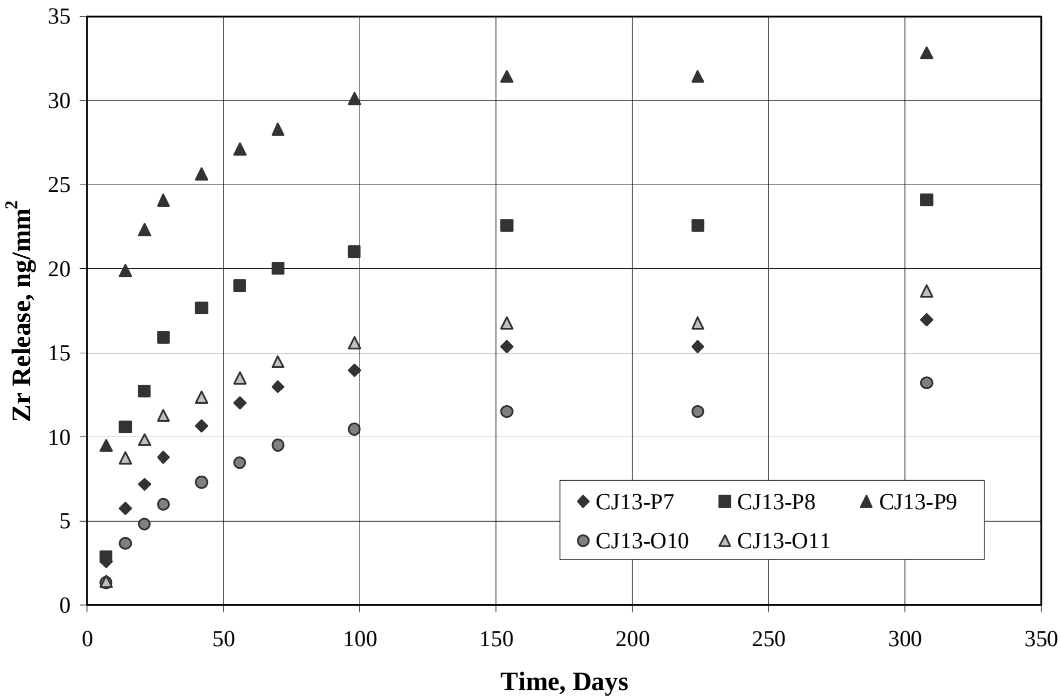

Figure III-16. Cumulative Zirconium releases in CJ13 at 90°C.

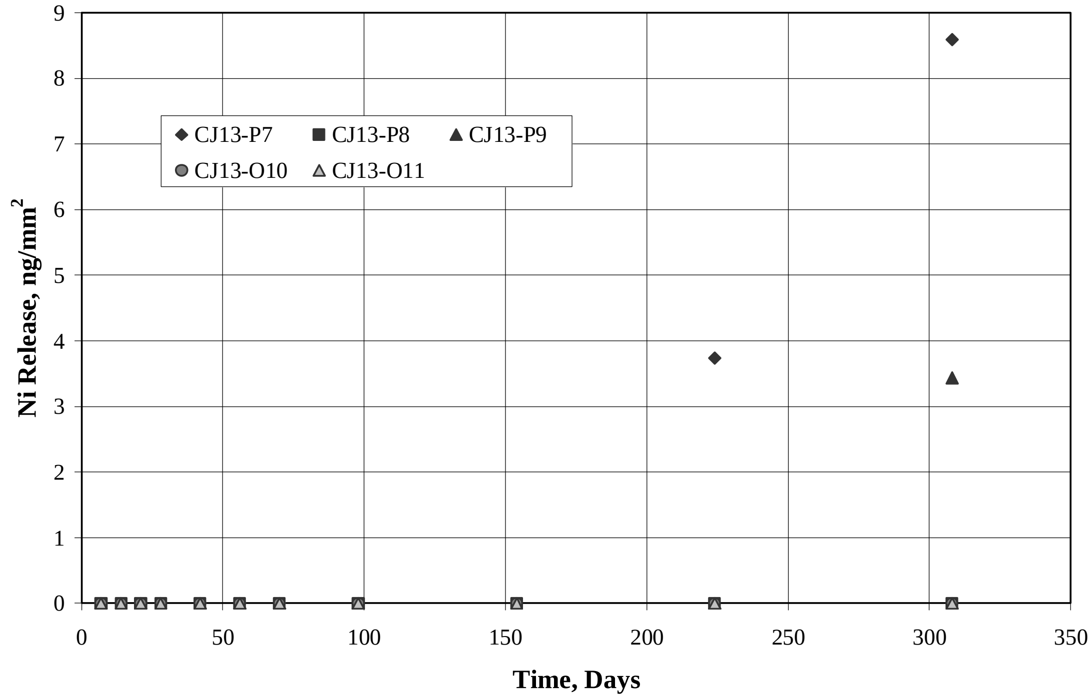

Figure III-17. Cumulative Nickel releases in CJ13 at 90ºC.

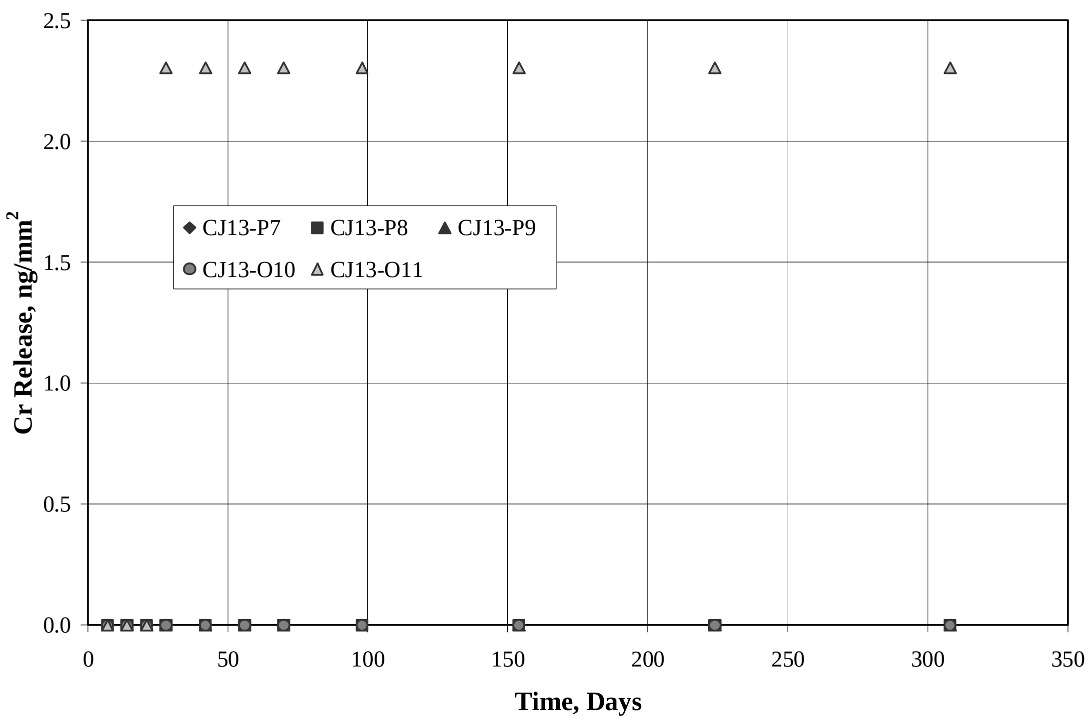

Figure III-18. Cumulative Chromium releases in CJ13 at 90ºC.

Release of Fission-Product Elements

Cumulative releases of the fission products, Nb, Pd, Ru, and Rh in CJ13 are shown in Figures III-19 through III-22. Releases of these fission products were detected in all samples for the first week of the tests. Figure III-19 shows that Nb releases from oxidized samples for the first four weeks were consistently lower than the Nb releases from polished samples, similar to the Fe release. Although the cumulative releases of Pd, shown in Figure III-20, are of similar magnitude to the Nb releases, the amounts of Pd detected in the control vials are often as large as the amount of Pd detected from Metal Waste Form samples (see Appendix F) indicating uncertainty in these data. Except for the first week of tests, releases of Ru and Rh were so small that they were often near detection limits or near the amounts detected from control vials.

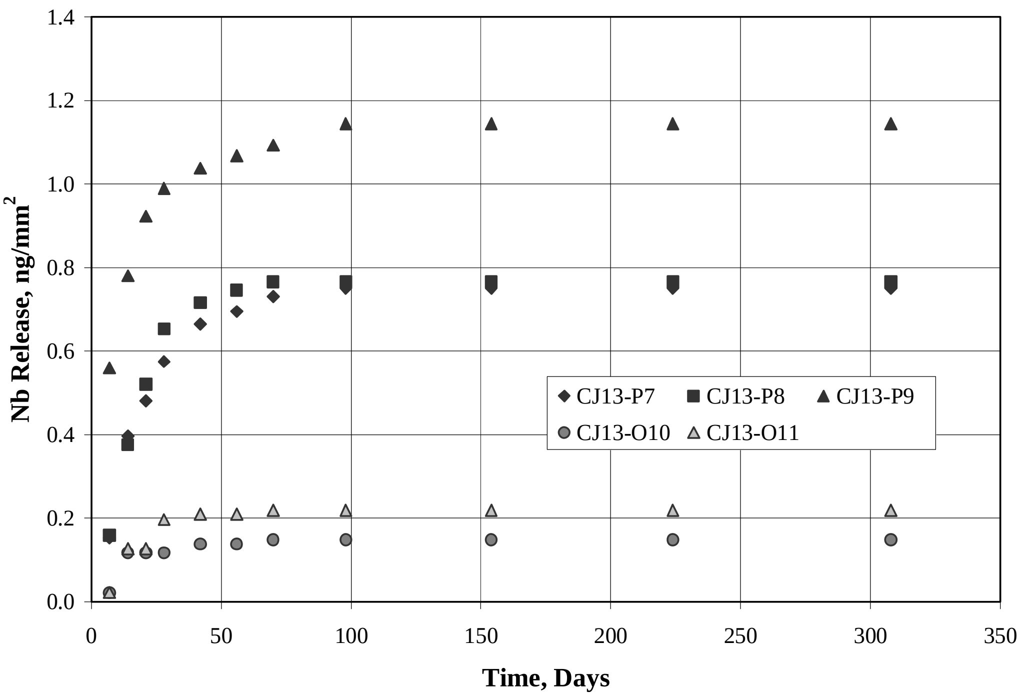

Figure III-19. Cumulative Niobium releases in CJ13 at 90ºC.

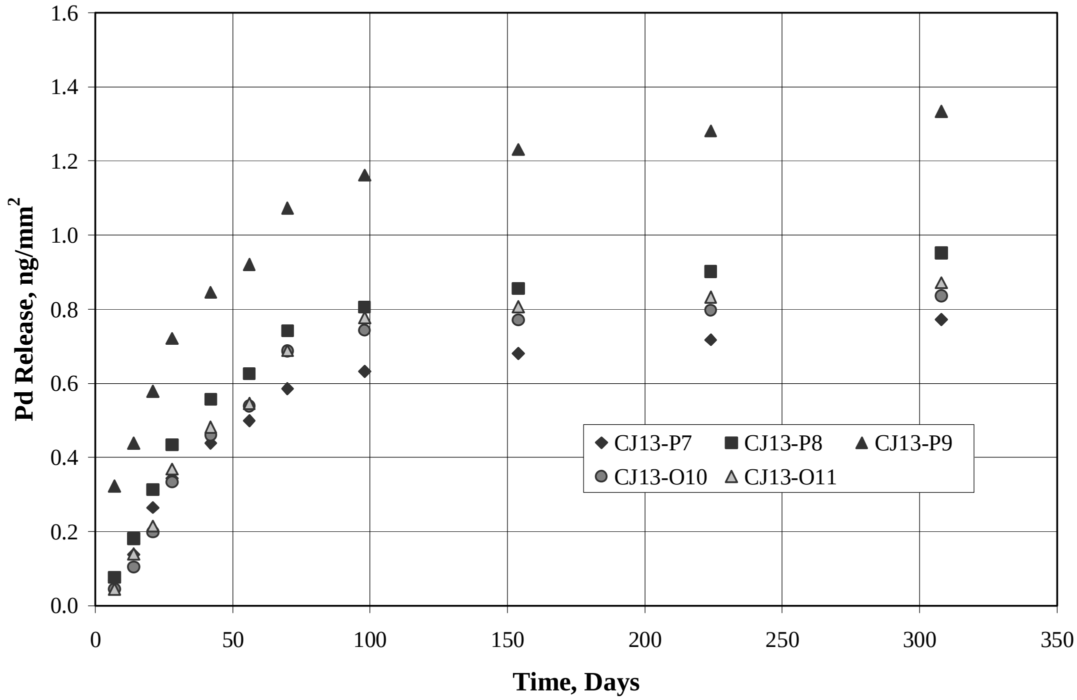

Figure III-20. Cumulative Palladium releases in CJ13 at 90ºC.

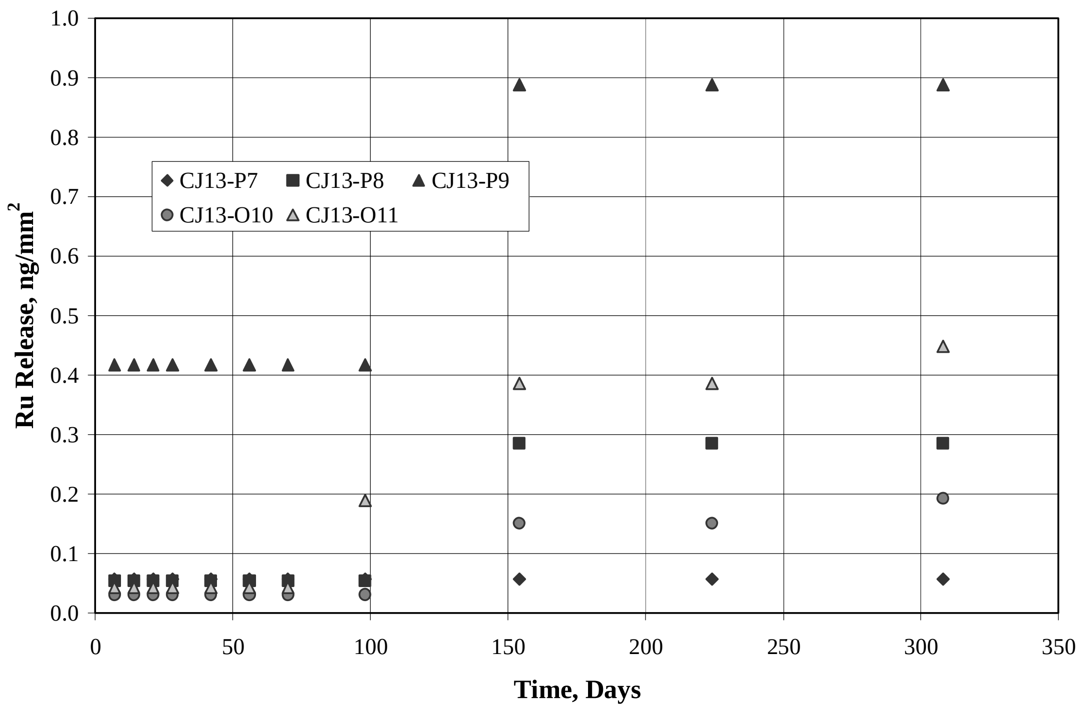

Figure III-21. Cumulative Ruthenium releases in CJ13 at 90ºC.

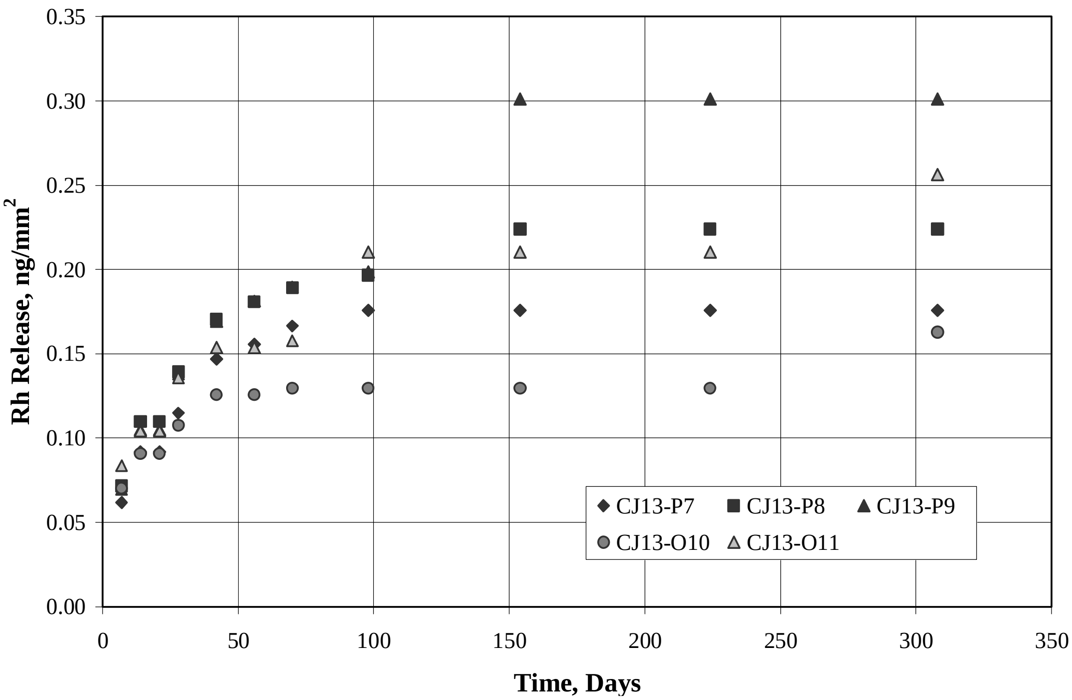

Figure III-22. Cumulative Rhodium releases in CJ13 at 90°C.

CJ13 Summary

Because significant differences were observed in the releases of some elements from oxidized samples and polished samples, these data were not averaged. In Figure III-23 the average total release from polished samples is compared with the average releases of Fe, Zr, Nb, Pd, Ru, and Rh from polished samples in CJ13. Average releases from oxidized samples are shown in Figure III-24. Comparison of these two figures shows some differences. For both polished and oxidized samples, the total release is dominated by the Fe release. However, the average cumulative Zr release is much closer to the average Fe release for oxide samples than for polished samples and thus makes a greater contribution to the total release for oxide samples than for polished samples. For both polished and oxidized samples, the fission-product elements are lower by an order of magnitude with releases close to the detection limits (as for SJ13).

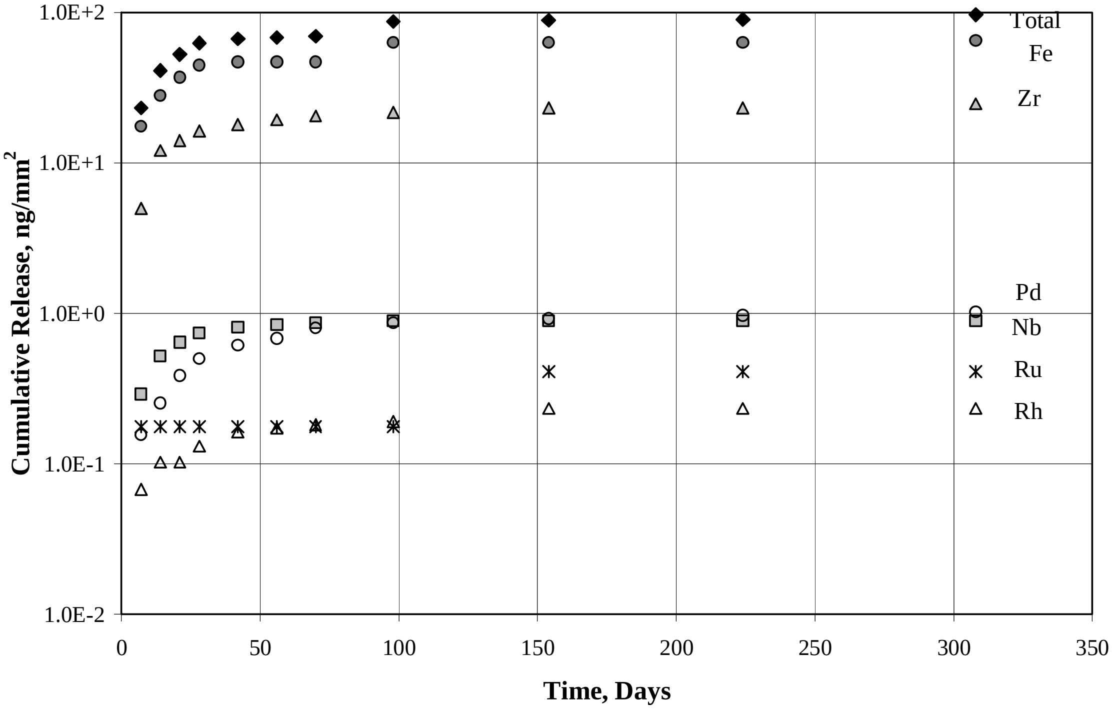

Figure III-23. Average cumulative release of polished samples in CJ13 at 90ºC.

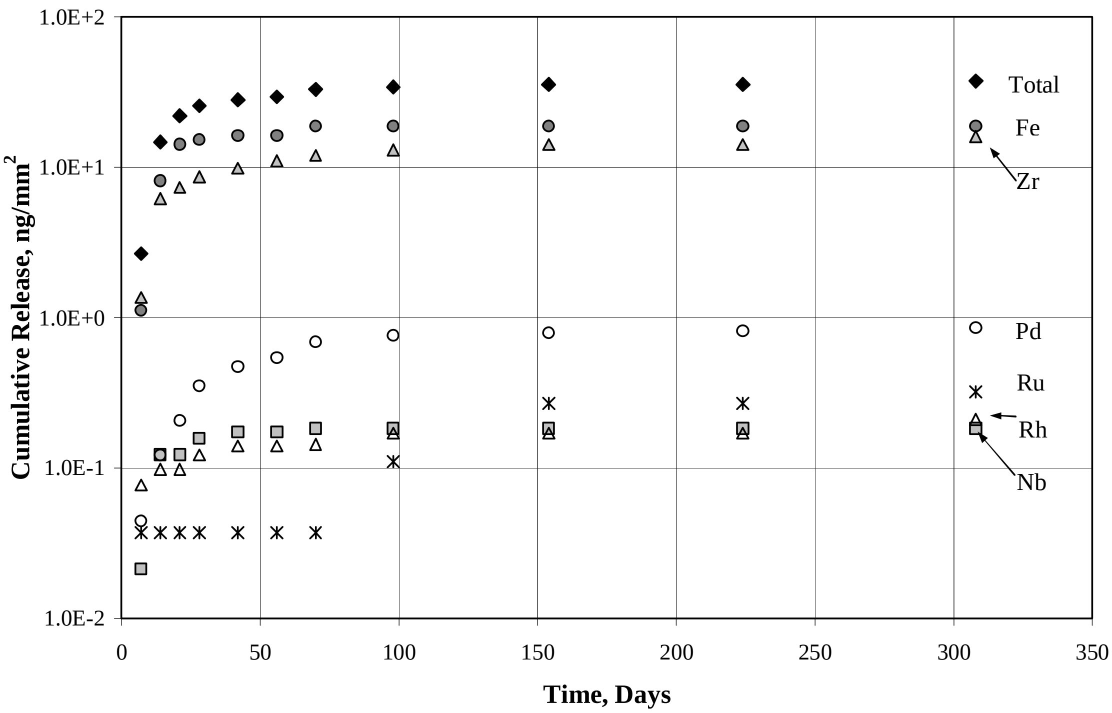

Figure III-24. Average cumulative release of oxidized samples in CJ13 at 90ºC.

c) 10KCl:

Cumulative total releases in 10KCl, shown in Figure III-25, are almost 2 orders of magnitude higher than the total releases in SJ13 and about 50 times higher than the total releases in CJ13. As with samples in SJ13, total releases are highest the first few weeks and decrease with time. However, unlike samples in SJ13, the cumulative release curves are still increasing slightly after 44 weeks (day 308). These high total releases are from the Cl^- attack of the components of stainless steel in the Metal Waste Form, as discussed below.

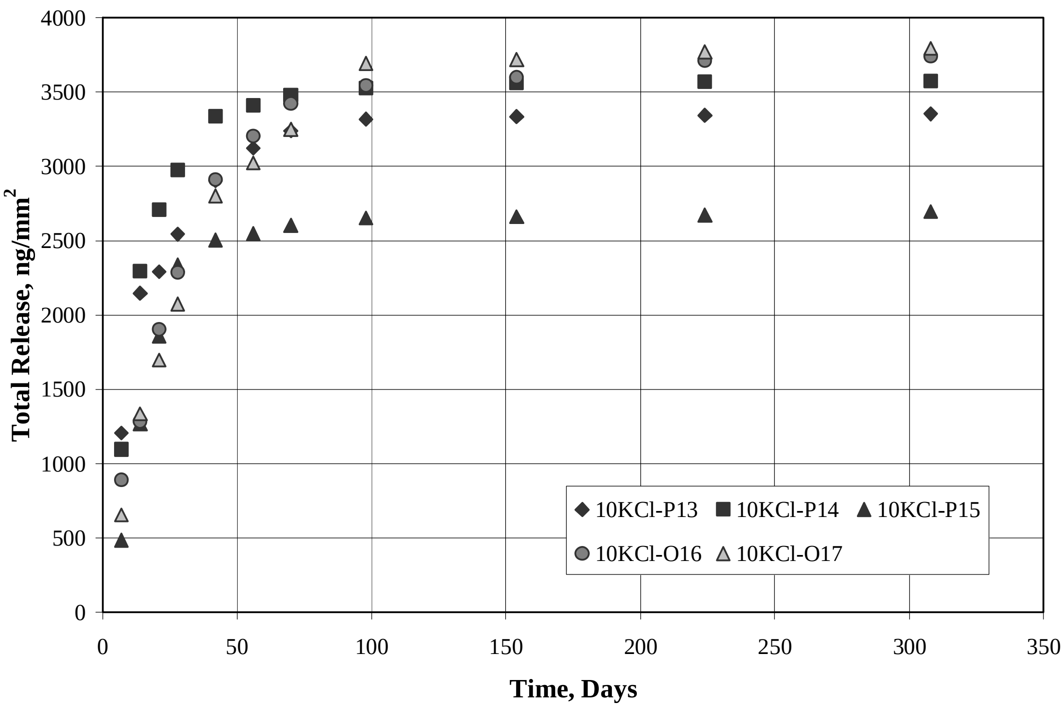

Figure III-25. Cumulative total release in 10KCl at 90°C.

Release of Major Elements

Cumulative releases of Fe, Cr, and Ni, the main components of stainless steel, are shown in Figures III-26 through III-28. The Fe releases are about a factor of 6 higher than the releases of Cr and Ni, which are of similar magnitude. Starting with day 42, releases from sample P15 are consistently lower than releases from other samples, making the cumulative releases from this sample lower than that from other samples. This is particularly pronounced for Fe. The reason for this is not known. It may only reflect the variability of the small samples. Although these releases are considerably higher than releases in SJ13, there is still considerable scatter in the data.

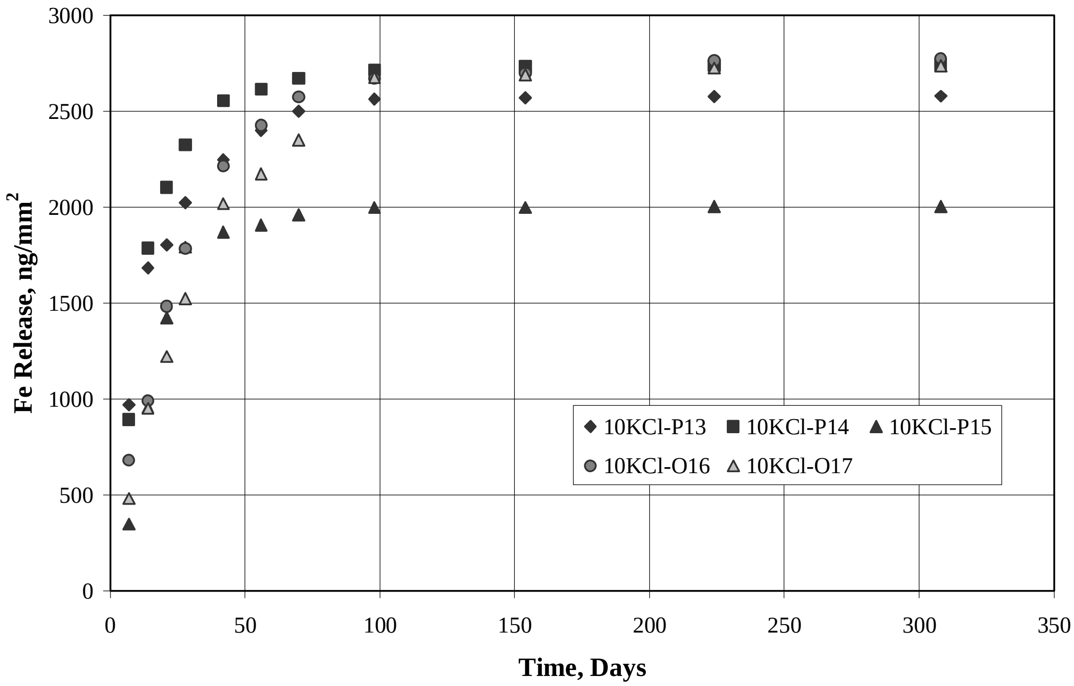

Figure III-26. Cumulative Iron release in 10KCl at 90ºC.

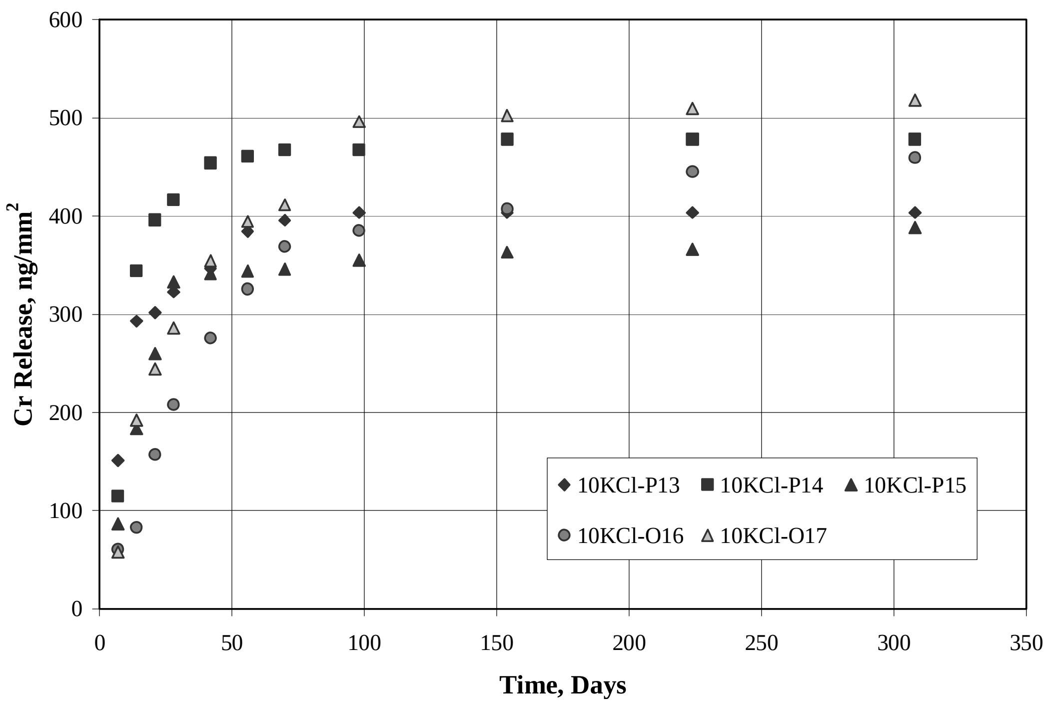

Figure III-27. Cumulative Chromium release in 10KCl at 90ºC.

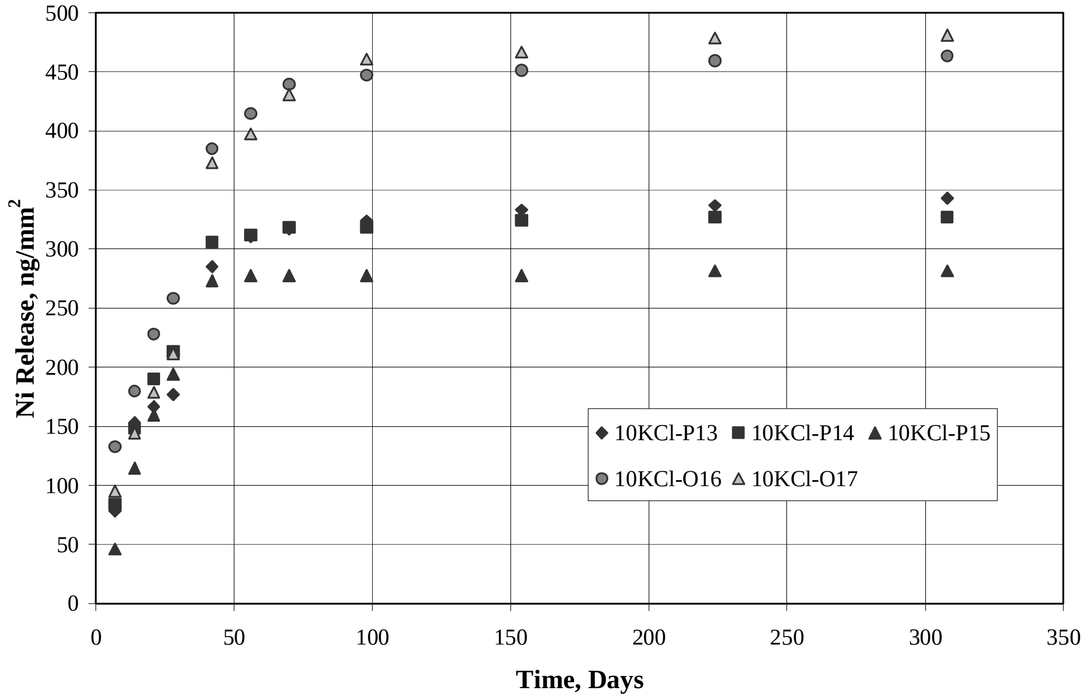

Figure III-28. Cumulative Nickel release in 10KCl at 90ºC.

Cumulative releases of Zr, shown in Figure III-29, are about an order of magnitude lower than the releases of Cr. Releases of Zr decrease with time, so that cumulative release curves turn over and flatten after about 98 days, 14 weeks.

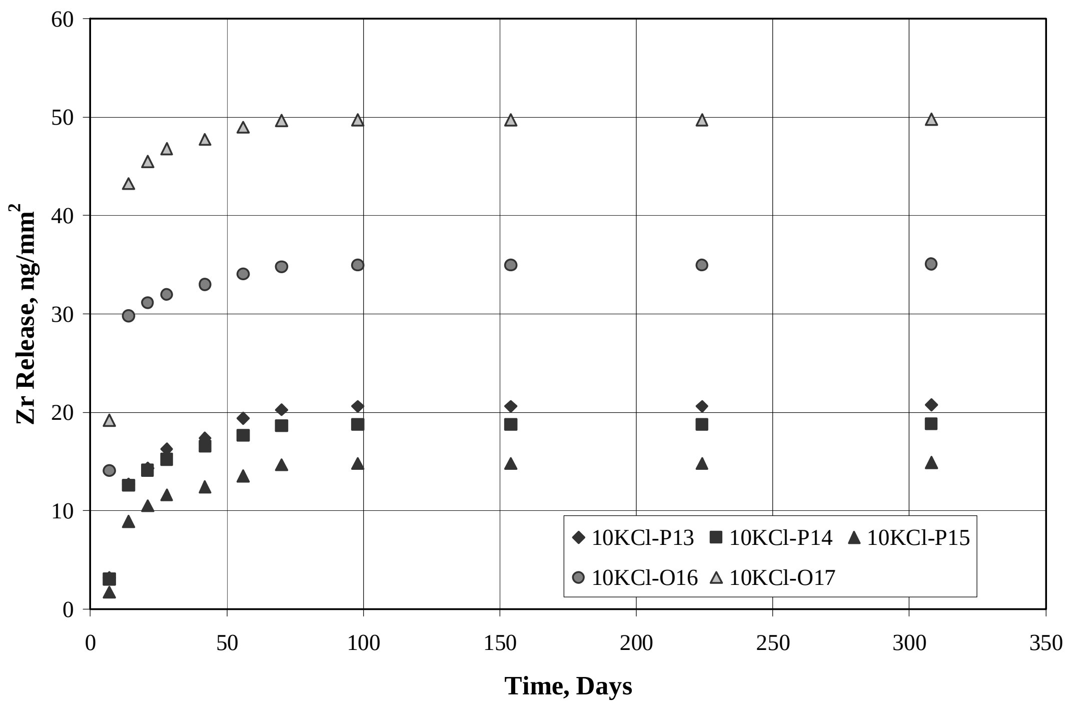

Figure III-29. Cumulative Zirconium release in 10KCl at 90ºC.

Release of Fission-Product Elements

The high Cl^- solution also gave higher releases of fission-product elements compared to the less aggressive solutions, SJ13, and CJ13. The cumulative releases of Nb as a function of time are shown in Figure III-30. The high Nb release from the oxidized sample O-17 from the second week of the test is reflected in the consistently higher cumulative releases from that sample throughout the rest of the test. From day 28 through day 98, releases were close to the detection limits creating significant scatter. No Nb was detected on day 154 and Nb was only detected in one sample after that time. Cumulative Pd releases in 10KCl are shown in Figure III-31. The data are fairly consistent until week 32 (day 224) at which time releases were near the detection limits for Pd. Although cumulative releases of Ru, shown in Figure III-32, are of similar magnitude to those for Pd, the data lack the consistency of the Pd data because of higher detection limits for Ru compared to Pd. The scatter in the data arises from releases near the detection limits and the variation in the detection limits from week to week. Cumulative Rh releases in 10KCl are shown in Figure III-33. On day 14, a release of 1.7 ng/mm^2 Rh was detected from sample O-17 compared to Rh releases on the order 0.2 ng/mm^2 from the other samples, causing the cumulative release from that sample to be higher after that time. Releases decreased with time. On day 224, Rh was detected in releases from only one sample. No Rh was detected on day 308.

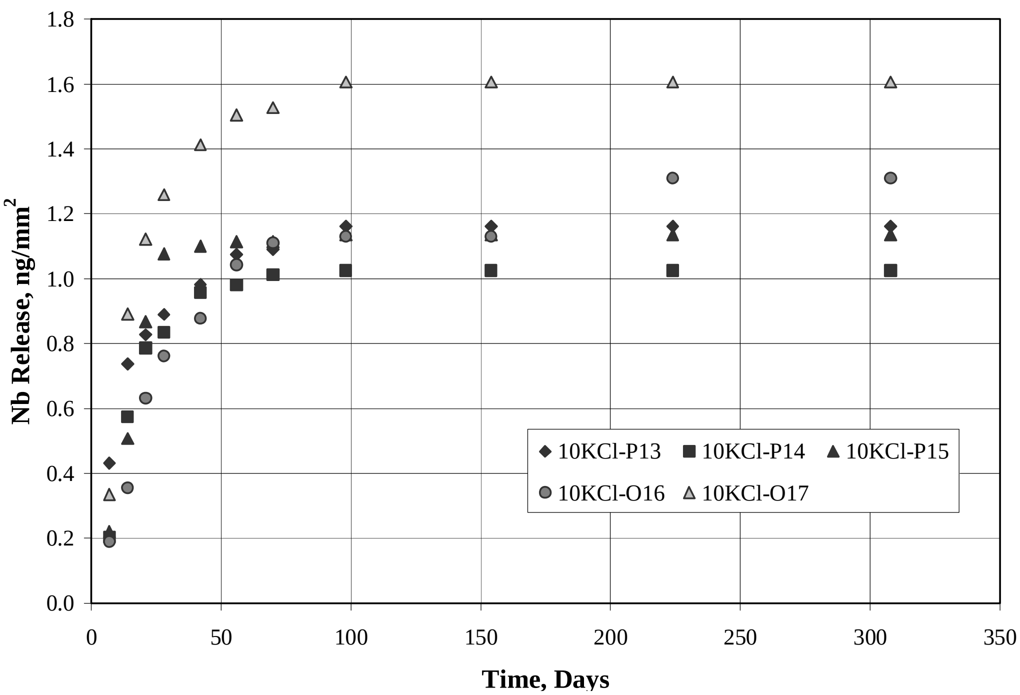

Figure III-30. Cumulative Niobium release in 10KCl at 90°C.

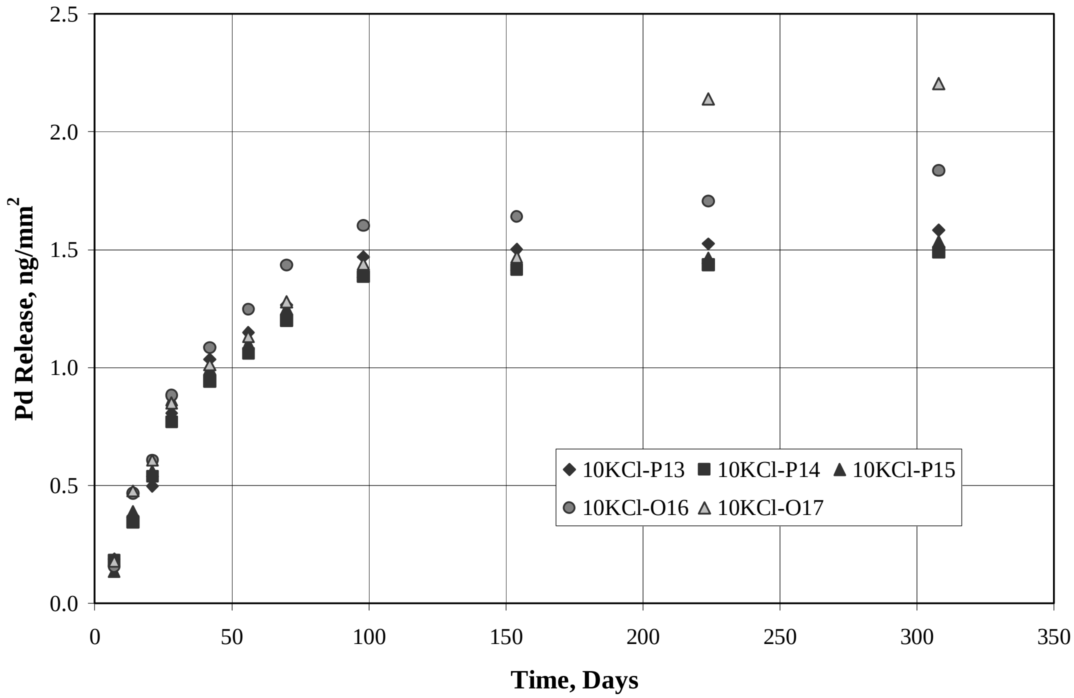

Figure III-31. Cumulative Palladium release in 10KCl at 90ºC.

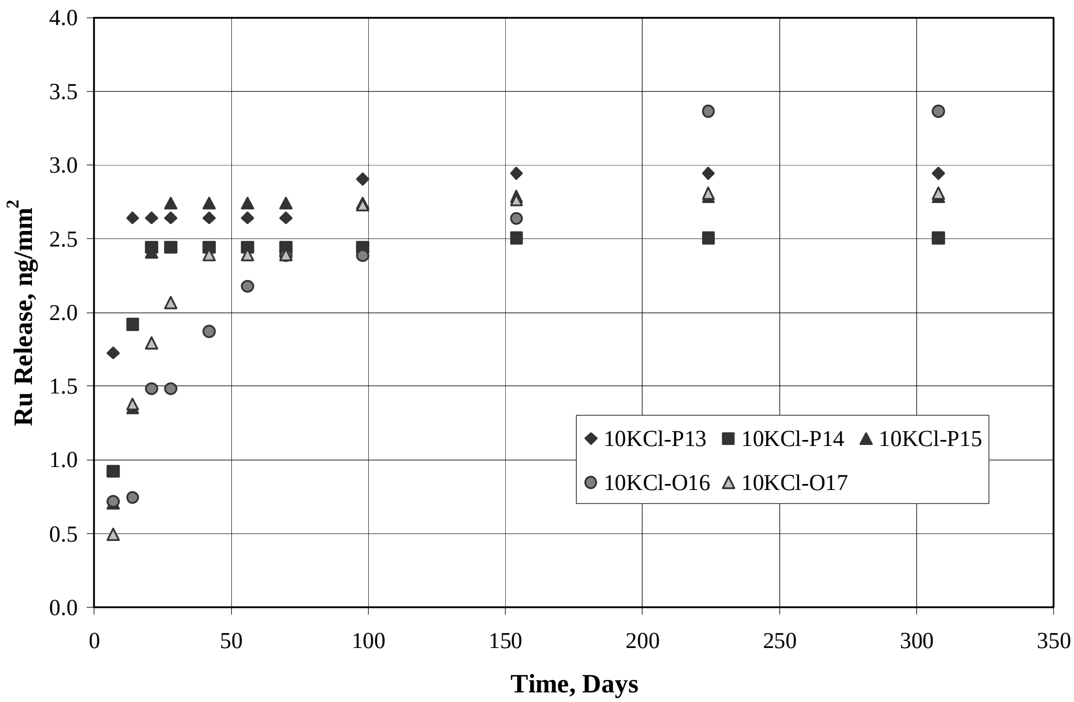

Figure III-32. Cumulative Ruthenium release in 10KCl at 90ºC.

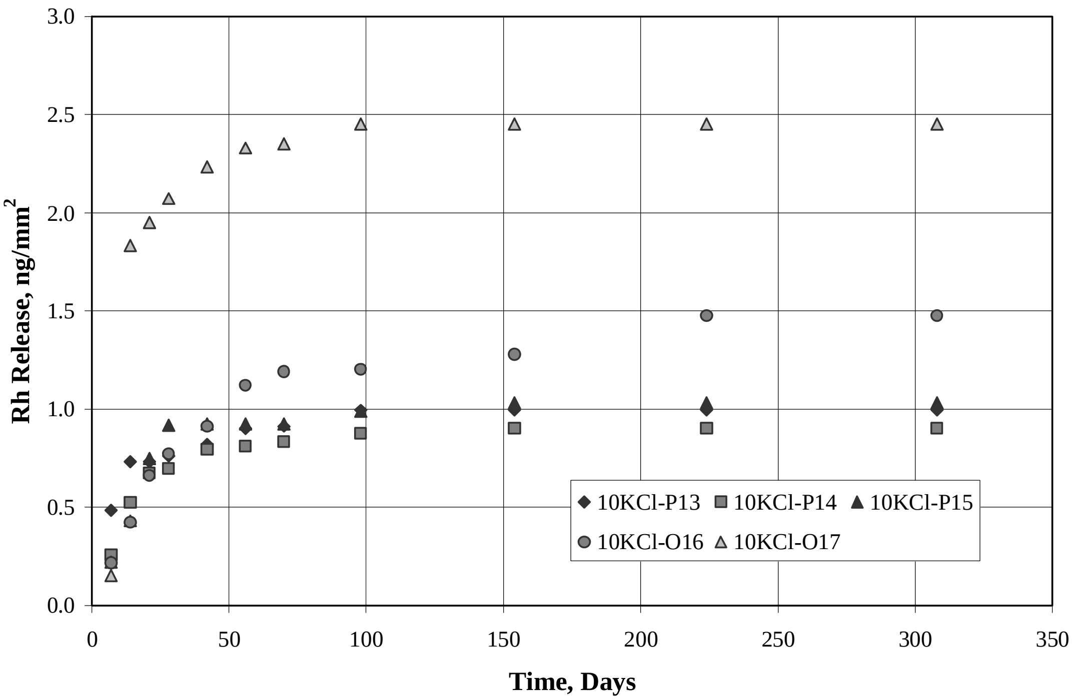

Figure III-33. Cumulative Rhodium release in 10KCl at 90ºC.

10KCl Summary

In Figure III-34, average cumulative releases of Fe, Zr, Nb, Pd, Ru, and Rh are compared with the average total release. As in the other solutions, the total release is dominated by the Fe release. However, releases of Cr and Ni, which are about a factor of 6 lower than the Fe release, make some contribution to the total release. The average cumulative Zr release is more than an order of magnitude lower than the total release. Releases of fission-product elements are about 3 orders of magnitude lower than the total release. The average Ru release is consistently higher than that of the other fission-product elements. The average cumulative release of Pd is slightly higher than those of Nb and Rh.

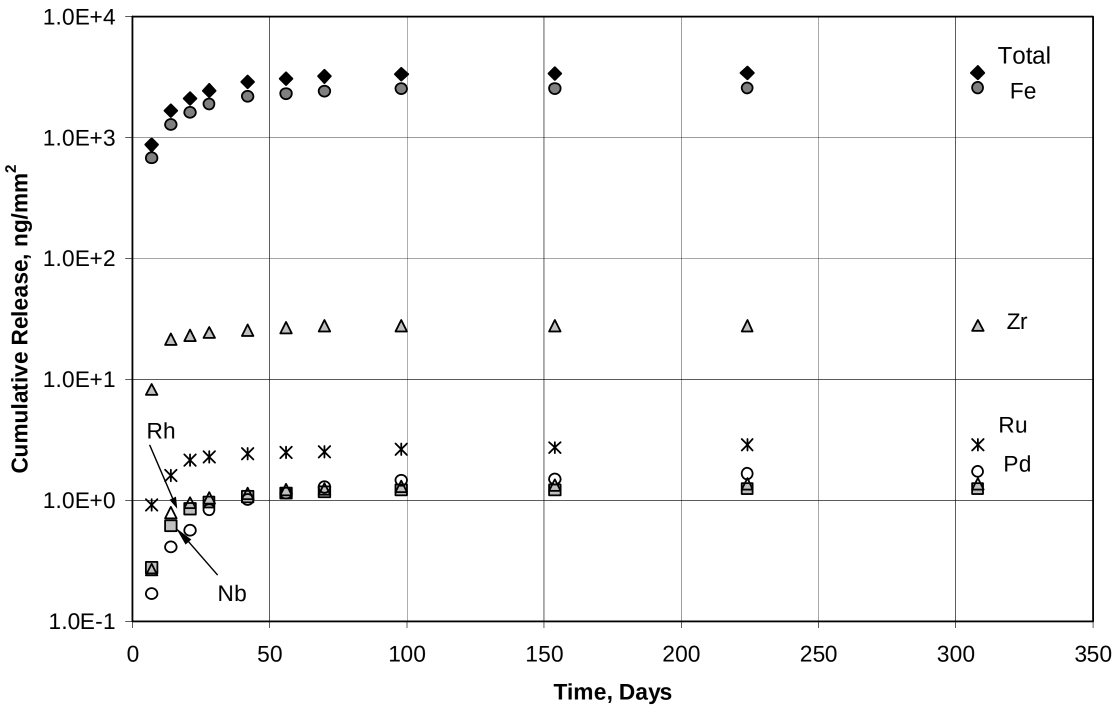

Figure III-34. Average cumulative release in 10KCl at 90ºC.

d) AJ13:

Cumulative total releases of the major elements and fission-product elements Nb, Pd, Ru, and Rh in AJ13 solution at 90ºC are shown in Figure III-35. Total releases in this pH=2 solution differ significantly from the releases in SJ13, CJ13, and the 10KCl solutions. Cumulative total releases in AJ13 continue to increase with time with only a small change in the linear slope. The cumulative total releases in SJ13, CJ13, and the 10KCl solution turned over and became almost flat. After 308 days of tests, cumulative total releases in AJ13 are two order of magnitude higher than the cumulative total releases in the 10KCl solution and four orders of magnitude higher than the cumulative total releases in SJ13.

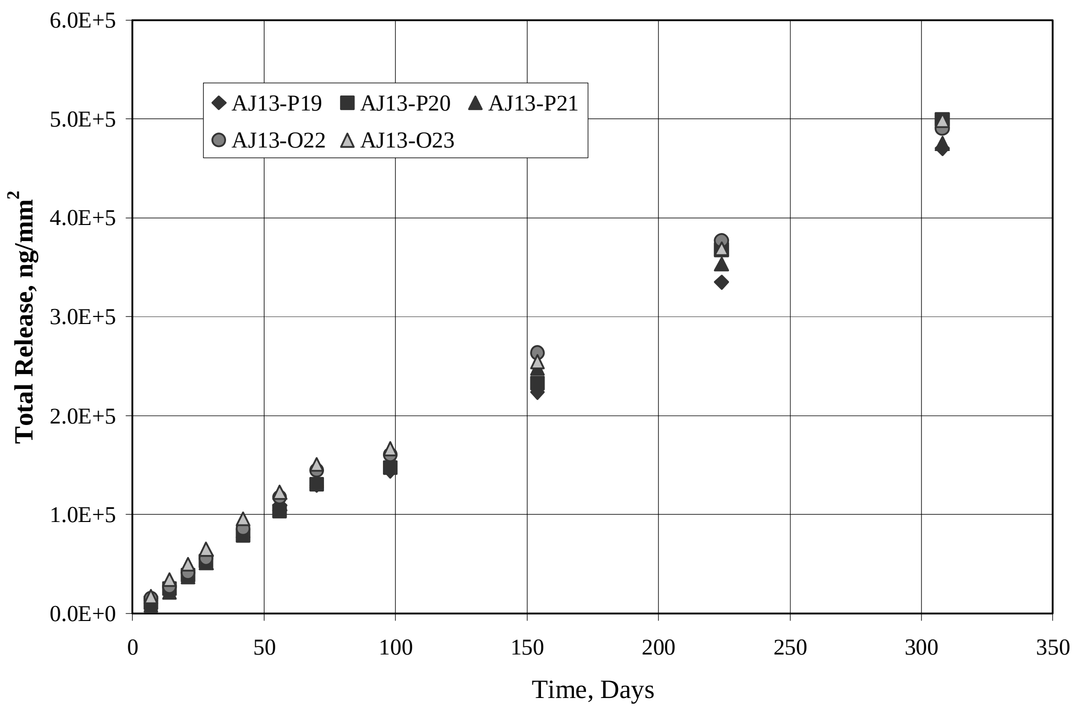

Figure III-35. Cumulative total release in AJ13 at 90ºC.

Release of Major Elements

The cumulative release of Fe in AJ13 solution at 90ºC, shown in Figure III-36, follows the same trend as the cumulative total release shown in Figure III-35. The initial slope is linear. The slope appears to change between 70 and 98 days but the trend from 98 through 308 days is also linear with a reduced slope. Unlike the tests in other solutions, there is little scatter in these Fe releases. The cumulative release of Cr in AJ13 solution at 90ºC, shown in Figure III-37, shows the same trends as the Fe release but is lower by about a factor of four and the data have more scatter. Cumulative releases of Ni in AJ13 solution at 90ºC, shown in Figure III-38, appear linear for the first 154 days with little scatter. There is then a jump after the analysis on day 224 and then the previous linear trend resumes with a similar slope. The reason for the discontinuity on day 224 is not known. The Zr cumulative releases in AJ13 at 90ºC, shown in Figure III-39, are much lower than the Fe, Cr, and Ni releases and show much scatter after 98 days.

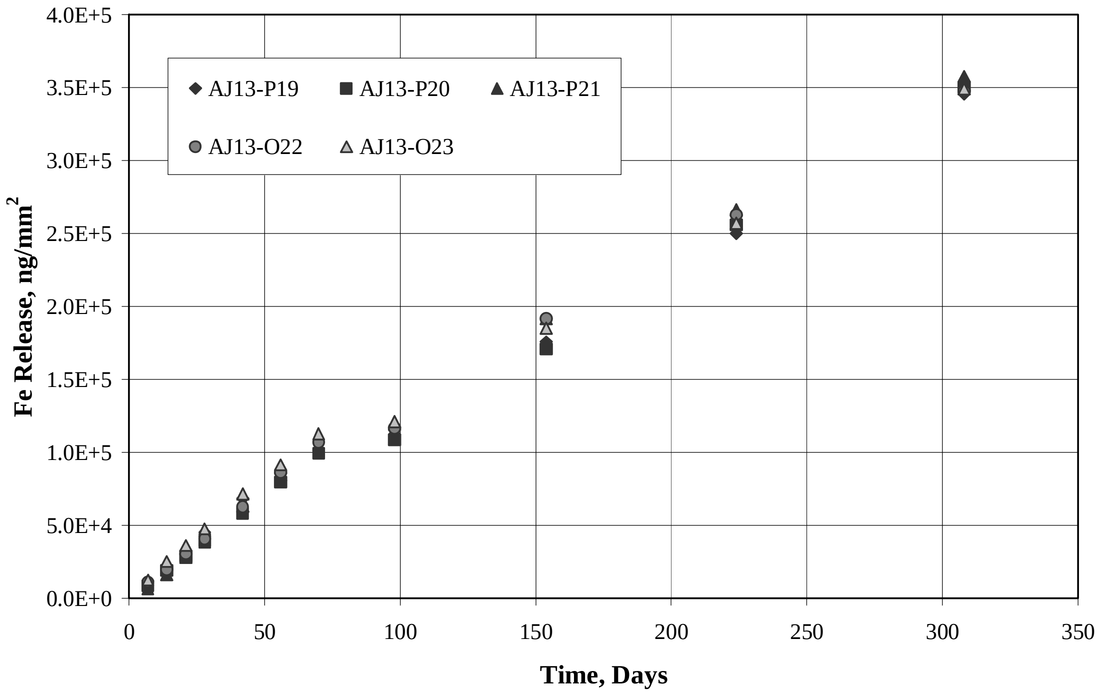

Figure III-36. Cumulative Iron release in AJ13 at 90ºC.

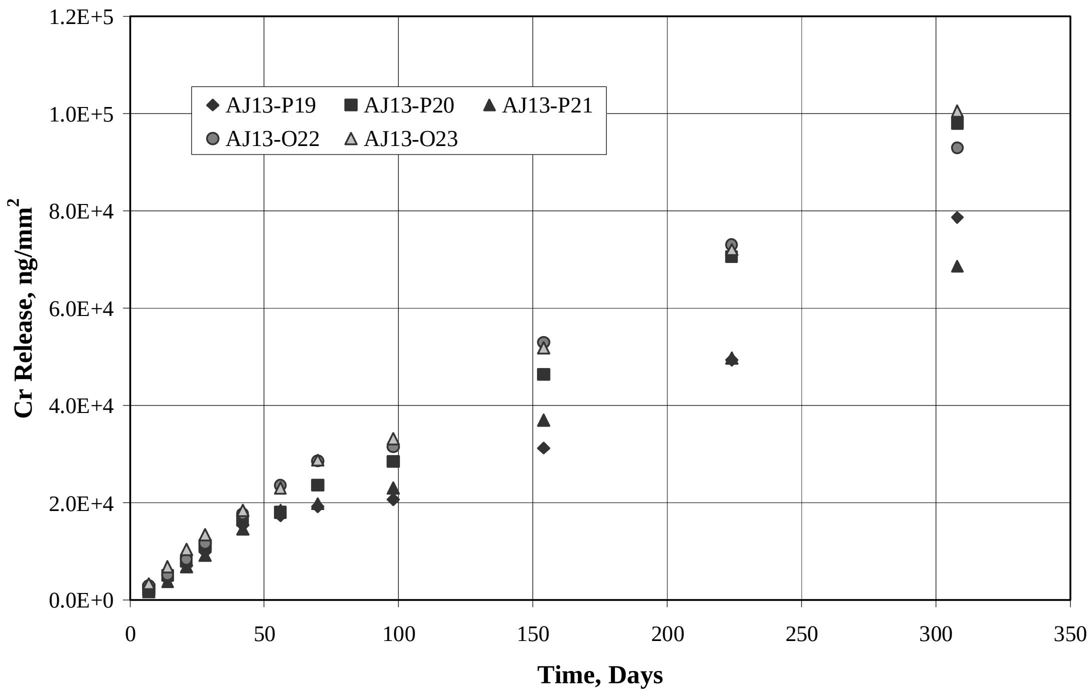

Figure III-37. Cumulative Chromium release in AJ13 at 90ºC.

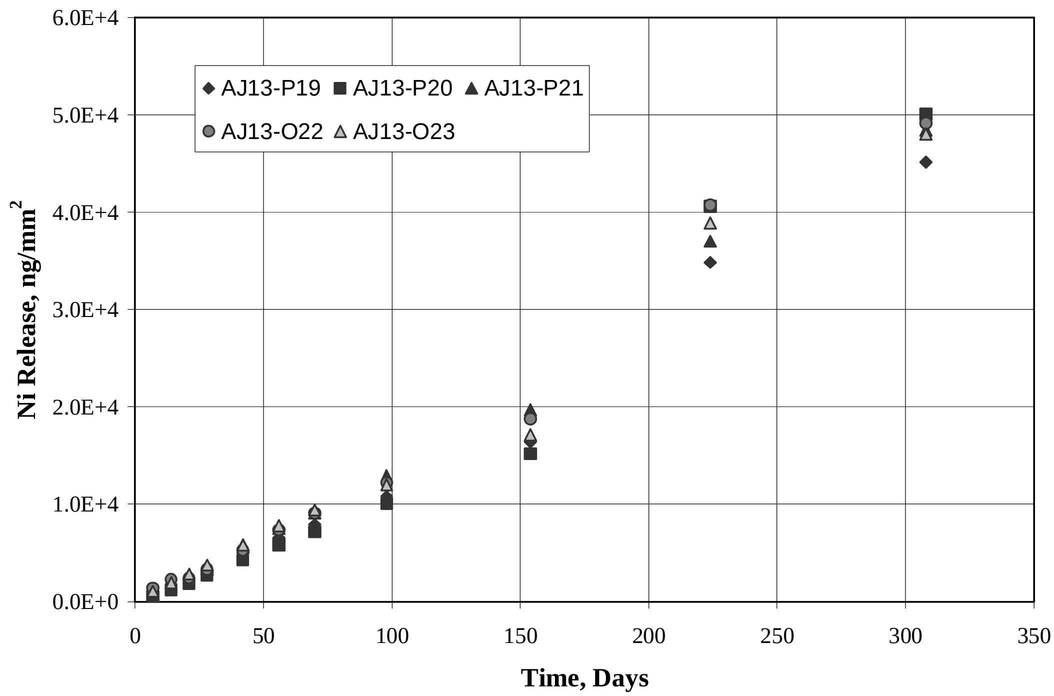

Figure III-38. Cumulative Nickel release in AJ13 at 90ºC.

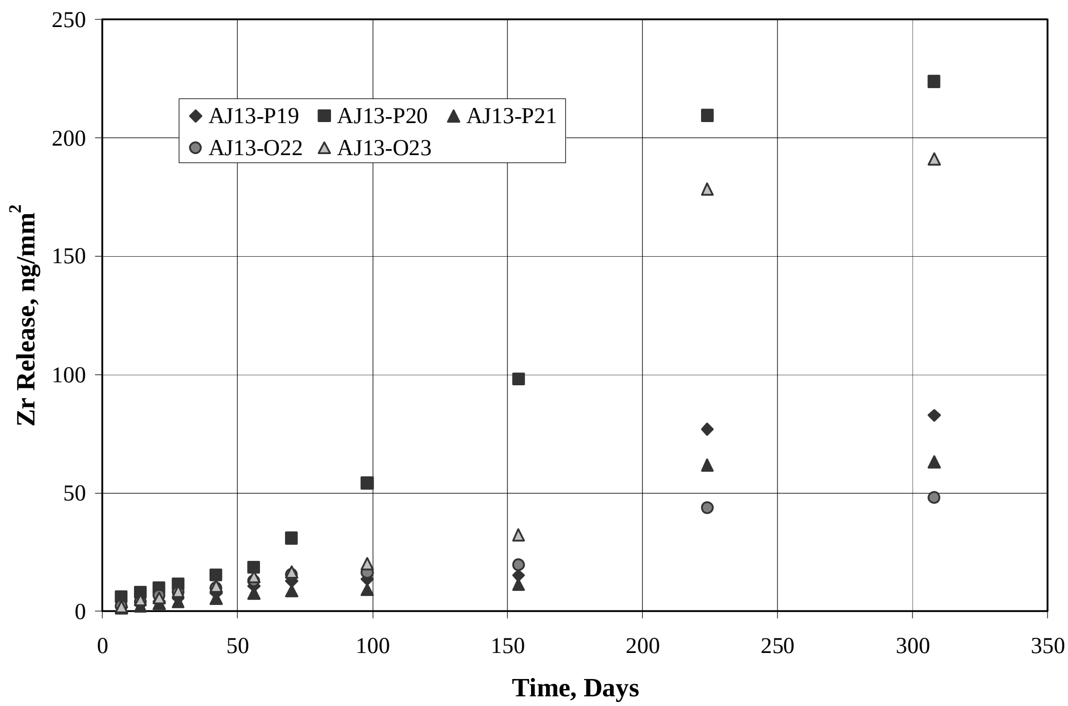

Figure III-39. Cumulative Zirconium release in AJ13 at 90ºC.

Release of Fission-Product Elements

The cumulative releases of the fission-product elements Nb, Pd, Ru and Rh, in AJ13 solution at 90ºC are significantly higher than their cumulative releases at 90ºC in the other test solutions. Cumulative releases of Nb and Pd in AJ13 at 90ºC, shown respectively, in Figures III-40 and III-41, do not show the linear trends observed for the cumulative release of Fe in AJ13. Both are about two orders of magnitude higher than their releases in SJ13. Cumulative releases of Ru and Rh in AJ13 at 90ºC, shown respectively, in Figures III-42 and III-43, have significant scatter but appear to be more linear then the cumulative releases of Nb and Pd. Scatter in the data increases with the duration of the tests.

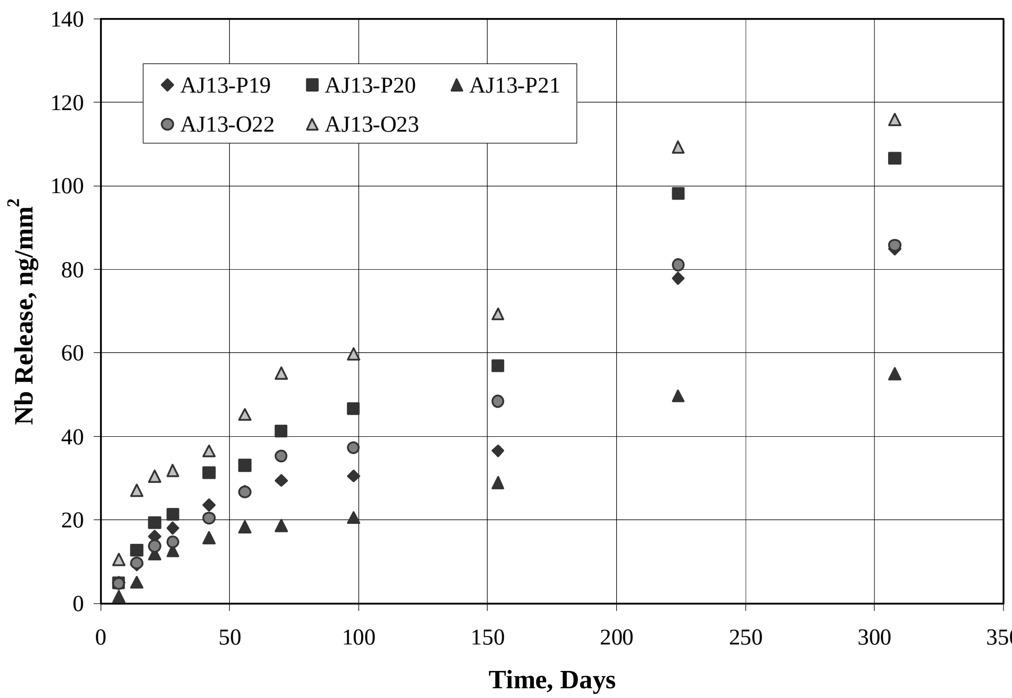

Figure III-40. Cumulative Niobium release in AJ13 at 90ºC.

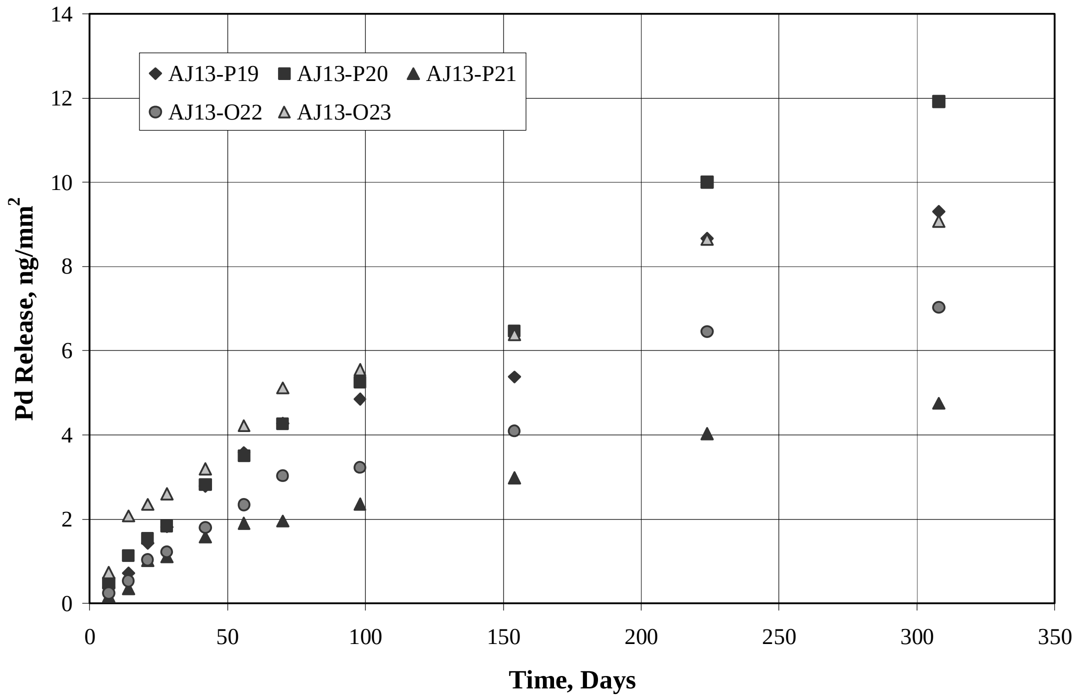

Figure III-41. Cumulative Palladium release in AJ13 at 90°C.

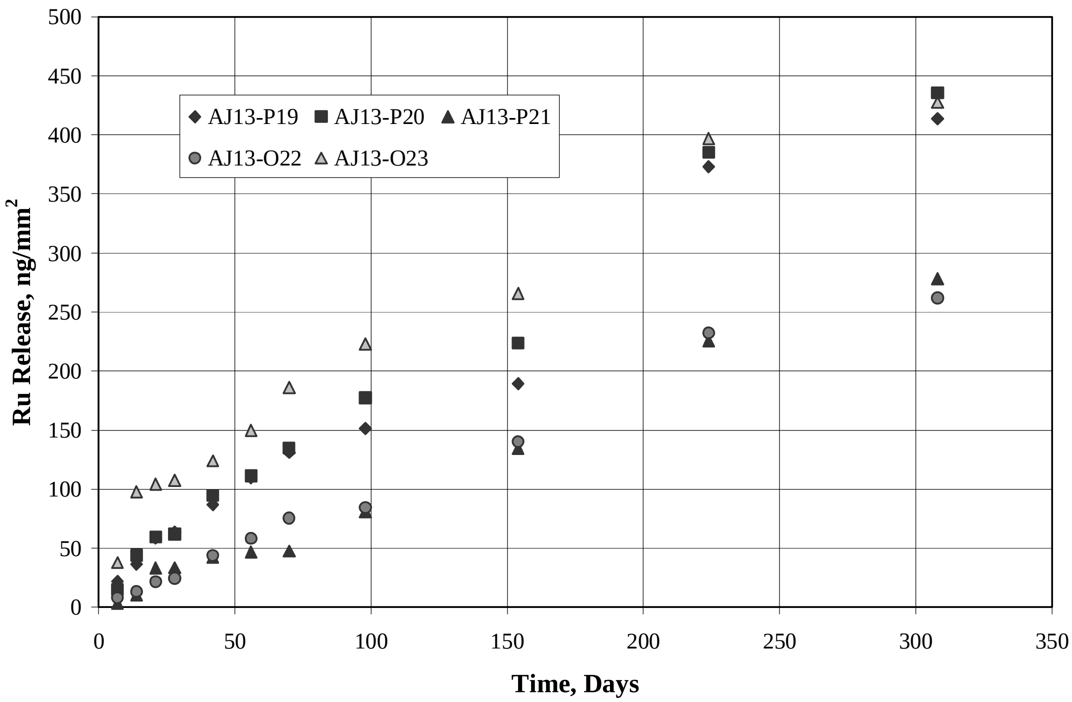

Figure III-42. Cumulative Ruthenium release in AJ13 at 90°C.

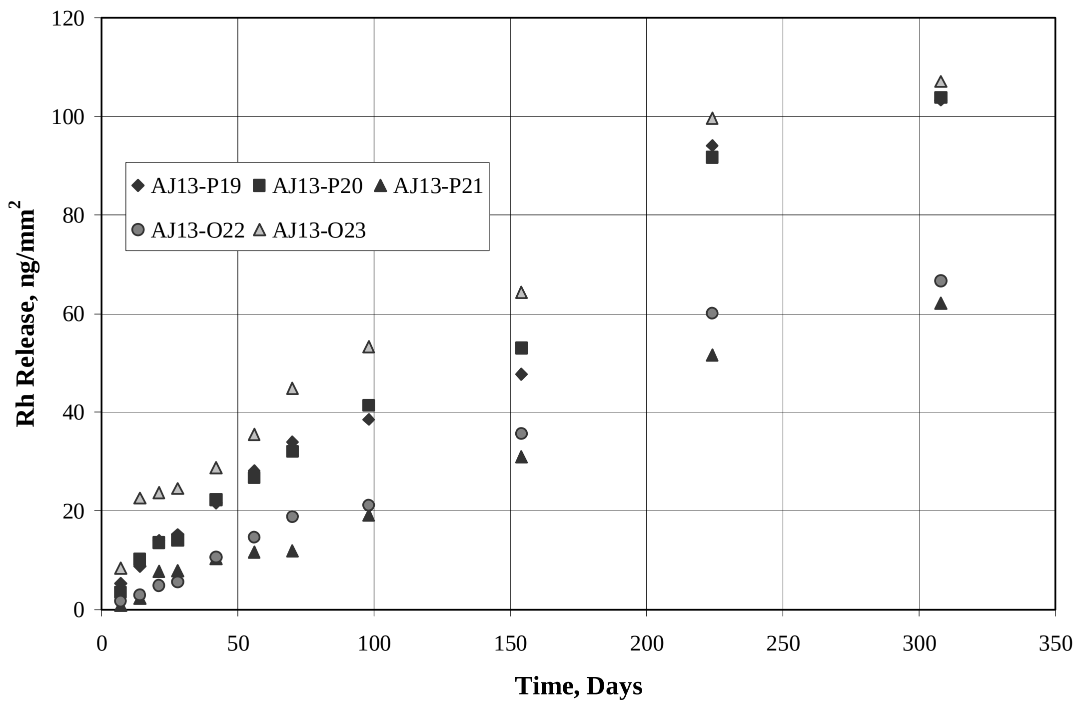

Figure III-43. Cumulative Rhodium release in AJ13 at 90ºC.

AJ13 Summary

The total release is dominated by the Fe release. Cr release is about a factor of four lower than the Fe release. Ni release is even lower (about a factor of seven). Releases of fission-product elements and Zr are more than two orders of magnitude lower than the Fe release. Average cumulative releases of Fe, Zr, Nb, Pd, Ru, and Rh are compared with the average cumulative total release (sum of major elements and these four fission-product elements) in Figure III-44. Note that in this low pH solution, the initial cumulative Zr release is lower than the initial cumulative releases of Ru, Rh, and Nb. At the end of the tests, the average cumulative Ru release is higher than the average cumulative Zr release. The average cumulative Pd release is the lowest.

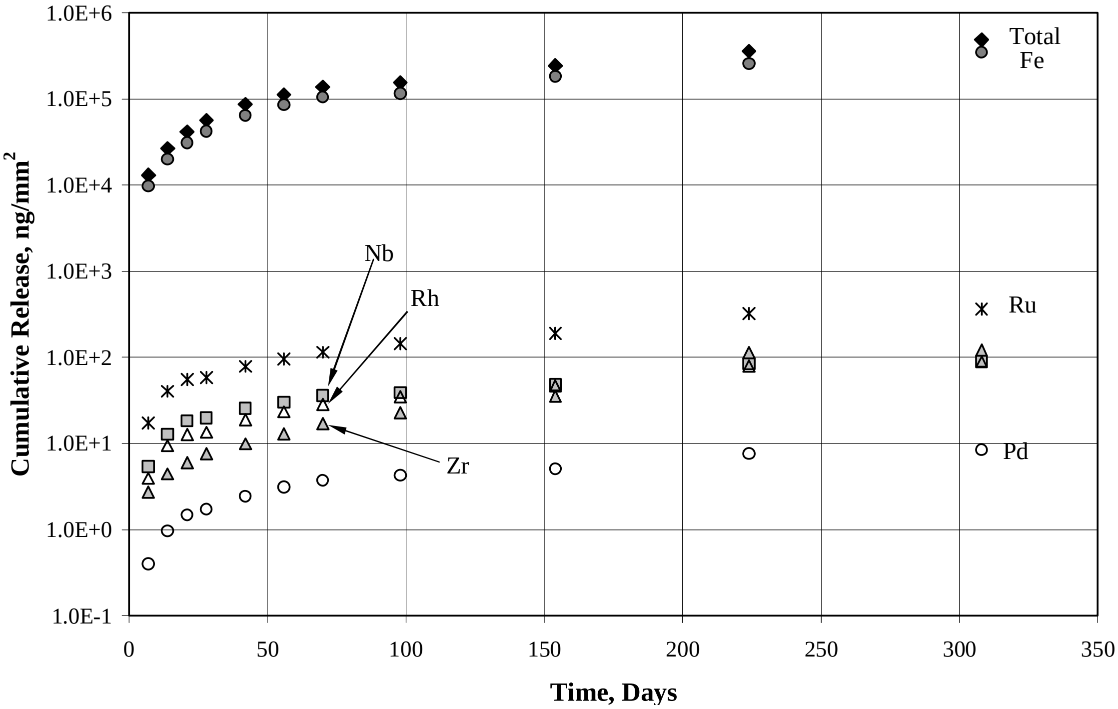

Figure III-44. Average cumulative release in AJ13 at 90ºC.

3. Comparison of 90ºC Cumulative Releases as a Function of Solution

The average cumulative total releases in the four solutions at 90ºC are compared in Figure III-45. Releases in the pH=2, AJ13 solution were more than three orders of magnitude higher than releases in SJ13. Releases in the 10KCl solution were about two orders of magnitude higher than releases in SJ13. Releases in CJ13 were similar to those in SJ13 with the releases from polished samples higher and those from oxidized samples lower. Fe cumulative releases in the four solutions, shown in Figure III-46, are similar to the total release trends, as expected because the total releases are mainly Fe. Cr and Ni releases have similar trends to Fe except for not being detected in some solutions.

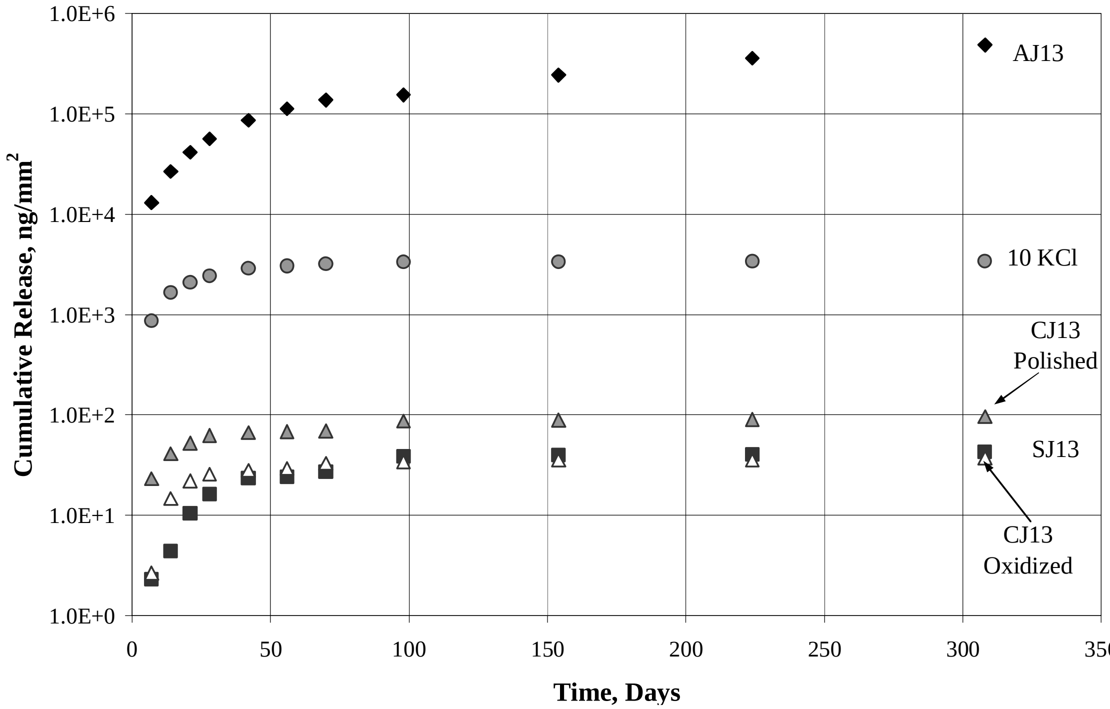

Figure III-45. Average cumulative total release at 90°C in four solutions.

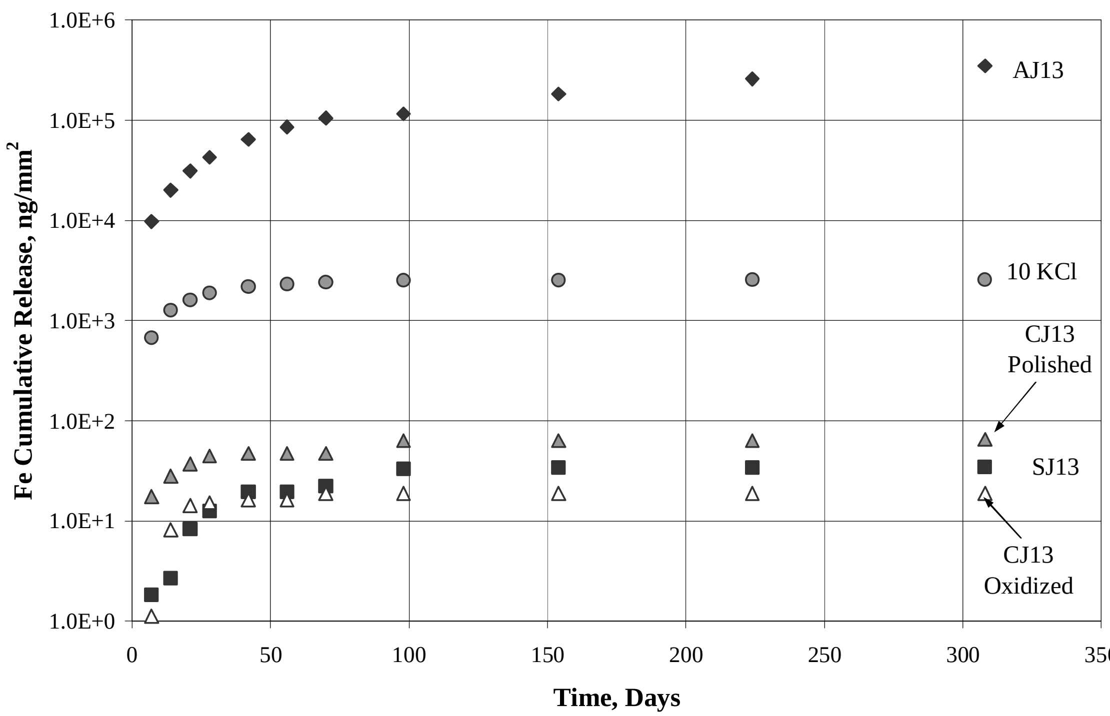

Figure III-46. Average cumulative Iron release at 90°C in four solutions.

Average cumulative Zr releases in the four solutions, shown in Figure III-47, do not have as large a difference between the different solutions as Fe. Zr releases are highest in AJ13 and lowest in SJ13. Releases of fission-product elements in the four solutions, Figures III-48 through III-51, show similar trends to Zr releases but with variations of about 3 orders of magnitude between SJ13 releases and AJ13 releases. These results indicate significant effect of pH on the releases of Fe, Cr, and Ni and the fission-product elements.

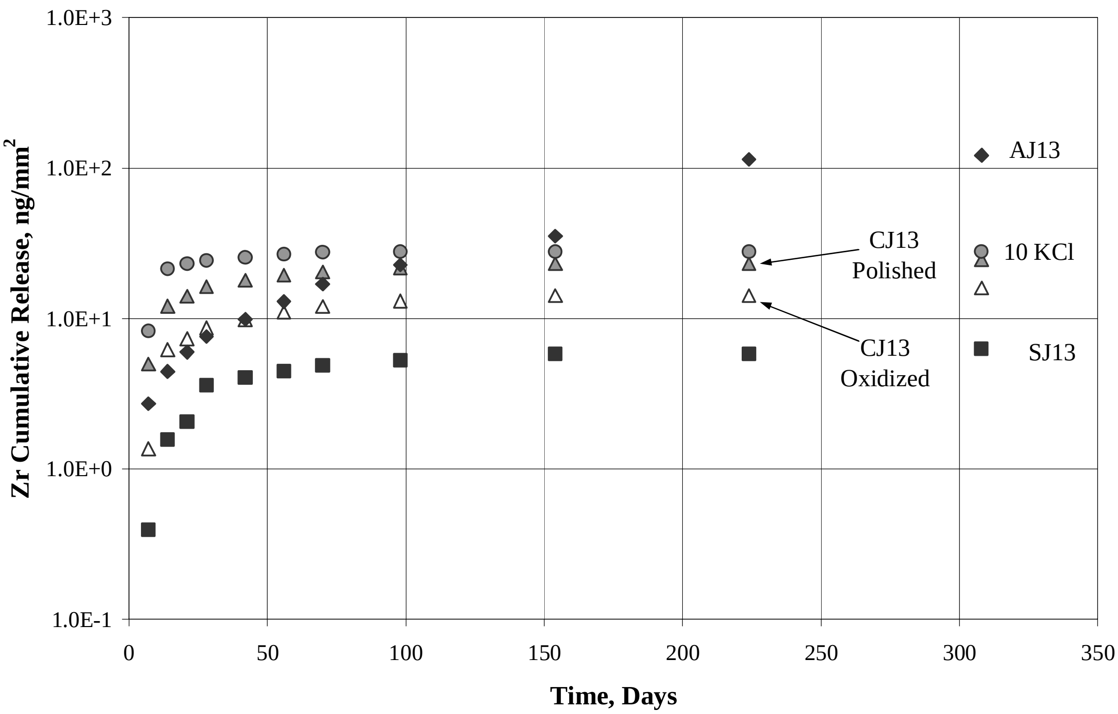

Figure III-47. Average cumulative Zirconium release at 90°C in four solutions.

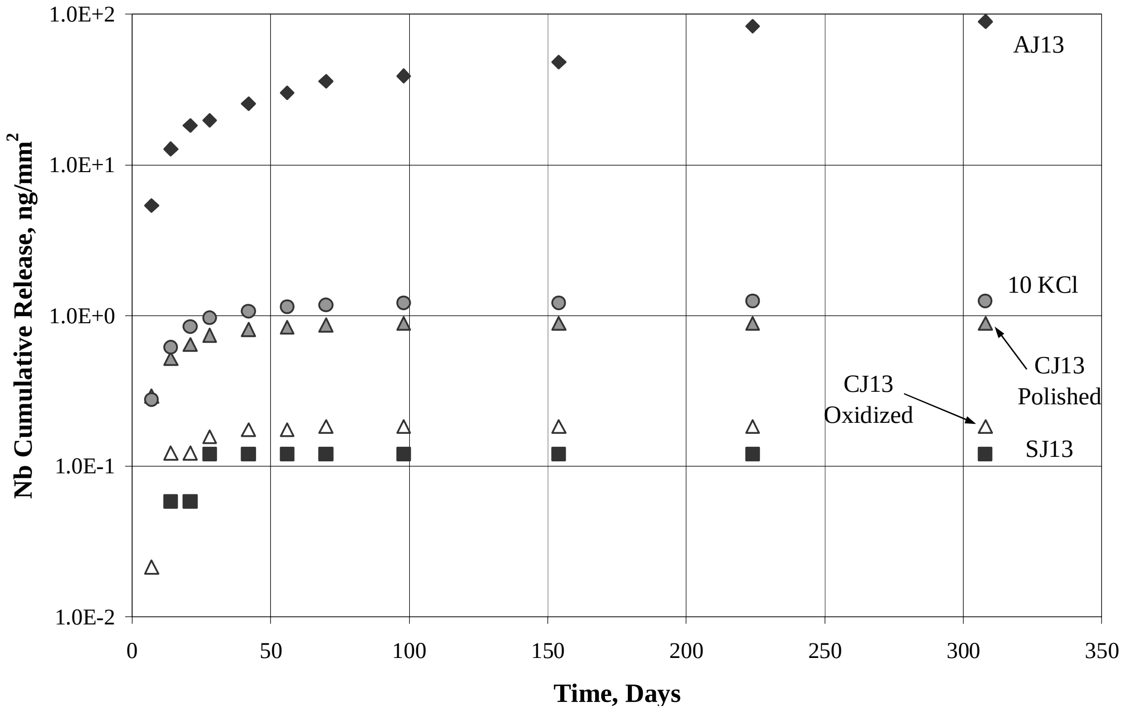

Figure III-48. Average cumulative Niobium release at 90ºC in four solutions.

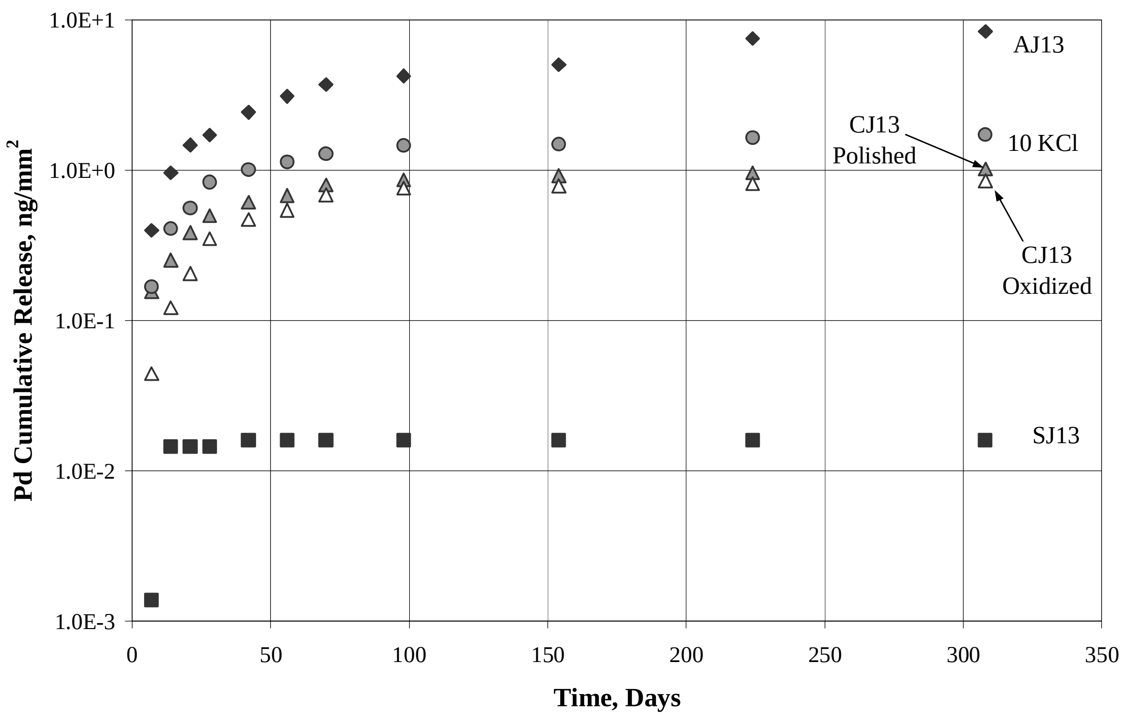

Figure III-49. Average cumulative Palladium release at 90ºC in four solutions.

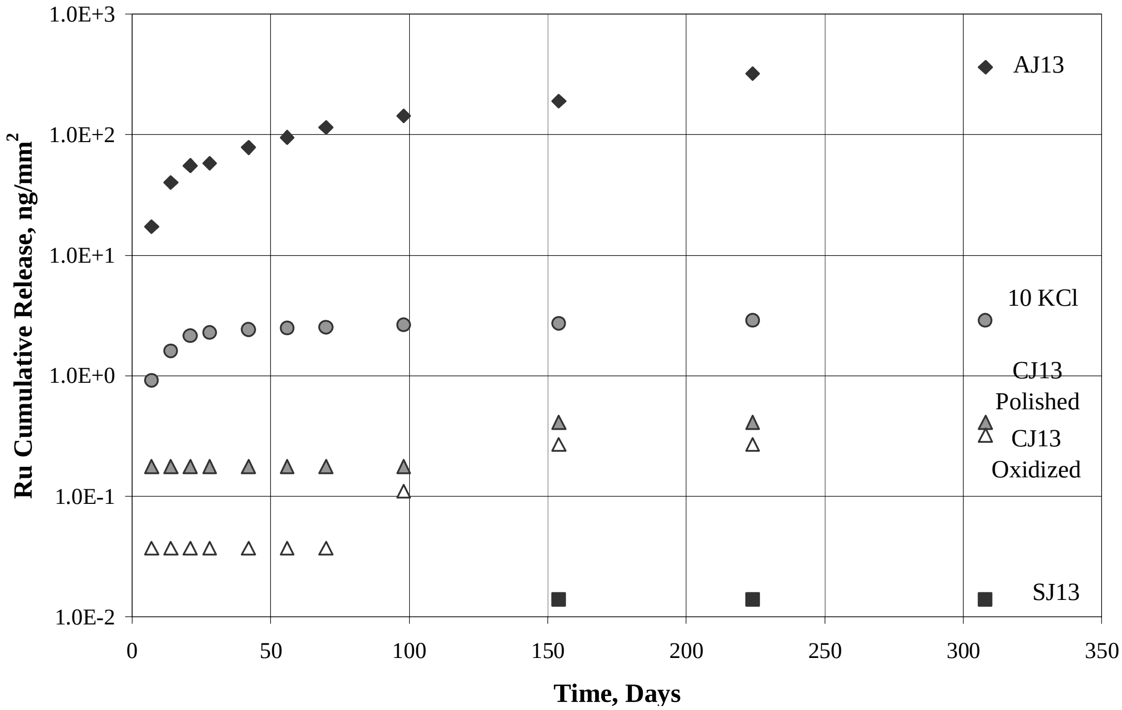

Figure III-50. Average cumulative Ruthenium release at 90°C in four solutions.

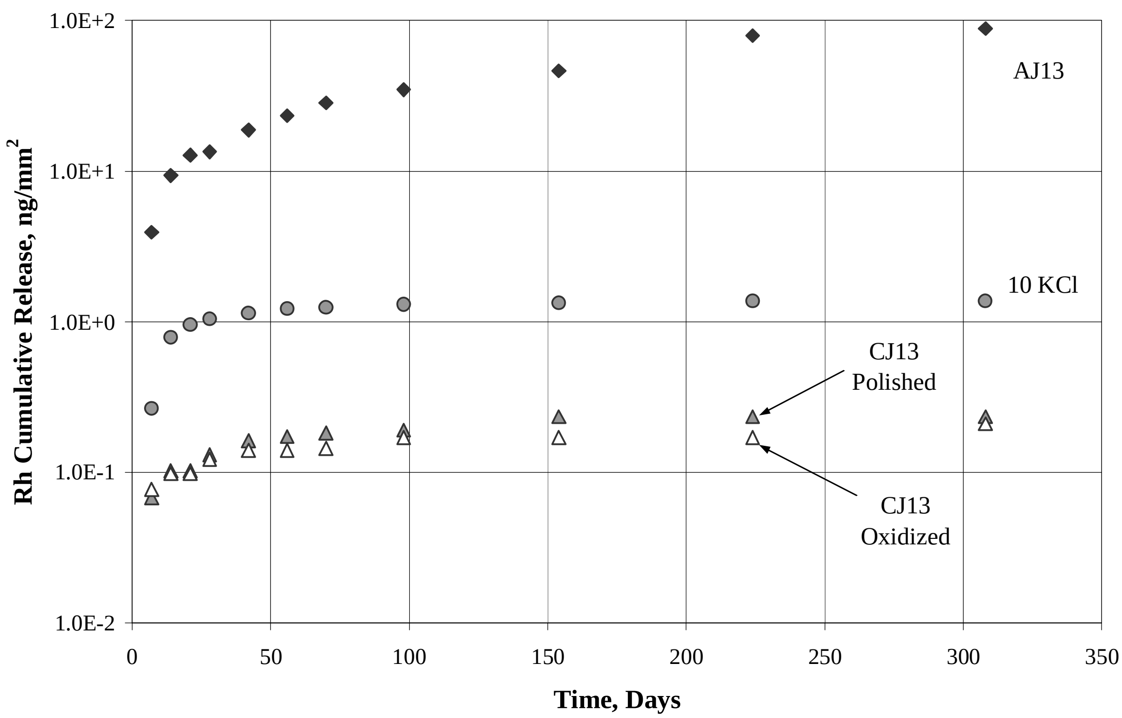

Figure III-51. Average cumulative Rhodium release at 90°C in three solutions.

B. Supplementary Test Samples

1. Releases of Elements from Each Test

Supplementary test samples were terminated at intervals of 14, 28, 42, 84, and 140 days. There were 3 samples and blanks conducted at ambient (room) temperature and 1 sample conducted at 90ºC. A solution of 1KCl was added in addition to the 10KCl and AJ13 solutions. One of the ambient temperature samples and the 90ºC sample consisted of the 1KCl solution. The remaining ambient temperature samples consisted of one 10KCl and one AJ13 solutions. After each sampling interval, the total release of each element was determined from the release to the solution, and the release to the walls obtained from the acid strip wash. There was no residue detected. The releases detected in the test solutions and the acid strip from the walls for each element are shown as bar graphs in Appendix J. Tabulated values are in Appendix K. Average detection limits for the leachate and acid strip have been included on the bar graphs. The detection limits of each as a function of time are given in Appendix L. Detection limits varied from day to day, depending on the instrument calibration. This variation of detection limits led to spurious results when the element released was so low that it was only detected on the days when the detection limit was lower than usual.

Appendix M contains graphs of the total releases of each element from the waste form samples in the 90ºC test in 1KCl solution, and the 3 waste form samples in the 1KCl, 10KCl, and AJ13 solutions at ambient temperature for each sampling interval, as a function of sampling interval. The amount of each element detected in the control vial solution has been included in the graphs as a bar graph for comparison. The control data provide useful information regarding the uncertainties in the tests. New vials were used for each test, so the uncertainties pertain solely to the test solution releases and do not include carryover from previous vial use.

a) Sample Contamination of Minor Elements and Mo

Examination of releases of Mo, Cu, and V showed fluctuations that could not be attributed to changes in detection limits. Upon checking the history of laboratory use during the test time of high releases, it was found that experimenters not involved in the Metal Waste Form (MWF) Project were using the laboratory balance and laboratory area in close proximity to the MWF work to measure powders of Mo, Cu, and V. It is believed that the test samples were contaminated from airborne powders of these elements. Thus, reported releases of these three elements are not reliable.

b) Mo and Minor Elements (Mn, Co, Cu, and V)

Due to the sample contamination with Mo, Cu, and V, and the low levels of release in the minor elements, releases of these elements will not be discussed. These elements have not been included in the reported total release.

2. Cumulative Release at 90°C

a) 1KCl:

Few elements were detected from the immersion test in1KCl. The small amounts detected were near the limits of detection.

Release of Major Elements

The major elements consist of Fe, Zr, Cr, and Ni. Fe had the highest release at 4.83 ng/mm^2 at 14 days as shown in Figure III-52. Ni was only detected on day 14 at 3.63 ng/mm^2 as shown in Figure III-53, 1.64 ng/mm^2 above the detection limit of 2.07 ng/mm^2 Zr releases were below 0.5 ng/mm^2 as shown in Figure III-54. Cr was not detected.

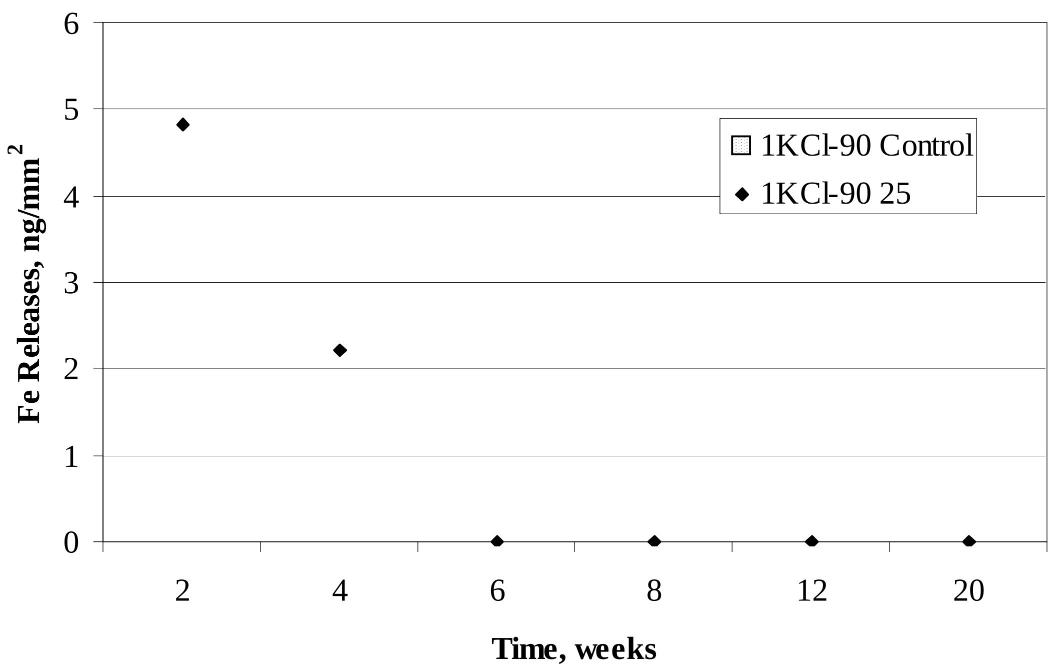

Figure III-52. Iron releases in 1KCl at 90°C.

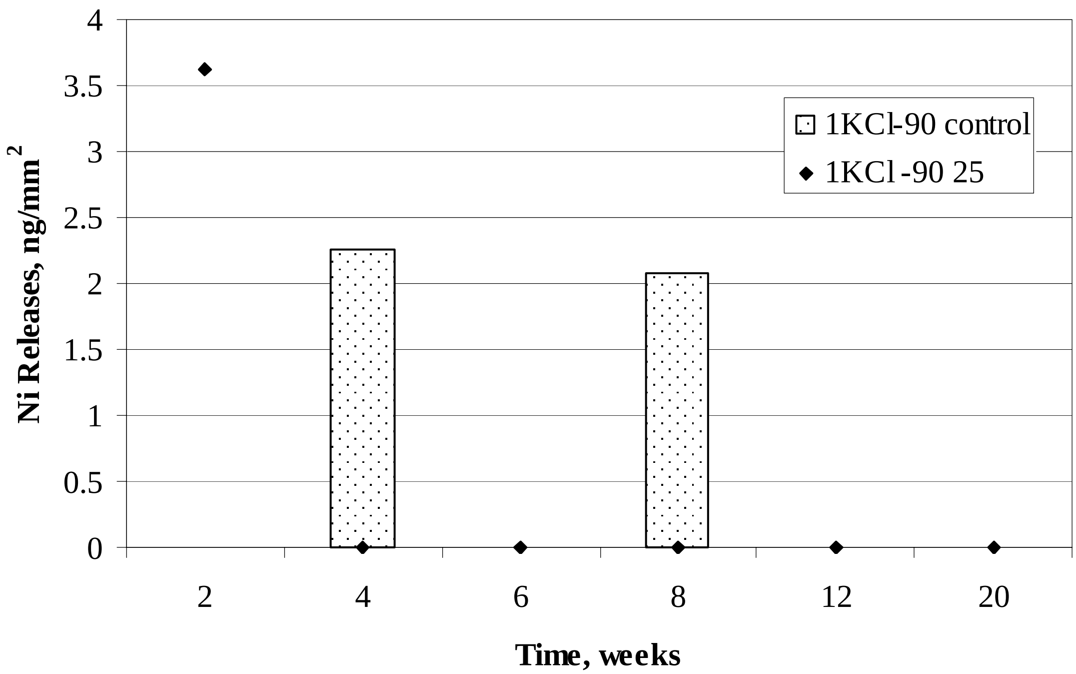

Figure III-53. Nickel releases in 1KCl at 90ºC.

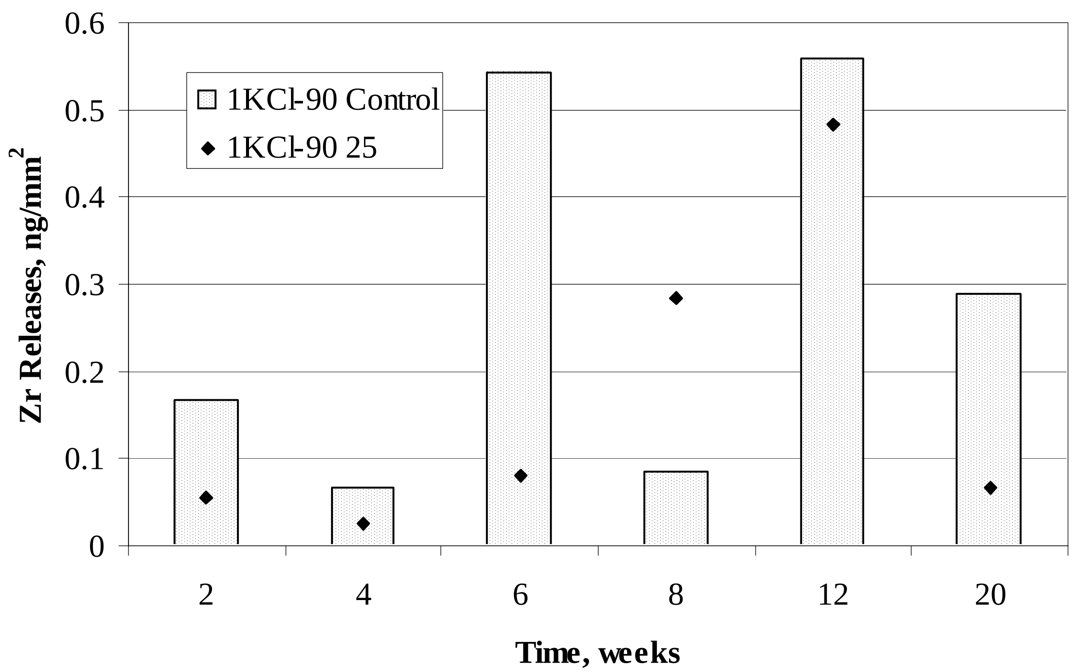

Figure III-54. Zirconium releases in 1KCl at 90ºC.

Release of Fission Product Elements

Fission product elements consist of Pd, Nb, Ru, and Rh. Both Rh and Ru were only detected on day 42 at approximately 0.03 ng/mm^2 as shown in Figures III-55 and III-56, 0.01 ng/mm^2 above the detection limit of 0.02 ng/mm^2. Nb and Pd were not detected.

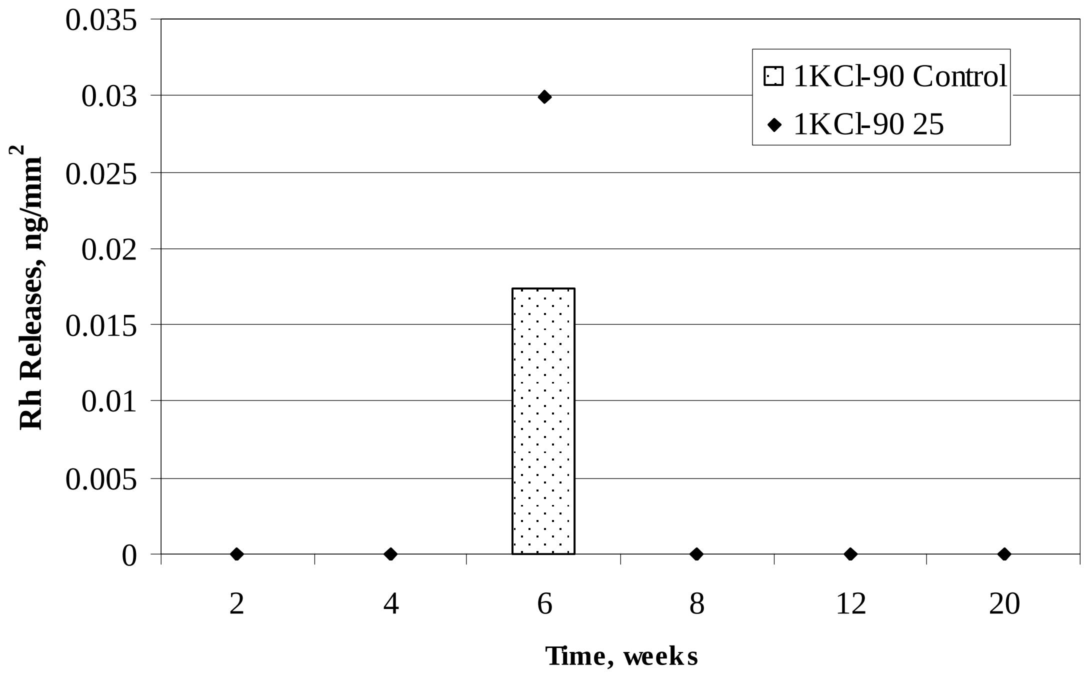

Figure III-55. Rhodium releases in 1KCl at 90°C.

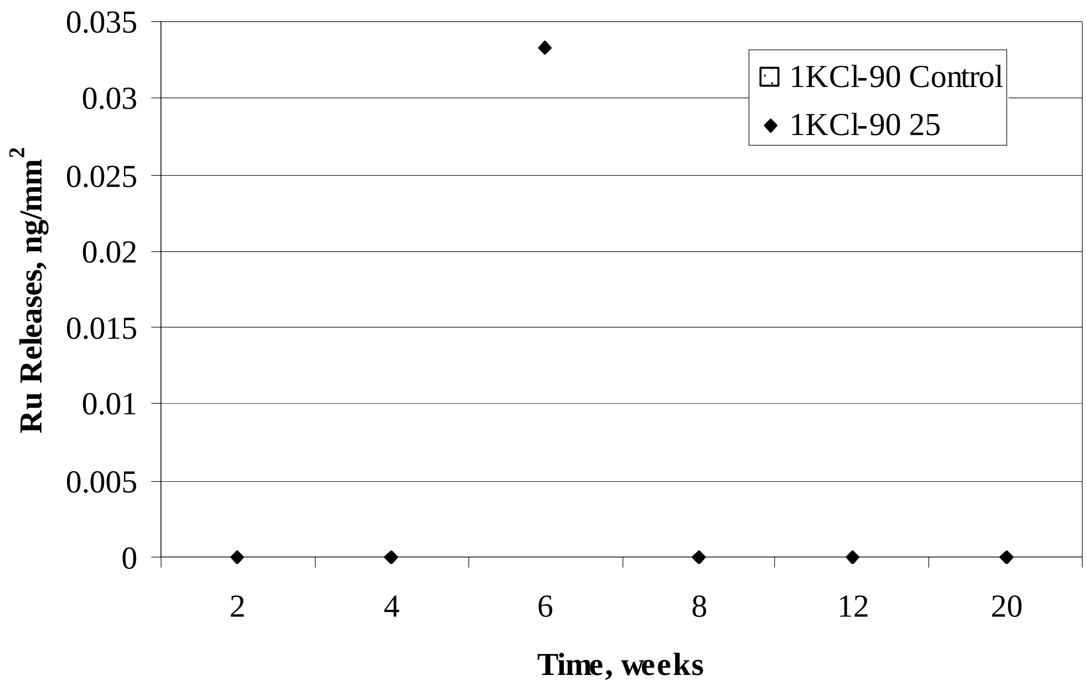

Figure III-56. Ruthenium releases in 1KCl at 90°C.

1KCl chloride Summary

Of the major elements Fe and Ni showed the highest releases at 90ºC, but even these values were just above the detection limits. Releases for Zr were below 0.5 ng/mm^2. Both Rh and Ru were detected once at 42 days with the release again just above the detection limit.

3. Cumulative Release at Ambient Temperature:

a) 1KCl:

Cumulative releases were near the detection limit or not detected.

Release of Major Elements

Of the major elements (Fe, Zr, Cr, Ni) Fe was detected at 14 days at 7.68 ng/mm^2, lower than the corresponding control vessel, as shown in Figure III-57. Ni was detected at 28 days at 4.54 ng/mm^2 as shown in Figure III-58. Zr was detected at 0.44 ng/mm^2 just above the detection limit on day 84 as shown in Figure III-59. Cr was not detected.

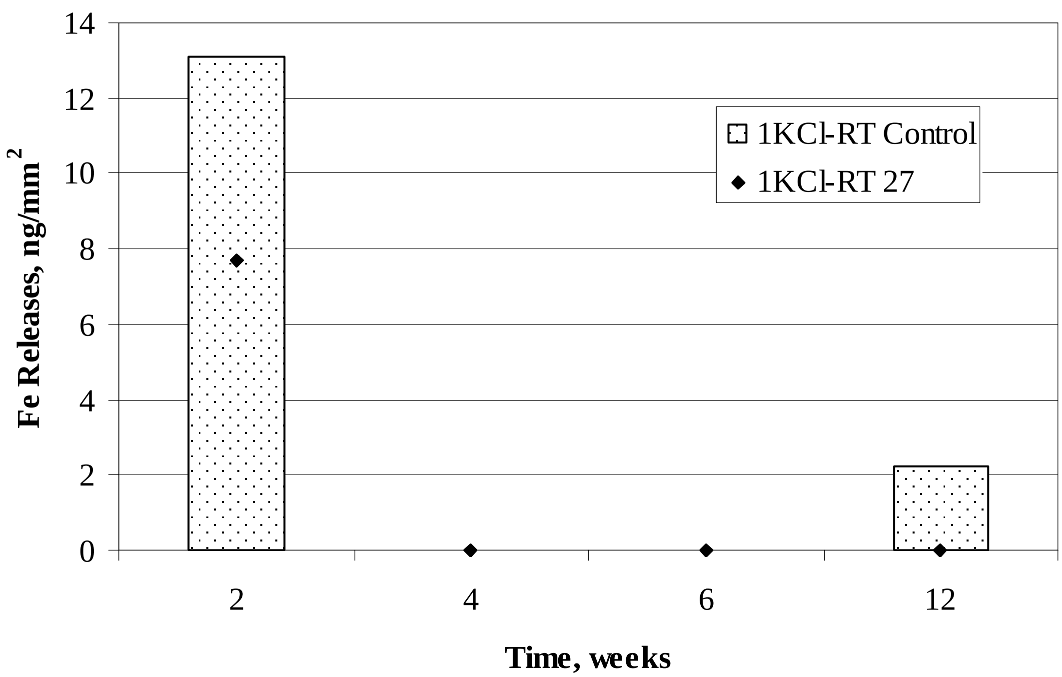

Figure III-57. Iron releases in 1KCl at room temperature.

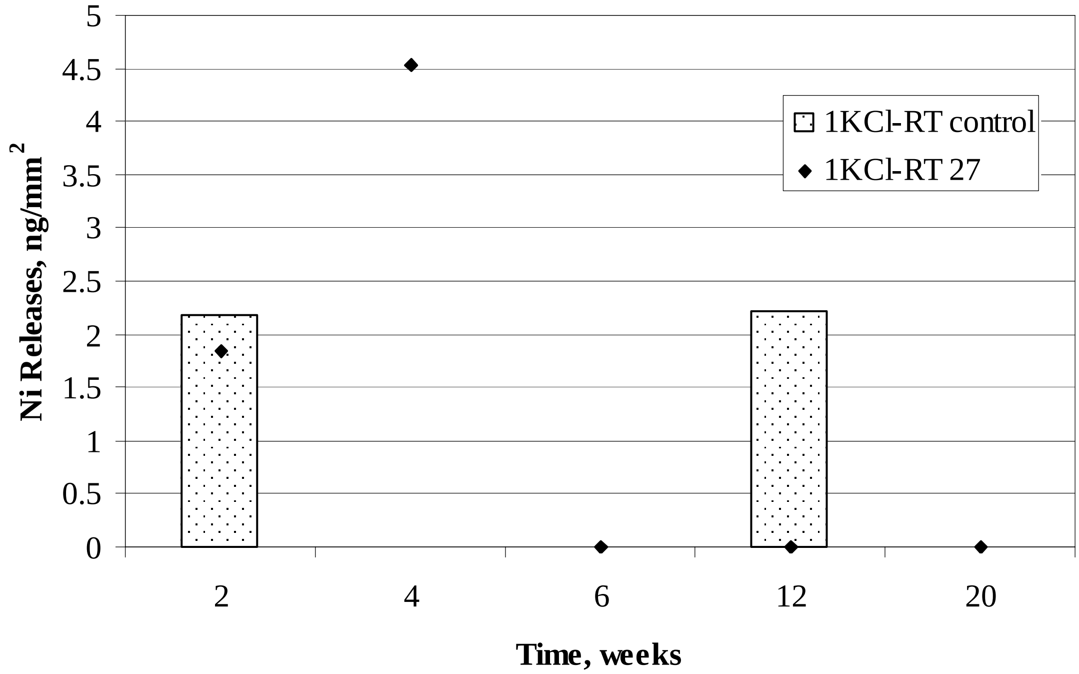

Figure III-58. Nickel releases in 1KCl at room temperature.

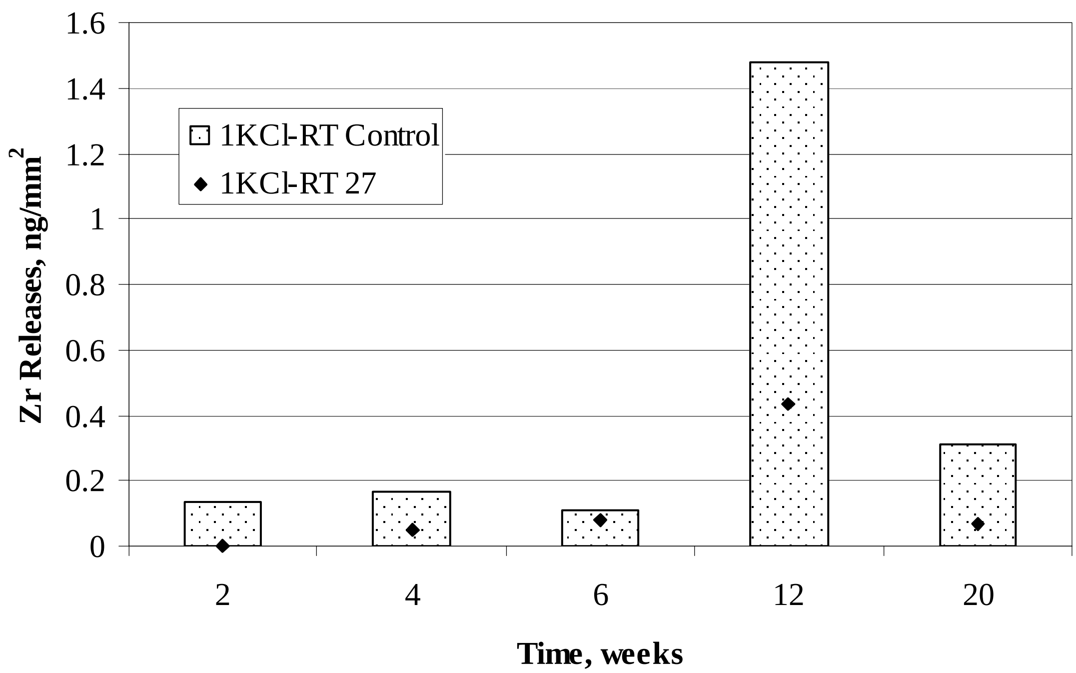

Figure III-59. Zirconium releases in 1KCl at room temperature.

Release of Fission Product Elements

None of the fission product elements (Pd, Nb, Ru, Rh) were detected.

1KCl Summary:

Most of the cumulative releases were near the detection limit or not detected. The highest releases were for the major elements Fe (7.68 ng/mm^2) and Ni (4.54 ng/mm^2) during the 14-28 day period. Zr was detected at just above the detection limit at 84 days. No fission product elements were detected.

b) 10KCl:

The highest releases were the major elements Fe, Cr, and Ni. The fission product elements and Zr were detected at just above the detection limit.

Release of Major Elements:

Of the major elements (Fe, Zr, Cr, Ni) Fe and Cr were detected at 84 days. Fe was detected at 262.25 ng/mm^2 as shown in Figure III-60 and Cr was detected at 74.50 ng/mm^2 as shown in Figure III-61. Ni was detected at 23.80 ng/mm^2 at 140 days as shown in Figure III-62. Zr was detected at 14 days at 1.19 ng/mm^2 as shown in Figure III-63.

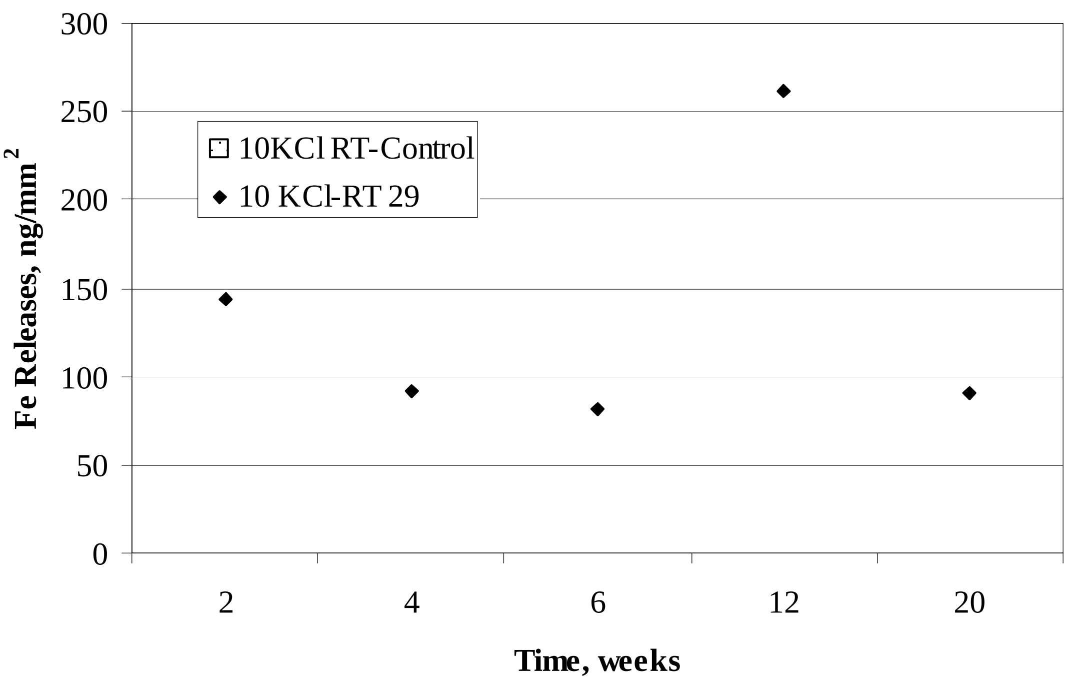

Figure III-60. Iron releases in 10KCl at room temperature.

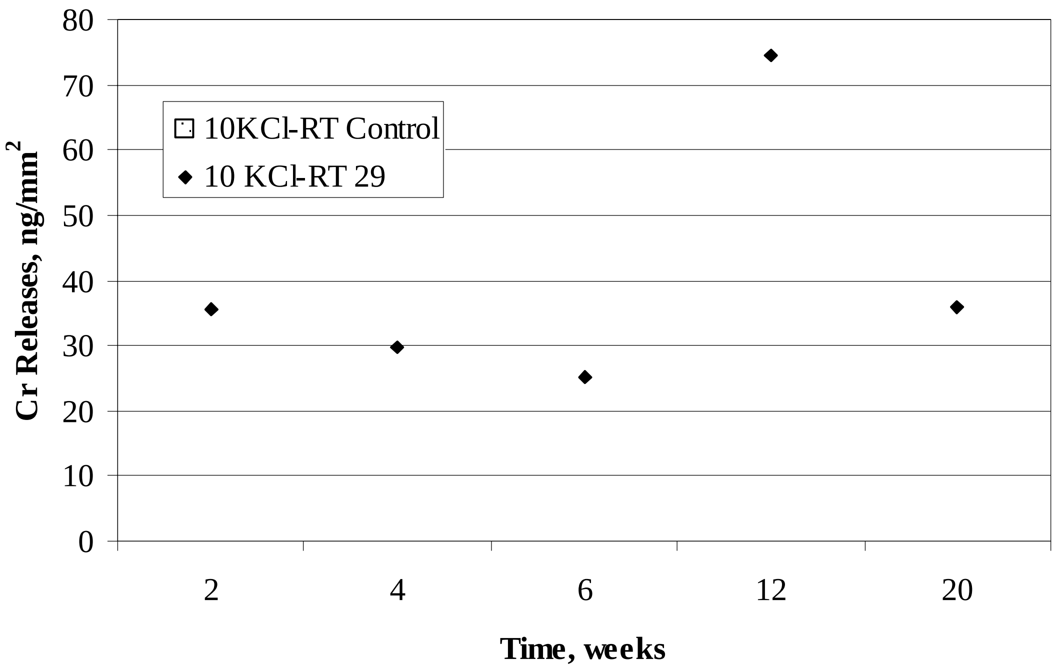

Figure III-61. Chromium releases in 10KCl at room temperature.

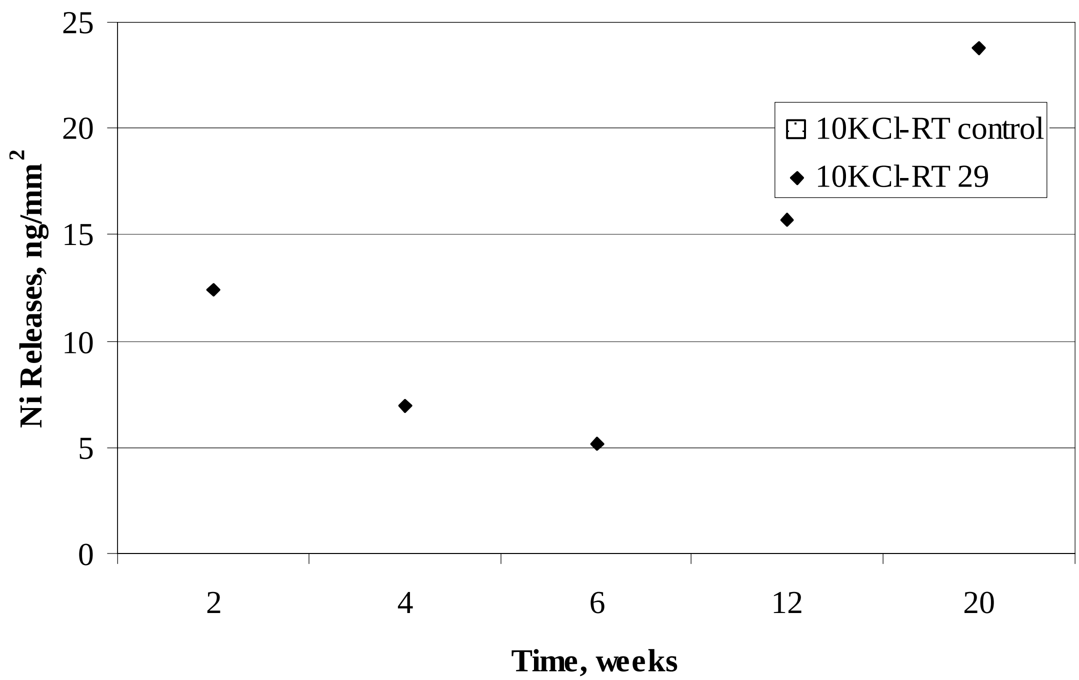

Figure III-62. Nickel releases in 10KCl at room temperature.

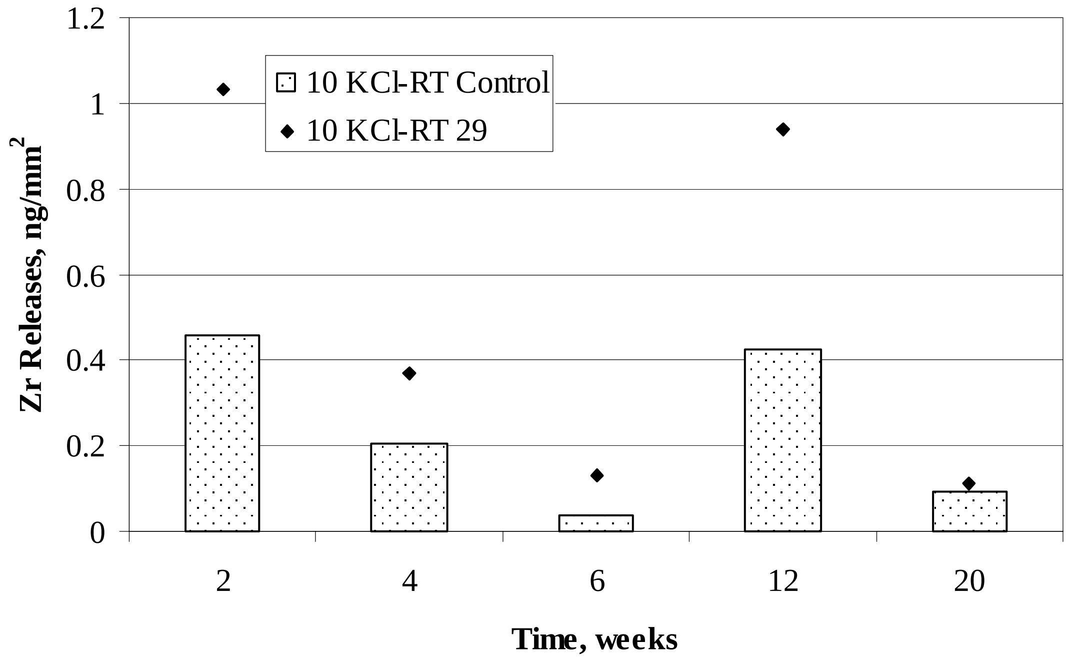

Figure III-63. Zirconium releases in 10KCl at room temperature.

Release of Fission Product Elements:

The fission product elements (Pd, Nb, Rh, Ru) were all detected at 84 days at levels just above the detection limits represented by Figure III-64. Pd was detected at 0.09 ng/mm^2, Nb at 0.16 ng/mm^2, Rh at 0.61 ng/mm^2 and Ru at 0.74 ng/mm^2.

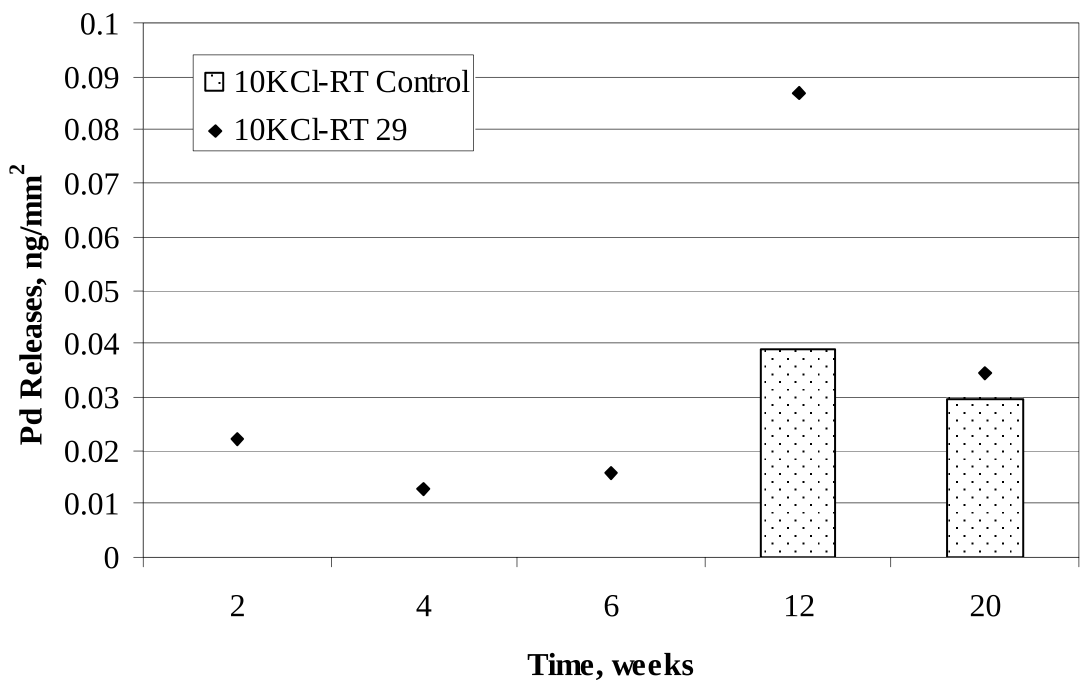

Figure III-64. Palladium releases in 10KCl at room temperature.

10KCl Summary

The highest releases were the major elements Fe, Cr, and Ni. Fe was the major contributor to the total cumulative release. Cr release was a factor of three lower than Fe release followed by Ni release at an order of magnitude lower. Fe and Cr were detected at 84 days and Ni was detected at 140 days. Zr was detected at 14 days. The fission product elements and Zr were detected at just above the detection limit.

c) AJ13:

The highest releases were for the major elements. Cumulative releases for the fission product elements were near the detection limit or not detected.

Release of Major Elements:

The highest releases of all the major elements (Fe, Zr, Cr, Ni) occurred primarily at 140 days. Fe was detected at 797.00 ng/mm^2 as shown in Figure III-65, Zr at 6.24 ng/mm^2, Cr at 248.92 ng/mm^2, and Ni at 57.20 ng/mm^2. These values represented a change in the release rate as, prior to this time, release into solution was very low.

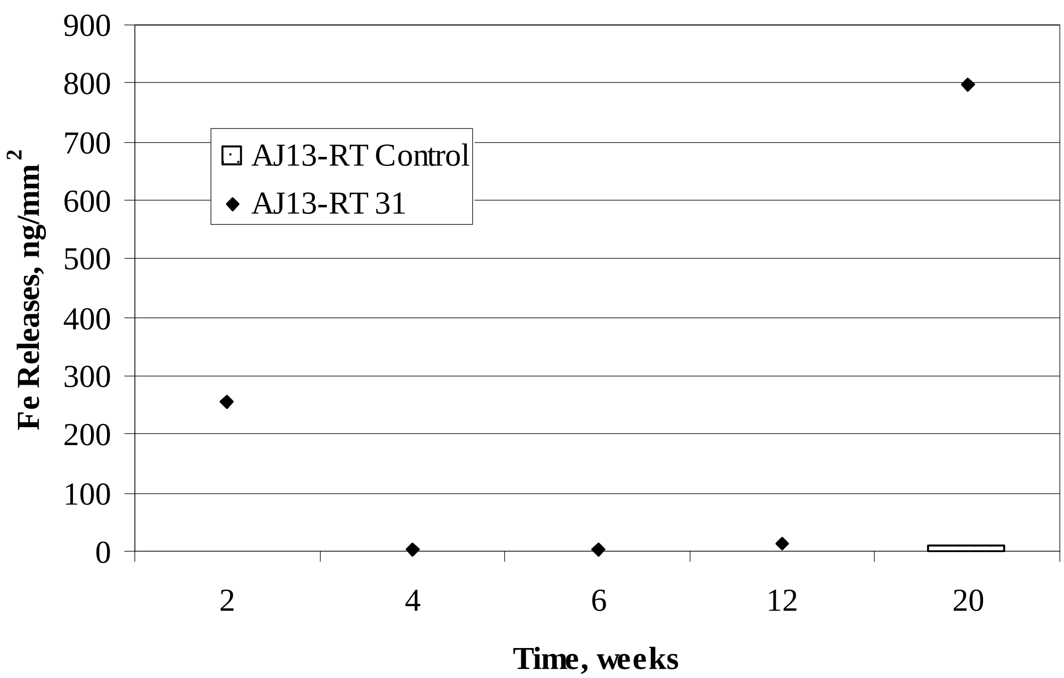

Figure III-65. Iron releases in AJ13 at room temperature.

Release of Fission Product Elements:

The highest release of fission product elements (Pd, Nb, Ru, Rh) was Ru at 2.48 ng/mm^2 at 140 days. Nb at 0.16 ng/mm^2 and Pd at 0.09 ng/mm^2 were detected at 84 days. The values are just above the detection limit for both elements. Rh was not detected.

AJ13 Summary

The highest releases were the major elements at 140 days. Fe was the major contributor to the total cumulative release. Cr release was a factor of three lower than Fe release followed by Ni release at just over one order of magnitude lower. Zr release was two orders of magnitude lower than Fe. Cumulative releases for the fission product elements Ru, Nb, and Pd occurred at 84 days and the values were near the detection limit. Rh was not detected.

4. Comparison of 90ºC and 25ºC Results as a Function of Solution

a) 10KCl

The 10KCl solution results were compared for both temperatures. The 25ºC results indicated that Fe was the major release element and contributed the most to the total value as shown in Figure III-66. This trend is consistent with the 90ºC data results. However, the temperature effect is evident on the magnitude of the values of total cumulative release as shown in Figure III-67. The 90ºC total is almost a factor of 5 greater than that of the 25ºC total.

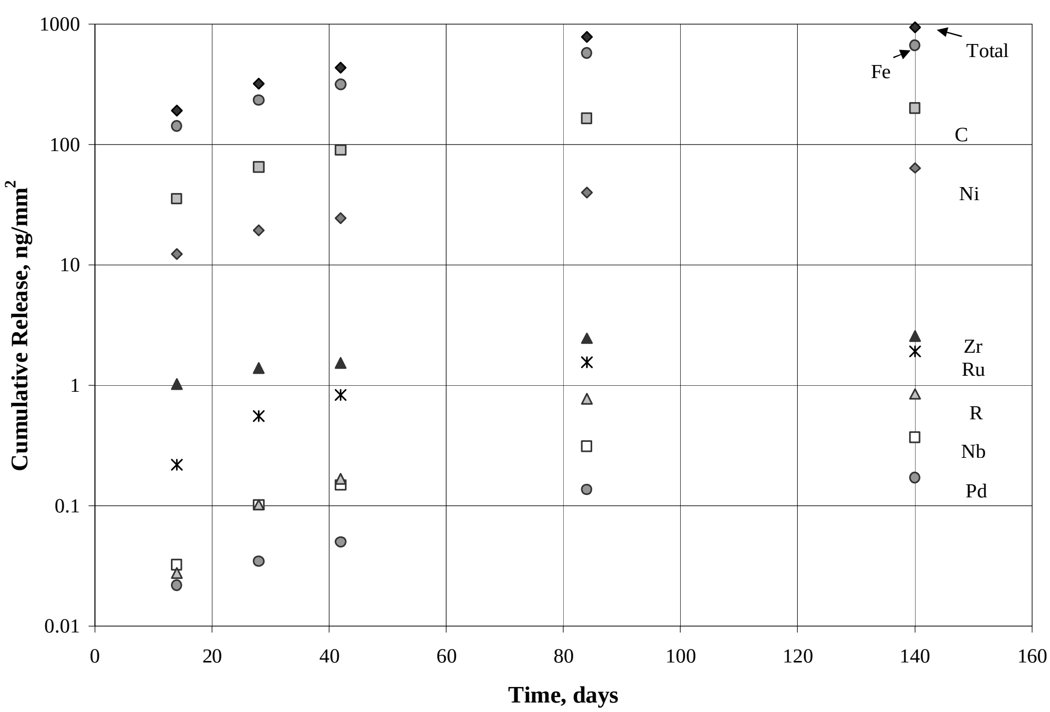

Figure III-66. Cumulative releases in 10KCl at room temperature.

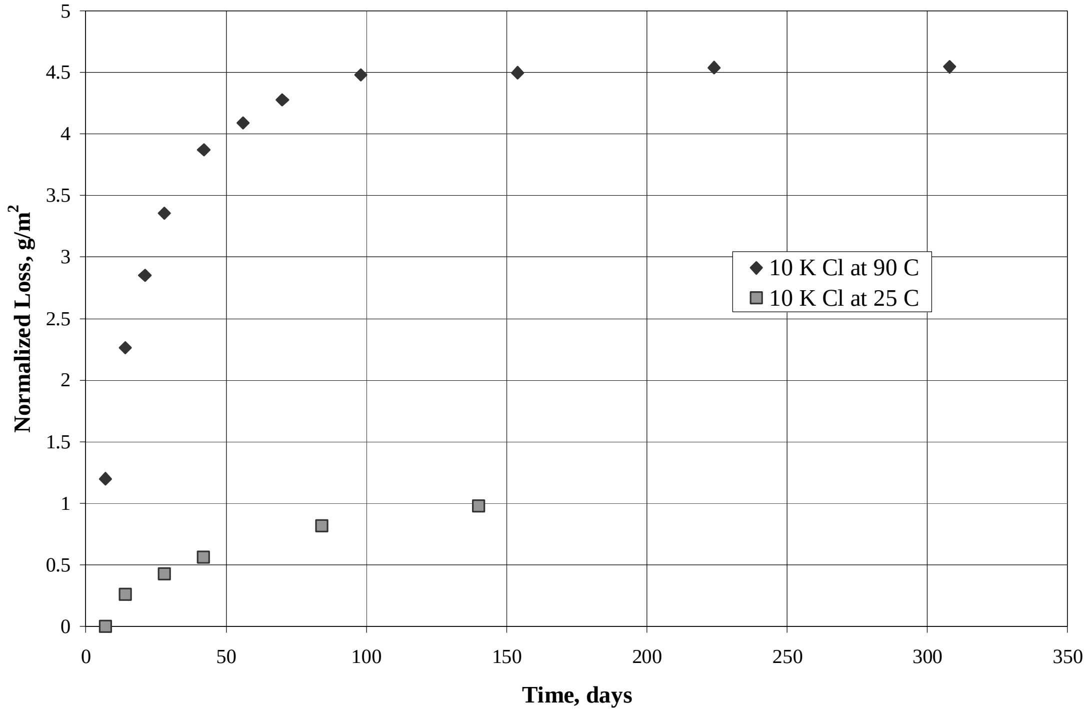

Figure III-67. Cumulative Loss of Iron in 10KCl.

b) AJ13

The AJ13 solution results were compared for both temperatures. The 25ºC results indicated that Fe was the major release element and contributed the most to the total value as shown in Figure III-68. This trend is consistent with the 90ºC data results. However, the temperature effect is evident on the magnitude of the values of total cumulative release as shown in Figure III-69. The 90ºC total is 3 orders of magnitude greater than that of the 25ºC total.

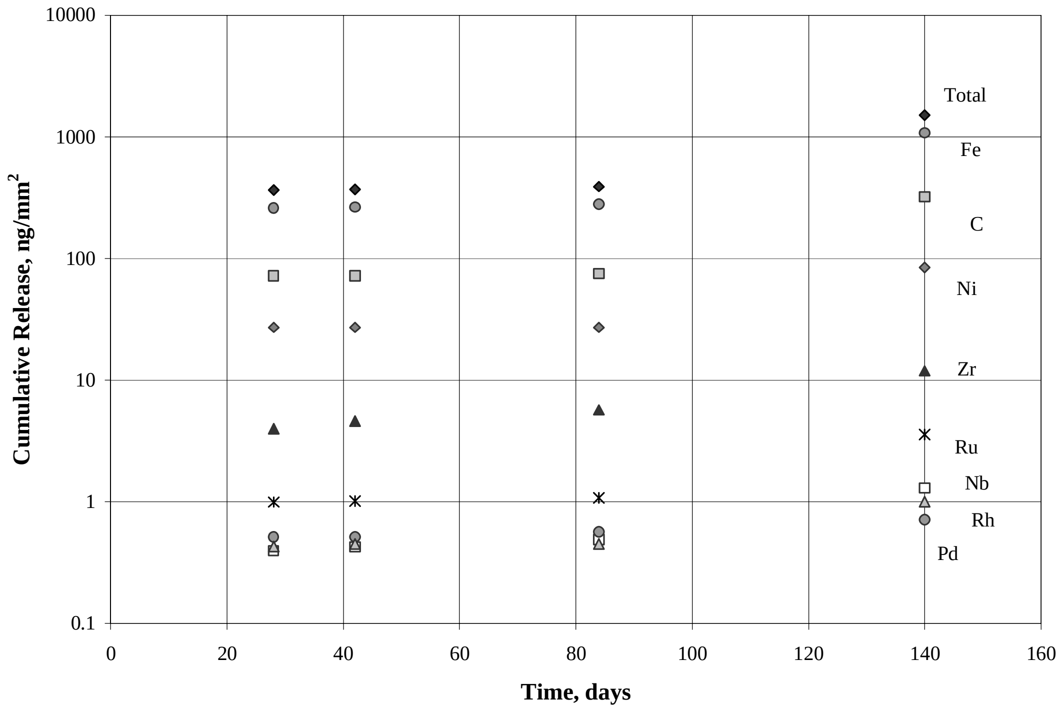

Figure III-68. Cumulative releases in AJ13 at room temperature.

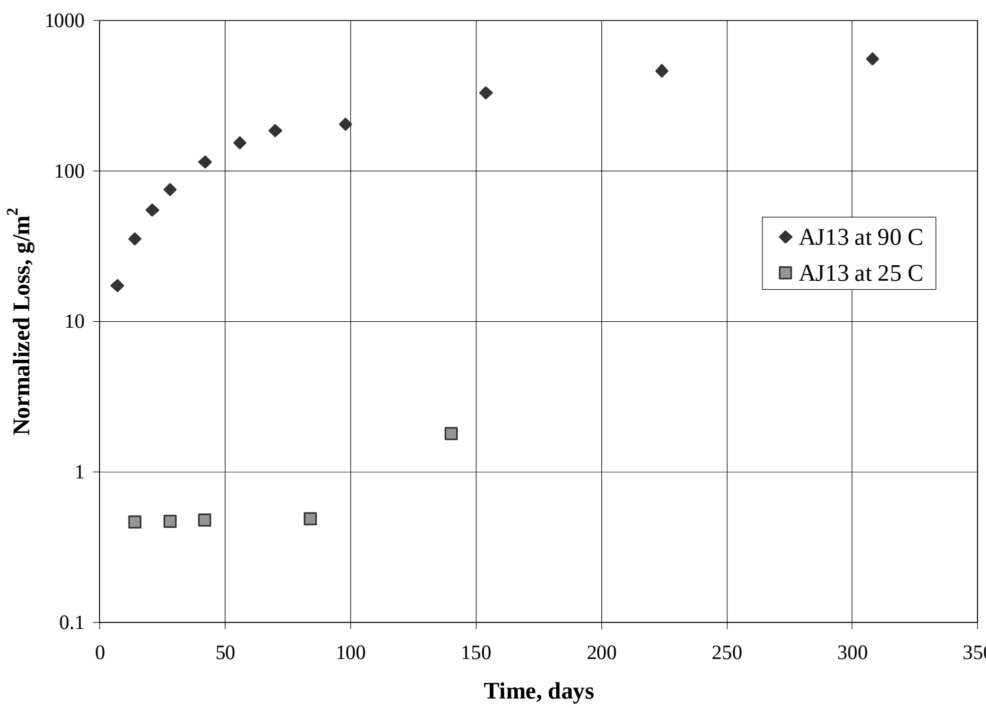

Figure III-69. Cumulative Loss of Iron in AJ13 solution.

5. Comparison at Ambient Temperature

a) 10KCl and AJ13

The 10KCl and AJ13 solutions represent the most aggressive groundwater seepage and/or vapor condensation environment the MWF may be subjected to in the repository. A comparison of total cumulative releases is shown in Figure III-20. The 10KCl solution showed a steady release over the entire 140 days. The AJ13 solution showed an initial release at 14 days and remained at this level until 140 days when the value increased by a factor of 4.

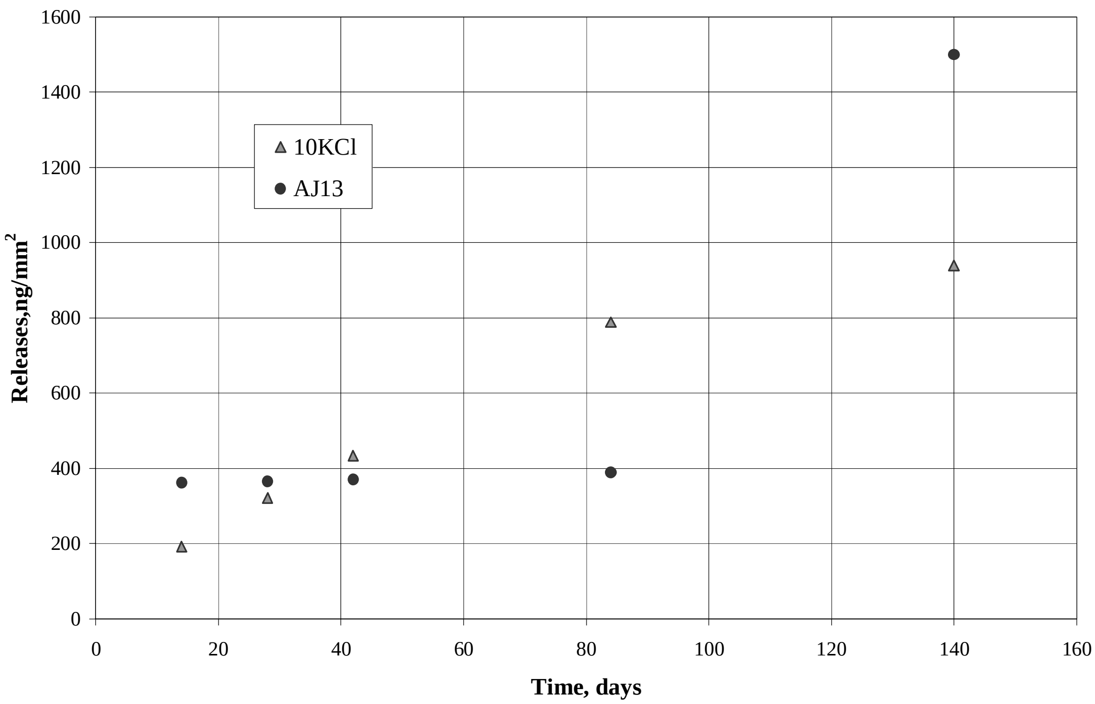

Figure III-70. Cumulative releases in 10KCl and AJ13 at Room Temperature.

The release curve trend for both solutions appears very similar. Curve fitting for cumulative loss of Fe in 10KCl and 1KCl is shown in Figures III-20 and III-21, respectively.

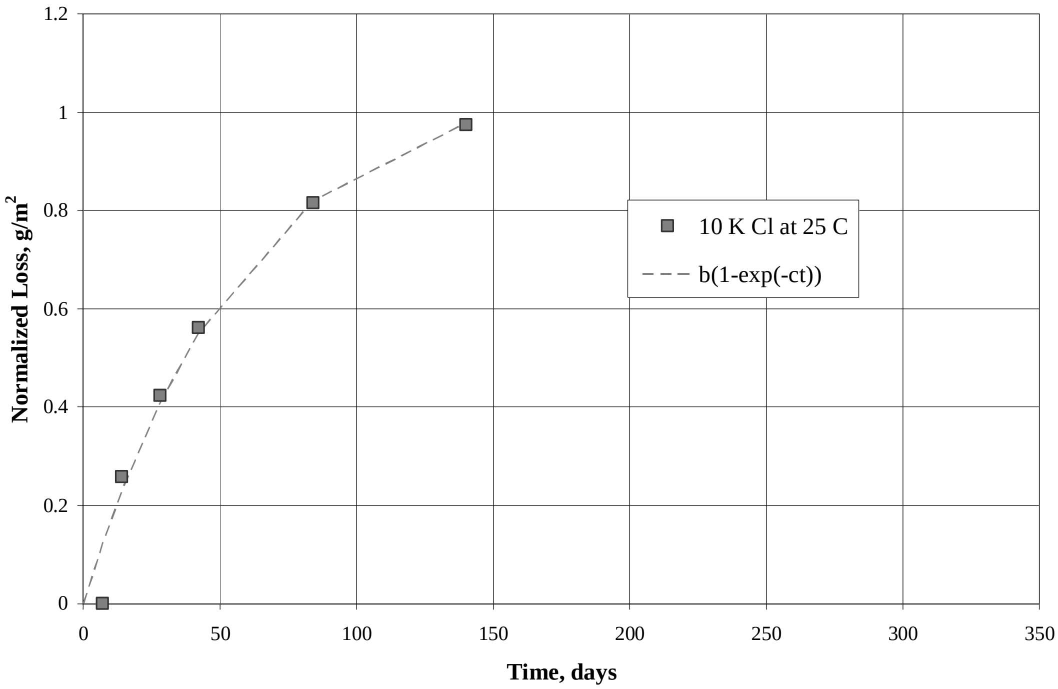

Figure III-71. Curve Fitting with Cumulative Loss of Iron in 10KCl solution at room temperature.

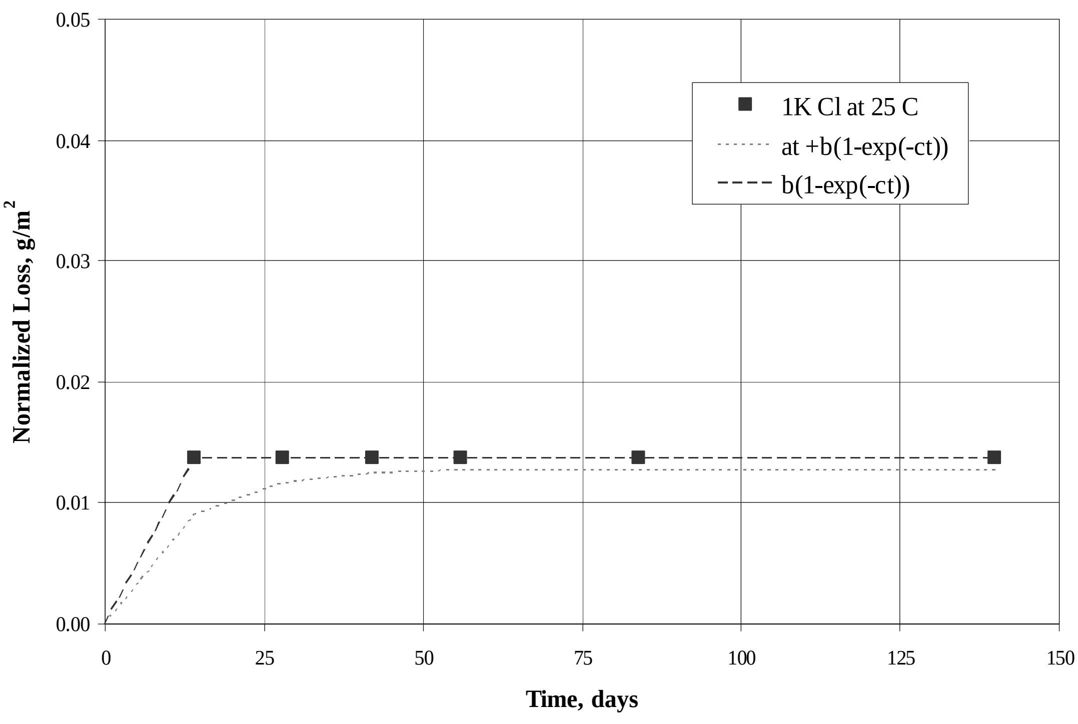

Figure III-72. Curve Fitting with Cumulative Loss of Iron in 1KCl solution at room temperature.

C. Comparison of 90ºC Releases with Electrochemical Corrosion Data

Because release data were not available, electrochemical corrosion data have been previously used to estimate releases from the metal waste form [4]. To determine the reliability of these estimates, the total releases at 90ºC have been compared with the electrochemical data. These comparisons are shown for the four solutions SJ13, CJ13, 10KCl, and AJ13 in Figures III-73 through III-76. The electrochemical corrosion rate data have been integrated to provide corrosion as a function of time from the corrosion rates. For completeness, the release rates for high level waste glass (HLWG) have been included in the figures.

Figures III-73 and III-74 show that in SJ13 and CJ13 (pH=9.2 and 8.2, respectively) the total releases from the metal waste form are one or more orders of magnitude lower than the electrochemical corrosion data and the releases from HLWG. However, in SJ13, the electrochemical corrosion data are of similar magnitude to releases from HLWG and in CJ13, the electrochemical corrosion data are higher than releases from HLWG.

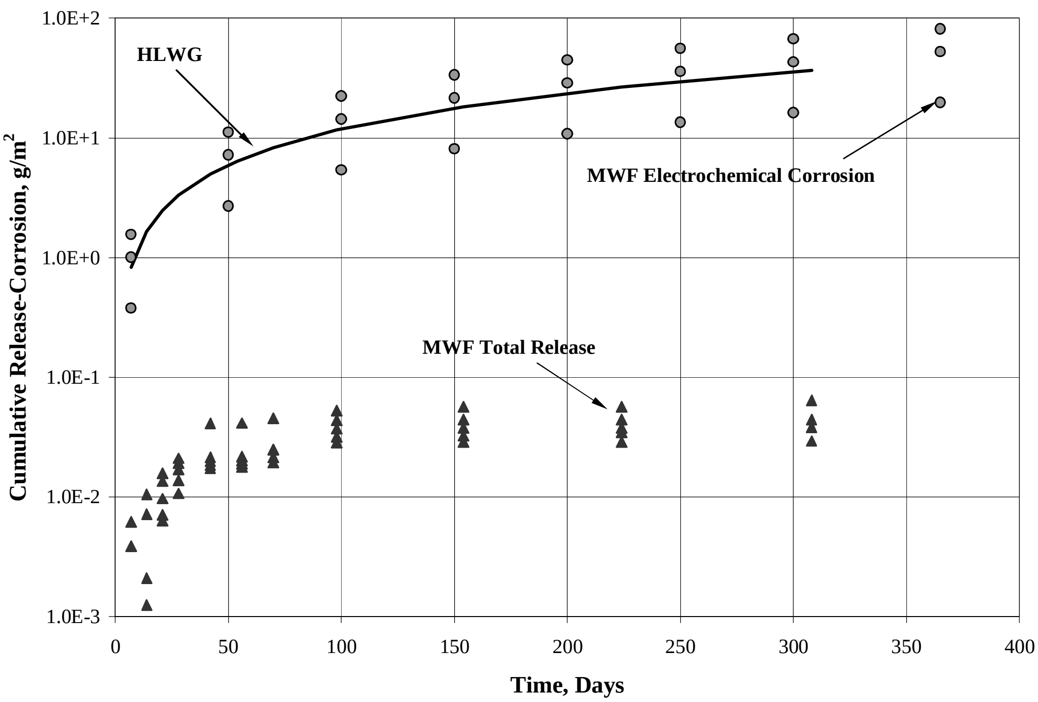

Figure III-73. Comparison of MWF Electrochemical Corrosion and Total releases in SJ13, pH=9.2, at 90ºC.

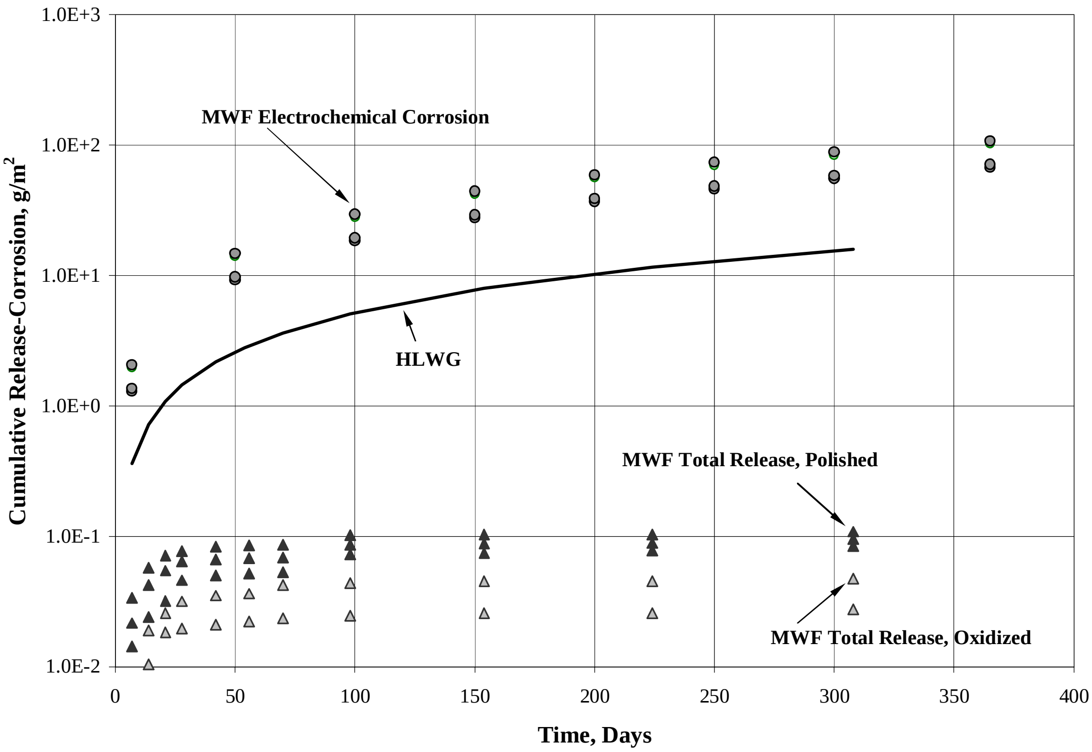

Figure III-74. Comparison of MWF Electrochemical Corrosion and Total releases in CJ13, pH=8.3, at 90ºC.

In 10KCl solutions with pH=6.9 (Figure III-75), the releases and corrosion of the MWF are similar at 7 days but the corrosion rate is higher giving higher corrosion at later time intervals. Releases from the MWF are initially higher than those from HLWG but after 98 days, the MWF releases level off so that at 224 days the total MWF releases are below those for HLWG.

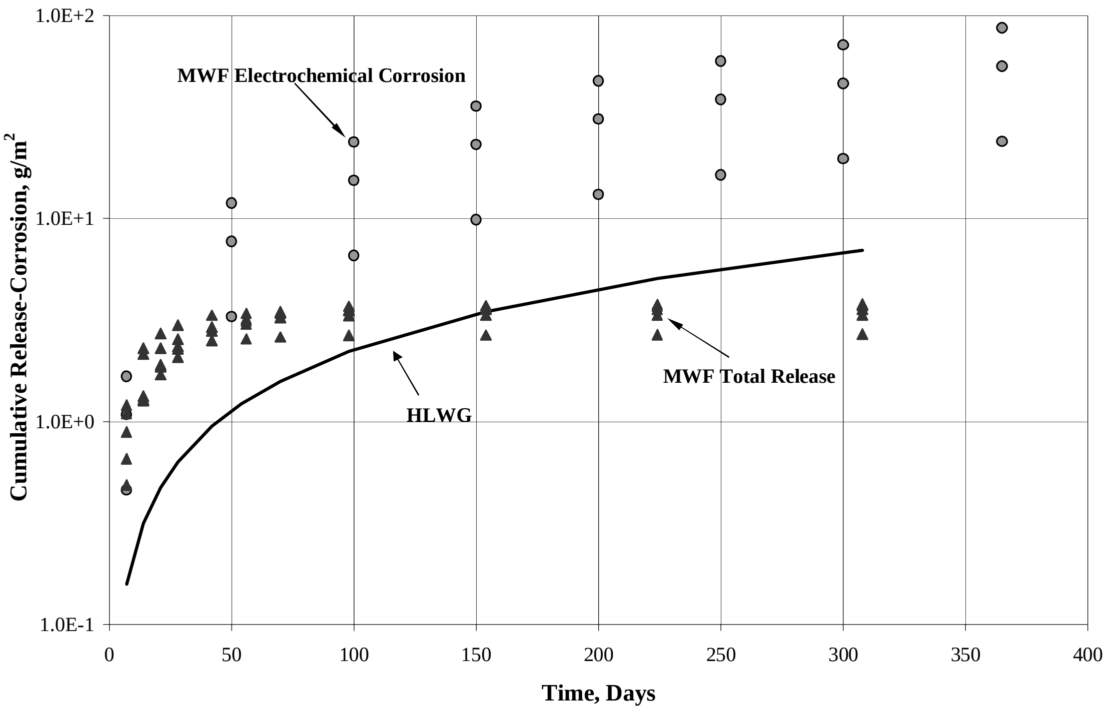

Figure III-75. Comparison of MWF Electrochemical Corrosion and Total releases in 10KCl, pH=6.9, at 90ºC.

Figure III-76 shows that at pH=2 and 90°C, the total releases from the MWF are higher than the MWF electrochemical corrosion. Releases from HLWG are higher than the total releases from the MWF samples. The fact that at the higher pH values (pH= 6.9, 8.2, and 9.2), the MWF releases are lower than the electrochemical corrosion but this trend is reversed for pH=2, indicates that, at 90ºC, MWF corrosion data have a different pH dependence than the release data. Thus, the electrochemical corrosion data cannot be used to estimate the releases from the MWF as was done by Fink et al.[4].

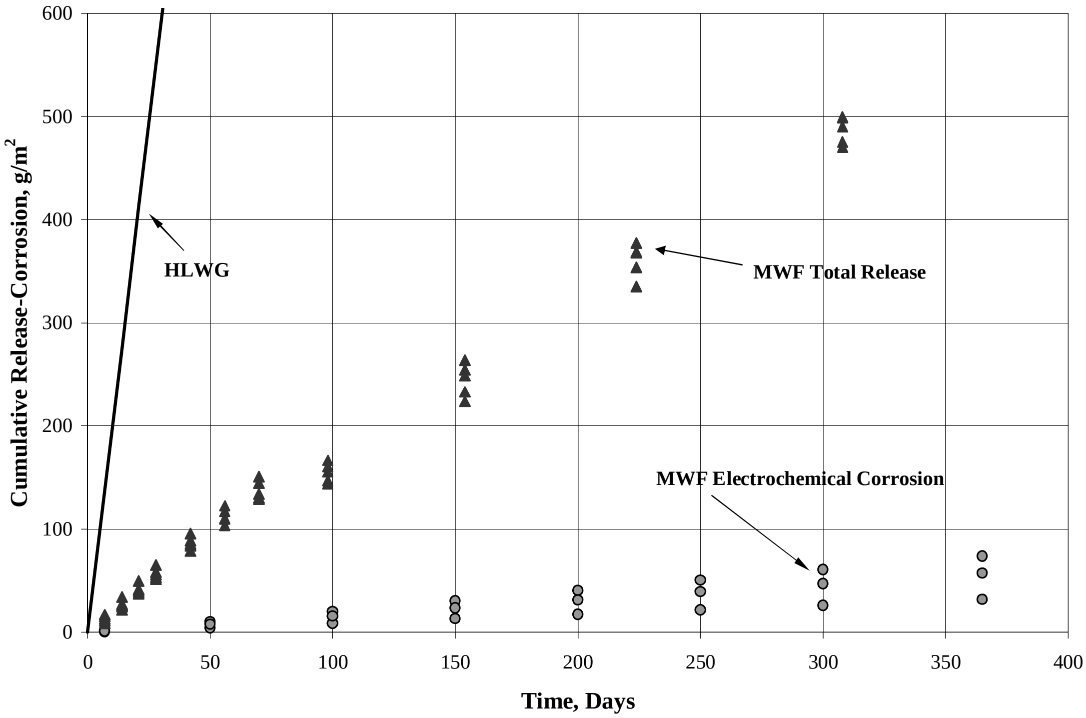

Figure III-76. Comparison of MWF Electrochemical Corrosion and Total releases in AJ13, pH=2, at 90ºC.

D. Comparison of Releases from the MWF and High Level Waste Glass

The release model for high level waste glass (HLWG) developed by Ebert et al. [6] is based on equations for the normalized loss of boron, the element released at the highest rate. Total releases from the metal waste form samples were comprised mainly of iron. Thus, for consistency with the HLWG release model, normalized losses of Fe have been determined as a function of pH and temperature from the 90ºC and room temperature tests. The equation used to determine the normalized losses of Fe is given in Section 2. The normalized loss of Fe from the five samples for each test were averaged except for the 90ºC test in CJ13 because for this tests the results for oxidized samples and polished samples belonged to different sets. For the CJ13 test, results from the three polished samples were averaged to obtain an averaged normalized loss of Fe from polished samples and the results from the two oxide samples were averaged to obtain the normalized loss from oxidized samples. In order to compare releases from the MWF with high level waste glass using Ebert's glass model, Fe normalized losses have been fit to an equation, suggested by Irving Johnson, which is:

$$at \quad + \quad b\,[1 - \exp(-c\,t)] \tag{1}$$

where the parameters *a*, *b*, and *c* are defined in Table 2.

The data were fit by a least squares minimization procedure in EXCEL using solver, which required reasonable first guesses of the coefficients. In order to easily obtain convergence, the data were first fit to the second term to obtain first guesses of b and c. Then the data were refit to Eq.(1) with these first guesses of b and c. In some instances, the best fit was obtained with the parameter for the linear term effectively 0. These cases indicate that the tests have not been run for long enough times to determine the linear term coefficient. The fits of the average cumulative normalized loss of Fe at 90ºC are shown in Figure III-77. The fits of the 25ºC Fe normalized losses are shown in Figure III-78. These figures show that reasonable fits were obtained for all the 90ºC tests and for the 25ºC test in 10KCl. However, the fit to the 25ºC AJ13 test data is not as good because very little Fe was detected at 4, 6, and 12 weeks even though significant Fe was found following 20 weeks of immersion. Thus, the datum at 20 weeks is defining the fit. The parameters used in these fits are given in Table 1. Standard deviations of the fits are shown in the last column of Table III-1.

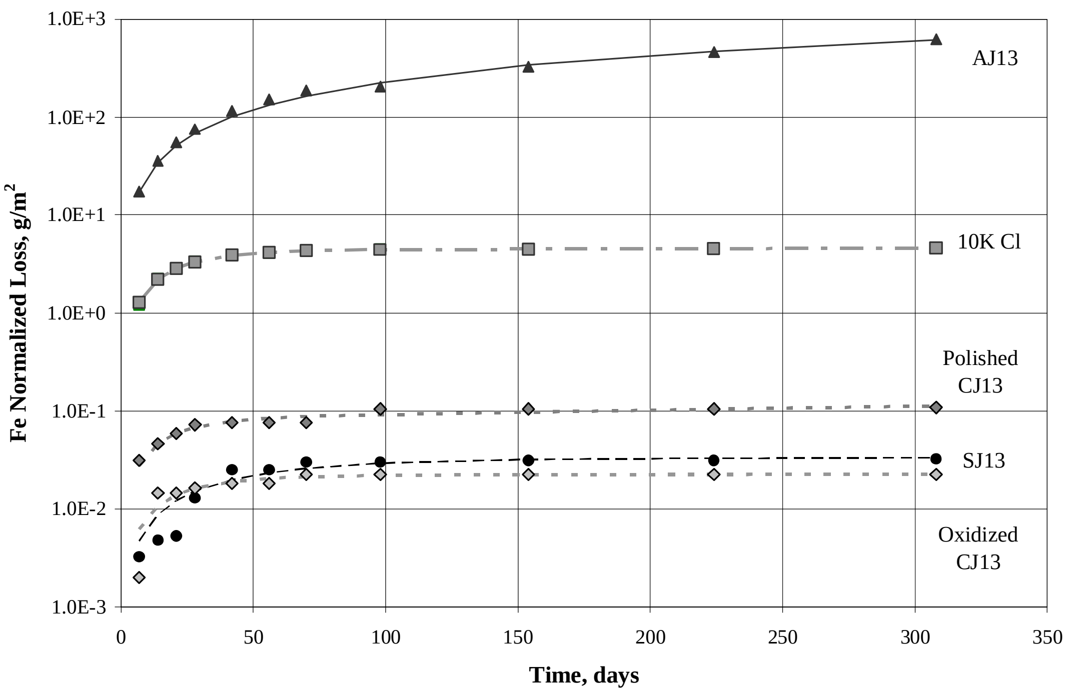

Figure III-77. Fits to the Average Cumulative Fe Normalized Losses at 90ºC.

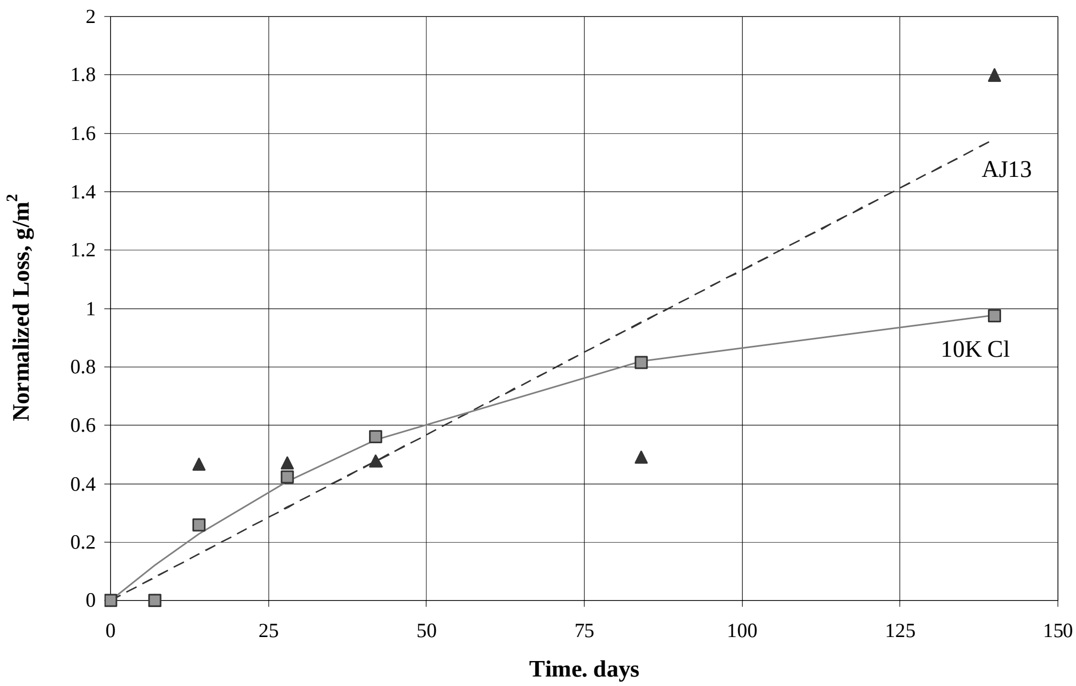

Figure III-78. Fits to Cumulative Fe Normalized Loss Data at 25ºC.

Table III-1. Parameters used in Equation (1) to Fit Fe Normalized Losses

Solution	T, °C	pH	a	b	c	Std[a]
SJ13	90	9.2	1.00 x 10-7	3.30 x 10-2	2.19 x 10-2	0.0036
CJ13 Polished	90	8.3	9.93 x 10-5	8.20 x 10-2	5.62 x 10-2	0.0073
CJ13 Oxidized	90	8.3	2.89 x 10-6	2.18 x 10-2	4.78 x 10-2	0.002
10KCl	90	6.9	5.23 x 10-4	4.42	4.91 x 10-2	0.05
AJ13	90	2	6.57 x 10-5	1.68 x 103	1.46 x 10-3	15.1
10KCl	25	6.1	0	1.08	1.72 x 10-2	0.063
AJ13	25	2	3.58 x 10-4	78.9	1.40 x 10-4	0.31

[a]Std is the standard deviation of the fit, defined as

$$Std = [\sum (Fit - Data)^2 / (N-3)]$$

where *N* is the number of data.

For comparison with high level waste glass (HLWG), the derivative of Eq.(1) was taken at 7 days to determine the rate of release, k. Comparison of release rates determined from Fe normalized losses from the MWF with the release rates from HLWG model of Ebert et al.[6] are shown in the Figure III-79. In all cases except 10KCl at 90^{o}C, the rates of release from the MWF are less than those from HLWG. Thus, except under high chloride conditions, releases of Fe and noble metal fission products are below those accepted for HLWG. Note that these tests did not measure releases of Tc and the actinide elements, U, Pu, and Np, so this comparison does not compare release rates of Tc and actinides with release rates from HLWG.

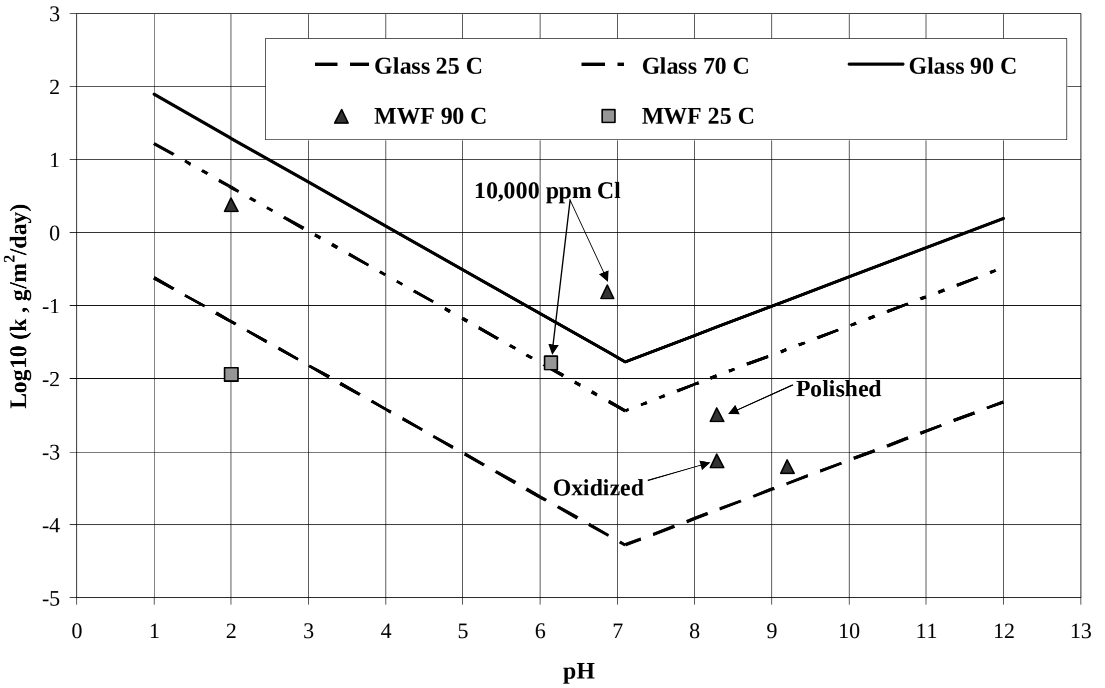

Figure III-79. Comparison of $\log_{10}$ of the release rates of the MWF and HLWG.

IV. SUMMARY AND CONCLUSIONS

A. Summary of Results

1. Results of Test Matrix Experiments

A test matrix to immerse polished and oxidized SS-15Zr-1Nb-1Ru-1Pd-1Rh samples in four different solutions at 90ºC was designed to address five issues. Four of these issues were to study the effects of (1) the solution aggressiveness, (2) high-chloride content of the solution, (3) solution pH, and (4) the state of the metal surface—polished vs. oxidized on the releases. The fifth issue was to determine if the releases are limited by iron saturation of the solution. Results from the 308-day immersion tests in SJ13, CJ13, 10KCl, and AJ13 are listed below relative to each of these issues.

1) The highest releases were detected in the most aggressive solution—AJ13 solution at 90ºC, which had a pH of 2. At the end of the 308 day tests, total releases in this solution were a factor of 1 x 10^4 greater than releases from the test at 90ºC in SJ13.

2) The high chloride solution (10KCl) mainly increased the releases of components from the steel—Fe, Cr, and Ni. Total releases were dominated by the Fe releases with releases of Cr and Ni about a factor of 6 lower. Releases of fission-product elements and Zr were at least an order of magnitude lower.

3) Releases of all elements were significantly increased in the pH=2 solution at 90ºC. Cumulative total releases continued to increase with time with only a small change in slope. This differed from the electrochemical data, which showed no significant change in corrosion rate with decreasing pH at 90ºC. In AJ13 solutions, total releases were dominated by Fe with Cr releases about a factor of 4 lower.

4) Except for a few cases, such as Fe and Zr releases in CJ13, differences between the releases from polished and oxidized samples were within expectations for statistical variation of multiple samples.

5) Saturation is not limiting the release of Fe. The significant reduction of releases with time in SJ13, CJ13, and 10KCl solutions appears to be from the formation of protective oxide films on the iron-solid-solution and intermetallic phases. Releases from the very aggressive AJ13 (pH=2) solution have not leveled off as much as the releases from tests in the other solutions. Samples used in these tests did not contain any minor phases (such as a sulfur phase). So these tests provide no data on releases from these phases, which are not expected to have protective oxide films.

2. Results from Additional Tests

Single samples immersed for 140 days in 10KCl at 25ºC, and AJ13 at 25ºC provided data to compare room temperature and 90ºC releases in aggressive solutions. As in the 90ºC tests, total releases at room temperature were dominated by Fe. After 140 days, releases of Ru and other fission products were more than a factor of 300 lower than the Fe releases in both room temperature solutions. Comparison of releases from 25ºC in 10KCl and AJ13 solutions with releases from samples immersed in these solutions at 90ºC showed that the increased temperature had a bigger effect for the AJ13 solution than for the 10KCl solution. After 140 days of immersion testing, the normalized loss of Fe in AJ13 at 90ºC was about a factor of 200 higher than the normalized loss of Fe in AJ13 at room temperature. After the same time, the normalized loss of Fe in 10KCl at 90ºC was only a factor of 4 higher than the normalized loss of Fe in 10KCl at room temperature.

B. Conclusions

1. MWF Release Conclusions

Even though the MWF samples used in these tests contained no actinides and no Tc, conclusions can be made with respect to the releases of the noble metal fission products and the stainless steel constituents. MWF conclusions are listed below.

- Fe releases are an order of magnitude or higher than the releases of the noble metal fission-product elements in all solutions.
- Releases of noble metal fission products and Cr and Ni in SJ13 and CJ13 solutions at 90ºC are close to the limits of detection.
- Solution concentration increased the Zr release. Zr releases from CJ13 were about a factor of 2 lower than the Fe release. In CJ13, Zr releases from oxidized samples were higher than from polished samples.
- Releases of all elements increased in the AJ13, pH=2 solution. Total cumulative releases as a function of time continued to increase for the 308 days of tests unlike the behavior in other test solutions. Tests in solutions with pH between 2 and 8 are needed to understand the different behavior.
- Except for high chloride solutions (10KCl) release rates of stainless steel elements and noble metal fission products from the MWF samples are lower than release rates from HLWG.

2. Other Conclusions

In addition to conclusions relative to releases from the MWF, conclusions have been drawn from these tests, which may be useful in other immersion tests. These are listed below.

- Electrochemical corrosion tests cannot be used to predict releases. They are different processes with different pH dependence.

- Teflon vials should not be reused. The cleaning procedure based on ASTM CFR C-1220-92 was not sufficient to remove all the elements that had migrated to the walls. Additional elements were detected from second acid washes when the vials contained the aggressive solutions—AJ13 and 10KCl.

- Blanks of each test solution should be run to detect problems in the test procedure such as sample contamination from the wall when vials were reused, contamination from other work being done in the laboratory where the tests were done, and uncertainties in chemical analysis.

- Caution must be taken in interpretation of low releases that are near the detection limit for a particular element. Because detection limits vary from day to day depending on calibrations, an element may be detected after one test interval and not for any other test intervals over the year. To aid in understanding these low releases, it may be useful to plot releases in ppb and detection limits in ppb for each element. Calculated normalized losses for elements released at the limits of detection are not reliable.

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APPENDICES

A. Data from Electrochemical Corrosion Tests Using the Polarization Resistance Method

Table A-1. Composition and Density of Alloys Tested.

Ingot	Alloy Description	Density (g/mL)
SS316	SS316	8.0
SS15ZR12	SS-15Zr-2Ru-1Pd-1Ag	7.8
SS15ZR14	SS-15Zr (annealed)	7.65
SS15ZR15	SS-15Zr-2Ru-1Nb-0.5Pd-0.5Ag	7.8
SS15ZR17	SS-15Zr (as-cast)	7.65
SS05ZR18	SS-5Zr-2Nb-1Ru-1Pd	7.8
SS20ZR19	SS-20Zr-2Nb-1Ru-1Pd	7.7
SS05ZR20	SS-5Zr-1Nb-0.5Ru-0.5Pd	7.8
SS05ZR21	SS-5Zr	7.9
SS15ZR23	SS-15Zr (cooled at 10^{o}C/min)	7.65
SS15ZR24	SS-15Zr (cooled at 5^{o}C/min)	7.65
SS15ZR25	SS-15Zr-1Nb-1Ru-1Pd-1Rh	7.8
SS15ZR26	SS-15Zr-1Nb-1Ru-1Pd-1Rh	7.8
SS15ZR27	SS-15Zr (cooled at 1^{o}C/min)	7.65
SS00ZR28	SS-2Nb-1Ru-1Pd-1Ag	8.0
Zr	Zr	6.5
ZR08SS02	Zr-8SS-1Ag-1Nb-1Pd-1Ru	6.7
ZR08SS04	Zr-8SS	6.6
Copper	Pure Copper	8.9
C-22	C-22	8.7
AISI 1018	Mild Steel	7.9

Table A-2. Typical Composition of Solutions Used for Electrochemical Testing at 20°C.

Solution	pH	Solution Composition (mg/L or ppm)								
		Na	K	Ca	Mg	Si	SO_4^{-2}	Cl^{-1}	NO_3^{-1}	HCO_3^{-1}
pH=12	~12	396	57	1.07	0.99	36.4	18.2	3.93	10.9	89
pH=10	~10	65.2	5.32	10.4	2.18	37.9	18	4.33	9.5	88
Sim. J-13	~9	50.9	5.21	10.2	2.09	33.8	18	4.31	10.1	109
Conc. J-13	~8.2	5300	510	6	1.9	30	22	727	11	12700
10000 ppm Cl	~6.3	6270	-	-	-	-	-	10000	-	-
1000 ppm Cl	~5.8	607	-	-	-	-	-	1000	-	-
pH=2	~2	49.1	5.1	10.9	2.12	35.1	17.8	443	10.5	4.4

Table A-3. Corrosion Rates (μm/y) Measured in pH=12 Solution at 20°C.

Ingot ID	Nominal Composition	Corrosion Rate (μm/y)
SS316	SS316	0.67
SS15ZR12	SS-15Zr-2Ru-1Pd-1Ag	0.57
SS15ZR14	SS-15Zr (annealed)	0.037
SS15ZR15	SS-15Zr-2Ru-1Nb-0.5Pd-0.5Ag	0.052
SS15ZR17	SS-15Zr (as-cast)	0.37
SS05ZR18	SS-5Zr-2Nb-1Ru-1Pd	1.37
SS20ZR19	SS-20Zr-2Nb-1Ru-1Pd	0.51
SS05ZR20	SS-5Zr-1Nb-0.5Ru-0.5Pd	0.28
SS05ZR21	SS-5Zr	0.58
SS15ZR23	SS-15Zr (cooled at 10°C/min)	1.56
SS15ZR24	SS-15Zr (cooled at 5°C/min)	1.06
SS15ZR25	SS-15Zr-1Nb-1Ru-1Pd-1Rh	1.58
SS15ZR26	SS-15Zr-1Nb-1Ru-1Pd-1Rh	1.51
SS15ZR27	SS-15Zr (cooled at 1°C/min)	0.6
SS00ZR28	SS-2Nb-1Ru-1Pd-1Ag	0.31
Zr	Zr	1.16
ZR08SS02	Zr-8SS-1Ag-1Nb-1Pd-1Ru	0.49
ZR08SS04	Zr-8SS	0.32
Copper	Pure Copper	3.14
C-22	C-22	0.41
AISI 1018	Mild Steel	1.67

Table A-4. Corrosion Rates (µm/y) Measured in pH=12 Solution at 20°C.

Ingot ID	Nominal Composition	Trial		Mean	Std. Dev.[a]
		2	3		
SS316	SS316	1.84	0.67	1.25	0.83
SS15ZR12	SS-15Zr-2Ru-1Pd-1Ag	0.61	0.57	0.59	0.03
SS15ZR14	SS-15Zr (annealed)	0.44	0.37	0.41	0.05
SS15ZR15	SS-15Zr-2Ru-1Nb-0.5Pd-0.5Ag	7.07	0.52	3.79	4.63
SS15ZR17	SS-15Zr (as-cast)	1.12	0.37	0.74	0.53
SS05ZR18	SS-5Zr-2Nb-1Ru-1Pd	1.51	1.37	1.44	0.1
SS20ZR19	SS-20Zr-2Nb-1Ru-1Pd	12.94	0.51	6.72	8.79
SS05ZR20	SS-5Zr-1Nb-0.5Ru-0.5Pd	0.00	0.28	0.14	0.2
SS05ZR21	SS-5Zr	0.95	0.58	0.77	0.26
SS15ZR23	SS-15Zr (cooled at10°C/min)	1.00	1.56	1.28	0.4
SS15ZR24	SS-15Zr (cooled at 5°C/min)	0.52	1.06	0.79	0.38
SS15ZR25	SS-15Zr-1Nb-1Ru-1Pd-1Rh	18.34	1.58	9.96	11.85
SS15ZR26	SS-15Zr-1Nb-1Ru-1Pd-1Rh	0.67	1.51	1.09	0.59
SS15ZR27	SS-15Zr (cooled at 1°C/min)	0.62	0.60	0.61	0.02
SS00ZR28	SS-2Nb-1Ru-1Pd-1Ag	0.48	0.31	0.40	0.12
Zr	Zr	1.52	1.16	1.34	0.25
ZR08SS02	Zr-8SS-1Ag-1Nb-1Pd-1Ru	0.73	0.49	0.61	0.17
ZR08SS04	Zr-8SS	7.62	0.32	3.97	5.17
Copper	Pure Copper	3.37	3.14	3.25	0.16
C-22	C-22	1.89	0.41	1.15	1.05
AISI 1018	Mild Steel	7.90	1.67	4.79	4.41

[a]Std. Dev =Standard Deviation (1σ)

Table A-5. Corrosion Rates (μm/y) Measured in CJ13 Solution[a] at 20°C.

Ingot ID	Nominal Composition	Trial			Mean	Std. Dev.[b]
		1	2	3		
SS316	SS316	3.28	0.61	2.66	2.18	1.40
SS15ZR12	SS-15Zr-2Ru-1Pd-1Ag	1.50	0.63	3.43	1.85	1.43
SS15ZR14	SS-15Zr (annealed)	0.74	0.41	0.61	0.59	0.17
SS15ZR15	SS-15Zr-2Ru-1Nb-0.5Pd-0.5Ag	1.79	0.71	0.32	0.94	0.76
SS15ZR17	SS-15Zr (as-cast)	0.88	0.42	0.80	0.70	0.25
SS05ZR18	SS-5Zr-2Nb-1Ru-1Pd	2.29	0.29	1.19	1.25	1.00
SS20ZR19	SS-20Zr-2Nb-1Ru-1Pd	2.40	0.75	2.25	1.80	0.91
SS05ZR20	SS-5Zr-1Nb-0.5Ru-0.5Pd	2.49	0.63	0.24	1.12	1.20
SS05ZR21	SS-5Zr	2.24	0.55	0.85	1.21	0.90
SS15ZR23	SS-15Zr (cooled at10°C/min)	1.42	0.44	0.72	0.86	0.51
SS15ZR24	SS-15Zr (cooled at 5°C/min)	2.07	0.62	0.50	1.06	0.87
SS15ZR25	SS-15Zr-1Nb-1Ru-1Pd-1Rh	1.21	0.41	1.20	0.94	0.46
SS15ZR26	SS-15Zr-1Nb-1Ru-1Pd-1Rh	1.71	0.44	4.39	2.18	2.02
SS15ZR27	SS-15Zr (cooled at 1°C/min)	1.20	0.45	2.57	1.41	1.08
SS00ZR28	SS-2Nb-1Ru-1Pd-1Ag	0.52	0.48	2.49	1.16	1.15
Zr	Zr	3.25	1.98	3.04	2.76	0.68
ZR08SS02	Zr-8SS-1Ag-1Nb-1Pd-1Ru	3.48	3.06	3.29	3.28	0.21
ZR08SS04	Zr-8SS	0.57	0.63	2.47	1.22	1.08
Copper	Pure Copper	44.30	20.39	17.75	27.48	14.63
C-22	C-22	0.56	0.78	1.30	0.88	0.38
AISI 1018	Mild Steel	2.24	1.99	2.36	2.20	0.19

[a]pH= 8.2
[b]Std. Dev =Standard Deviation (1σ)

Table A-6. Corrosion Rates (μm/y) Measured in 10KCl Solution at 20°C.

Ingot ID	Nominal Composition	Trial			Mean	Std. Dev.[b]
		1	2	3		
SS316	SS316	1.19	1.85	3.89	2.31	1.41
SS15ZR12	SS-15Zr-2Ru-1Pd-1Ag	0.56	0.22	3.06	1.28	1.55
SS15ZR14	SS-15Zr (annealed)	0.58	0.25	2.22	1.02	1.06
SS15ZR15	SS-15Zr-2Ru-1Nb-0.5Pd-0.5Ag	1.40	0.48	3.35	1.74	1.47
SS15ZR17	SS-15Zr (as-cast)	1.02	0.39	1.40	0.94	0.51
SS05ZR18	SS-5Zr-2Nb-1Ru-1Pd	0.35	0.16	1.74	0.75	0.86
SS20ZR19	SS-20Zr-2Nb-1Ru-1Pd	0.59	1.95	3.82	2.12	1.62
SS05ZR20	SS-5Zr-1Nb-0.5Ru-0.5Pd	0.47	0.18	1.72	0.79	0.82
SS05ZR21	SS-5Zr	0.53	1.09	0.86	0.83	0.28
SS15ZR23	SS-15Zr (cooled at 10°C/min)	0.27	0.27	1.10	0.55	0.48
SS15ZR24	SS-15Zr (cooled at 5°C/min)	0.23	0.62	1.16	0.67	0.47
SS15ZR25	SS-15Zr-1Nb-1Ru-1Pd-1Rh	0.45	0.33	1.03	0.61	0.38
SS15ZR26	SS-15Zr-1Nb-1Ru-1Pd-1Rh	0.27	0.62	3.70	1.53	1.89
SS15ZR27	SS-15Zr (cooled at 1°C/min)	0.23	0.20	0.71	0.38	0.29
SS00ZR28	SS-2Nb-1Ru-1Pd-1Ag	0.31	0.51	0.38	0.40	0.10
Zr	Zr	0.71	0.09	0.23	0.34	0.32
ZR08SS02	Zr-8SS-1Ag-1Nb-1Pd-1Ru	0.24	1.80	0.59	0.87	0.82
ZR08SS04	Zr-8SS	0.68	0.20	1.86	0.91	0.86
Copper	Pure Copper	7.99	38.00	29.69	25.23	15.50
C-22	C-22	0.47	0.51	1.45	0.81	0.56
AISI 1018	Mild Steel	191.26	174.32	163.53	176.37	13.98

[a]pH= 6.3
[b]Std. Dev =Standard Deviation (1σ)

Table A-7. Corrosion Rates (µm/y) Measured in 1KCl Solution[a] at 20°C.

Ingot ID	Nominal Composition	Trial			Mean	Std. Dev.[b]
		1	2	3		
SS316	SS316	1.03	1.75	2.31	1.70	0.65
SS15ZR12	SS-15Zr-2Ru-1Pd-1Ag	0.38	0.50	0.48	0.46	0.06
SS15ZR14	SS-15Zr (annealed)	0.38	0.58	0.36	0.44	0.12
SS15ZR15	SS-15Zr-2Ru-1Nb-0.5Pd-0.5Ag	1.73	0.78	0.59	1.03	0.61
SS15ZR17	SS-15Zr (as-cast)	0.74	0.89	1.09	0.91	0.18
SS05ZR18	SS-5Zr-2Nb-1Ru-1Pd	1.34	0.48	0.29	0.70	0.56
SS20ZR19	SS-20Zr-2Nb-1Ru-1Pd	0.39	1.00	1.57	0.99	0.59
SS05ZR20	SS-5Zr-1Nb-0.5Ru-0.5Pd	2.33	0.62	0.33	1.10	1.08
SS05ZR21	SS-5Zr	1.46	0.25	0.19	0.63	0.72
SS15ZR23	SS-15Zr (cooled at 10°C/min)	0.57	0.88	0.24	0.56	0.32
SS15ZR24	SS-15Zr (cooled at 5°C/min)	0.89	0.67	0.57	0.71	0.16
SS15ZR25	SS-15Zr-1Nb-1Ru-1Pd-1Rh	0.98	0.61	0.62	0.74	0.21
SS15ZR26	SS-15Zr-1Nb-1Ru-1Pd-1Rh	0.36	0.51	0.70	0.52	0.17
SS15ZR27	SS-15Zr (cooled at 1°C/min)	0.22	0.67	0.64	0.51	0.25
SS00ZR28	SS-2Nb-1Ru-1Pd-1Ag	0.82	0.53	0.42	0.59	0.21
Zr	Zr	2.02	0.15	1.82	1.33	1.03
ZR08SS02	Zr-8SS-1Ag-1Nb-1Pd-1Ru	0.38	1.80	0.26	0.81	0.85
ZR08SS04	Zr-8SS	0.35	0.23	1.19	0.59	0.53
Copper	Pure Copper	8.75	6.10	8.17	7.68	1.39
C-22	C-22	0.56	0.53	0.60	0.56	0.04
AISI 1018	Mild Steel	122.96	77.85	114.15	104.99	23.91

[a]pH= 5.8
[b]Std. Dev =Standard Deviation (1σ)

Table A-8. Typical Composition of Solutions Used for Electrochemical Testing at 60°C.

Solution	pH	Solution Composition (mg/L or ppm)								
		Na	K	Ca	Mg	Si	SO_4^{-2}	Cl^{-1}	NO_3^{-1}	HCO_3^{-1}
pH=10	~10	65.2	5.32	10.4	2.18	37.9	18	4.33	9.5	88
Conc. J-13	~8.2	5300	510	6	1.9	30	22	727	11	12700
10000 ppm Cl	~6.3	6270	-	-	-	-	-	10000	-	-
1000 ppm Cl	~5.8	607	-	-	-	-	-	1000	-	-
pH= 2	2	49.1	5.1	10.9	2.12	35.1	17.8	443	10.5	4.4

Table A-9. Corrosion Rates (µm/y) Measured in pH=10 Solution at 60°C.

Ingot ID	Nominal Composition	Trial			Mean	Std. Dev.[a]
		1	2	3		
SS316	SS316	0.59	1.71	4.74	2.35	2.15
SS15ZR17	SS-15Zr (as-cast)	4.89	3.35	5.04	4.43	0.93
SS05ZR18	SS-5Zr-2Nb-1Ru-1Pd	2.71	2.80	5.21	3.57	1.41
SS20ZR19	SS-20Zr-2Nb-1Ru-1Pd	3.30	4.60	2.79	3.56	0.94
SS15ZR25	SS-15Zr-1Nb-1Ru-1Pd-1Rh	10.56	6.95	7.25	8.26	2.00

[a]Std. Dev =Standard Deviation (1σ)

Table A-10. Corrosion Rates (µm/y) Measured in CJ13 Solution[a] at 60°C.

Ingot ID	Nominal Composition	Trial			Mean	Std. Dev.[b]
		1	2	3		
SS316	SS316	3.17	5.18	5.00	4.45	1.11
SS15ZR17	SS-15Zr (as-cast)	3.42	3.50	10.53	5.82	4.09
SS05ZR18	SS-5Zr-2Nb-1Ru-1Pd	2.69	2.00	12.46	5.72	5.85
SS20ZR19	SS-20Zr-2Nb-1Ru-1Pd	3.17	3.92	13.08	6.72	5.52
SS15ZR25	SS-15Zr-1Nb-1Ru-1Pd-1Rh	4.24	5.45	12.51	7.40	4.47

[a]pH= 8.2
[b]Std. Dev =Standard Deviation (1σ)

Table A-11. Corrosion Rates (µm/y) Measured in 10KCl Solution[a] at 60ºC

Ingot ID	Nominal Composition	Trial 1	Trial 2	Trial 3	Mean	Std. Dev.[b]
SS316	SS316	4.60	7.49	14.30	8.80	4.98
SS15ZR17	SS-15Zr (as-cast)	7.60	5.17	8.24	7.00	1.62
SS05ZR18	SS-5Zr-2Nb-1Ru-1Pd	14.29	6.95	9.15	10.13	3.77
SS20ZR19	SS-20Zr-2Nb-1Ru-1Pd	8.25	17.94	6.84	11.01	6.04
SS15ZR25	SS-15Zr-1Nb-1Ru-1Pd-1Rh	4.56	8.07	5.01	5.88	1.91

[a]pH= 6.3
[b]Std. Dev =Standard Deviation (1σ)

Table A-12. Corrosion Rates (µm/y) Measured in 1KCl Solution[a] at 60ºC.

Ingot ID	Nominal Composition	Trial 1	Trial 2	Trial 3	Mean	Std. Dev.[b]
SS316	SS316	2.79	2.53	8.70	4.68	3.49
SS15ZR17	SS-15Zr (as-cast)	6.16	6.60	7.33	6.70	0.59
SS05ZR18	SS-5Zr-2Nb-1Ru-1Pd	3.08	3.00	1.89	2.66	0.67
SS20ZR19	SS-20Zr-2Nb-1Ru-1Pd	4.81	7.60	10.89	7.77	3.05
SS15ZR25	SS-15Zr-1Nb-1Ru-1Pd-1Rh	6.14	2.54	4.17	4.28	1.80

[a]pH= 5.8
[b]Std. Dev =Standard Deviation (1σ)

Table A-13. Corrosion Rates (µm/y) Measured in pH=2 Solution at 60ºC.

Ingot ID	Nominal Composition	Trial 1	Trial 2	Trial 3	Mean	Std. Dev.[a]
SS316	SS316	3.13	14.94	3.31	7.13	6.77
SS15ZR17	SS-15Zr (as-cast)	5.70	13.38	10.28	9.79	3.86
SS05ZR18	SS-5Zr-2Nb-1Ru-1Pd	1.77	7.81	3.44	4.34	3.12
SS20ZR19	SS-20Zr-2Nb-1Ru-1Pd	5.87	6.85	2.99	5.24	2.01
SS15ZR25	SS-15Zr-1Nb-1Ru-1Pd-1Rh	4.07	9.47	7.35	6.96	2.72

[a]Std. Dev =Standard Deviation (1σ)

Table A-14. Typical Composition of Solutions Used for Electrochemical Testing at 90°C.

Solution	pH	Solution Composition (mg/L or ppm)								
		Na	K	Ca	Mg	Si	SO_4^{-2}	Cl^{-1}	NO_3^{-1}	HCO_3^{-1}
pH=10	~10	65.2	5.32	10.4	2.18	37.9	18	4.33	9.5	88
Sim. J-13	~9	50.9	5.21	10.2	2.09	33.8	18	4.31	10.1	109
Conc. J-13	~8.2	5300	510	6	1.9	30	22	727	11	12700
10000 ppm Cl	~6.3	6270	-	-	-	-	-	10000	-	-
1000 ppm Cl	~5.8	607	-	-	-	-	-	1000	-	-
pH=2	~2	49.1	5.1	10.9	2.12	35.1	17.8	443	10.5	4.4

Table A-15. Corrosion Rates (μm/y) Measured in pH=10 Solution at 90°C.

Ingot ID	Nominal Composition	Trial			Mean	Std. Dev.[a]
		1	2	3		
SS316	SS316	13.82	5.44	3.00	7.42	5.67
SS15ZR17	SS-15Zr (as-cast)	7.89	5.18	13.25	8.77	4.11
SS05ZR18	SS-5Zr-2Nb-1Ru-1Pd	5.16	4.89	7.40	5.82	1.38
SS20ZR19	SS-20Zr-2Nb-1Ru-1Pd	2.67	9.06	9.46	7.06	3.81
SS15ZR25	SS-15Zr-1Nb-1Ru-1Pd-1Rh	2.82	10.71	7.87	7.13	3.99

[a]Std. Dev =Standard Deviation (1σ)

Table A-16. Corrosion Rates (μm/y) Measured in SJ13 Solution[a] at 90°C.

Ingot ID	Nominal Composition	Trial			Mean	Std. Dev.[b]
		1	2	3		
SS316	SS316	4.42	2.56	1.59	2.86	1.44
SS15ZR17	SS-15Zr (as-cast)	4.91	17.00	10.57	10.83	6.05
SS05ZR18	SS-5Zr-2Nb-1Ru-1Pd	6.14	5.23	6.38	5.91	0.60
SS20ZR19	SS-20Zr-2Nb-1Ru-1Pd	7.74	2.78	3.85	4.79	2.61
SS15ZR25	SS-15Zr-1Nb-1Ru-1Pd-1Rh	6.71	10.45	2.53	6.57	3.97

[a]pH= 9
[b]Std. Dev =Standard Deviation (1σ)

Table A-17. Corrosion Rates (μm/y) Measured in CJ13 Solution[a] at 90°C.

Ingot ID	Nominal Composition	Trial			Mean	Std. Dev.[b]
		1	2	3		
SS316	SS316	3.68	4.01	15.00	7.56	6.44
SS15ZR17	SS-15Zr (as-cast)	6.10	6.81	13.44	8.78	4.05
SS05ZR18	SS-5Zr-2Nb-1Ru-1Pd	2.16	9.49	8.79	6.81	4.04
SS20ZR19	SS-20Zr-2Nb-1Ru-1Pd	5.76	8.66	7.16	7.19	1.45
SS15ZR25	SS-15Zr-1Nb-1Ru-1Pd-1Rh	8.67	13.84	9.11	10.54	2.87

[a]pH= 8.2
[b]Std. Dev =Standard Deviation (1σ)

Table A-18. Corrosion Rates (μm/y) in 10KCl Solution[a] at 90°C.

Ingot ID	Nominal Composition	Trial			Mean	Std. Dev.[b]
		1	2	3		
SS316	SS316	13.69	7.76	3.96	8.47	4.91
SS15ZR17	SS-15Zr (as-cast)	12.75	15.68	14.69	14.37	1.49
SS05ZR18	SS-5Zr-2Nb-1Ru-1Pd	6.88	3.40	9.96	6.75	3.28
SS20ZR19	SS-20Zr-2Nb-1Ru-1Pd	12.69	9.14	10.51	10.78	1.79
SS15ZR25	SS-15Zr-1Nb-1Ru-1Pd-1Rh	11.14	7.21	3.07	7.14	4.03

[a]pH= 6.3
[b]Std. Dev =Standard Deviation (1σ)

Table A-19. Corrosion Rates (μm/y) Measured in 1KCl Solution[a] at 90°C.

Ingot ID	Nominal Composition	Trial			Mean	Std. Dev.[b]
		1	2	3		
SS316	SS316	4.00	4.77	1.43	3.40	1.75
SS15ZR17	SS-15Zr (as-cast)	8.07	9.04	7.03	8.04	1.00
SS05ZR18	SS-5Zr-2Nb-1Ru-1Pd	5.17	5.80	4.42	5.13	0.69
SS20ZR19	SS-20Zr-2Nb-1Ru-1Pd	5.40	9.50	9.73	8.21	2.44
SS15ZR25	SS-15Zr-1Nb-1Ru-1Pd-1Rh	3.75	4.44	5.07	4.42	0.66

[a]pH= 5.8
[b]Std. Dev =Standard Deviation (1σ)

Table A-20. Corrosion Rates (μm/y) Measured in pH=2 Solution at 90°C.

Ingot ID	Nominal Composition	Trial			Mean	Std. Dev.[b]
		1	2	3		
SS316	SS316	18.27	2.92	10.80	10.66	7.68
SS15ZR17	SS-15Zr (as-cast)	7.08	2.75	2.72	4.19	2.51
SS05ZR18	SS-5Zr-2Nb-1Ru-1Pd	2.33	9.67	8.21	6.73	3.89
SS20ZR19	SS-20Zr-2Nb-1Ru-1Pd	11.88	10.70	12.50	11.69	0.91
SS15ZR25	SS-15Zr-1Nb-1Ru-1Pd-1Rh	4.45	-	-	4.45	-

[a]Std. Dev =Standard Deviation (1σ)

Table A-21. Comparison of Corrosion Rates (μm/y) Measured at 90°C, 60°C, and 20°C in pH=10 Solution.

Ingot ID	Nominal Composition	90°C		60°C		20°C	
		Avg. [a]	SD[b]	Avg.[a]	SD[b]	Avg. [a]	SD[b]
SS316	SS316	7.42	5.67	2.35	2.15	0.34	0.12
SS15ZR17	SS-15Zr	8.77	4.11	4.43	0.93	0.17	0.06
SS05ZR18	SS-5Zr-2Nb-1Pd-1Ru	5.82	1.38	3.57	1.41	0.25	0.11
SS20ZR19	SS-20Zr-2Nb-1Pd-1Ru	7.06	3.81	3.56	0.94	0.23	0.07
SS15ZR25	SS-15Zr-1Nb-1Pd-1Rh-1Ru	7.13	3.99	8.26	2.00	0.24	0.05

[a]Average from three specimens
[b]SD=Standard Deviation (1σ).

Table A-22. Comparison of Corrosion Rates (μm/y) Measured at 90°C, 60°C, and 20°C in CJ13 Solution (pH= 8.2).

Ingot ID	Nominal Composition	90°C		60°C		20°C	
		Avg. [a]	SD[b]	Avg. [a]	SD[b]	Avg. [a]	SD[b]
SS316	SS316	7.56	6.44	4.45	1.11	2.18	1.40
SS15ZR17	SS-15Zr	8.78	4.05	5.82	4.09	0.70	0.25
SS05ZR18	SS-5Zr-2Nb-1Pd-1Ru	6.81	4.04	5.72	5.85	1.25	1.00
SS20ZR19	SS-20Zr-2Nb-1Pd-1Ru	7.19	1.45	6.72	5.52	1.80	0.91
SS15ZR25	SS-15Zr-1Nb-1Pd-1Rh-1Ru	10.54	2.87	7.40	4.47	0.94	0.46

[a]Average from three specimens
[b]SD=Standard Deviation (1σ).

Table A-23. Comparison of Corrosion Rates (μm/y) Measured at 90°C, 60°C, and 20°C in 10KCl Solution (pH~6.2).

Ingot ID	Nominal Composition	90°C		60°C		20°C	
		Avg. [a]	SD [b]	Avg. [a]	SD [b]	Avg. [a]	SD [b]
Disc	SS316	8.47	4.91	8.80	4.98	2.31	1.41
SS15ZR17	SS-15Zr	14.37	1.49	7.00	1.62	0.94	0.51
SS05ZR18	SS-5Zr-2Nb-1Pd-1Ru	6.75	3.28	10.13	3.77	0.75	0.86
SS20ZR19	SS-20Zr-2Nb-1Pd-1Ru	10.78	1.79	11.01	6.04	2.12	1.62
SS15ZR25	SS-15Zr-1Nb-1Pd-1Rh-1Ru	7.14	4.03	5.88	1.91	0.61	0.38

[a]Average from three specimens
[b]SD=Standard Deviation (1σ).

Table A-24. Comparison of Corrosion Rates (μm/y) Measured at 90°C, 60°C, and 20°C in 1KCl Solution (pH~5.7).

Ingot ID	Nominal Composition	90°C		60°C		20°C	
		Avg. [a]	SD [b]	Avg. [a]	SD [b]	Avg. [a]	SD [b]
SS316	SS316	3.40	1.75	4.68	3.49	1.39	0.51
SS15ZR17	SS-15Zr	8.04	1.00	6.70	0.59	0.82	0.11
SS05ZR18	SS-5Zr-2Nb-1Pd-1Ru	5.13	0.69	2.66	0.67	1.70	1.72
SS20ZR19	SS-20Zr-2Nb-1Pd-1Ru	8.21	2.44	7.77	3.05	0.70	0.43
SS15ZR25	SS-15Zr-1Nb-1Pd-1Rh-1Ru	4.42	0.66	4.28	1.80	0.80	0.26

[a]Average from three specimens
[b]SD=Standard Deviation (1σ).

Table A-25. Comparison of Corrosion Rates (μm/y) Measured at 90°C, 60°C, and 20°C in pH=2 Solution.

Ingot ID	Nominal Composition	90°C		60°C		20°C	
		Avg. [a]	SD [b]	Avg. [a]	SD [b]	Avg. [a]	SD [b]
Disc	SS316	10.66	7.68	7.13	6.77	3.43	3.1
SS15ZR17	SS-15Zr	4.19	2.51	9.79	3.86	4.24	2.22
SS05ZR18	SS-5Zr-2Nb-1Pd-1Ru	6.73	3.89	4.34	3.12	8.51	2.23
SS20ZR19	SS-20Zr-2Nb-1Pd-1Ru	11.69	0.91	5.24	2.01	2.51	0.96
SS15ZR25	SS-15Zr-1Nb-1Pd-1Rh-1Ru	4.45 [c]	-	6.96	2.72	3.82	0.73

[a]Average from three specimens
[b]SD=Standard Deviation (1σ)
[c]One Measurement

B. Publications by D. P. Abraham on the Metal Waste Form Alloy and Protective Oxide Layers

1. D.P. Abraham, N. Dietz, Accepted for publication in Mater. Sci. Eng. A., (2001), **Title**: Role of Laves Intermetallics in Nuclear Waste Disposal

2. D. P. Abraham, N. L. Dietz, and N. Finnegan, Proc. of the Corrosion 2001 Conf., Houston, TX, March 11-17, 2001, **Title**: Characterization of Oxidation Products on a $ZrFe_2$-type Laves Intermetallic Exposed to 200˚C Steam.

3. T.H. Bauer, D.P. Abraham, J. Fink, I. Johnson, S.G. Johnson, and R.A. Wigeland, Proc. of the 9th International High-Level Radioactive Waste Management Conference (IHLRWM), American Nuclear Society; April 29-May 3, 2001, Las Vegas NV; **Title**: Modeling Corrosion and Constituent Release from a Metal Waste Form.

4. D.D. Keiser, Jr., D.P. Abraham, W. Sinkler, J. W. Richardson, Jr., and S. M. McDeavitt, J. Nucl. Mater. 279 (2000) pp. 234-244; **Title:** Actinide Distribution in a Stainless Steel-15 wt% Zirconium High-Level Nuclear Waste Form.

5. D.D. Keiser, Jr., D.P. Abraham, J. W. Richardson, Jr., J. Nucl. Mater. 277 (2000) 333; **Title:** Influence of Technetium on the Microstructure of a Stainless Steel-Zirconium alloy.

6. J. S. Luo and D. P. Abraham, Mat. Res. Soc. Symp. Proc. Vol. 608, 2000, **pp.** Materials Research Society, Pittsburgh, PA; (Scientific Basis for Nuclear Waste Management XXIII, R.W. Smith and D.W. Shoesmith, eds.); **Title:** TEM Characterization of Corrosion Products formed on a Stainless Steel-Zirconium alloy.

7. D. P. Abraham, J.J. Peterson, N.K. Katyal, D.D. Keiser, Jr., and B.A. Hilton, Proc. CORROSION 2000, Paper No. 205, NACE Publications, Houston, TX, (2000); **Title:** Electrochemical Testing of Metal Waste Forms

8. D.D. Keiser, Jr., W. Sinkler, D.P. Abraham, J. W. Richardson, Jr., and S. M. McDeavitt, Rare Earths and Actinides: Science, Technology and Applications IV, R.G. Bautista and B. Mishra, eds., The Minerals, Metals and Materials Society, Warrendale, PA, (2000), pp. 111-121. **Title:** The Effects of Actinides on the Microstructural Development in a Metallic High-Level Nuclear Waste Form.

9. D. P. Abraham, J. W. Richardson, Jr., in: Long Term Stability of High Temperature Materials, G.E. Fuchs, K.A. Dannemann and T.C. Deragon, eds., TMS, Warrendale, PA, 1999, 169-179; **Title:** Phase Stability of Laves Intermetallics in a Stainless Steel-Zirconium alloy.

10. D. P. Abraham, L. J. Simpson, M. J. DeVries and D. E. Callahan, Proc. CORROSION 99, Paper No. 466, NACE Publications, Houston, TX, (1999); **Title:** Corrosion Behavior of Stainless Steel-Zirconium Alloy Waste Forms.

C. Data from 7, 14, 28, 60, 95, 182 and 365 day Immersion Tests at 90ºC in 1KCl and CJ13

Table C-1. Composition (wt%) of SS15ZR25 Alloy Samples[a]

Major Elements				Noble Metal Fission Products					Minor Elements				
Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V	Si
56.5	14.1	8.65	14.2	0.8	0.98	0.93	0.92	1.66	1.13	0.19	0.4	0.09	0.32

[a]Sample composition was determined by ACL-CMT using ICPMS and ICPAES

Table C-2. Composition of Solutions used for the Immersion Tests[a]

Solution	pH	Solution Composition (mg/L or ppm)								
		Na	K	Ca	Mg	Si	SO_4^{-2}	Cl^{-1}	NO_3^{-1}	HCO_3^{-1}
1000 ppm Cl	~ 5.8	607	-	-	-	-	-	1000	-	-
Conc. J-13	~ 8.2	5300	510	6	1.9	30	22	727	11	12700

[a]Solutions were prepared and analyzed by ACL-CMT.

Table C-3. Weight Change Data and Surface Examination Results from Specimens Immersed in 1KCl solution (pH ~5.7)

Test ID	Duration days	Sample Wt. (g)			Final pH	Comments
		Start	End	Gain		
1KCl-1	7	1.2022	1.2022	0	7.21	Mainly unaffected; some rust observed.
1KCl-2[a]	7				6.47	
1KCl-3	14	1.229	1.2289	-0.0001	6.93	Mild tarnish; red-colored rust observed on one edge
1KCl-4[a]	14				6.48	
1KCl-5	28	1.2326	1.2324	-0.0002	6.84	Mild tarnish; red-colored rust observed on one edge
1KCl-6[a]	28				6.50	
1KCl-7	60	1.2106	1.2105	-0.0001	7.03	Mild tarnish; red-colored rust observed on one edge
1KCl-8[a]	60				6.20	
1KCl-9	95	1.218	1.2181	0.0001	5.87	Faint red tinge
1KCl-10[a]	95				5.80	
1KCl-11	182	1.2193	1.2193	0	9.14	Mild tarnish; red-colored rust observed on two edges
1KCl-12[a]	182				7.85	
1KCl-13	365	1.2135	1.2139	0.0004	7.48	Mild tarnish; red-colored rust spots on one edge
1KCl-14[a]	365				7.41	

[a]Control Vessel

Table C-4. Weight Change Data and Surface Examination Results from Specimens Immersed in CJ13 solution (pH ~8.2)

Test ID	Duration, days	Sample Wt. (g)			Final pH	Comments
		Start	End	Gain		
MJ-1	7	1.2179	1.2181	0.0002	9.33	Unaffected
MJ-2[a]	7				9.27	
MJ-3	14	1.2194	1.2197	0.0003	9.57	Mild tarnish
MJ-4[a]	14				9.67	
MJ-5	28	1.2131	1.2134	0.0003	10.03	Mild tarnish
MJ-6[a]	28				10.03	
MJ-7	60	1.2273	1.228	0.0007	10.14	Some pits at edges
MJ-8[a]	60				10.13	
MJ-9	95	1.2305	1.2308	0.0003	10.20	Mild tarnish
MJ-10[a]	95				10.18	
MJ-11	182	1.2285	1.2287	0.0002	10.46	Mild tarnish
MJ-12[a]	182				10.43	
MJ-13	365	1.2168	1.2168	0	10.88	Mild tarnish
MJ-14[a]	365				10.61	

[a]Control Vessel

Table C-5. Leachate Data (μg/L) for 90°C Immersion in 1KCl Solution

Test ID	Test Duration	Major Elements				NMFPs					Minor Elements				
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V	Si
1KCl-1	7	a	a	130	a	a	a	a	a	a	36	a	2.22	1.5	a
1KCl-2[b]	7	a	a	a	a	a	a	a	a	a	a	a	a	1.4	a
1KCl-3	14	a	110	170	a	a	a	0.02	a	14	9.7	a	1.42	1.7	26.9
1KCl-4[b]	14	a	a	a	a	a	a	a	a	a	a	26.2	4.5	1.5	22.6
1KCl-5	28	a	19.2	290	a	a	a	0.06	a	8.2	96	13	3.06	1.38	41.7
1KCl-6[b]	28	a	a	a	a	a	a	a	a	a	a	0.04	3.99	1.4	34.6
1KCl-7	60	a	25.5	366	1.3	1.2	a	a	a	10	74.9	12.8	6.54	0.4	42.1
1KCl-8[b]	60	a	a	a	a	a	a	a	a	a	a	a	32	0.3	59.5
1KCl-9	95	a	a	17	a	a	a	a	a	a	6.6	1	23.5	0.3	45.2
1KCl-10[b]	95	a	a	a	a	a	a	a	a	a	a	a	15.3	0.4	37.2
1KCl-11	182	a	12.4	4.36	a	a	a	0.06	0.09	7.11	a	4.36	1.6	0.36	a
1KCl-12[b]	182	a	a	a	a	a	a	a	0.03	1.66	a	a	2.95	0.34	a
1KCl-13	365	a	9.1	14.3	0.08	a	0.07	0.08	0.12	50.9	1.57	0.55	1.04	5.04	100
1KCl-14[b]	365	a	a	0.92	0.06	a	0.03	0.08	0.09	2.52	0.31	0.06	4.09	6.79	111

NMFPs = Noble Metal Fission Products

[a]Element below detection limits of measuring instrument.

[b]Control Vessel

Table C-6. Acid Strip Data (μg/L) for 90°C Immersion in 1KCl Solution

Test ID	Test Duration	Major Elements				NMFPs					Minor Elements				
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V	Si
1KCl-1AS	7	141	51.1	a	a	a	a	0.09	a	a	a	a	1.2	a	a
1KCl-2AS[b]	7	a	a	a	a	a	a	a	a	a	a	7.81	a	a	a
1KCl-3AS	14	491	193	100	a	0.4	a	0.99	a	a	40	a	6.16	a	a
1KCl-4AS[b]	14	a	a	0.8	a	a	a	a	a	a	a	22.5	1.42	a	a
1KCl-5AS	28	244	126	126	0.14	0.2	2.4	0.9	3.5	2	35	3.9	3.59	1.5	a
1KCl-6AS[b]	28	a	a	a	0.08	a	a	a	a	1.9	a	a	1.39	a	a
1KCl-7AS	60	286	123	45.6	a	0.2	a	a	a	a	29	a	10.7	a	a
1KCl-8AS[b]	60	a	2.36	a	a	a	a	a	3.6	a	a	a	4.79	a	a
1KCl-9AS	95	40.4	a	a	a	a	a	a	a	a	a	a	4.73	a	a
1KCl-10AS[b]	95	a	a	a	a	a	a	a	a	a	a	a	4.08	a	5.22
1KCl-11AS	182	945	89.8	0.25	a	0.19	a	0.51	1.85	0.94	33.6	3.59	5.75	0.25	a
1KCl-12AS[b]	182	a	a	a	a	a	a	a	0.03	a	a	a	0.48	0.06	a
1KCl-13AS	365	859	48.1	125	0.48	0.17	0	0.64	2.18	0.41	93	4.14	4.8	a	a
1KCl-14AS[b]	365	6.8	4.7	0.86	0.42	a	a	a	a	a	0.59	a	a	a	a

NMFPs = Noble Metal Fission Products

[a]Element below detection limits of measuring instrument.

[b]Control Vessel

Table C-7. Leachate Data (μg/L) for 90°C Immersion in CJ13 Solution

Test ID	Test Duration	Major Elements				NMFPs					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
MJ-1	7	146	2.2	7.4	20.1	1.0	a	0.12	a	5.5	0.9	a	4.62	0.7
MJ-2*	7	17.2	a	a	9.9	0.07	a	0.03	a	a	a	a	2.47	a
MJ-3	14	20	5.85	a	40.6	1.4	a	0.13	a	13	0.4	8.25	1.2	0.7
MJ-4*	14	a	a	a	9.3	0.02	a	0.09	a	12	a	18.1	a	0.4
MJ-5	28	46	12.8	a	50.5	1.8	a	0.3	a	12	1.1	0.36	5.95	0.62
MJ-6*	28	5.13	a	a	8.6	0.03	a	0.1	a	9.3	12	1.01	2.52	0.32
MJ-7	60	41.4	14.5	a	65.6	2.5	2.9	a	a	10	a	a	44.9	1.2
MJ-8*	60	a	2.28	a	8.3	0.04	a	a	a	a	a	a	28.5	a
MJ-9	95	36.2	22.4	a	76.3	2.3	2.7	a	a	12	a	a	23.3	a
MJ-10*	95	a	2.8	a	6.9	0.03	a	a	a	7.3	a	a	18.9	a
MJ-11	182	24.6	35.4	a	56	1.87	2.54	0.08	0.62	12.4	a	a	3.07	0.27
MJ-12*	182	a	a	3.12	4.4	0.06	a	0.02	0.03	4.1	7.5	0.08	0.31	0.22
MJ-13	365	33.3	50.1	0.41	39.7	1.29	2.68	0.08	0.27	15.4	0.81	0.06	1.63	1.47
MJ-14*	365	a	a	0.41	2.29	0.07	0.48	0.22	0.12	9.14	0.33	0.06	2.22	1.66

NMFPs = Noble Metal Fission Products

[a]Element below detection limits of measuring instrument.

[b]Control Vessel

Table C-8. Acid Strip Data (μg/L) for 90°C Immersion in Modified J-13 Solution

Test ID	Test Duration	Major Elements				NMFPs					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
MJ-1AS	7	12	a	1.0	a	0.01	a	0.19	a	a	0.9	a	a	a
MJ-2AS[b]	7	a	a	a	a	a	a	0.01	a	a	a	6.35	a	a
MJ-3AS	14	177	2.72	9.6	a	0.7	a	0.05	a	a	2.6	31.3	3.65	a
MJ-4AS[b]	14	27.4	a	2	a	0.02	a	a	a	a	0.7	a	6.26	a
MJ-5AS	28	237	a	24	1.8	0.88	a	0.3	a	2.2	6.5	1.1	3.53	a
MJ-6AS[b]	28	29.9	a	a	1.4	a	a	a	a	a	1.6	0.04	3.15	a
MJ-7AS	60	255	2.84	a	1.8	0.8	a	a	a	a	a	a	6.97	a
MJ-8AS[b]	60	29.5	a	a	0.9	a	a	a	a	a	a	a	6.42	a
MJ-9AS	95	345	4.98	a	3.55	0.8	a	a	a	a	a	a	6.3	a
MJ-10AS[b]	95	29.9	a	a	1.1	a	a	a	a	a	a	a	8.74	a
MJ-11AS	182	517	a	15.4	12.6	1.23	a	0.87	0.13	0.25	a	1.07	5.35	0.25
MJ-12AS[b]	182	32.3	a	a	5.03	0.09	a	a	0.03	a	a	0.06	6.01	0.06
MJ-13AS	365	632	7.9	37.8	29.9	1.68	0.17	1.09	0.25	a	8.24	1.34	6.94	a
MJ-14AS[b]	365	42.3	4.9	1.94	6	0.14	0.03	a	a	a	1.34	0.07	6.19	a

NMFPs = Noble Metal Fission Products

[a]Element below detection limits of measuring instrument.

[b]Control Vessel

Table C-9. Total Concentrations and Mass Releases in Leachate and Acid Wash in 1KCl Solution at 90ºC

Test ID	Test Duration (days)	Leachate			Acid Wash			Total Mass (µg)
		Concentration (µg/L)	Volume (mL)	Mass (µg)	Concentration (µg / L)	Volume (mL)	Mass (µg)	
1KCl-1	7	174	19.8	3.4	193	24.6	4.8	8.2
1KCl-3	14	335	19.8	6.6	832	24.6	20.5	27.1
1KCl-5	28	473	22.0	10.4	549	24.6	13.5	23.9
1KCl-7	60	541	20.0	10.8	494	25.4	12.6	23.4
1KCl-9	95	94	21.4	2.0	45	23.7	1.1	3.1
1KCl-11	182	30	23.6	0.7	1082	24.0	25.9	26.6
1KCl-13	365	183	25.5	4.7	1138	24.9	28.3	33.0

Table C-10. Total Concentrations and Mass Releases in Leachate and Acid Wash in CJ13 at 90ºC

Test ID	Test Duration (days)	Leachate			Acid Wash			Total Mass (µg)
		Concentration (µg/L)	Volume (mL)	Mass (µg)	Concentration (µg/L)	Volume (mL)	Mass (µg)	
MJ-1	7	189	19.3	3.6	14	25	0.4	4
MJ-3	14	92	19.4	1.8	230	26	6	7.8
MJ-5	28	131	23.1	3	277	25.2	7	10
MJ-7	60	183	20.7	3.8	267	25	6.7	10.5
MJ-9	95	175	21.8	3.8	361	24.4	8.8	12.6
MJ-11	182	137	24.7	3.4	554	24.1	13.4	16.7
MJ-13	365	147	26.2	3.9	727	24.7	18	21.8

Table C-11. Normalized Loss (g/m^2) for Specimens Immersed in 1KCl Solution at 90°C

Test	Duration	Major Elements				Noble Metal Fission Products					Minor Elements				
ID	Days	Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V	Si
1KCl-1	7	0.028	0.041	0.136	a	a	a	0.001	a	a	0.288	a	0.084	0.01	a
1KCl-3	14	0.097	0.224	0.306	a	0.006	a	0.012	a	0.076	0.474	a	0.063	0.02	0.121
1KCl-5	28	0.048	0.114	0.499	5.6E-5	0.003	0.027	0.011	0.043	0.052	1.198	0.913	0.044	0.184	0.223
1KCl-7	60	0.059	0.116	0.447	0.001	0.017	a	a	a	0.055	0.902	0.615	a	0.01	a
1KCl-9	95	0.008	a	0.019	a	a	a	a	a	a	0.057	0.051	0.215	a	0.064
1KCl-11	182	0.182	0.079	0.006	a	0.003	a	0.007	0.022	0.041	0.324	0.452	0.108	0.026	a
1KCl-13	365	0.171	0.043	0.18	a	0.002	a	0.008	0.027	0.341	0.937	0.277	0.047	a	a

[a]Element below detection limits of measuring instrument.

Table C-12. Normalized Loss (g/m^2) for Specimens Immersed in CJ13 Solution at 90°C

Test	Duration	Major Elements				Noble Metal Fission Products					Minor Elements			
ID	Days	Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
MJ-1	7	0.023	0.001	0.009	0.006	0.01	a	0.003	a	0.029	0.016	a	0.047	0.069
MJ-3	14	0.035	0.006	0.011	0.02	0.025	a	0.001	a	0.005	0.024	1.491	a	0.03
MJ-5	28	0.049	0.01	0.032	0.031	0.036	a	0.006	a	0.032	a	0.028	0.098	0.035
MJ-7	60	0.052	0.01	a	0.039	0.04	0.028	a	a	0.057	a	a	0.4	0.126
MJ-9	95	0.068	0.018	a	0.05	0.039	0.027	a	a	0.028	a	a	0.026	a
MJ-11	182	0.099	0.028	0.015	0.047	0.041	0.029	0.011	0.008	0.058	a	0.053	0.056	0.029
MJ-13	365	0.124	0.045	0.047	0.05	0.04	0.028	0.011	0.005	0.045	0.074	0.075	0.004	a

[a]Element below detection limits of measuring instrument.

D. Vial Use

For the first 22 weeks of the immersion tests, the Teflon vials were reused following acid washes. Then it became apparent that the acid washes did not always remove all the elements that had migrated to the Teflon walls. Elements, such as iron, were detected in analysis of solutions of vials that contained no samples. The probability for this to occur was greatest for vials that were used for the pH 2 solution, AJ13, and the solution containing 10,000 ppm chloride. Thus, following week 22 new Teflon vials were used for each immersion test. Information on which vials had been used for each test had been recorded in the laboratory notebooks. These data are summarized in the table in this appendix. For ease of relation of these data to the test results, which are reported according to days, the relation between test week and days of the test are summarized below.

Week/Day Relationships

Week	1	2	3	4	6	8	10	14	22	32	44
Days	7	14	21	28	42	56	70	98	154	224	308

Table D-1. Table of Vial Use

Vial	Solution	Ingot ID	Week	Solution/sample	Week	Solution/sample
1	365-SJ13	Blank	1	SJ13-P1	8	AJ13-P21
2		SS316	1	SJ13-P2	8	AJ13-O22
3		SS316	1	SJ13-P3	8	AJ13-O23
4		SS316	1	SJ13-O4	8	AJ13 blank
5		SS-15Zr	1	SJ13-O5	10	AJ13-P21
6		SS-15Zr	1	SJ13 blank	10	AJ13-O22
7		SS-15Zr	1	CJ13-P7	10	AJ13-O23
8		SS-5Zr-2Nb-1Ru-1Pd	1	CJ13-P8	10	AJ13 blank
9		SS-5Zr-2Nb-1Ru-1Pd	1	CJ13-P9	14	SJ13-P1
10		SS-5Zr-2Nb-1Ru-1Pd	1	CJ13-O10	14	SJ13-P2
11		SS-20Zr-2Nb-1Ru-1Pd	1	CJ13-O11	14	SJ13-P3
12		SS-20Zr-2Nb-1Ru-1Pd	1	CJ13 blank	14	SJ13-O4
13		SS-20Zr-2Nb-1Ru-1Pd	1	10KCl-P13	14	SJ13-O5
14		SS-5Zr-2Nb-0.5Ru-0.5Pd	1	10KCl-P14	14	SJ13-blank
15		SS-5Zr-2Nb-0.5Ru-0.5Pd	1	10KCl-P15	14	CJ13-P1
16		SS-5Zr-2Nb-0.5Ru-0.5Pd	1	10KCl-O16	14	CJ13-P2
17		SS-5Zr	1	10KCl-O17	14	CJ13-P3
18		SS-5Zr	1	10KCl blank	14	CJ13-O4
19		SS-5Zr	1	AJ13-P19	14	CJ13-O5
20		slag-SS-15Zr-2Nb-1Ru-1Pd	1	AJ13-P20	14	CJ13 blank
21		slag-SS-15Zr-2Nb-1Ru-1Pd	1	AJ13-P21	14	10KCl-P13
22		slag-SS-15Zr-2Nb-1Ru-1Pd	1	AJ13-O22	14	10KCl-P14
23		SS-15Zr 10C/min	1	AJ13-O23	14	10KCl-P15
24		SS-15Zr 10C/min	1	AJ13 blank	14	10KCl-O16
25		SS-15Zr 10C/min	2	SJ13-P1	14	10KCl-O17
26		SS-15Zr 5C/min	2	SJ13-P2	14	10KCl blank
27		SS-15Zr 5C/min	2	SJ13-P3	14	AJ13-P19
28		SS-15Zr 5C/min	2	SJ13-O4	14	AJ13-P20
29		SS-15Zr-1Nb-1Ru-1Pd-1Rh	2	SJ13-O5	14	AJ13-P21
30		SS-15Zr-1Nb-1Ru-1Pd-1Rh	2	SJ13 blank	14	AJ13-O22
31		SS-15Zr-1Nb-1Ru-1Pd-1Rh	2	CJ13-P7	14	AJ13-O23
32		SS-15Zr 1C/min	2	CJ13-P8	14	AJ13 blank
33		SS-15Zr 1C/min	2	CJ13-P9	22	SJ13-P1
34		SS-15Zr 1C/min	2	CJ13-O10	22	SJ13-P2
35		slag	2	CJ13-O11	22	SJ13-P3
36		slag	2	CJ13 blank	22	SJ13-O4

Table D-1b. Table of Vial Use (Cont'd)

Vial	Solution	Ingot ID	Week	Solution/sample	Week	Solution/sample
37		slag	2	10KCl-P13		
38		SS-2Nb-1Ru-1Pd-1Ag	2	10KCl-P14		
39		SS-2Nb-1Ru-1Pd-1Ag	2	10KCl-P15		
40		SS-2Nb-1Ru-1Pd-1Ag	2	10KCl-O16	22	SJ13-O5
41	365-H_20	Blank	2	10KCl-O17	22	SJ13-blank
42		SS316	2	10KCl blank	22	CJ13-P7
43		SS316	2	AJ13-P19	22	CJ13-P8
44		SS316	2	AJ13-P20	22	CJ13-P9
45		SS-15Zr	2	AJ13-P21	22	CJ13-O10
46		SS-15Zr	2	AJ13-O22	22	CJ13-O11
47		SS-15Zr	2	AJ13-O23	22	CJ13-blank
48		SS-5Zr-2Nb-1Ru-1Pd	2	AJ13 blank	22	10KCl-P13
49		SS-5Zr-2Nb-1Ru-1Pd	3	SJ13-P1	22	10KCl-P14
50		SS-5Zr-2Nb-1Ru-1Pd	3	SJ13-P2	22	10KCl-P15
51		SS-20Zr-2Nb-1Ru-1Pd	3	SJ13-P3		
52		SS-20Zr-2Nb-1Ru-1Pd	3	SJ13-O4	22	10KCl-O16
53		SS-20Zr-2Nb-1Ru-1Pd	3	SJ13-O5	22	10KCl-O17
54		SS-5Zr-2Nb-0.5Ru-0.5Pd	3	SJ13 blank	22	10KCl blank
55		SS-5Zr-2Nb-0.5Ru-0.5Pd	3	CJ13-P7	22	AJ13-P19
56		SS-5Zr-2Nb-0.5Ru-0.5Pd	3	CJ13-P8	22	AJ13-P20
57		SS-5Zr	3	CJ13-P9	22	AJ13-P21
58		SS-5Zr	3	CJ13-O10	22	AJ13-O22
59		SS-5Zr	3	CJ13-O11	22	AJ13-O23
60		slag-SS-15Zr-2Nb-1Ru-1Pd	3	CJ13 blank	22	AJ13 blank2
61		slag-SS-15Zr-2Nb-1Ru-1Pd	3	10KCl-P13		
62		slag-SS-15Zr-2Nb-1Ru-1Pd	3	10KCl-P14		
63		SS-15Zr 10C/min	3	10KCl-P15		
64		SS-15Zr 10C/min	3	10KCl-O16		
65		SS-15Zr 10C/min	3	10KCl-O17		
66		SS-15Zr 5C/min	3	10KCl blank		
67		SS-15Zr 5C/min	3	AJ13-P19		
68		SS-15Zr 5C/min	3	AJ13-P20		
69		SS-15Zr-1Nb-1Ru-1Pd-1Rh	3	AJ13-P21		
70		SS-15Zr-1Nb-1Ru-1Pd-1Rh	3	AJ13-O22		
71		SS-15Zr-1Nb-1Ru-1Pd-1Rh	3	AJ13-O23		
72		SS-15Zr 1C/min	3	AJ13 blank		

Table D-1c. Table of Vial Use (Cont'd)

Vial	Solution	Ingot ID	Week	Solution/sample	Week	Solution/sample
73		SS-15Zr 1C/min	4	SJ13-P1		
74		SS-15Zr 1C/min	4	SJ13-P2		
75		slag	4	SJ13-P3		
76		slag	4	SJ13-O4		
77		slag	4	SJ13-O5		
78		SS-2Nb-1Ru-1Pd-1Ag	4	SJ13 blank		
79		SS-2Nb-1Ru-1Pd-1Ag	4	CJ13-P7		
80		SS-2Nb-1Ru-1Pd-1Ag	4	CJ13-P8		
81	90-SJ13	Blank	4	CJ13-P9		
82		SS316	4	CJ13-O10		
83		SS316	4	CJ13-O11		
84		SS316	4	CJ13 blank		
85		SS-15Zr	4	10KCl-P13		
86		SS-15Zr	4	10KCl-P14		
87		SS-15Zr	4	10KCl-P15		
88		SS-5Zr-2Nb-1Ru-1Pd	4	10KCl-O16		
89		SS-5Zr-2Nb-1Ru-1Pd	4	10KCl-O17		
90		SS-5Zr-2Nb-1Ru-1Pd	4	10KCl blank		
91		SS-20Zr-2Nb-1Ru-1Pd	4	AJ13-P19		
92		SS-20Zr-2Nb-1Ru-1Pd	4	AJ13-P20		
93		SS-20Zr-2Nb-1Ru-1Pd	4	AJ13-P21		
94		SS-5Zr-2Nb-0.5Ru-0.5Pd	4	AJ13-O22		
95		SS-5Zr-2Nb-0.5Ru-0.5Pd	4	AJ13-O23		
96		SS-5Zr-2Nb-0.5Ru-0.5Pd	4	AJ13 blank		
97		SS-5Zr	6	SJ13-P1		
98		SS-5Zr	6	SJ13-P2		
99		SS-5Zr	6	SJ13-P3		
100		slag-SS-15Zr-2Nb-1Ru-1Pd	6	SJ13-O4		
101		slag-SS-15Zr-2Nb-1Ru-1Pd	6	SJ13-O5		
102		slag-SS-15Zr-2Nb-1Ru-1Pd	6	SJ13 blank		
103		SS-15Zr 10C/min	6	CJ13-P7		
104		SS-15Zr 10C/min	6	CJ13-P8		
105		SS-15Zr 10C/min	6	CJ13-P9		
106		SS-15Zr 5C/min	6	CJ13-O10		
107		SS-15Zr 5C/min	6	CJ13-O11		
108		SS-15Zr 5C/min	6	CJ13 blank		

Table D-1d. Table of Vial Use (Cont'd)

Vial	Solution	Ingot ID	Week	Solution/sample	Week	Solution/sample
109		SS-15Zr-1Nb-1Ru-1Pd-1Rh	6	10KCl-P13		
110		SS-15Zr-1Nb-1Ru-1Pd-1Rh	6	10KCl-P14		
111		SS-15Zr-1Nb-1Ru-1Pd-1Rh	6	10KCl-P15		
112		SS-15Zr 1C/min	6	10KCl-O16		
113		SS-15Zr 1C/min	6	10KCl-O17		
114		SS-15Zr 1C/min	6	10KCl blank		
115		slag	6	AJ13-P19		
116		slag	6	AJ13-P20		
117		slag	6	AJ13-P21		
118		SS-2Nb-1Ru-1Pd-1Ag	6	AJ13-O22		
119		SS-2Nb-1Ru-1Pd-1Ag	6	AJ13-O23		
120		SS-2Nb-1Ru-1Pd-1Ag	6	AJ13 blank		
121	90-H_2O	blank	8	SJ13-P1		
122		SS316	8	SJ13-P2		
123		SS316	8	SJ13-P3		
124		SS316	8	SJ13-O4		
125		SS-15Zr	8	SJ13-O5		
126		SS-15Zr	8	SJ13 blank		
127		SS-15Zr	8	CJ13-P7		
128		SS-5Zr-2Nb-1Ru-1Pd	8	CJ13-P8		
129		SS-5Zr-2Nb-1Ru-1Pd	8	CJ13-P9		
130		SS-5Zr-2Nb-1Ru-1Pd	8	CJ13-O10		
131		SS-20Zr-2Nb-1Ru-1Pd	8	CJ13-O11		
132		SS-20Zr-2Nb-1Ru-1Pd	8	CJ13 blank		
133		SS-20Zr-2Nb-1Ru-1Pd	8	10KCl-P13		
134		SS-5Zr-2Nb-0.5Ru-0.5Pd	8	10KCl-P14		
135		SS-5Zr-2Nb-0.5Ru-0.5Pd	8	10KCl-P15		
136		SS-5Zr-2Nb-0.5Ru-0.5Pd	8	10KCl-O16		
137		SS-5Zr	8	10KCl-O17		
138		SS-5Zr	8	10KCl blank		
139		SS-5Zr	8	AJ13-P1		
140		slag-SS-15Zr-2Nb-1Ru-1Pd	8	AJ13-P2		
141		slag-SS-15Zr-2Nb-1Ru-1Pd	10	SJ13-P1		
142		slag-SS-15Zr-2Nb-1Ru-1Pd	10	SJ13-P2		
143		SS-15Zr 10C/min	10	SJ13-P3		
144		SS-15Zr 10C/min	10	SJ13-O4		
145		SS-15Zr 10C/min	10	SJ13-O5		
146		SS-15Zr 5C/min	10	SJ13 blank		

Table D-1e. Table of Vial Use (Cont'd)

Vial	Solution	Ingot ID	Week	Solution/sample	Week	Solution/sample
147		SS-15Zr 5C/min	10	CJ13-P7		
148		SS-15Zr 5C/min	10	CJ13-P8		
149		SS-15Zr-1Nb-1Ru-1Pd-1Rh	10	CJ13-P9		
150		SS-15Zr-1Nb-1Ru-1Pd-1Rh	10	CJ13-O10		
151		SS-15Zr-1Nb-1Ru-1Pd-1Rh	10	CJ13-O11		
152		SS-15Zr 1C/min	10	CJ13 blank		
153		SS-15Zr 1C/min	10	10KCl-P13		
154		SS-15Zr 1C/min	10	10KCl-P14		
155		slag	10	10KCl-P15		
156		slag	10	10KCl-O16		
157		slag	10	10KCl-O17		
158		SS-2Nb-1Ru-1Pd-1Ag	10	10KCl blank		
159		SS-2Nb-1Ru-1Pd-1Ag	10	AJ13-P19		
160		SS-2Nb-1Ru-1Pd-1Ag	10	AJ13-P20		

E. Releases and Detection Limits

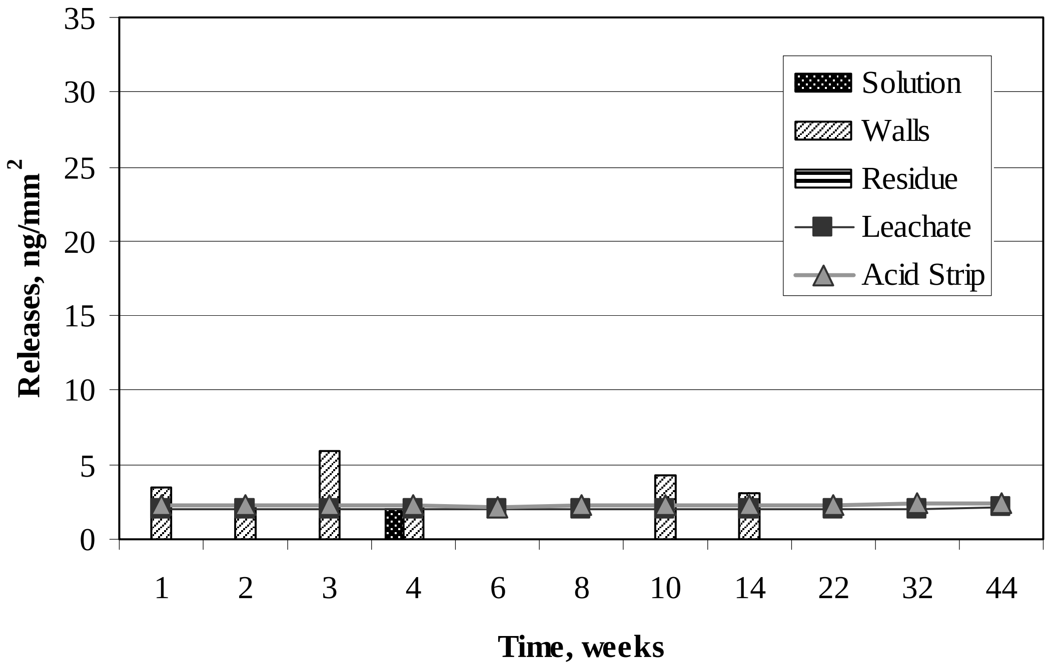


Figure E-1. Iron Releases in Solution, on Walls, and in Residue from Polished Sample 1 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

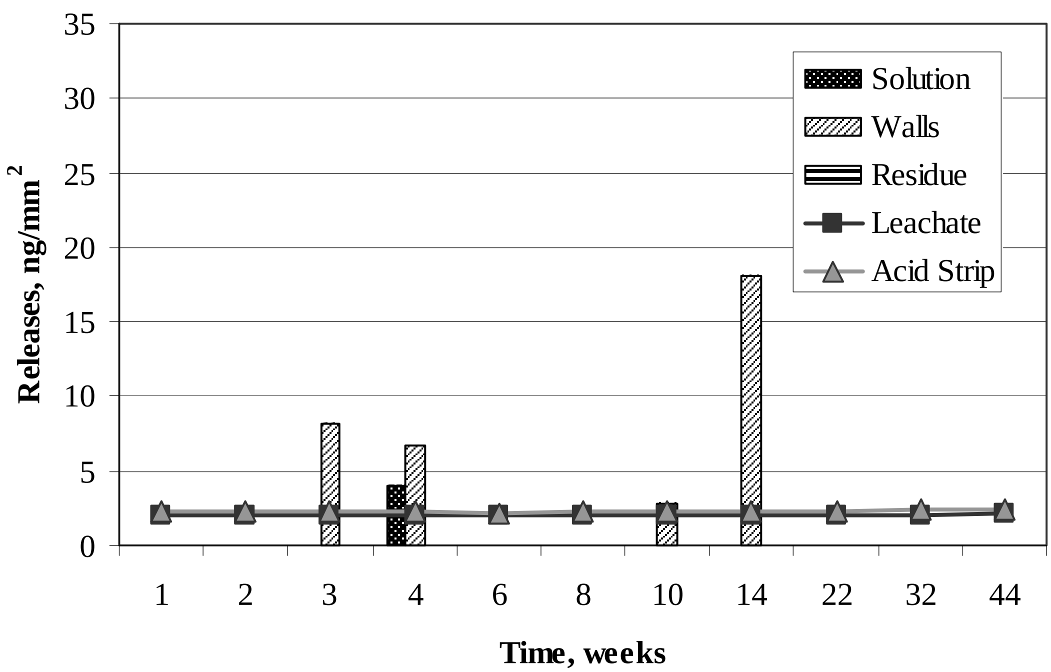


Figure E-2. Iron Releases in Solution, on Walls, and in Residue from Polished Sample 2 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

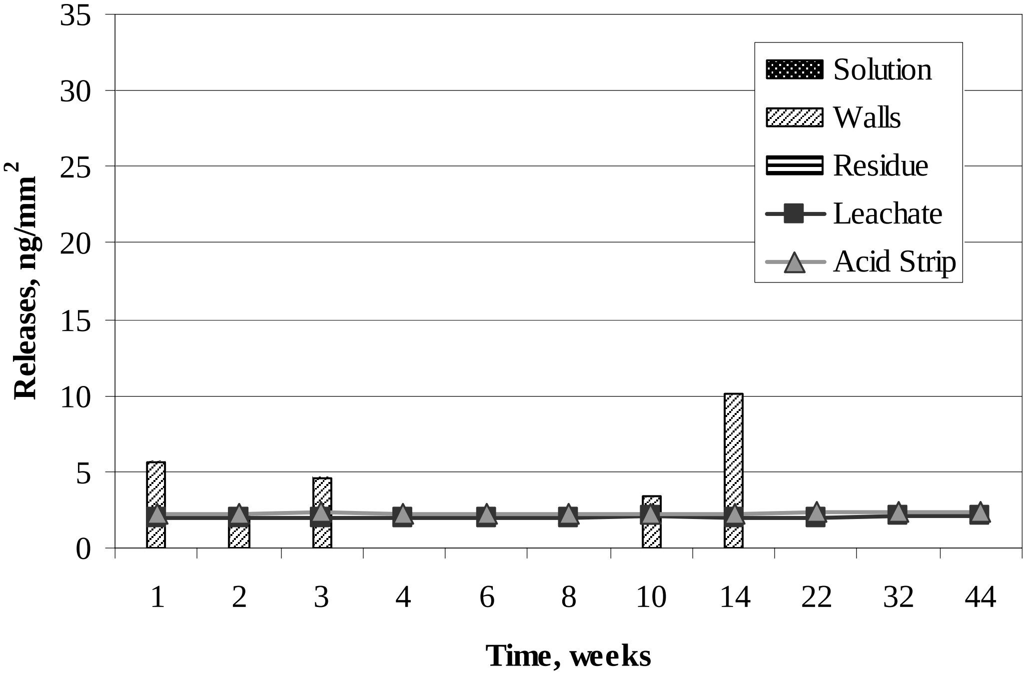


Figure E-3. Iron Releases in Solution, on Walls, and in Residue from Polished Sample 3 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

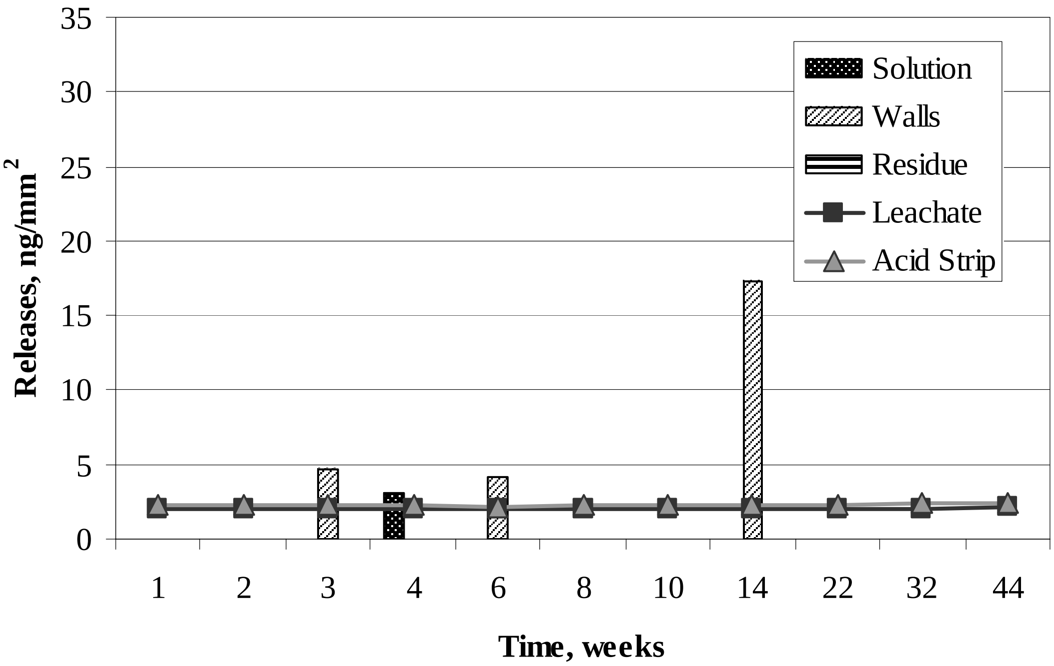


Figure E-4. Iron Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

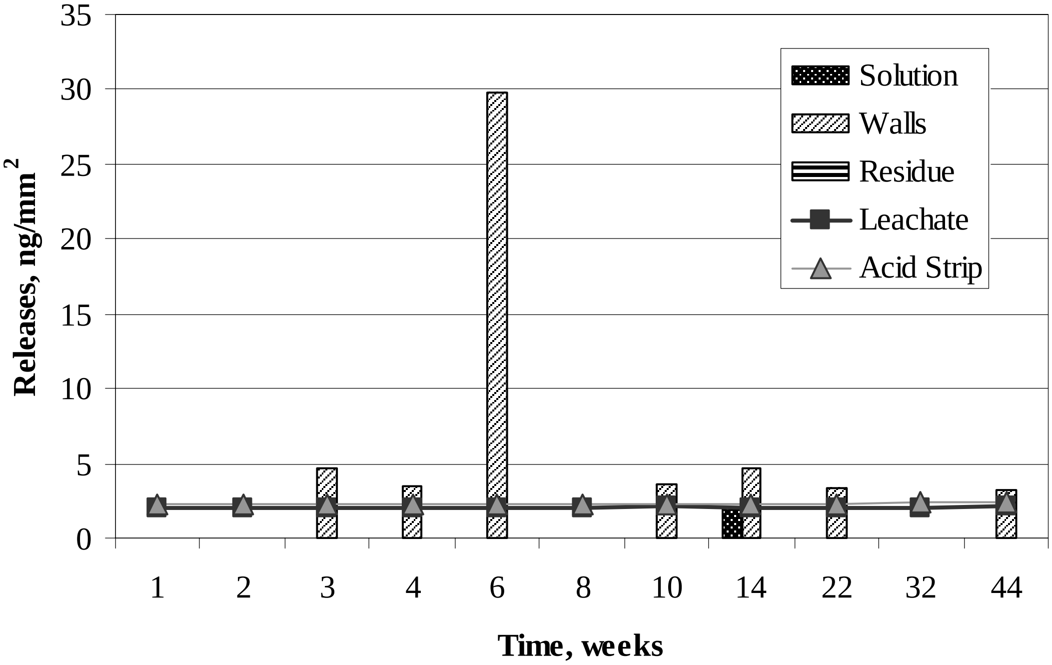


Figure E-5. Iron Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

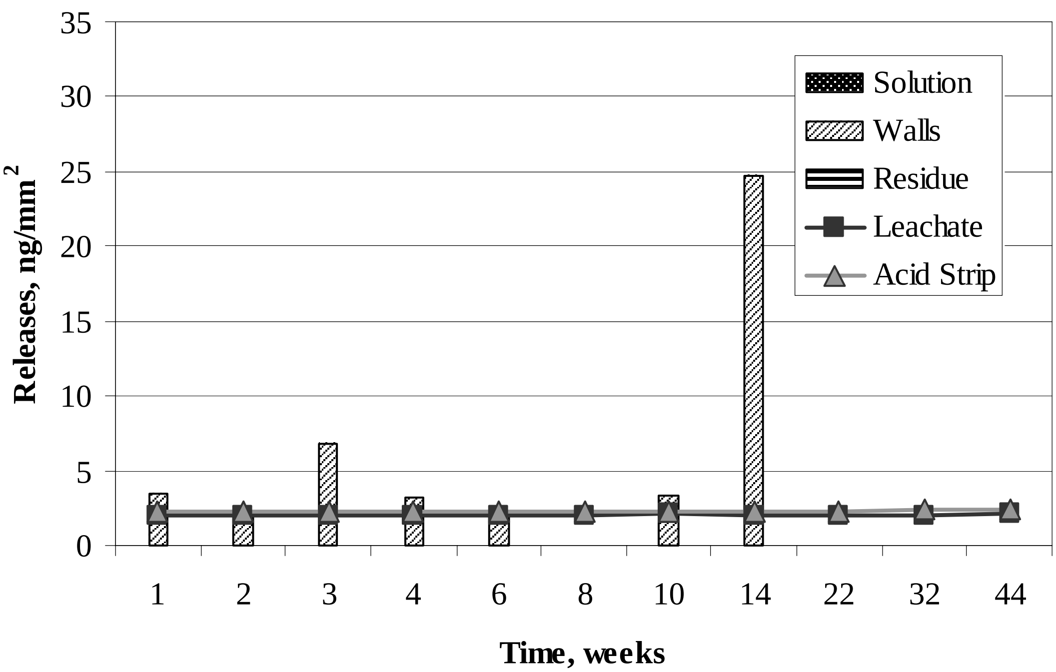


Figure E-6. Iron Present in Solution, on Walls, and in Residue from SJ13 Control and Average Detection Limits for Leachate and Acid Strip.

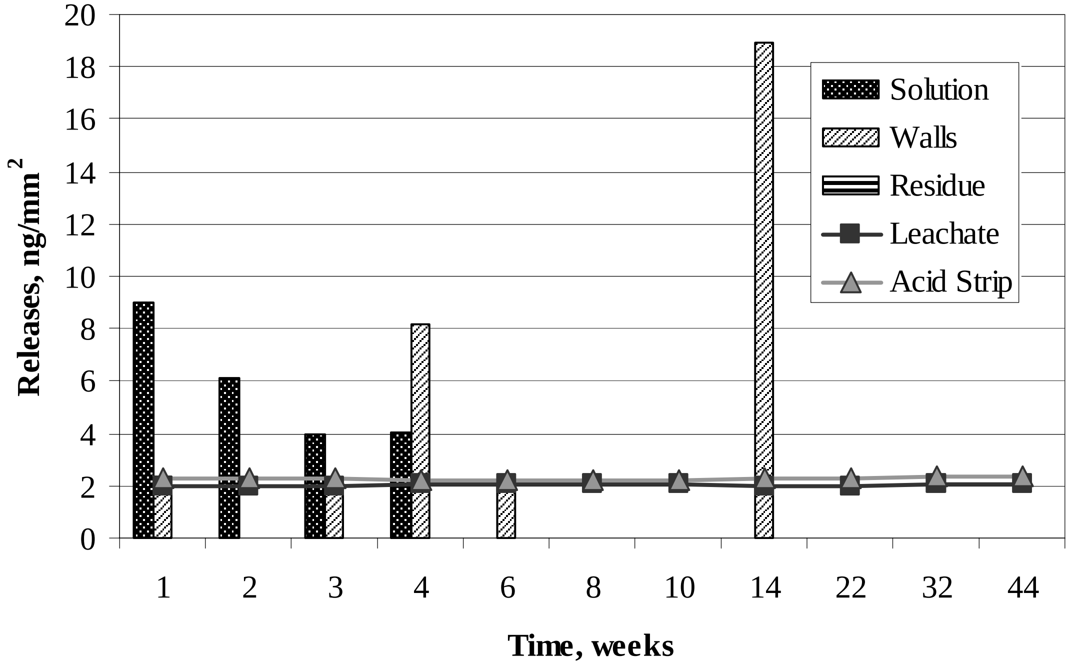


Figure E-7. Iron Releases in Solution, on Walls, and in Residue from Polished Sample 1 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

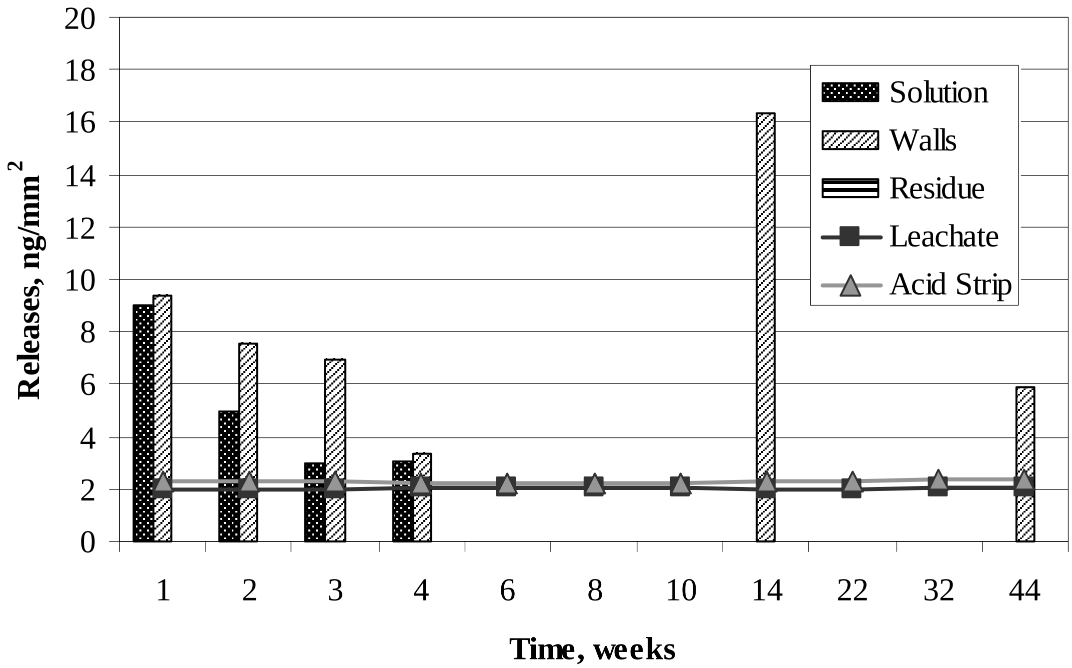


Figure E-8. Iron Releases in Solution, on Walls, and in Residue from Polished Sample 2 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

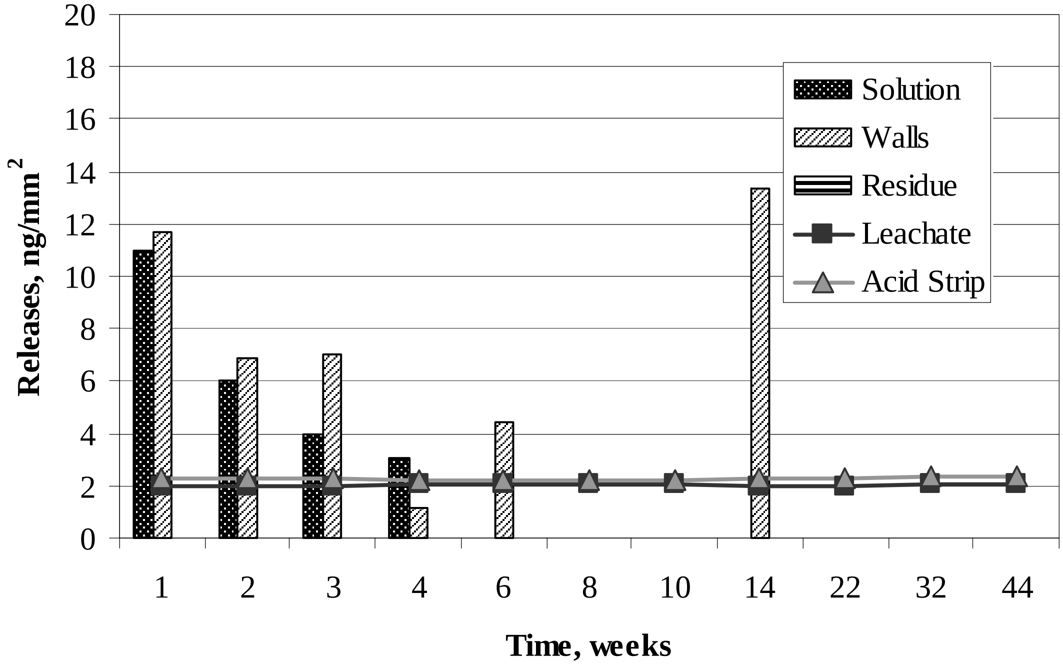


Figure E-9. Iron Releases in Solution, on Walls, and in Residue from Polished Sample 3 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

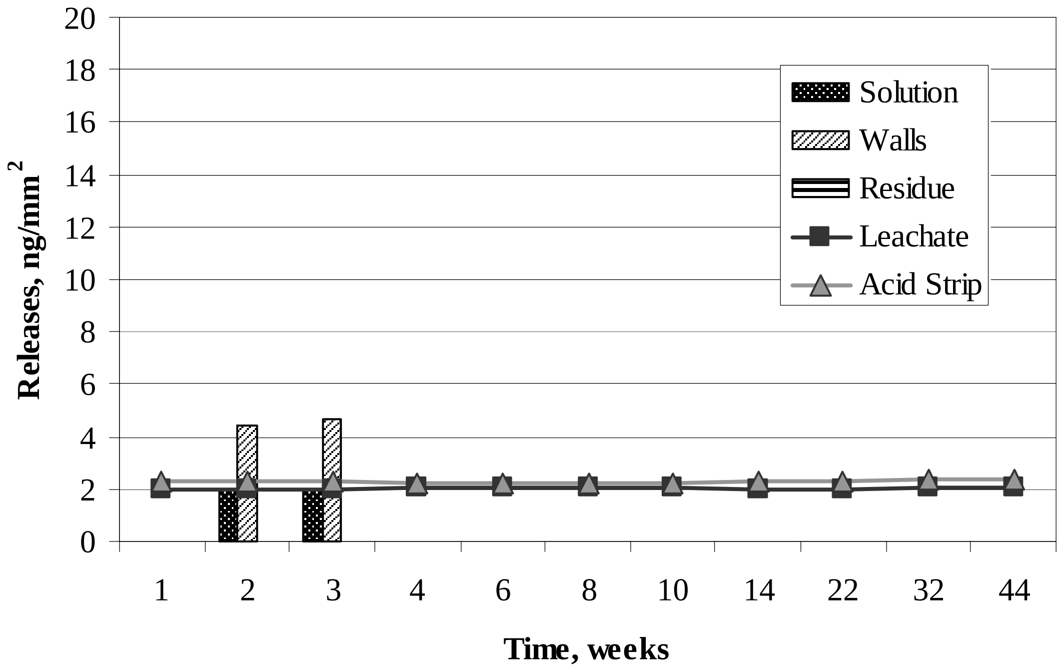


Figure E-10. Iron Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

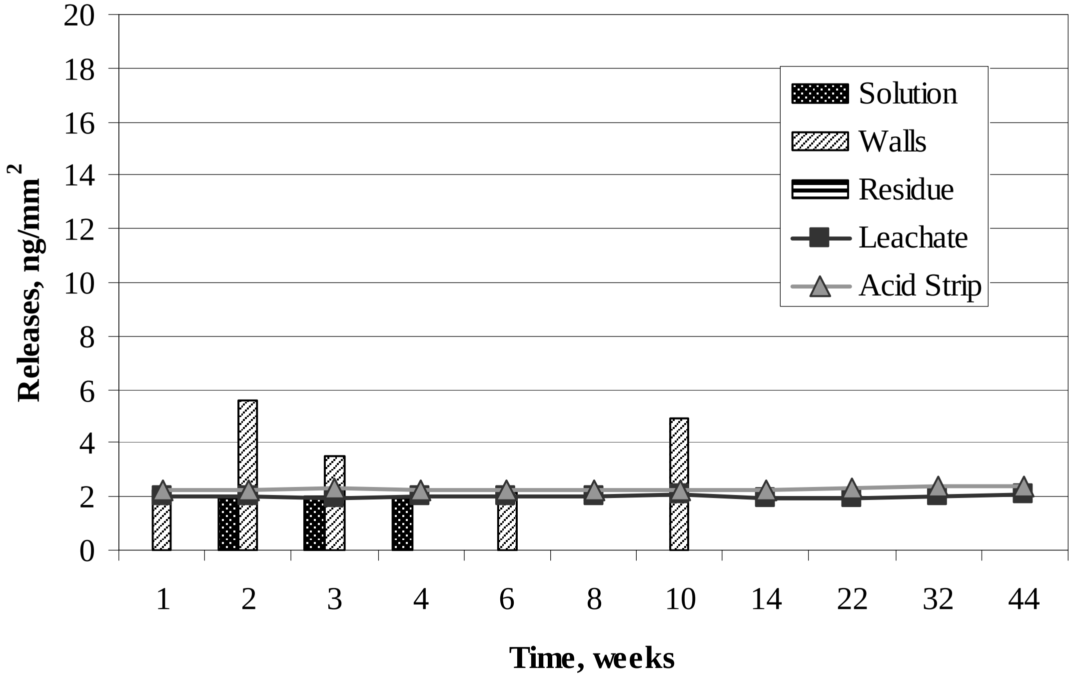


Figure E-11. Iron Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

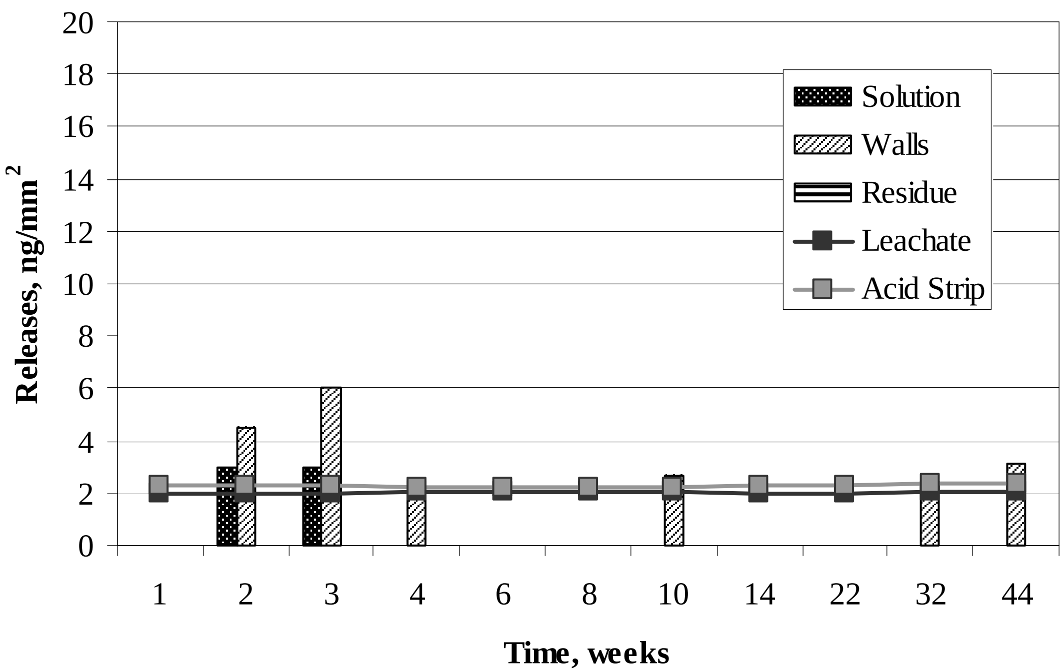


Figure E-12. Iron Present in Solution, on Walls, and in Residue from CJ13 Control and Average Detection Limits for Leachate and Acid Strip.

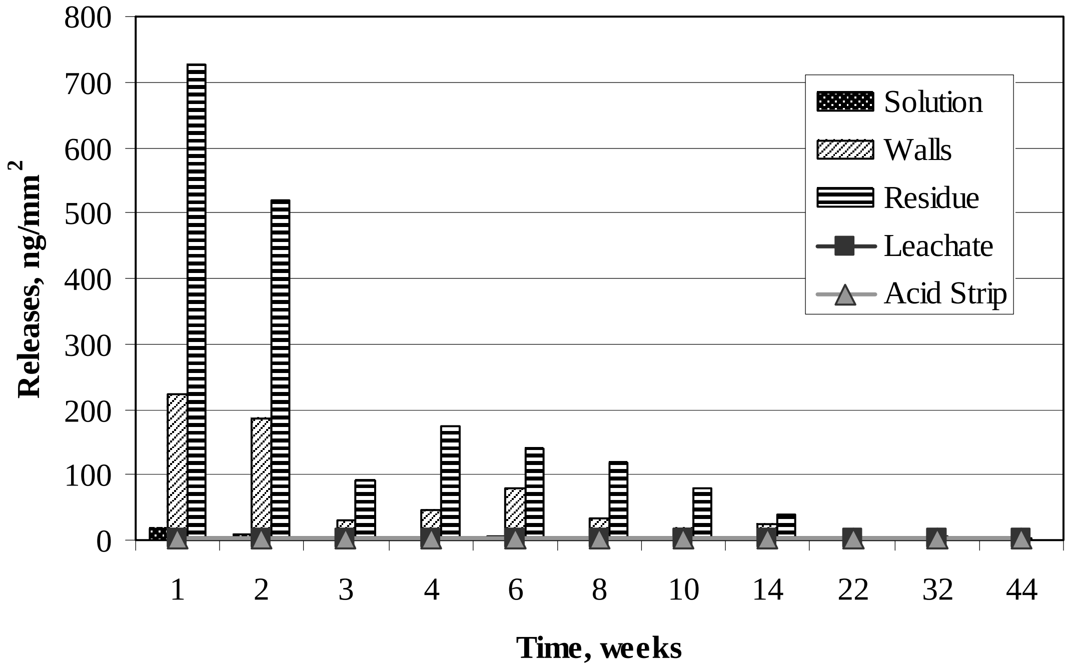


Figure E-13. Iron Releases in Solution, on Walls, and in Residue from Polished Sample 1 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

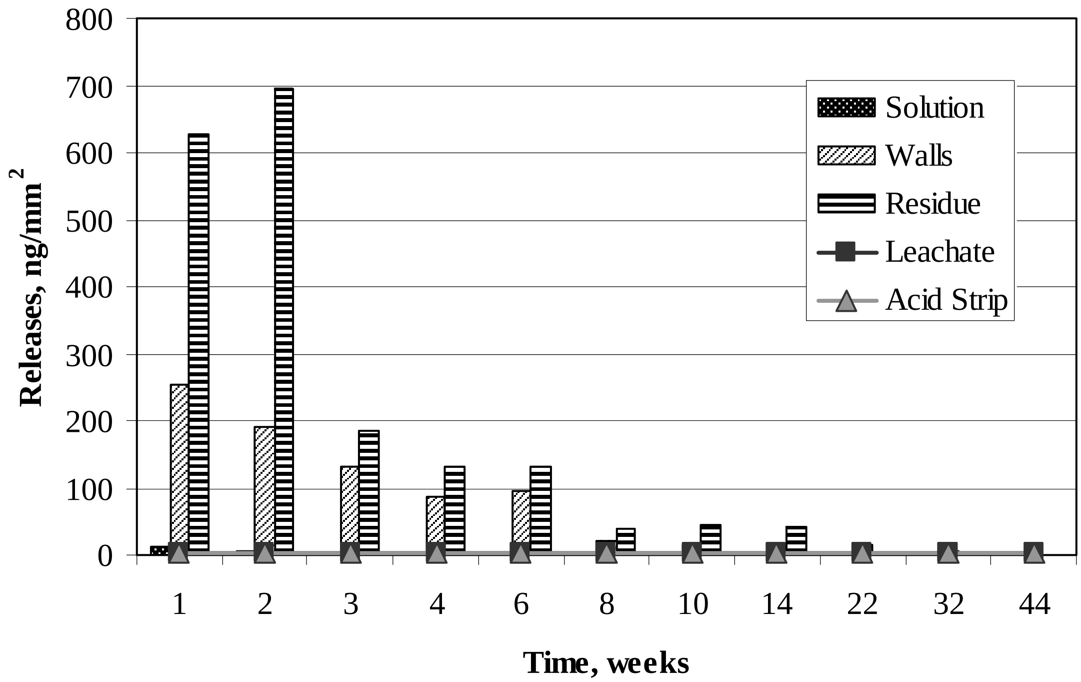


Figure E-14. Iron Releases in Solution, on Walls, and in Residue from Polished Sample 2 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

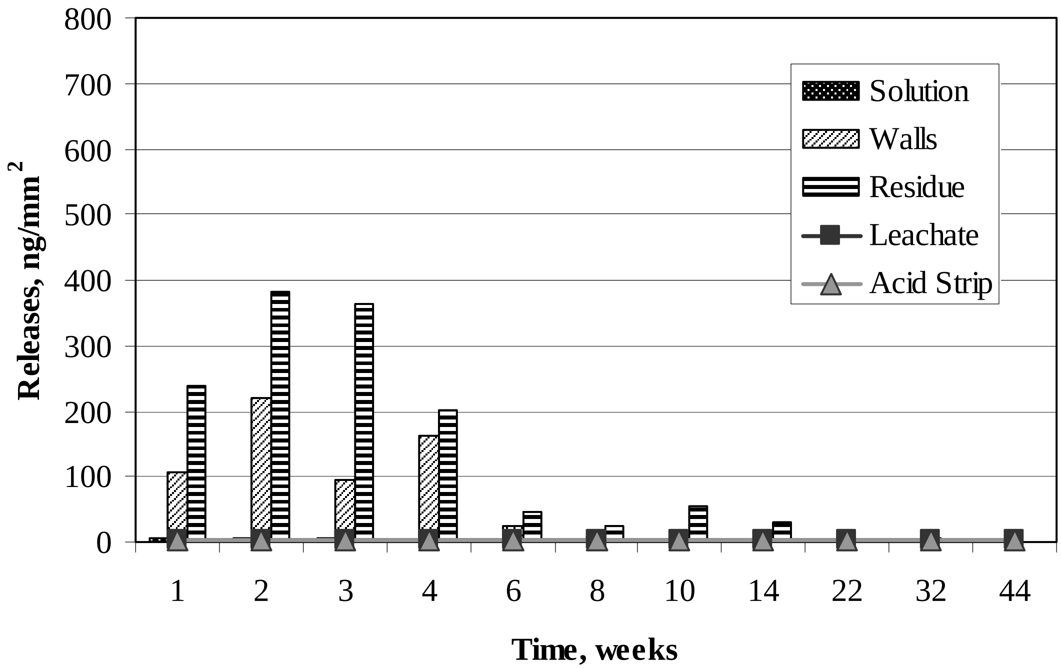


Figure E-15. Iron Releases in Solution, on Walls, and in Residue from Polished Sample 3 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

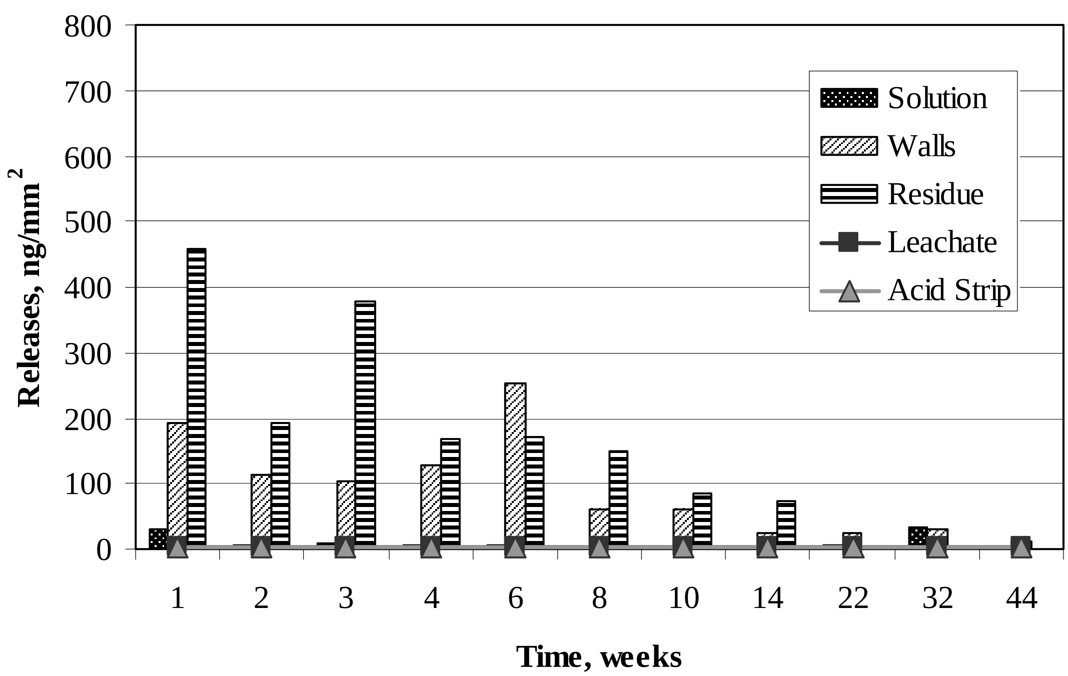


Figure E-16. Iron Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

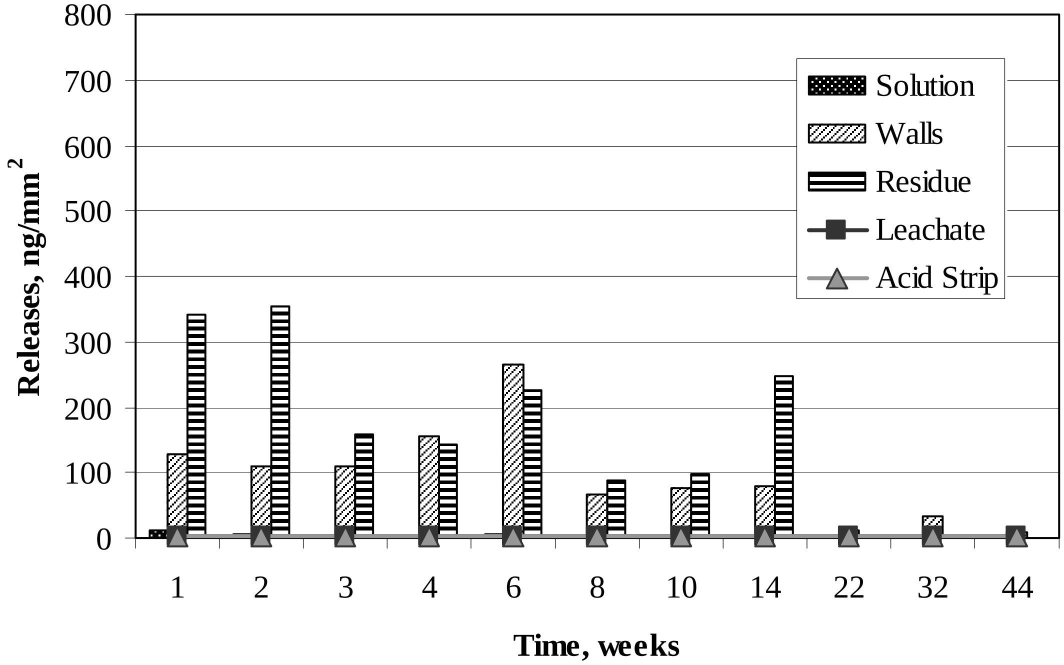


Figure E-17. Iron Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

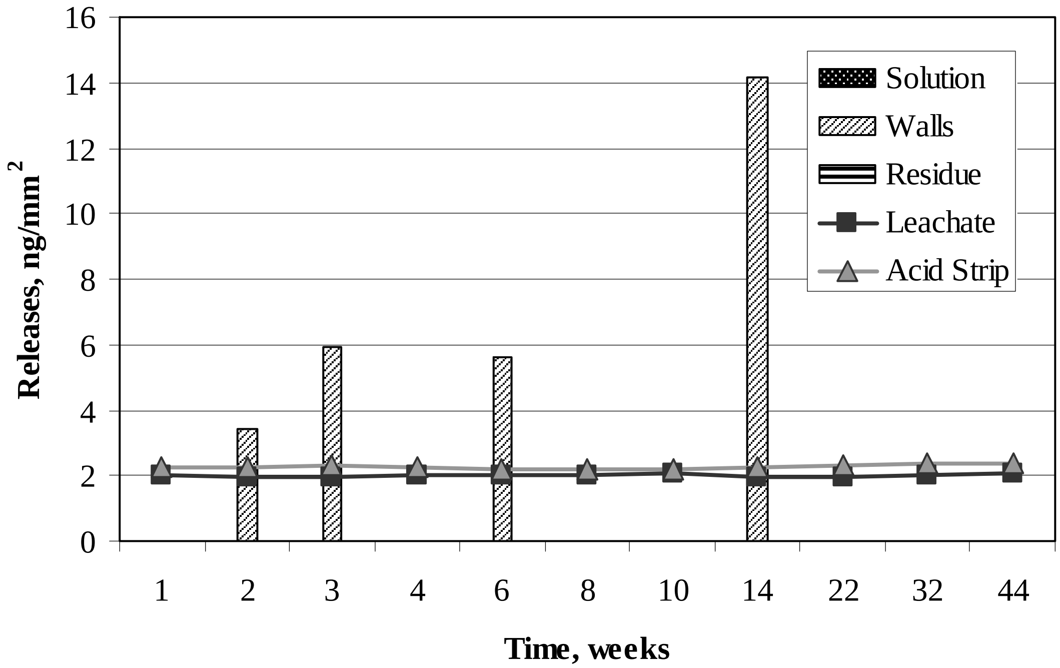


Figure E-18. Iron Present in Solution, on Walls, and in Residue from 10KCl Control and Average Detection Limits for Leachate and Acid Strip.

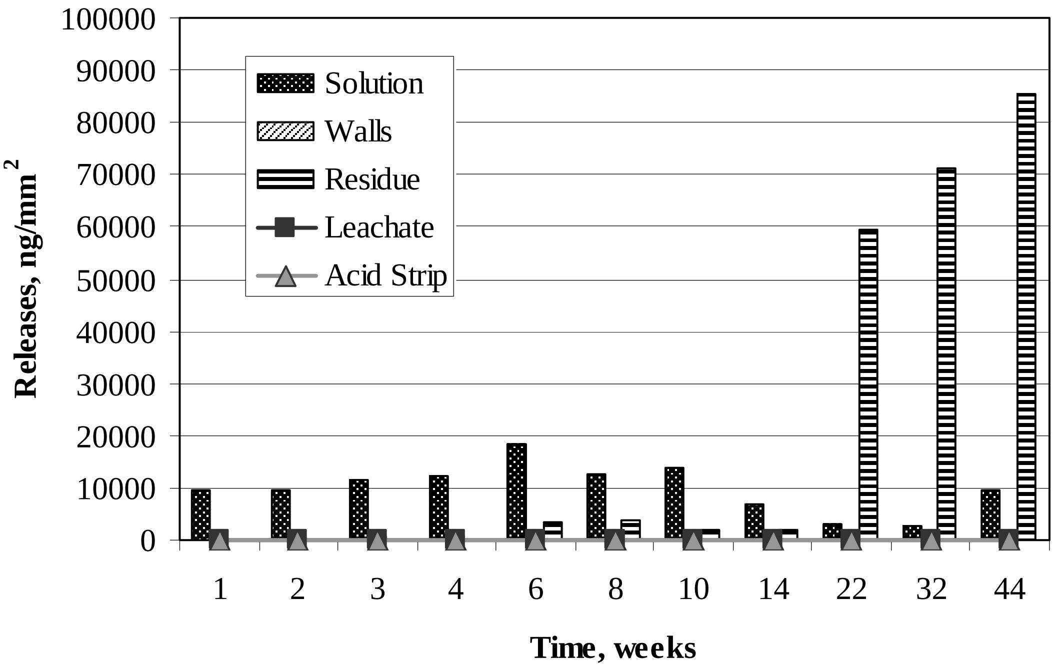


Figure E-19. Iron Releases in Solution, on Walls, and in Residue from Polished Sample 1 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

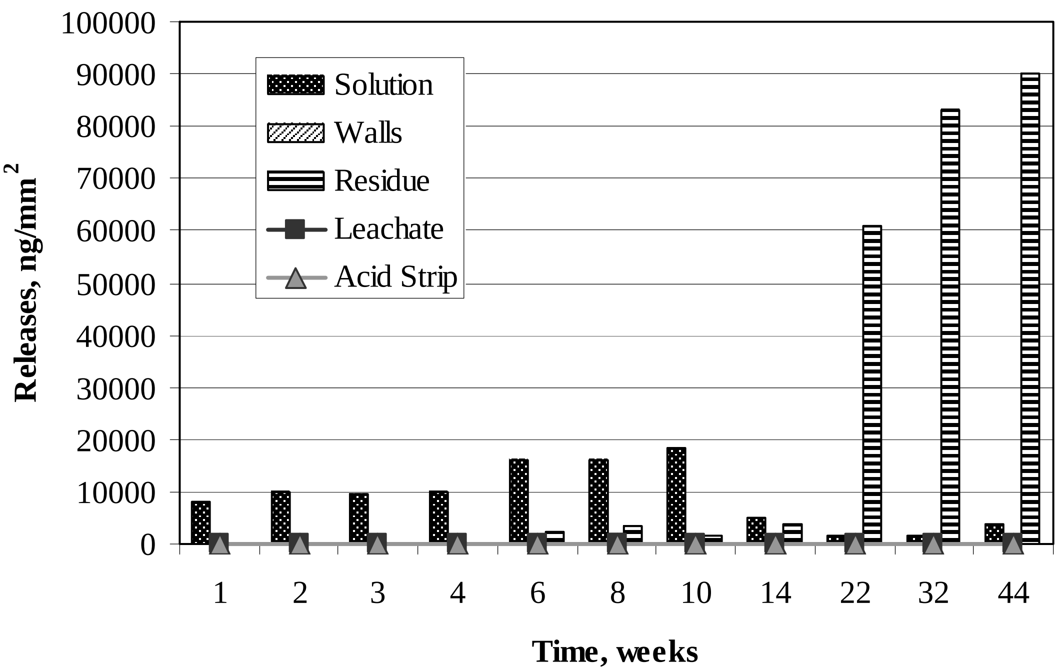


Figure E-20. Iron Releases in Solution on Walls and in Residue from Polished Sample 2 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

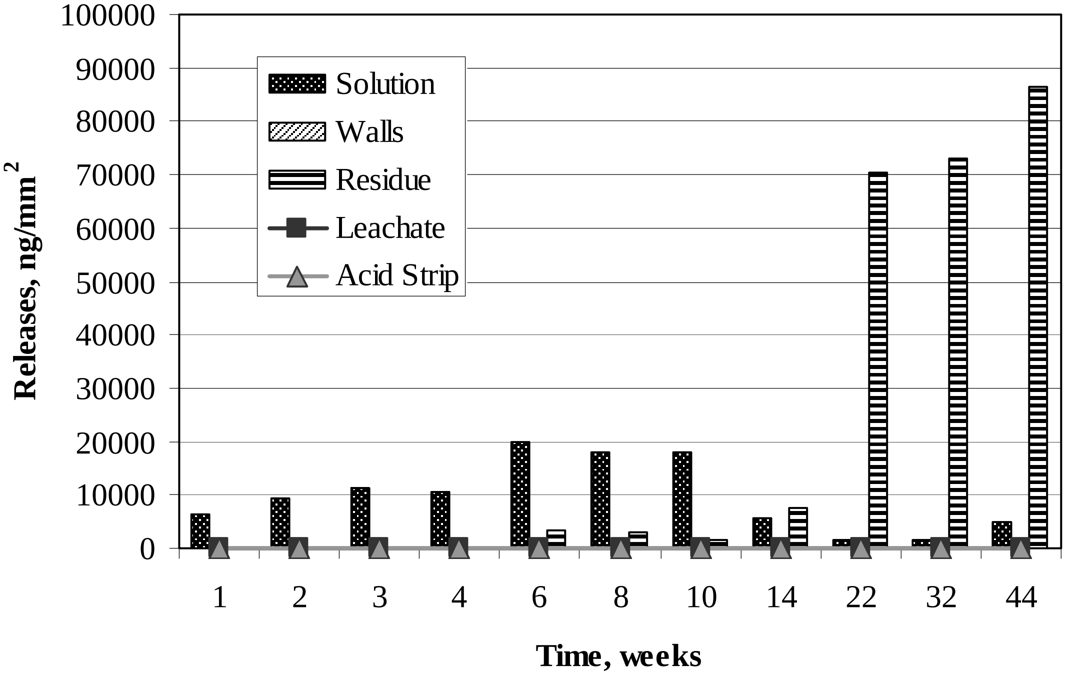


Figure E-21. Iron Releases in Solution, on Walls, and in Residue from Polished Sample 3 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

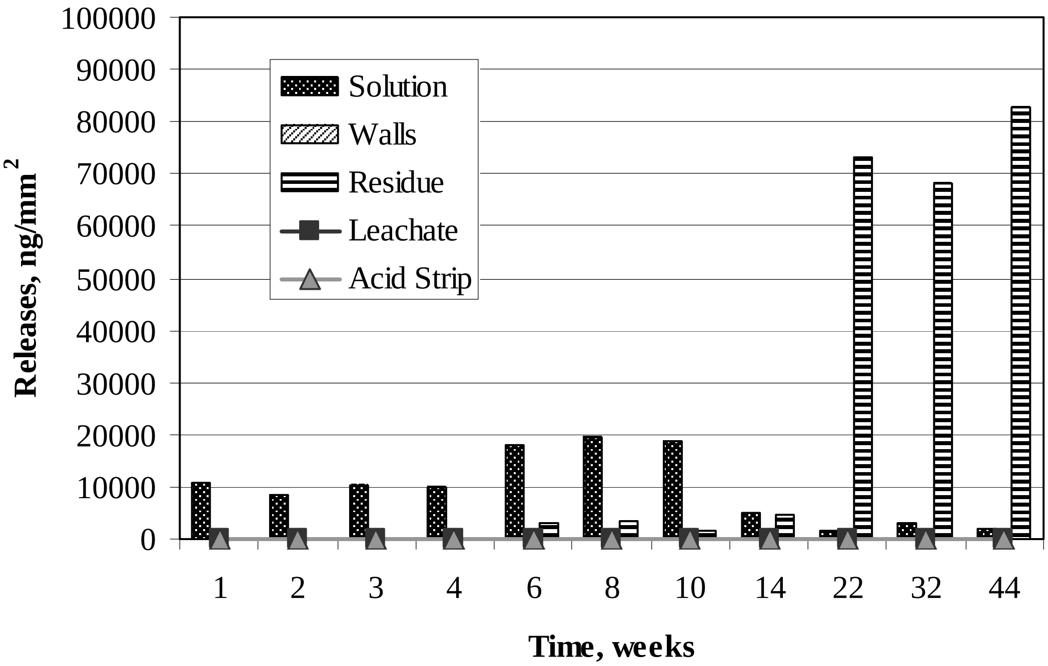


Figure E-22. Iron Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

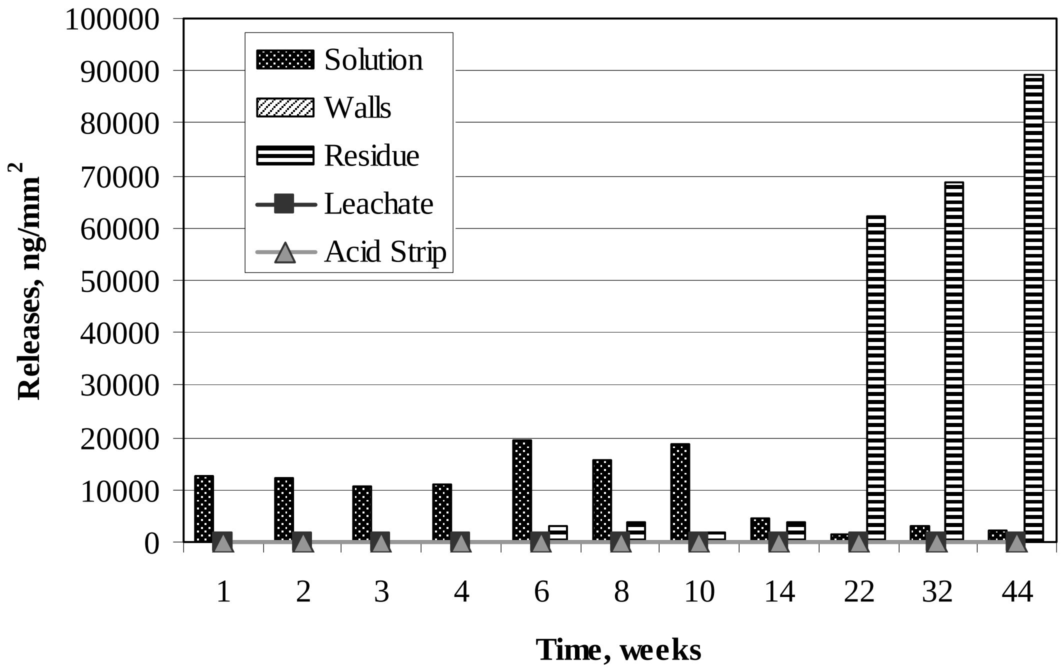


Figure E-23. Iron Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

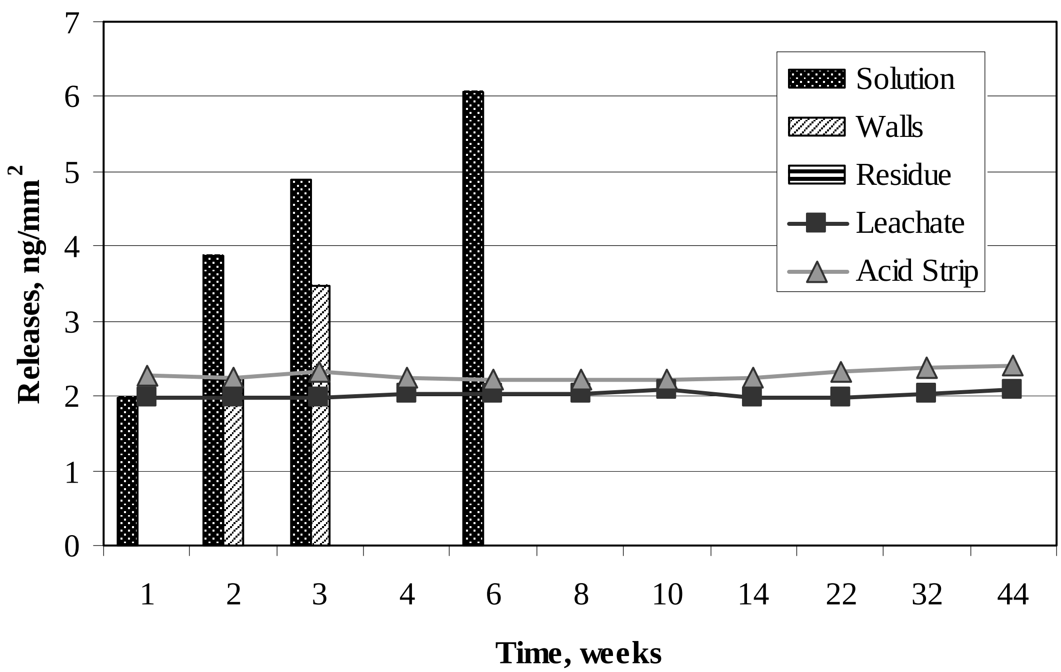


Figure E-24. Iron Present in Solution, on Walls, and in Residue from AJ13 Control and Average Detection Limits for Leachate and Acid Strip.

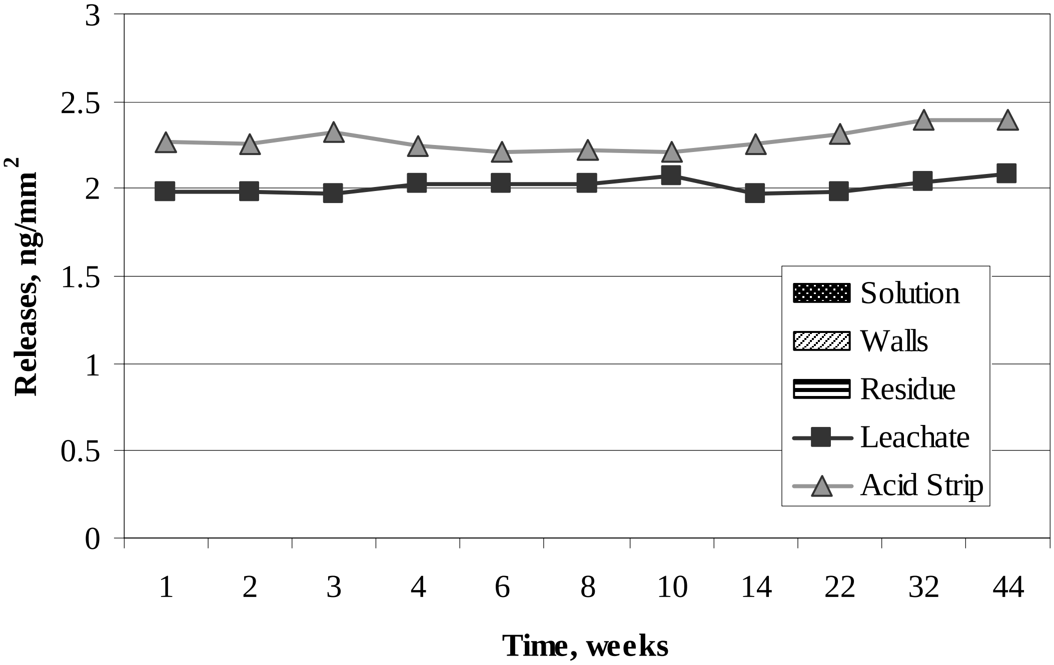


Figure E-25. Chromium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

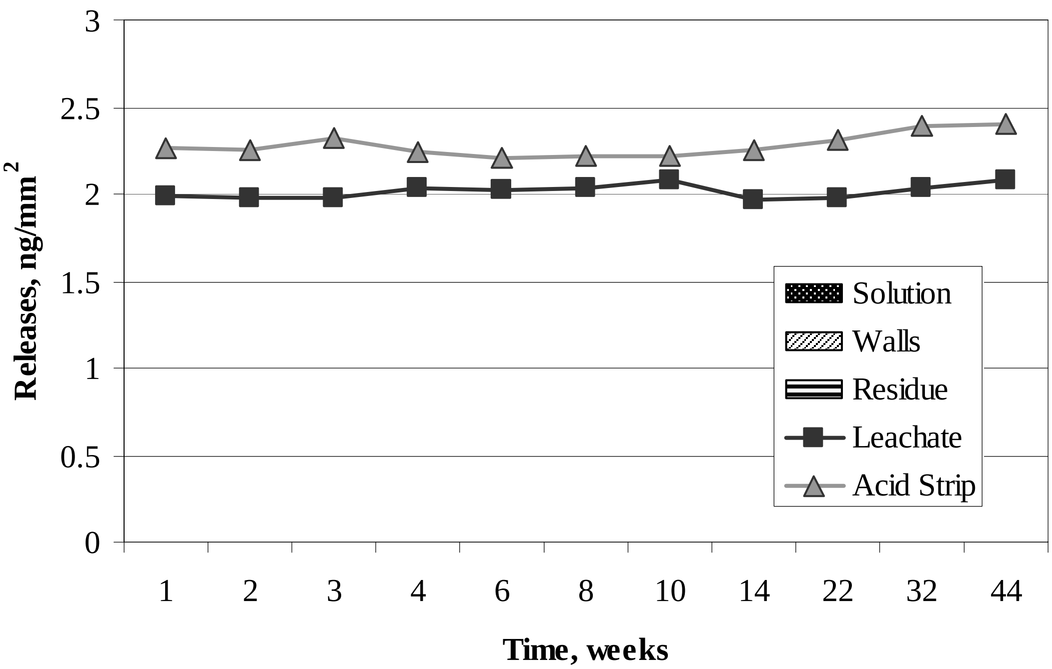


Figure E-26. Chromium Releases in Solution, on Walls, and in Residue from Polished Sample in SJ13 and Average Detection Limits for Leachate and Acid Strip.

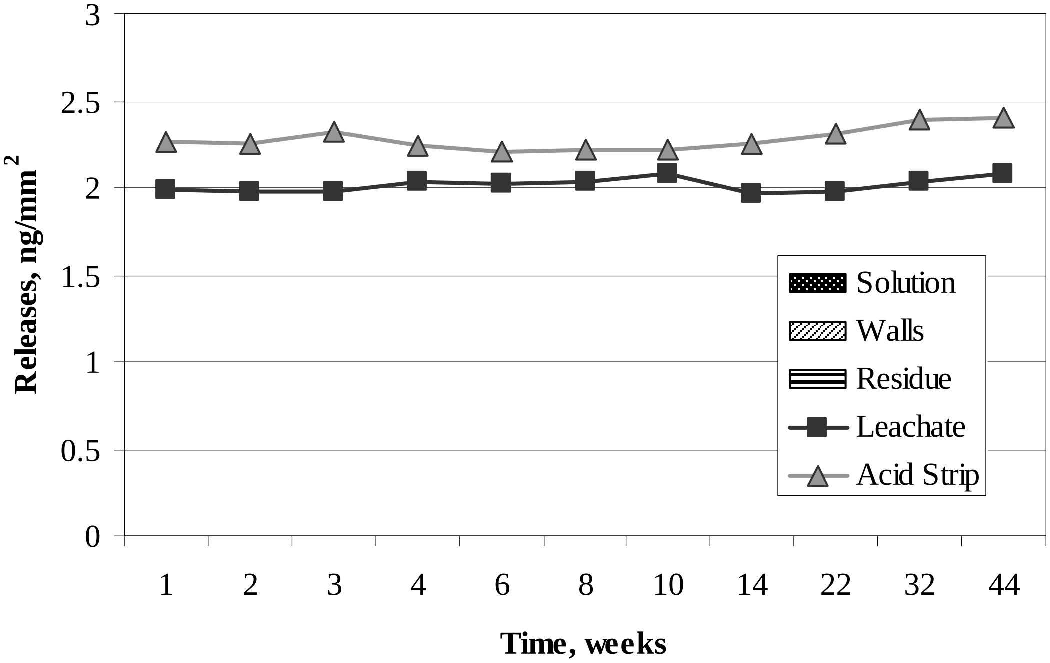


Figure E-27. Chromium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

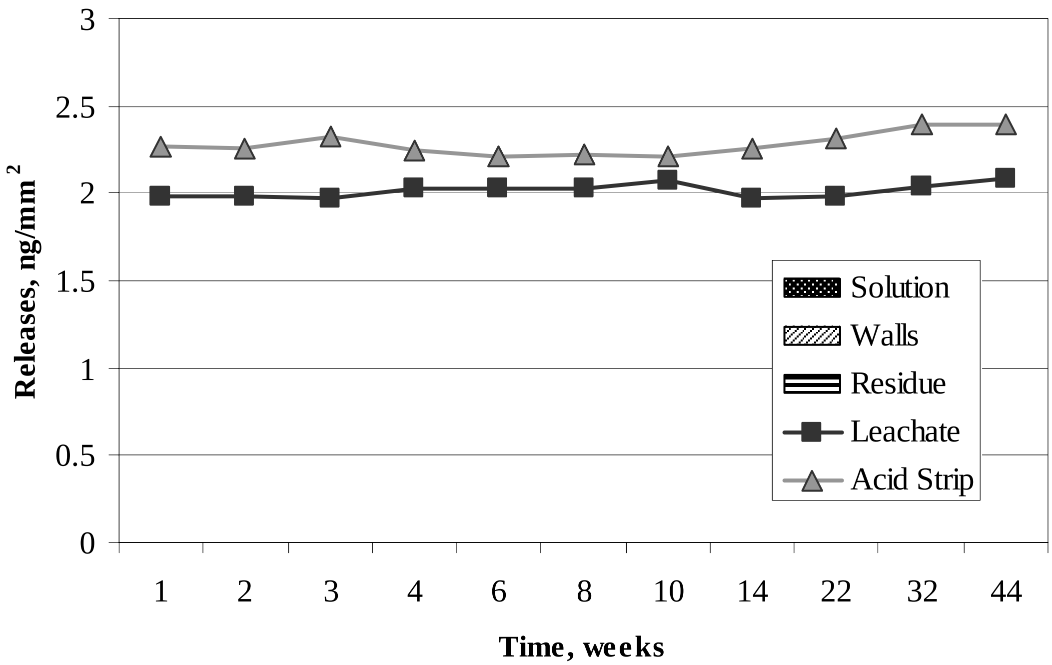


Figure E-28. Chromium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

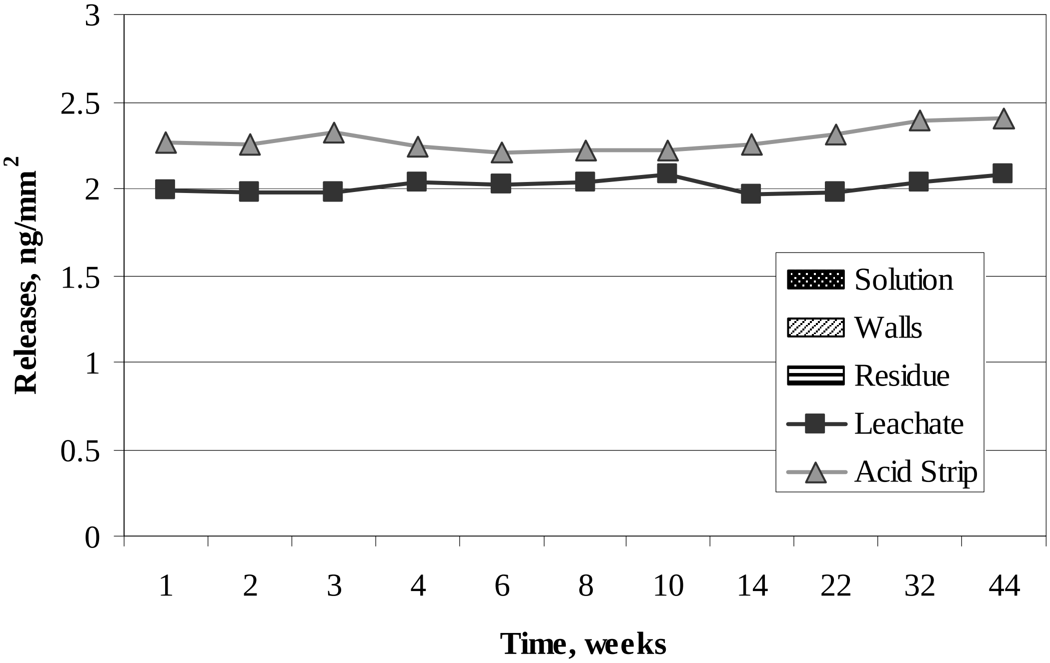


Figure E-29. Chromium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

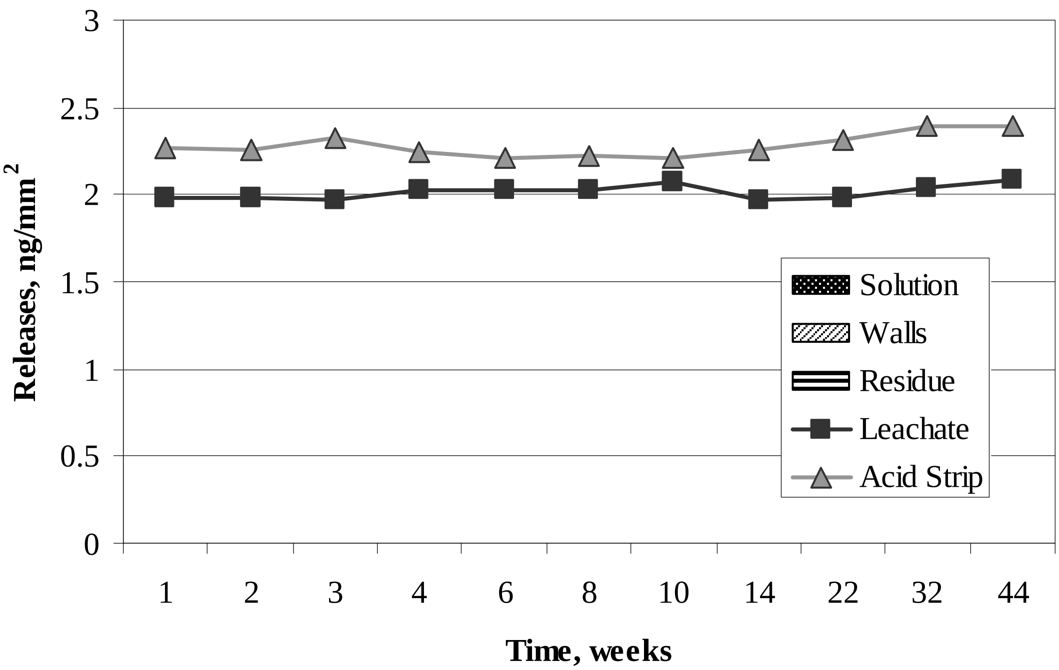


Figure E-30. Chromium Present in Solution, on Walls, and in Residue from SJ13 Control and Average Detection Limits for Leachate and Acid Strip.

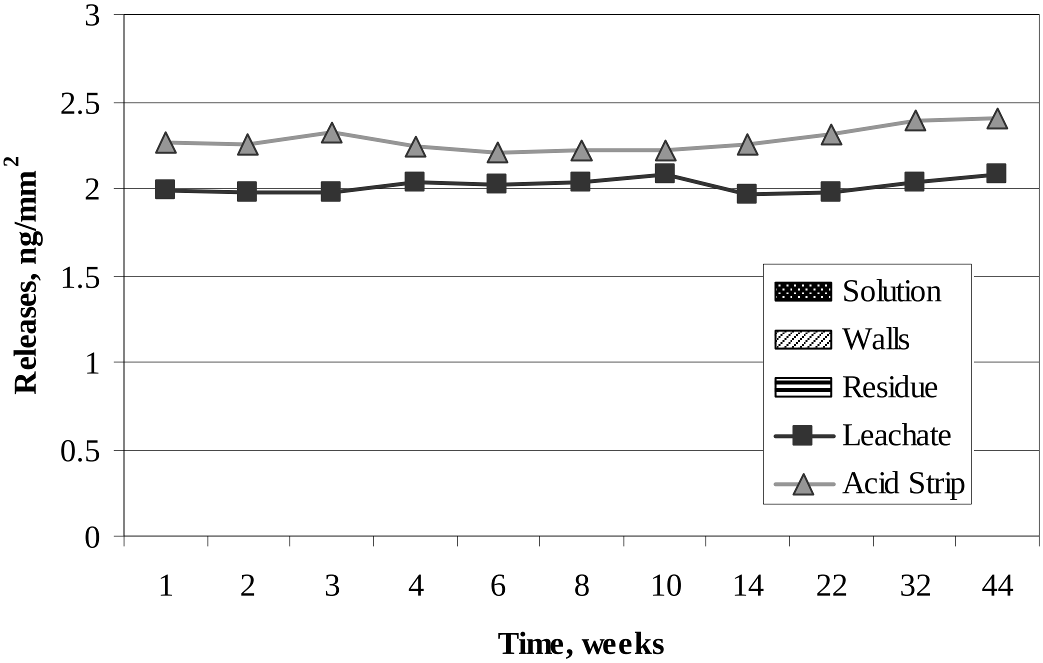


Figure E-31. Chromium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

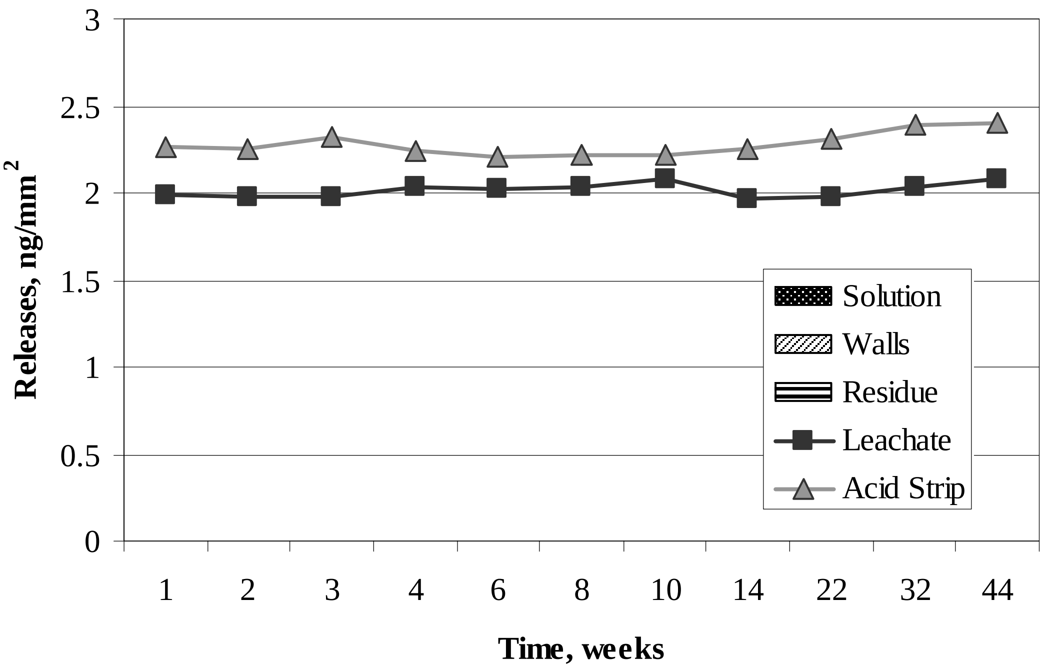


Figure E-32. Chromium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

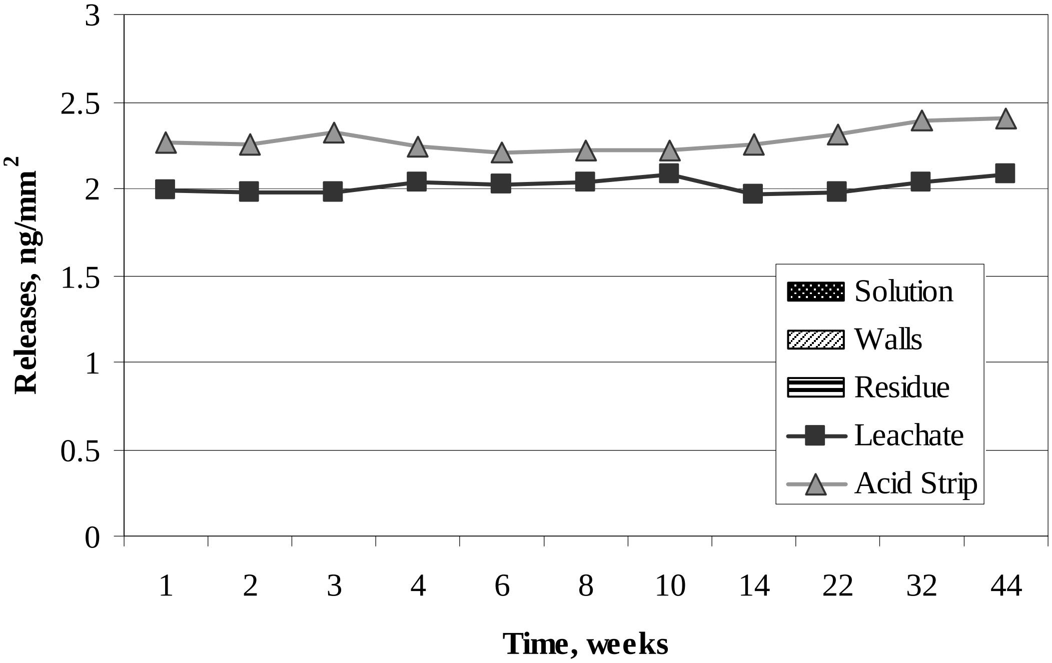


Figure E-33. Chromium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

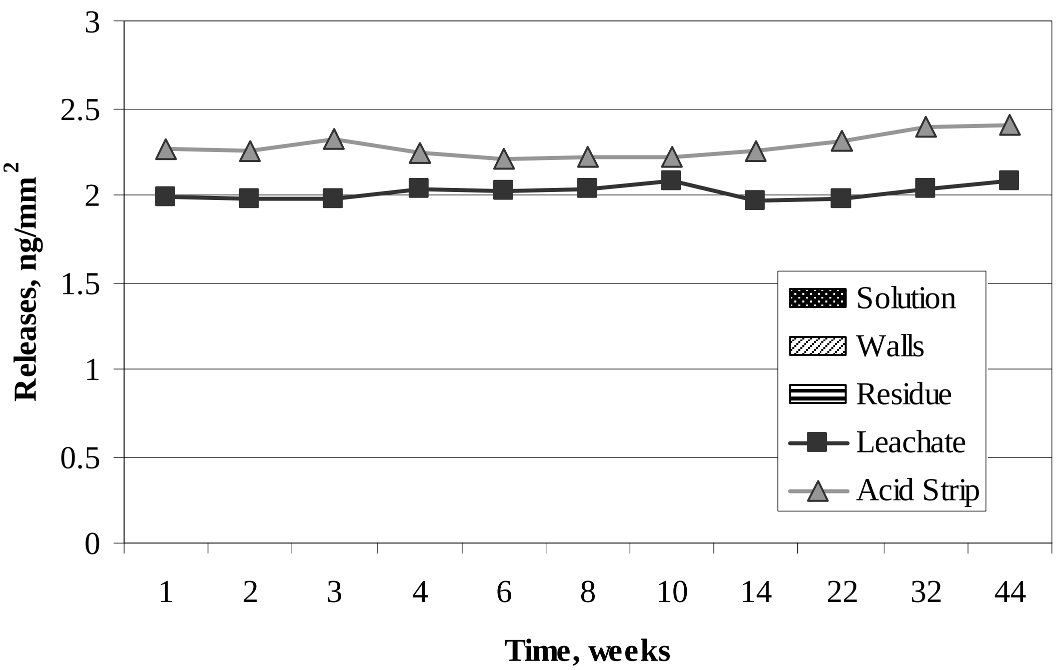


Figure E-34. Chromium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

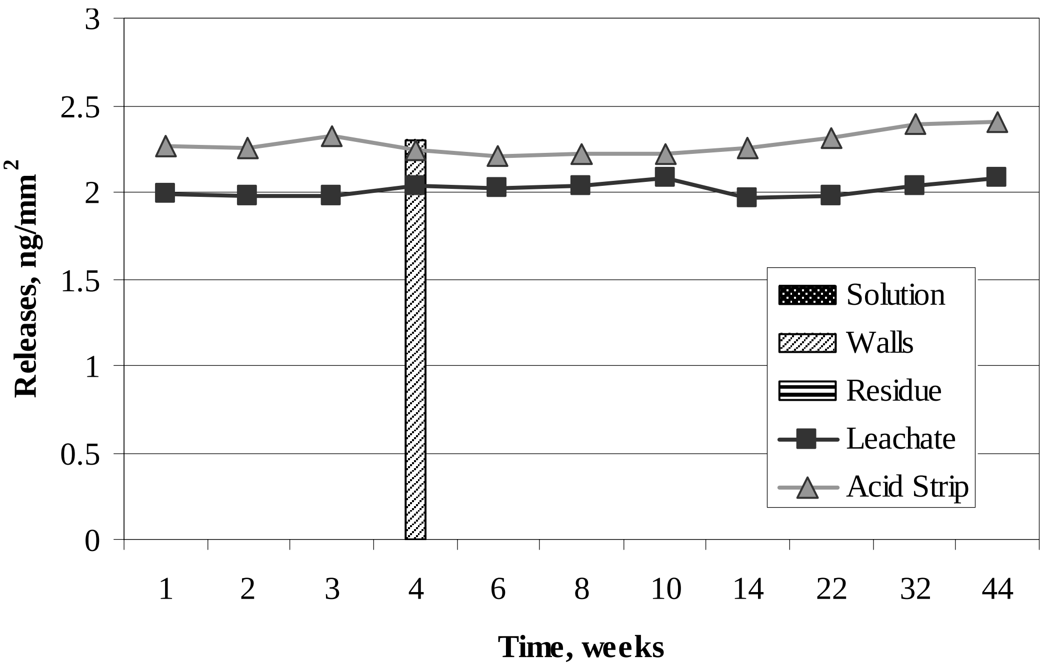


Figure E-35. Chromium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

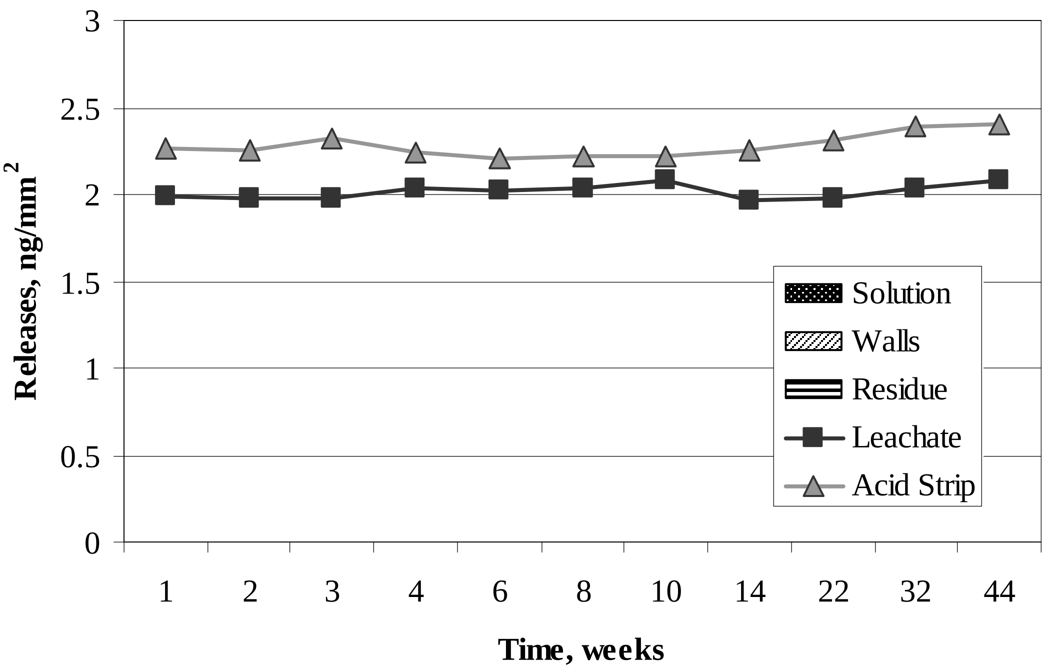


Figure E-36. Chromium Present in Solution, on Walls, and in Residue from CJ13 Control and Average Detection Limits for Leachate and Acid Strip.

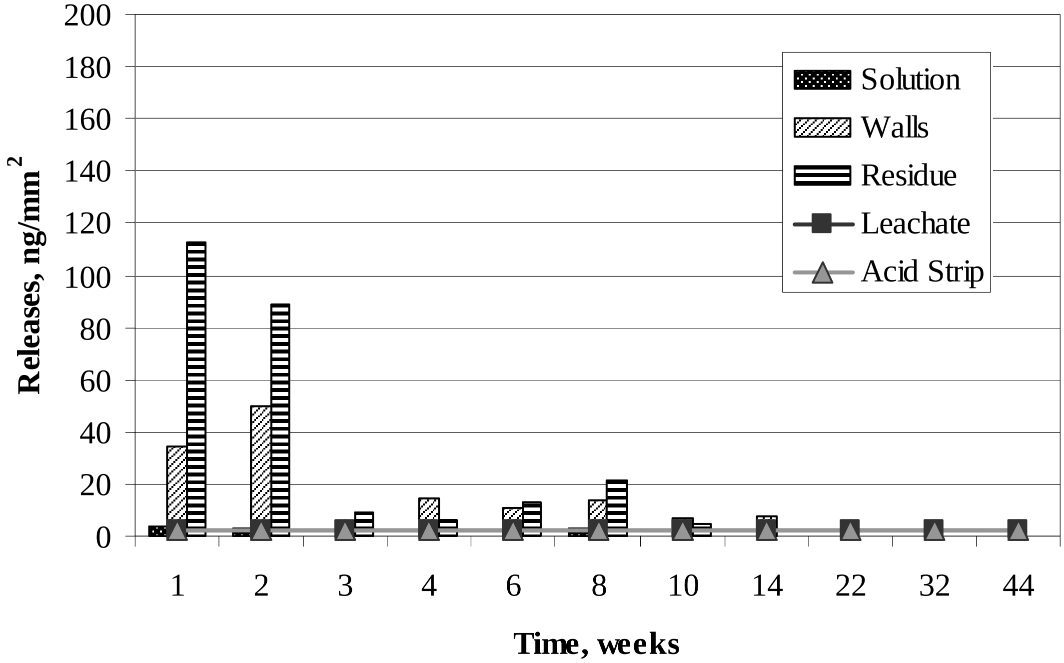


Figure E-37. Chromium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

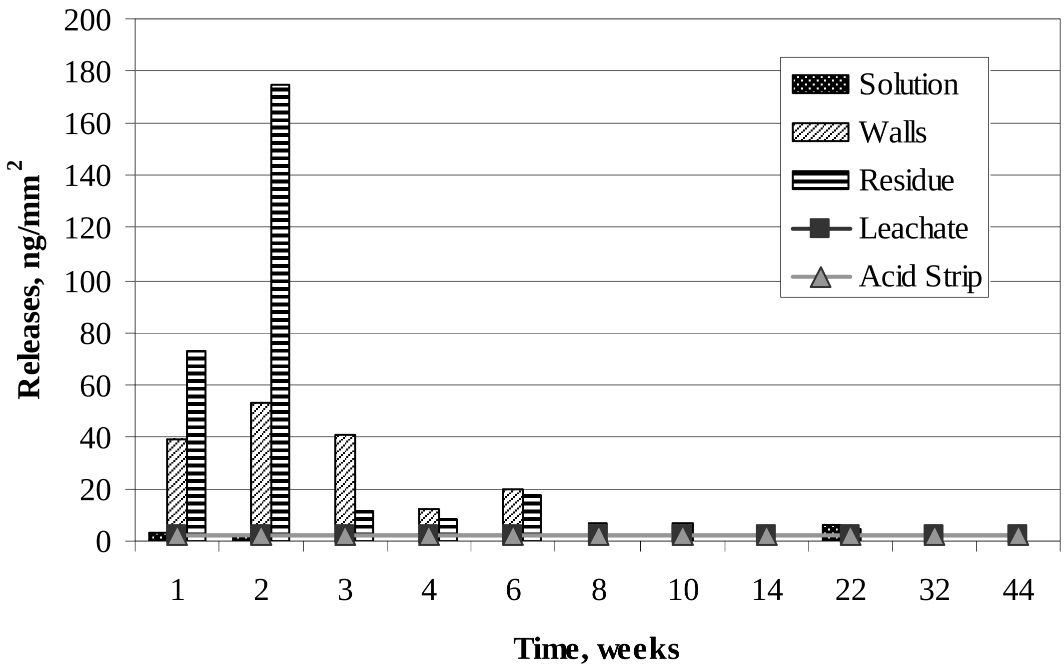


Figure E-38. Chromium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

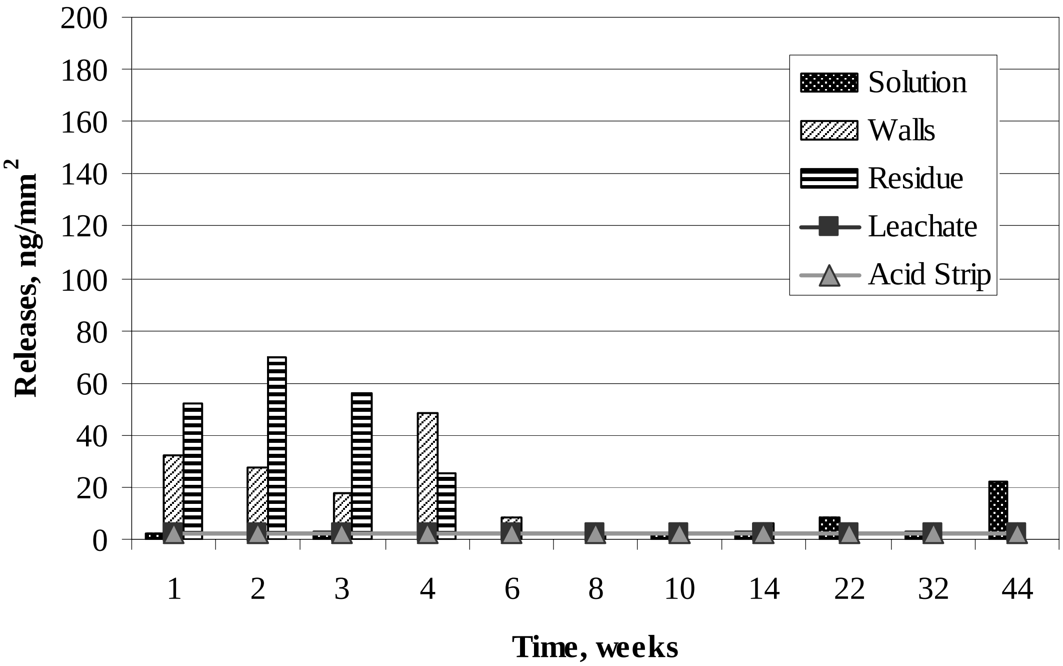


Figure E-39. Chromium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

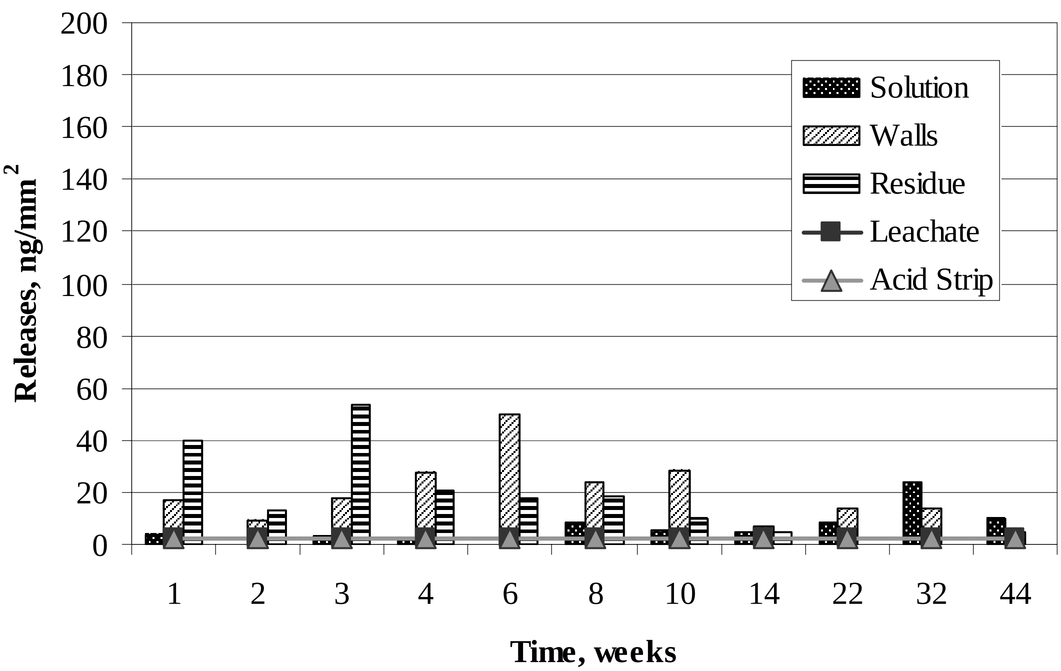


Figure E-40. Chromium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

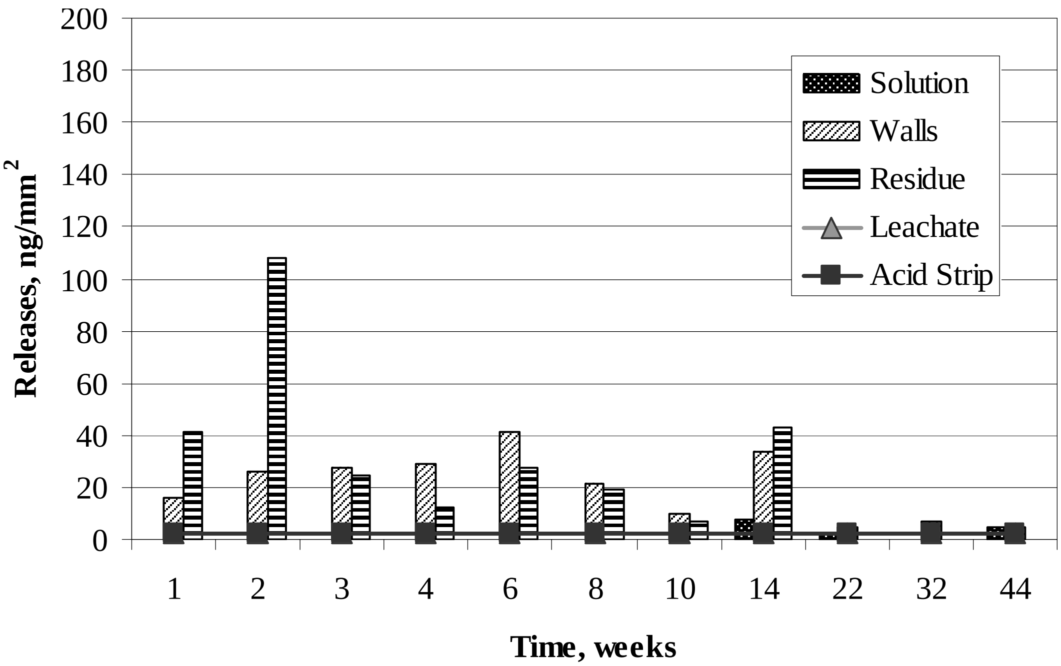


Figure E-41. Chromium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

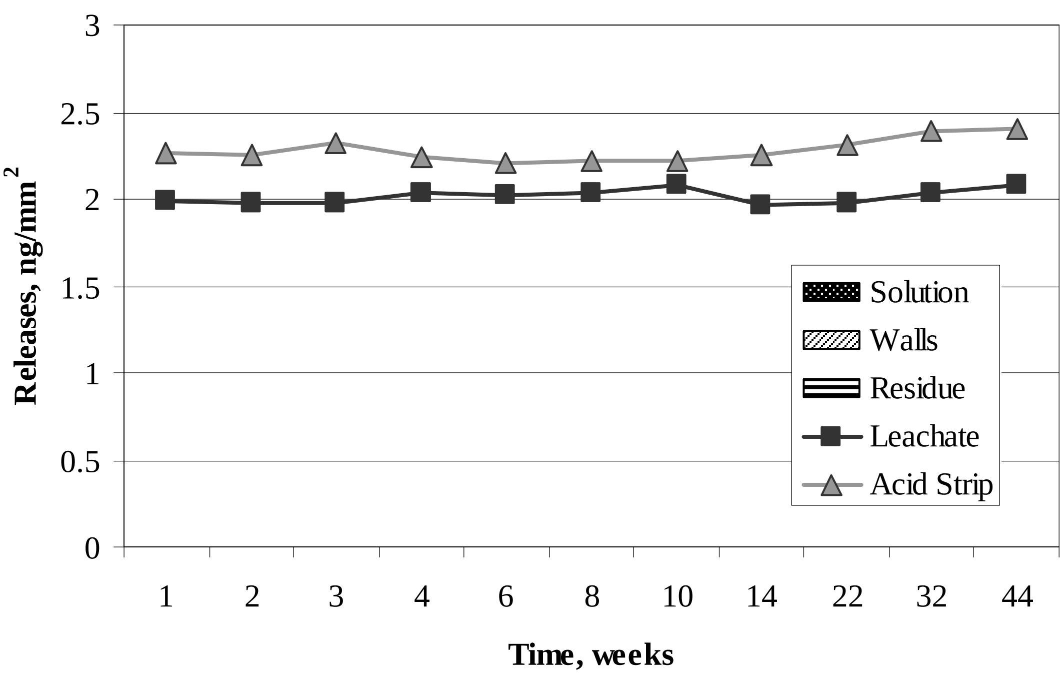


Figure E-42. Chromium Present in Solution, on Walls, and in Residue from 10KCl Control and Average Detection Limits for Leachate and Acid Strip.

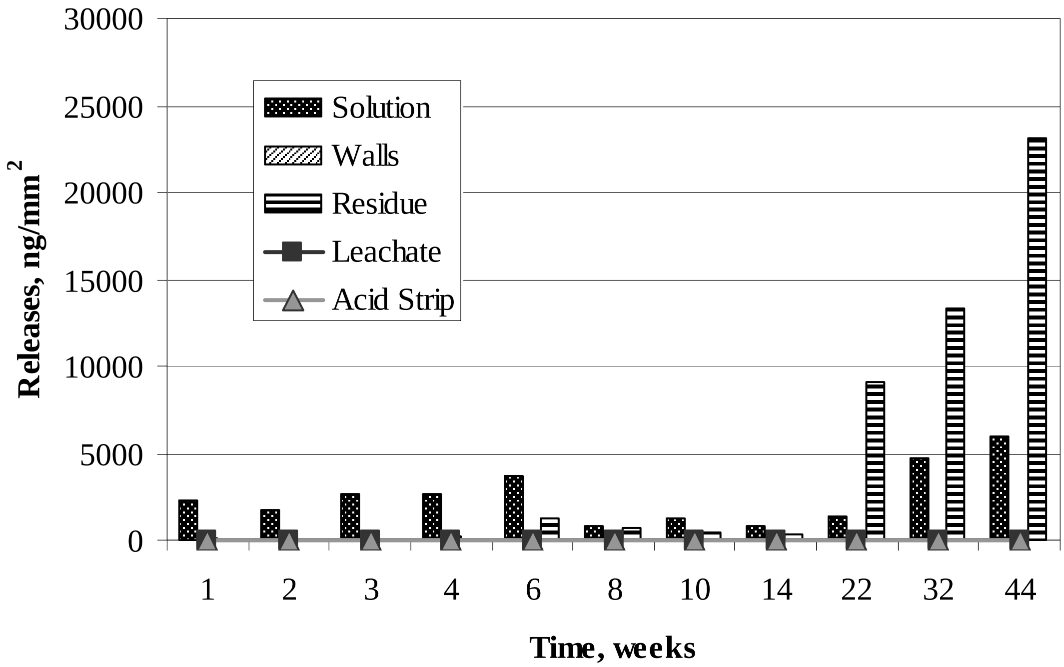


Figure E-43. Chromium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

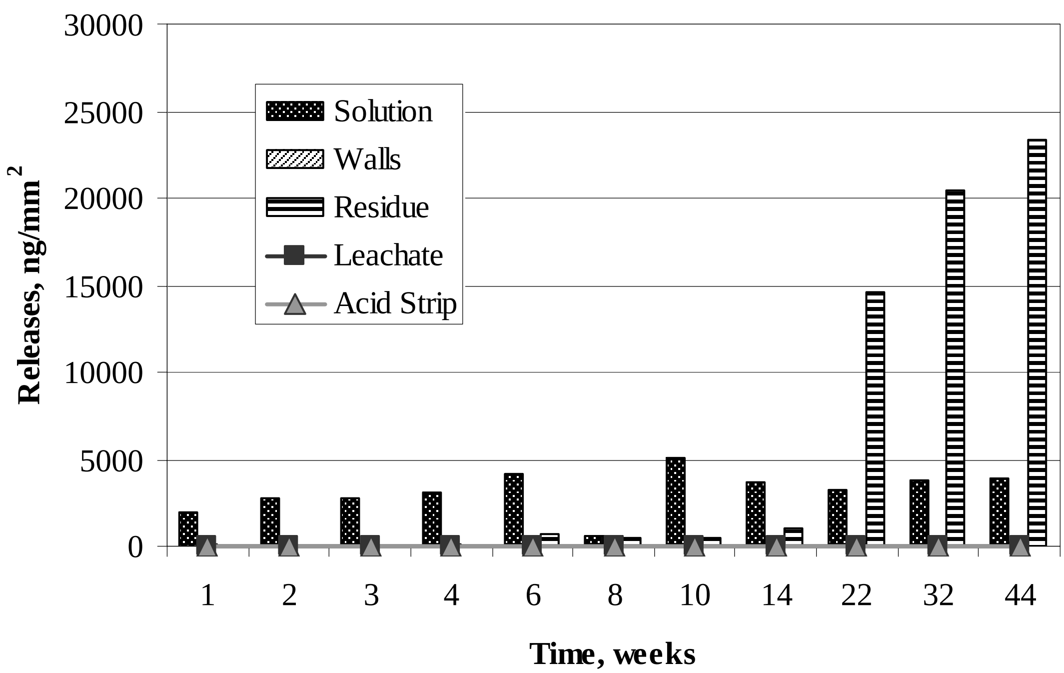


Figure E-44. Chromium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

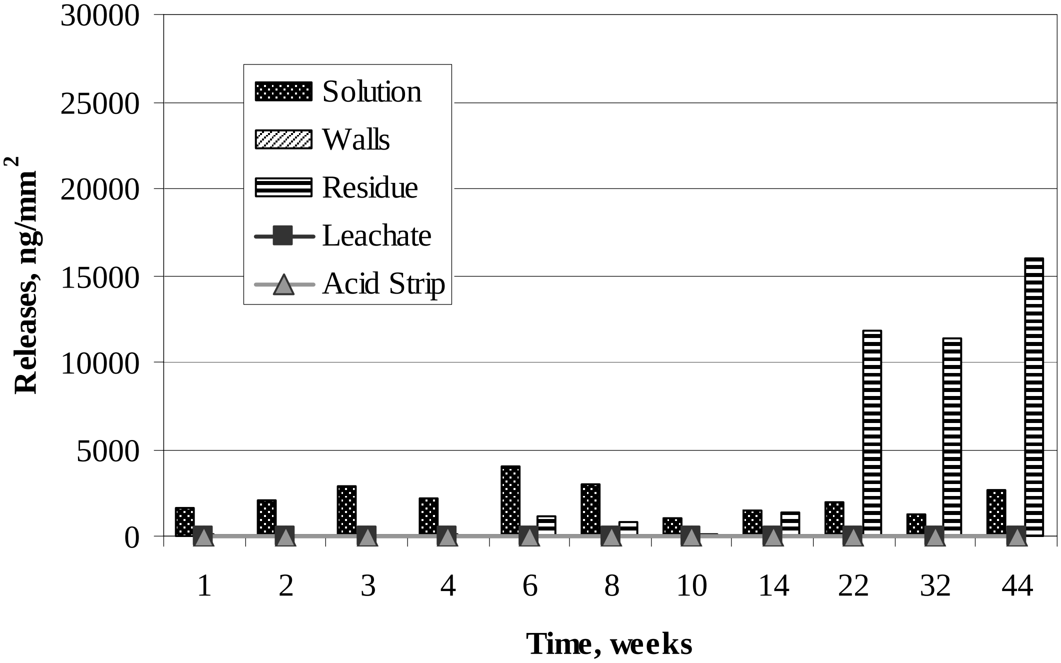


Figure E-45. Chromium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

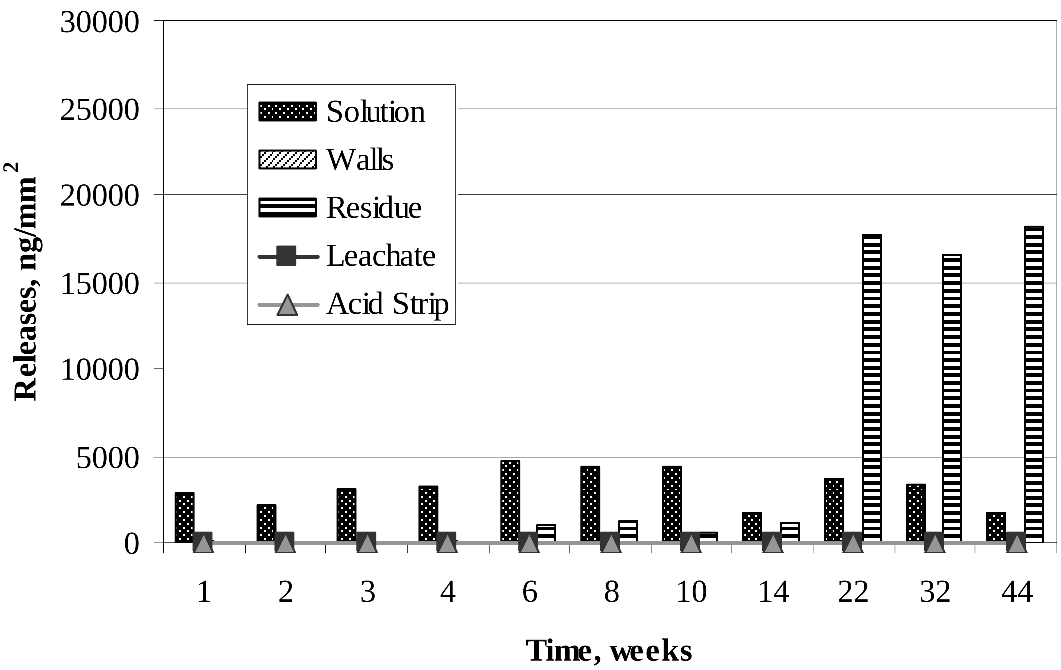


Figure E-46. Chromium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

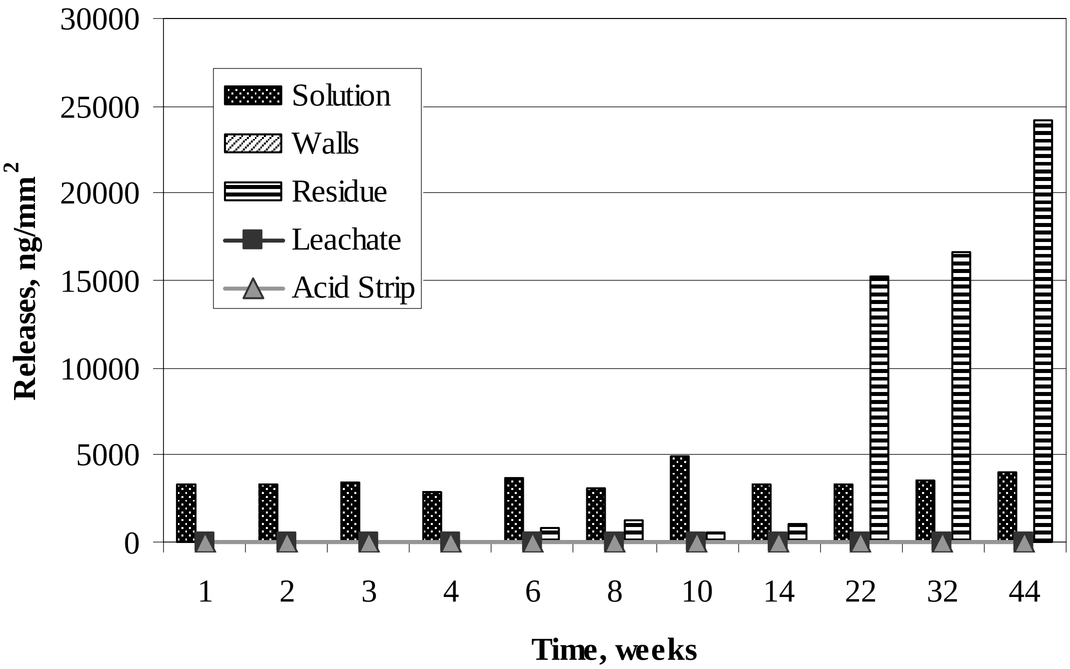


Figure E-47. Chromium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

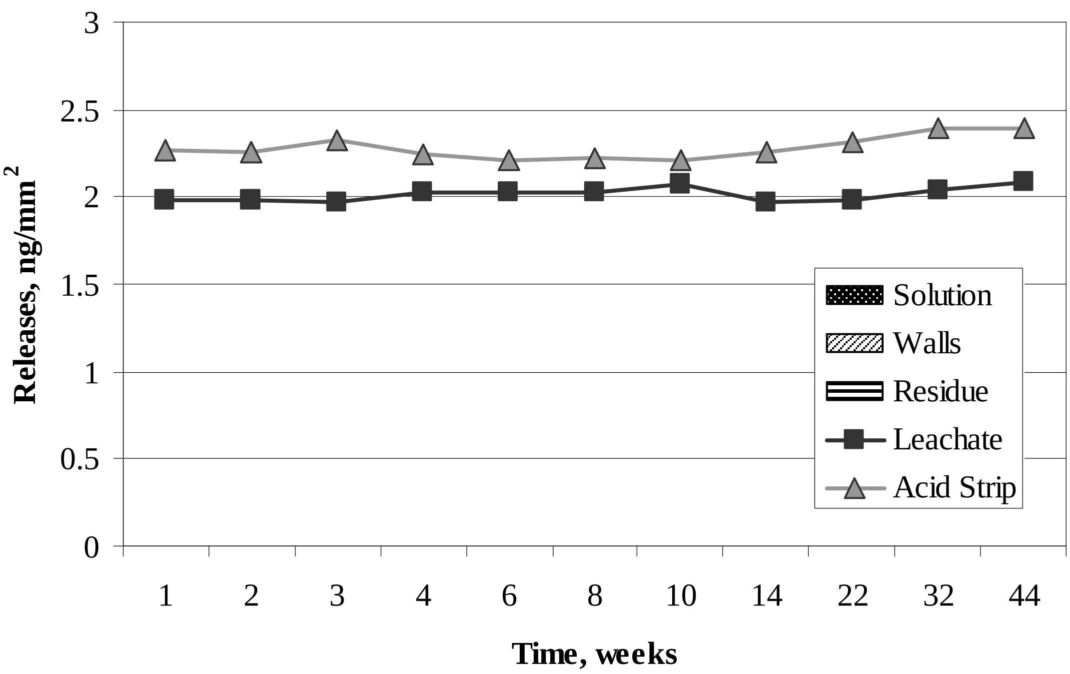


Figure E-48. Chromium Present in Solution, on Walls, and in Residue from AJ13 Control and Average Detection Limits for Leachate and Acid Strip.

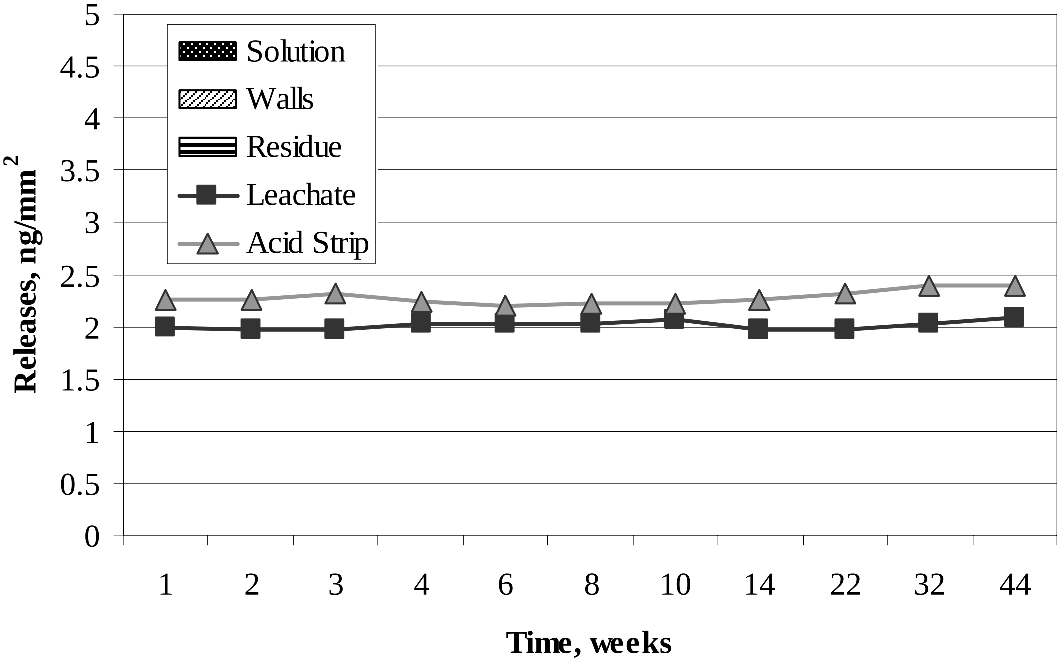


Figure E-49. Nickel Releases in Solution, on Walls, and in Residue from Polished Sample 1 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

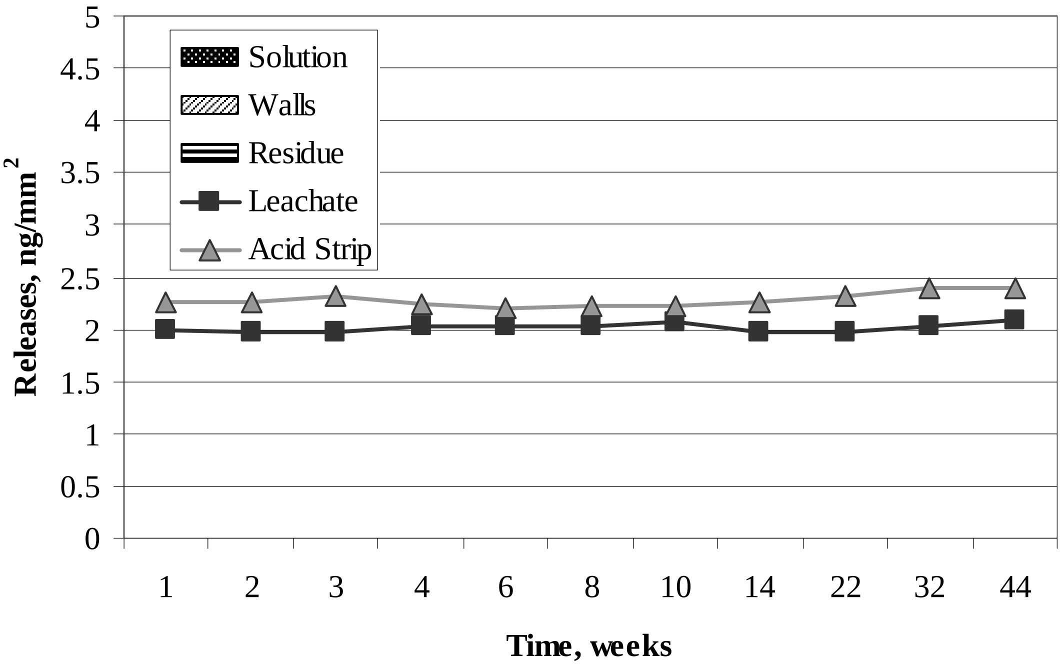


Figure E-50. Nickel Releases in Solution, on Walls, and in Residue from Polished Sample 2 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

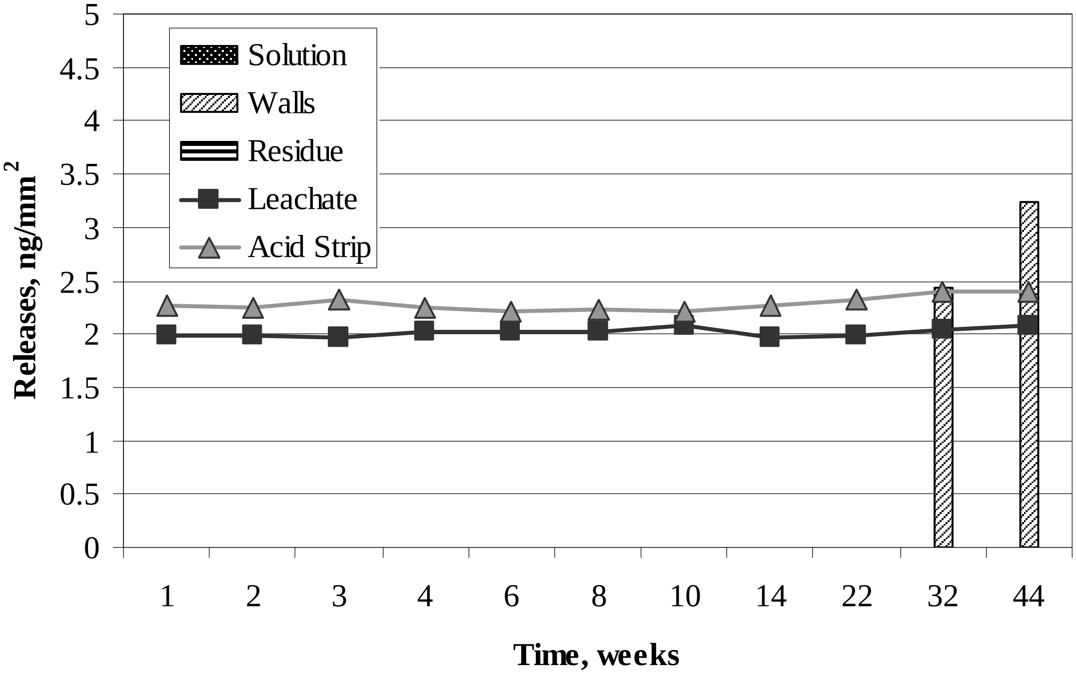


Figure E-51. Nickel Releases in Solution, on Walls, and in Residue from Polished Sample 3 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

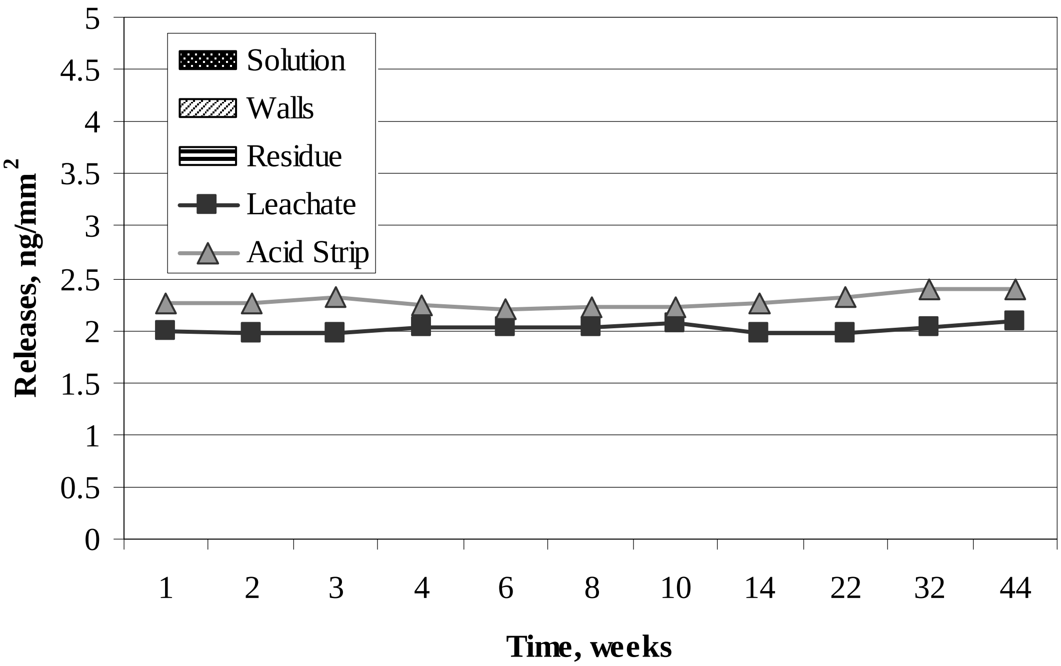


Figure E-52. Nickel Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

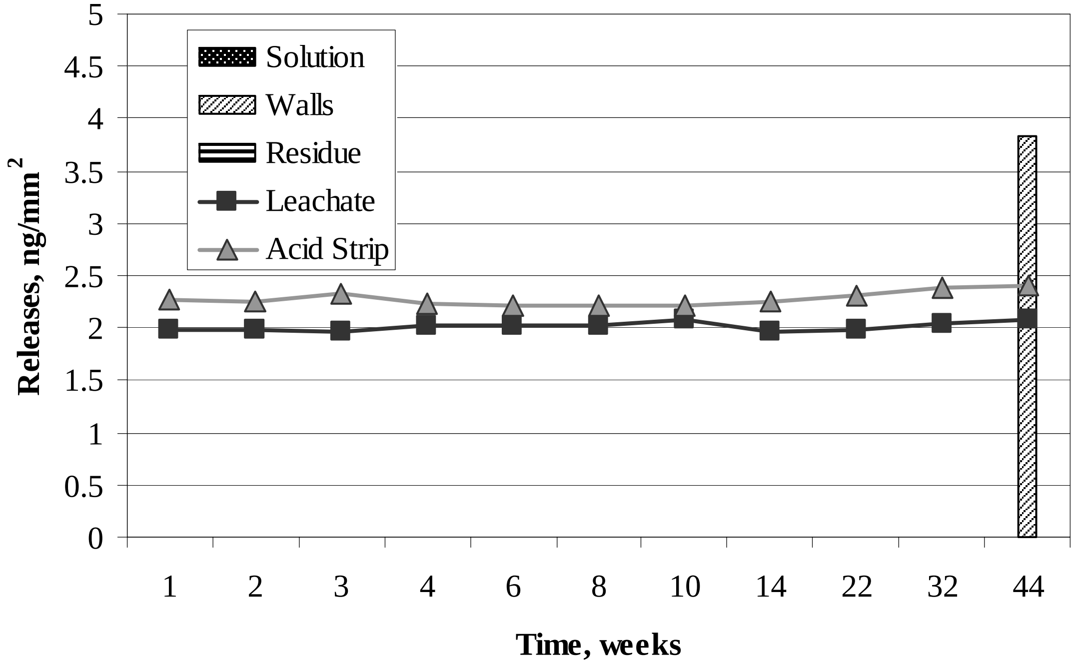


Figure E-53. Nickel Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

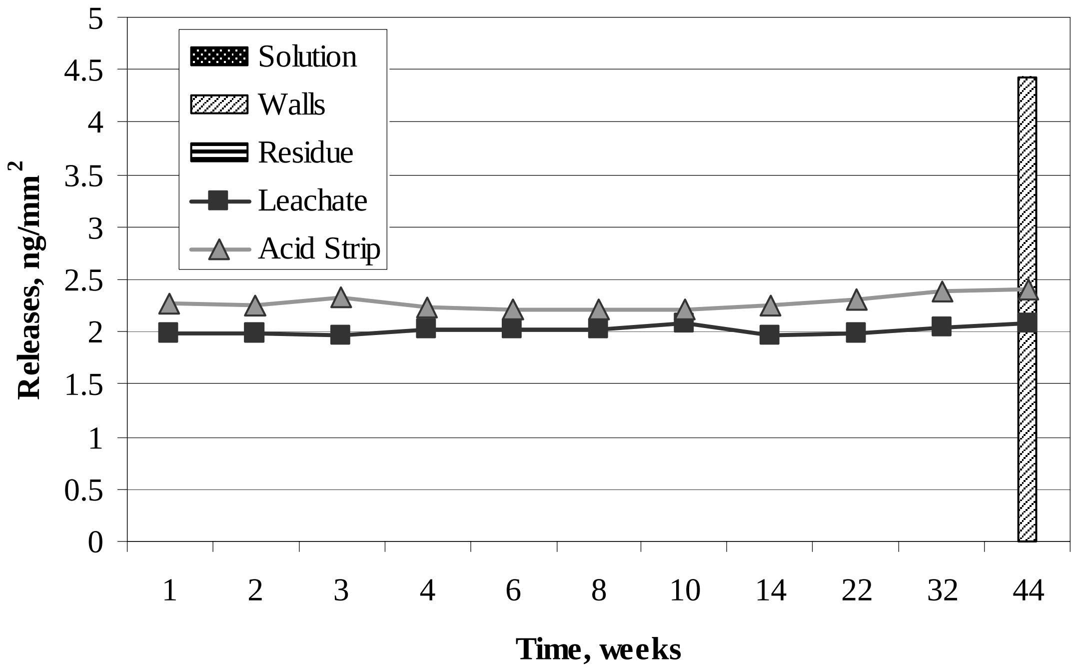


Figure E-54. Nickel Present in Solution, on Walls, and in Residue from SJ13 Control and Average Detection Limits for Leachate and Acid Strip.

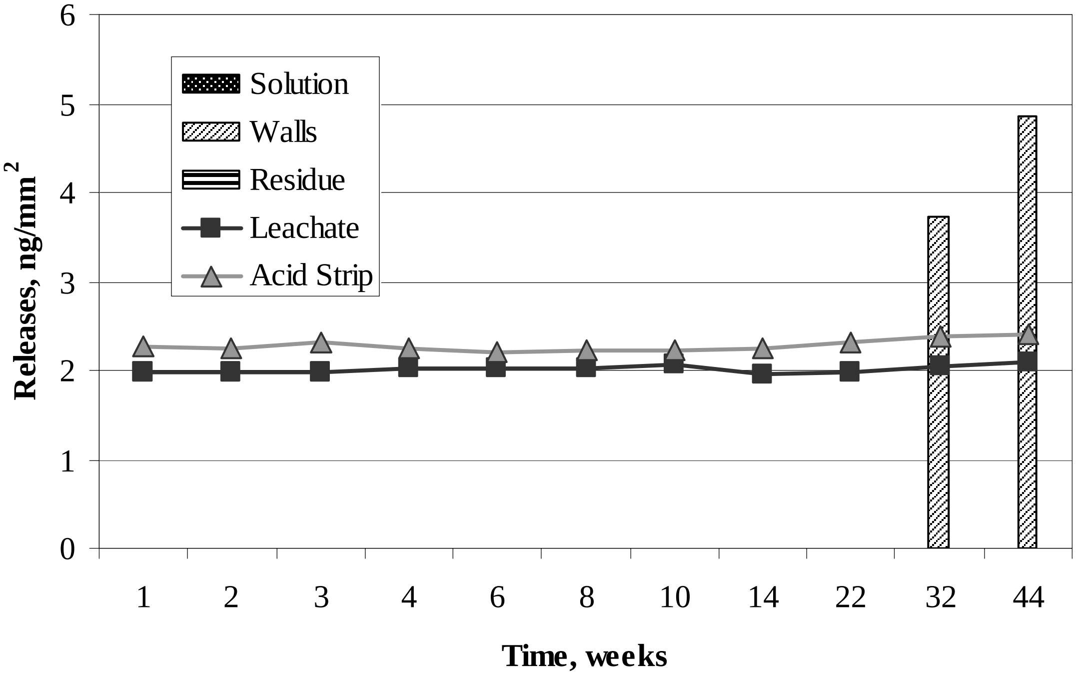


Figure E-55. Nickel Releases in Solution, on Walls, and in Residue from Polished Sample 1 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

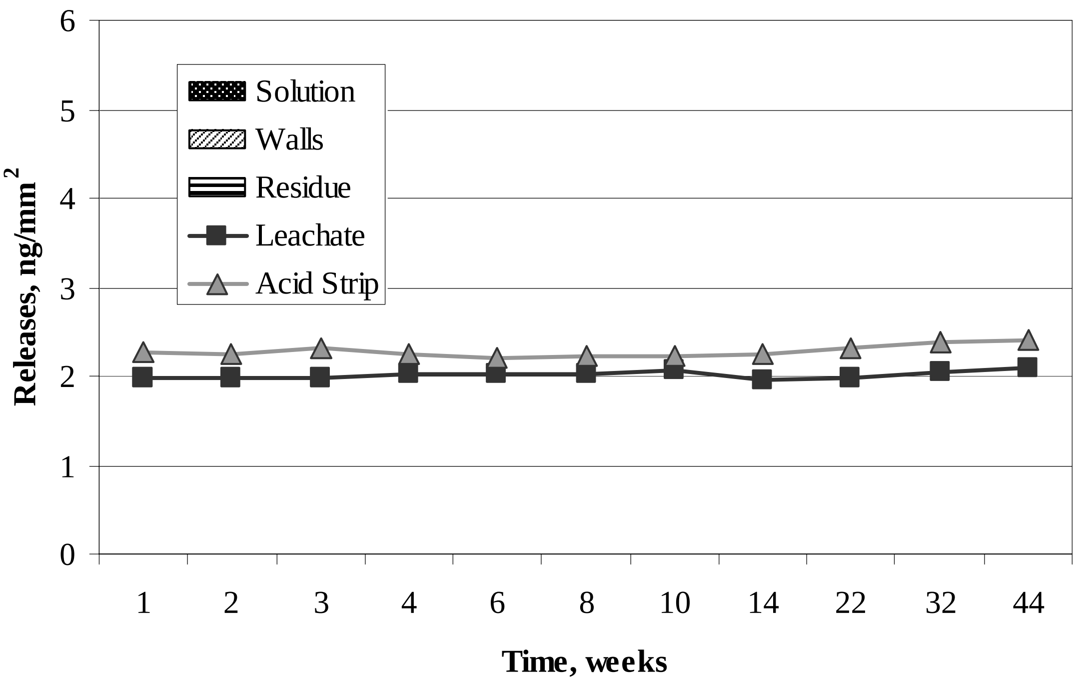


Figure E-56. Nickel Releases in Solution, on Walls, and in Residue from Polished Sample 2 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

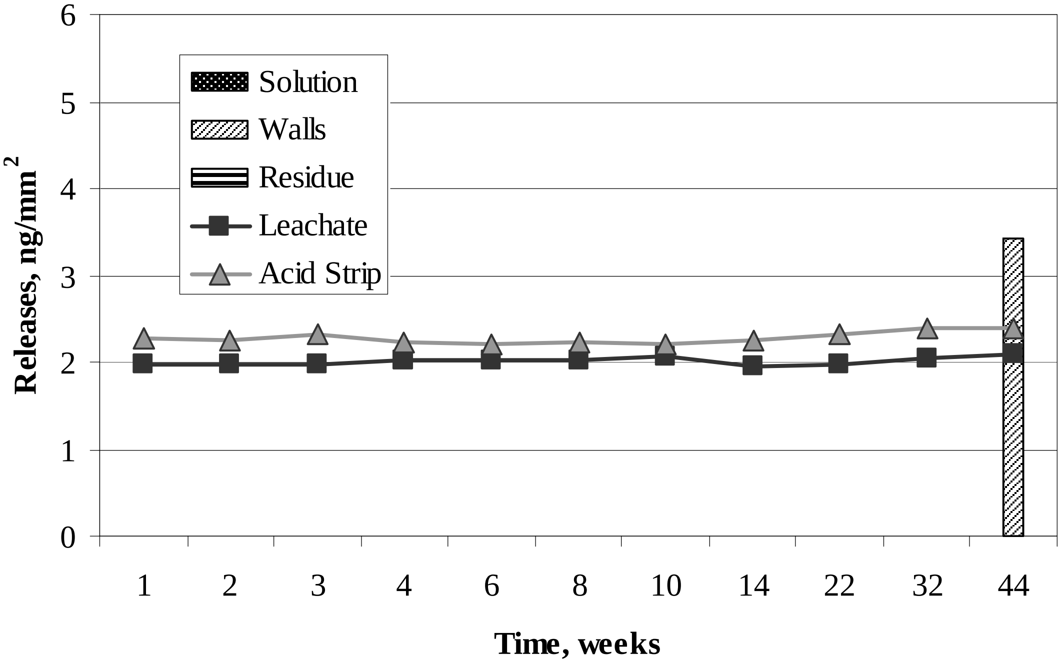


Figure E-57. Nickel Releases in Solution, on Walls, and in Residue from Polished Sample 3 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

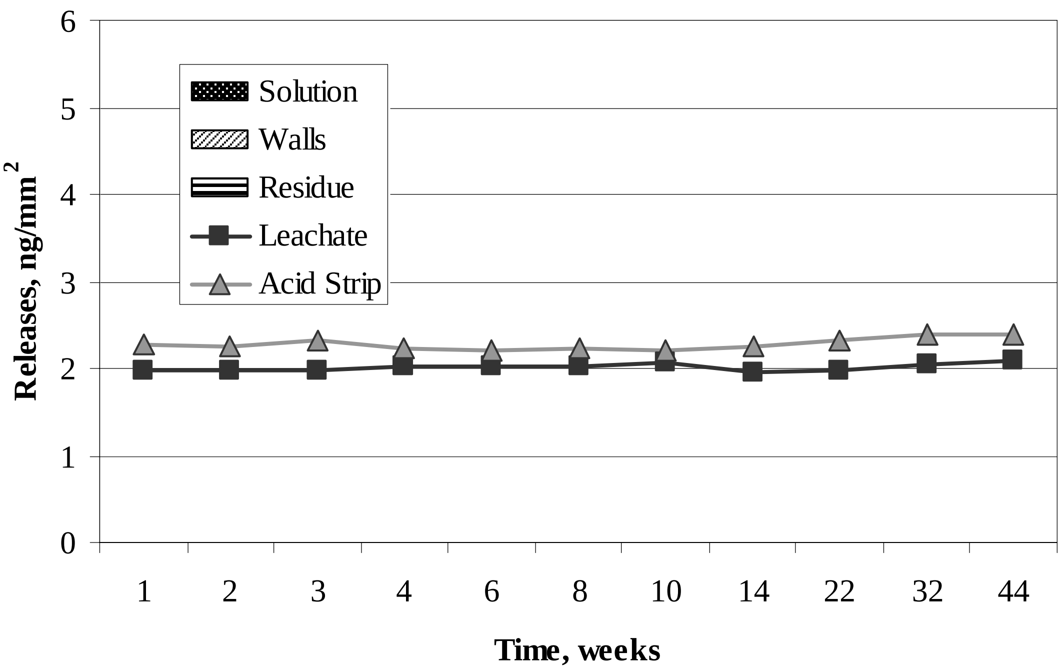


Figure E-58. Nickel Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

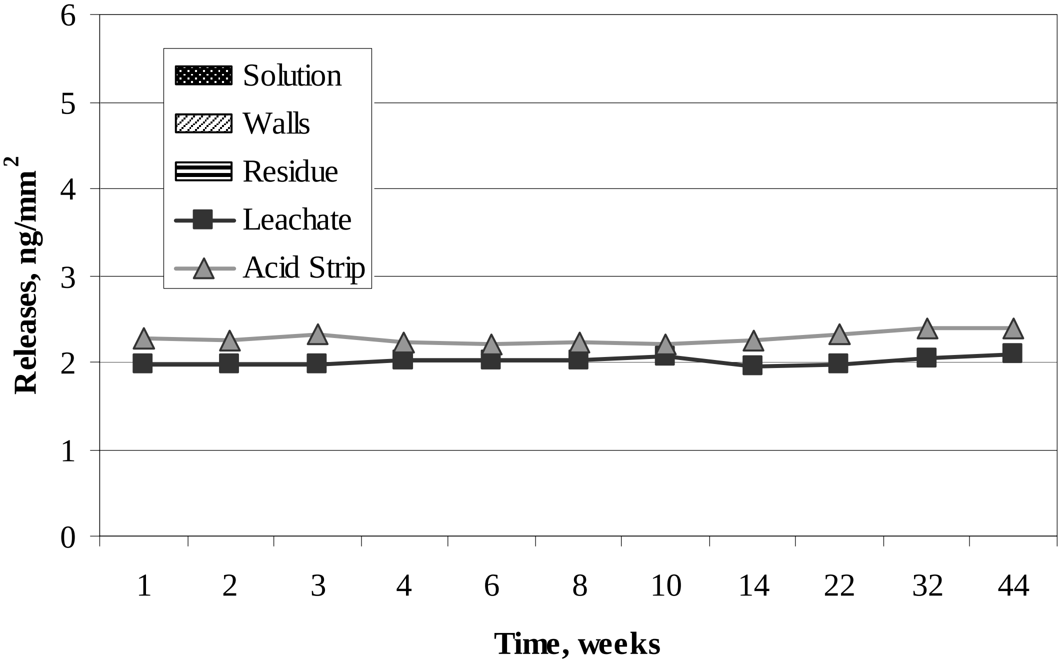


Figure E-59. Nickel Releases in Solution, on Walls, and in Acid Strip from Oxidized Sample 5 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

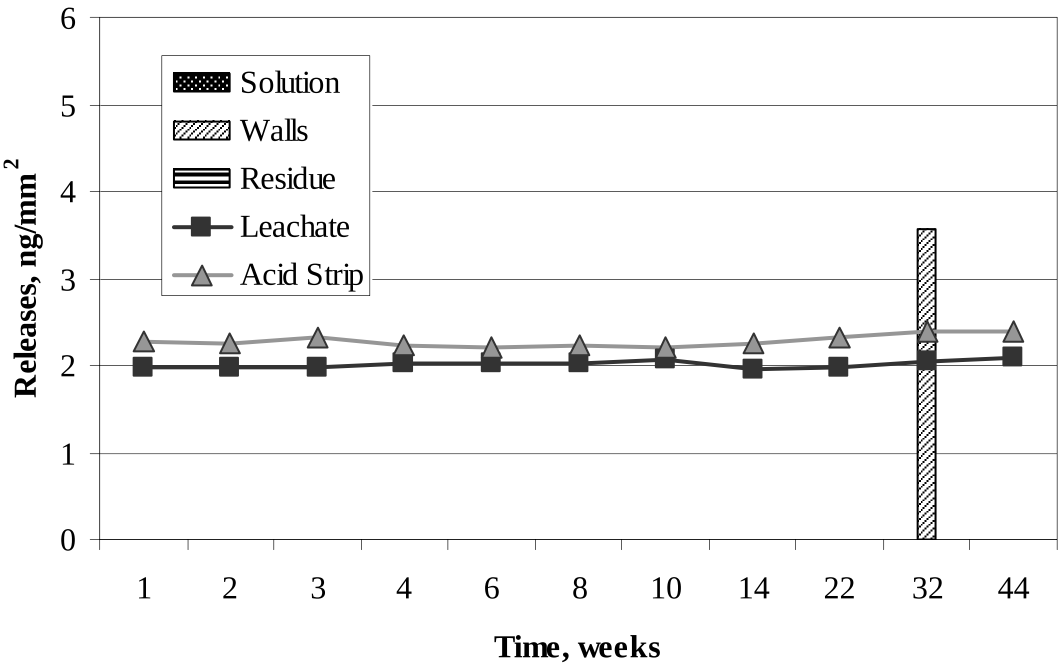


Figure E-60. Nickel Present in Solution, on Walls, and in Acid Strip from CJ13 Control and Average Detection Limits for Leachate and Acid Strip.

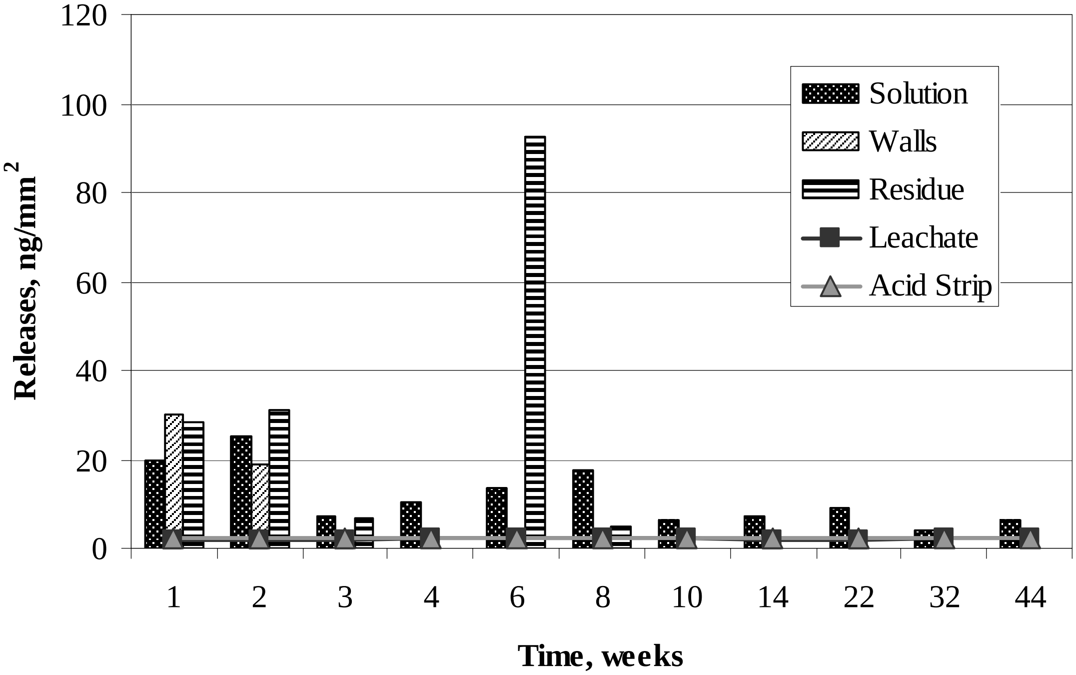


Figure E-61. Nickel Releases in Solution, on Walls, and in Residue from Polished Sample 1 in 10KCl an Average Detection Limits for Leachate and Acid Strip.

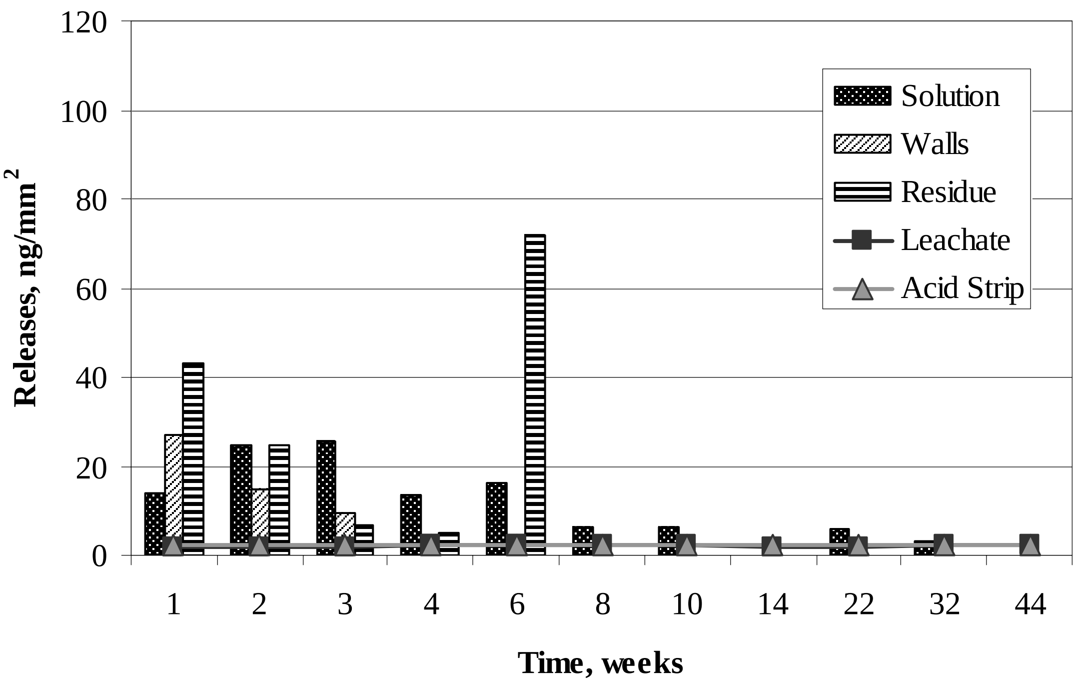


Figure E-62. Nickel Releases in Solution, on Walls, and in Residue from Polished Sample 2 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

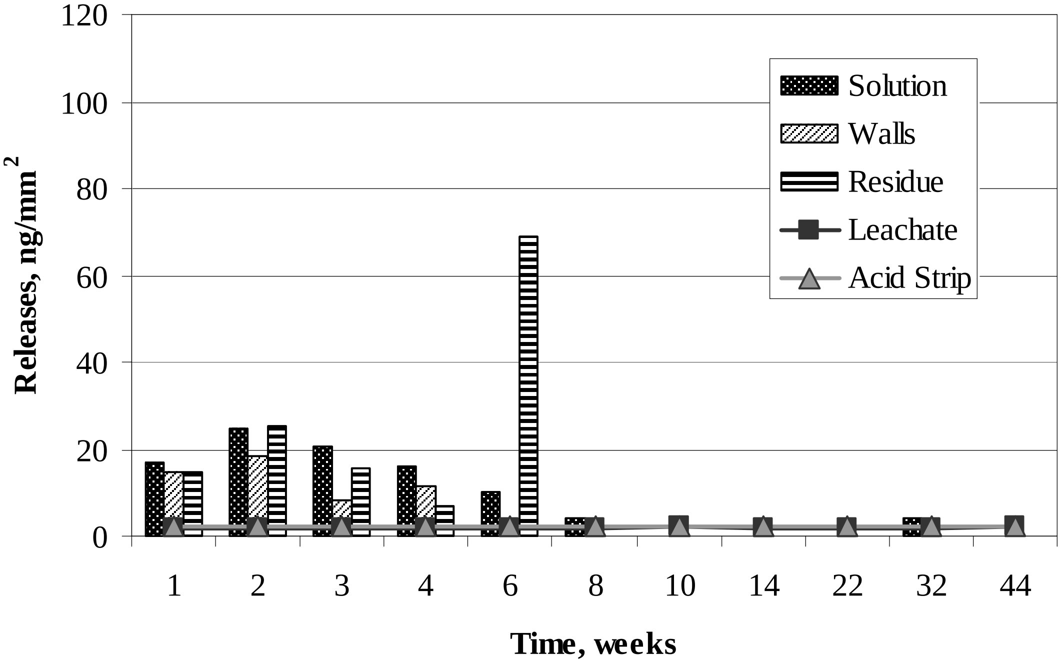


Figure E-63. Nickel Releases in Solution, on Walls, and in Residue from Polished Sample 3 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

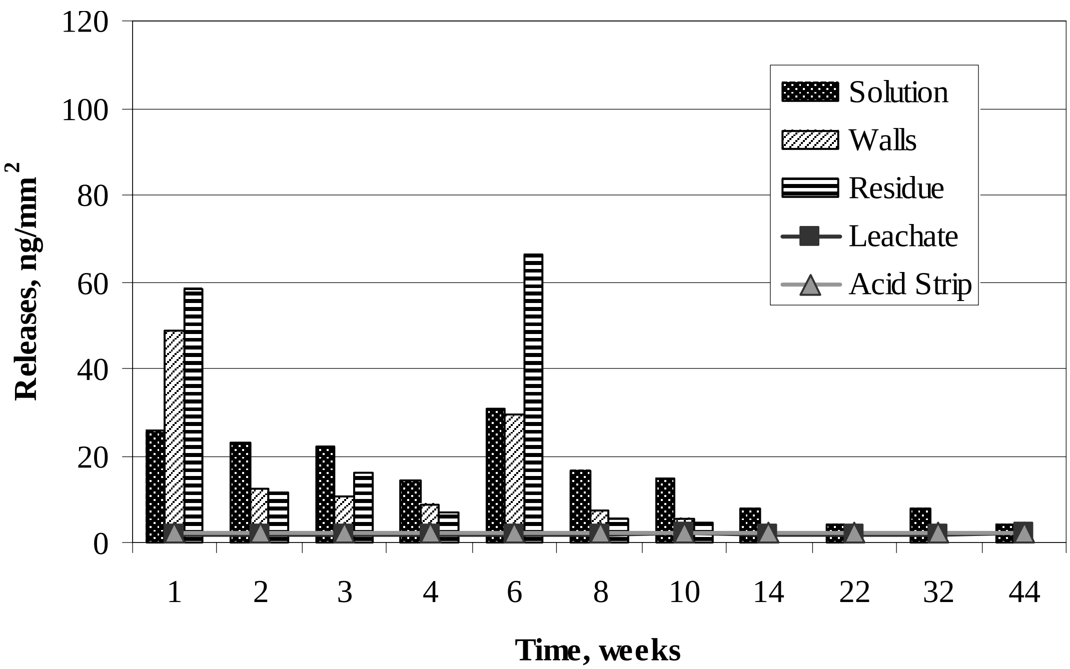


Figure E-64. Nickel Releases in Solution, on Walls, and in Residue from Oxidized Sample in 10KCl and Average Detection Limits for Leachate and Acid Strip.

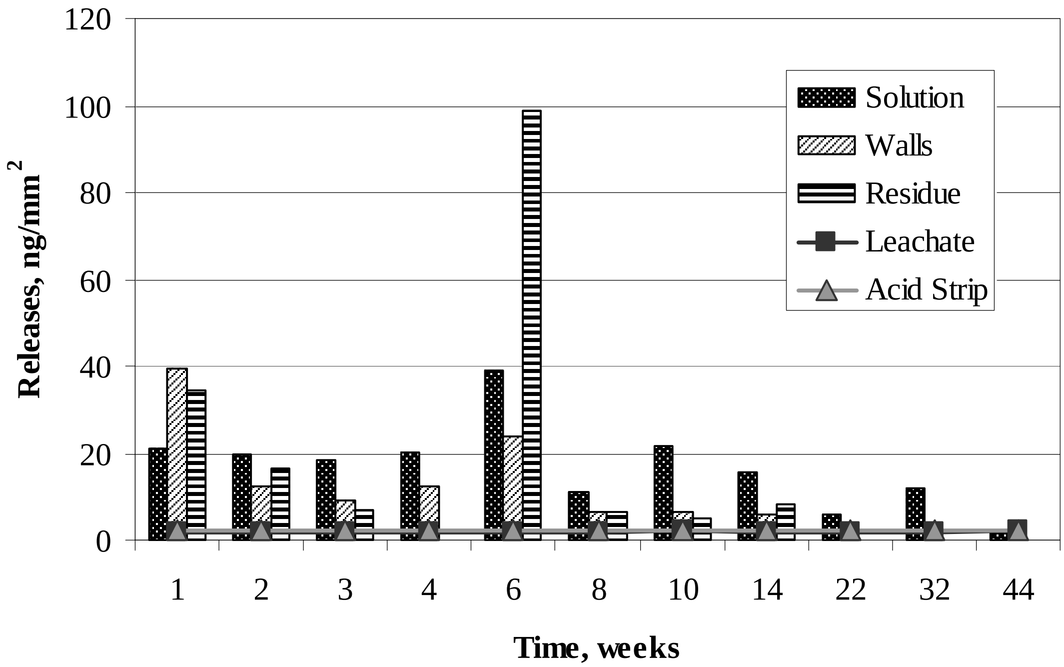


Figure E-65. Nickel Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

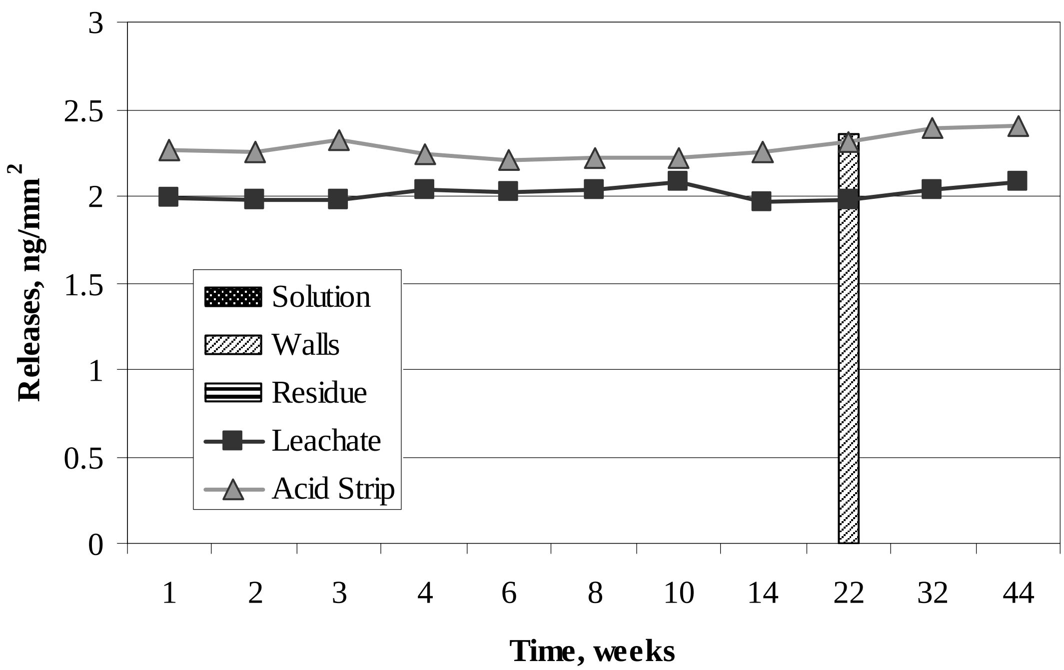


Figure E-66. Nickel Present in Solution, on Walls, and in Residue from 10KCl Control and Average Detection Limits for Leachate and Acid Strip.

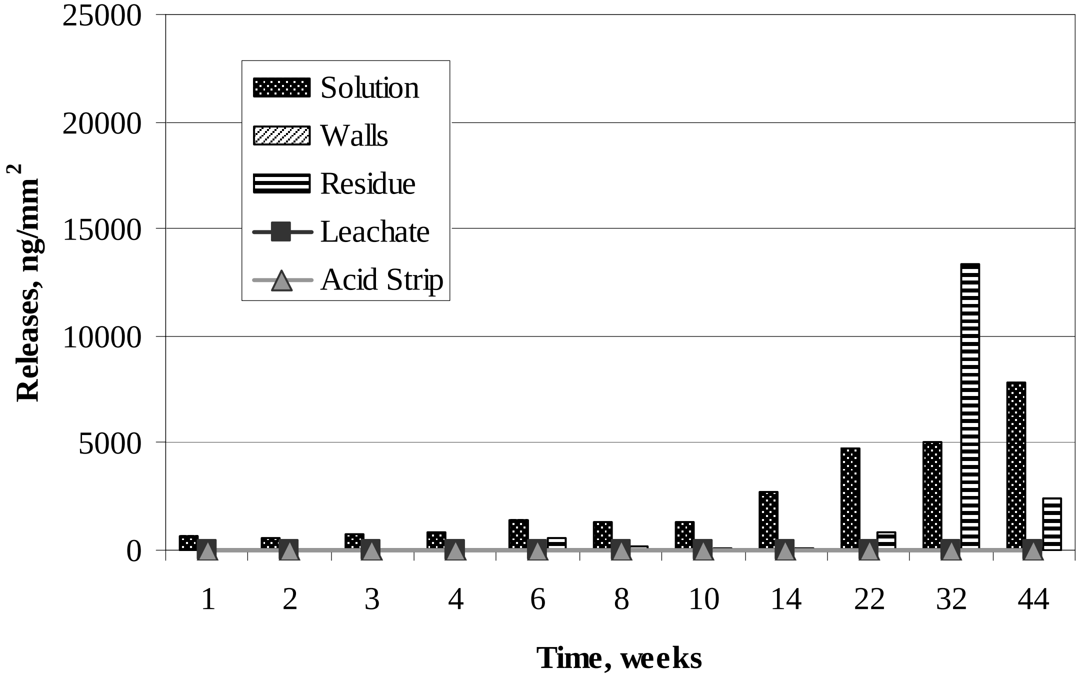


Figure E-67. Nickel Releases in Solution, on Walls, and in Residue from Polished Sample 1 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

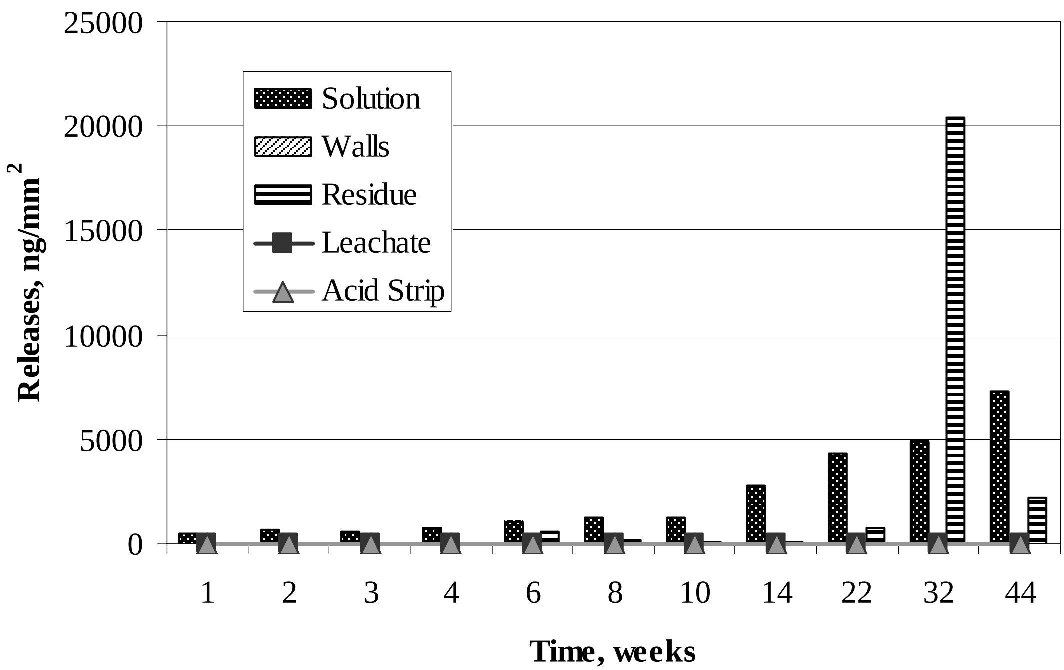


Figure E-68. Nickel Releases in Solution, on Walls, and in Residue from Polished Sample 2 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

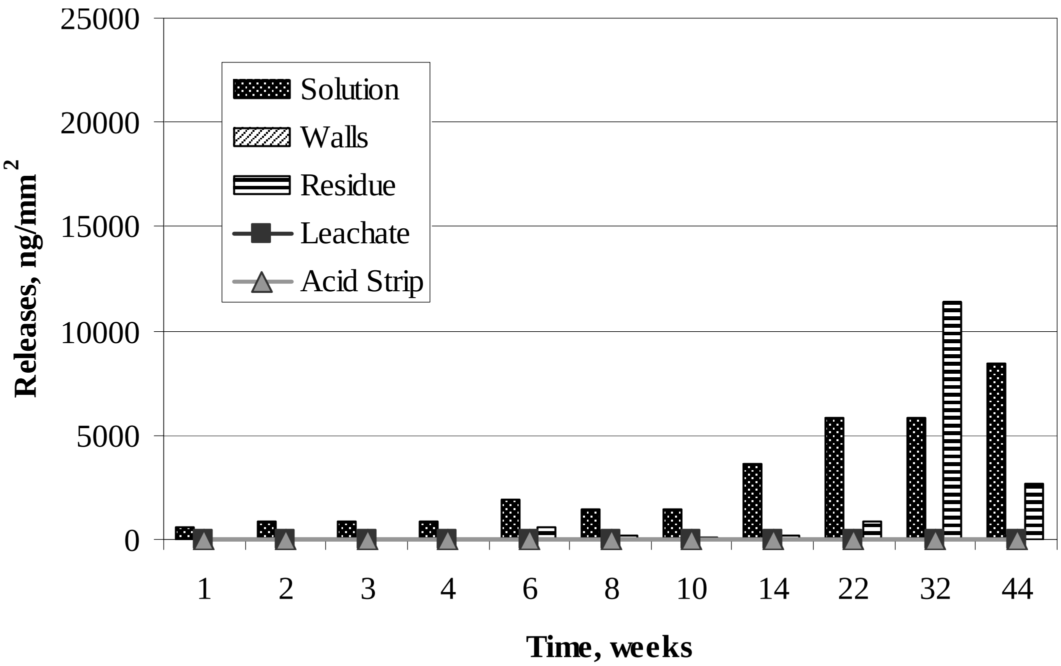


Figure E-69. Nickel Releases in Solution, on Walls, and in Residue from Polished Sample 3 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

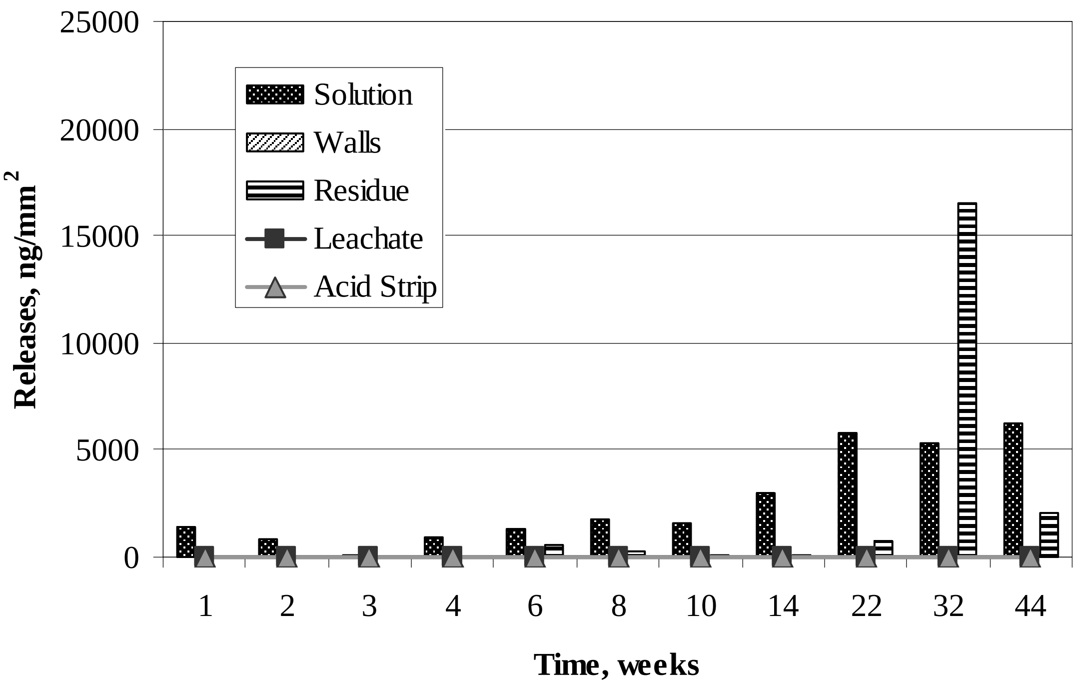


Figure E-70. Nickel Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

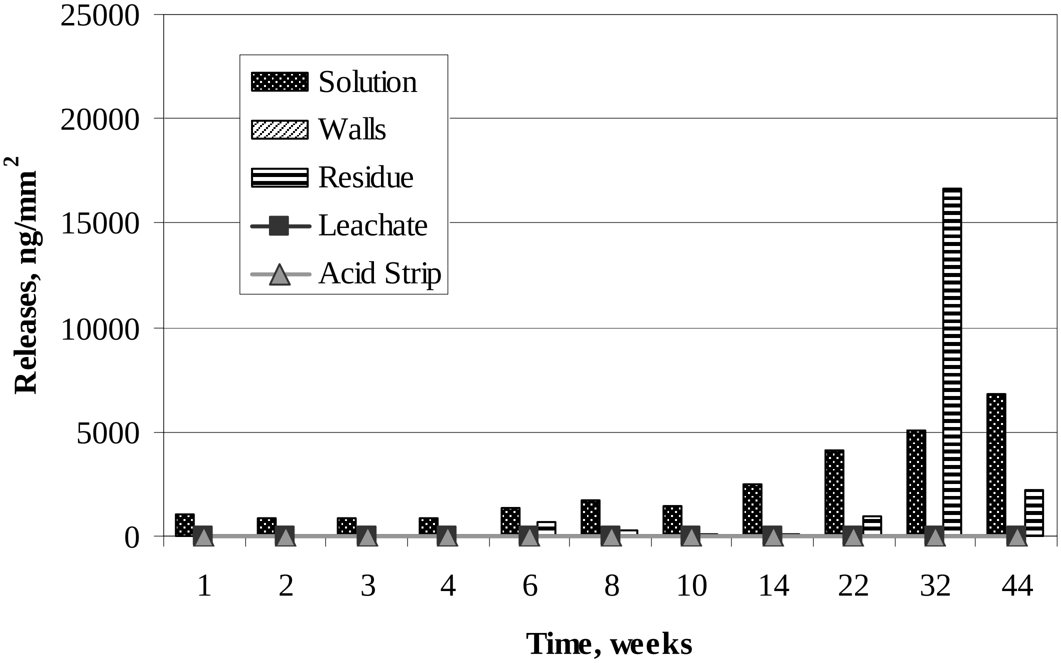


Figure E-71. Nickel Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

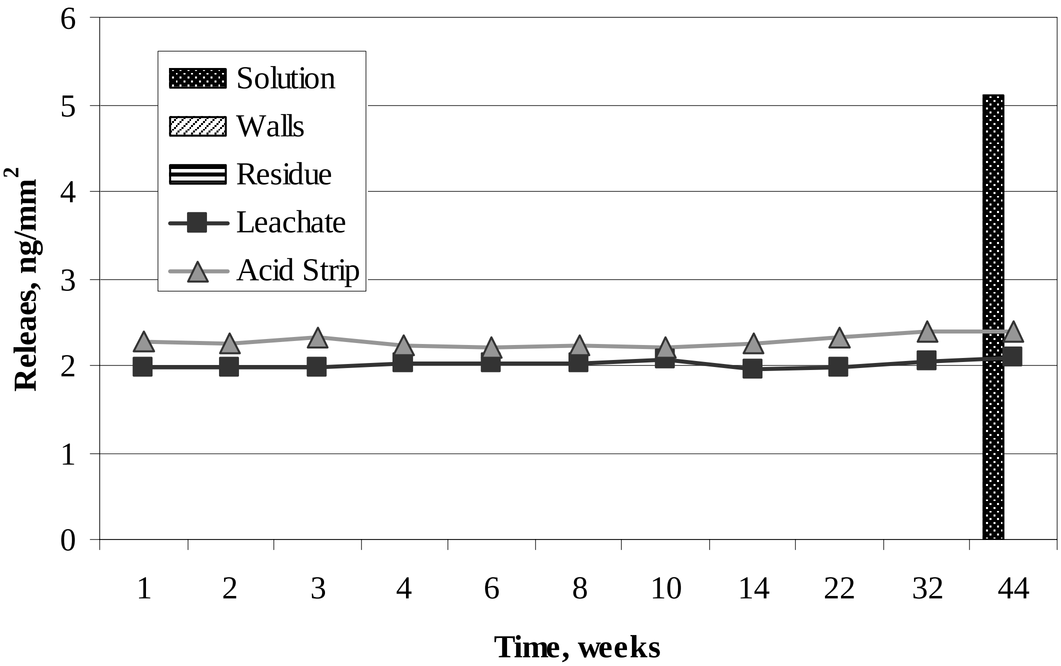


Figure E-72. Nickel Present in Solution, on Walls, and in Residue from AJ13 Control and Average Detection Limits for Leachate and Acid Strip.

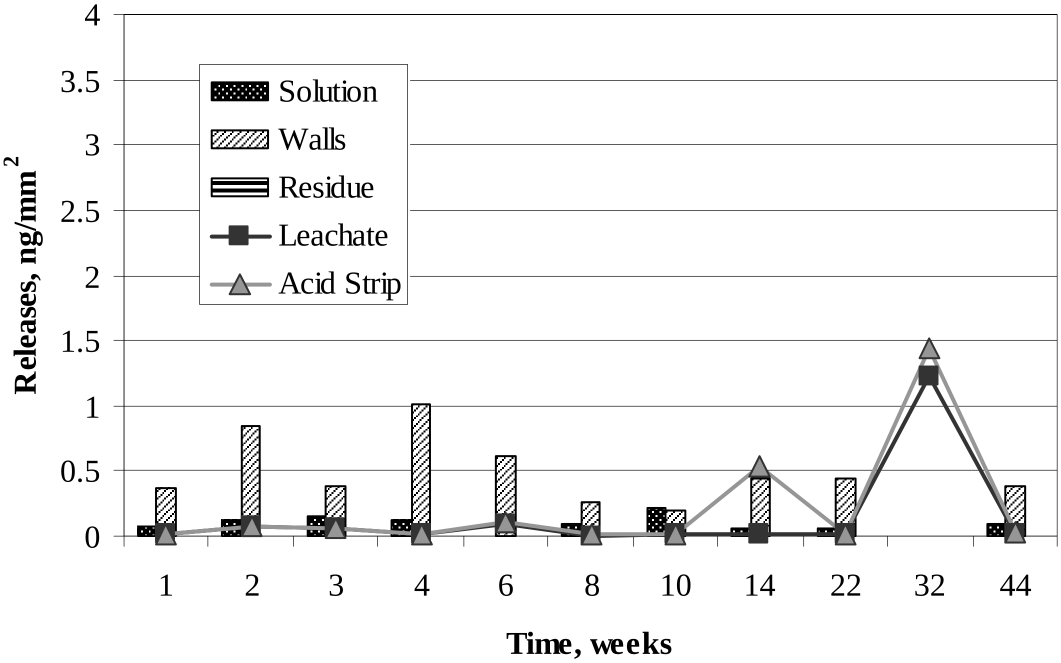


Figure E-73. Zirconium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

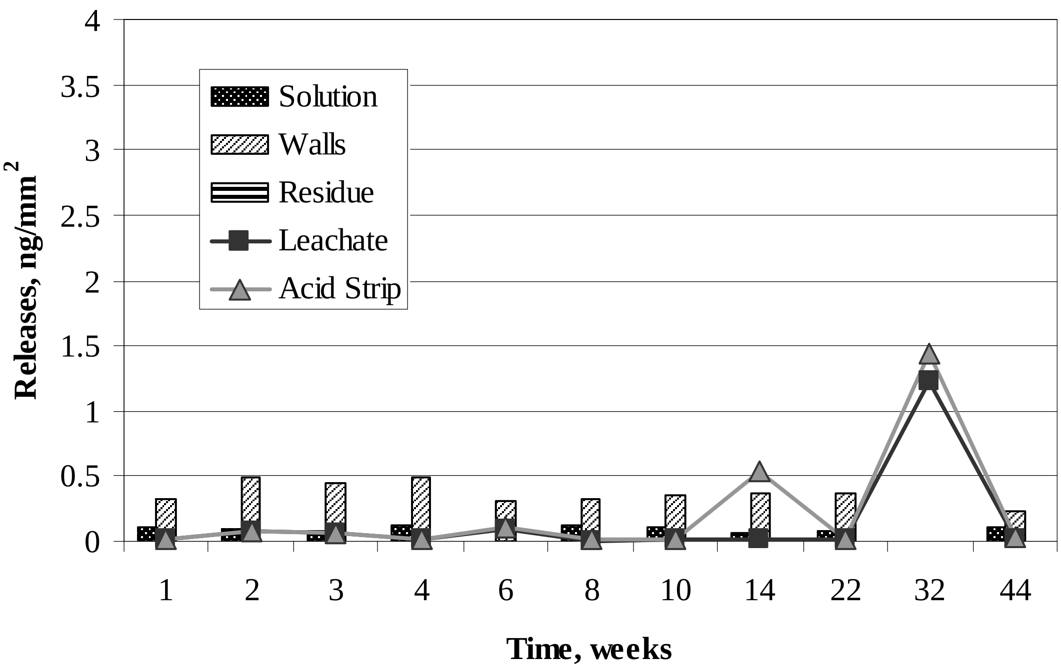


Figure E-74. Zirconium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

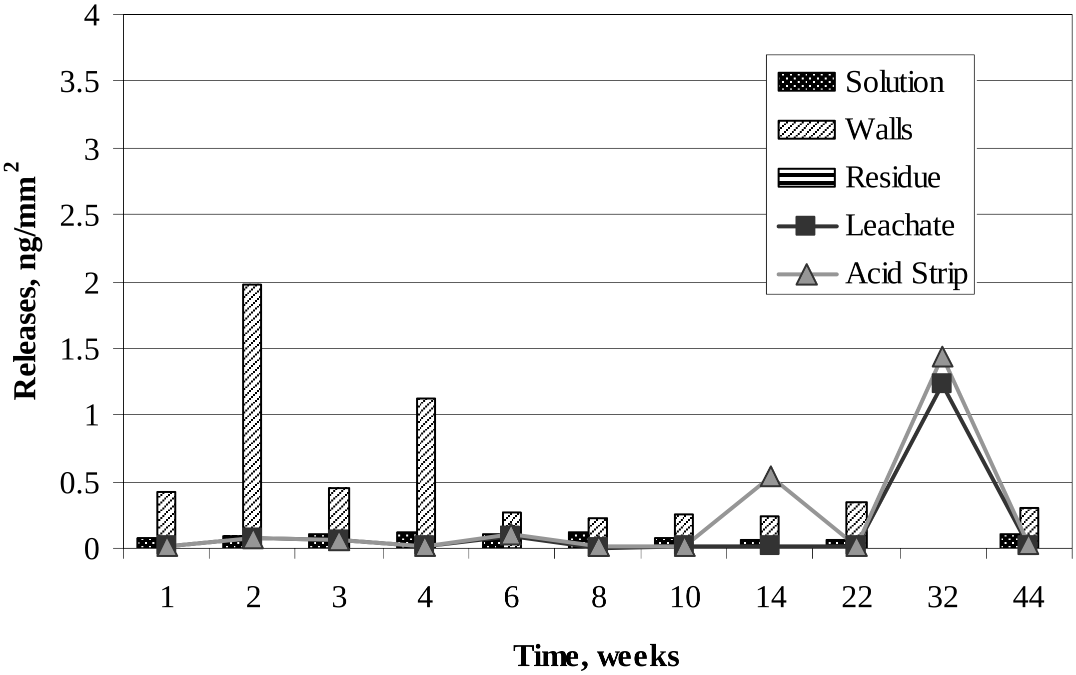


Figure E-75. Zirconium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

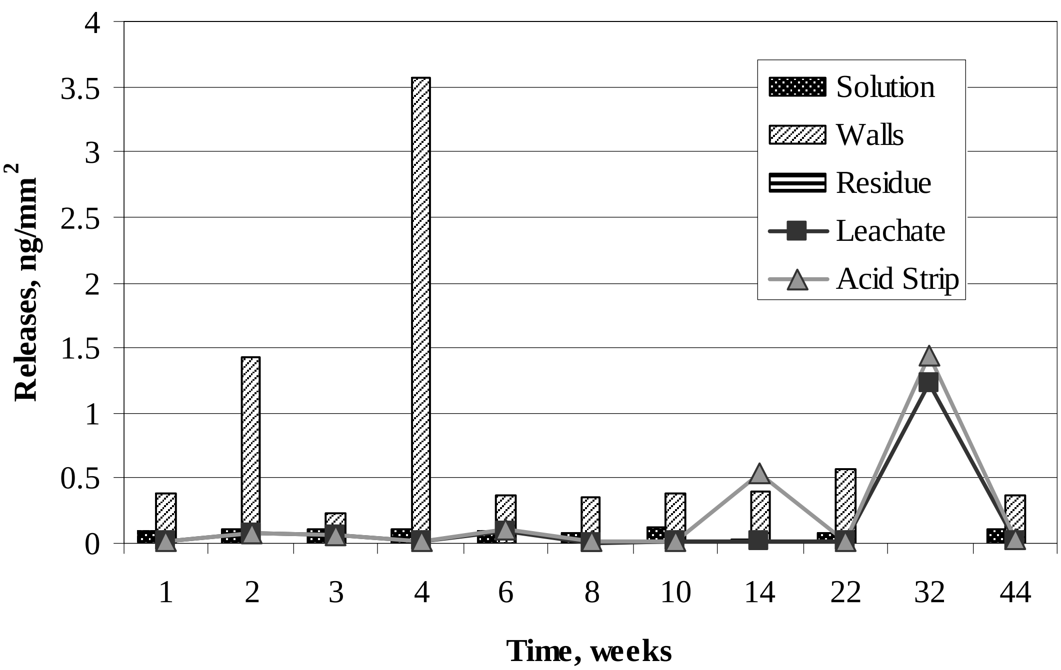


Figure E-76. Zirconium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

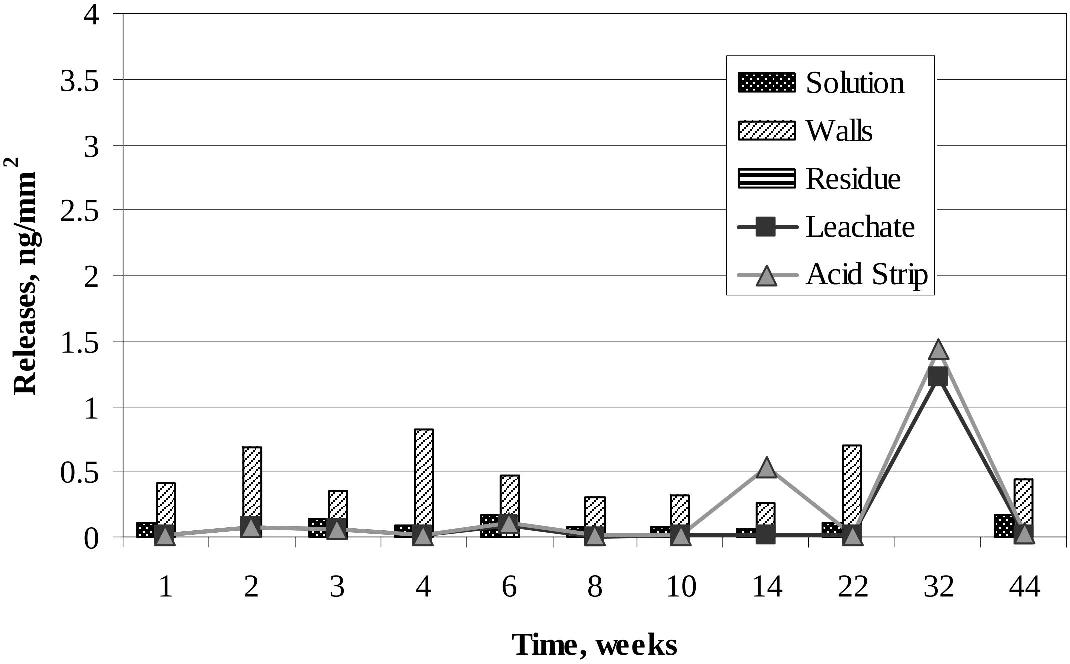


Figure E-77. Zirconium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

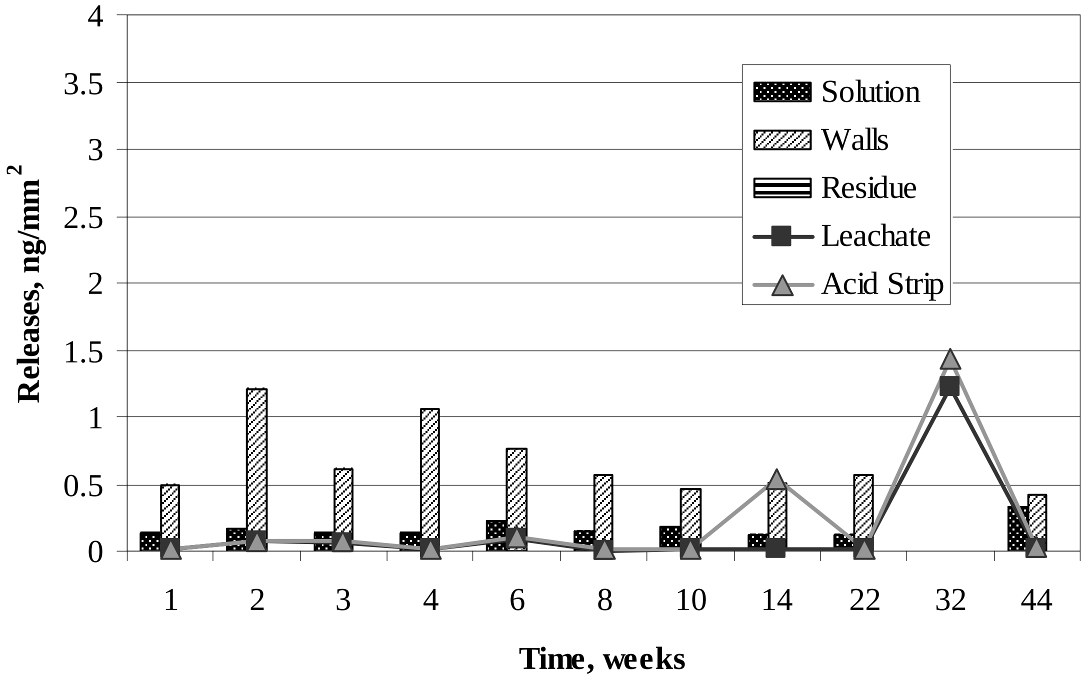


Figure E-78. Zirconium Present in Solution, on Walls, and in Residue from SJ13 Control and Average Detection Limits for Leachate and Acid Strip.

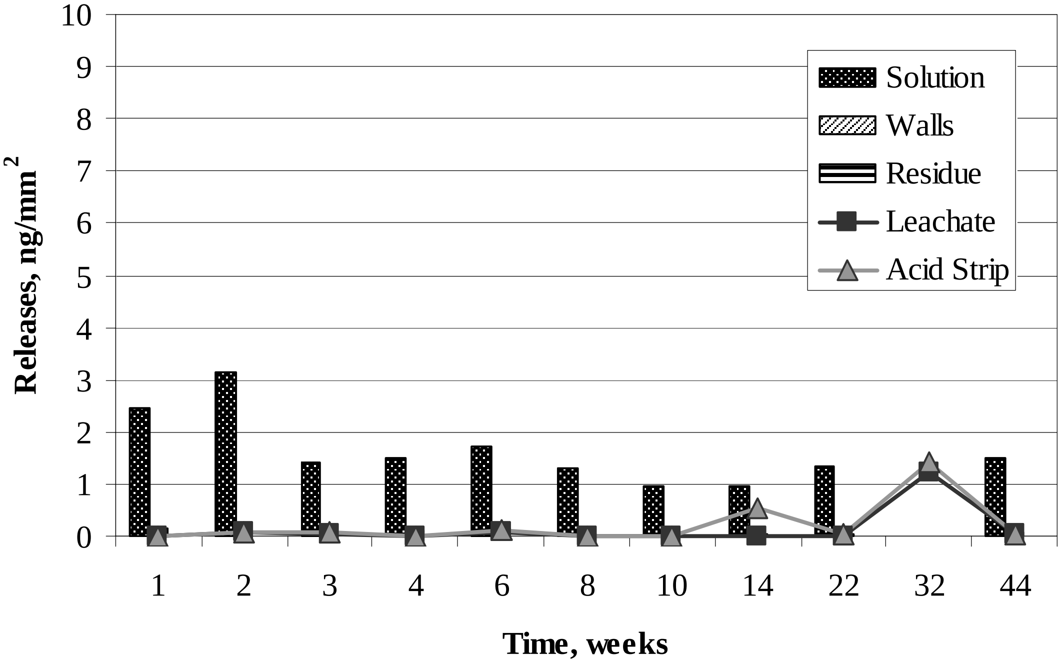


Figure E-79. Zirconium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

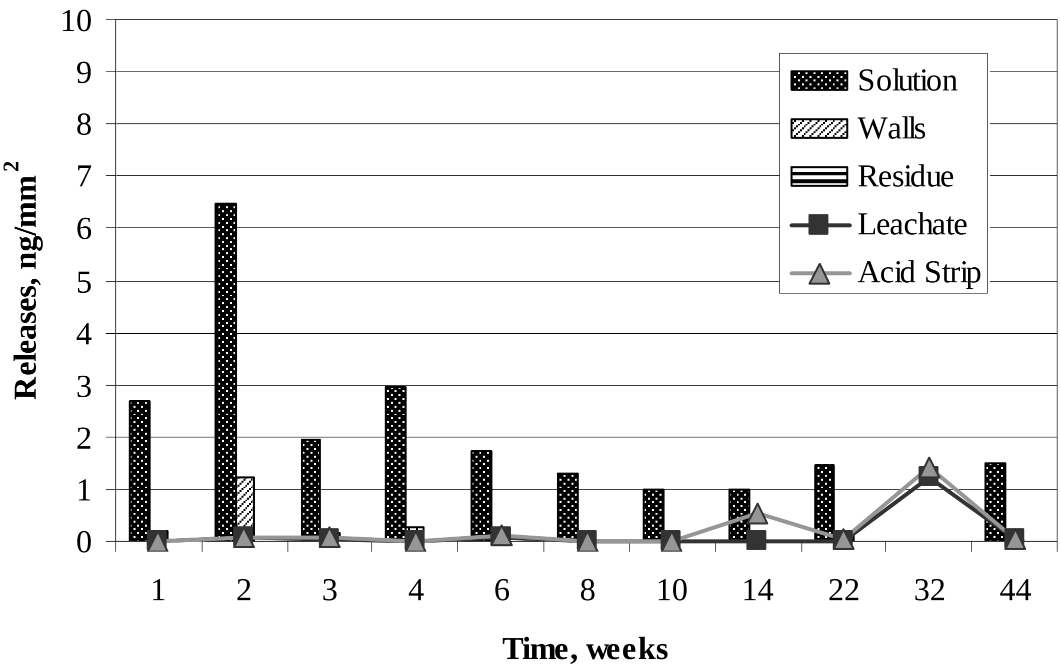


Figure E-80. Zirconium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

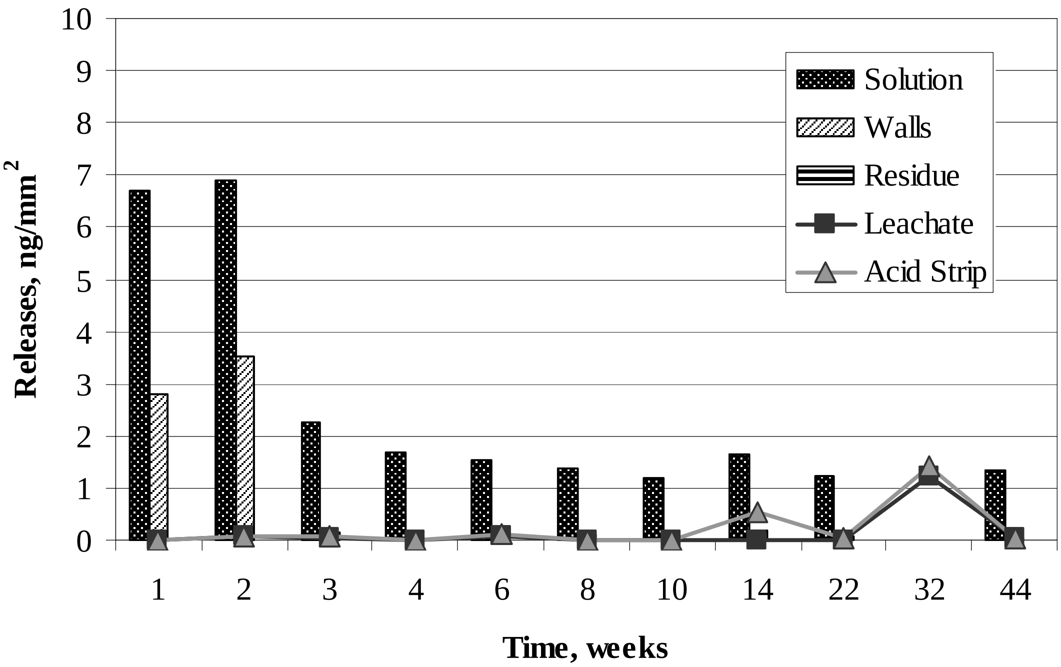


Figure E-81. Zirconium Releases in Solution, on Walls, and in Acid Strip from Polished Sample 3 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

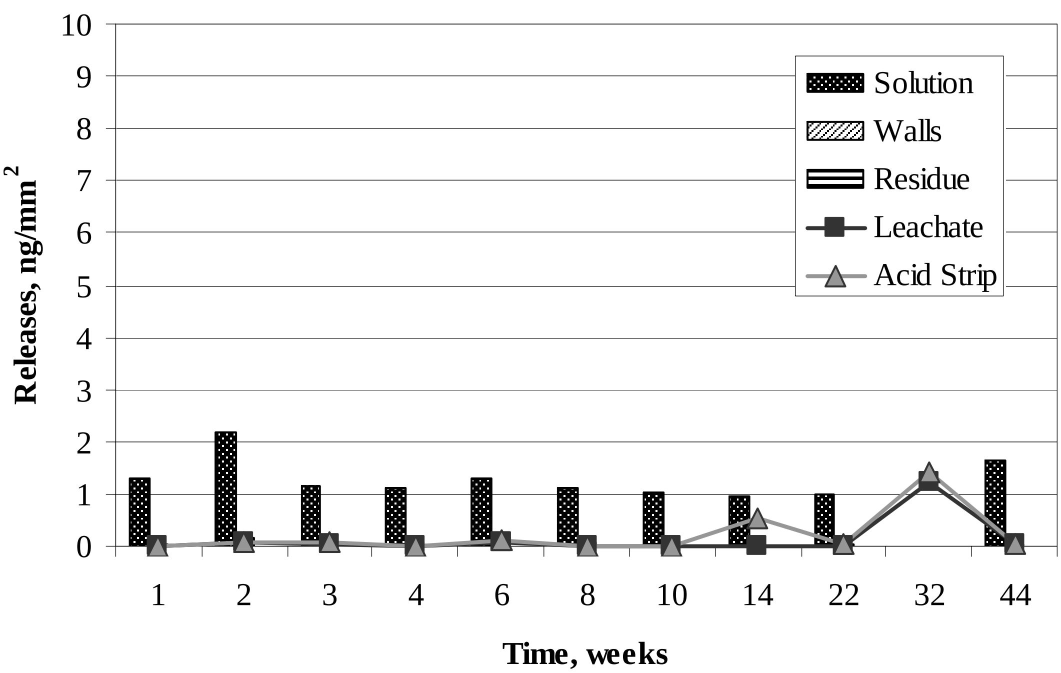


Figure E-82. Zirconium Releases in Solution, on Walls, and in Acid Strip from Oxidized Sample 4 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

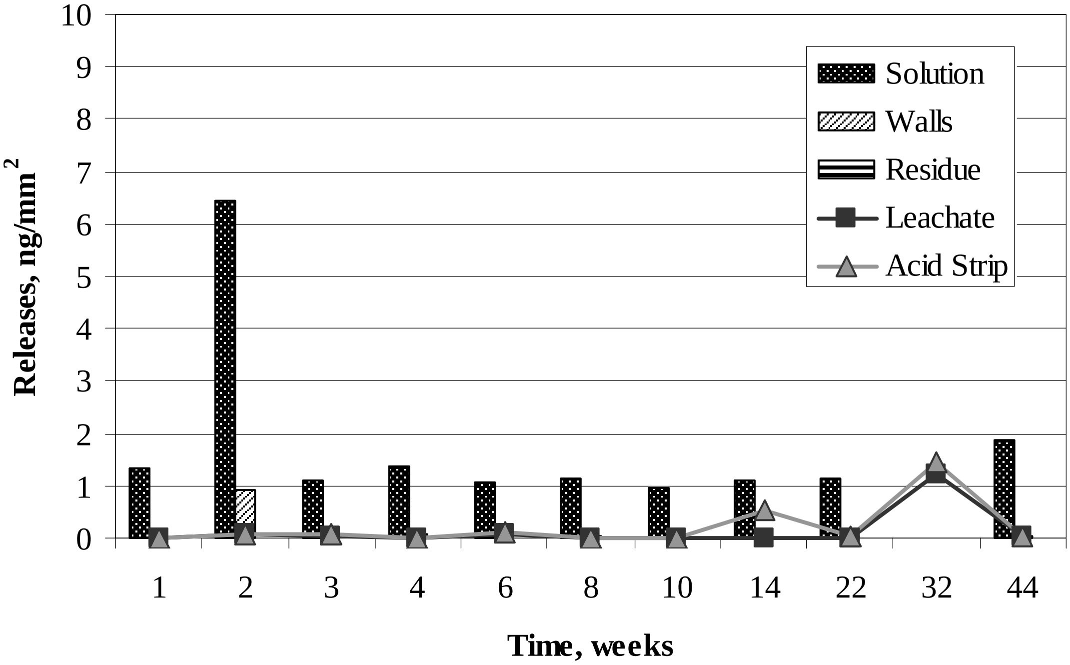


Figure E-83. Zirconium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

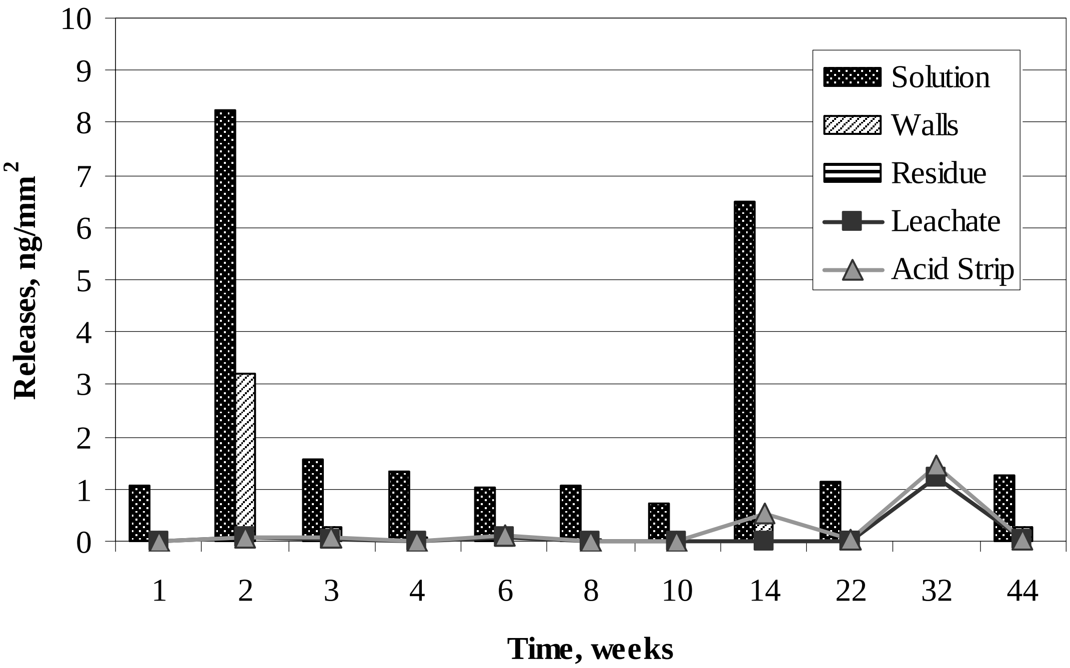


Figure E-84. Zirconium Present in Solution, on Walls, and in Residue from CJ13 Control and Average Detection Limits for Leachate and Acid Strip.

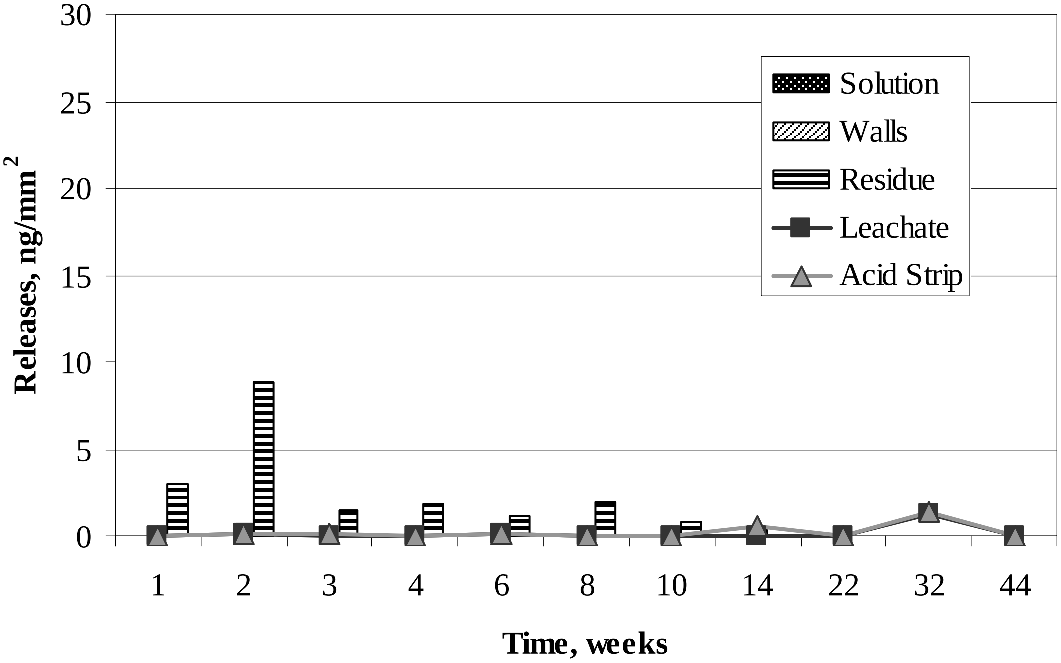


Figure E-85. Zirconium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

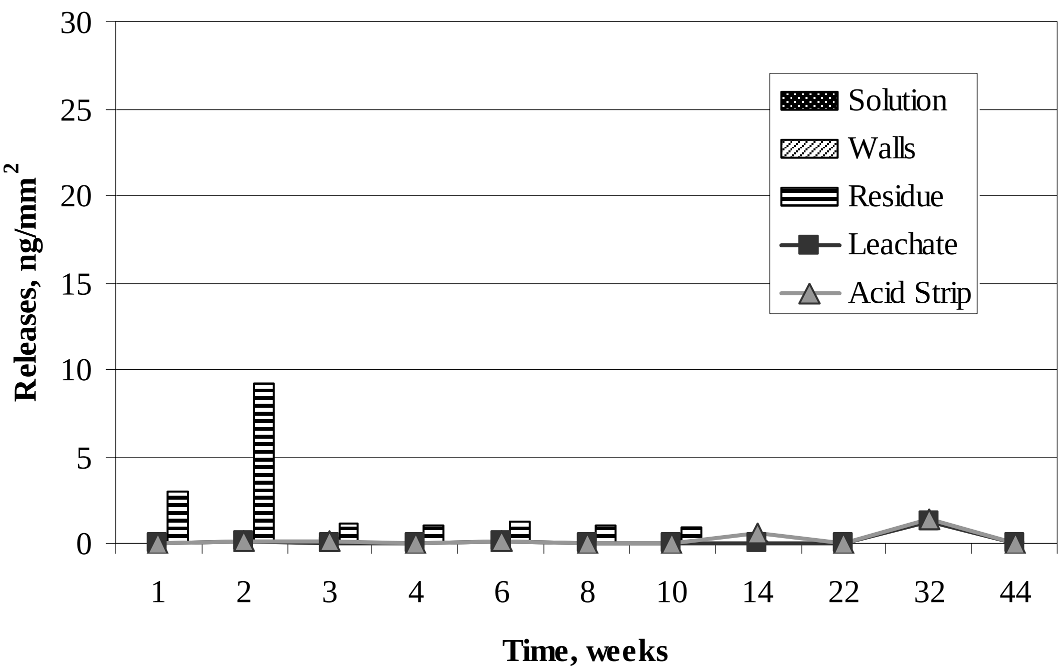


Figure E-86. Zirconium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

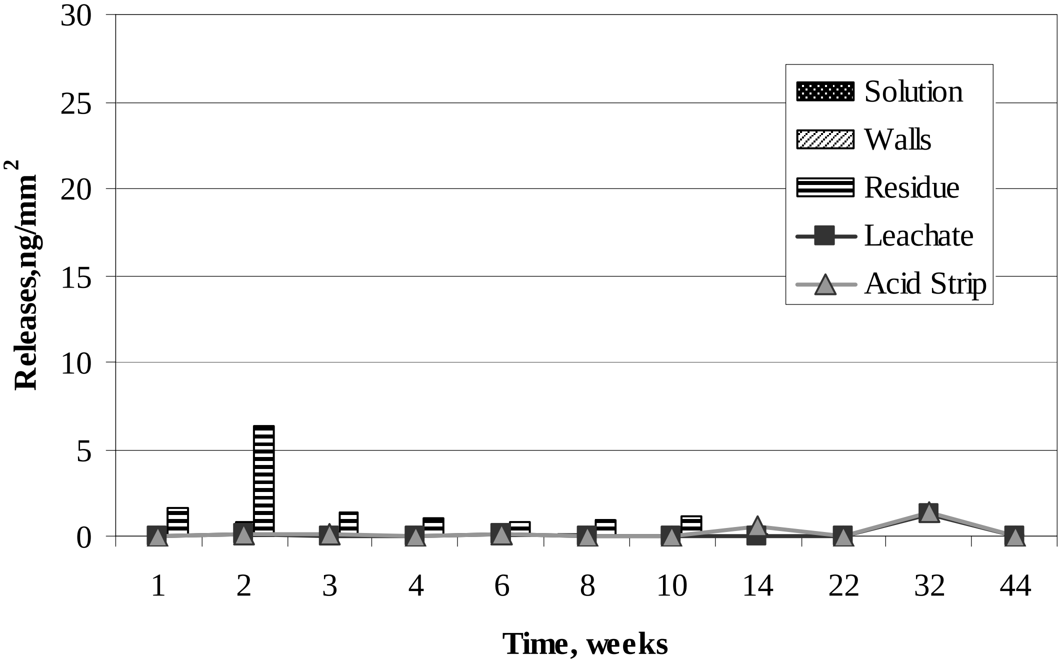


Figure E-87. Zirconium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

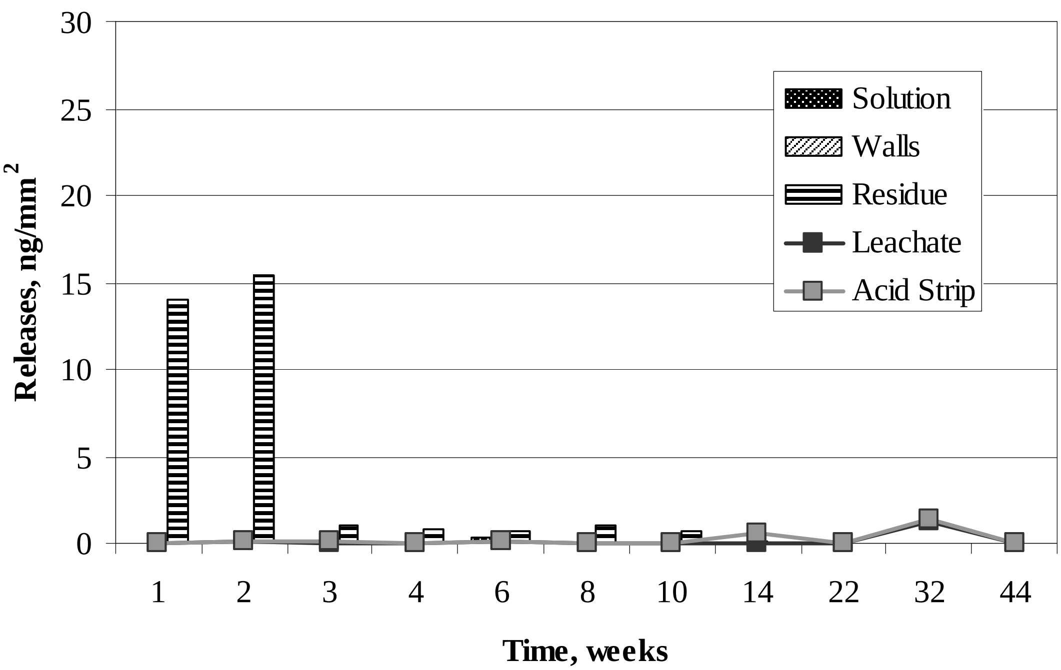


Figure E-88. Zirconium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

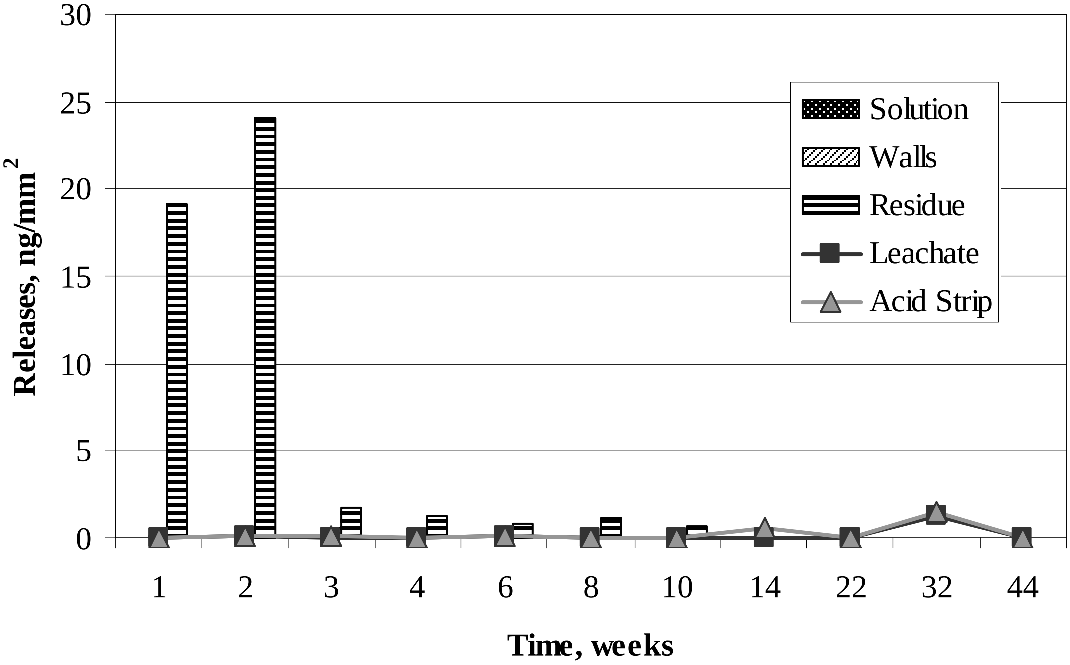


Figure E-89. Zirconium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

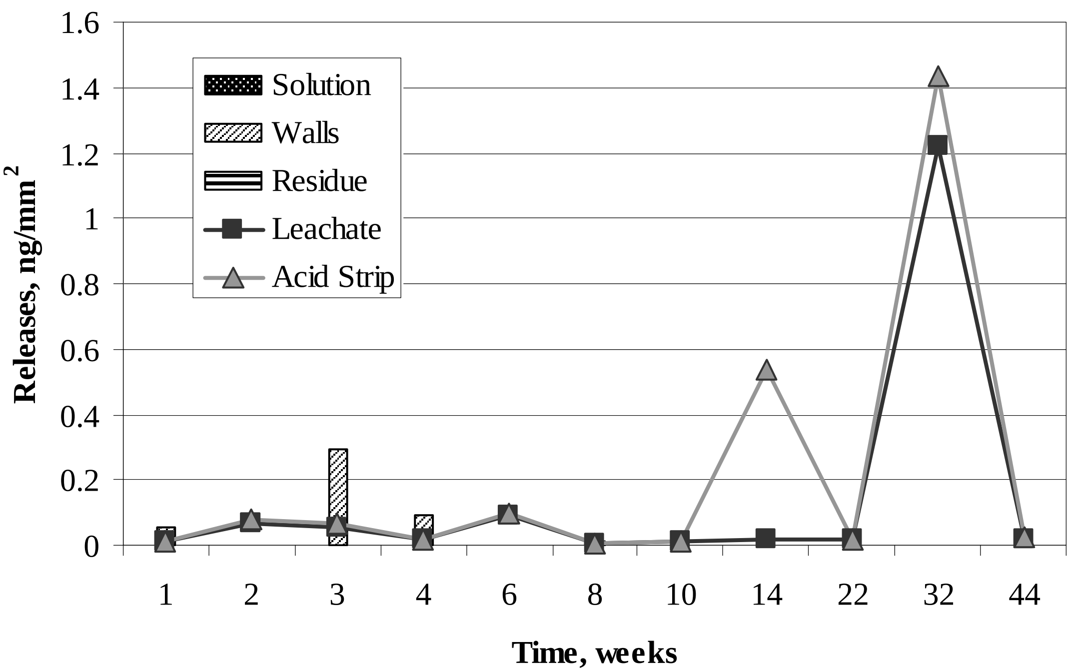


Figure E-90. Zirconium Present in Solution, on Walls, and in Residue in 10KCl Control and Average Detection Limits for Leachate and Acid Strip.

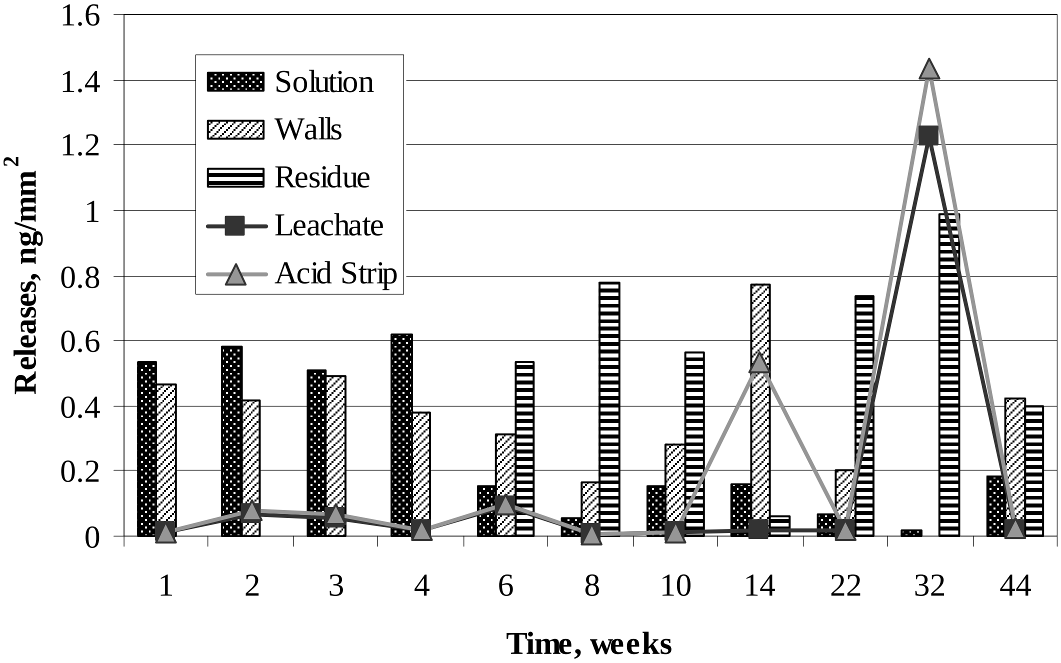


Figure E-91. Zirconium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

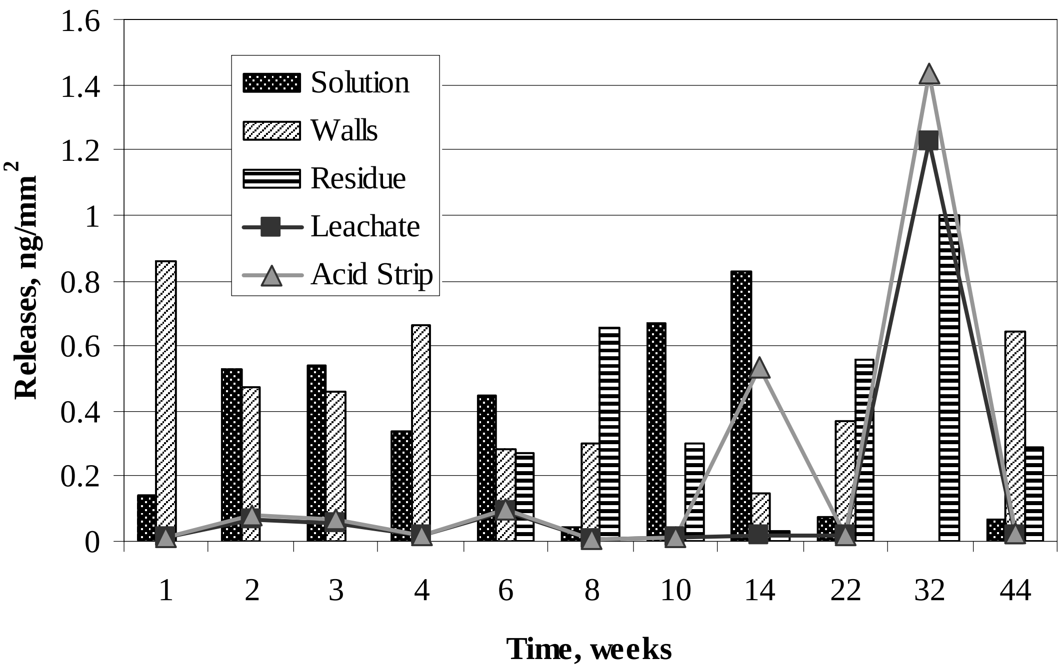


Figure E-92. Zirconium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

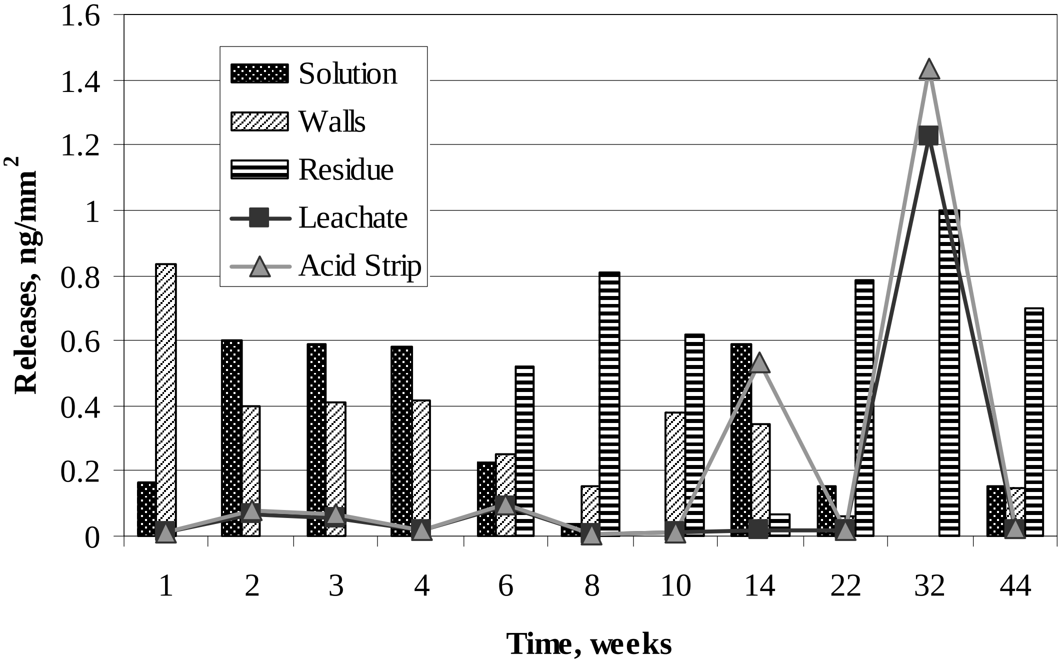


Figure E-93. Zirconium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

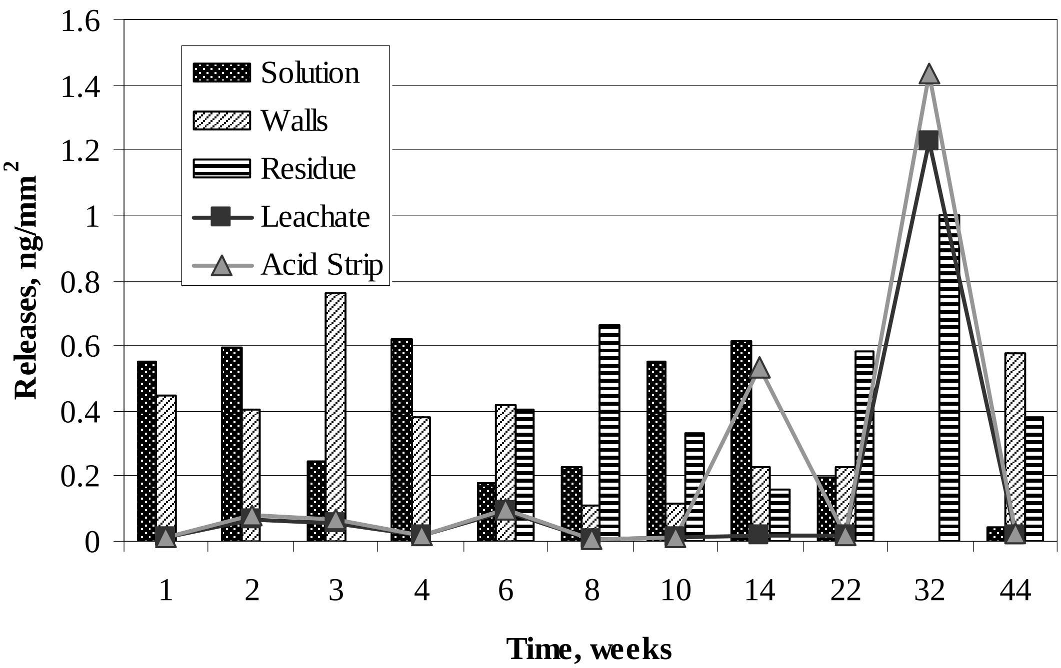


Figure E-94. Zirconium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

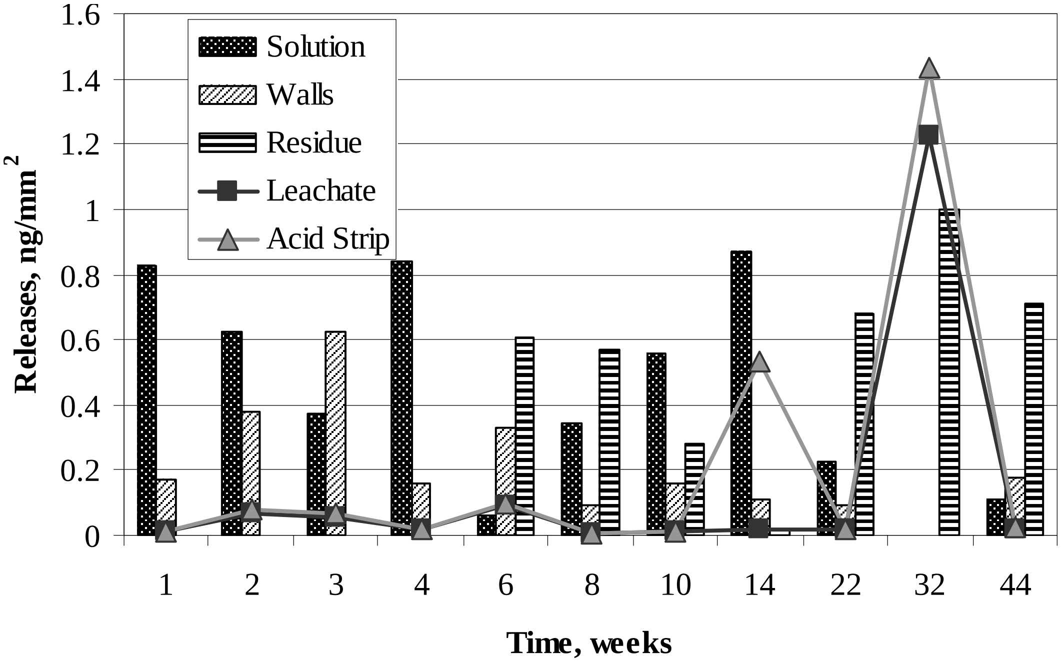


Figure E-95. Zirconium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

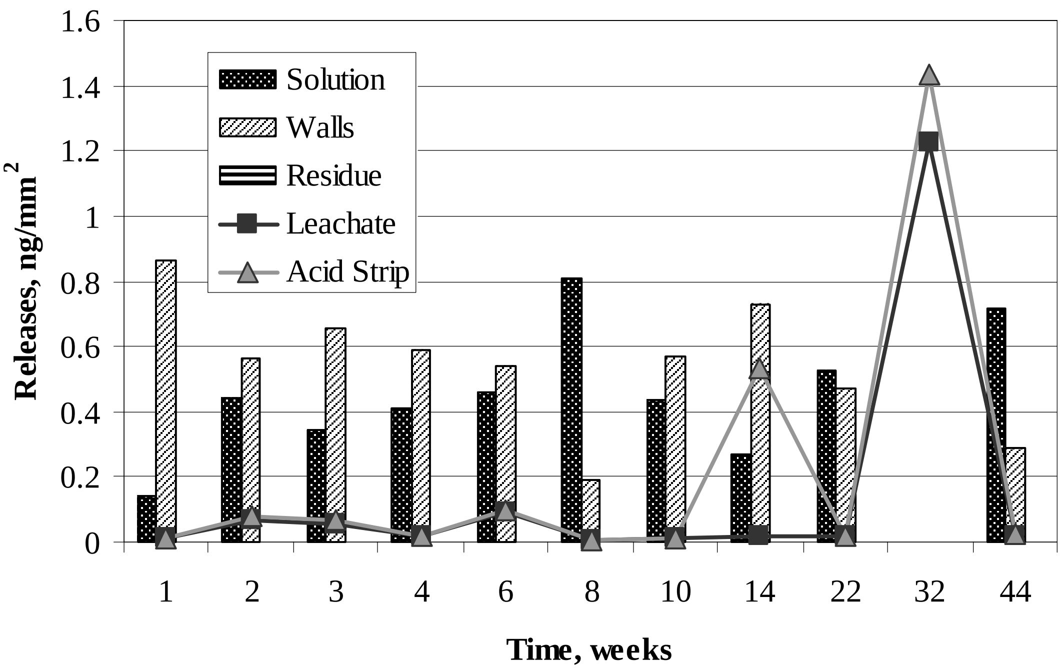


Figure E-96. Zirconium Present in Solution, on Walls, and in Residue from AJ13 Control and Average Detection Limits for Leachate and Acid Strip.

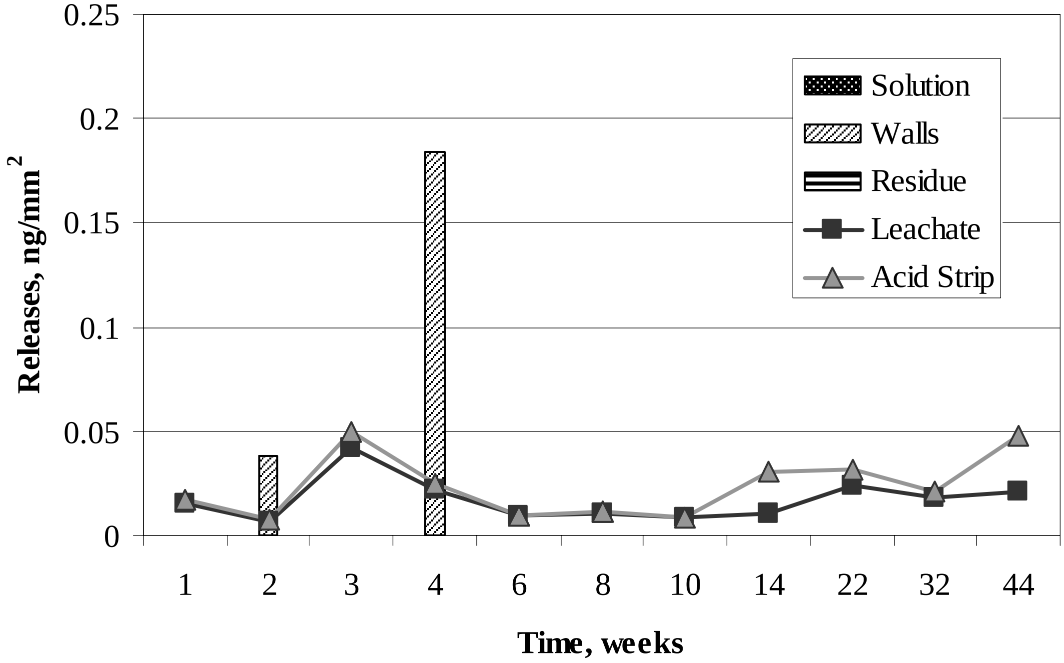


Figure E-97. Niobium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

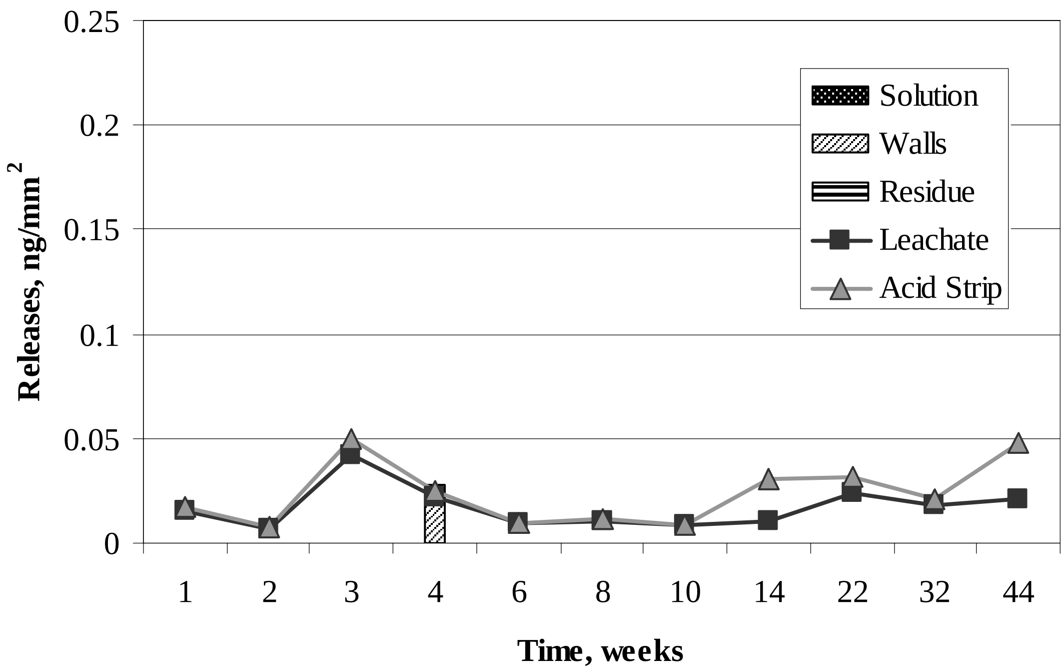


Figure E-98. Niobium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

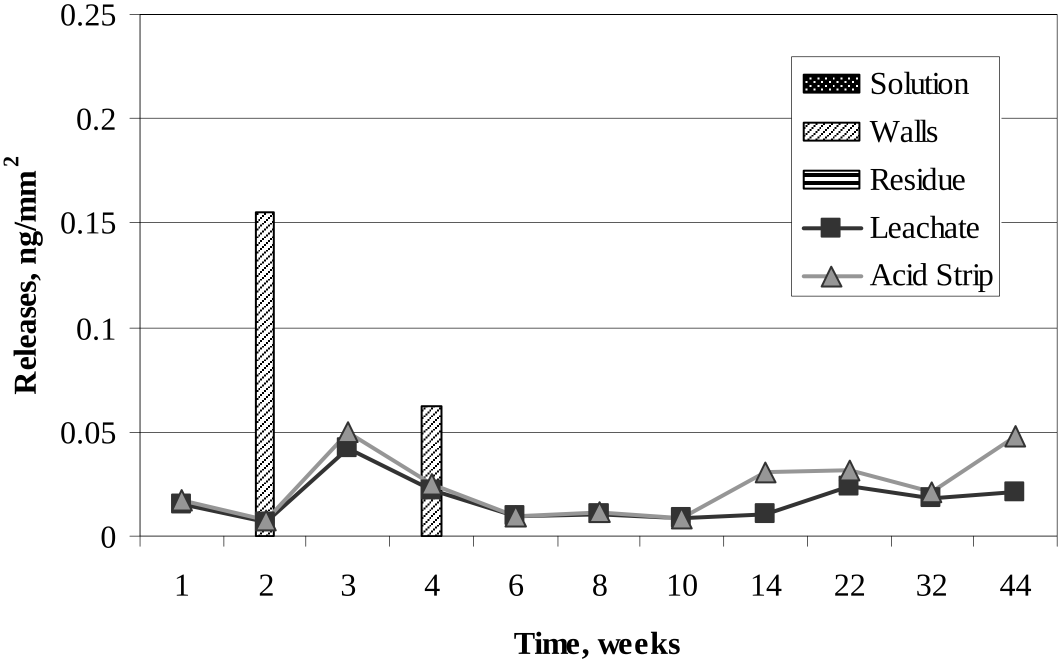


Figure E-99. Niobium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

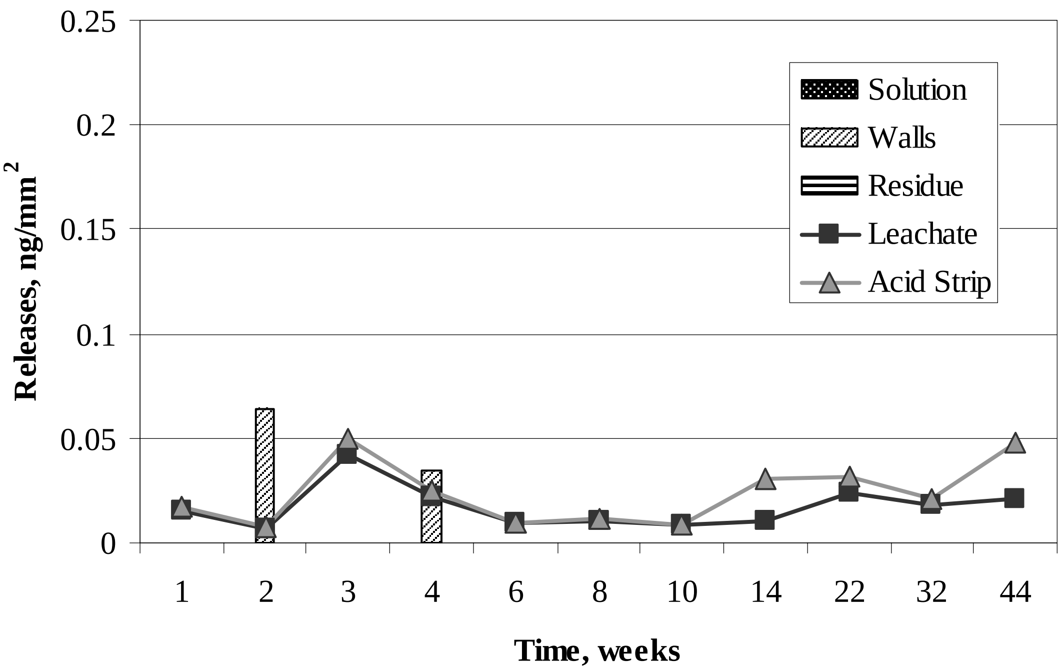


Figure E-100. Niobium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

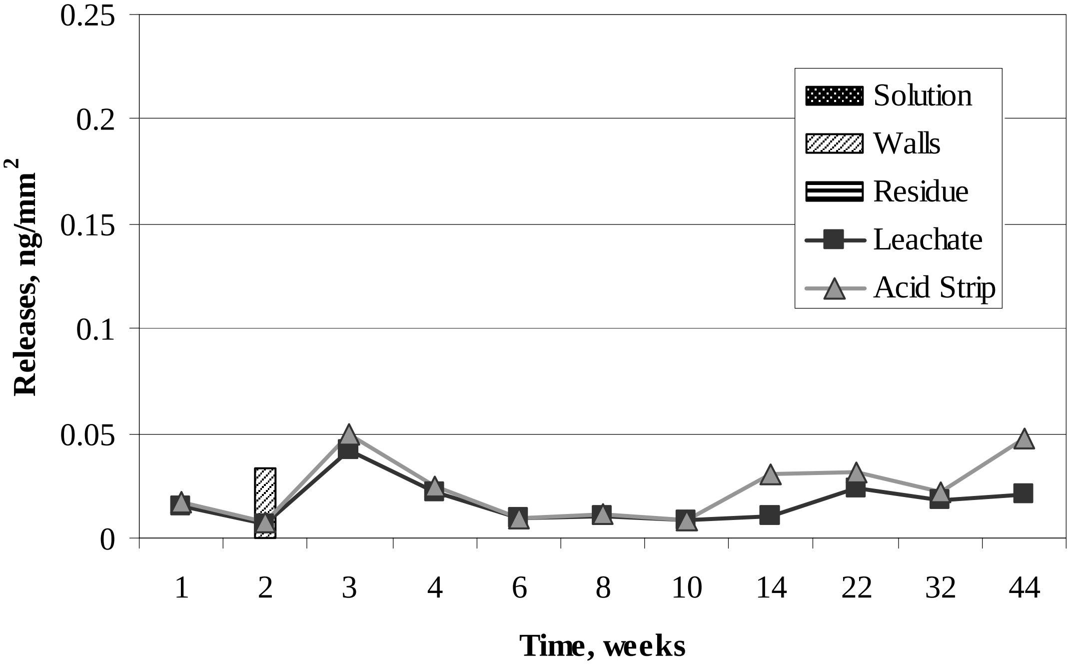


Figure E-101. Niobium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

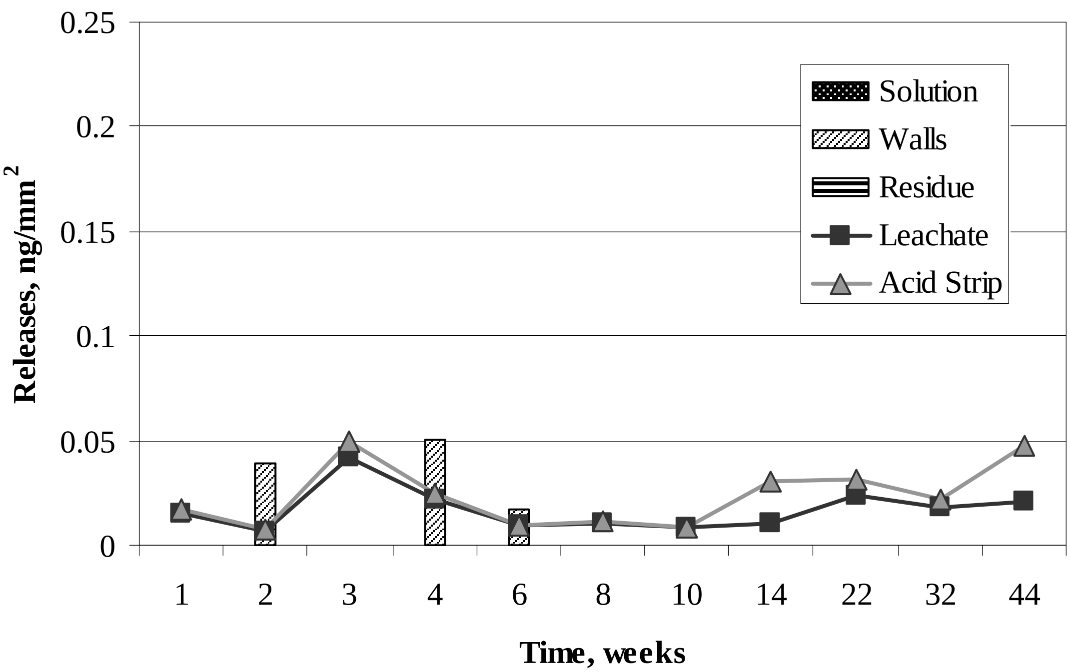


Figure E-102. Niobium Present in Solution, on Walls, and in Residue from SJ13 Control and Average Detection Limits for Leachate and Acid Strip.

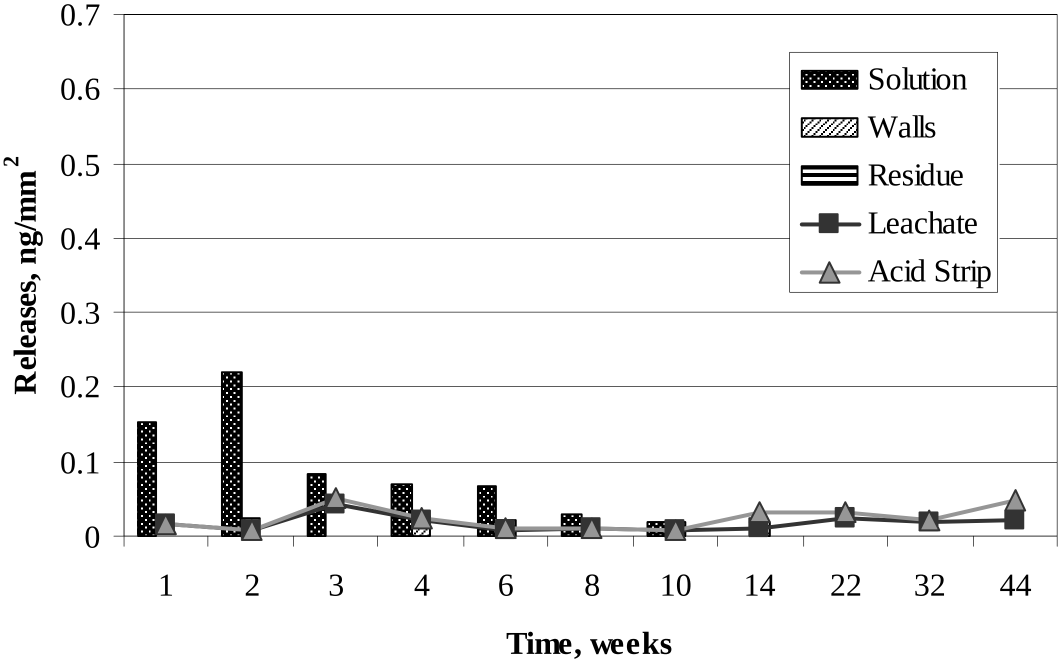


Figure E-103. Niobium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

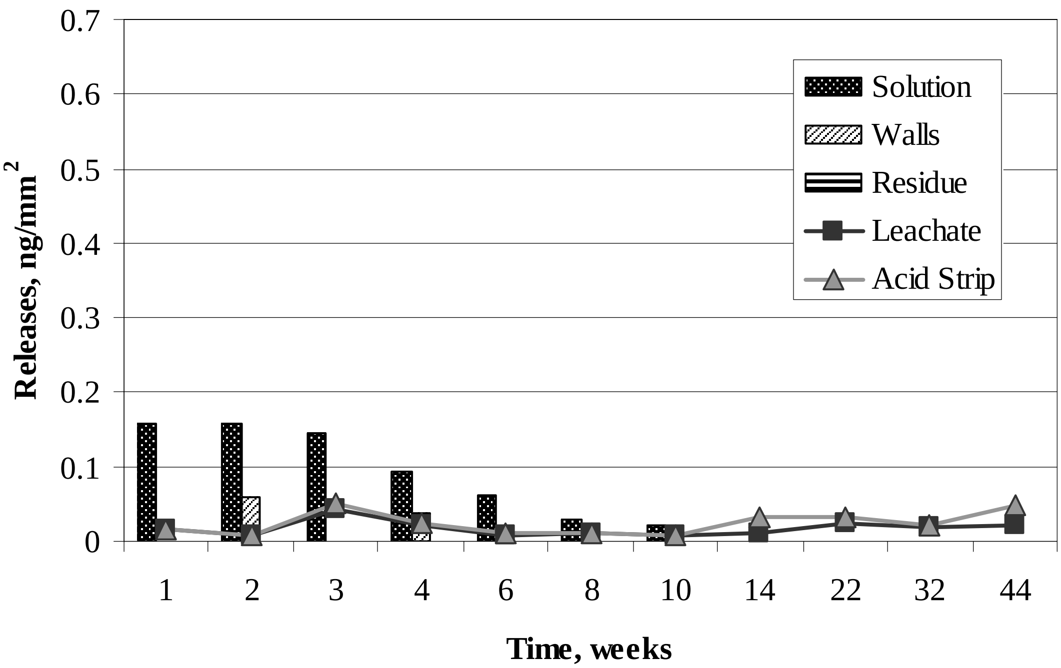


Figure E-104. Niobium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

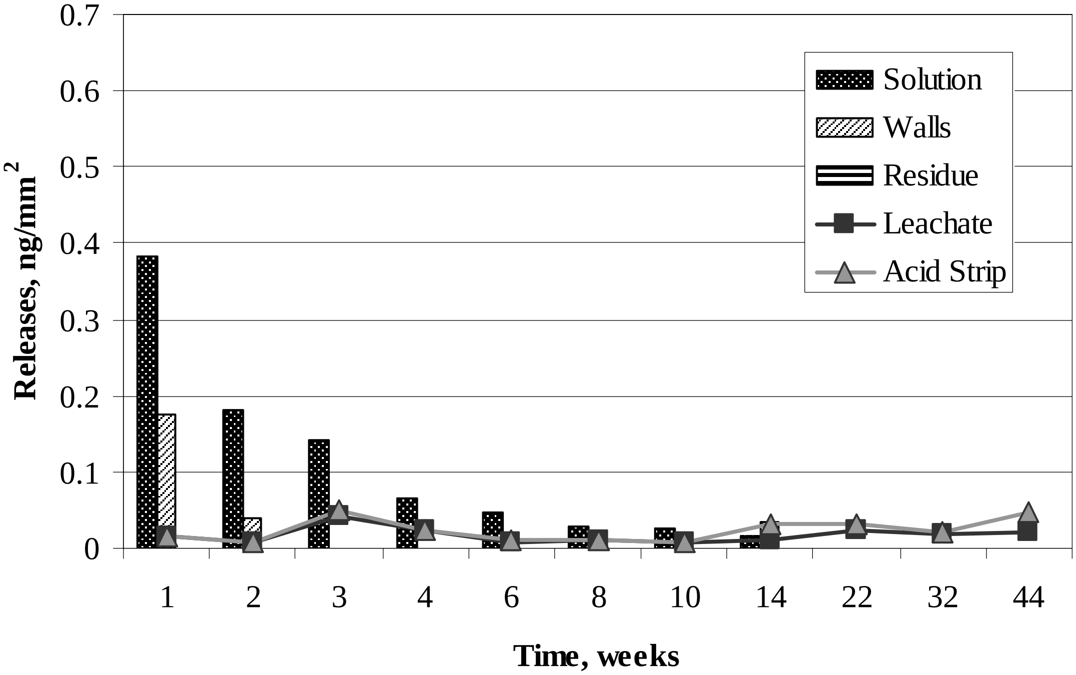


Figure E-105. Niobium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

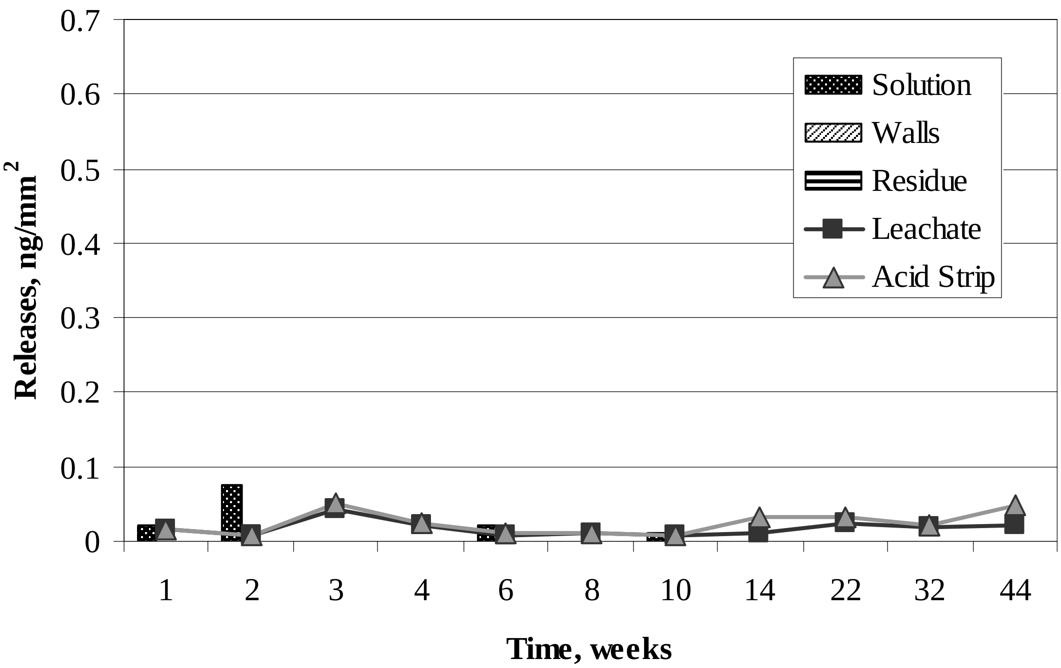


Figure E-106. Niobium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

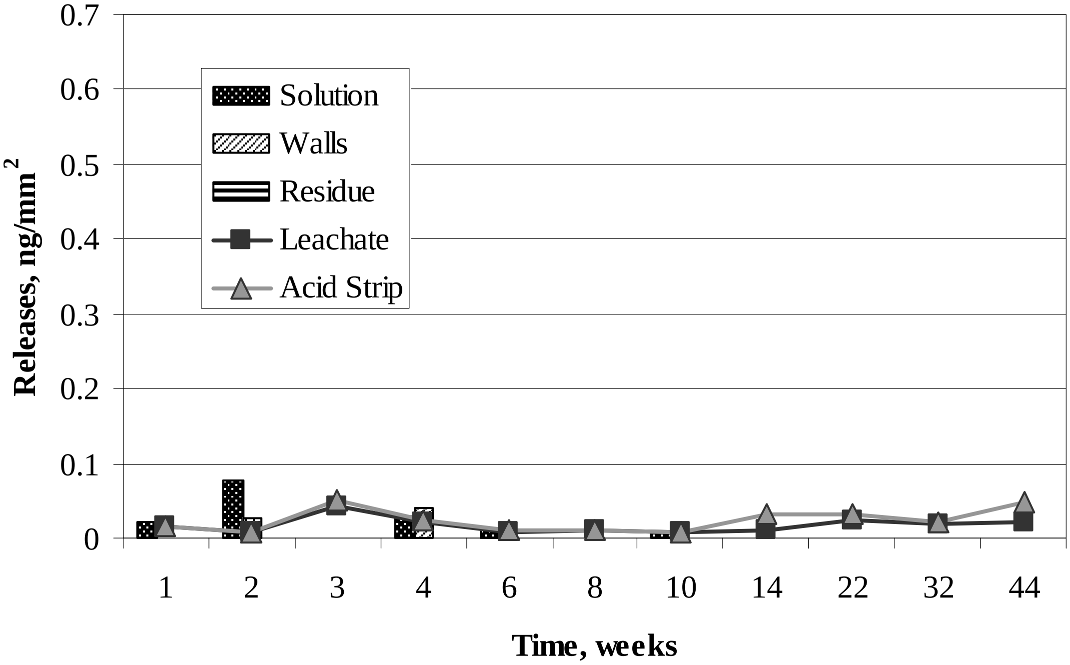


Figure E-107. Niobium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

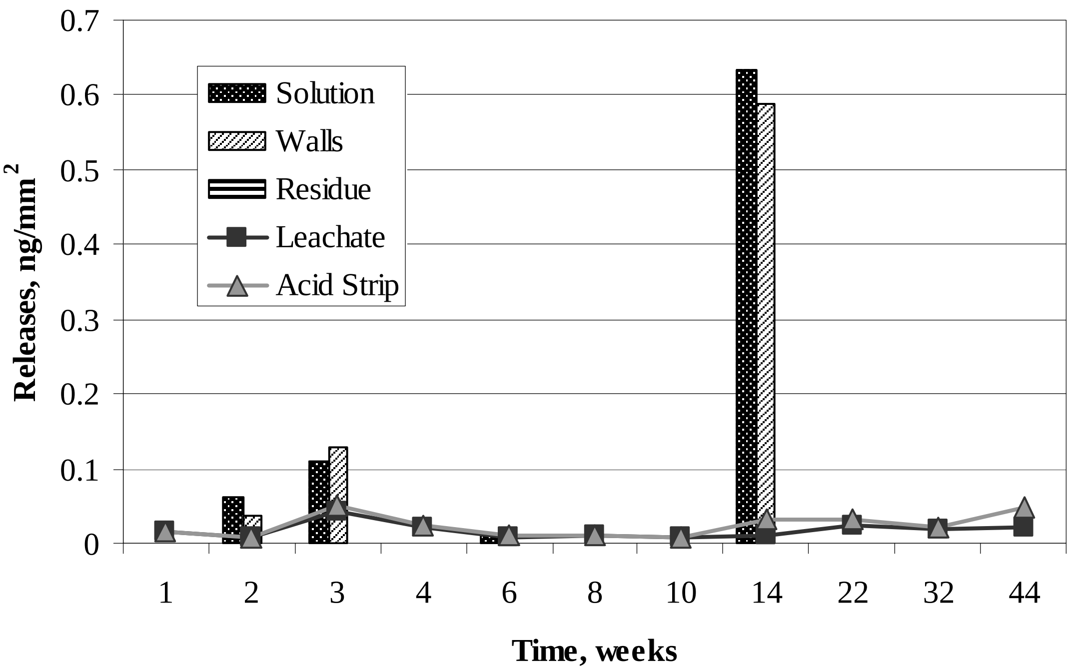


Figure E-108. Niobium Present in Solution, on Walls, and in Residue from CJ13 Control and Average Detection Limits for Leachate and Acid Strip.

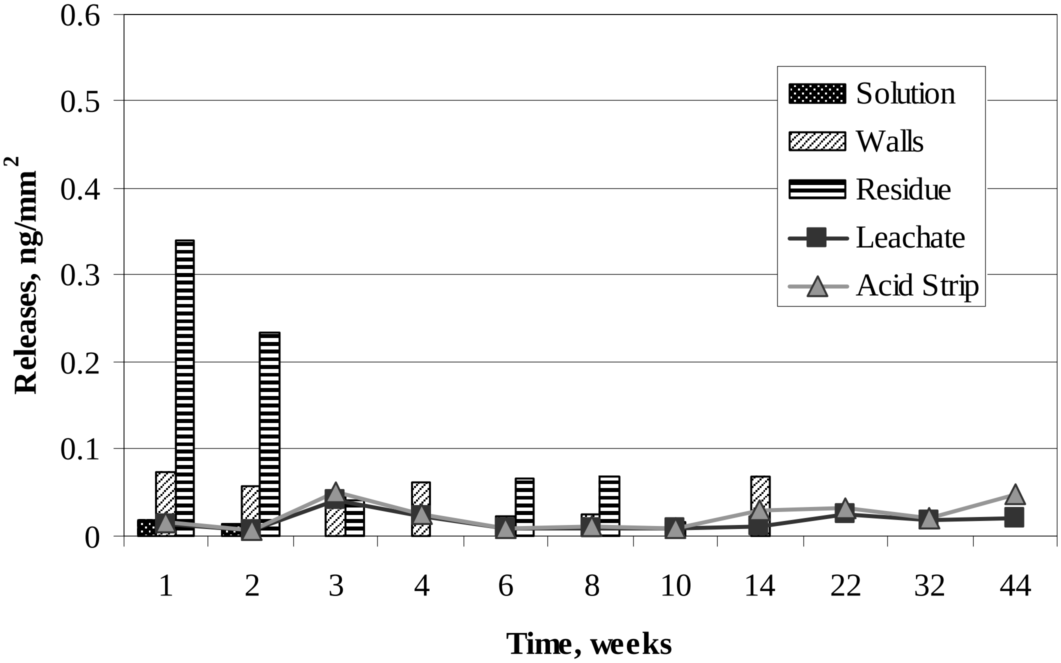


Figure E-109. Niobium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

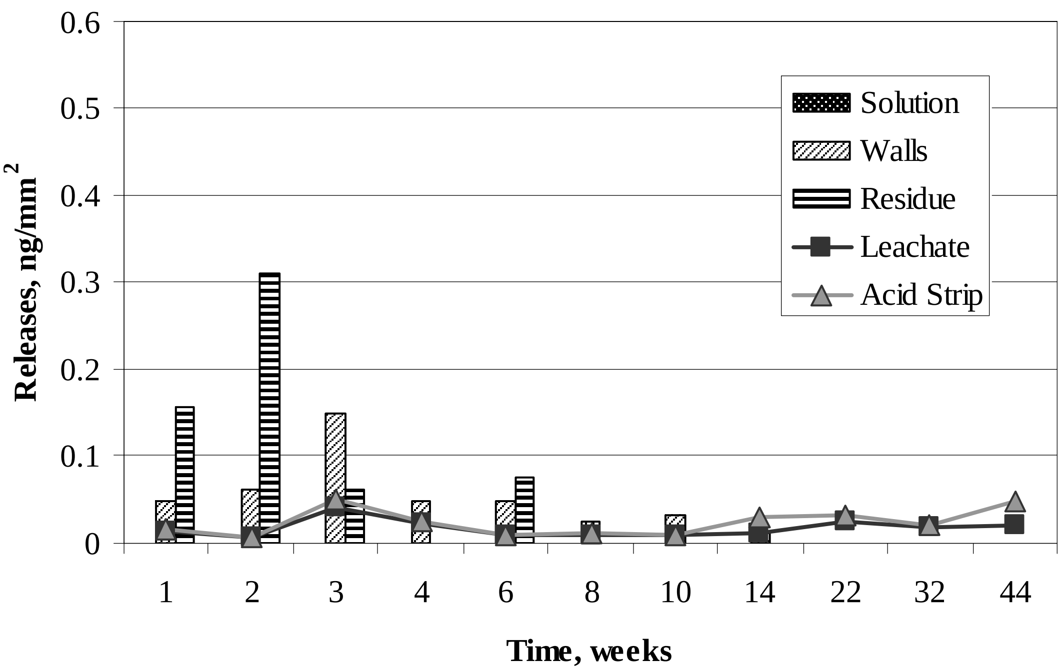


Figure E-110. Niobium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

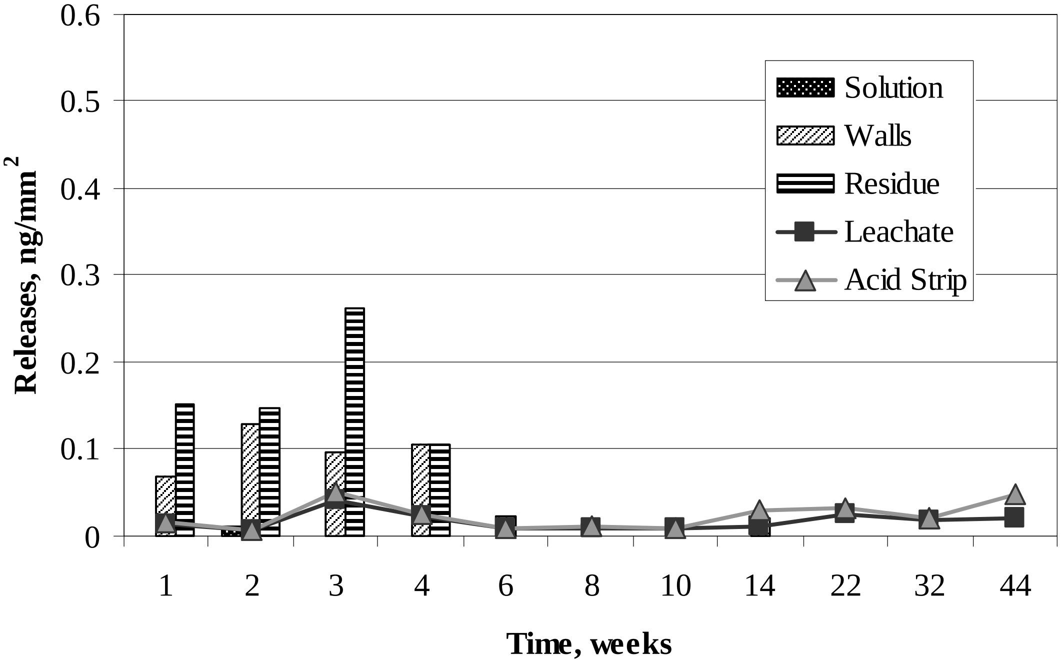


Figure E-111. Niobium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

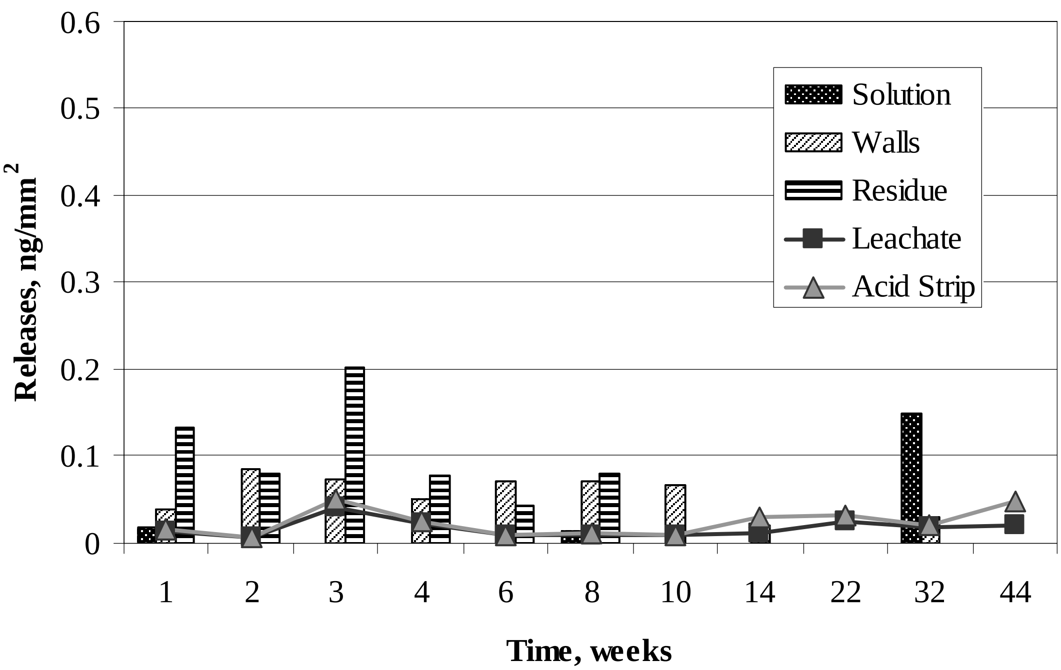


Figure E-112. Niobium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

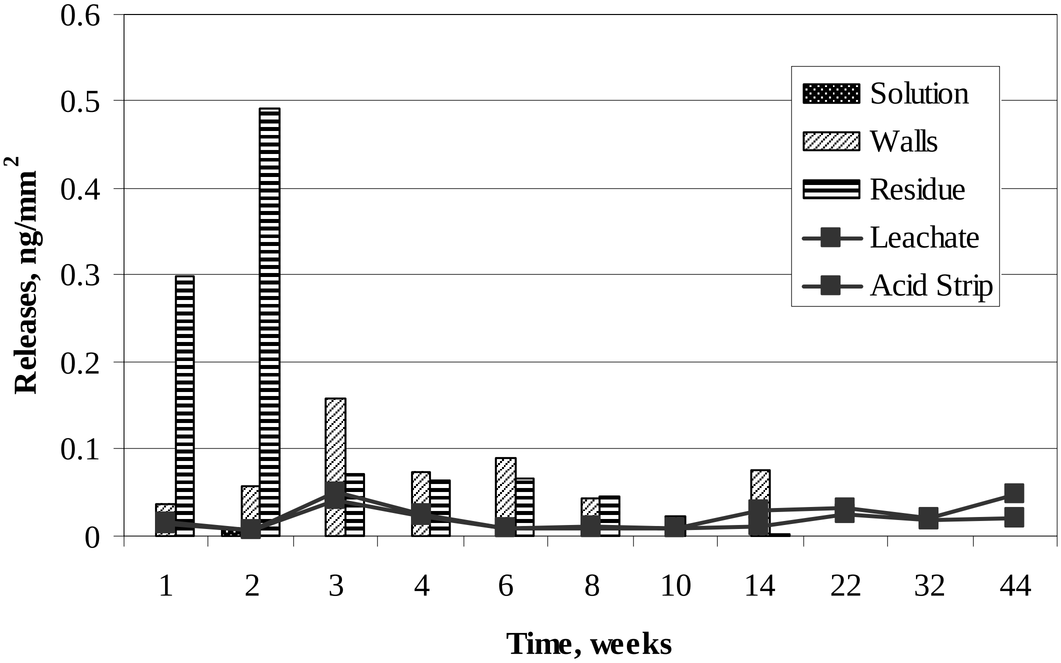


Figure E-113. Niobium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

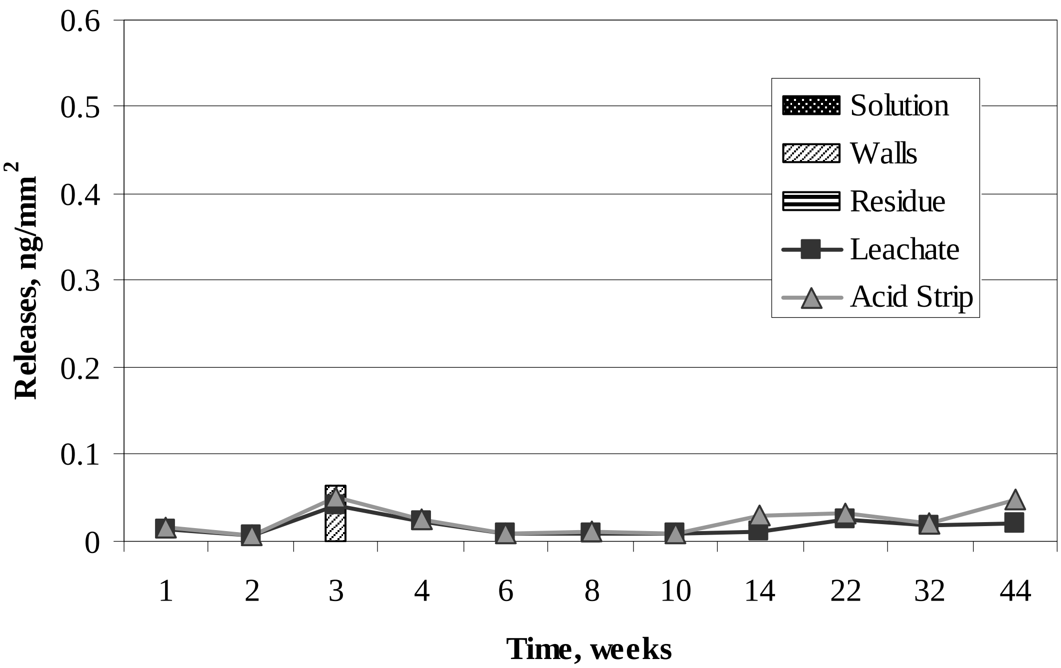


Figure E-114. Niobium Present in Solution, on Walls, and in Residue from 10KCl Control and Average Detection Limits for Leachate and Acid Strip.

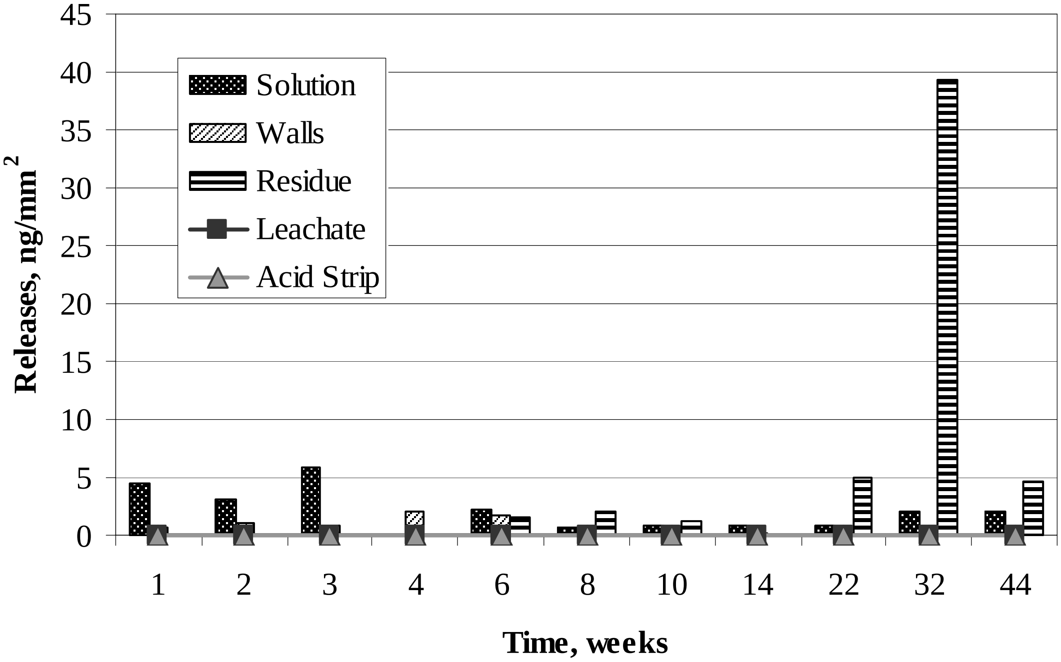


Figure E-115. Niobium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

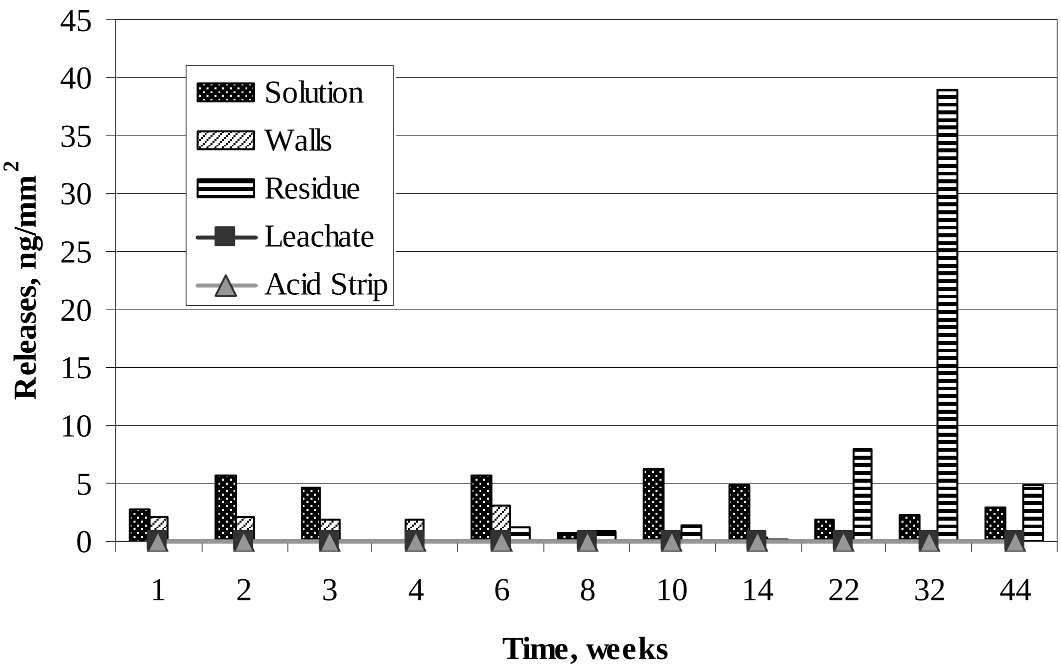


Figure E-116. Niobium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

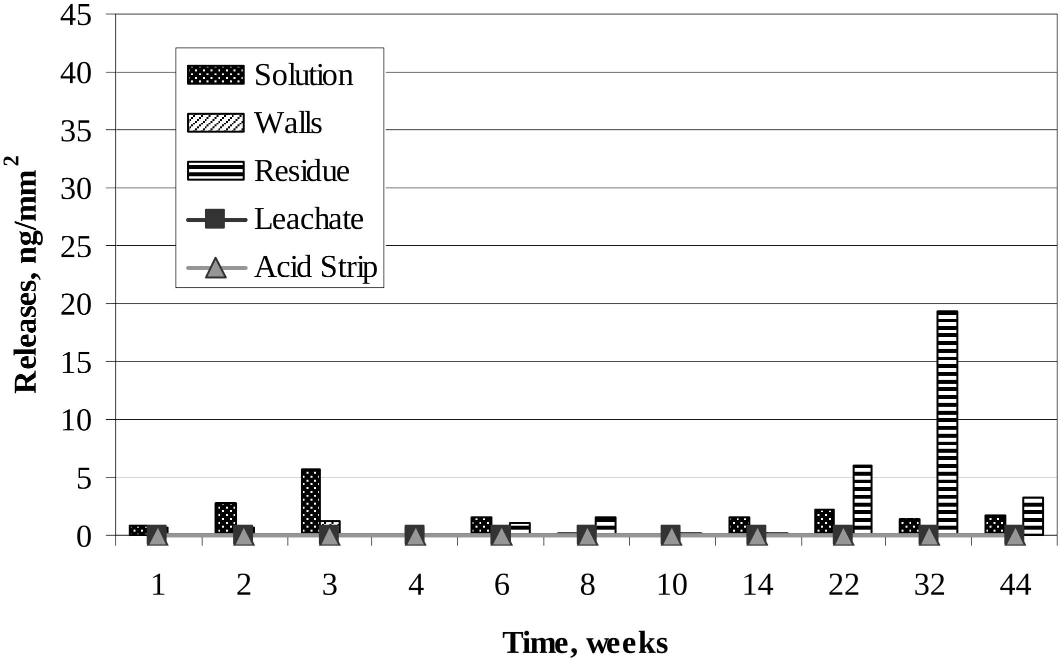


Figure E-117. Niobium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

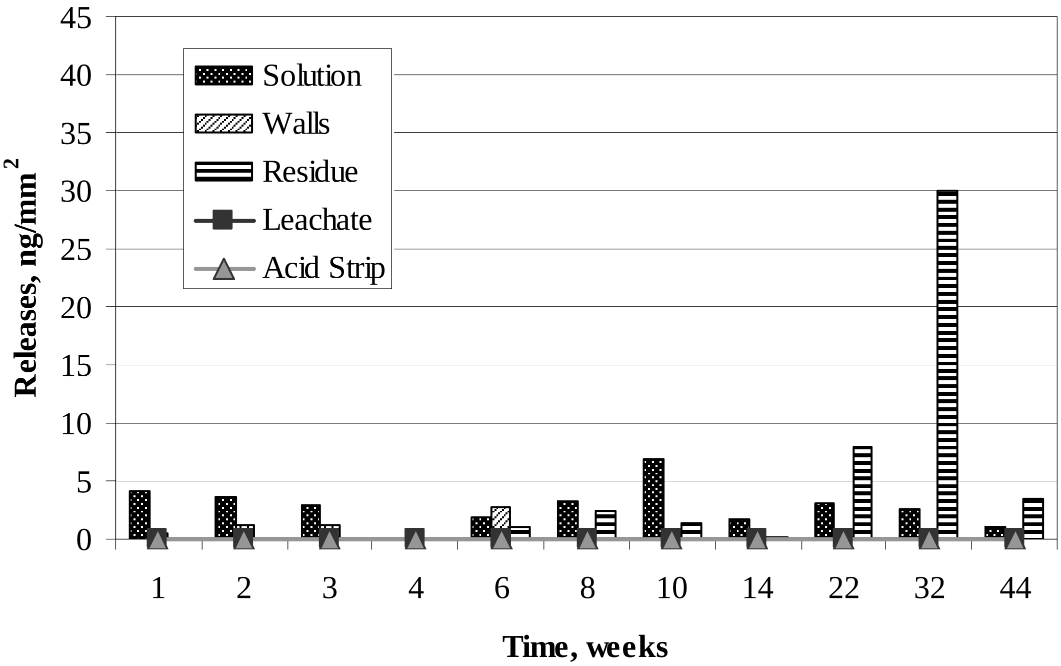


Figure E-118. Niobium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

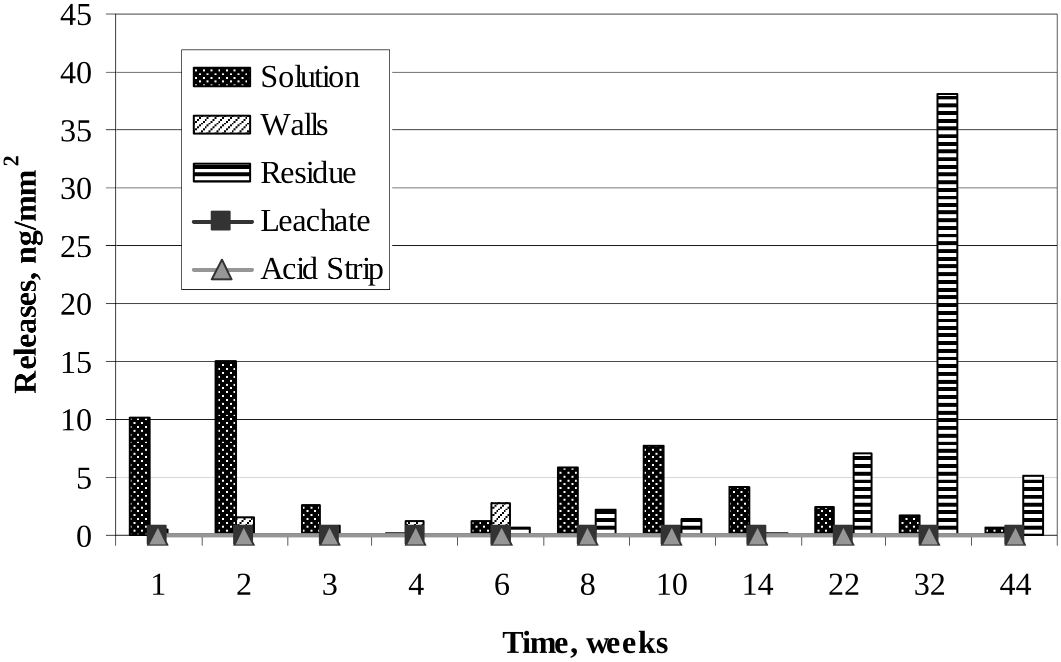


Figure E-119. Niobium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

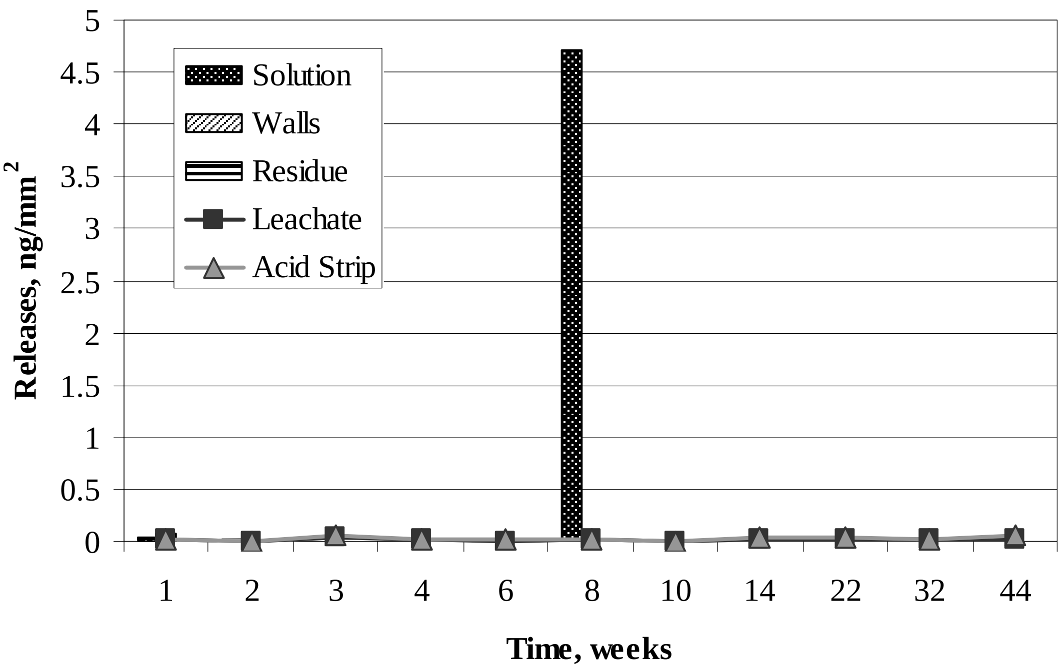


Figure E-120. Niobium Present in Solution, on Walls, and in Residue from AJ13 Control and Average Detection Limits for Leachate and Acid Strip.

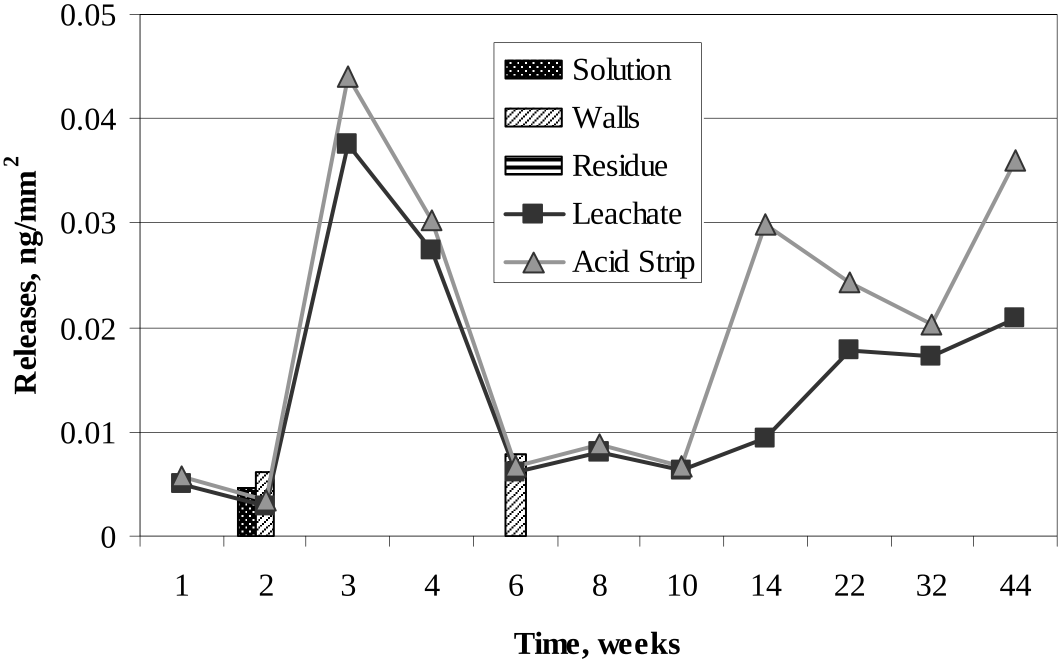


Figure E-121. Paladium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

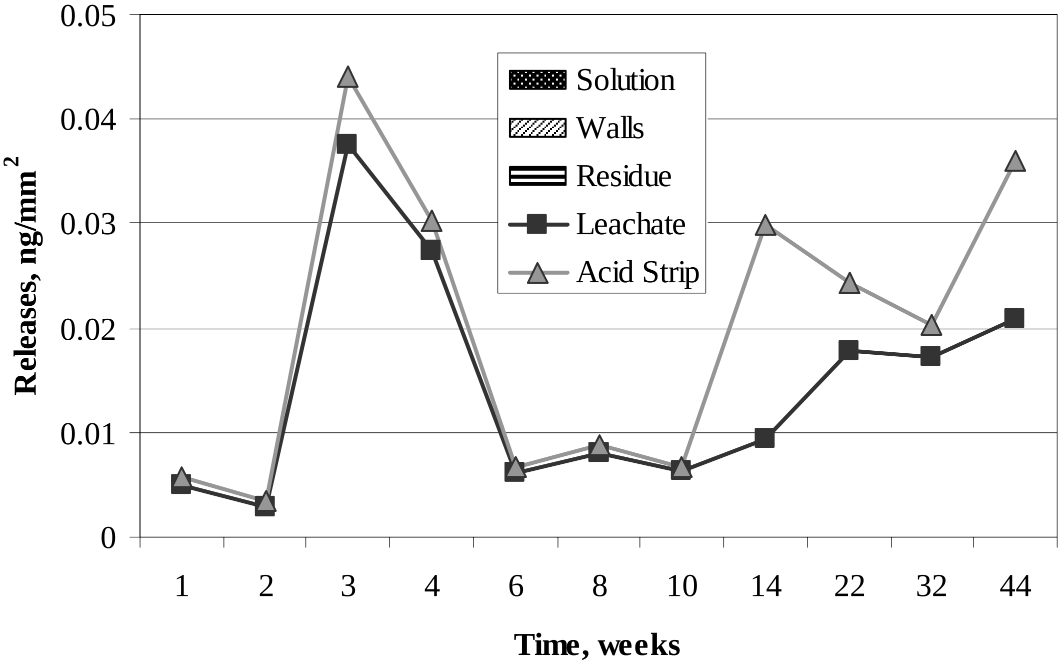


Figure E-122. Paladium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

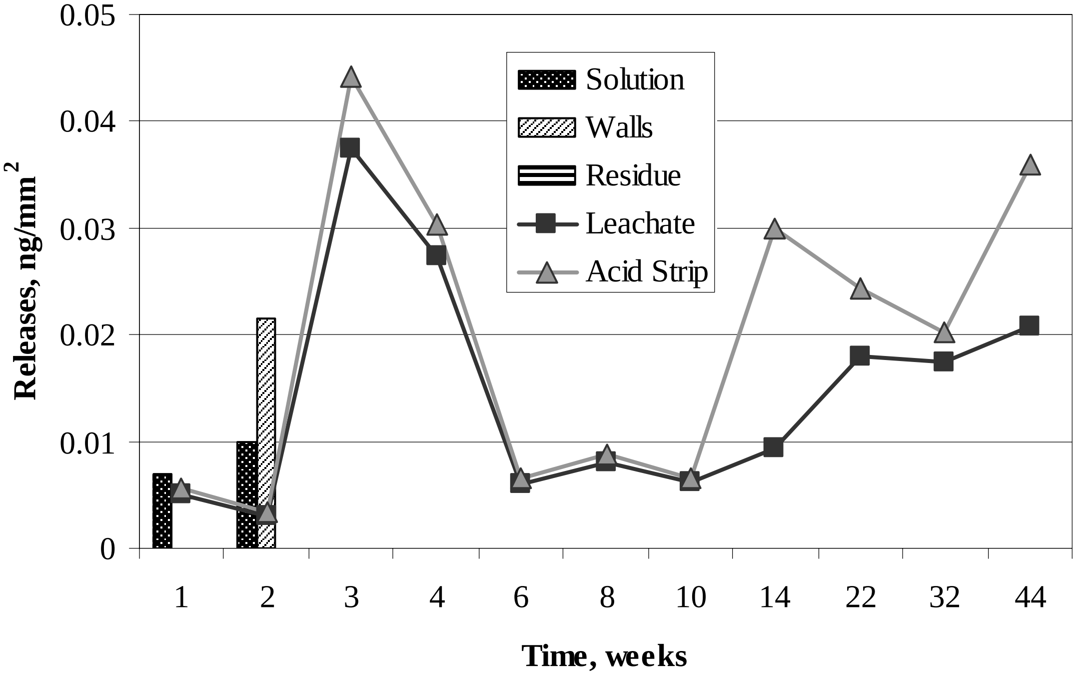


Figure E-123. Paladium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

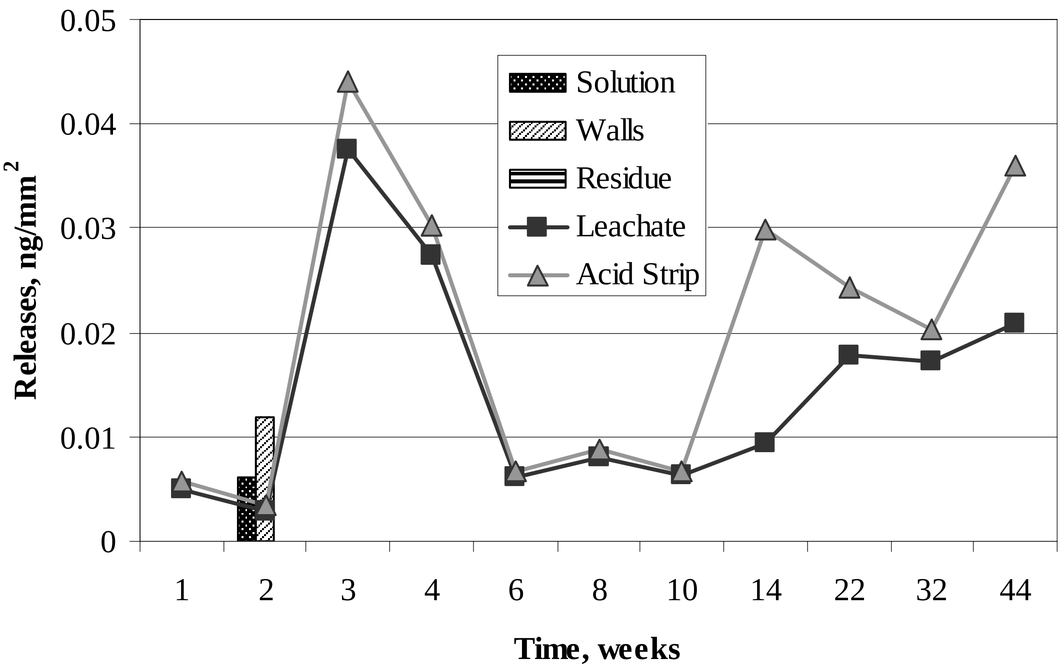


Figure E-124. Paladium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

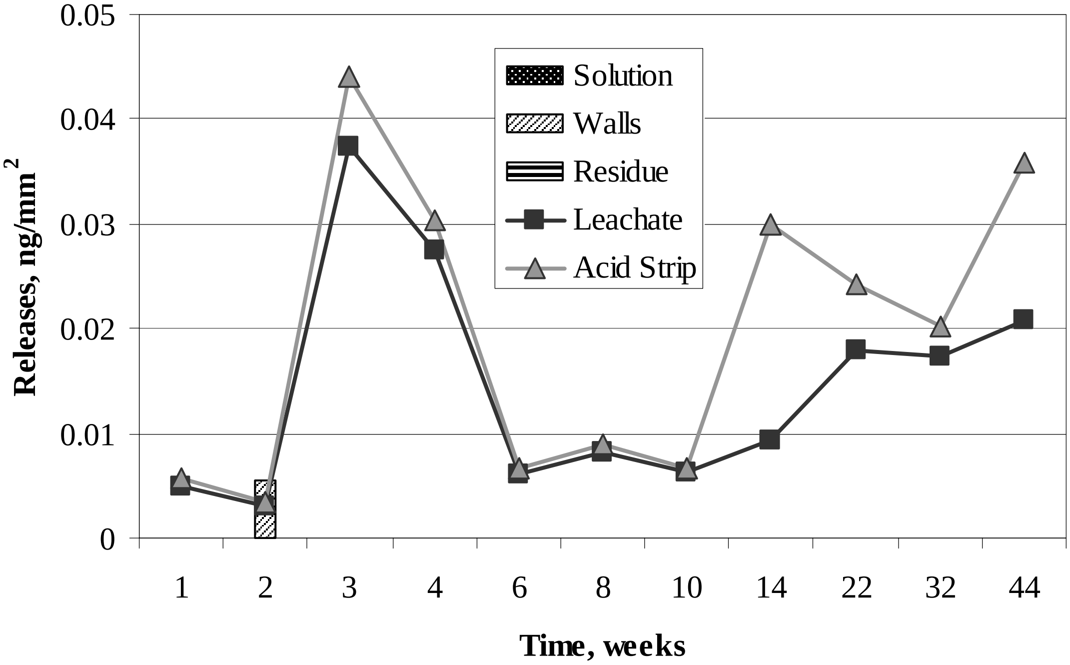


Figure E-125. Paladium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

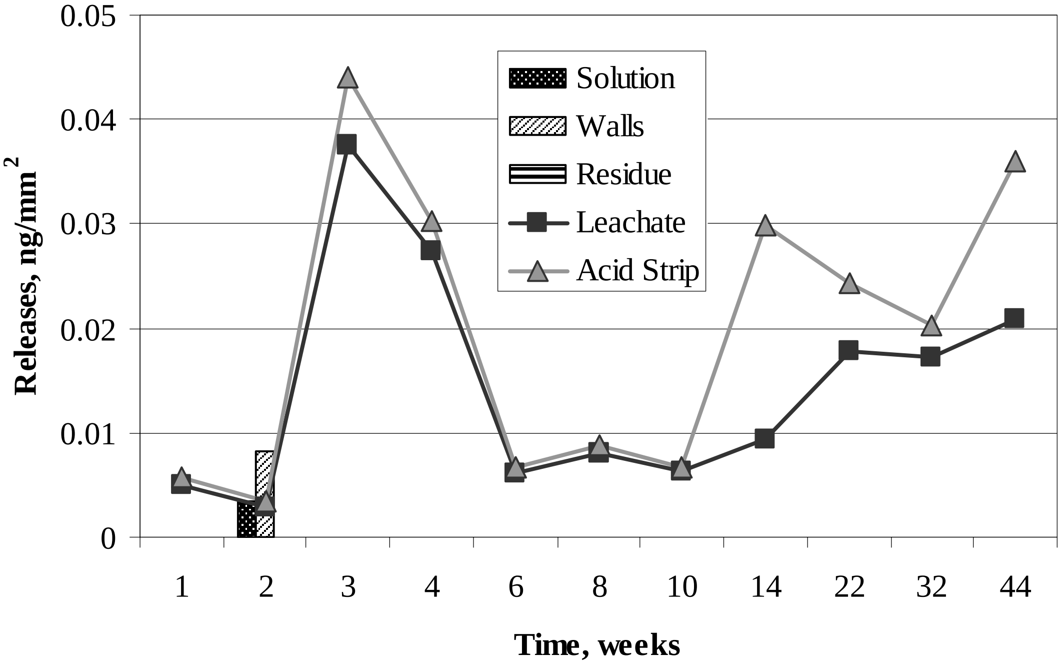


Figure E-126. Paladium Present in Solution, on Walls, and in Residue from SJ13 Control and Average Detection Limits for Leachate and Acid Strip.

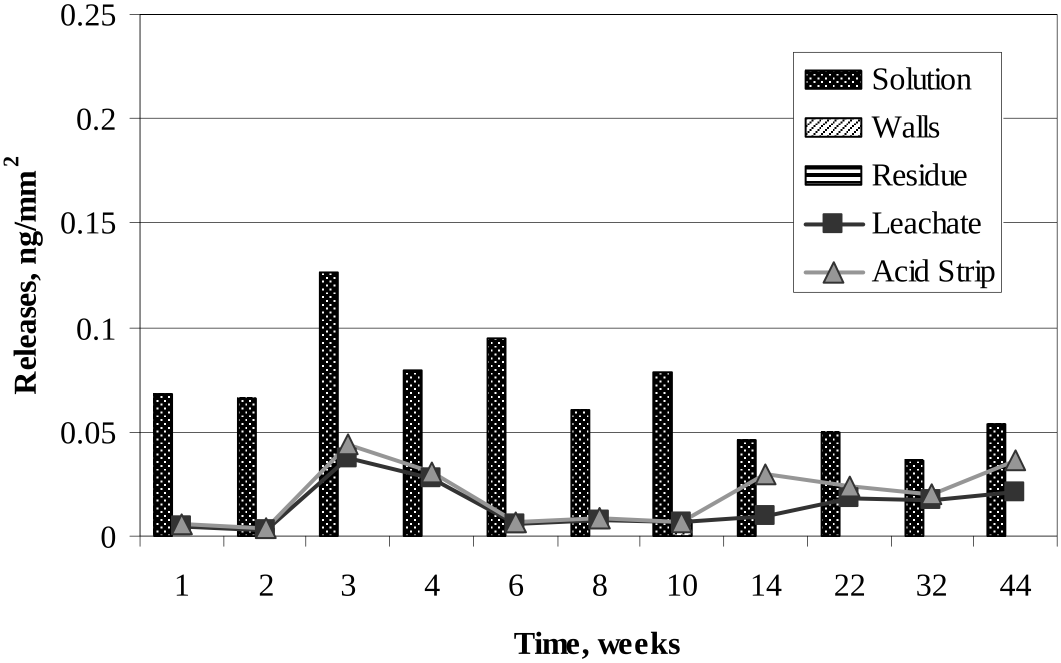


Figure E-127. Paladium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

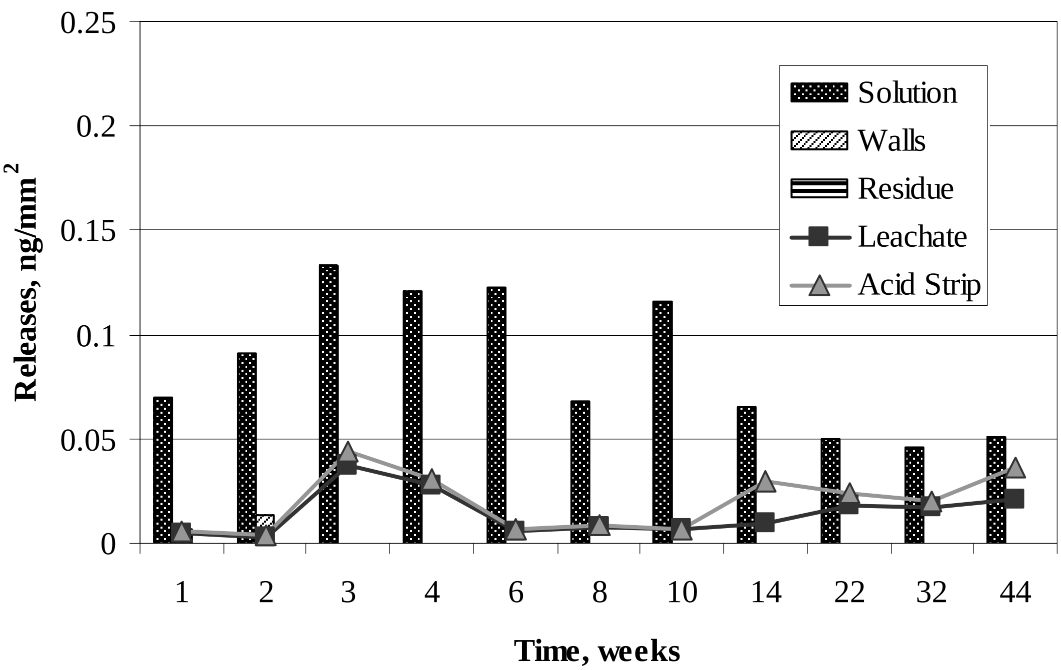


Figure E-128. Paladium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

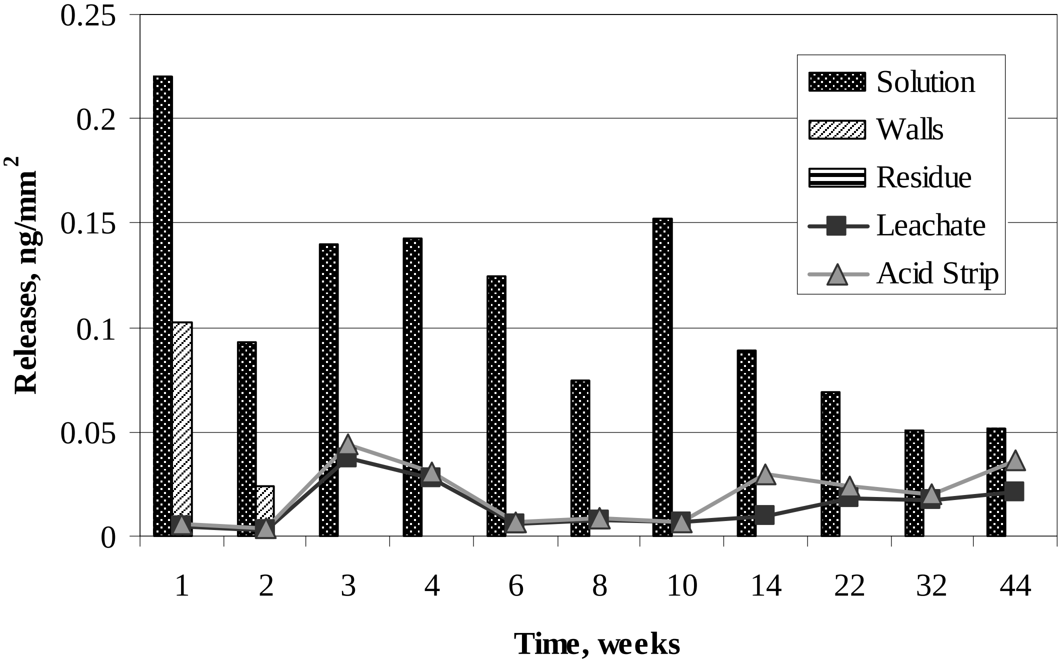


Figure E-129. Paladium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

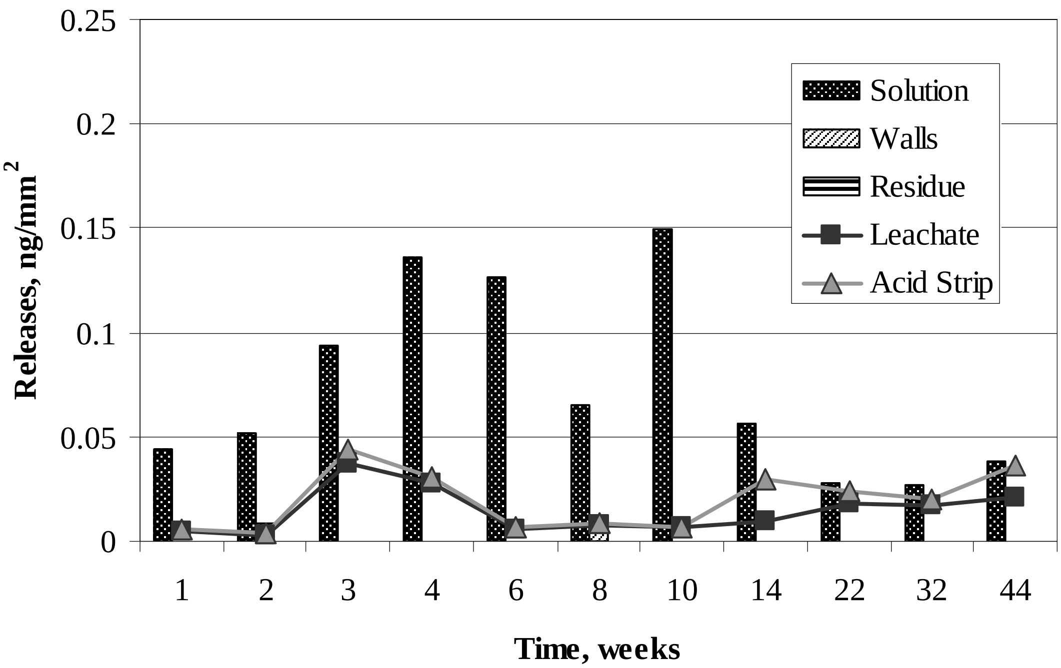


Figure E-130. Paladium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

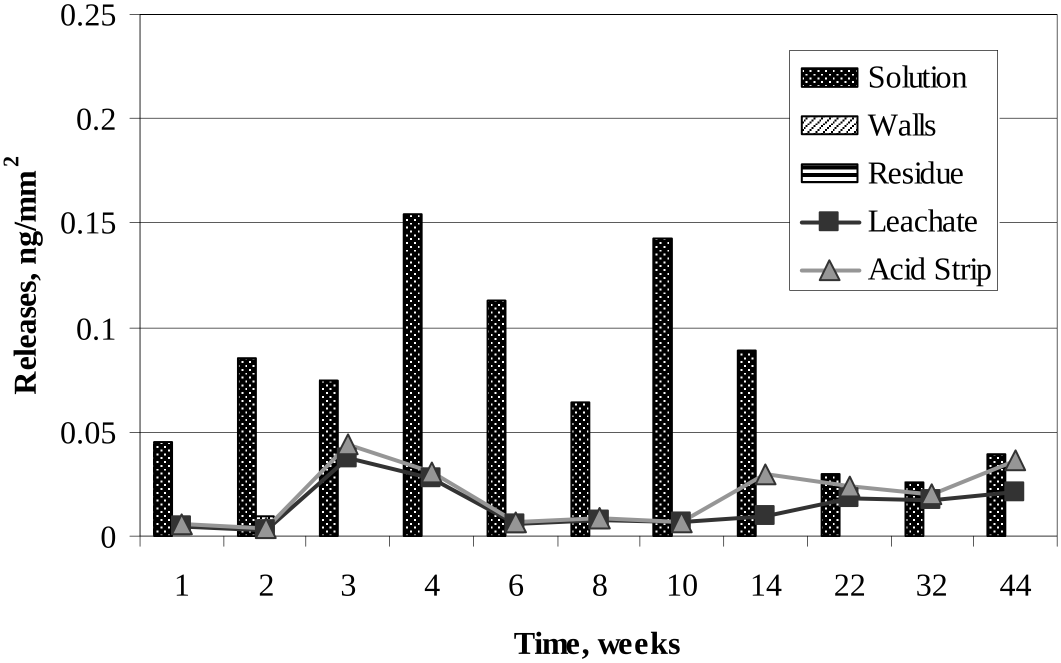


Figure E-131. Paladium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

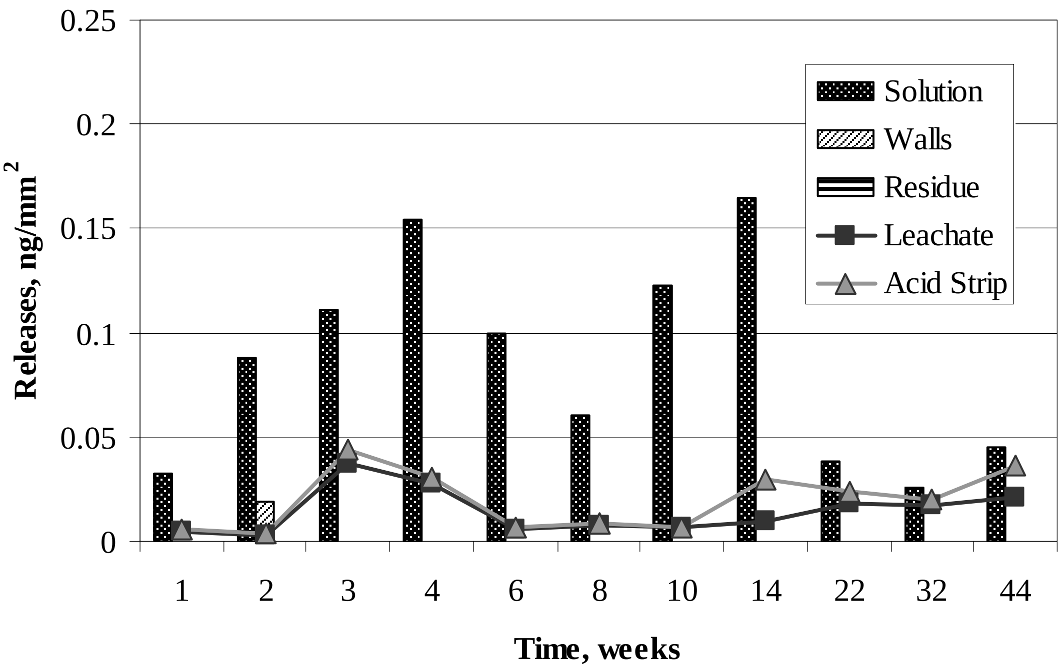


Figure E-132. Paladium Present in Solution, on Walls, and in Residue from CJ13 Control and Average Detection Limits for Leachate and Acid Strip.

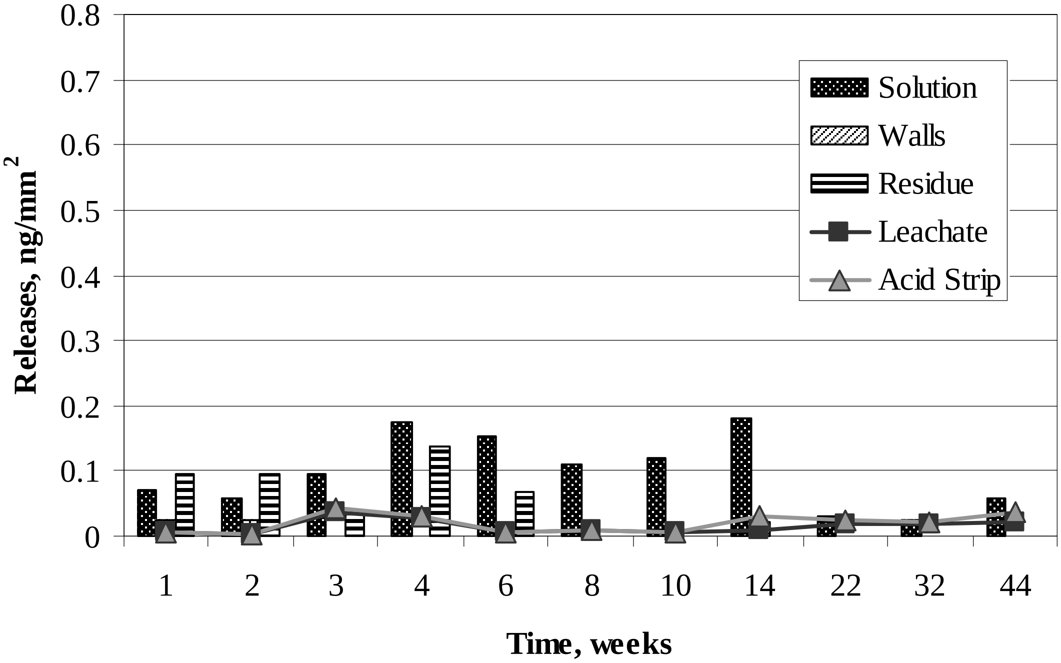


Figure E-133. Paladium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

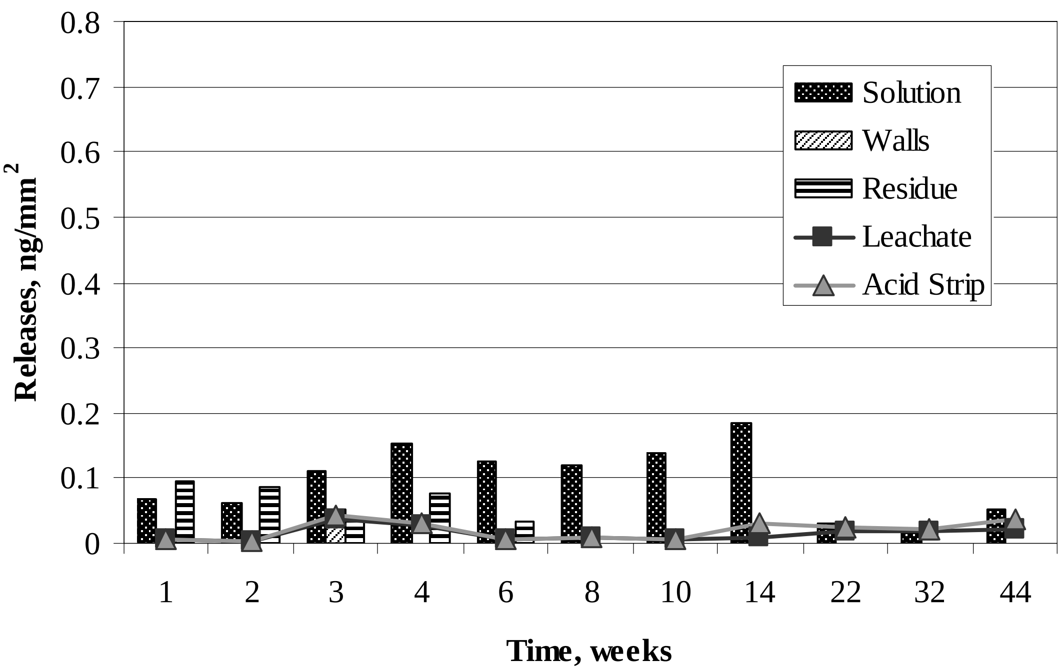


Figure E-134. Paladium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

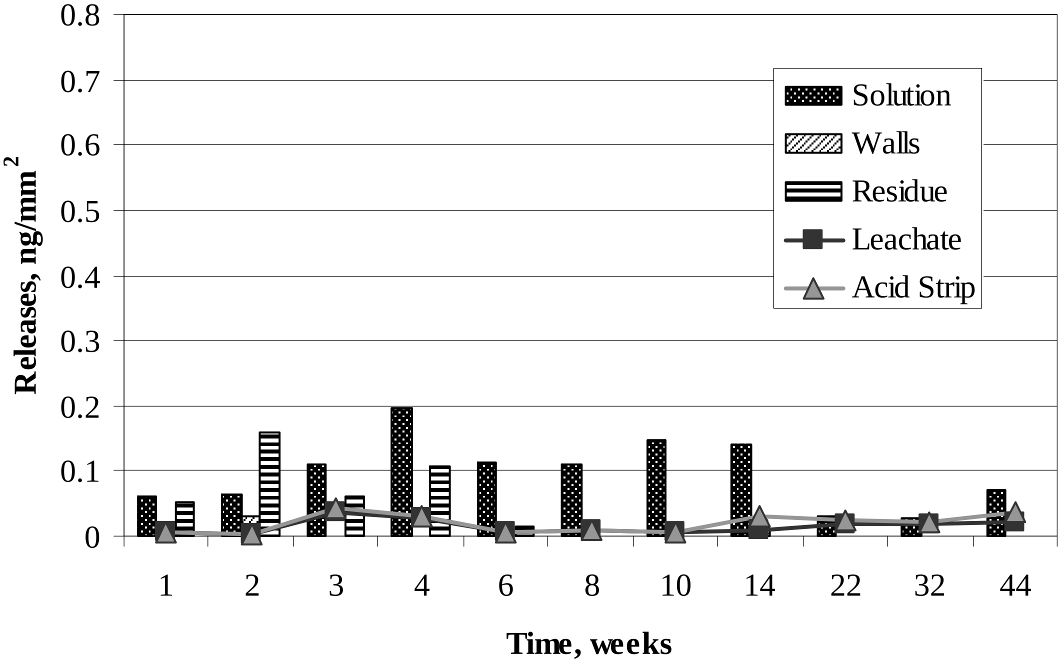


Figure E-135. Paladium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

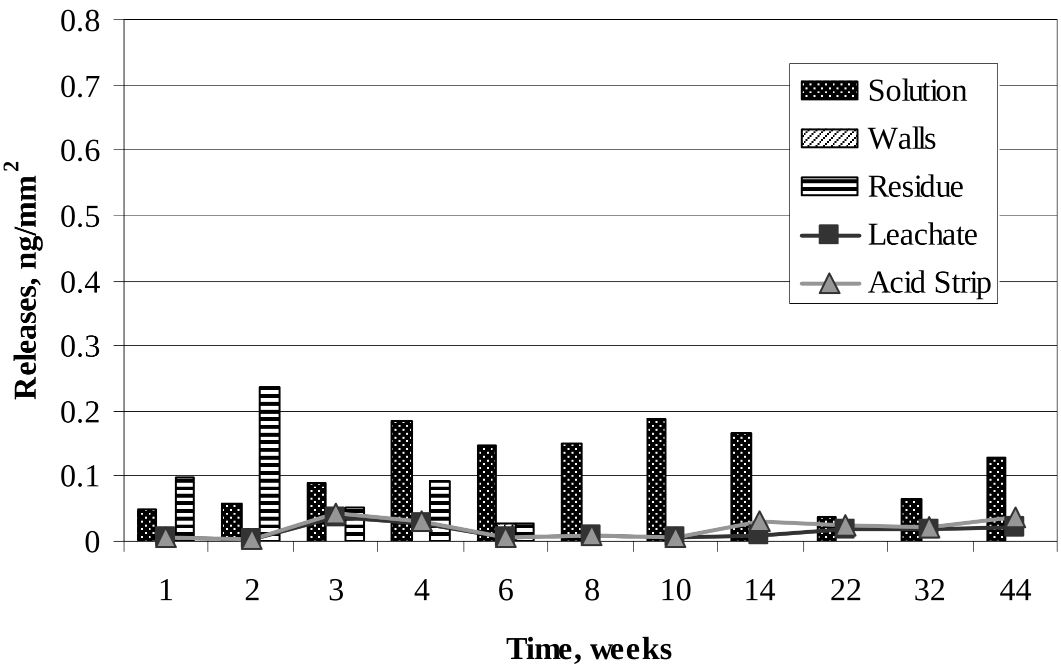


Figure E-136. Paladium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

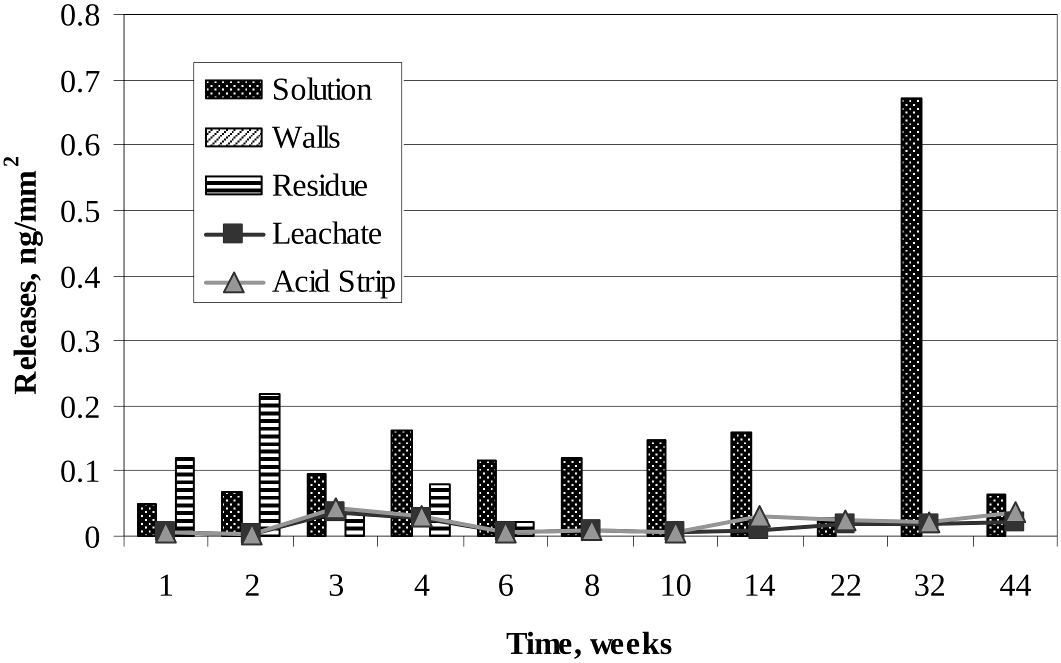


Figure E-137. Paladium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

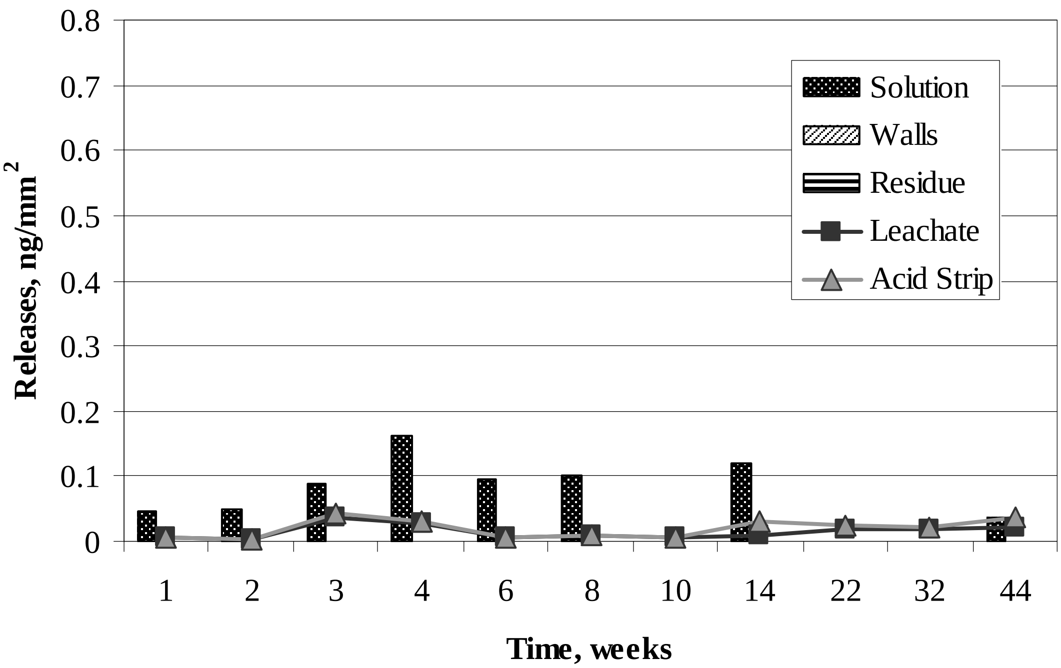


Figure E-138. Paladium Present in Solution, on Walls, and in Residue from 10KCl Control and Average Detection Limits for Leachate and Acid Strip.

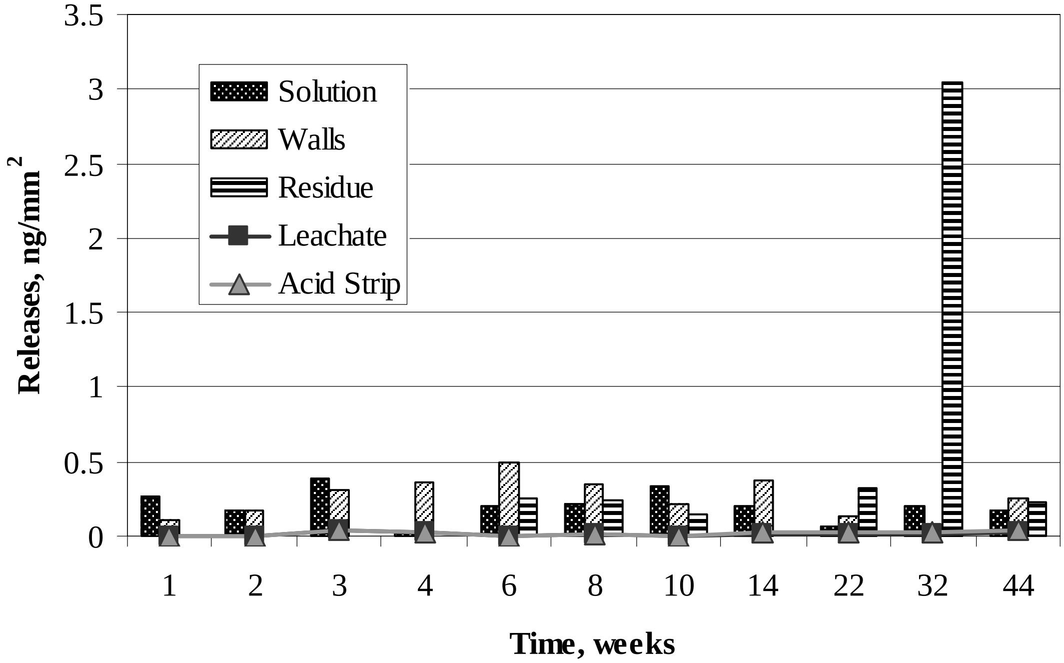


Figure E-139. Paladium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

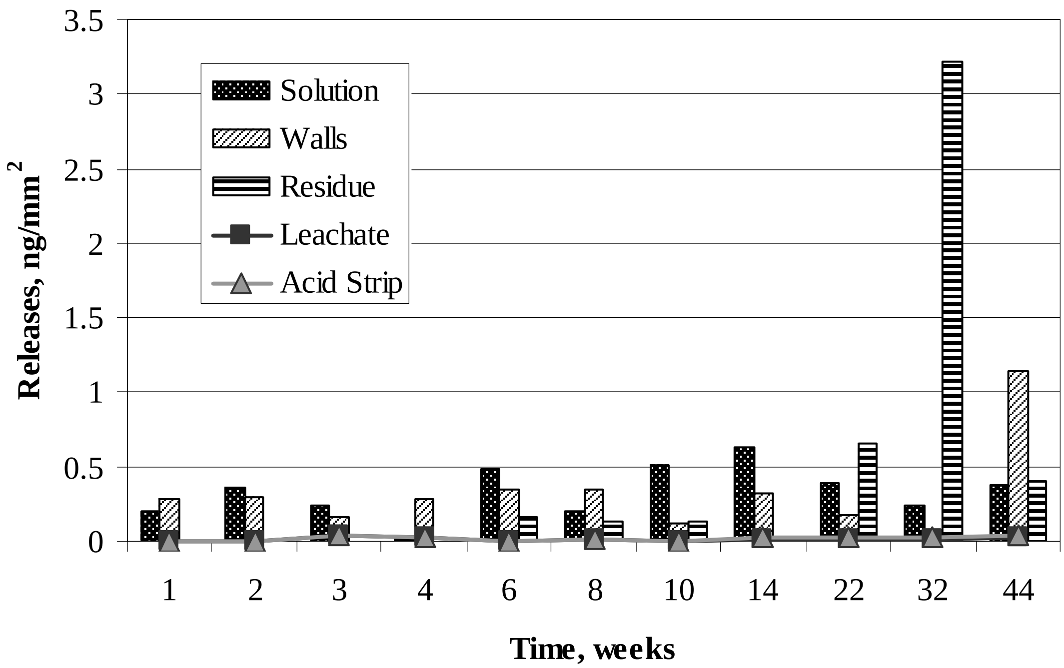


Figure E-140. Paladium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

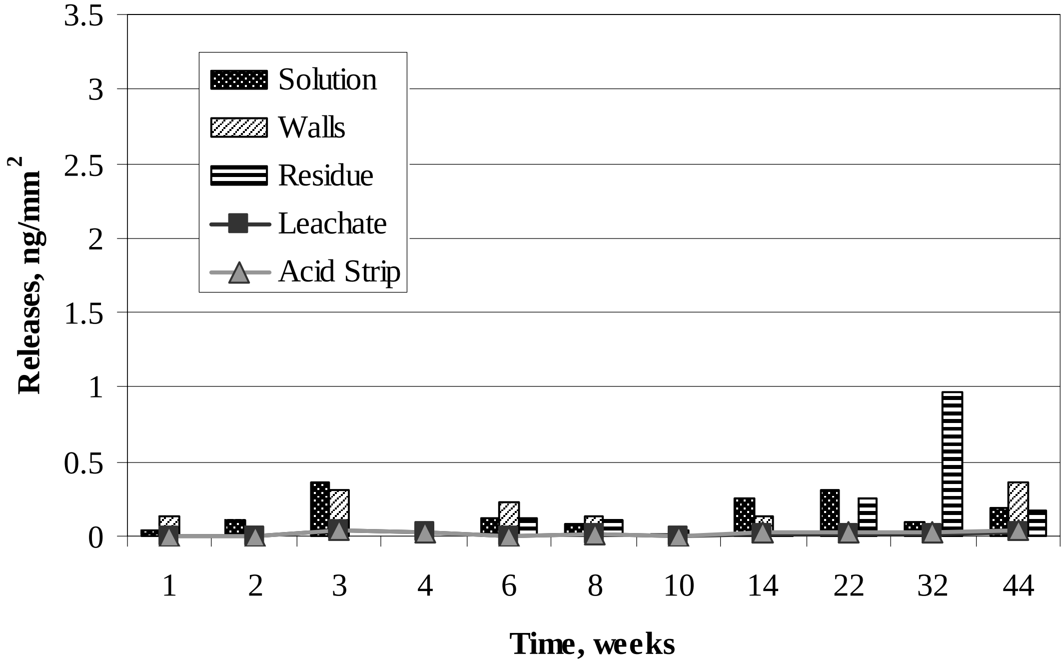


Figure E-141. . Paladium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

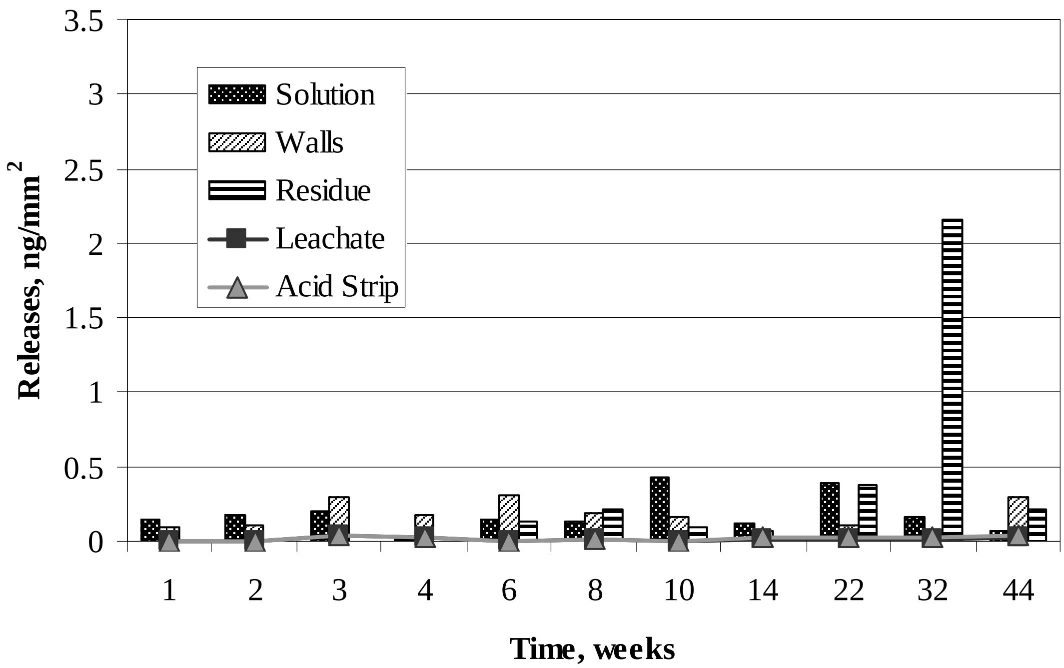


Figure E-142. Paladium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

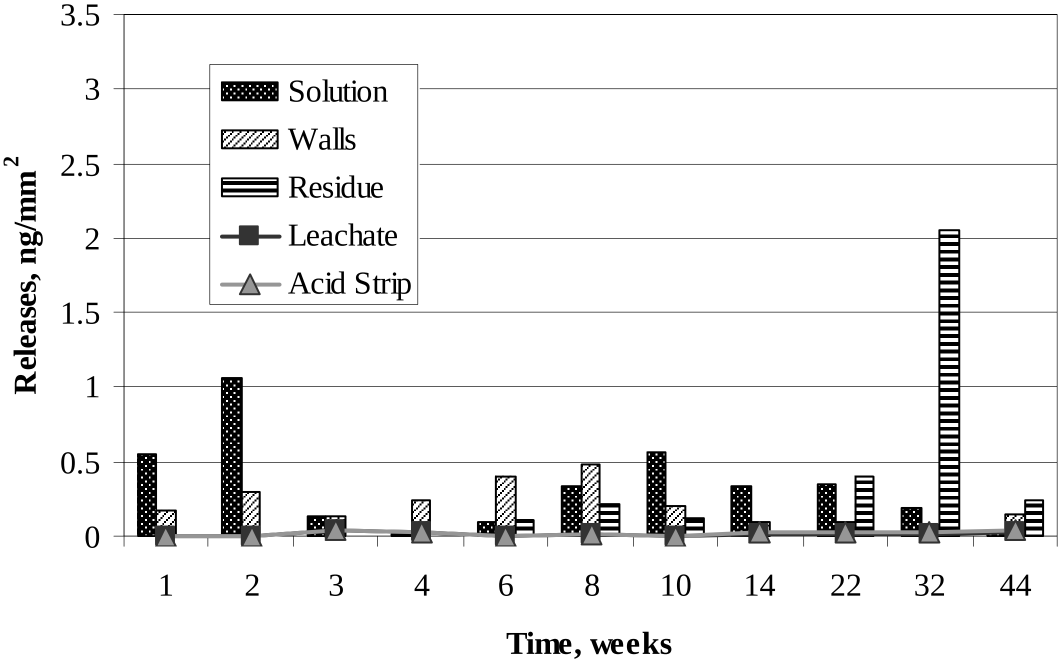


Figure E-143. Paladium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

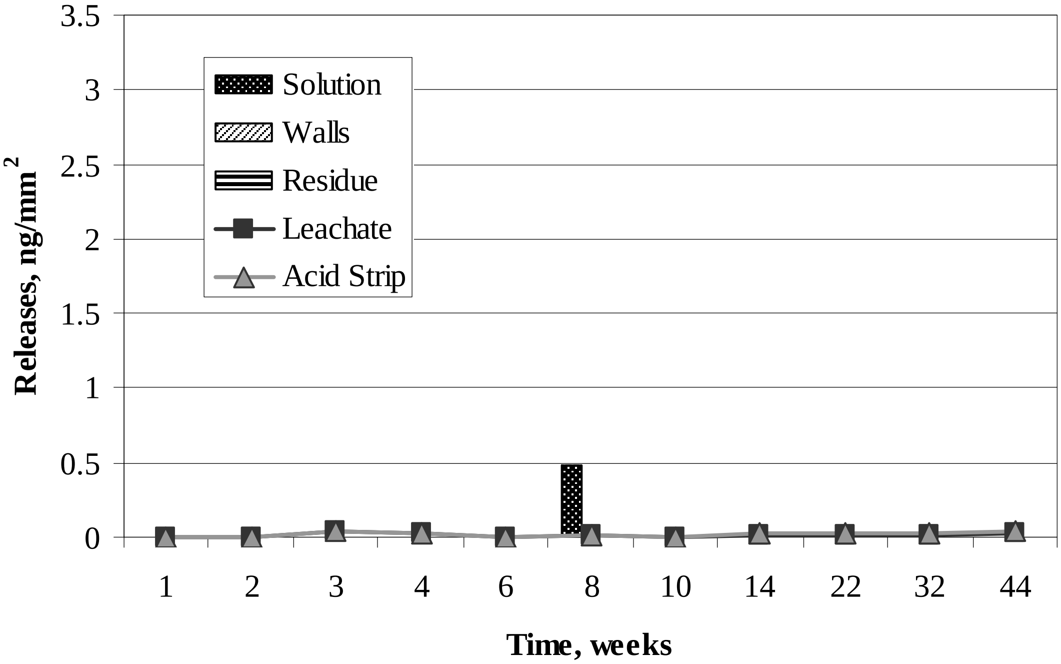


Figure E-144. Paladium Present in Solution, on Walls, and in Residue from AJ13 Control and Average Detection Limits for Leachate and Acid Strip.

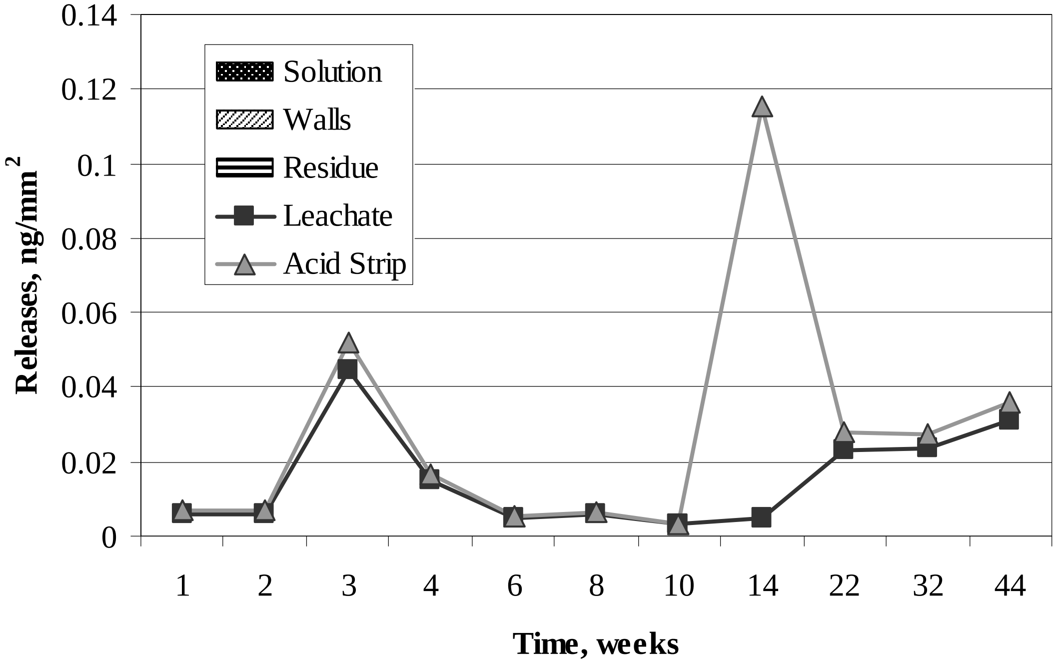


Figure E-145. Rhodium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

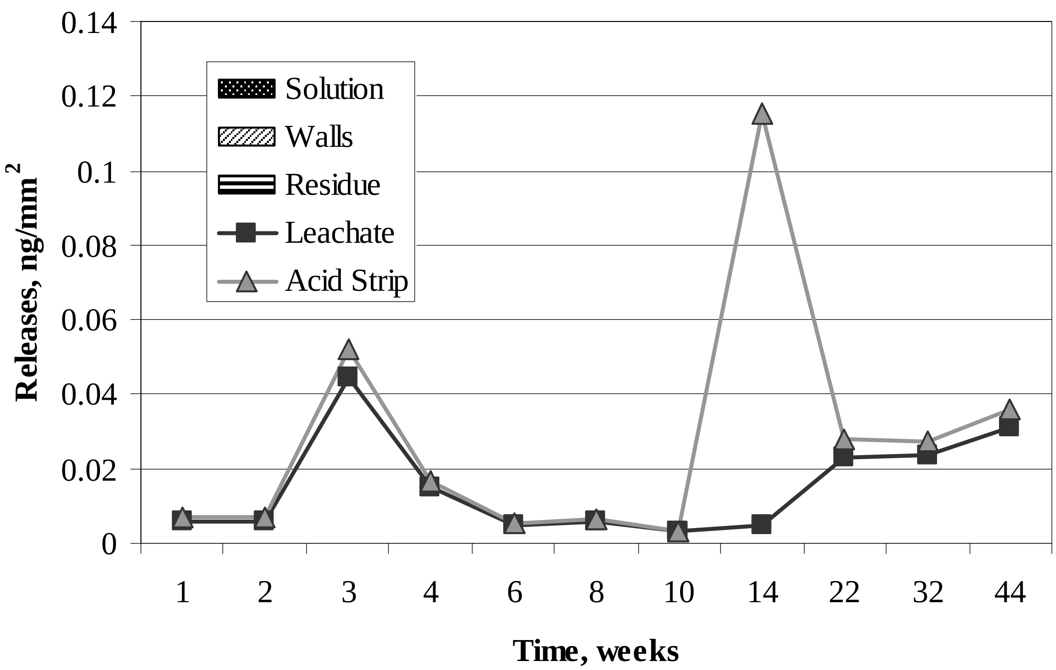


Figure E-146. Rhodium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

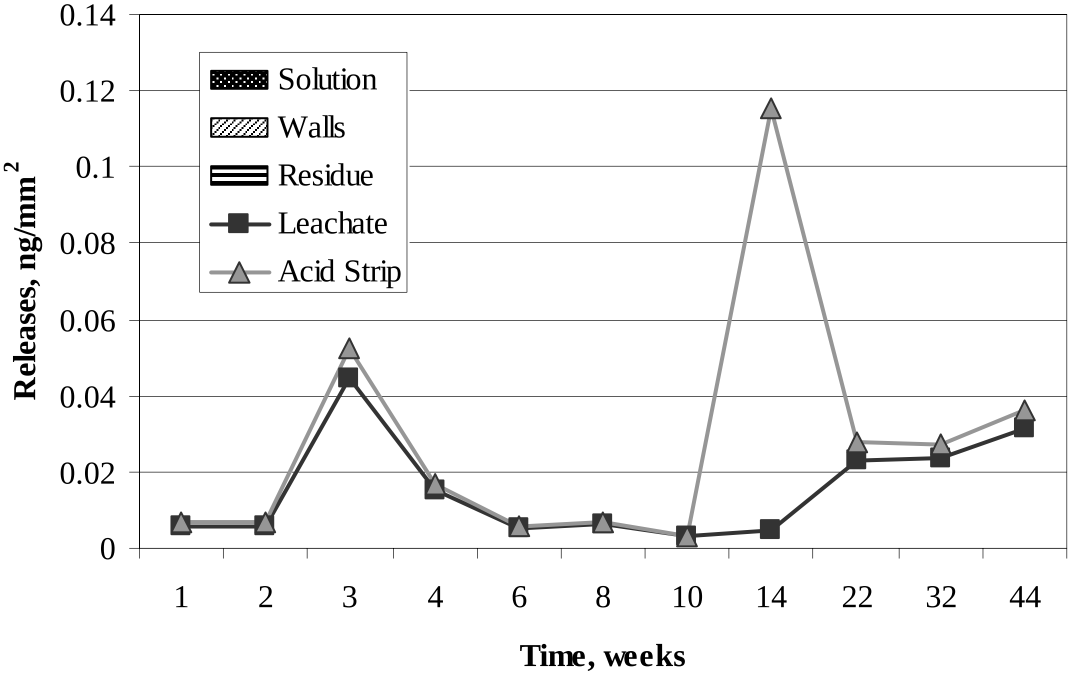


Figure E-147. Rhodium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

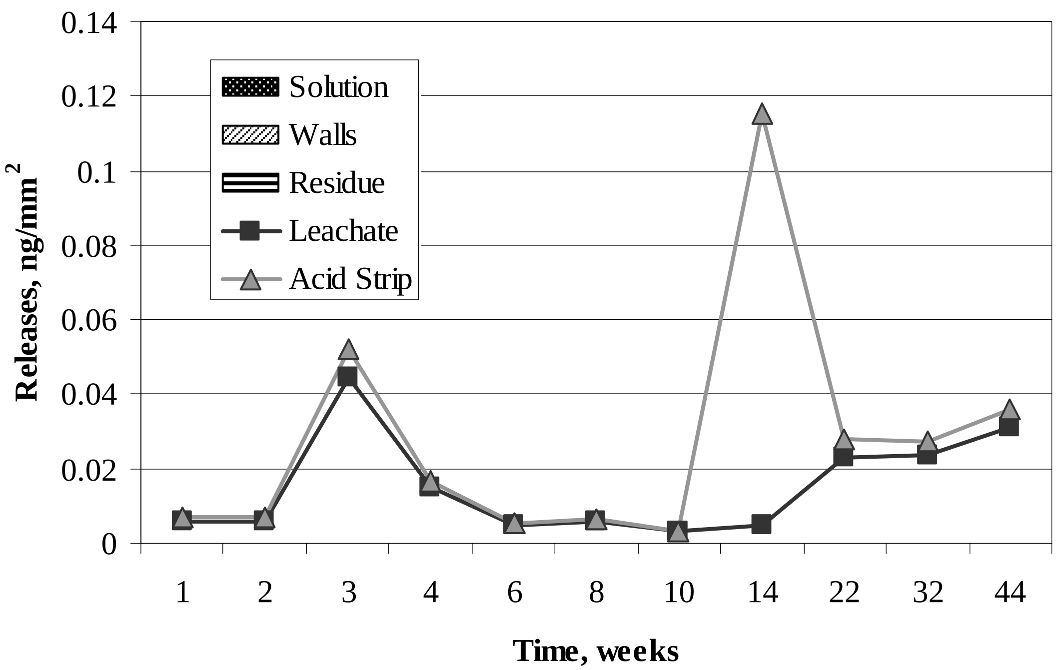


Figure E-148. Rhodium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

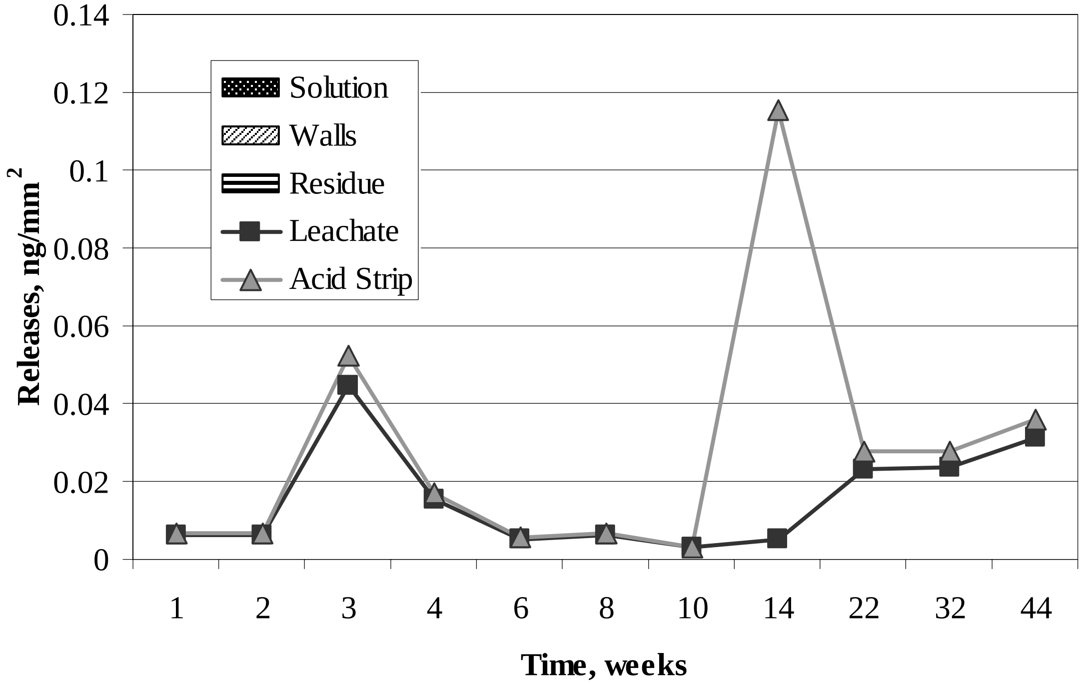


Figure E-149. Rhodium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

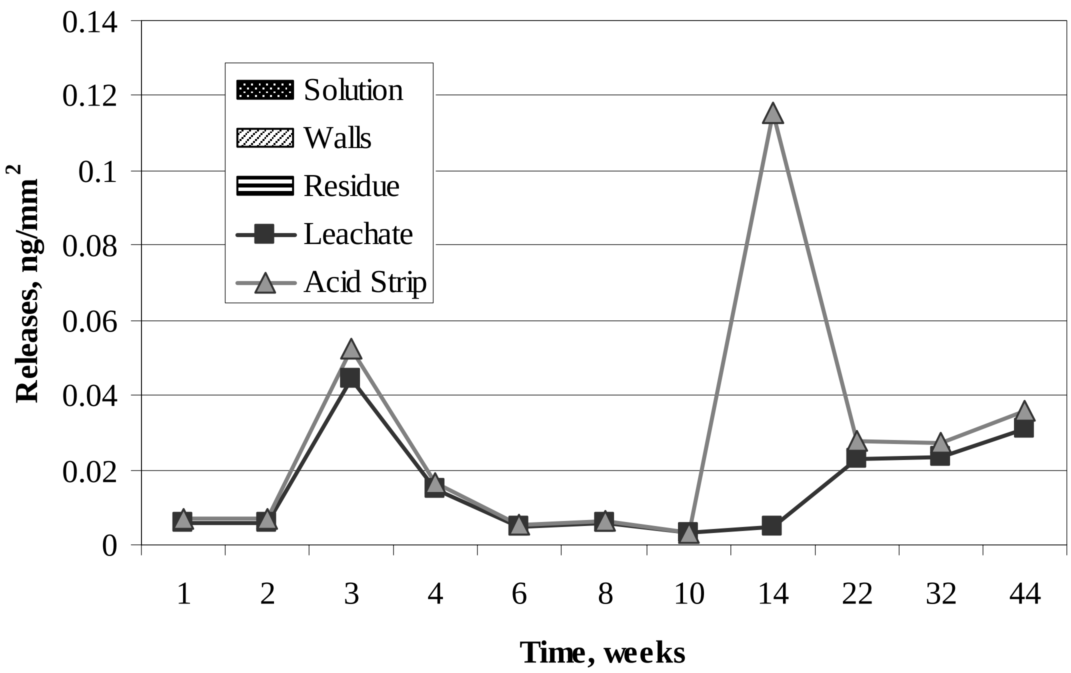


Figure E-150. Rhodium Present in Solution, on Walls, and in Residue from SJ13 Control and Average Detection Limits for Leachate and Acid Strip.

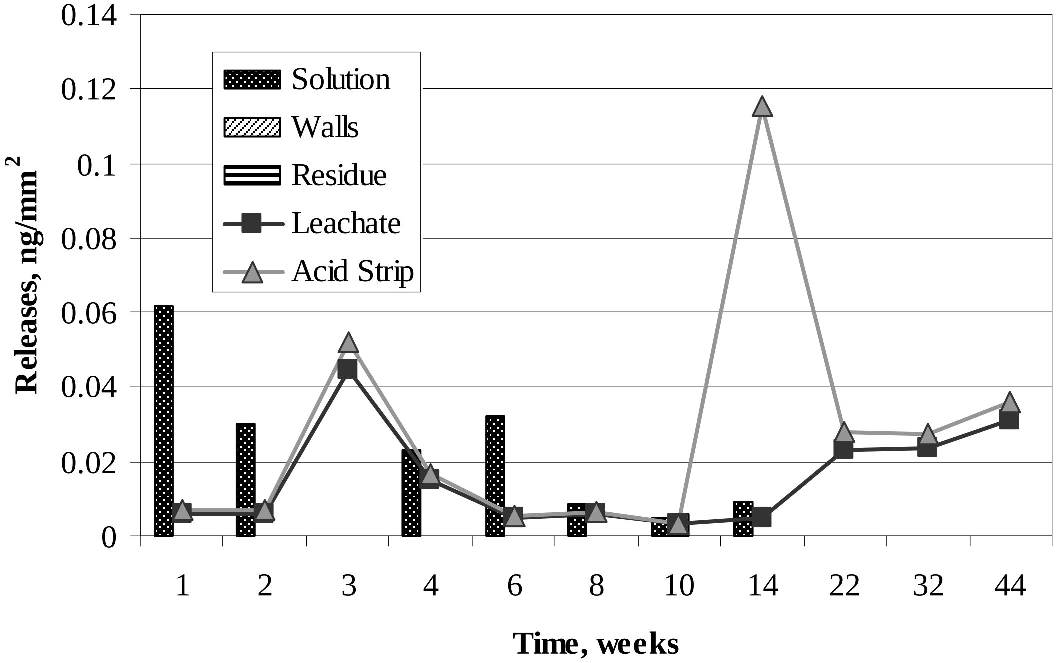


Figure E-151. Rhodium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

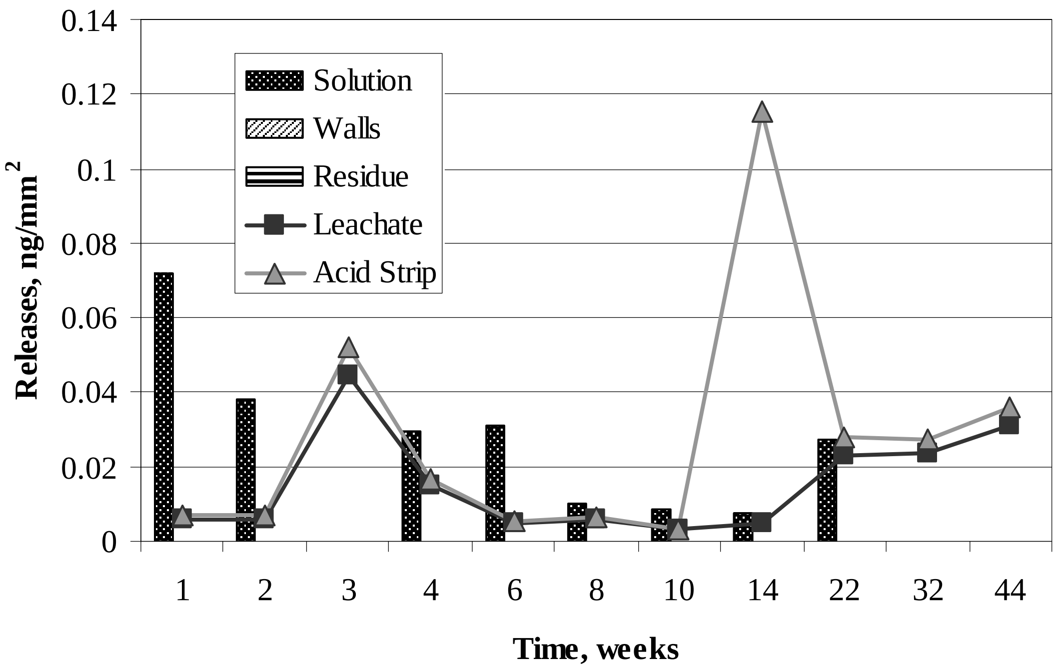


Figure E-152. Rhodium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

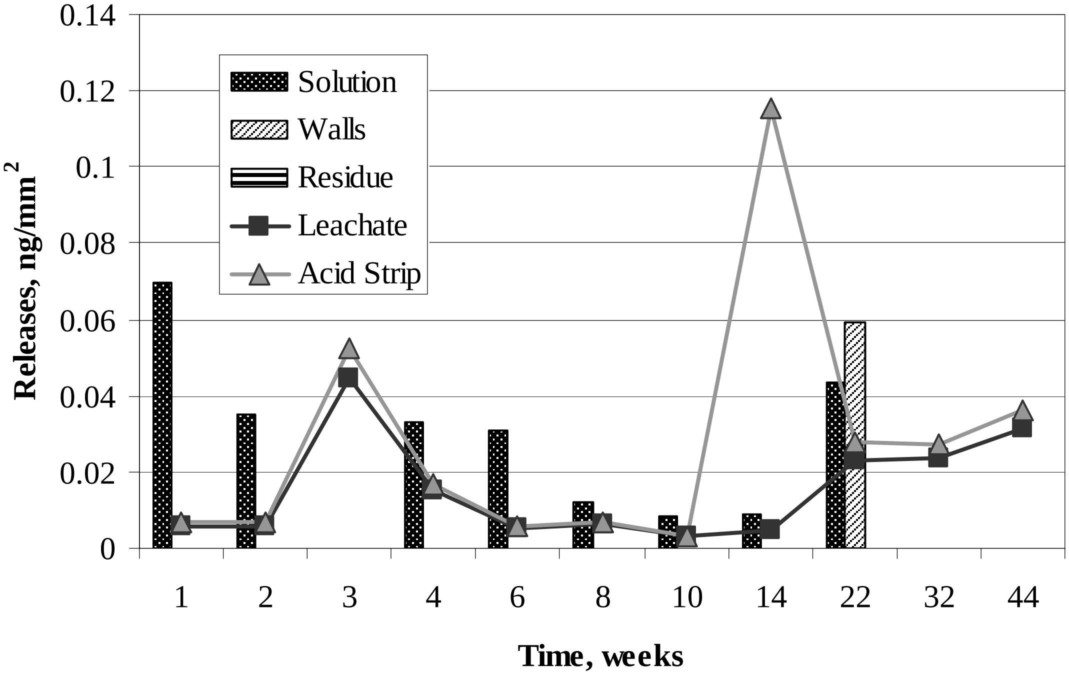


Figure E-153. Rhodium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

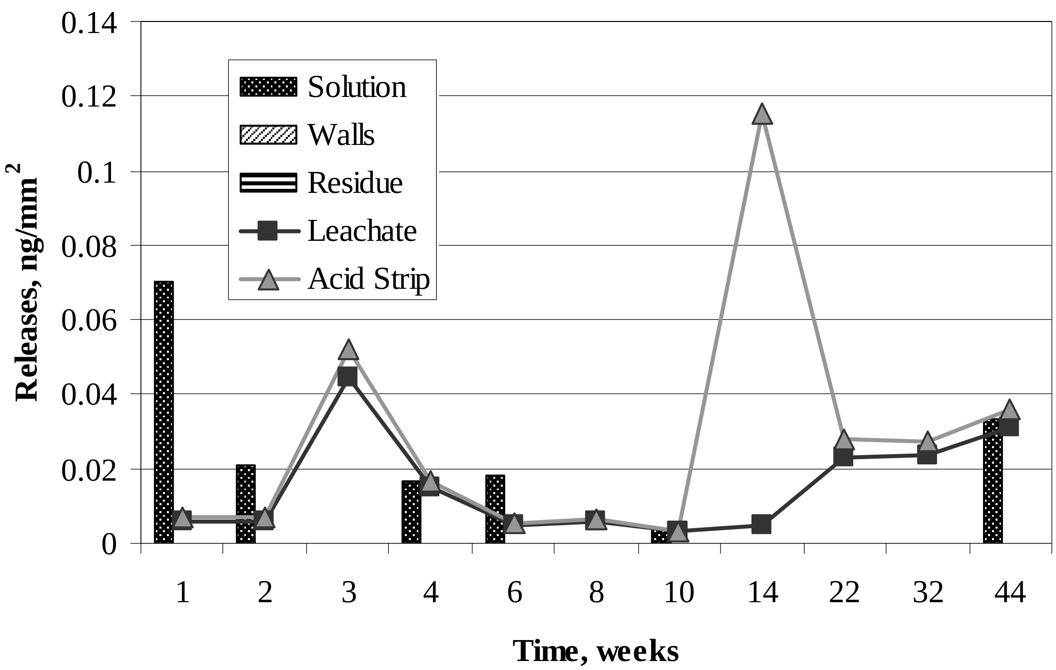


Figure E-154. Rhodium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

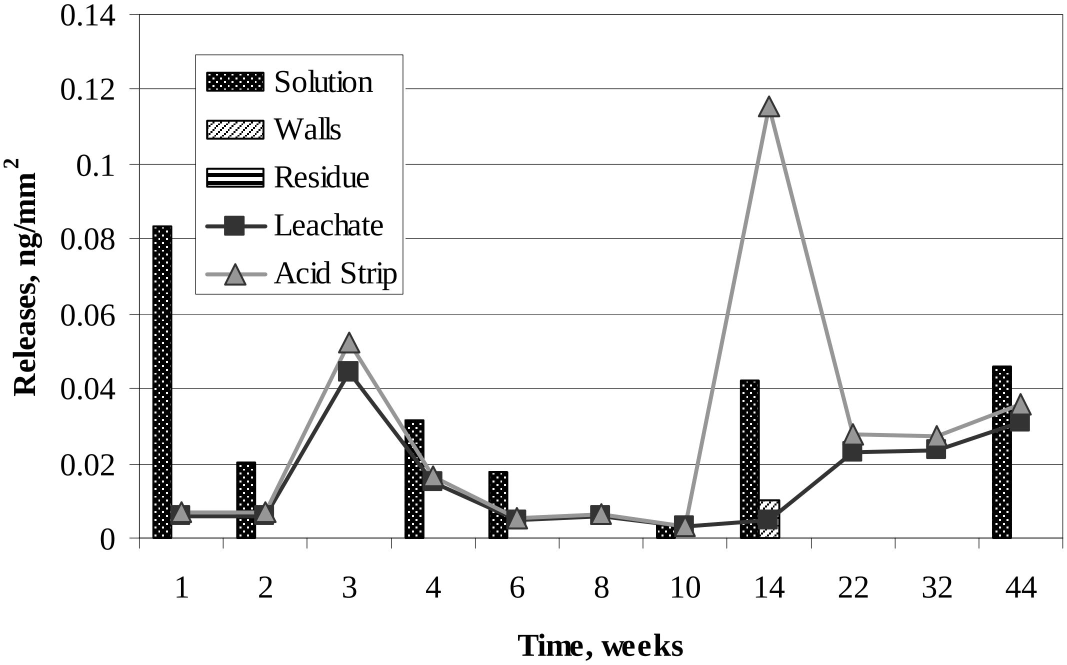


Figure E-155. Rhodium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

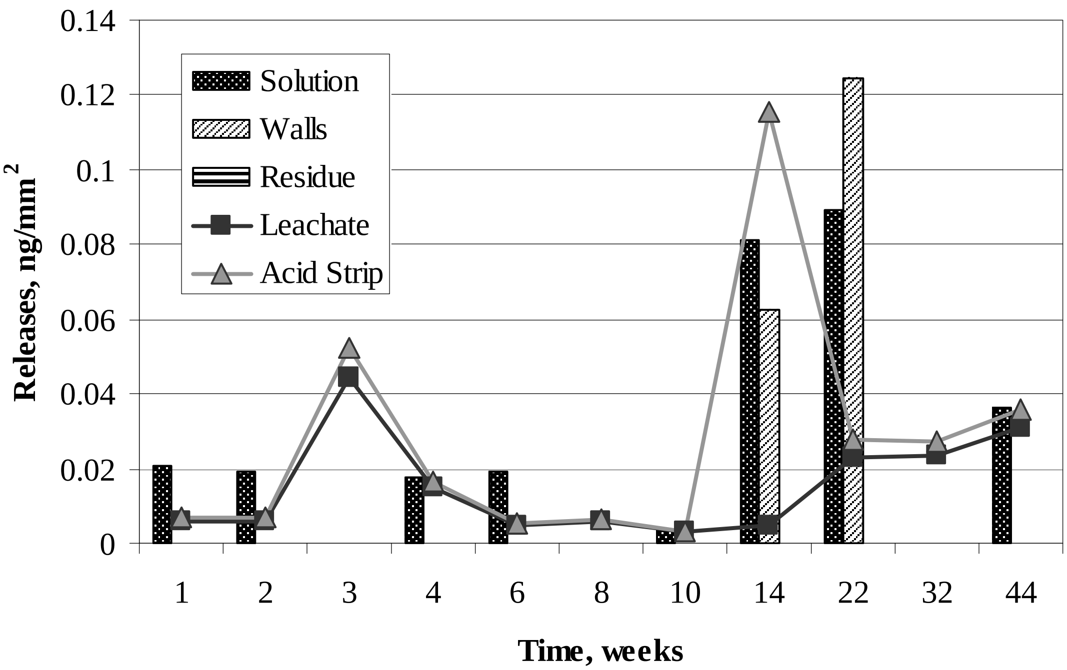


Figure E-156. Rhodium Present in Solution, on Walls, and in Residue from CJ13 Control and Average Detection Limits for Leachate and Acid Strip.

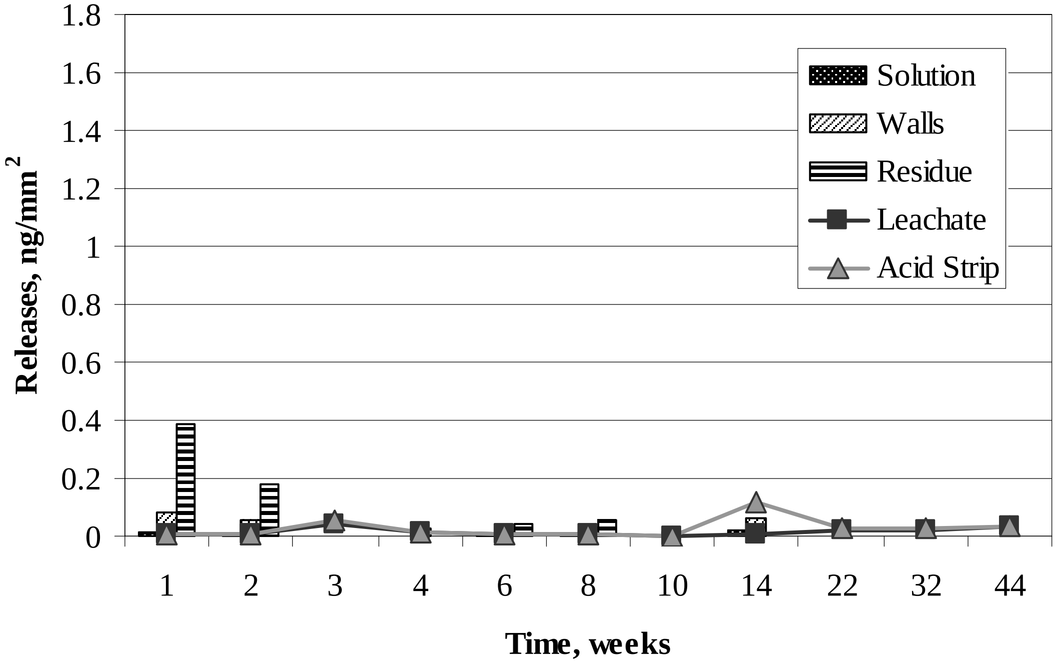


Figure E-157. Rhodium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

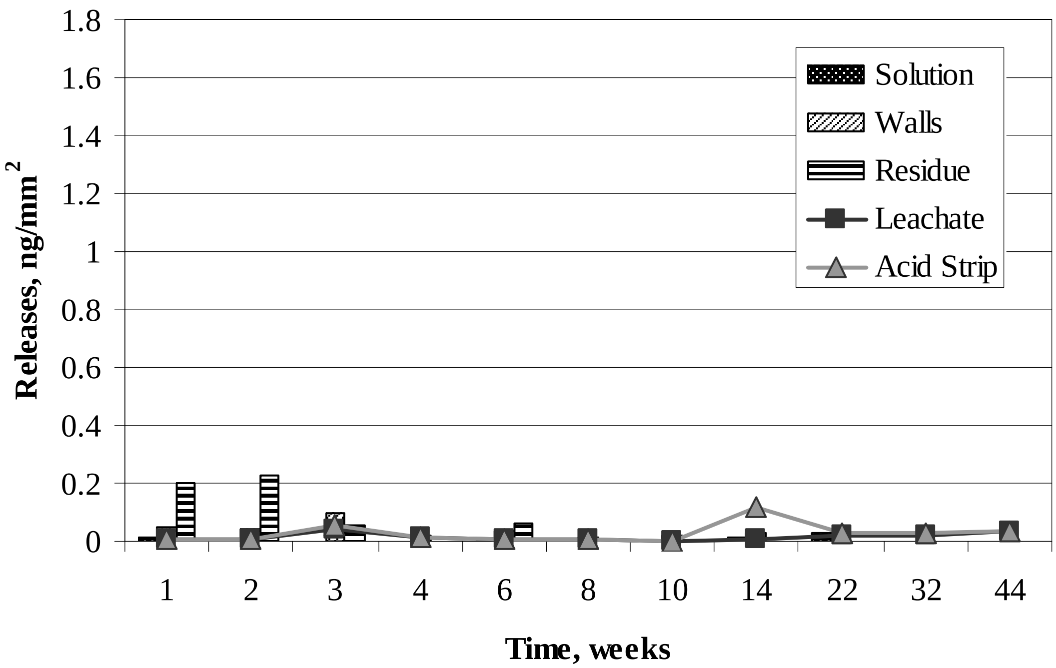


Figure E-158. Rhodium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

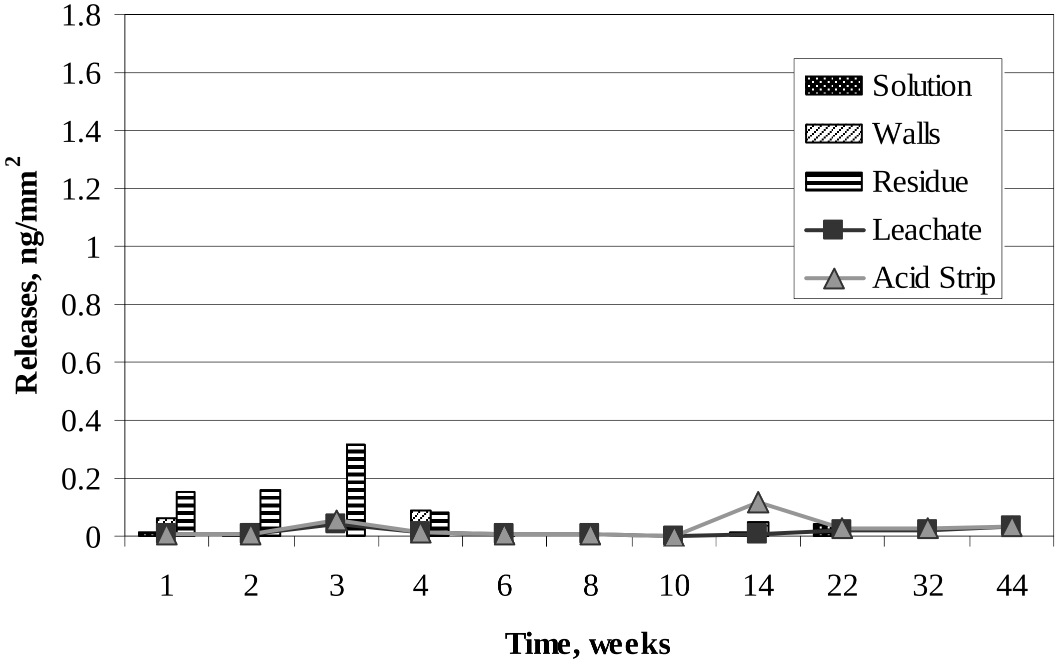


Figure E-159. Rhodium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

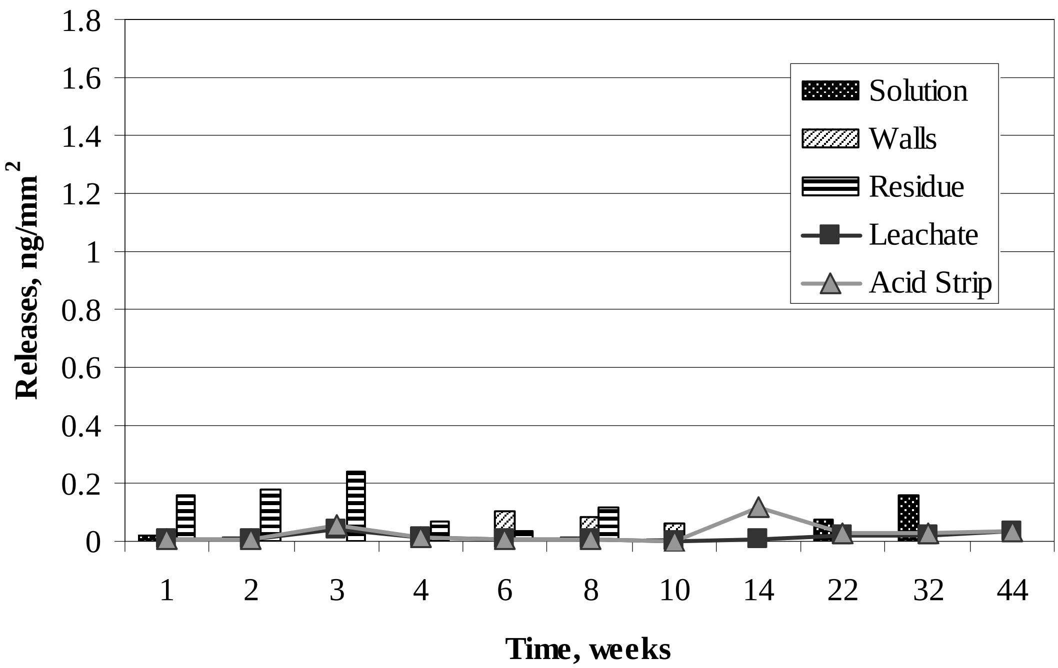


Figure E-160. Rhodium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

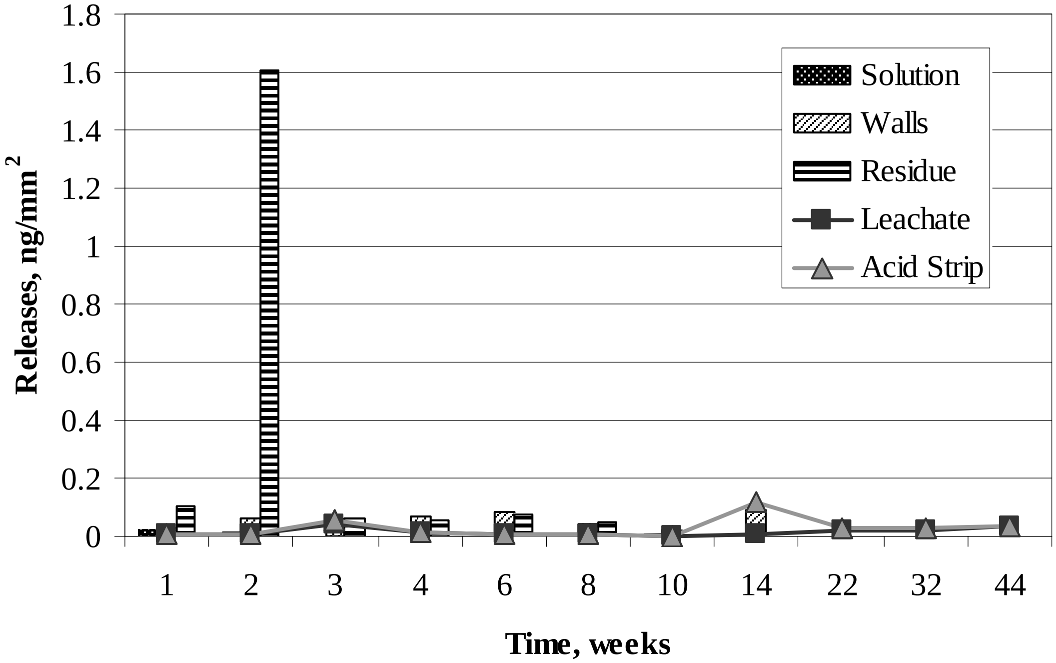


Figure E-161. Rhodium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

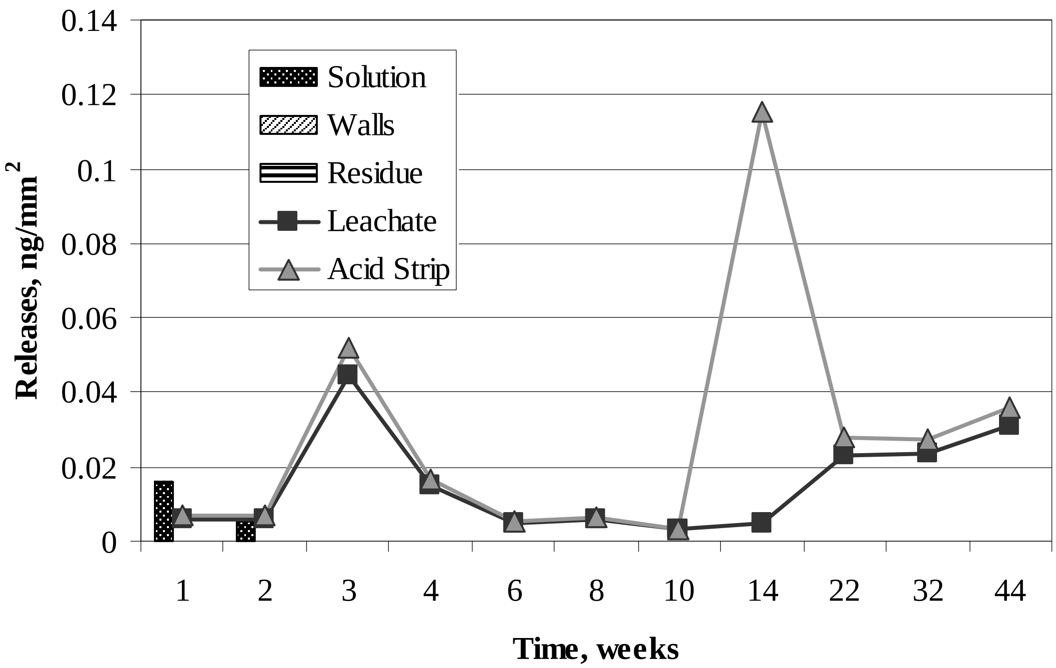


Figure E-162. Rhodium Present in Solution, on Walls, and in Residue from 10KCl Control and Average Detection Limits for Leachate and Acid Strip.

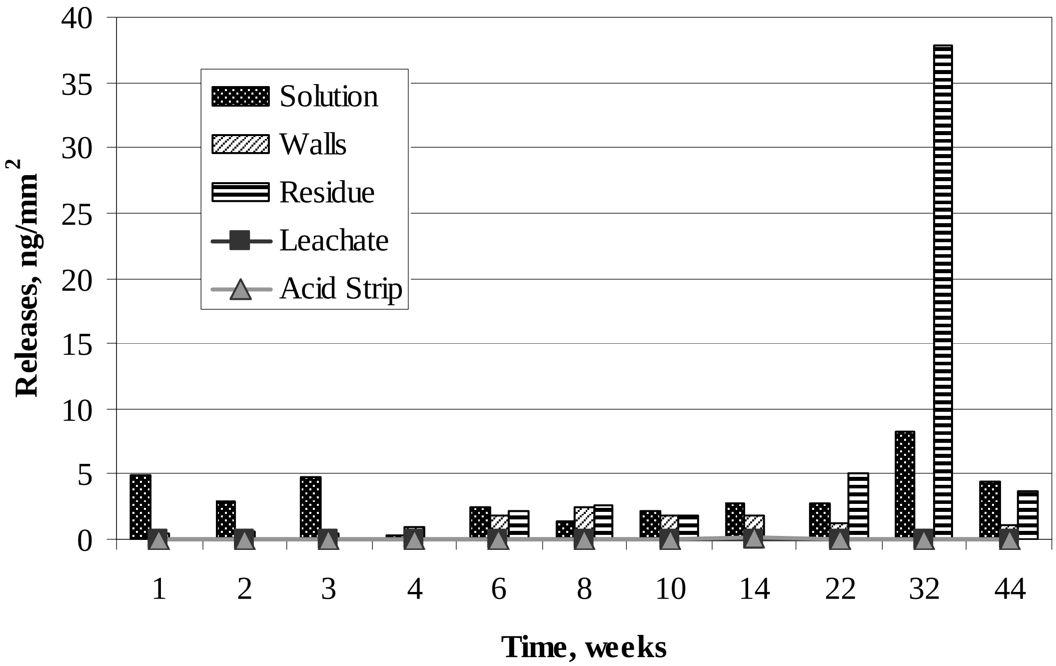


Figure E-163. Rhodium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

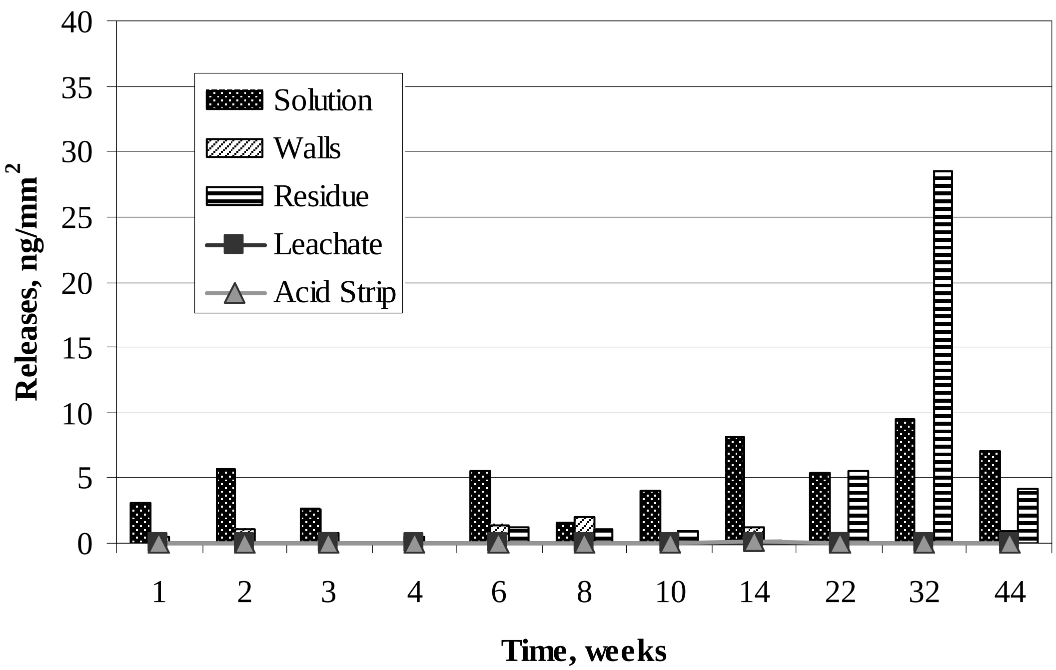


Figure E-164. Rhodium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

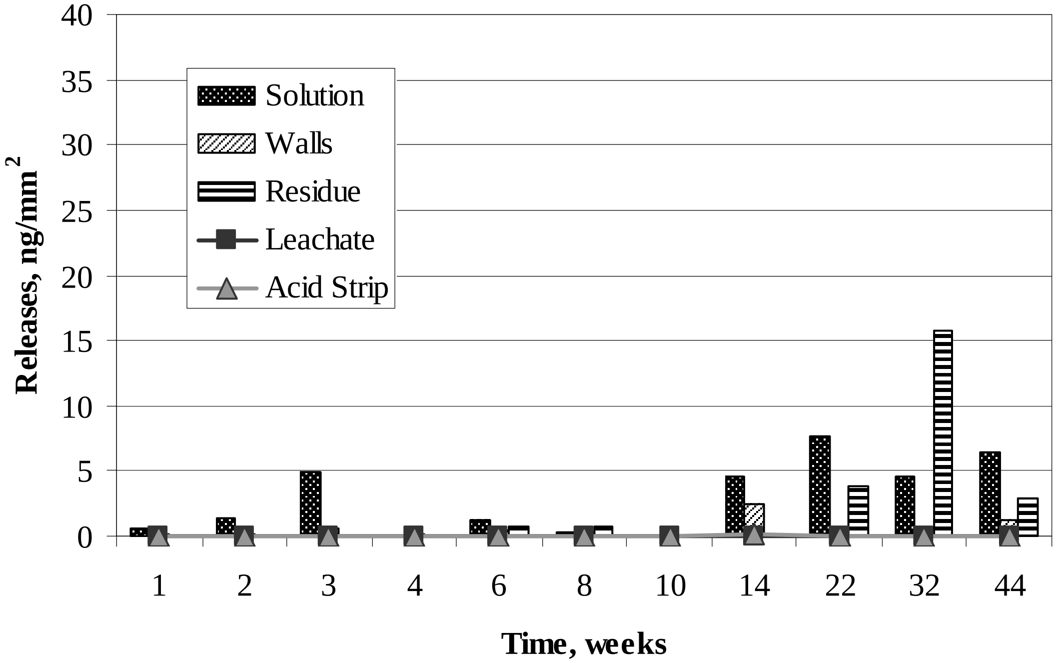


Figure E-165. Rhodium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

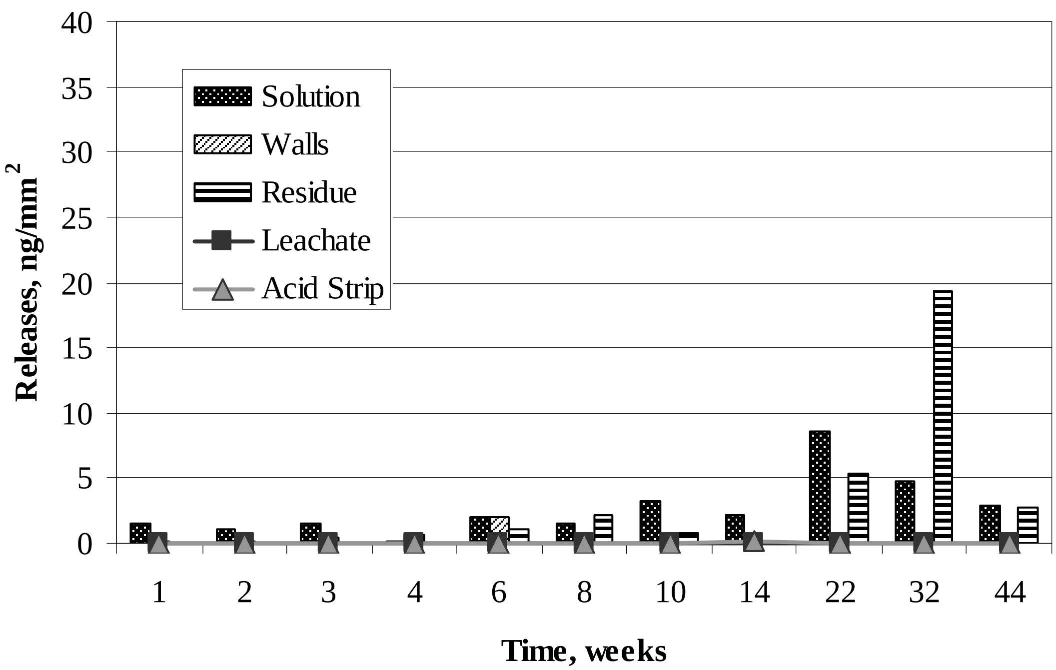


Figure E-166. Rhodium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

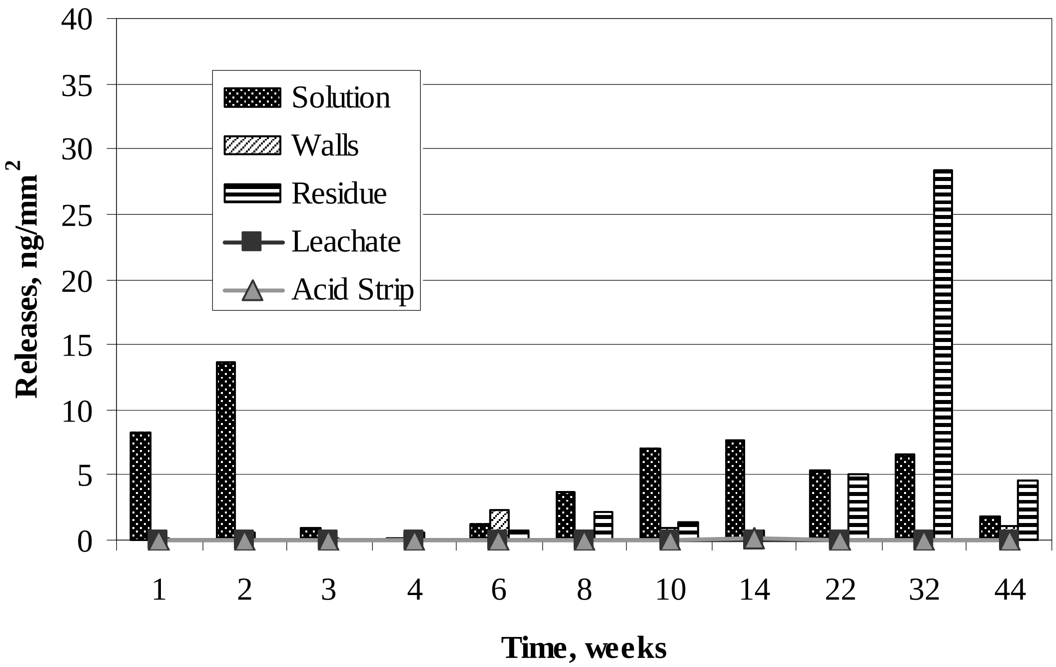


Figure E-167. Rhodium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

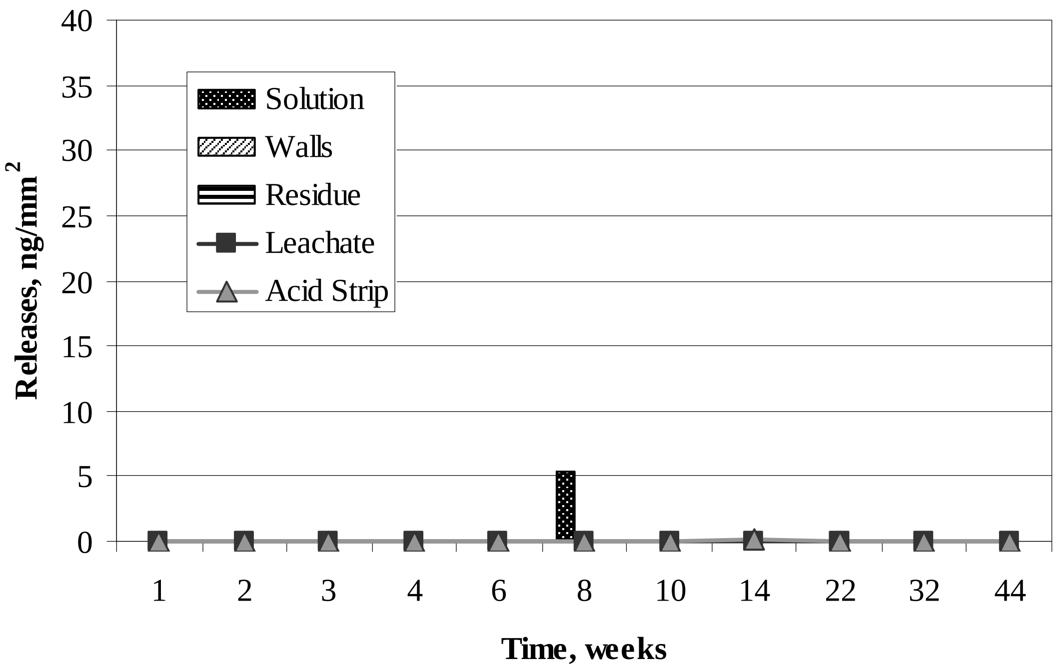


Figure E-168. Rhodium Present in Solution, on Walls, and in Residue from AJ13 Control and Average Detection Limits for Leachate and Acid Strip.

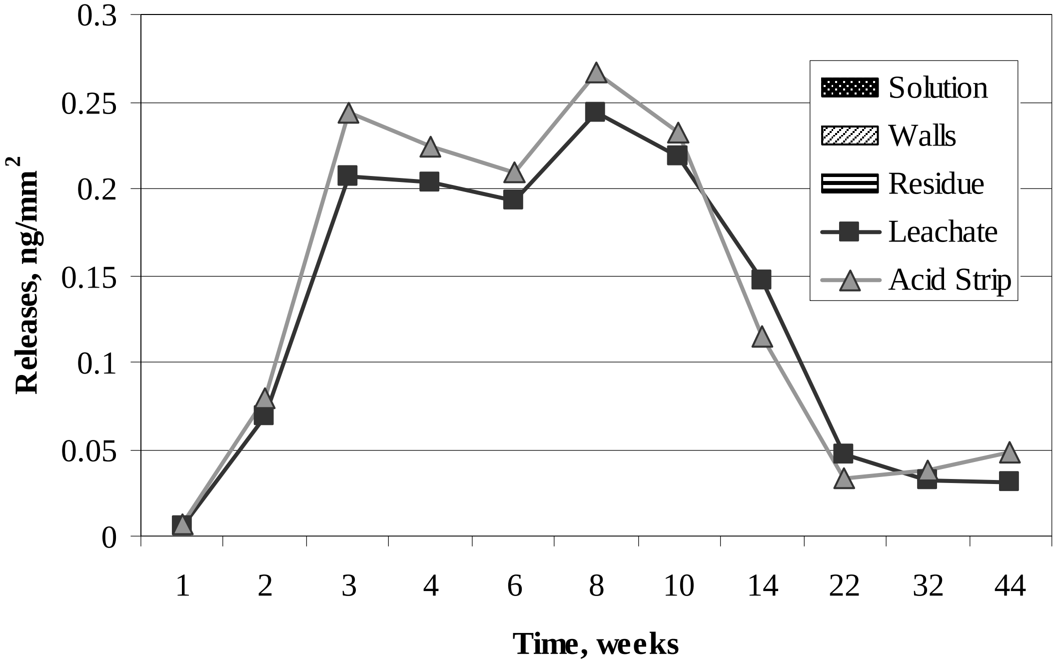


Figure E-169. Ruthenium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

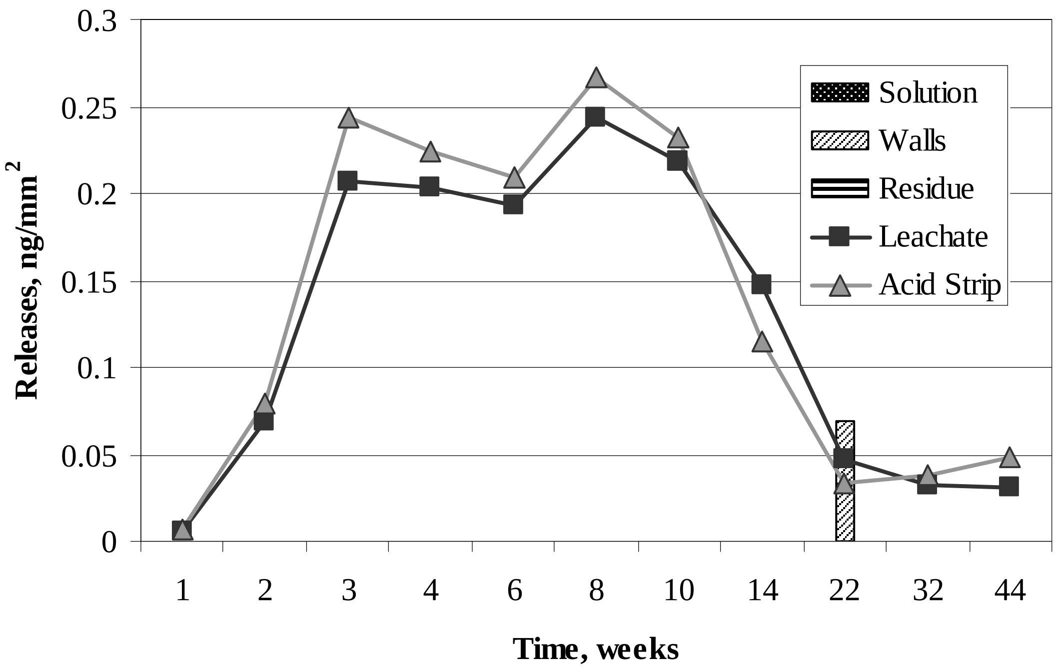


Figure E-170. Ruthenium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

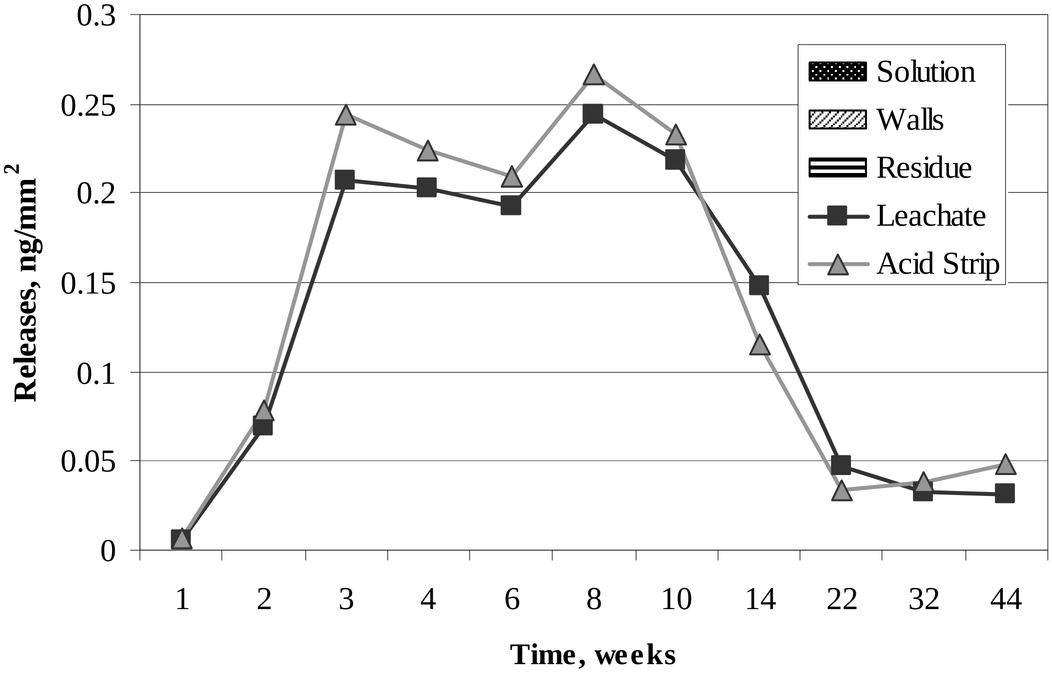


Figure E-171. Ruthenium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

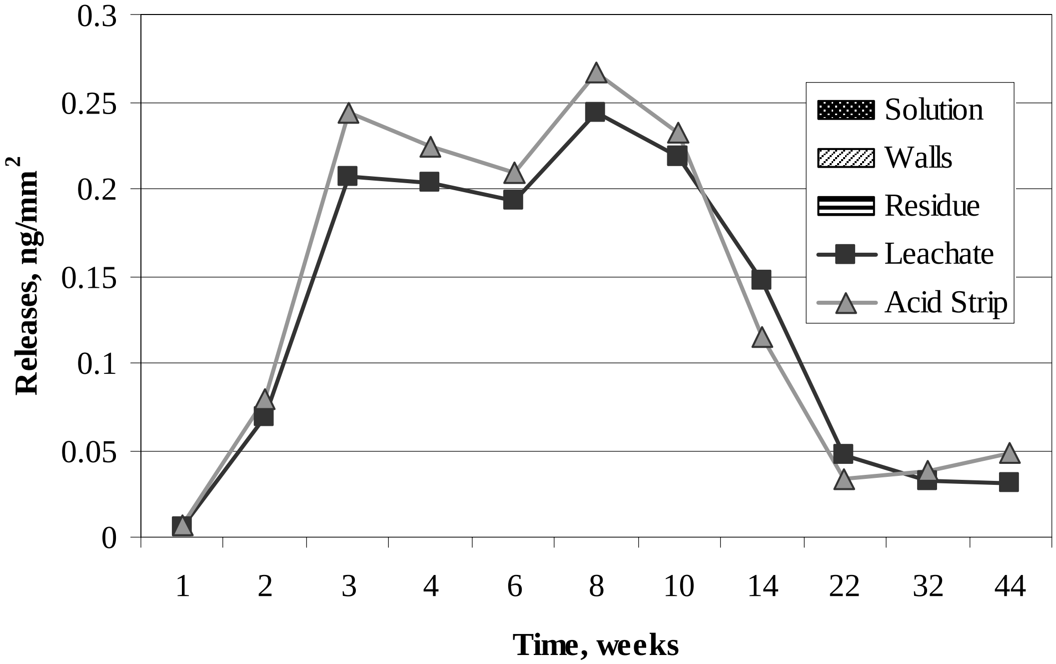


Figure E-172. Ruthenium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

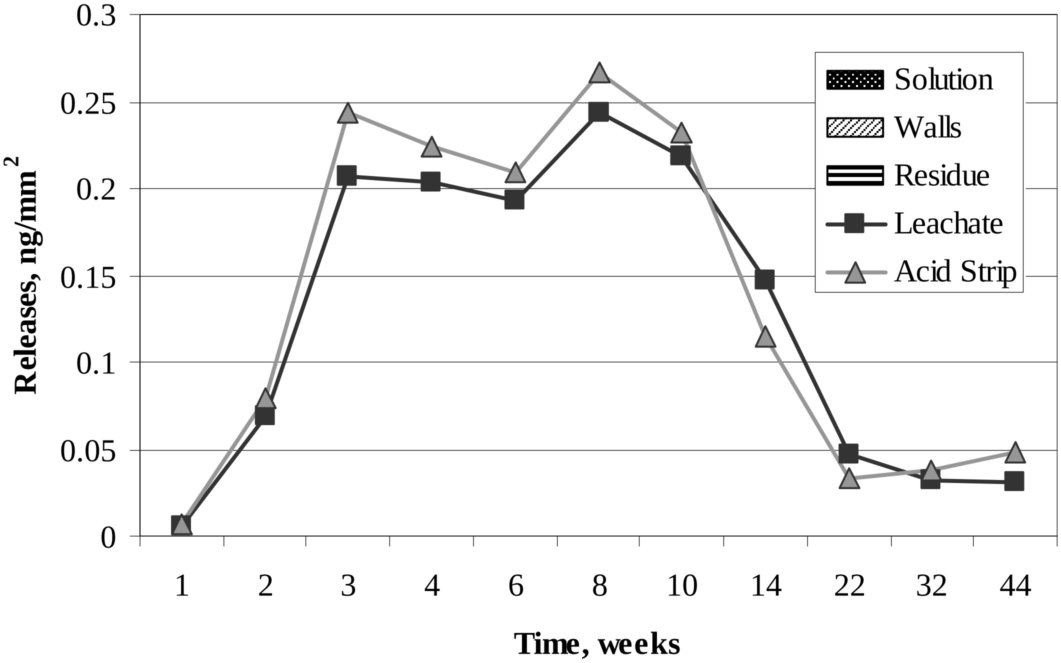


Figure E-173. Ruthenium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

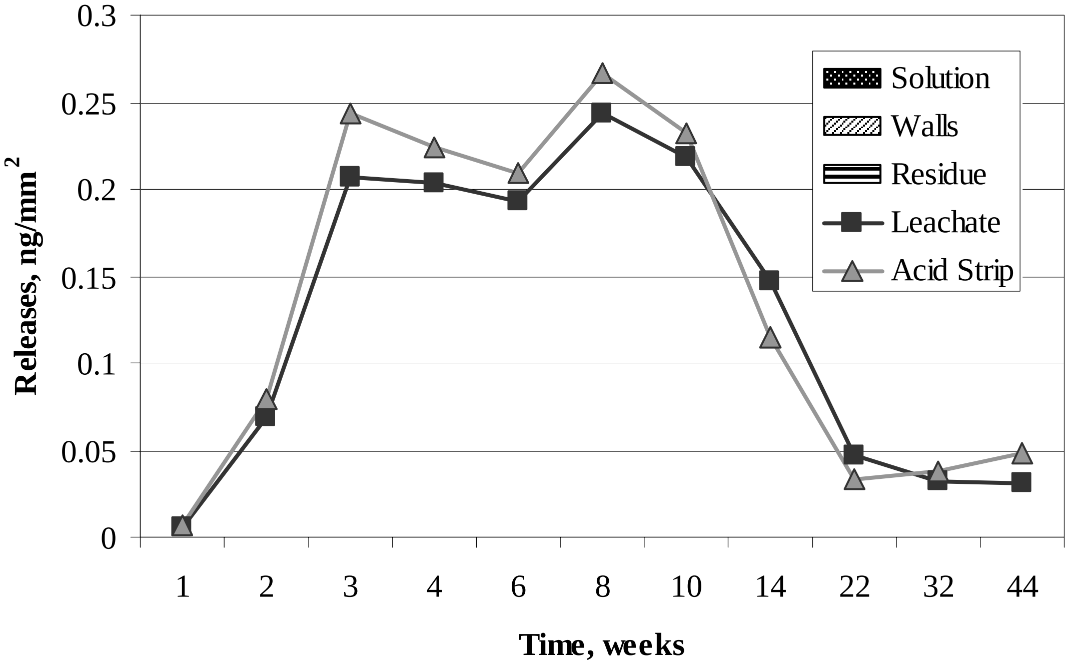


Figure E-174. Ruthenium Present in Solution, on Walls, and in Residue from SJ13 Control and Average Detection Limits for Leachate and Acid Strip.

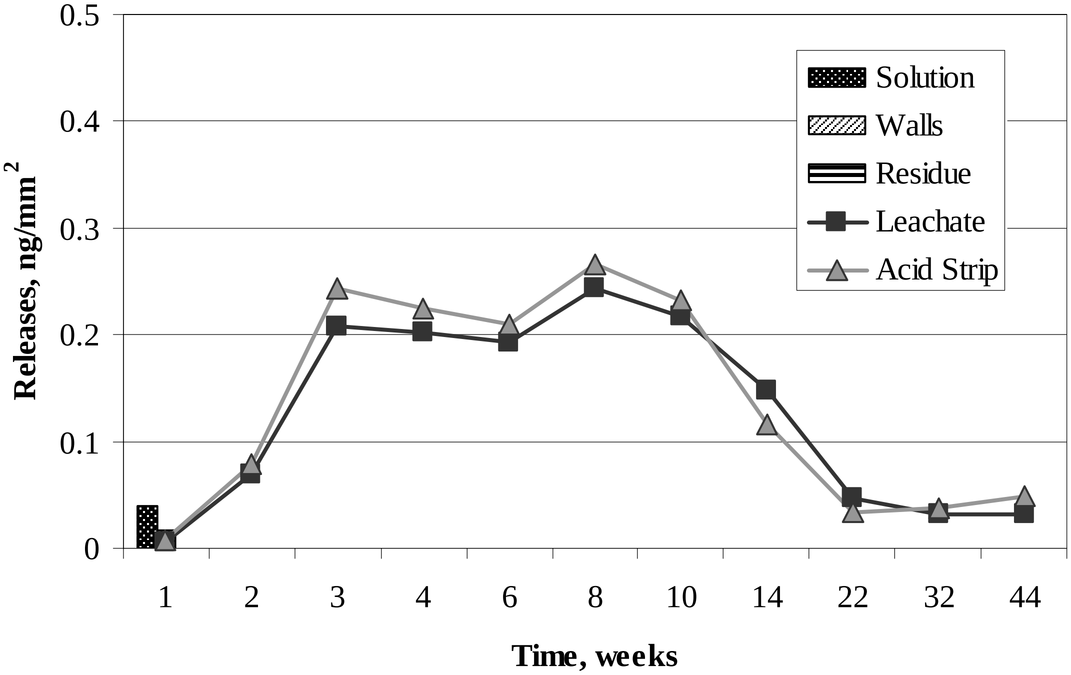


Figure E-175. Ruthenium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

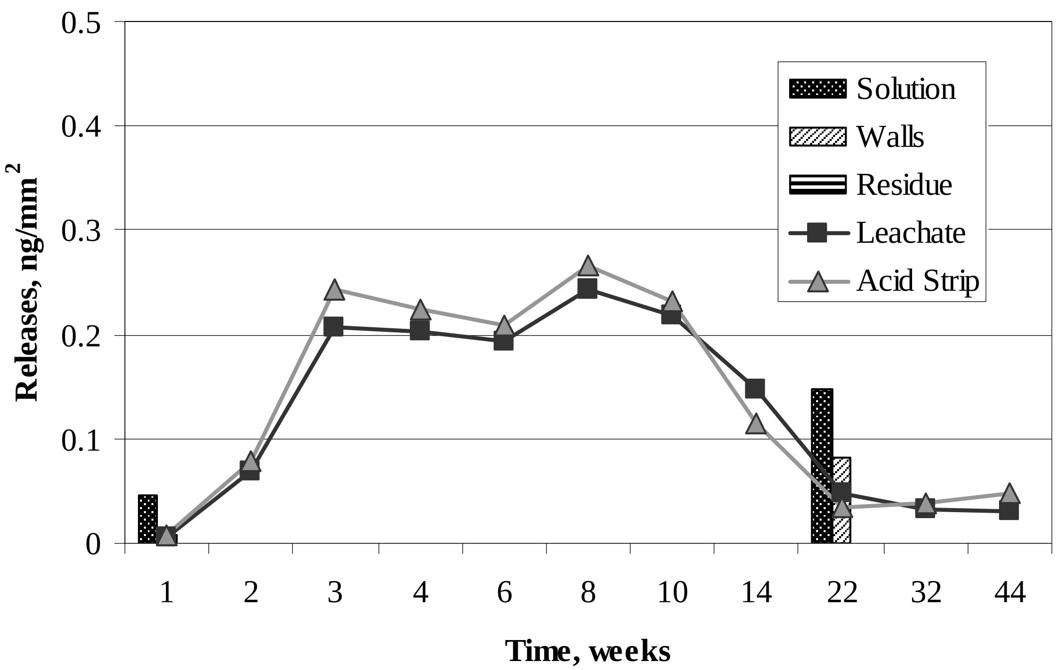


Figure E-176. Ruthenium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

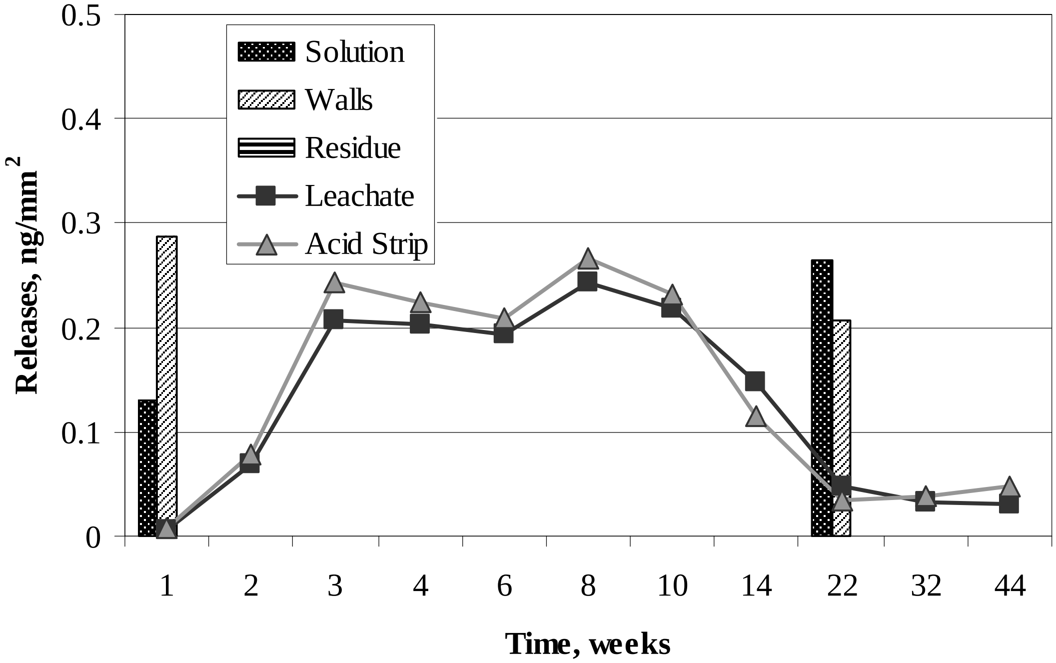


Figure E-177. Ruthenium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

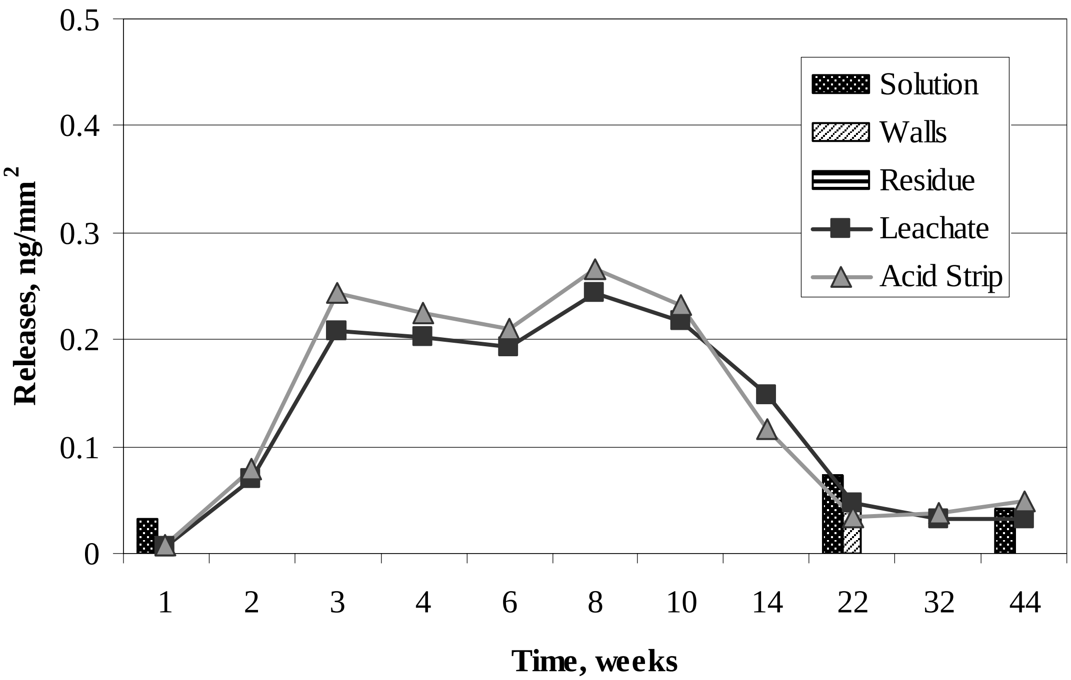


Figure E-178. Ruthenium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

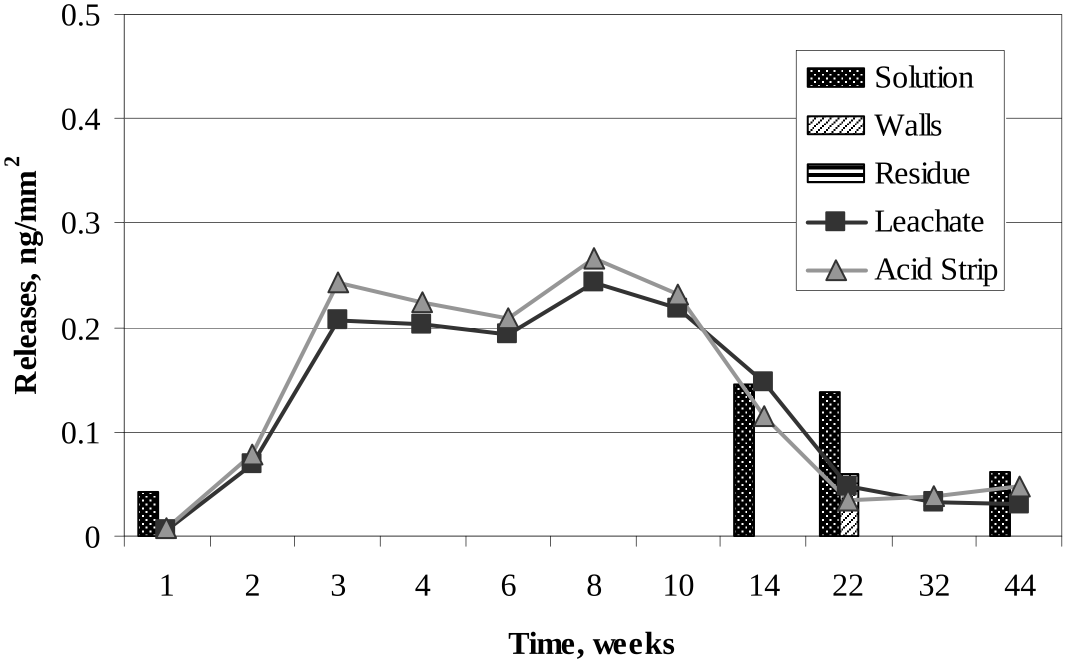


Figure E-179. Ruthenium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

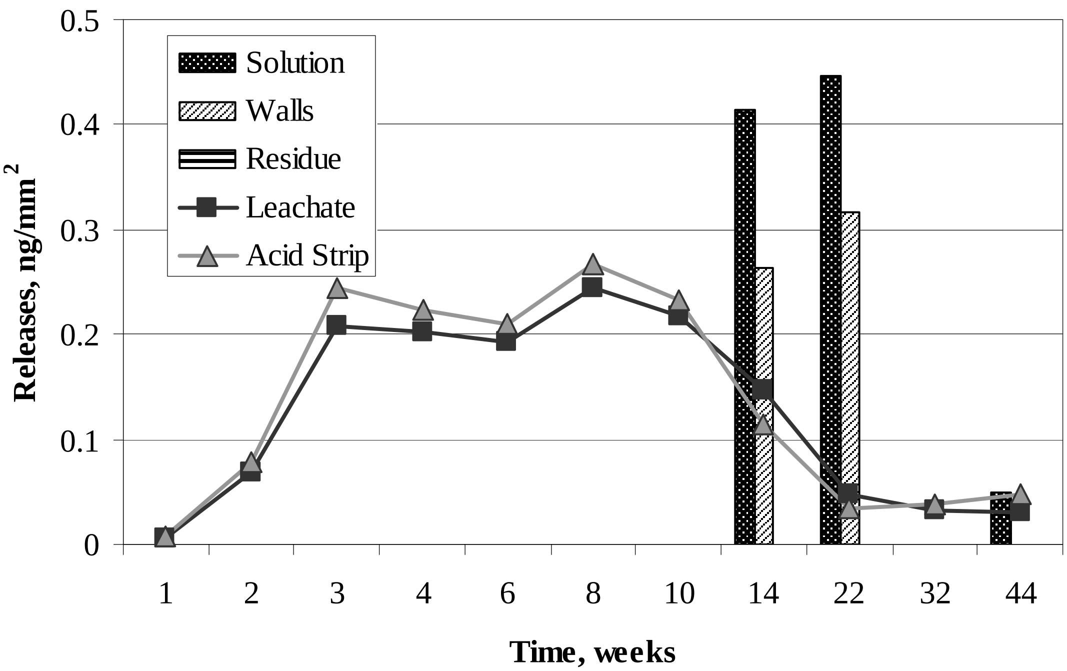


Figure E-180. Ruthenium Present in Solution, on Walls, and in Residue from CJ13 Control and Average Detection Limits for Leachate and Acid Strip.

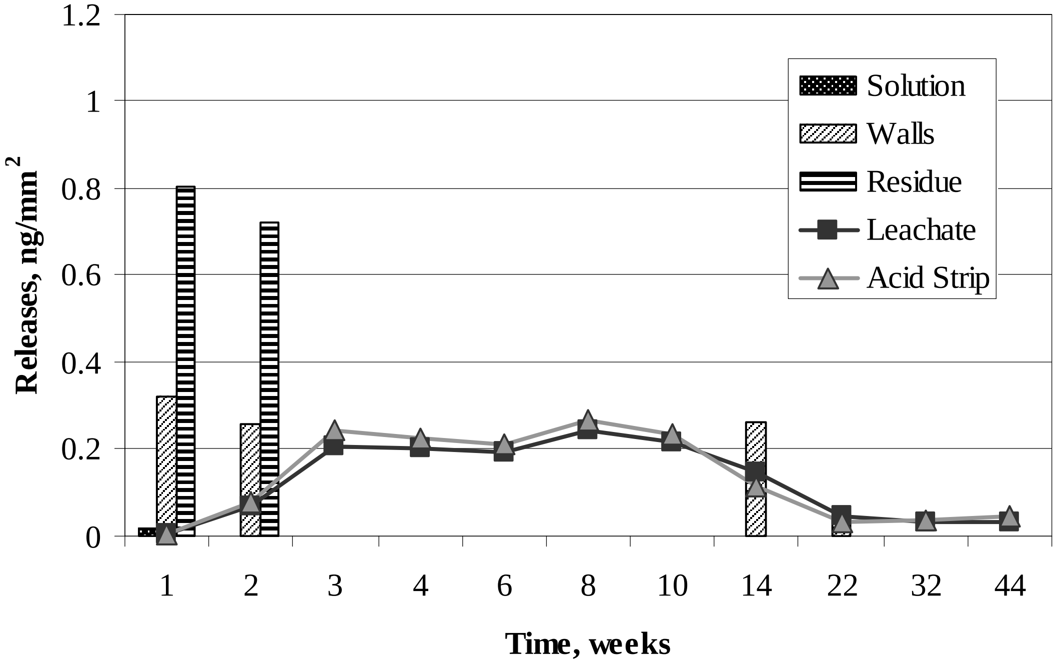


Figure E-181. Ruthenium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

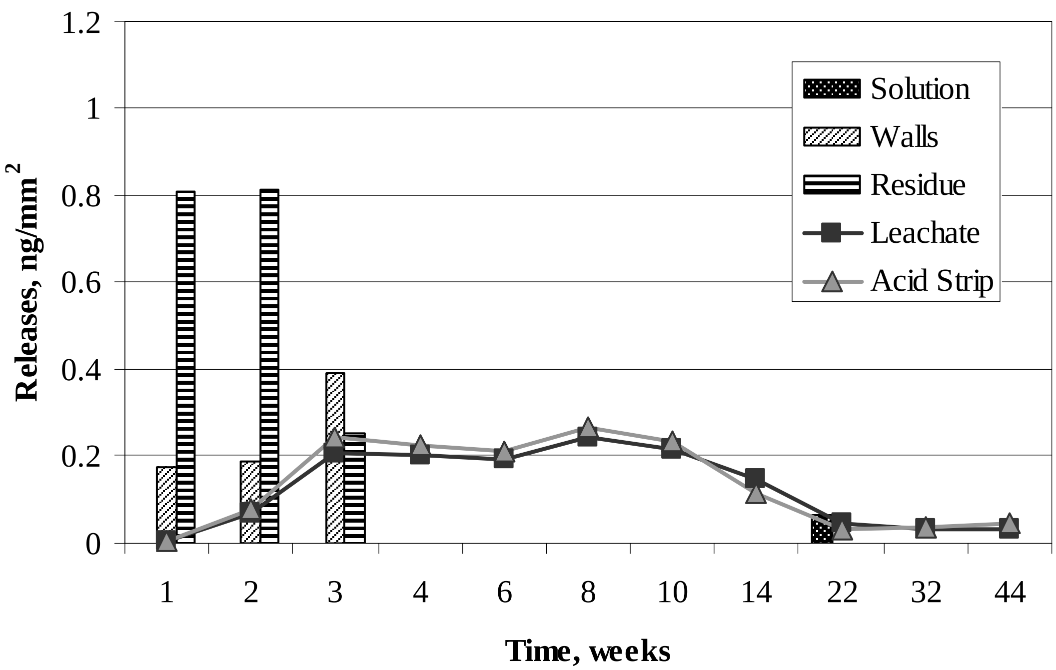


Figure E-182. Ruthenium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

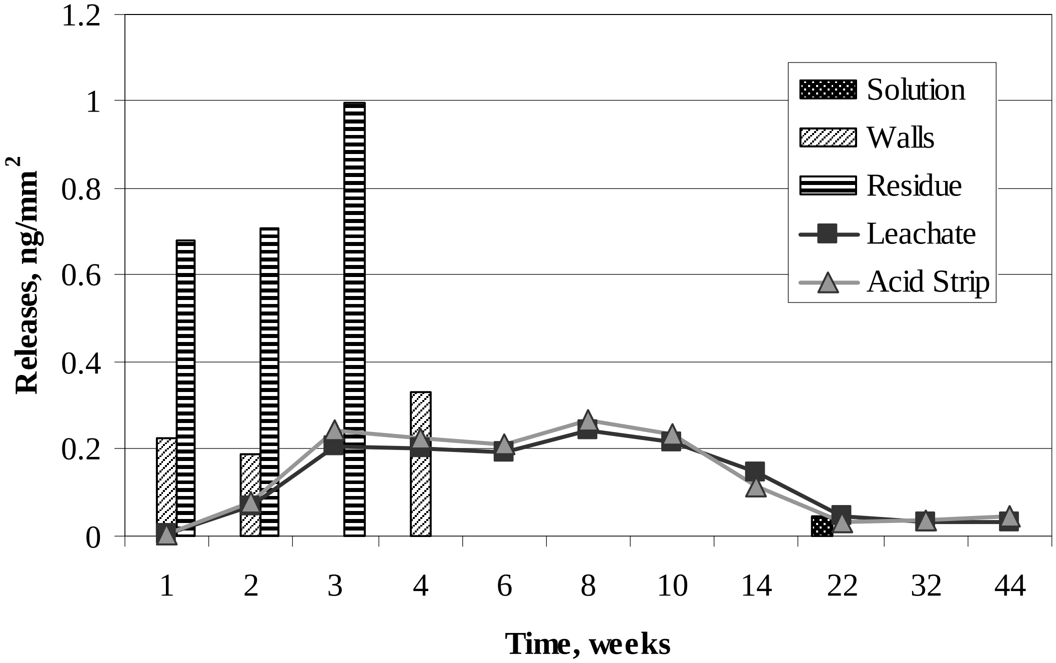


Figure E-183. Ruthenium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

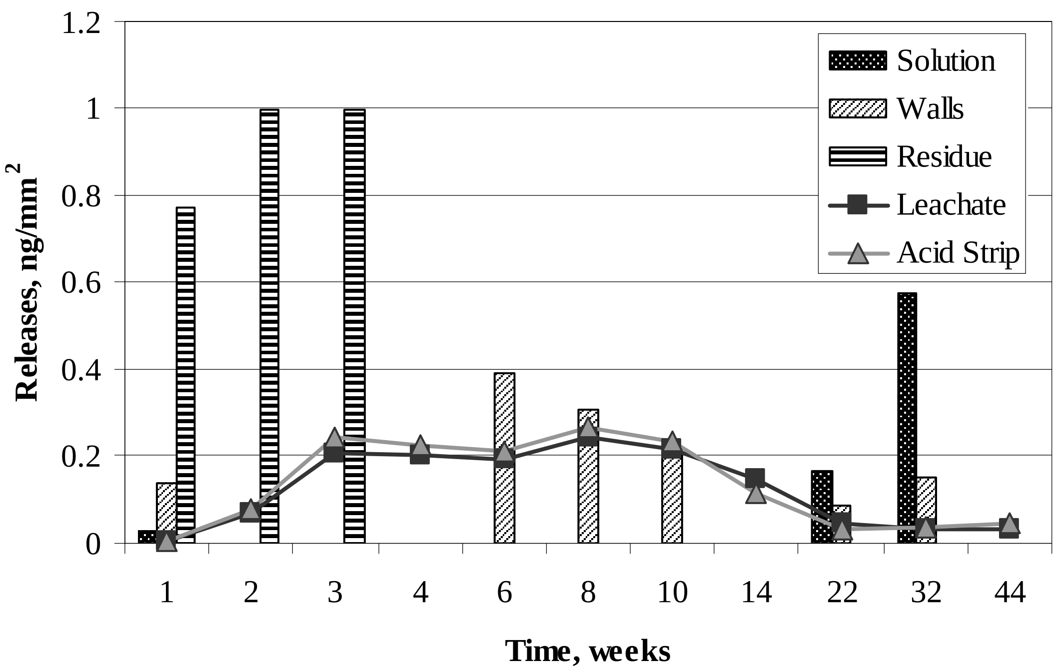


Figure E-184. Ruthenium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

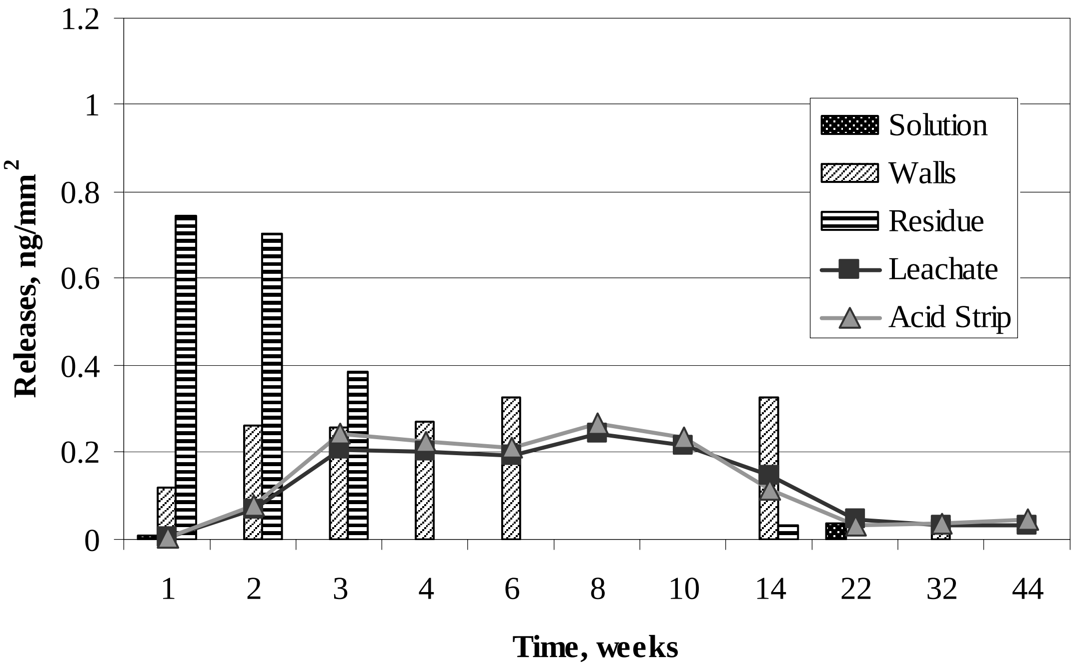


Figure E-185. Ruthenium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

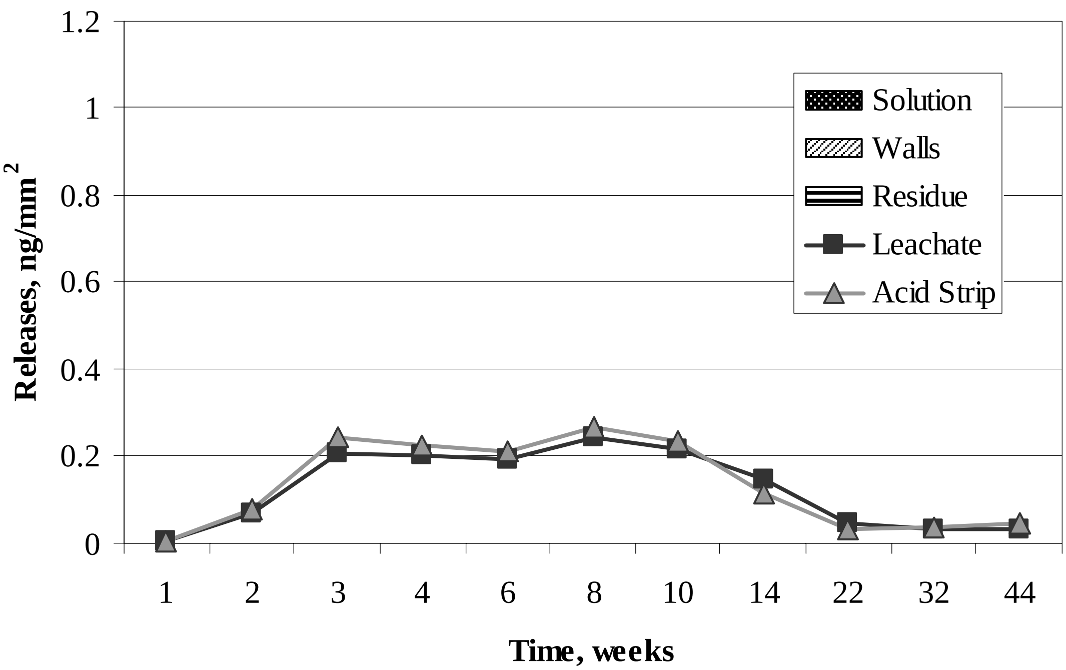


Figure E-186. Ruthenium Present in Solution, on Walls, and in Residue from 10KCl Control and Average Detection Limits for Leachate and Acid Strip.

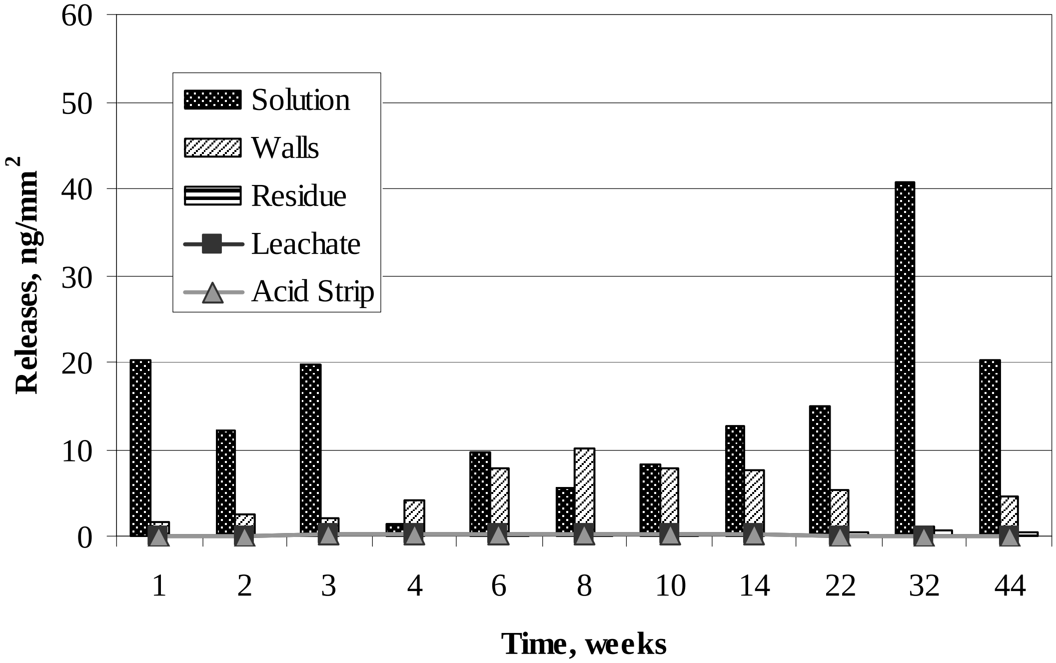


Figure E-187. Ruthenium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

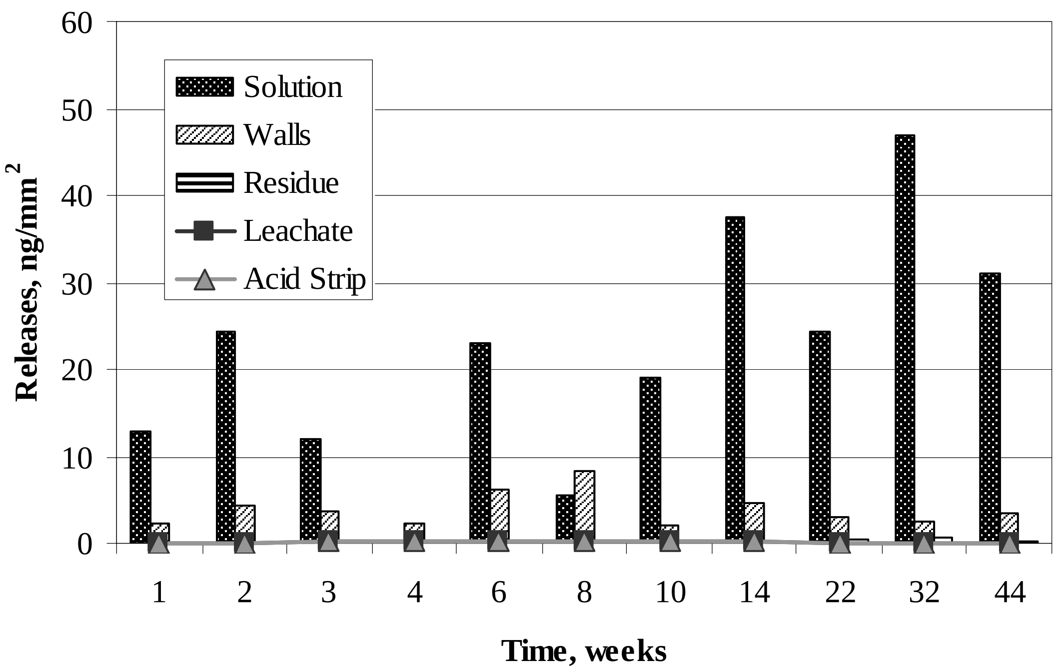


Figure E-188. Ruthenium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

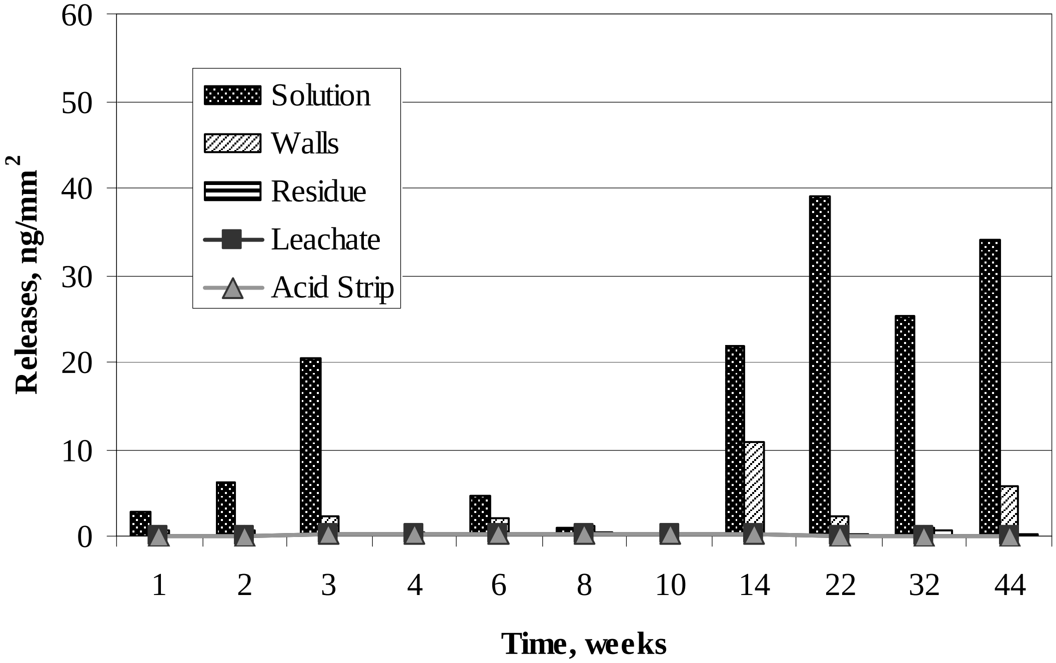


Figure E-189. Ruthenium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

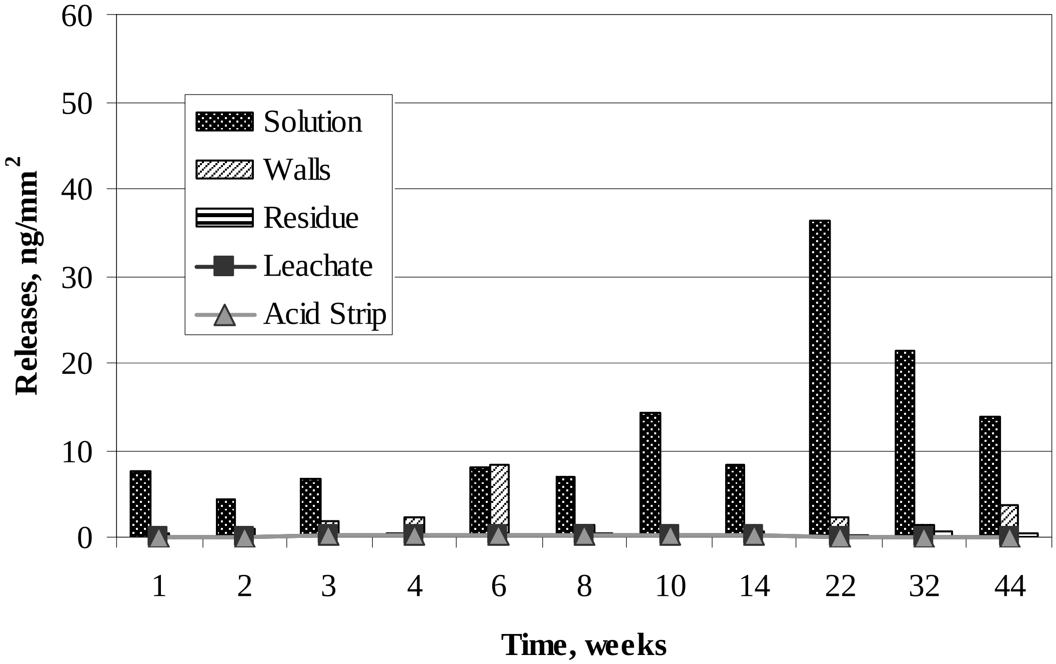


Figure E-190. Ruthenium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

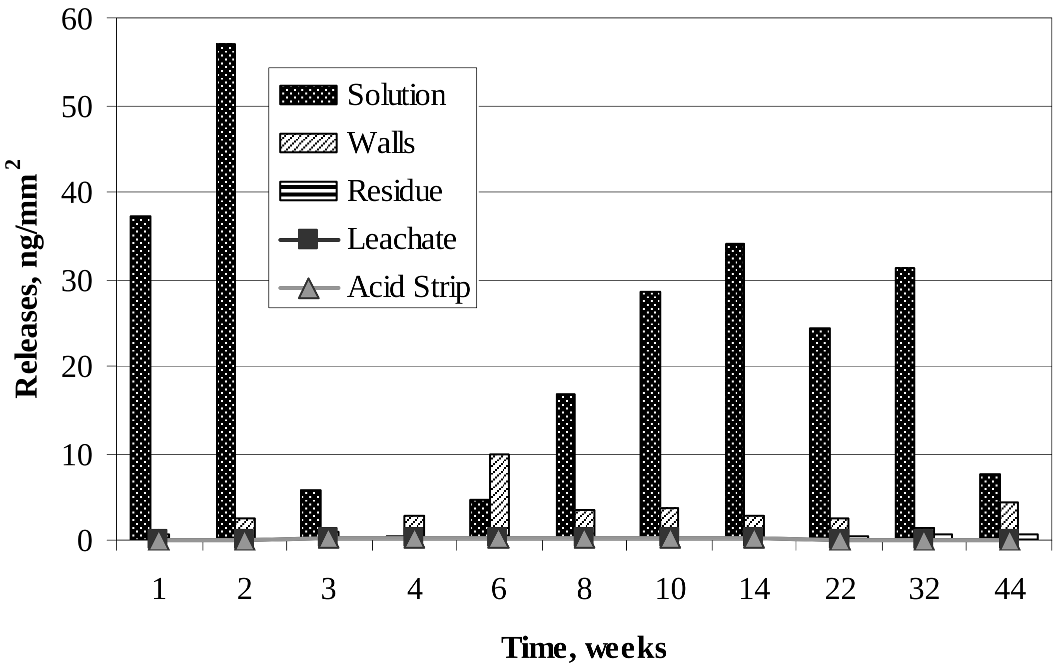


Figure E-191. Ruthenium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

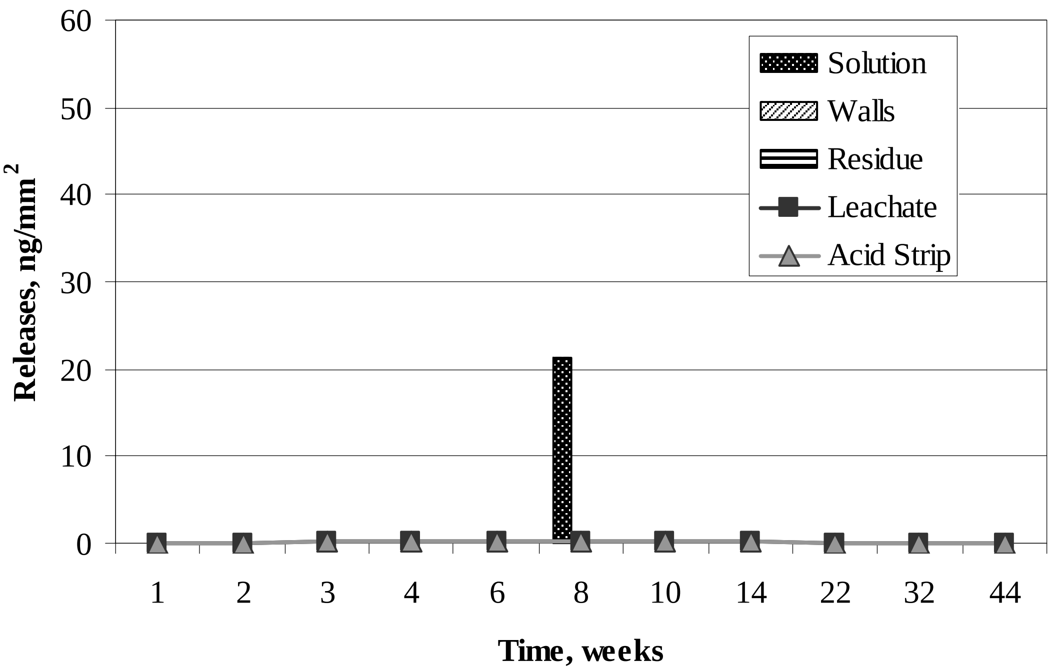


Figure E-192. Ruthenium Present in Solution, on Walls, and in Residue from AJ13 Control and Average Detection Limits for Leachate and Acid Strip.

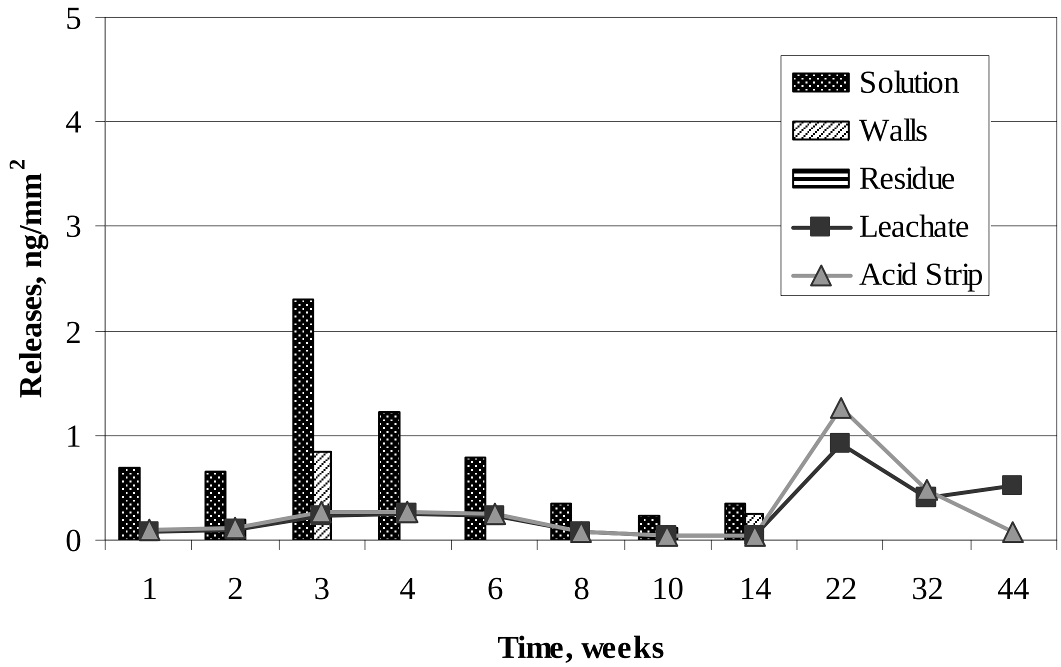


Figure E-193. Molybdenum Releases in Solution, on Walls, and in Residue from Polished Sample 1 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

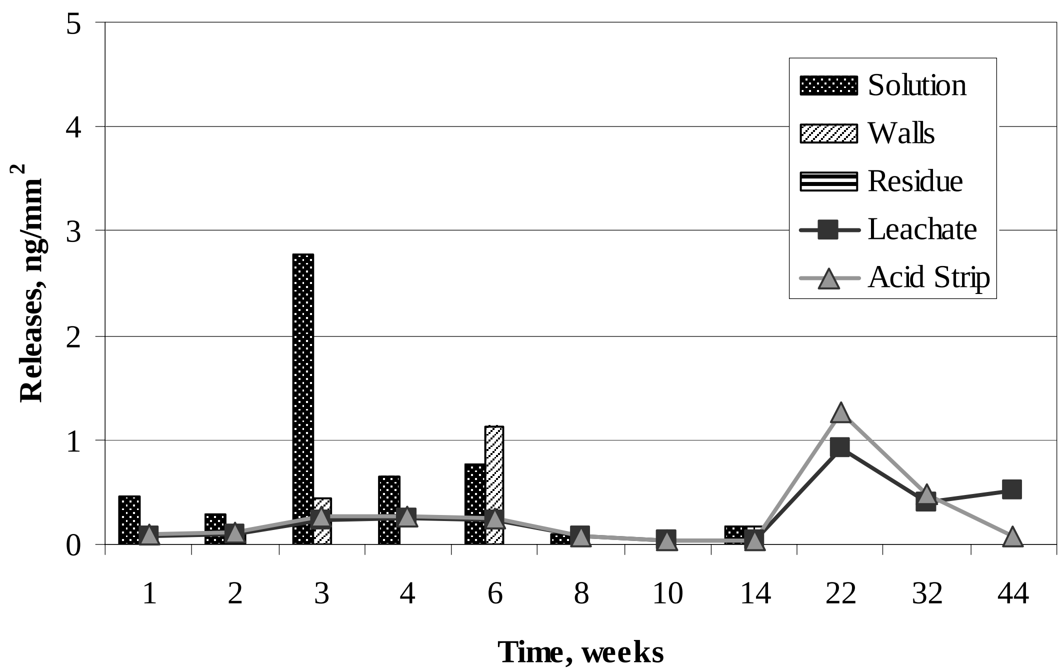


Figure E-194. Molybdenum Releases in Solution, on Walls, and in Residue from Polished Sample 2 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

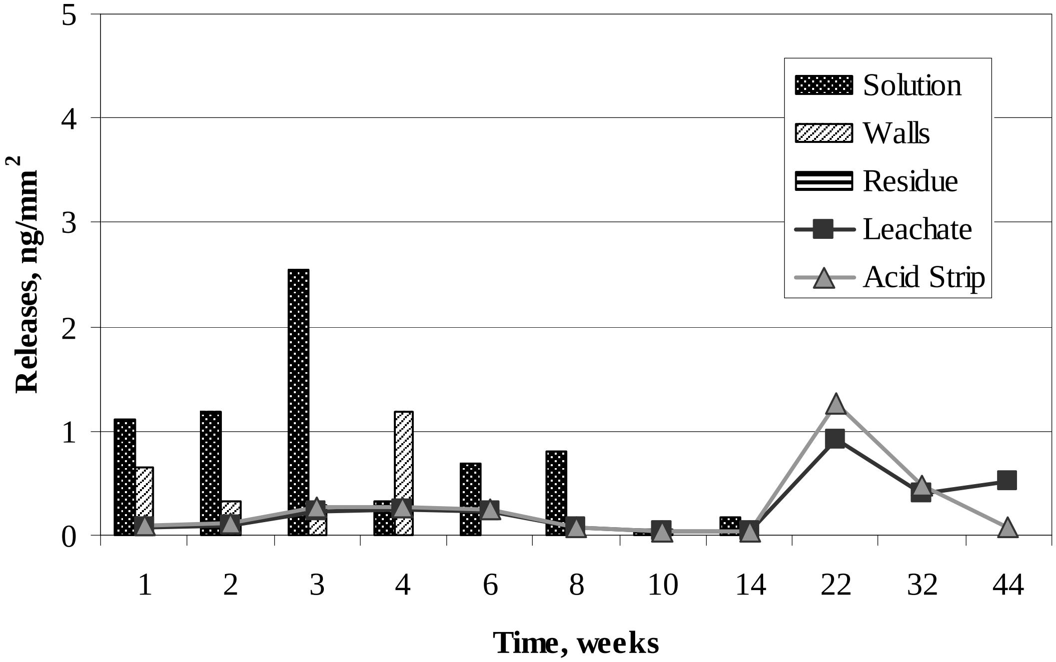


Figure E-195. Molybdenum Releases in Solution, on Walls, and in Residue from Polished Sample 3 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

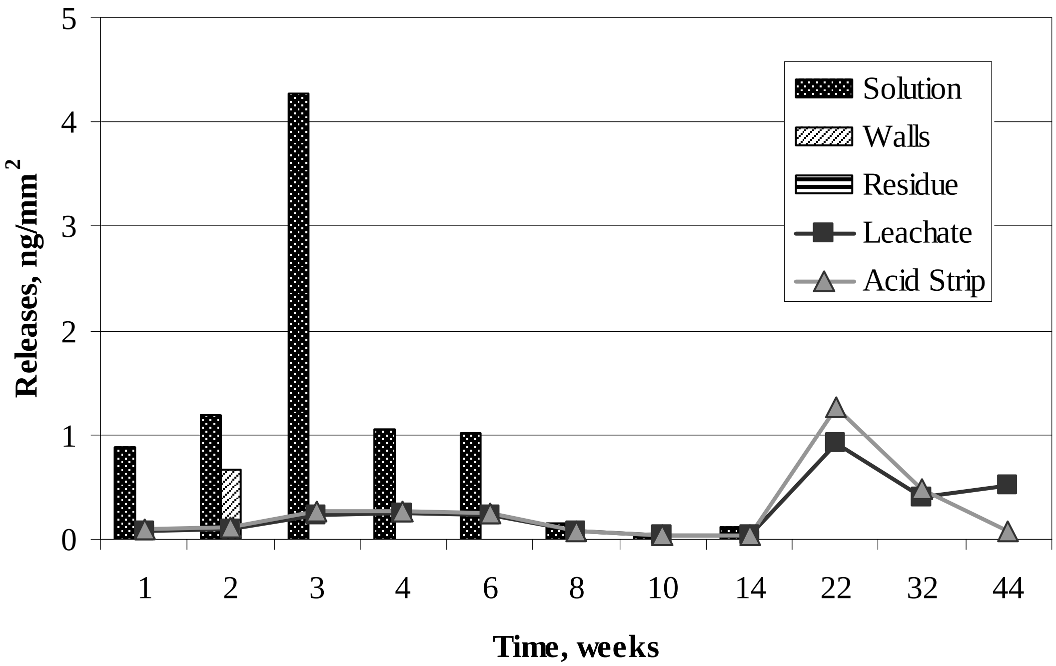


Figure E-196. Molybdenum Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

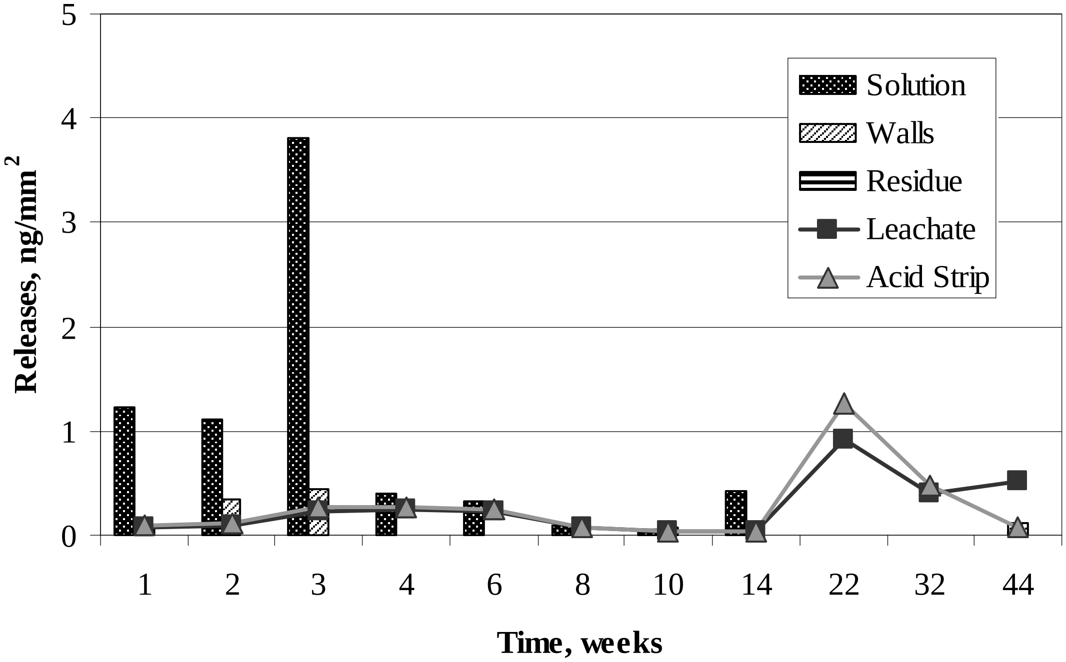


Figure E-197. Molybdenum Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

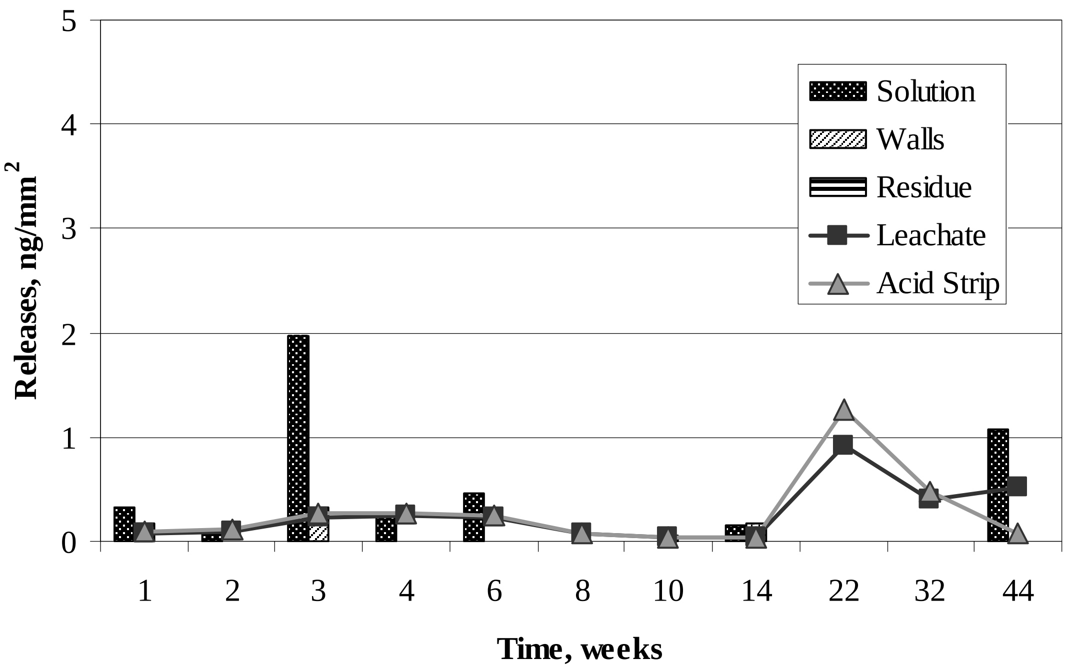


Figure E-198. Molybdenum Present in Solution, on Walls, and in Residue from SJ13 Control and Average Detection Limits for Leachate and Acid Strip.

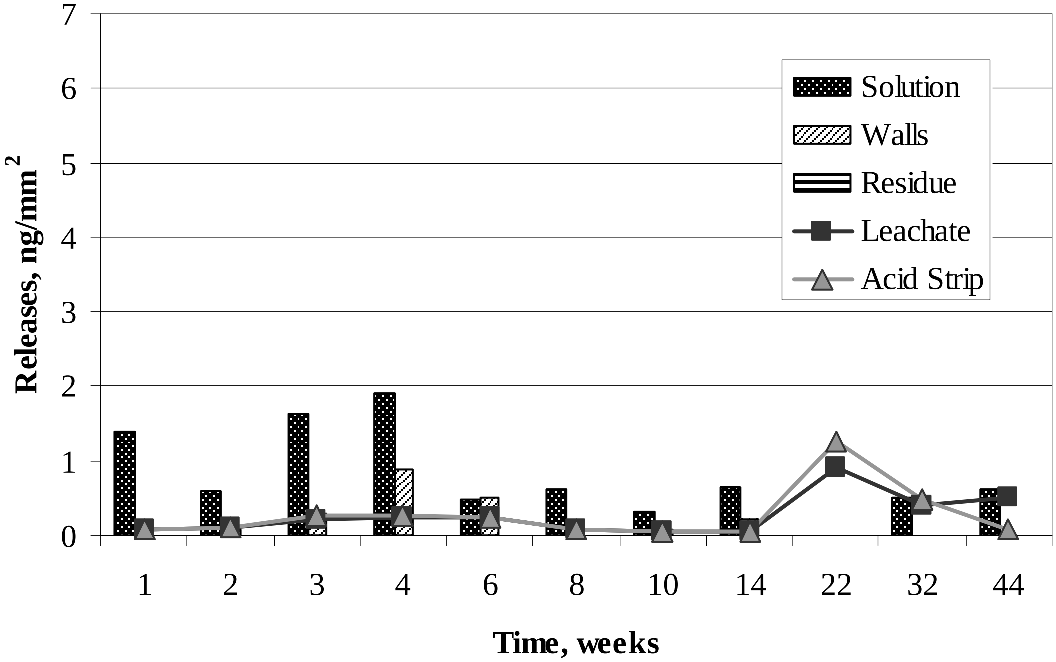


Figure E-199. Molybdenum Releases in Solution, on Walls, and in Residue from Polished Sample 1 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

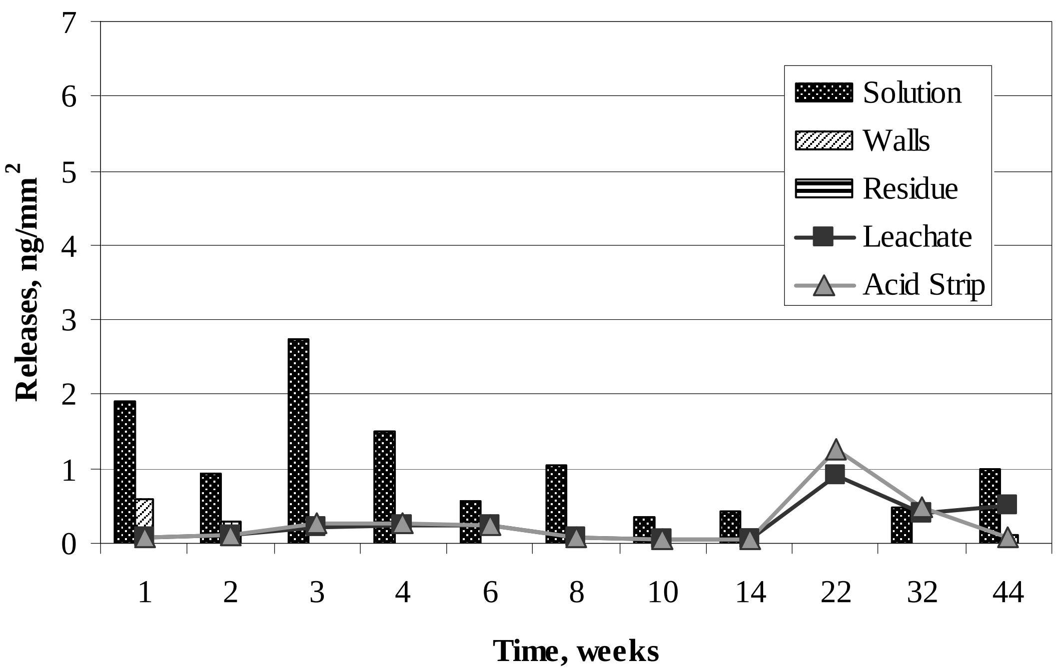


Figure E-200. Molybdenum Releases in Solution, on Walls, and in Residue from Polished Sample 2 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

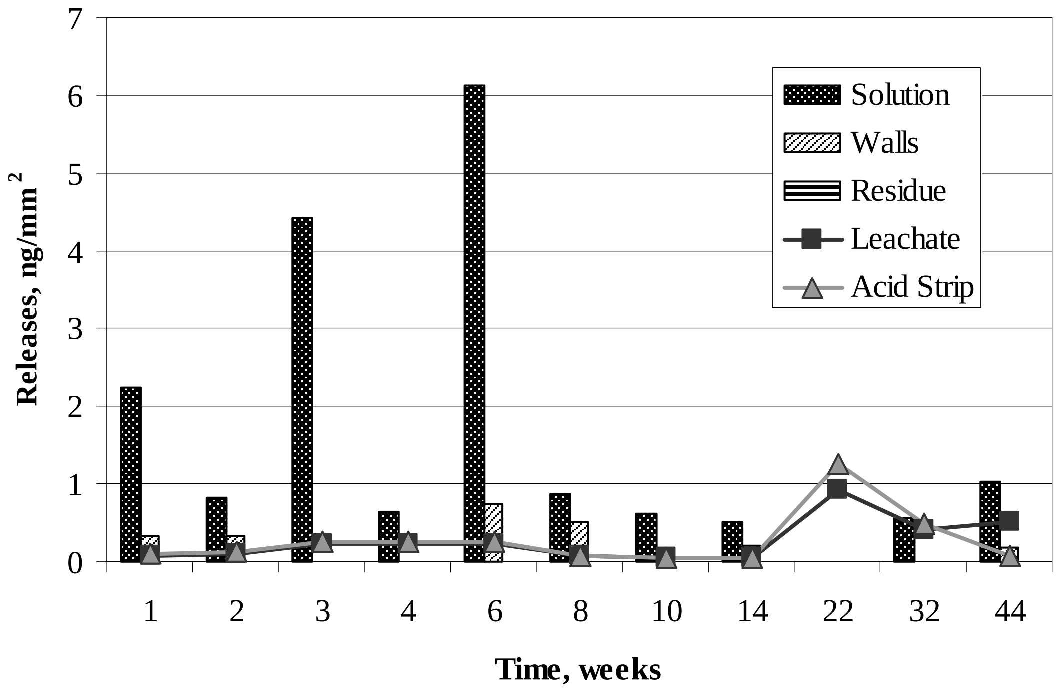


Figure E-201. Molybdenum Releases in Solution, on Walls, and in Residue from Polished Sample 3 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

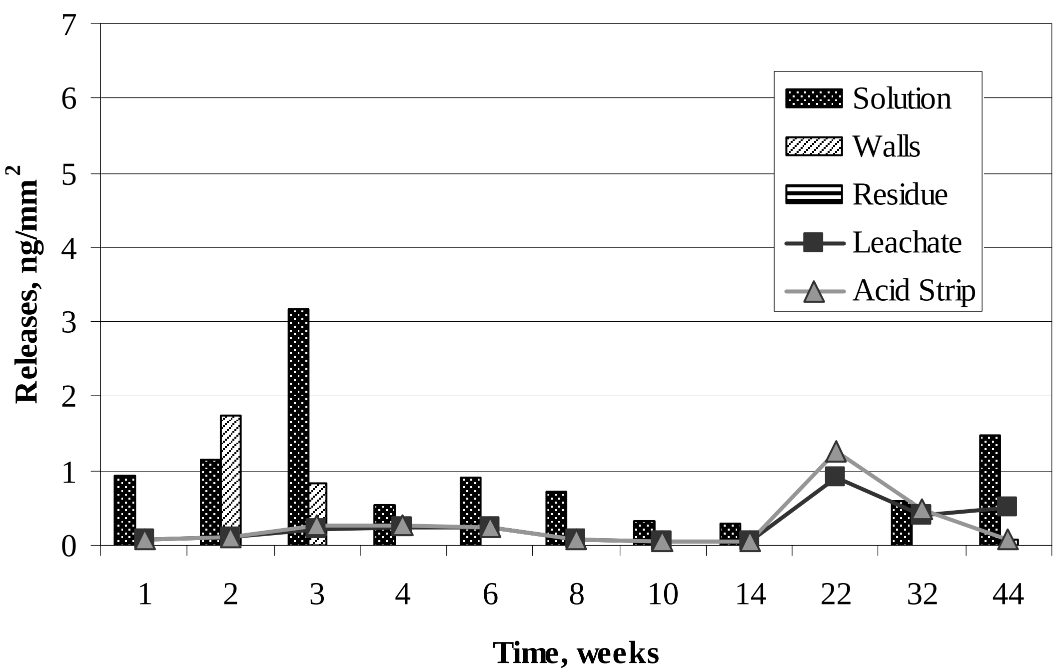


Figure E-202. Molybdenum Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

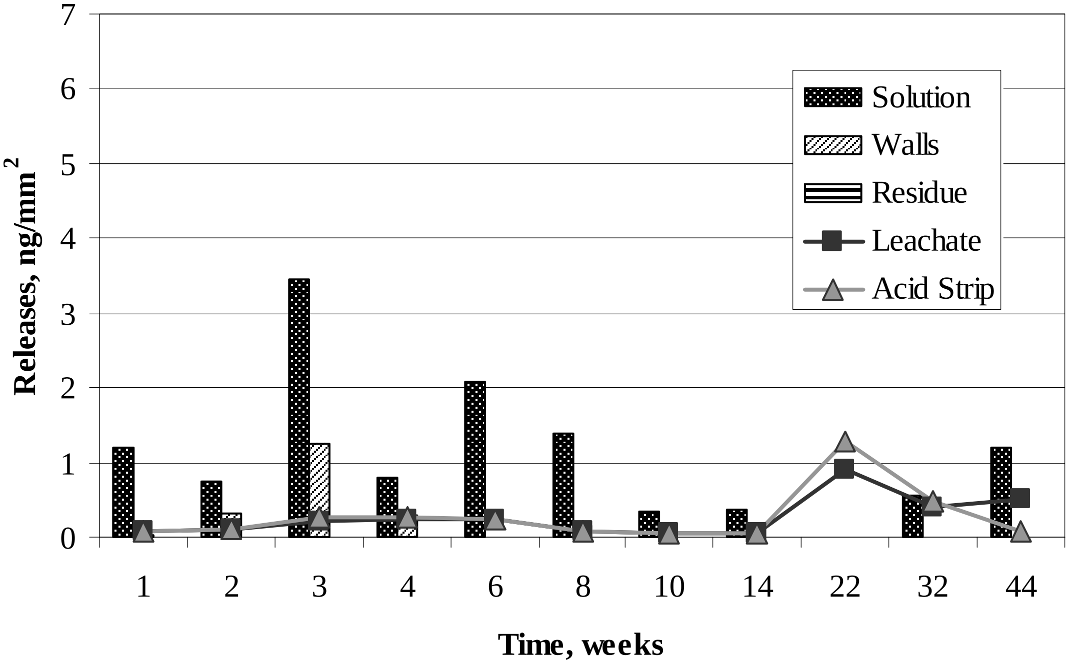


Figure E-203. Molybdenum Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

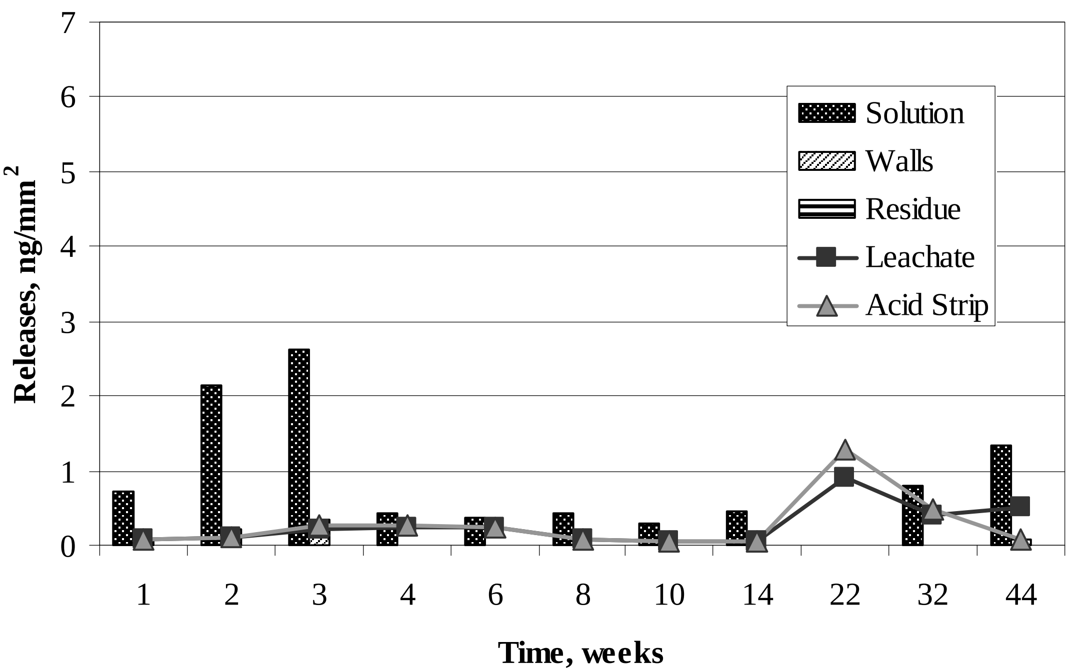


Figure E-204. Molybdenum Present in Solution, on Walls, and in Residue from CJ13 Control and Average Detection Limits for Leachate and Acid Strip.

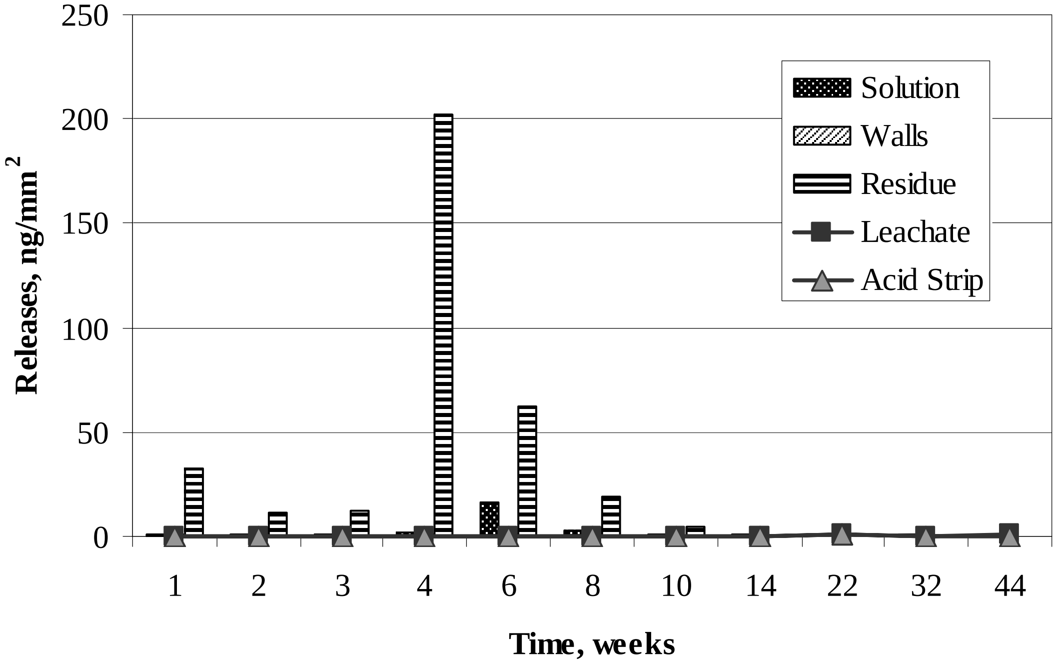


Figure E-205. Molybdenum Releases in Solution, on Walls, and in Residue from Polished Sample 1 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

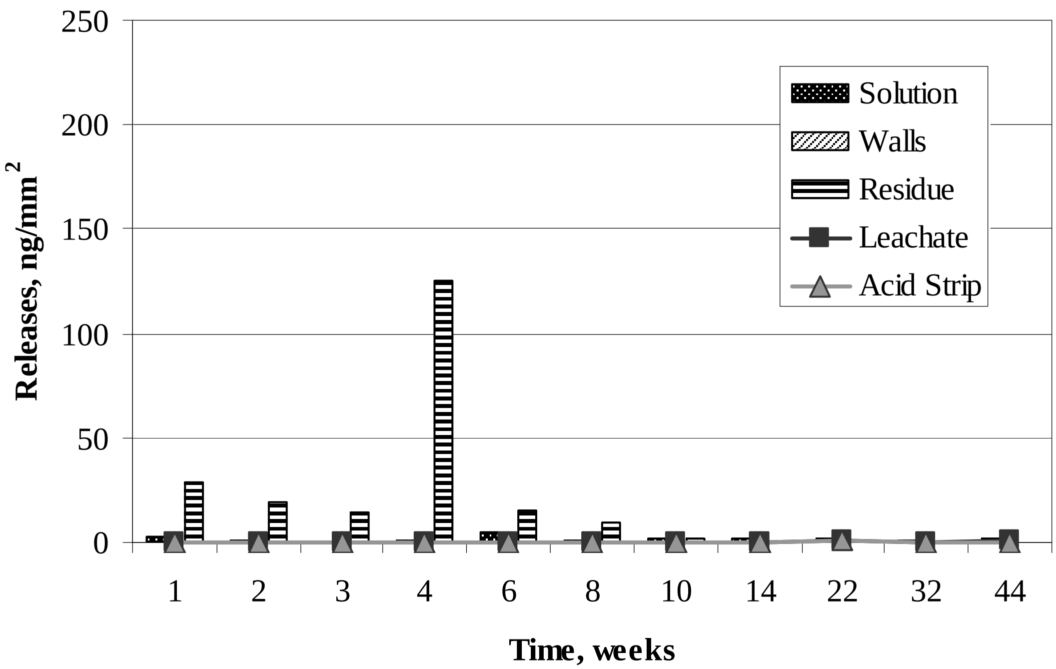


Figure E-206. Molybdenum Releases in Solution, on Walls, and in Residue from Polished Sample 2 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

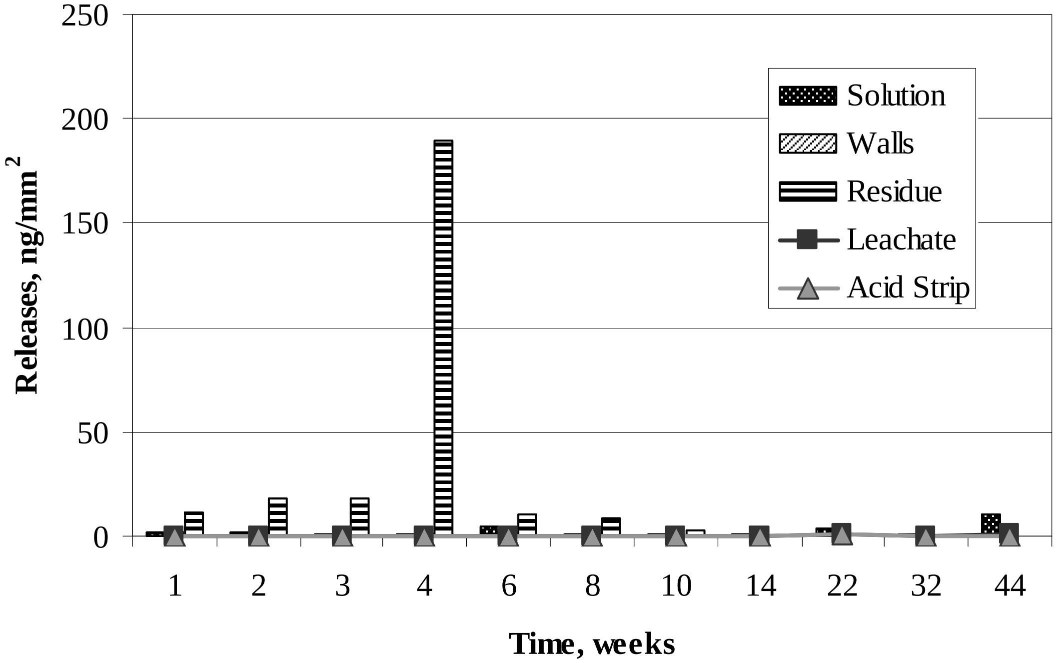


Figure E-207. Molybdenum Releases in Solution, on Walls, and in Residue from Polished Sample 3 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

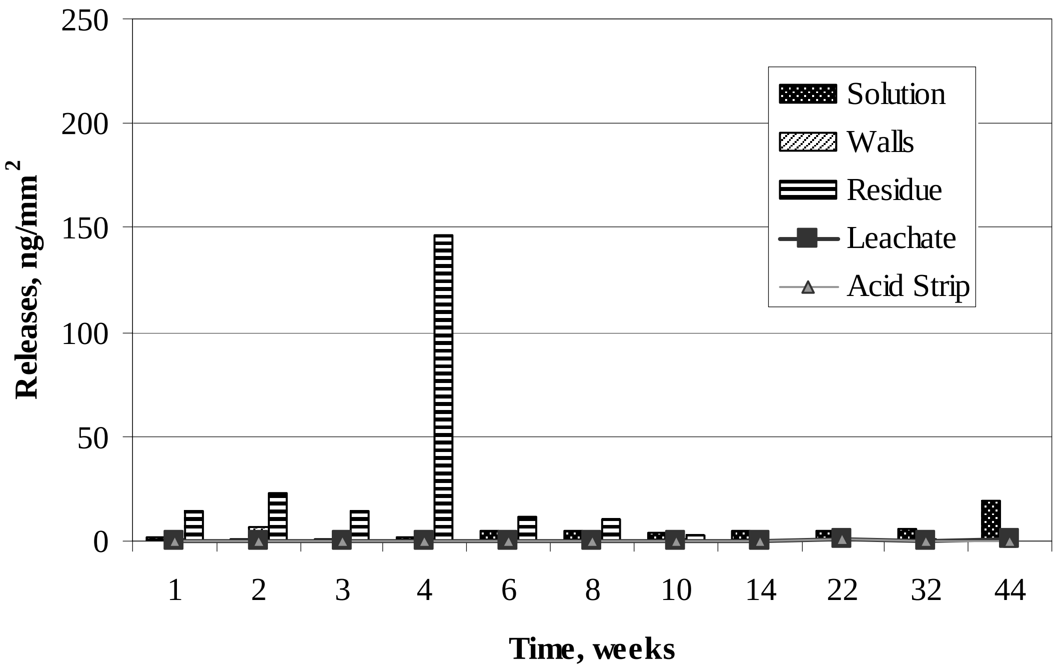


Figure E-208. Molybdenum Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

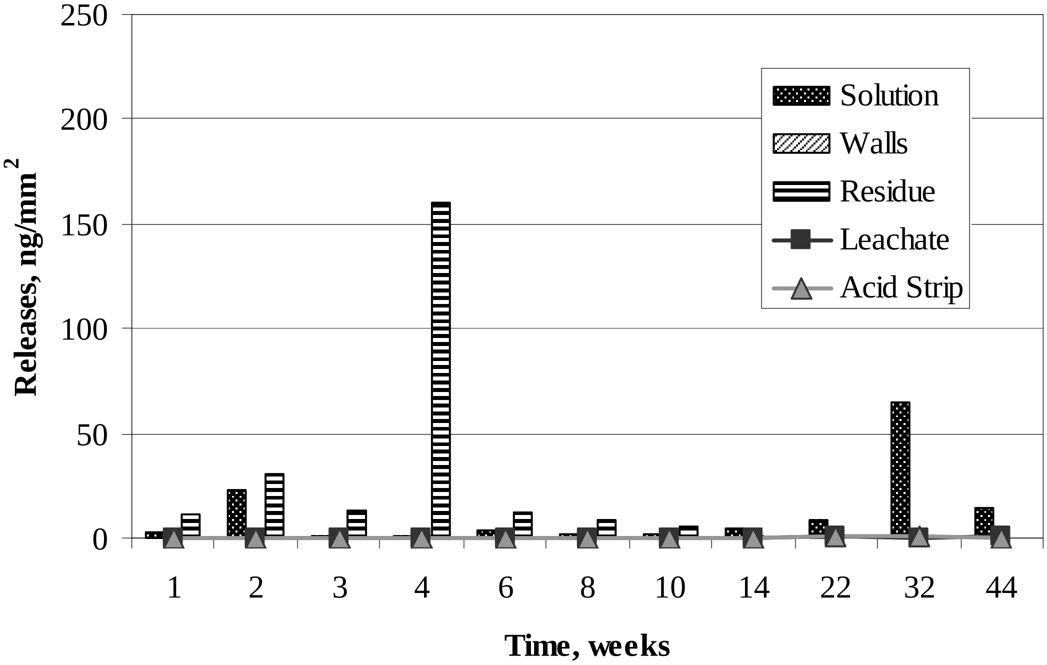


Figure E-209. Molybdenum Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

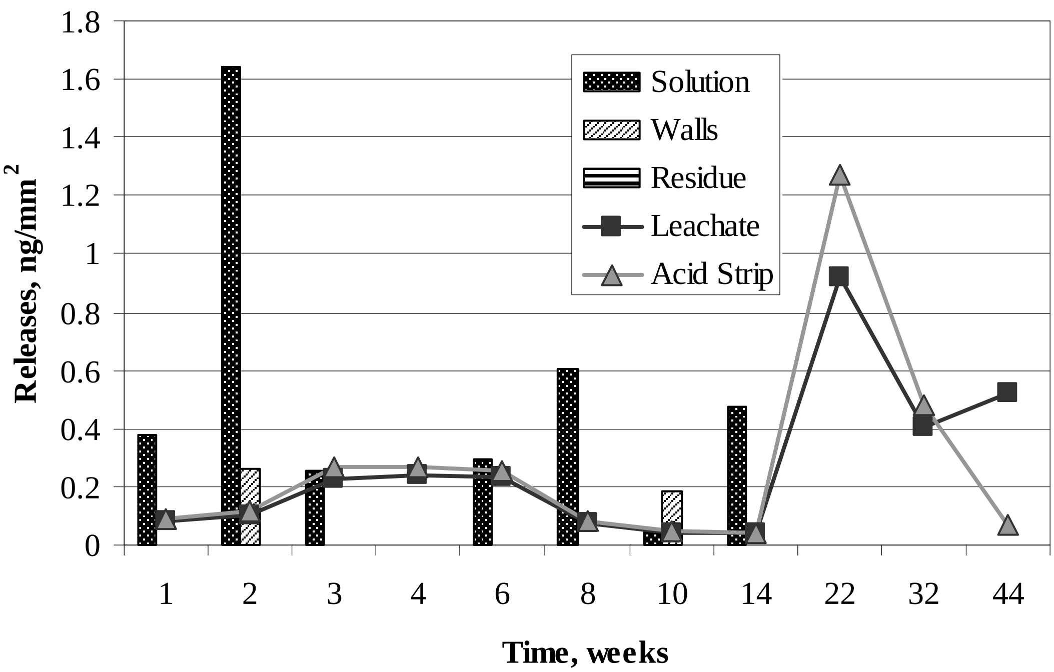


Figure E-210. Molybdenum Present in Solution, on Walls, and in Residue from 10KCl Control and Average Detection Limits for Leachate and Acid Strip.

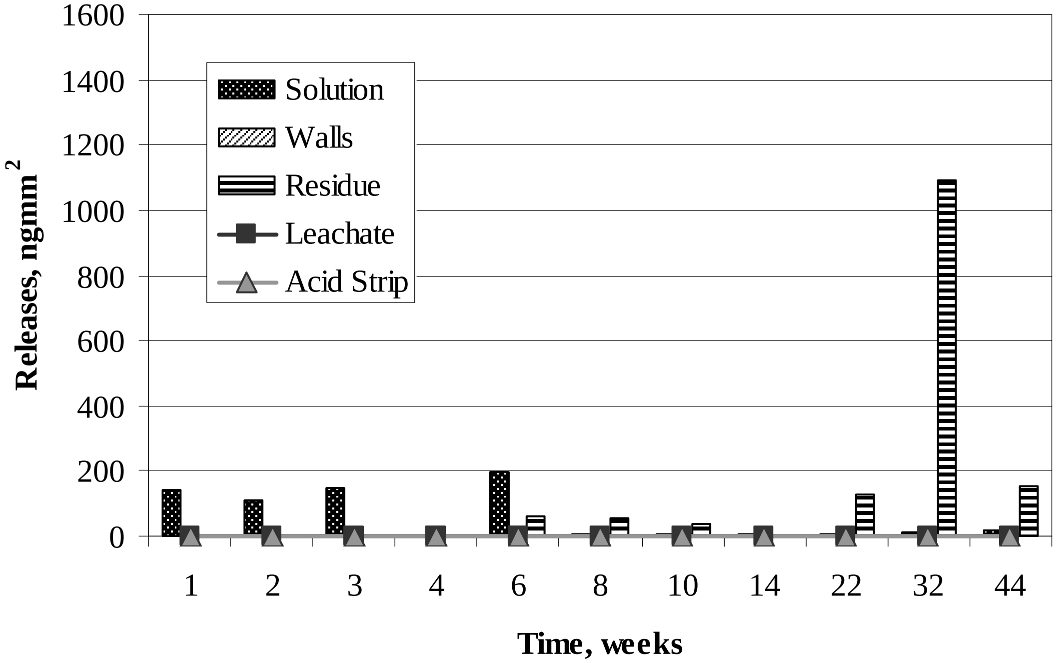


Figure E-211. Molybdenum Releases in Solution, on Walls, and in Residue from Polished Sample 1 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

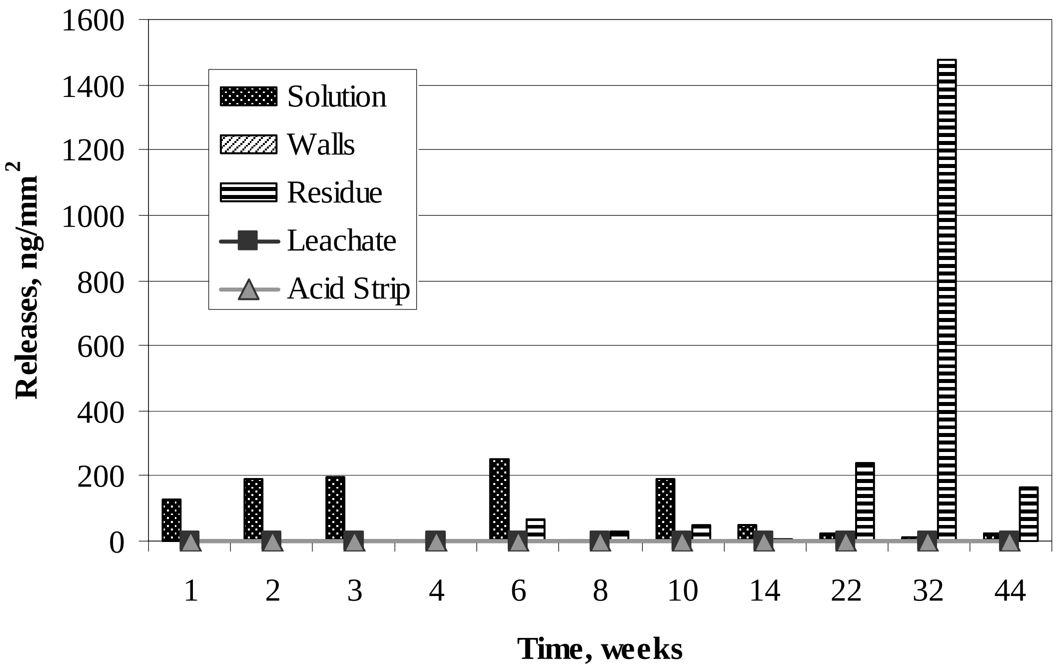


Figure E-212. Molybdenum Releases in Solution, on Walls, and in Residue from Polished Sample 2 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

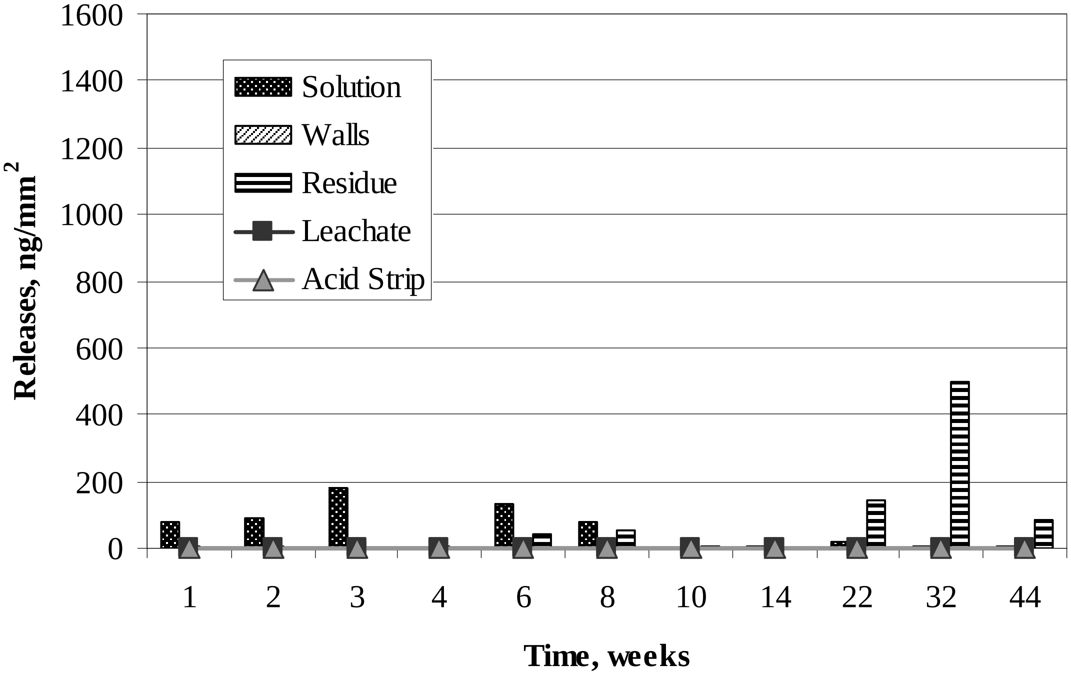


Figure E-213. Molybdenum Releases in Solution, on Walls, and in Residue from Polished Sample 3 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

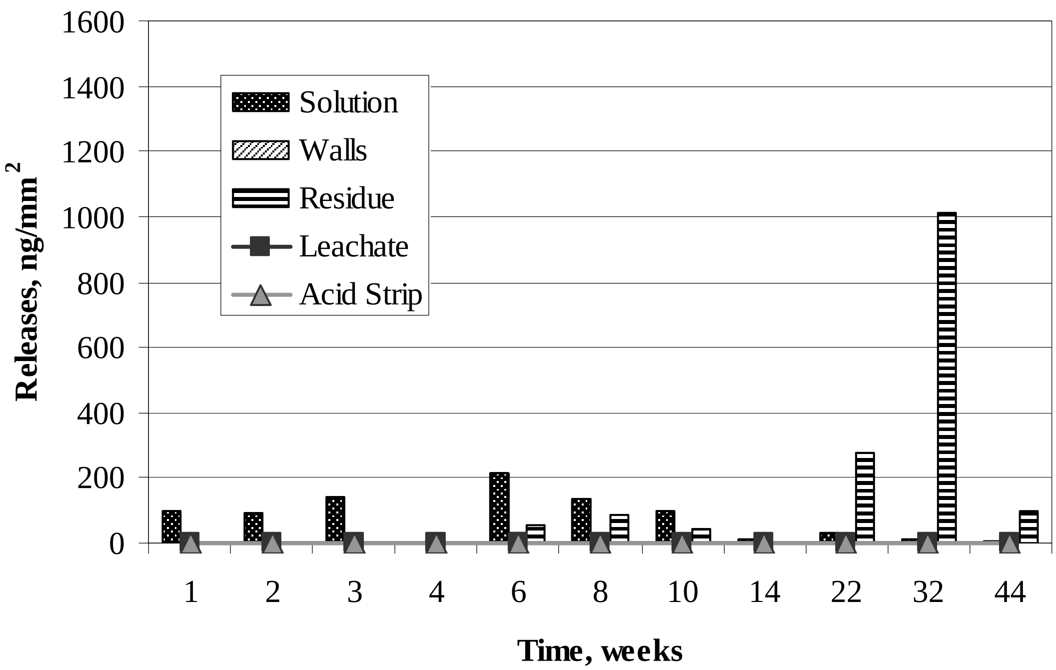


Figure E-214. Molybdenum Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

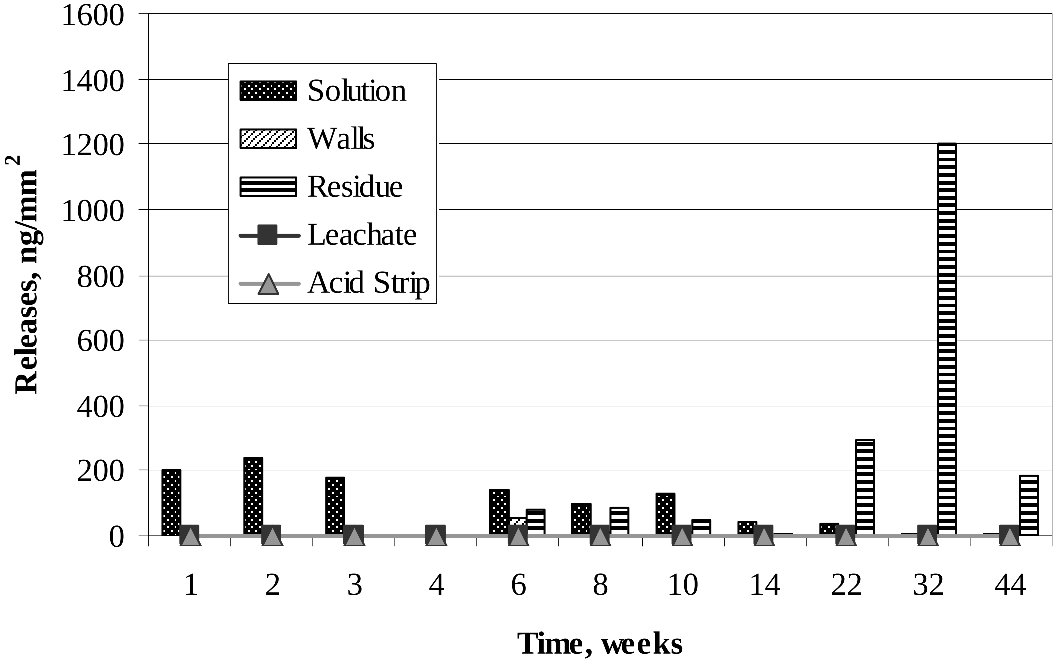


Figure E-215. Molybdenum Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

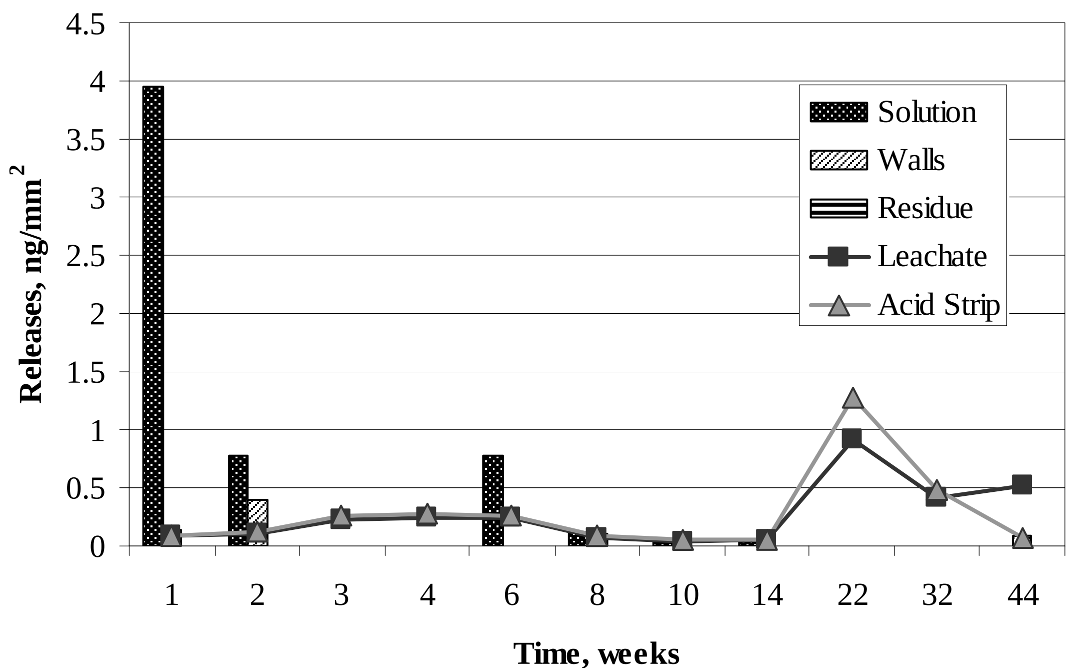


Figure E-216. Molybdenum Present in Solution, on Walls, and in Residue from AJ13 Control and Average Detection Limits for Leachate and Acid Strip.

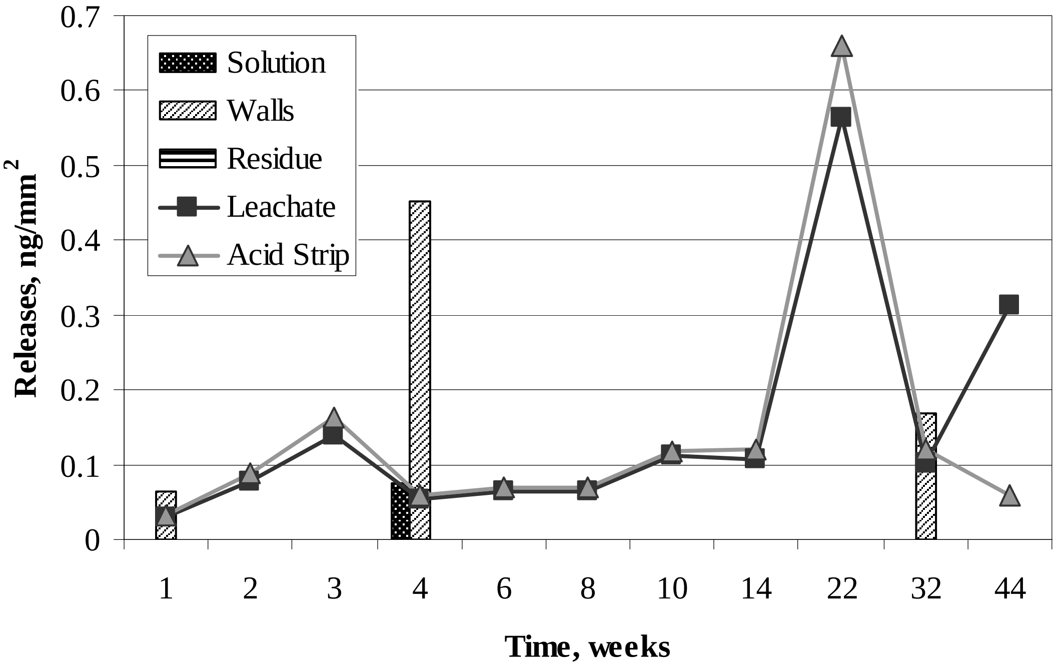


Figure E-217. Manganese Releases in Solution, on Walls, and in Residue from Polished Sample 1 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

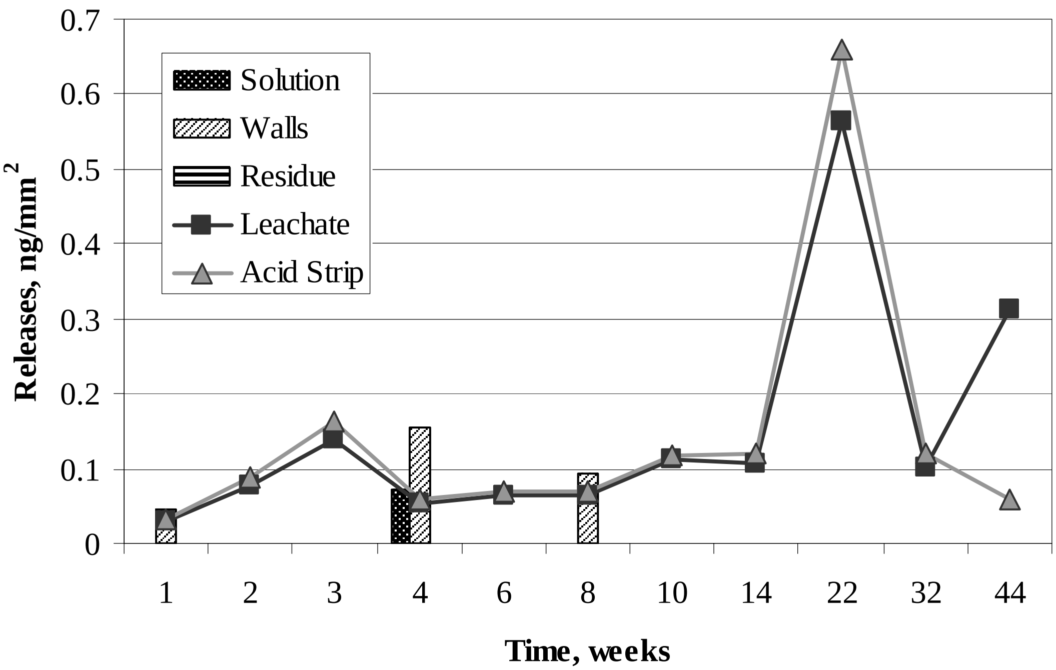


Figure E-218. Manganese Releases in Solution, on Walls, and in Residue from Polished Sample 2 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

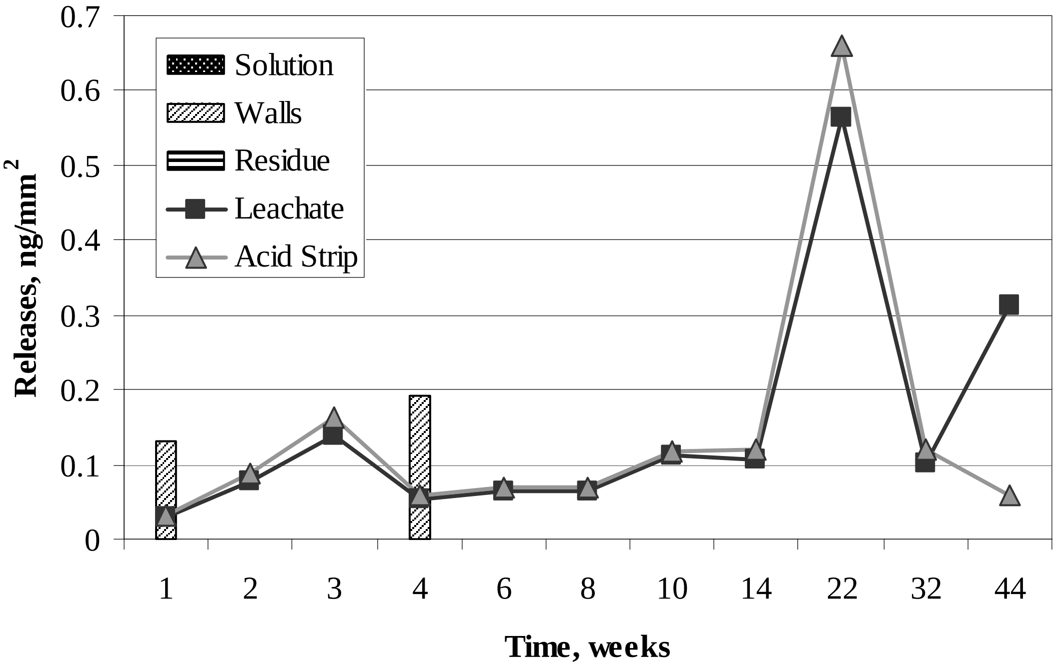


Figure E-219. Manganese Releases in Solution, on Walls, and in Residue from Polished Sample 3 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

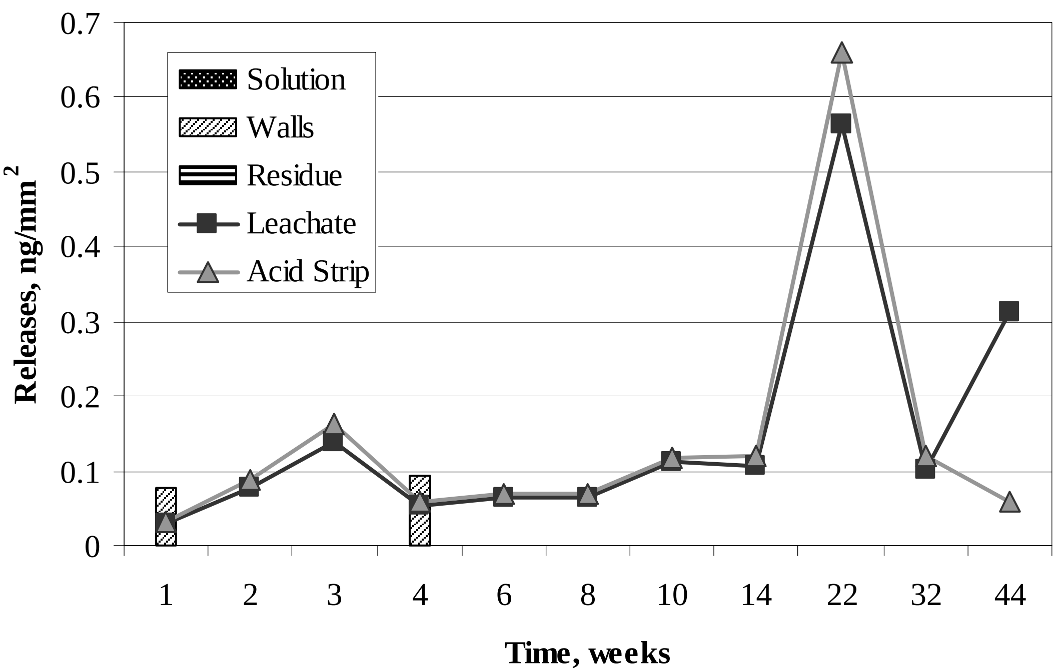


Figure E-220. Manganese Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

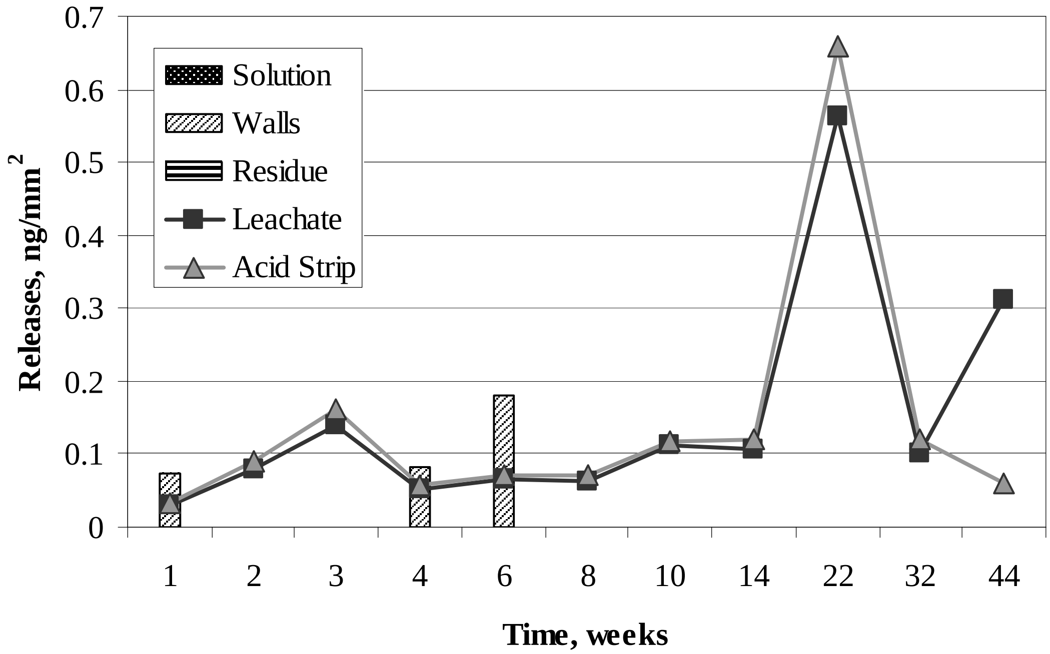


Figure E-221. Manganese Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

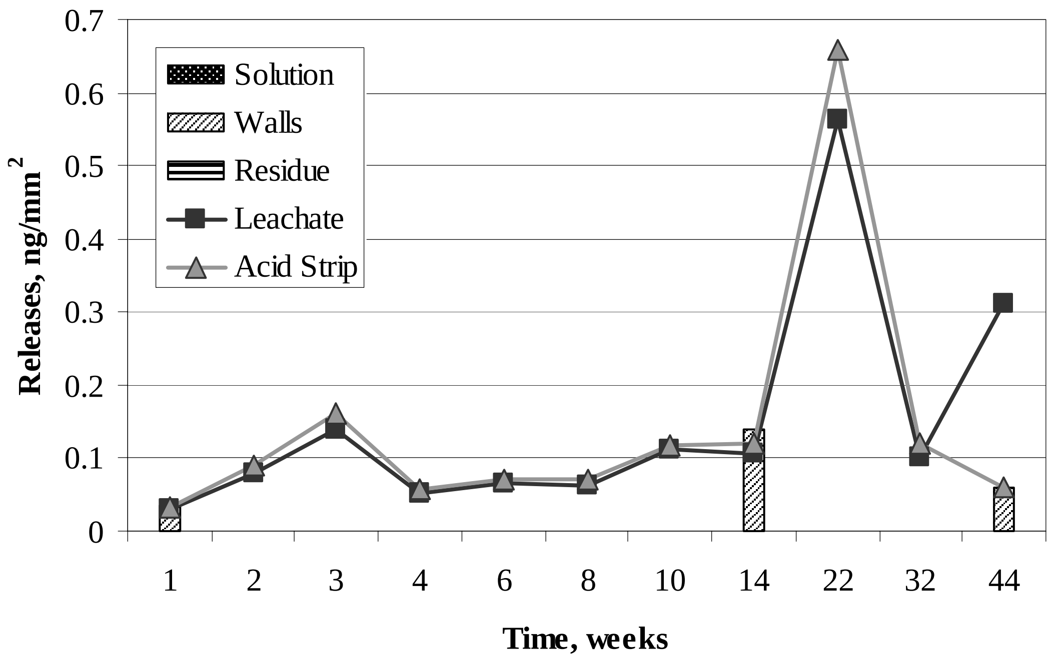


Figure E-222. Manganese Present in Solution, on Walls, and in Residue from SJ13 Control and Average Detection Limits for Leachate and Acid Strip.

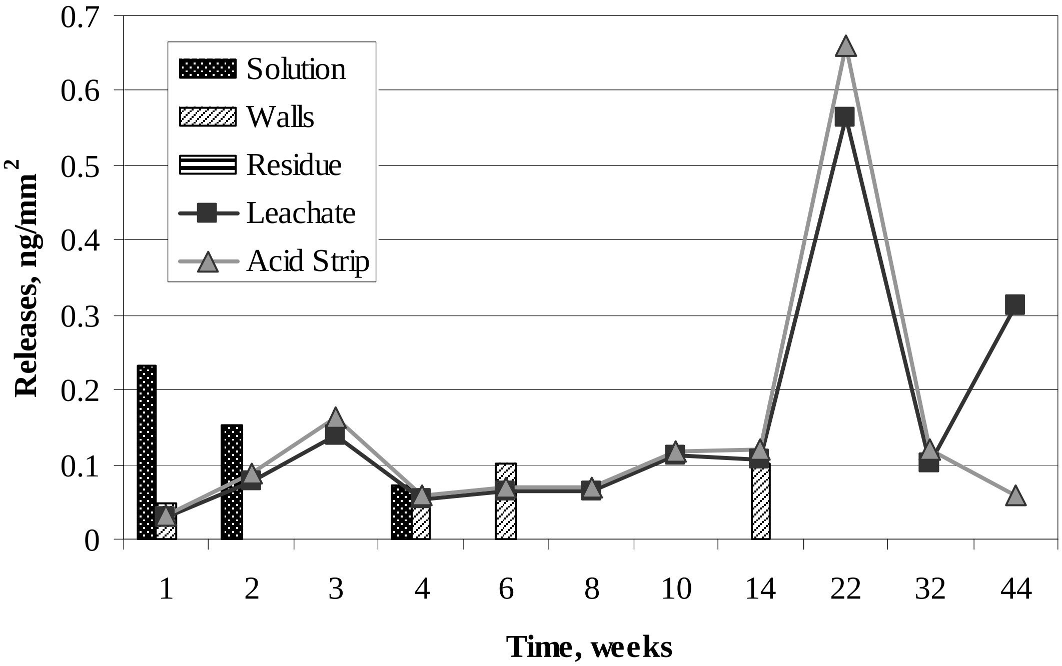


Figure E-223. Manganese Releases in Solution, on Walls, and in Residue from Polished Sample 1 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

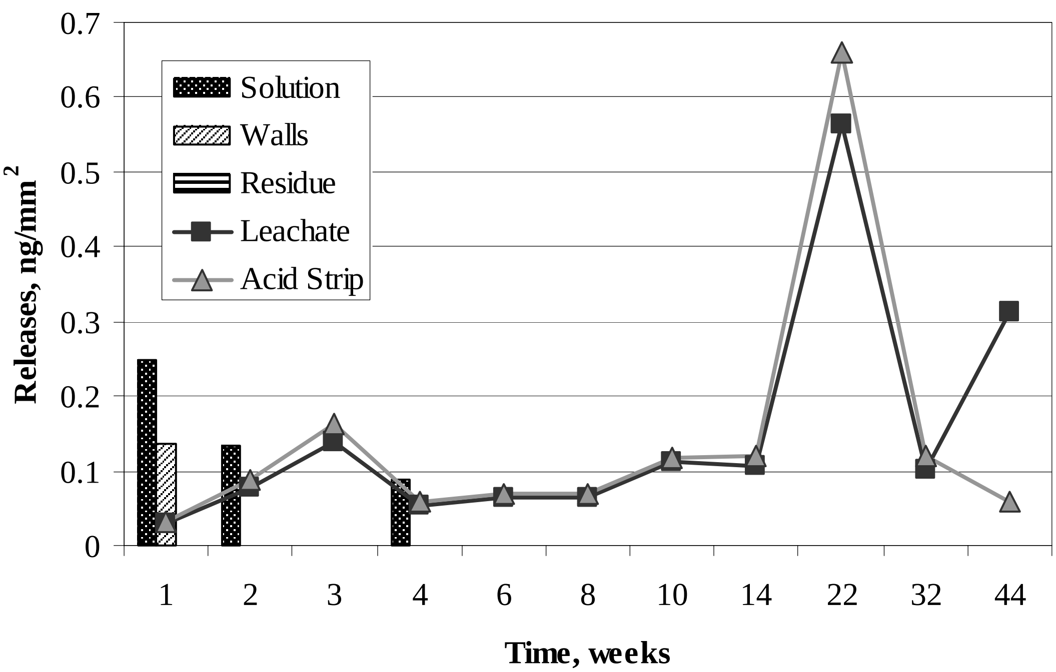


Figure E-224. Manganese Releases in Solution, on Walls, and in Residue from Polished Sample 2 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

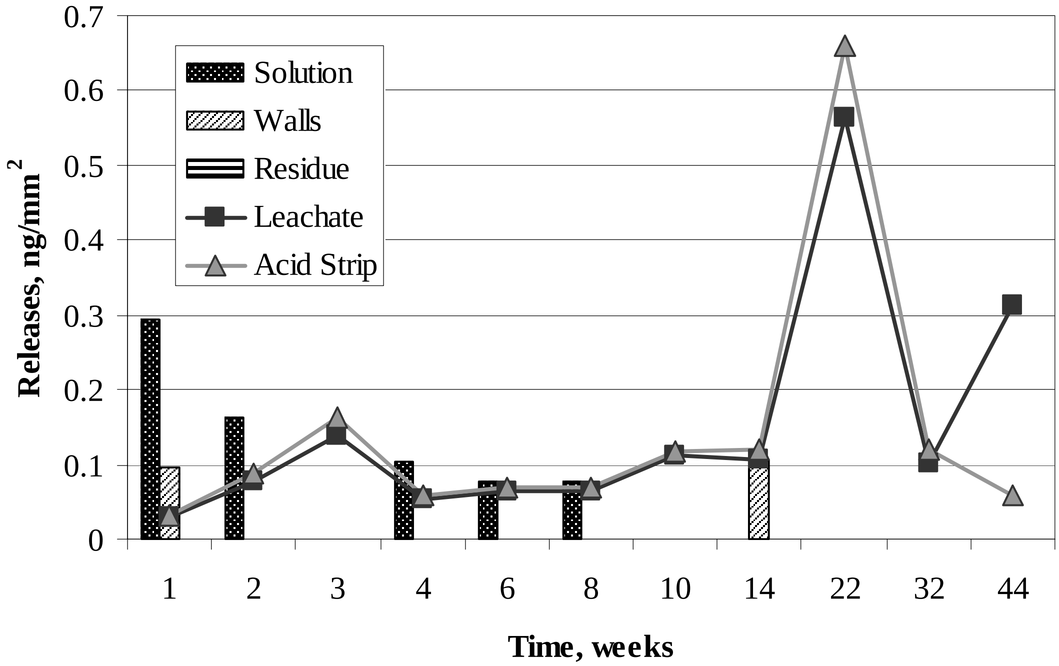


Figure E-225. Manganese Releases in Solution, on Walls, and in Residue from Polished Sample 3 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

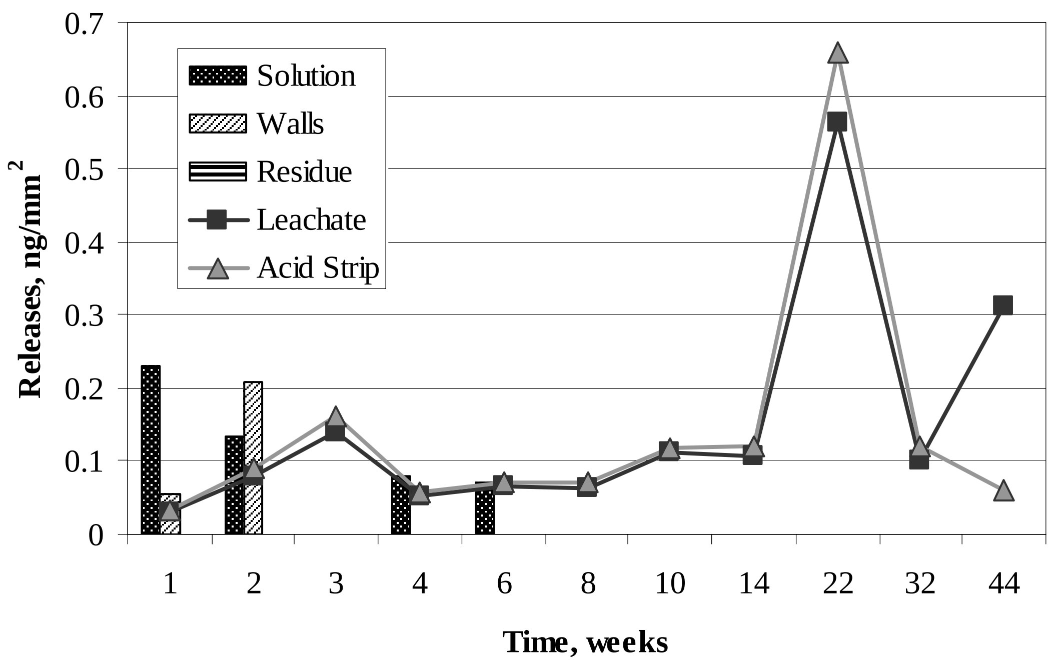


Figure E-226. Manganese Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

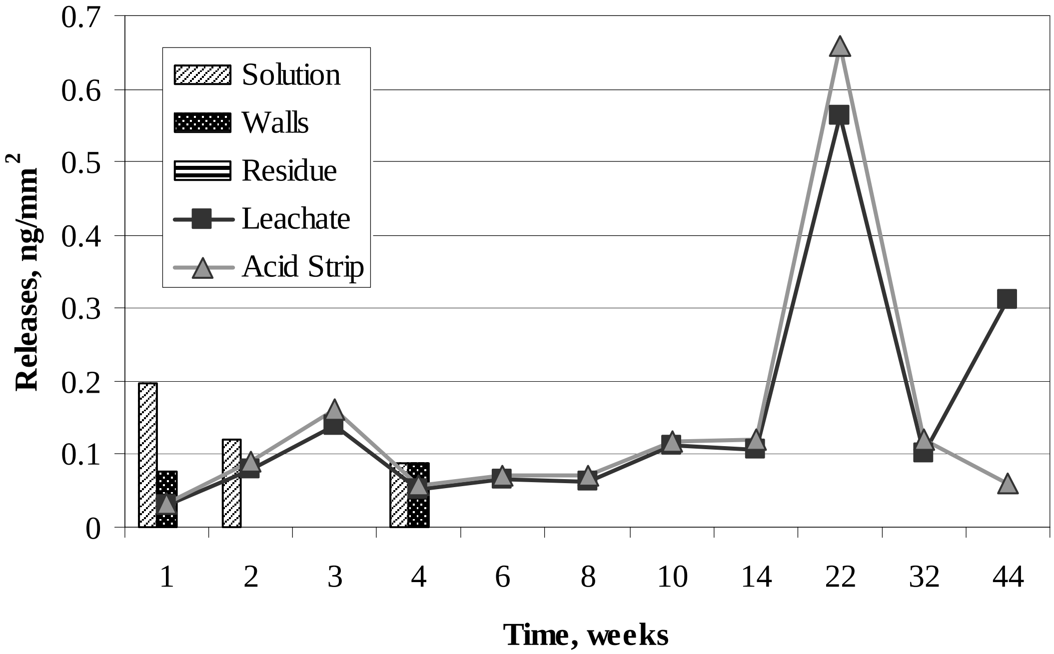


Figure E-227. Manganese Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

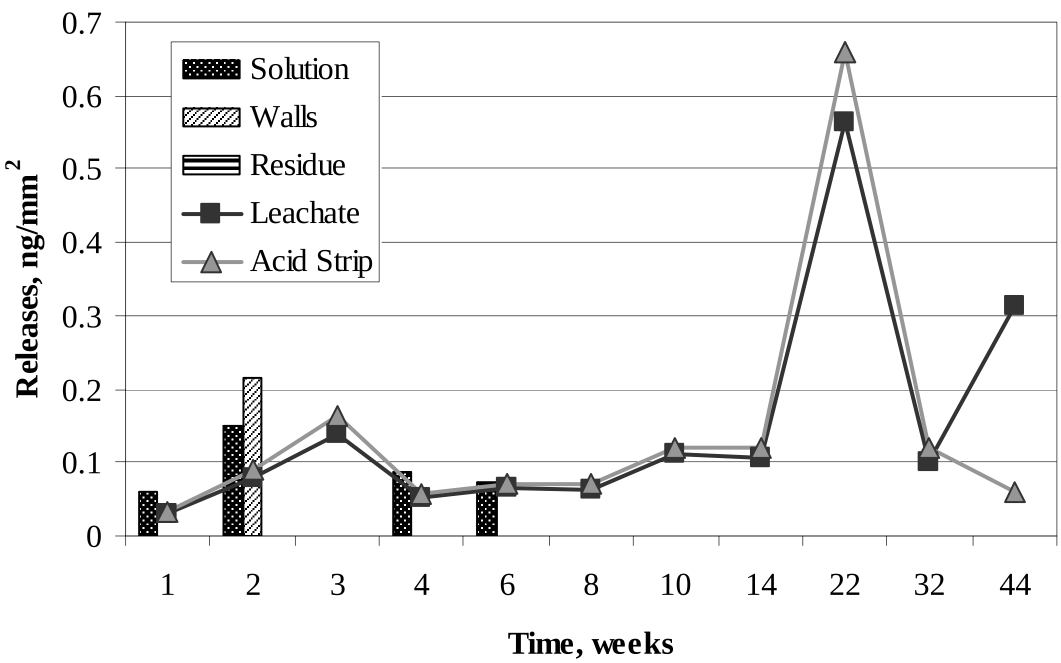


Figure E-228. Manganese Present in Solution, on Walls, and in Residue from CJ13 Control and Average Detection Limits for Leachate and Acid Strip.

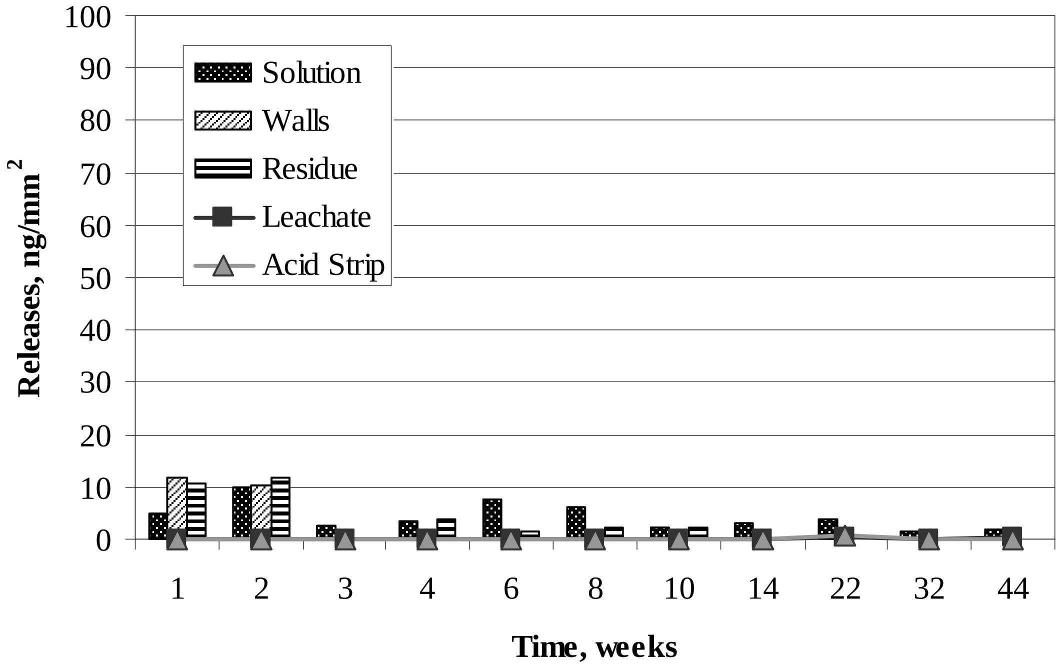


Figure E-229. Manganese Releases in Solution, on Walls, and in Residue from Polished Sample 1 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

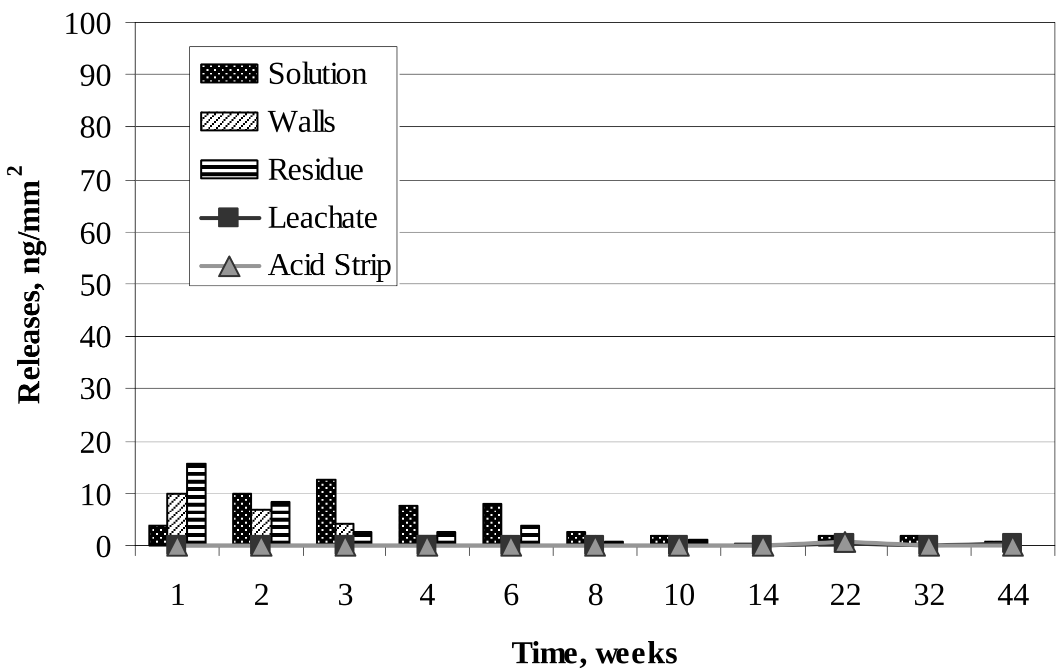


Figure E-230. Manganese Releases in Solution, on Walls, and in Residue from Polished Sample 2 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

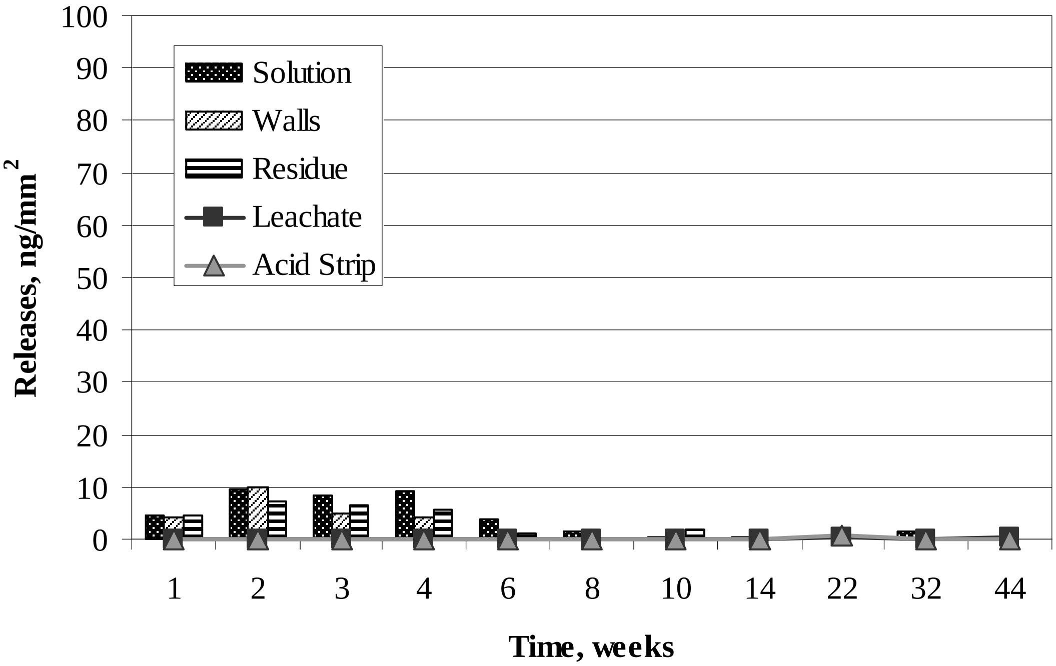


Figure E-231. Manganese Releases in Solution, on Walls, and in Residue from Polished Sample 3 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

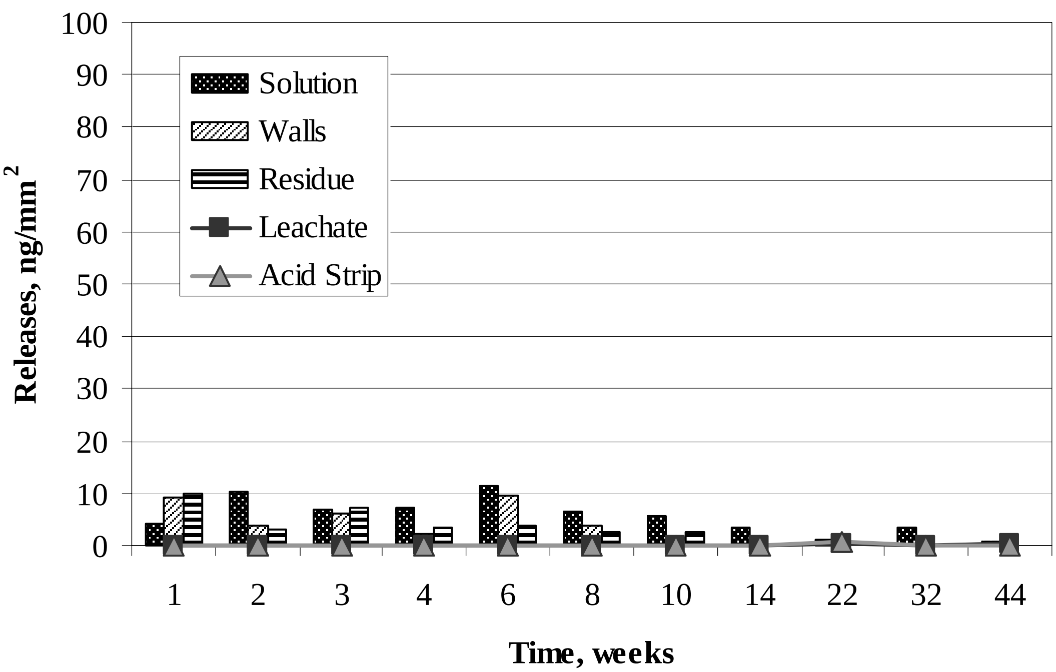


Figure E-232. Manganese Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

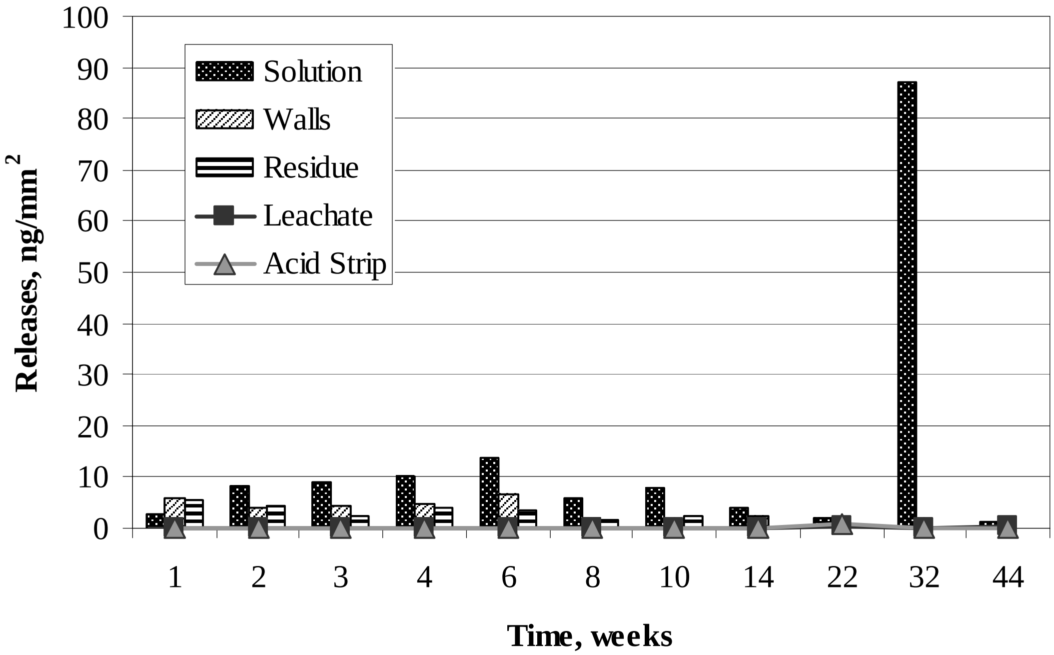


Figure E-233. Manganese Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

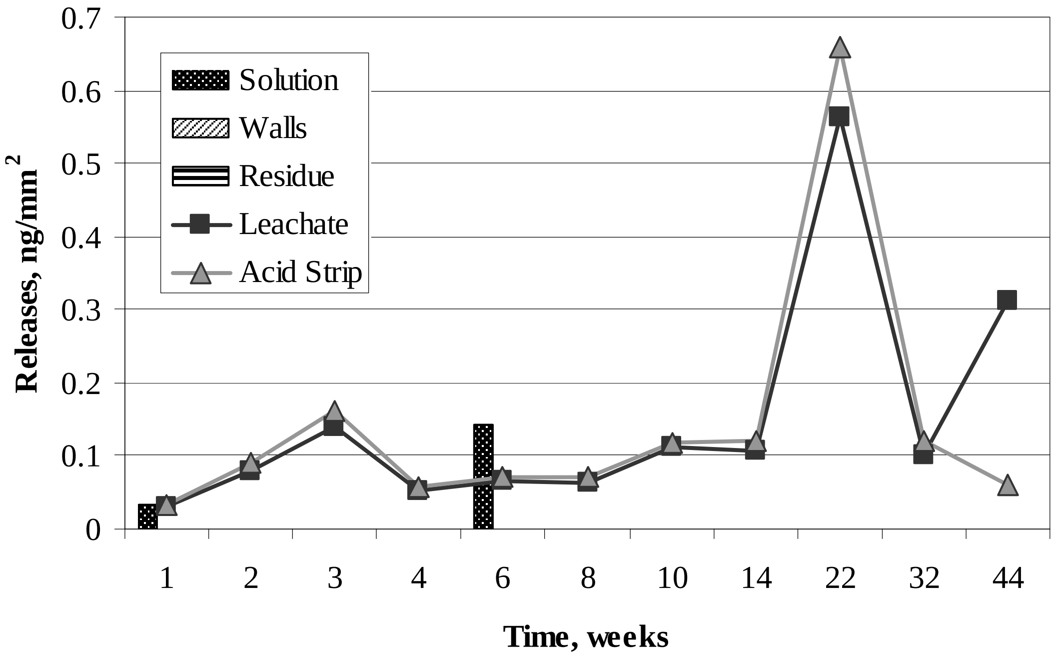


Figure E-234. Manganese Present in Solution, on Walls, and in Residue from 10KCl Control and Average Detection Limits for Leachate and Acid Strip.

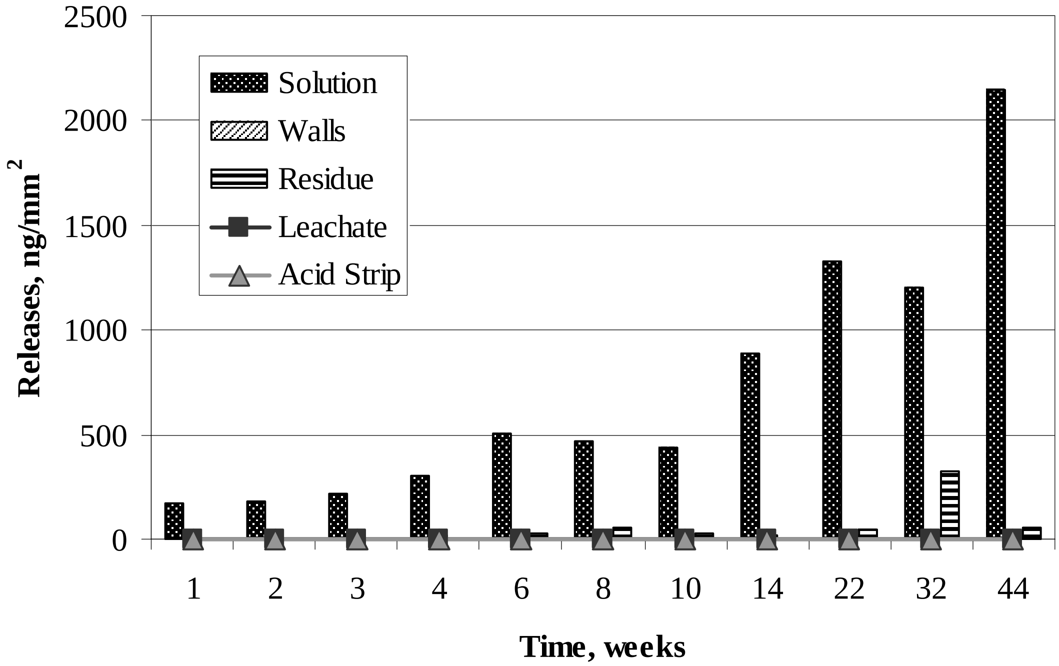


Figure E-235. Manganese Releases in Solution, on Walls, and in Residue from Polished Sample 1 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

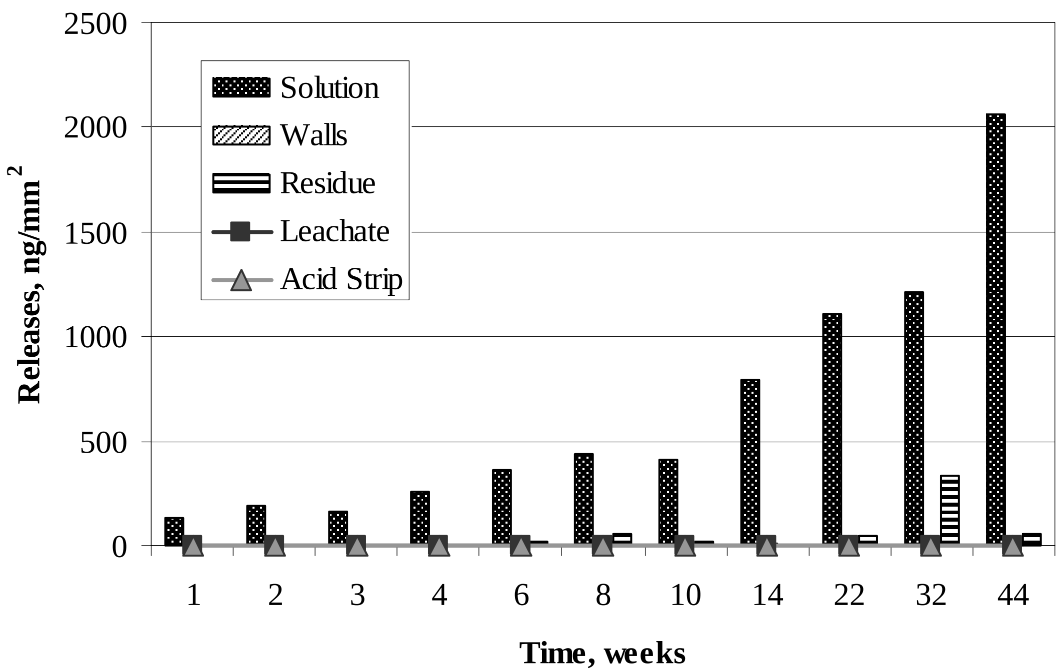


Figure E-236. Manganese Releases in Solution, on Walls, and in Residue from Polished Sample 2 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

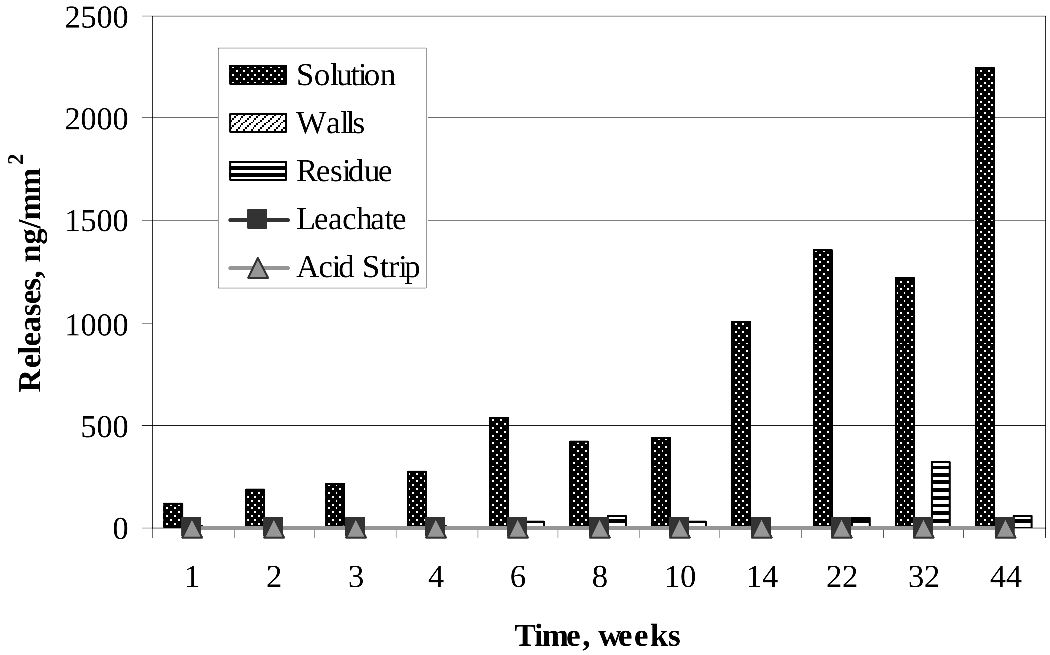


Figure E-237. Manganese Releases in Solution, on Walls, and in Residue from Polished Sample 3 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

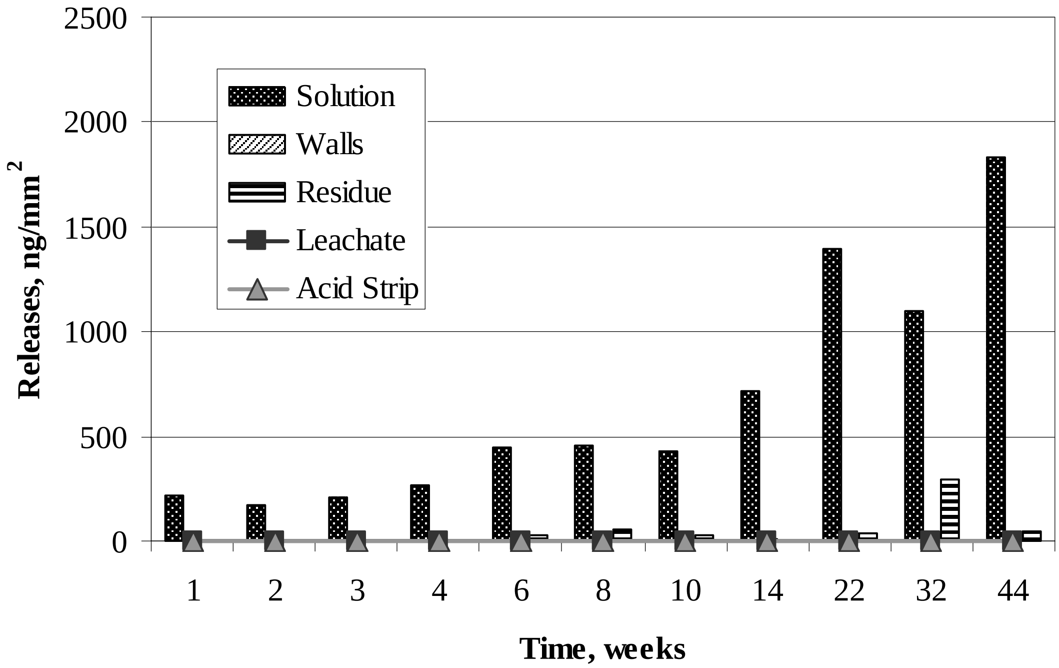


Figure E-238. Manganese Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

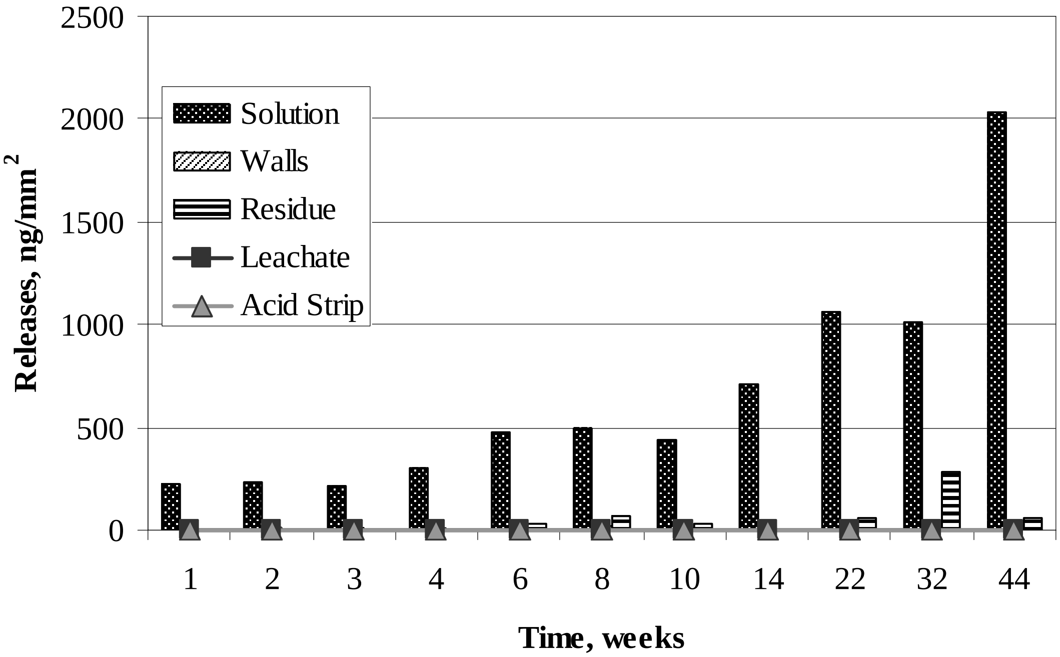


Figure E-239. Manganese Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

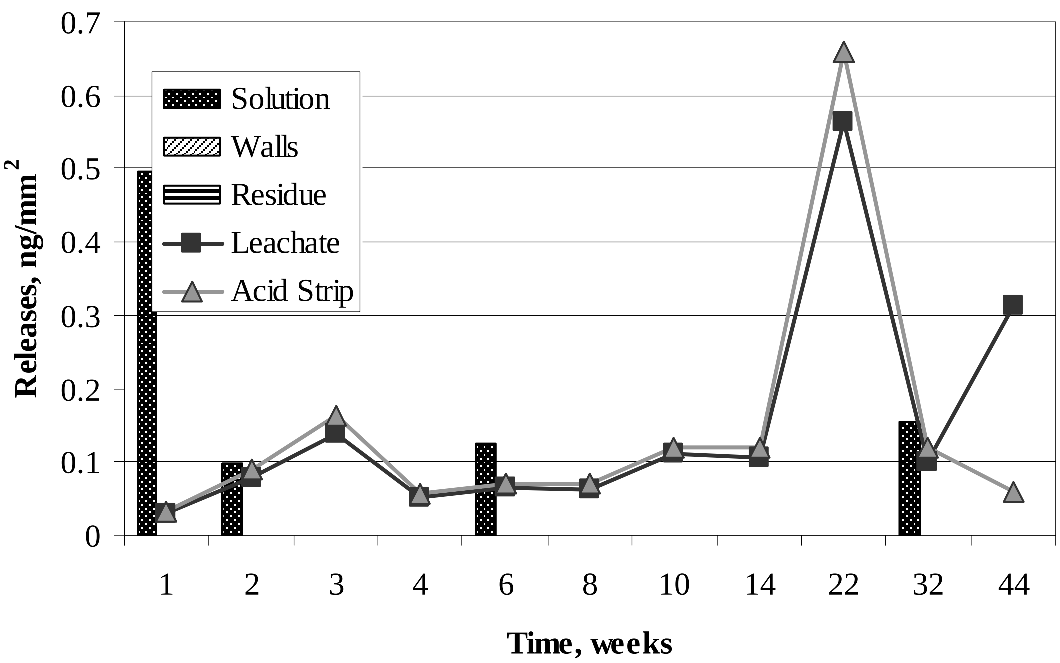


Figure E-240. Manganese Present in Solution, on Walls, and in Residue from AJ13 Control and Average Detection Limits for Leachate and Acid Strip.

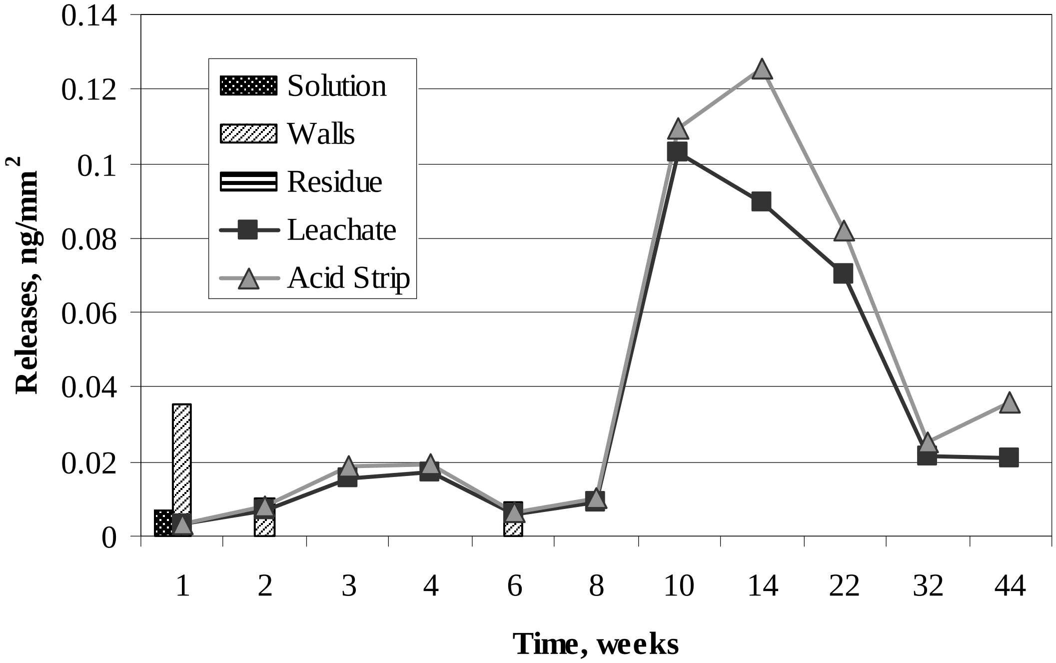


Figure E-241. Cobalt Releases in Solution, on Walls, and in Residue from Polished Sample 1 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

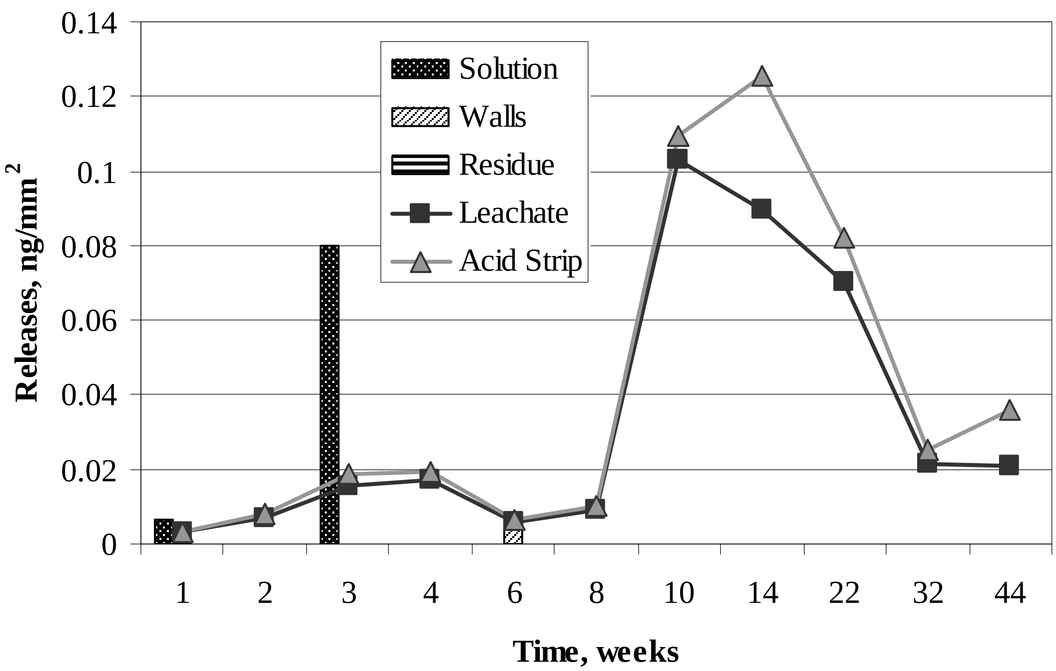


Figure E-242. Cobalt Releases in Solution, on Walls, and in Residue from Polished Sample 2 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

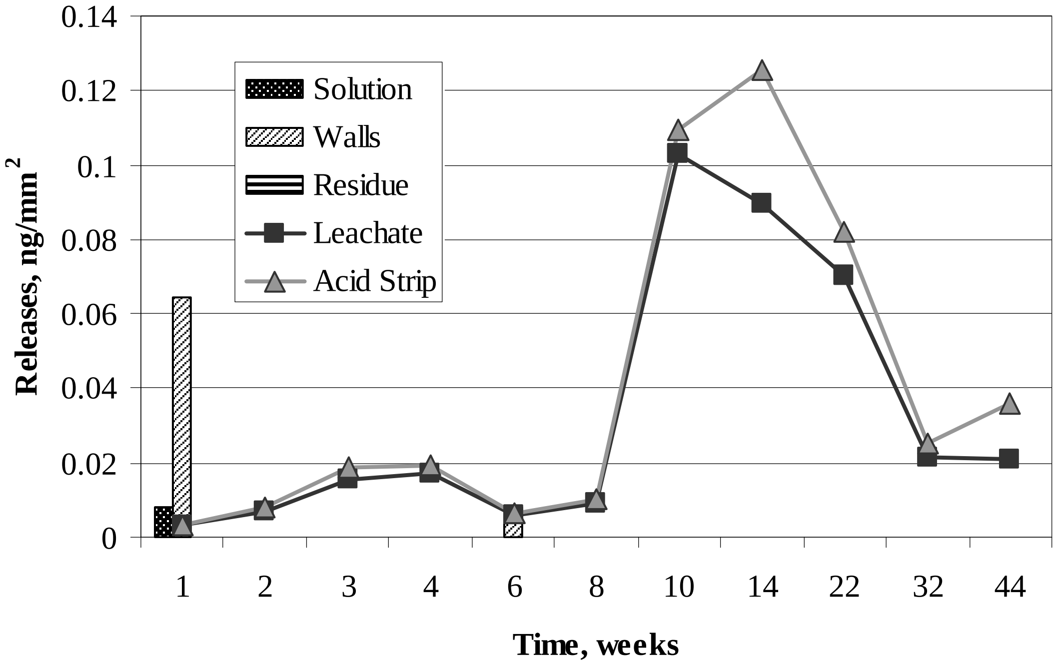


Figure E-243. Cobalt Releases in Solution, on Walls, and in Residue from Polished Sample 3 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

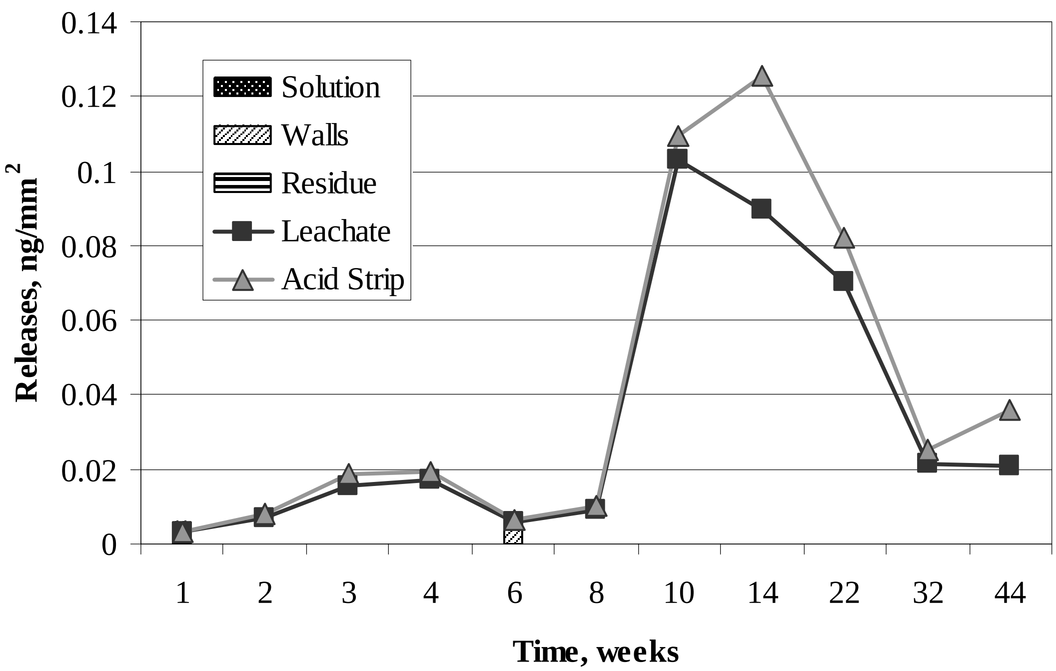


Figure E-244. Cobalt Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

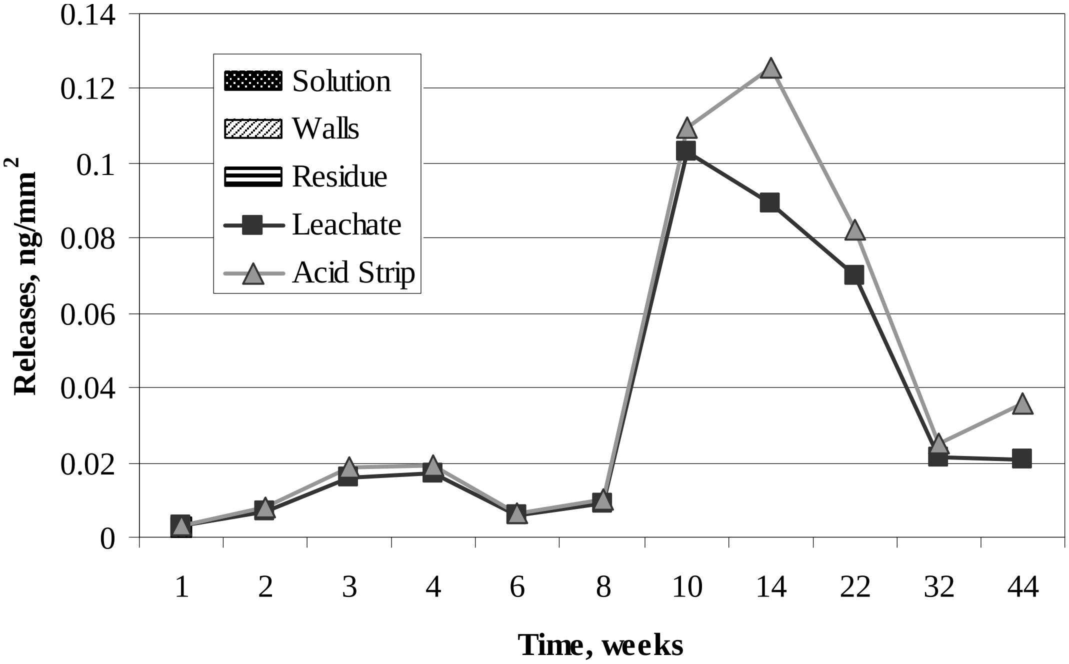


Figure E-245. Cobalt Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

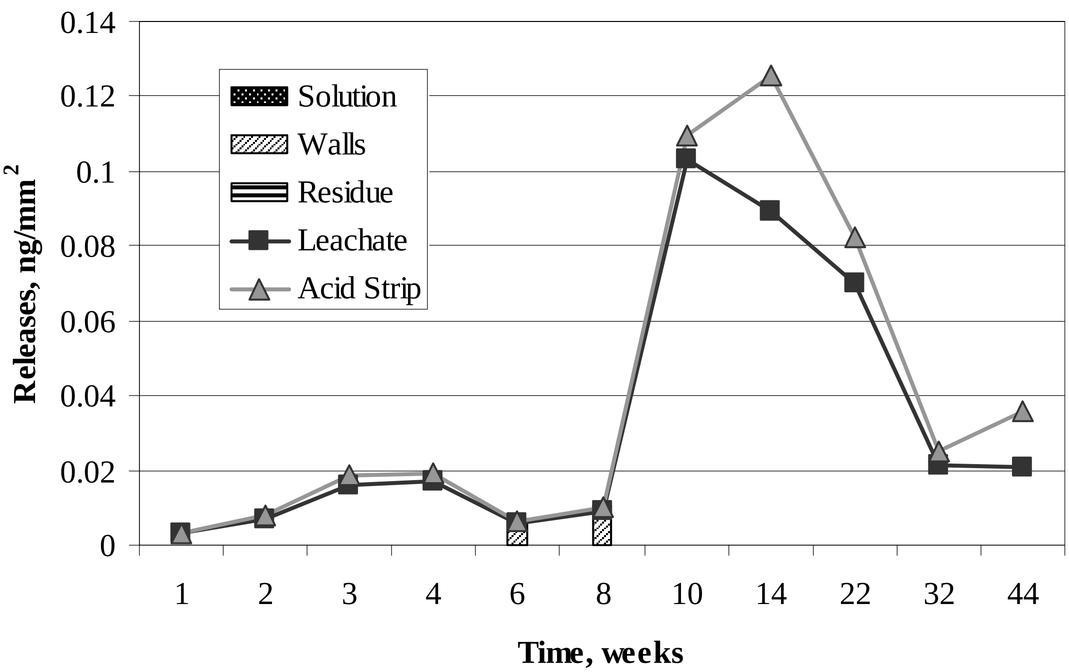


Figure E-246. Cobalt Present in Solution, on Walls, and in Residue from SJ13 Control and Average Detection Limits for Leachate and Acid Strip.

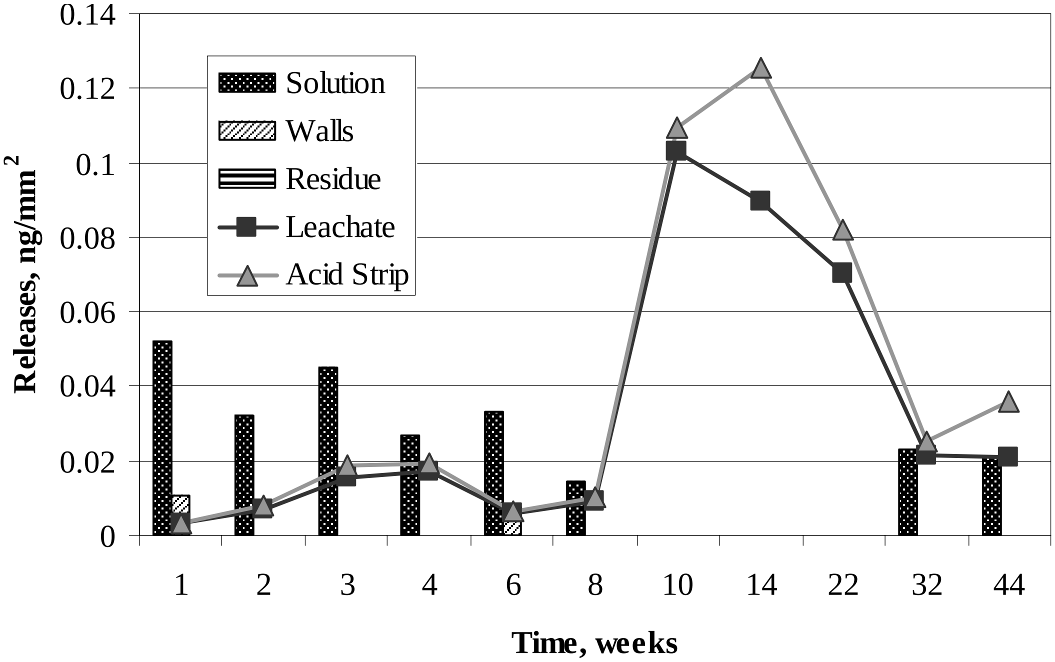


Figure E-247. Cobalt Releases in Solution, on Walls, and in Residue from Polished Sample 1 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

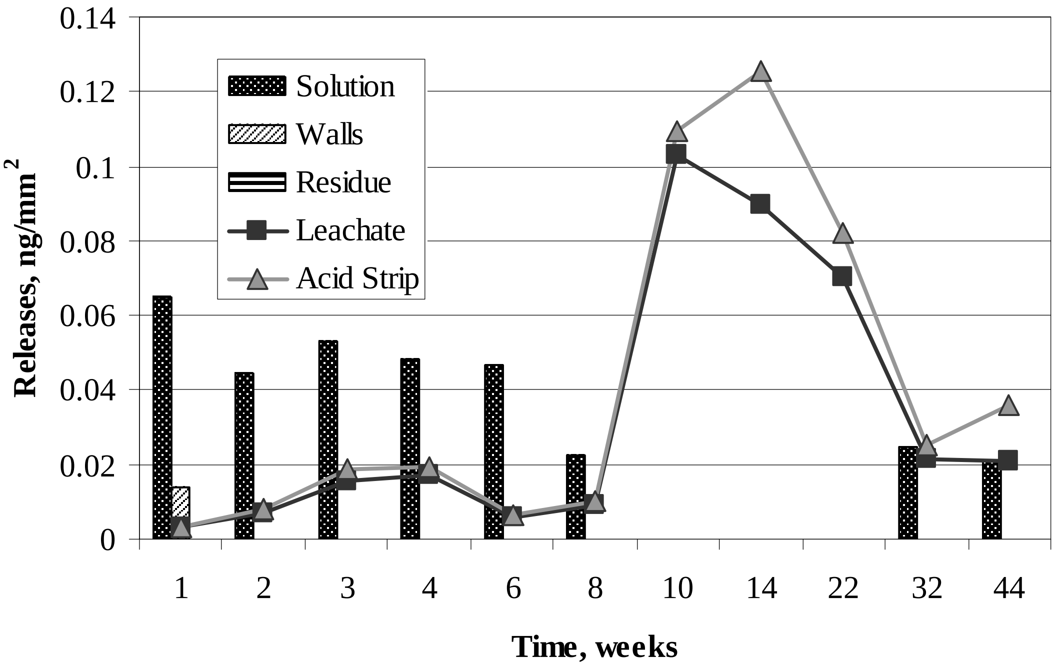


Figure E-248. Cobalt Releases in Solution, on Walls, and in Residue from Polished Sample 2 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

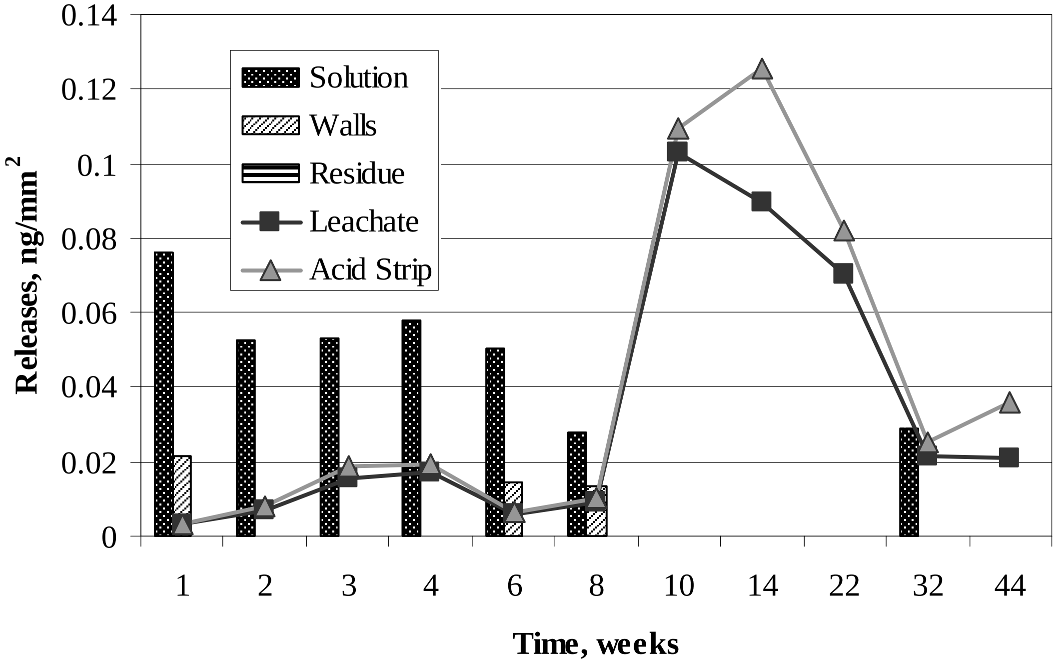


Figure E-249. Cobalt Releases in Solution, on Walls, and in Residue from Polished Sample 3 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

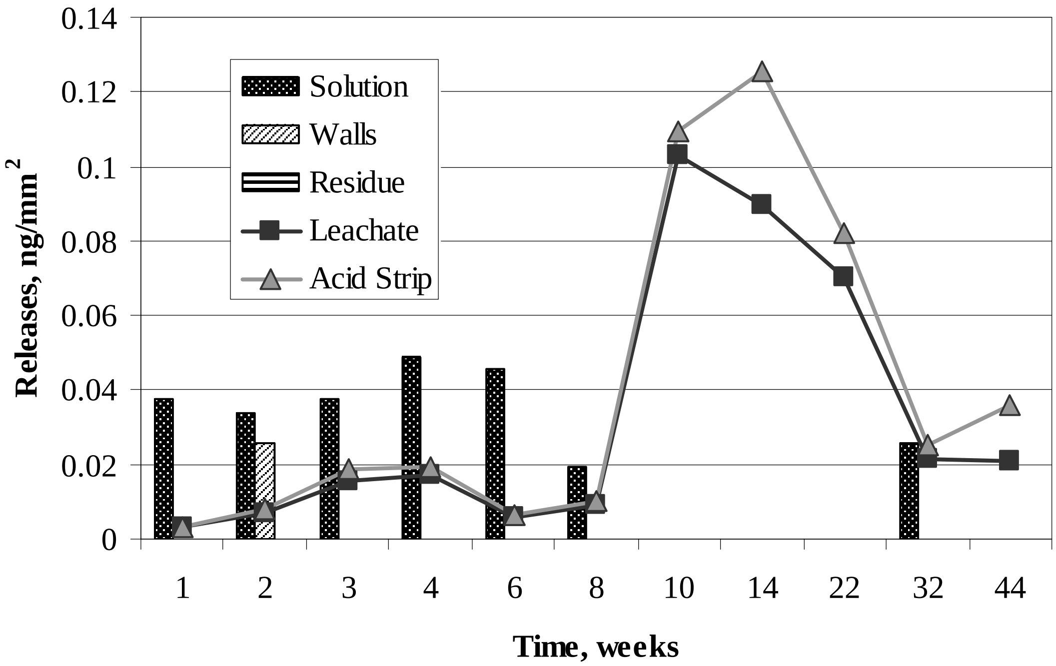


Figure E-250. Cobalt Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

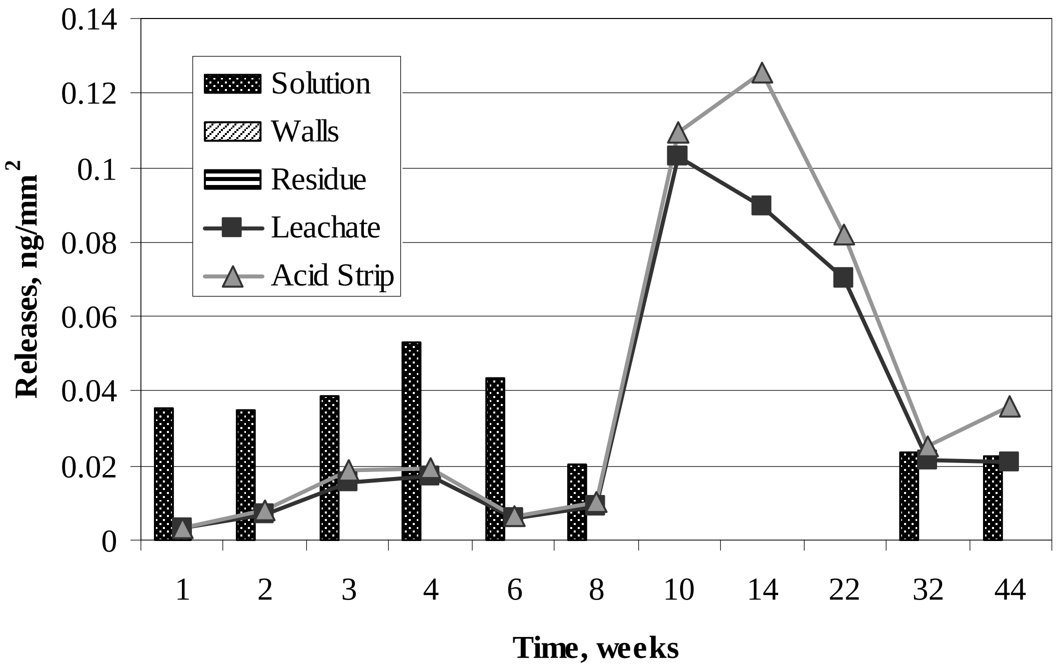


Figure E-251. Cobalt Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

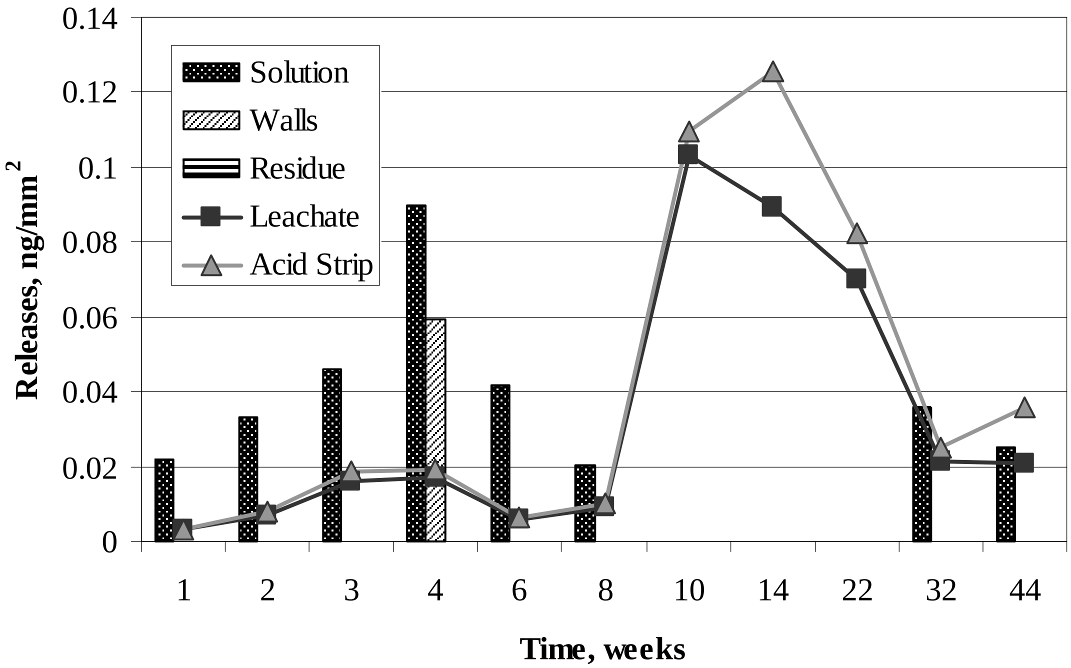


Figure E-252. Cobalt Present in Solution, on Walls, and in Residue from CJ13 Control and Average Detection Limits for Leachate and Acid Strip.

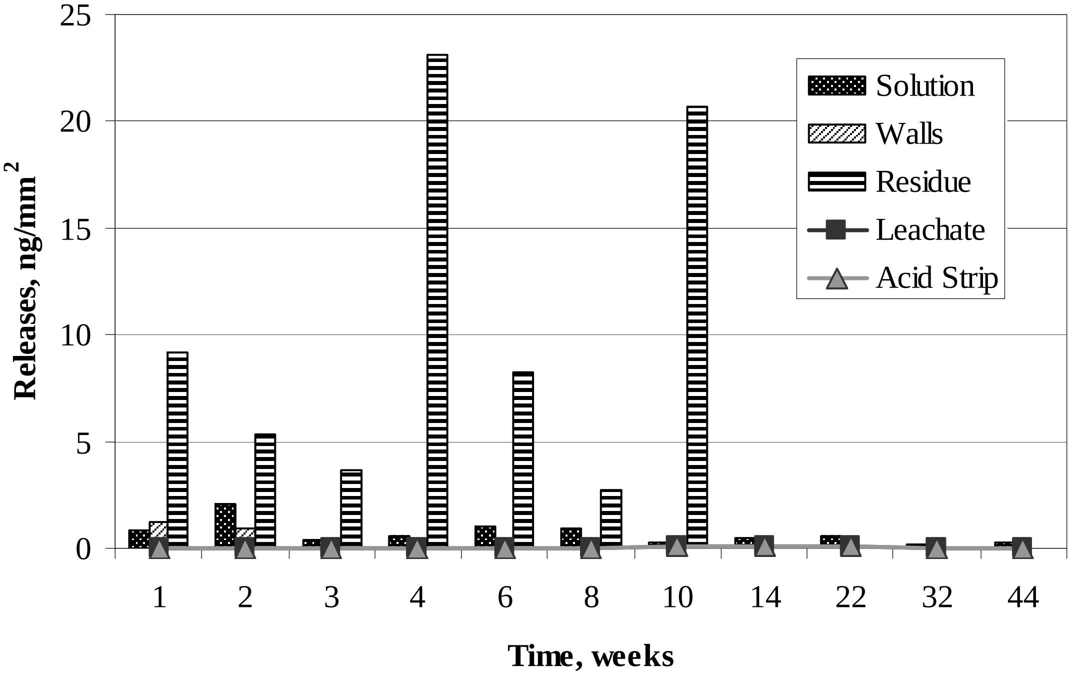


Figure E-253. Cobalt Releases in Solution, on Walls, and in Residue from Polished Sample 1 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

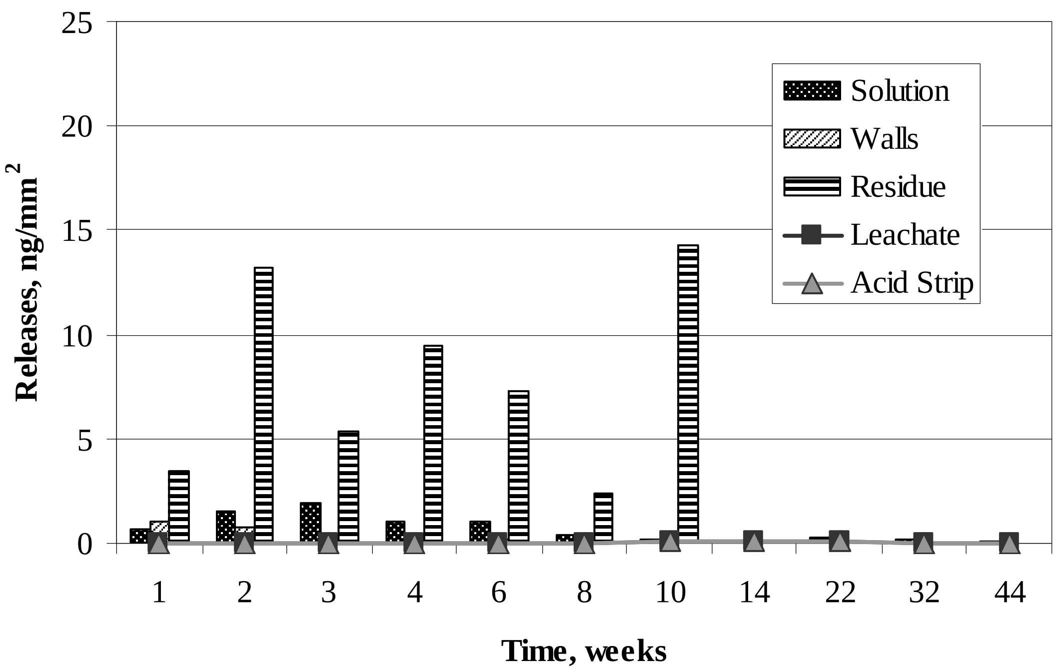


Figure E-254. Cobalt Releases in Solution, on Walls, and in Residue from Polished Sample 2 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

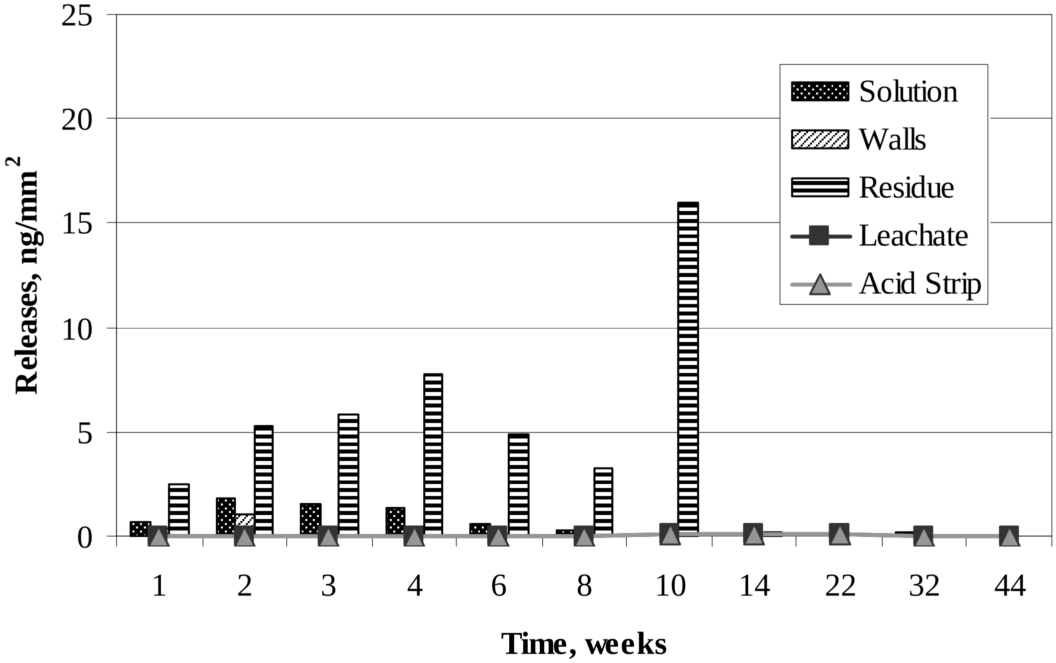


Figure E-255. Cobalt Releases in Solution, on Walls, and in Residue from Polished Sample 3 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

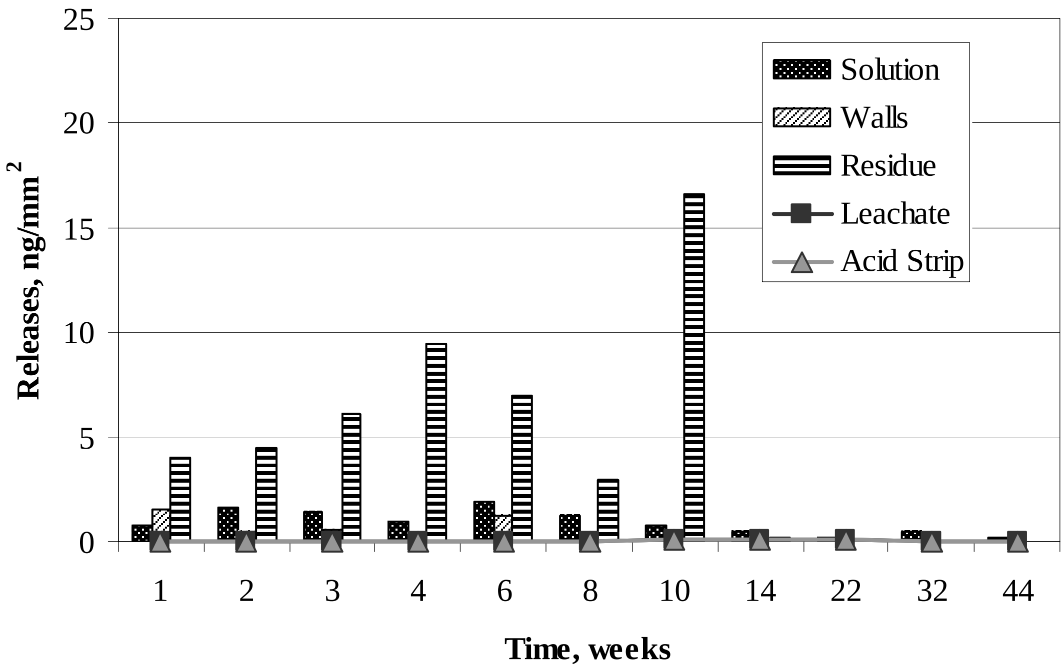


Figure E-256. Cobalt Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

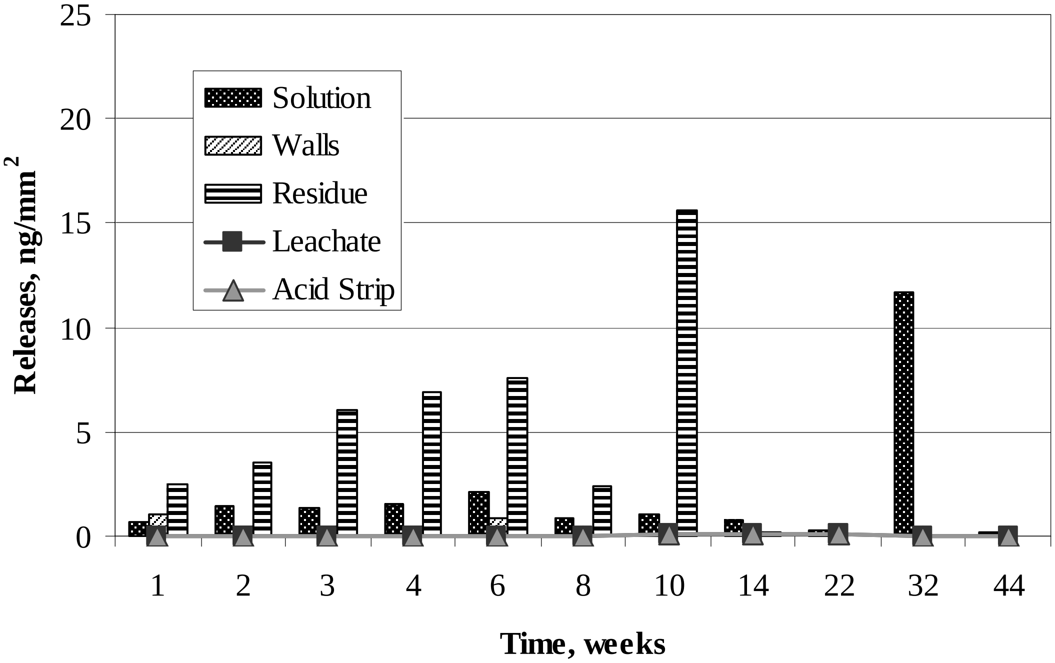


Figure E-257. Cobalt Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

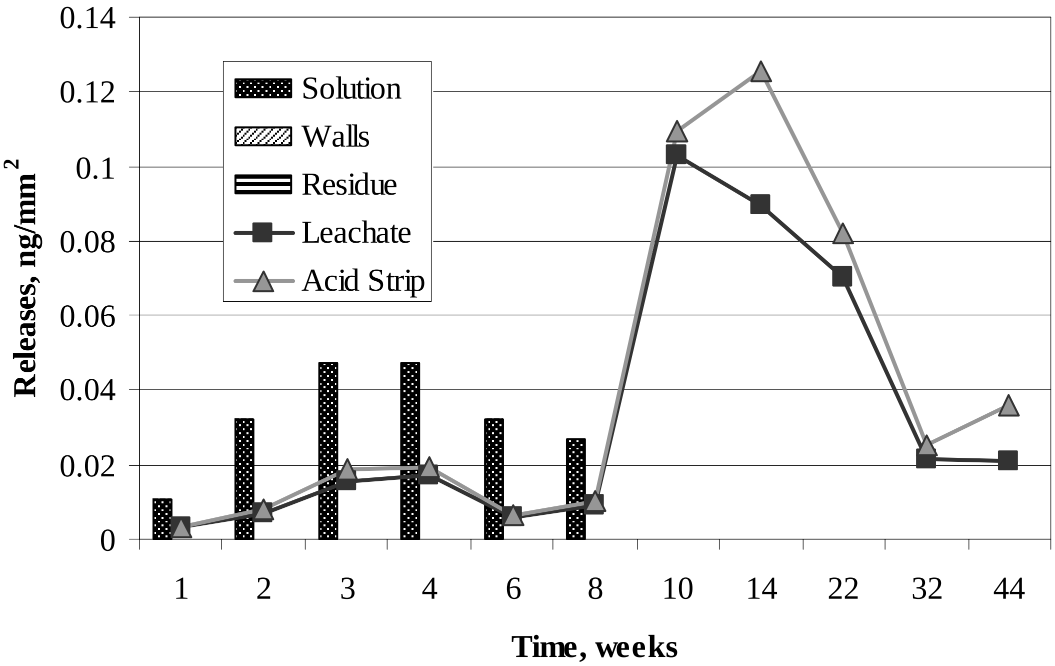


Figure E-258. Cobalt Present in Solution, on Walls, and in Residue from 10KCl Control and Average Detection Limits for Leachate and Acid Strip.

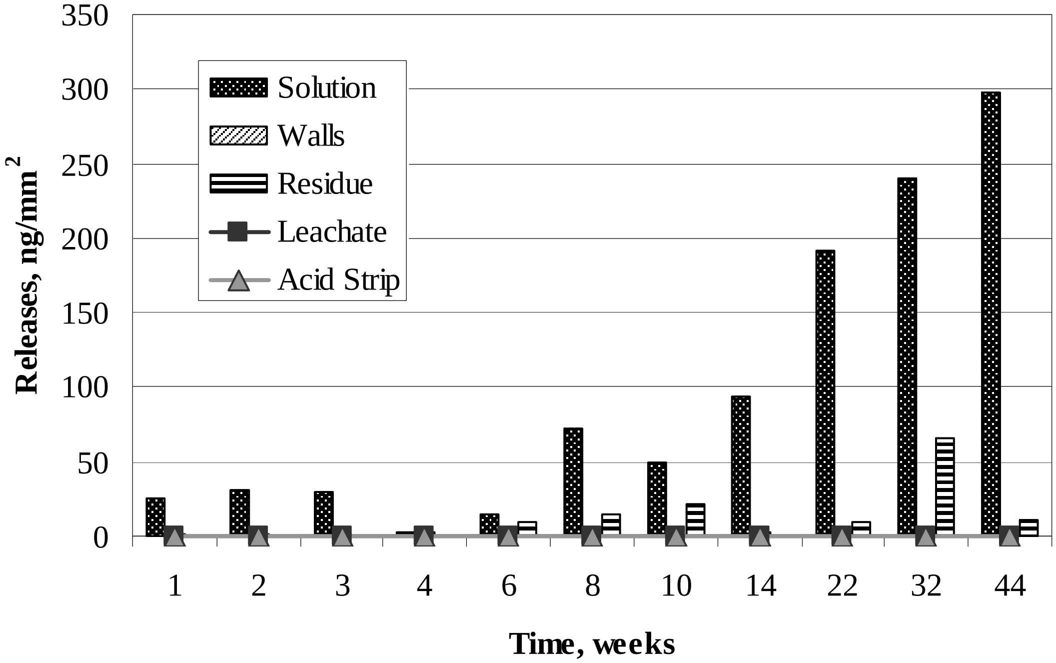


Figure E-259. Cobalt Releases in Solution, on Walls, and in Residue from Polished Sample 1 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

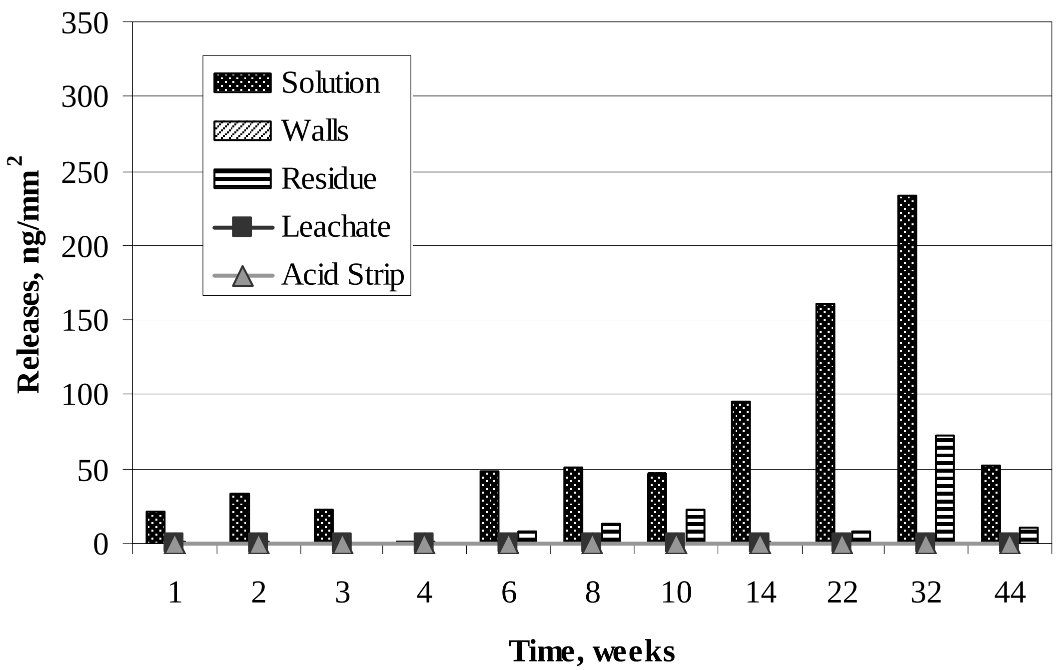


Figure E-260. Cobalt Releases in Solution, on Walls, and in Residue from Polished Sample 2 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

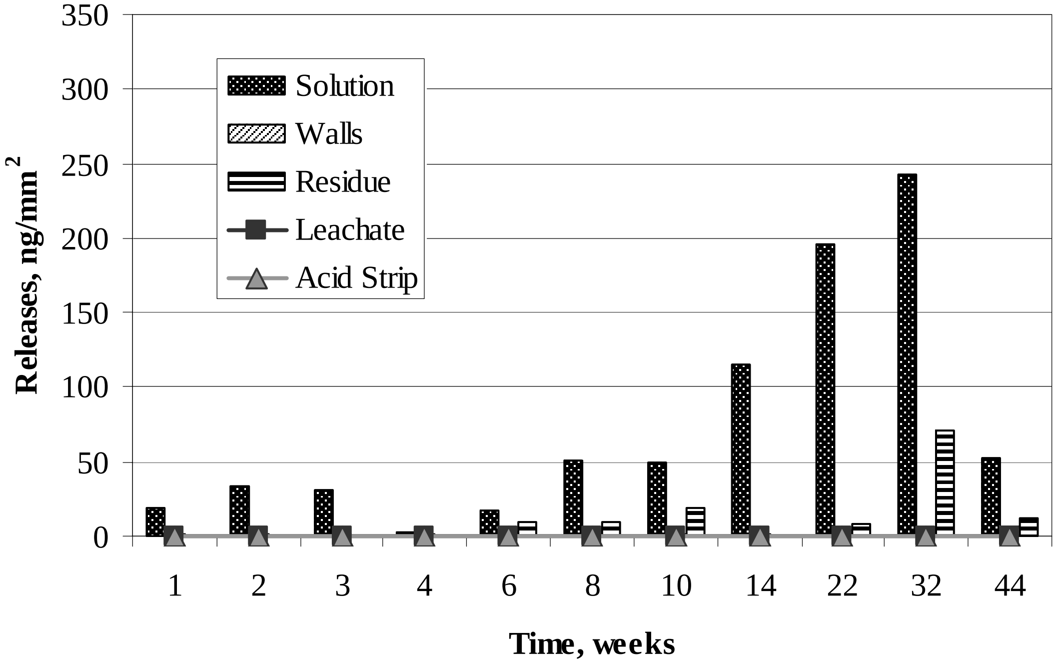


Figure E-261. Cobalt Releases in Solution, on Walls, and in Residue from Polished Sample 3 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

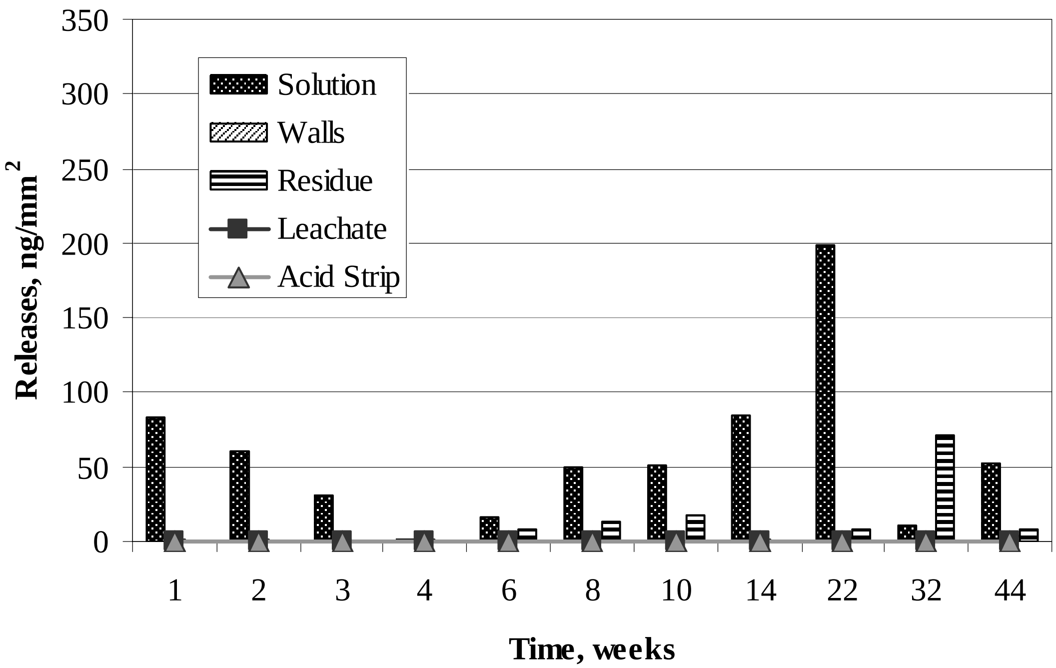


Figure E-262. Cobalt Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

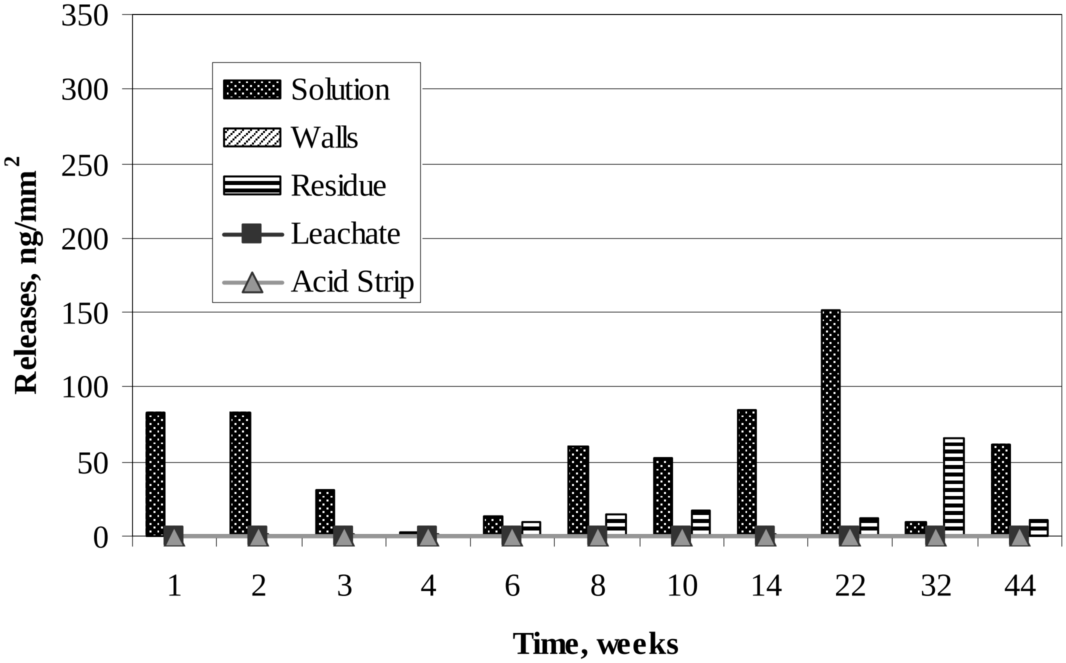


Figure E-263. Cobalt Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

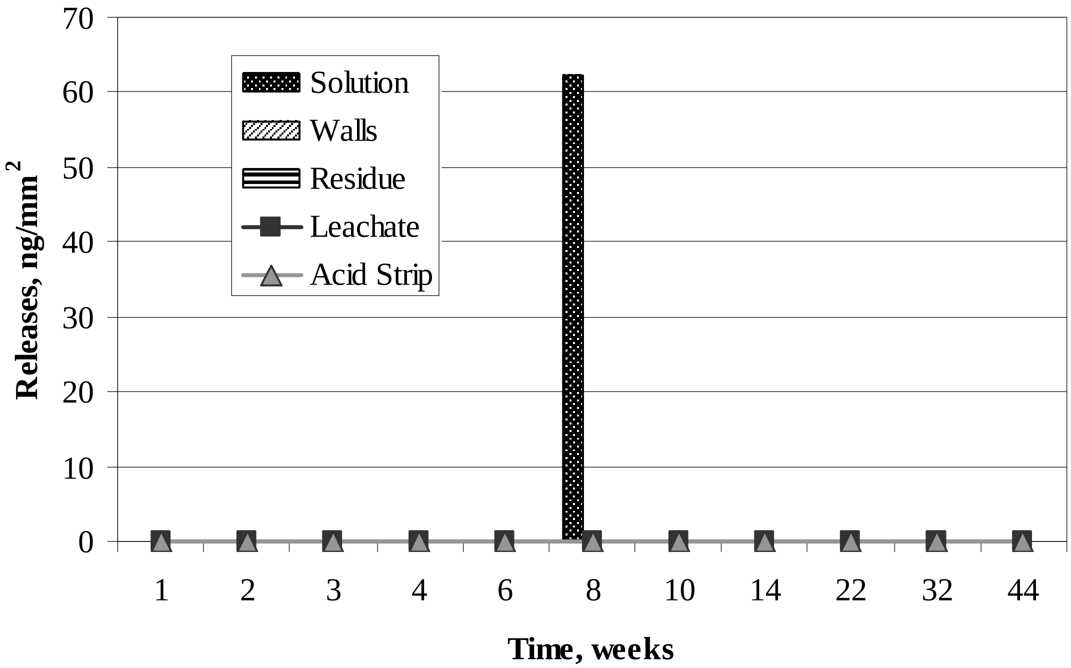


Figure E-264. Cobalt Present in Solution, on Walls, and in Residue from AJ13 Control and Average Detection Limits for Leachate and Acid Strip.

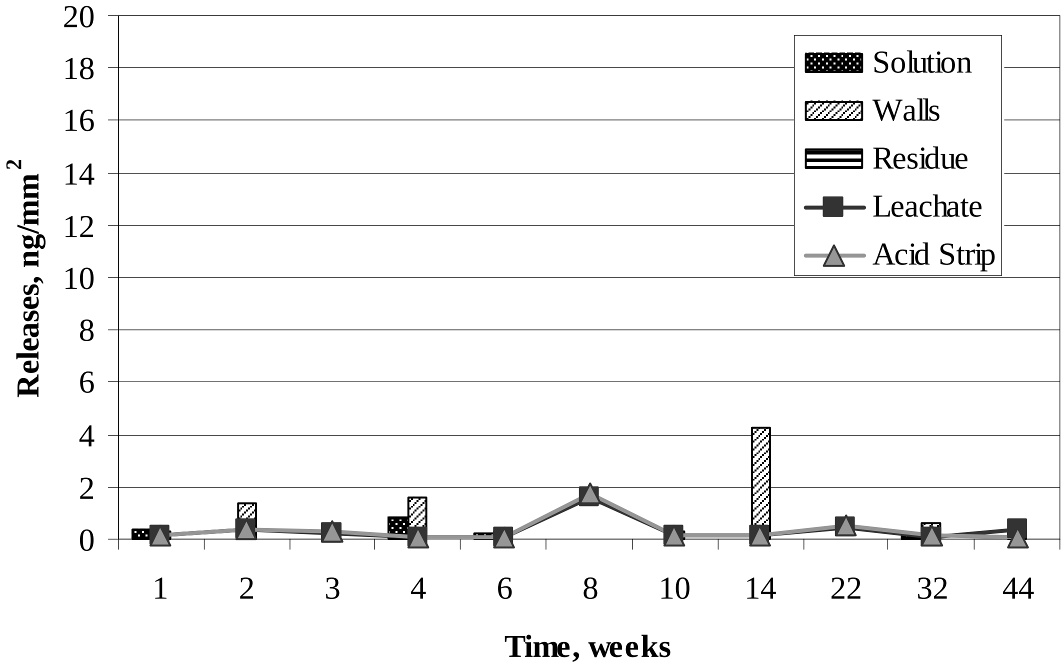


Figure E-265. Copper Releases in Solution, on Walls, and in Residue from Polished Sample 1 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

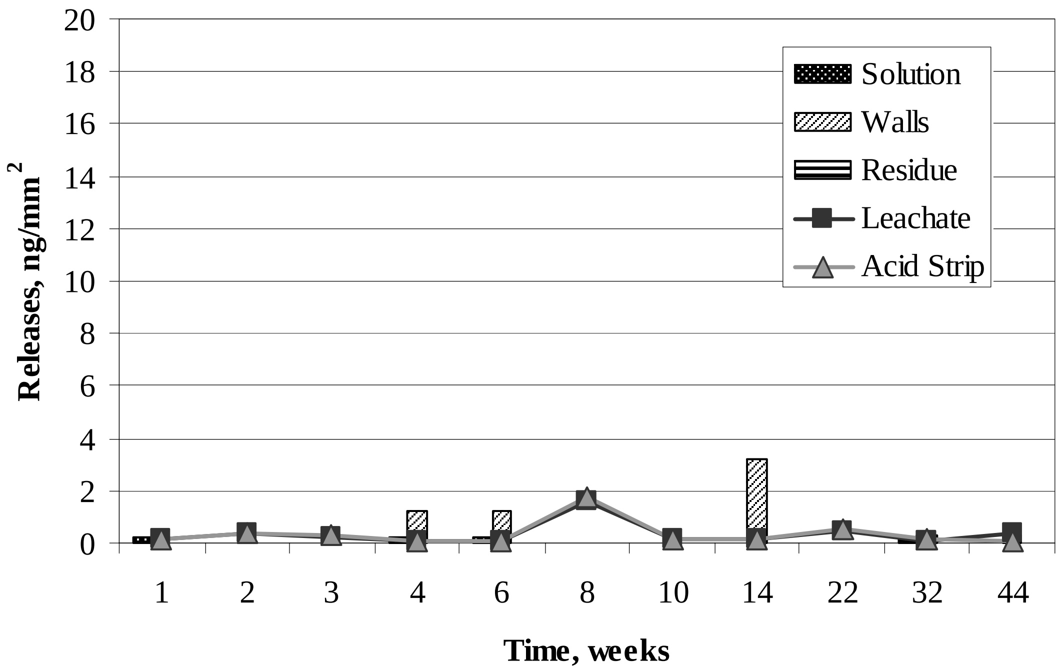


Figure E-266. Copper Releases in Solution, on Walls, and in Residue from Polished Sample 2 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

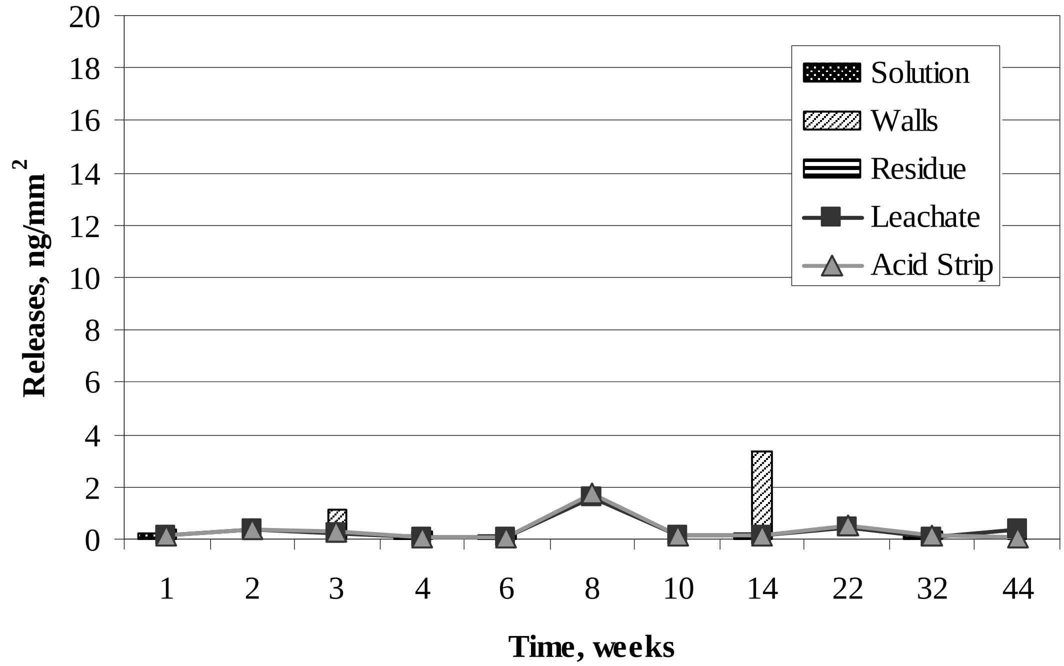


Figure E-267. Copper Releases in Solution, on Walls, and in Residue from Polished Sample 3 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

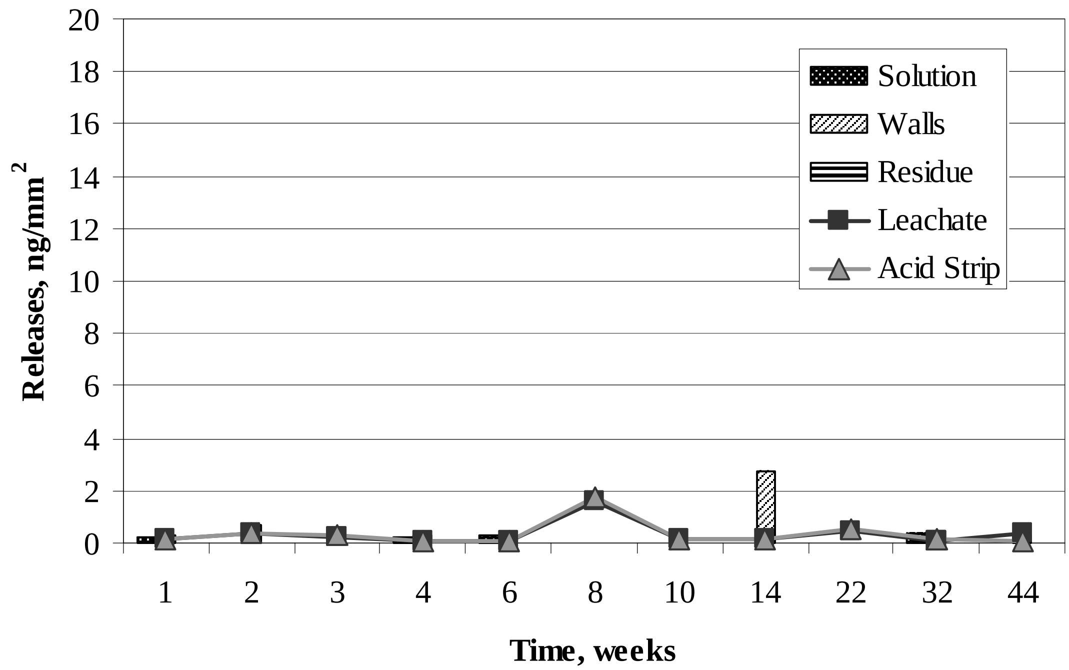


Figure E-268. Copper Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

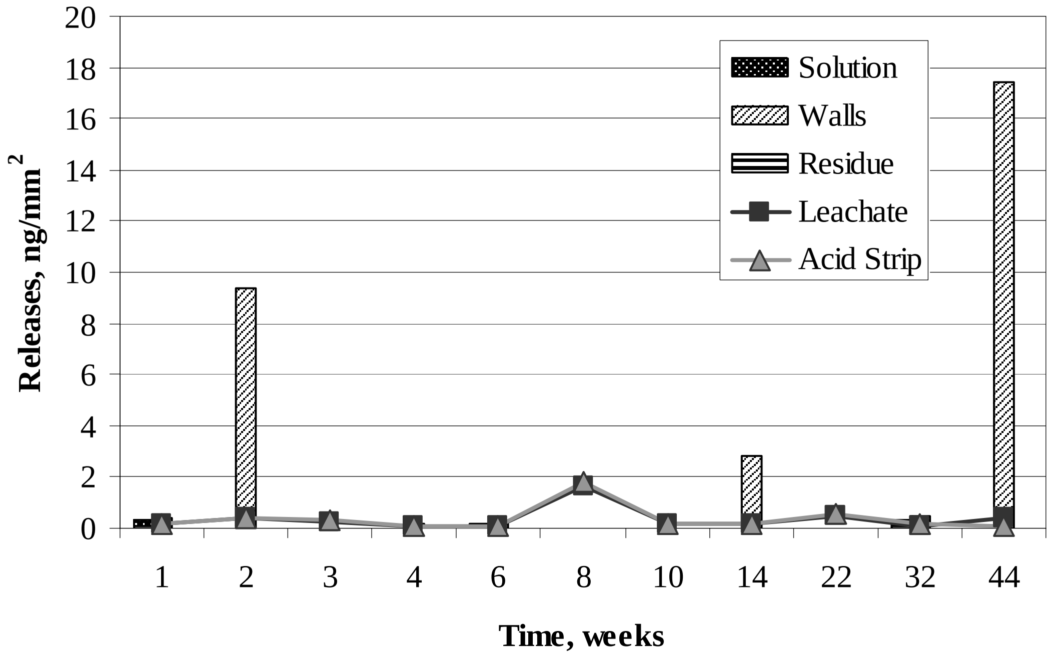


Figure E-269. Copper Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

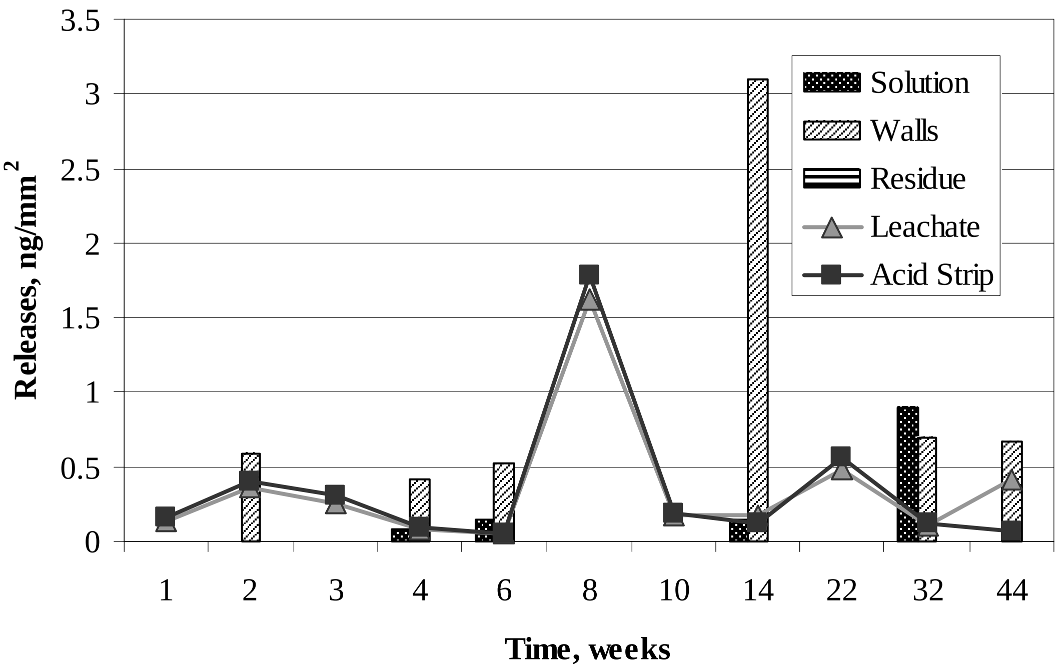


Figure E-270. Copper Present in Solution, on Walls, and in Residue from SJ13 Control and Average Detection Limits for Leachate and Acid Strip.

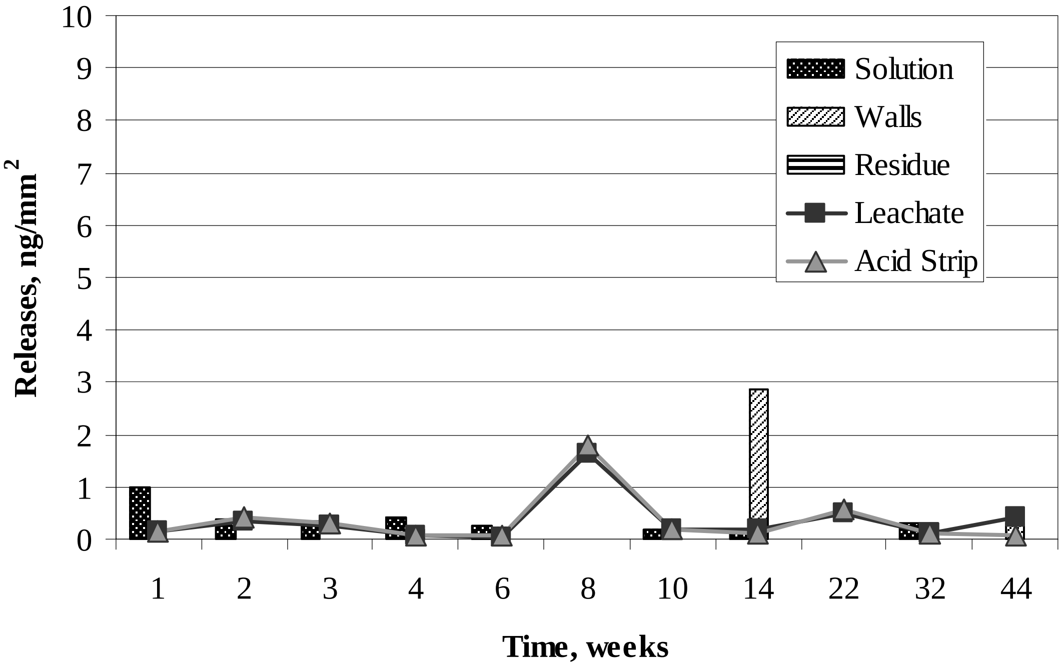


Figure E-271. Copper Releases in Solution, on Walls, and in Residue from Polished Sample 1 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

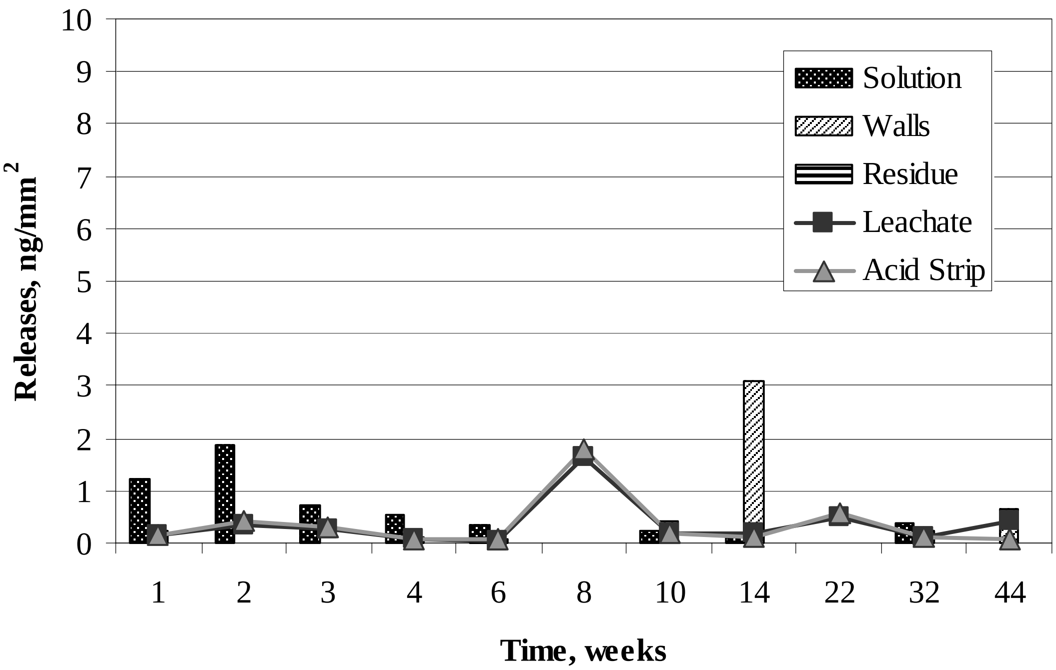


Figure E-272. Copper Releases in Solution, on Walls, and in Residue from Polished Sample 2 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

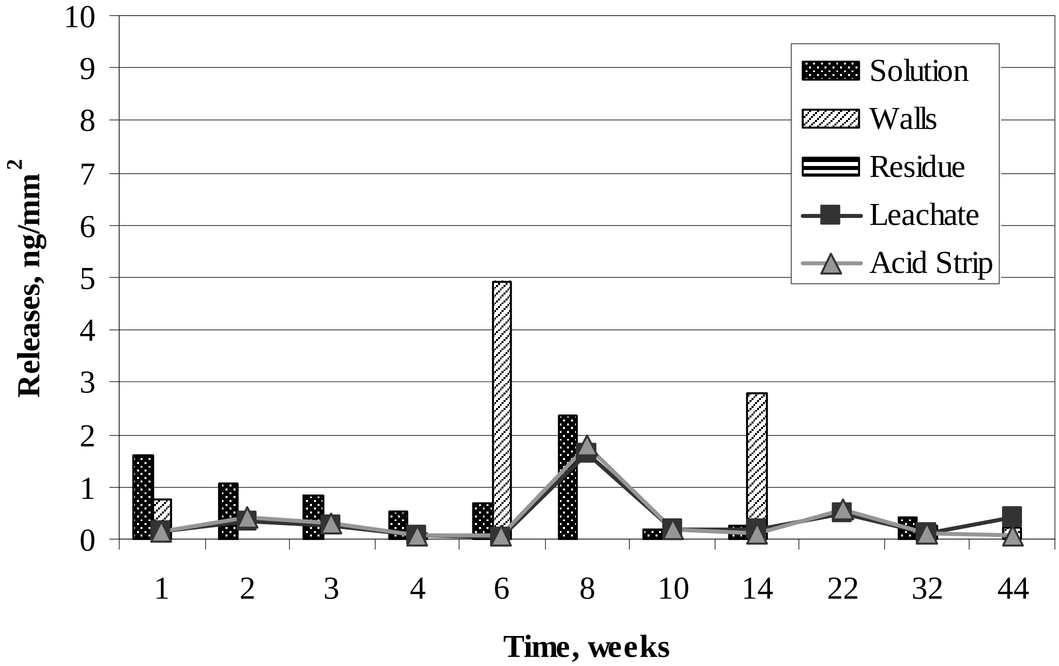


Figure E-273. Copper Releases in Solution, on Walls, and in Residue from Polished Sample 3 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

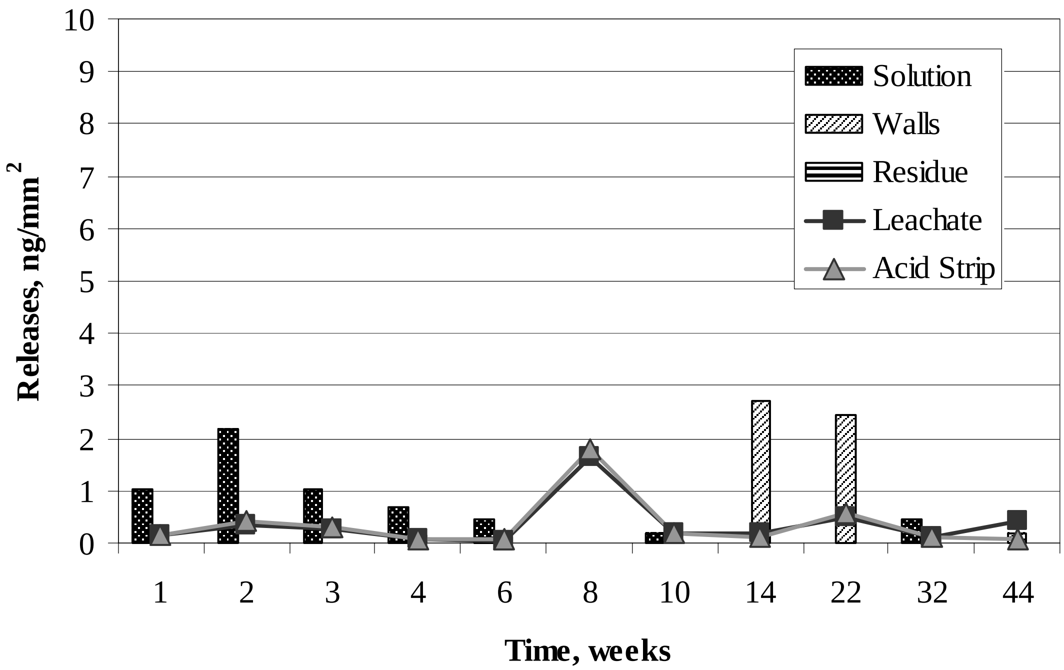


Figure E-274. Copper Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

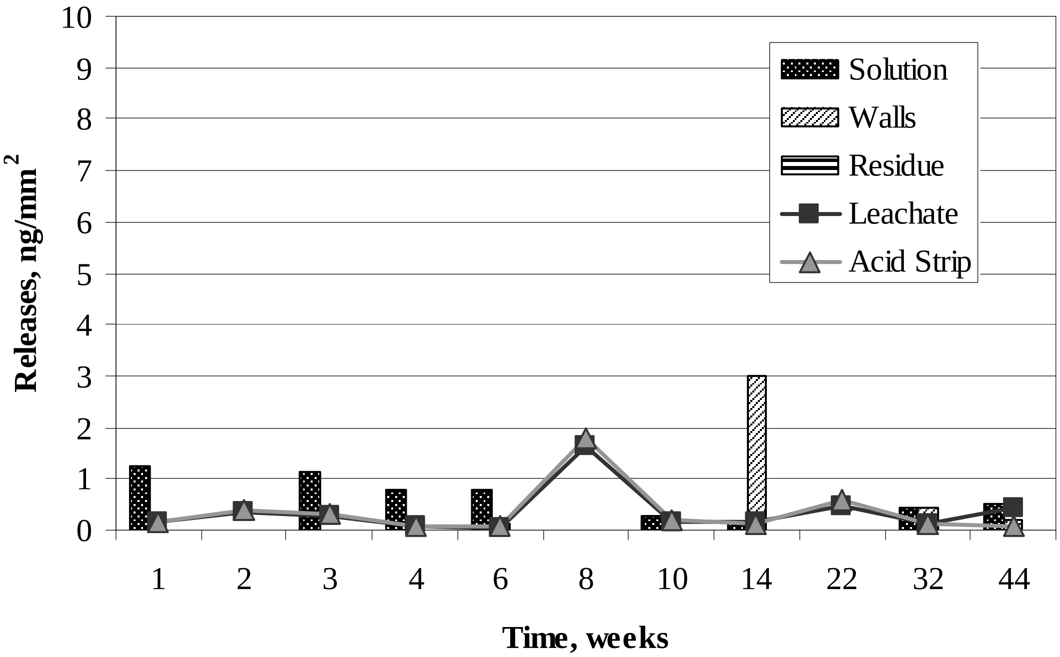


Figure E-275. Copper Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

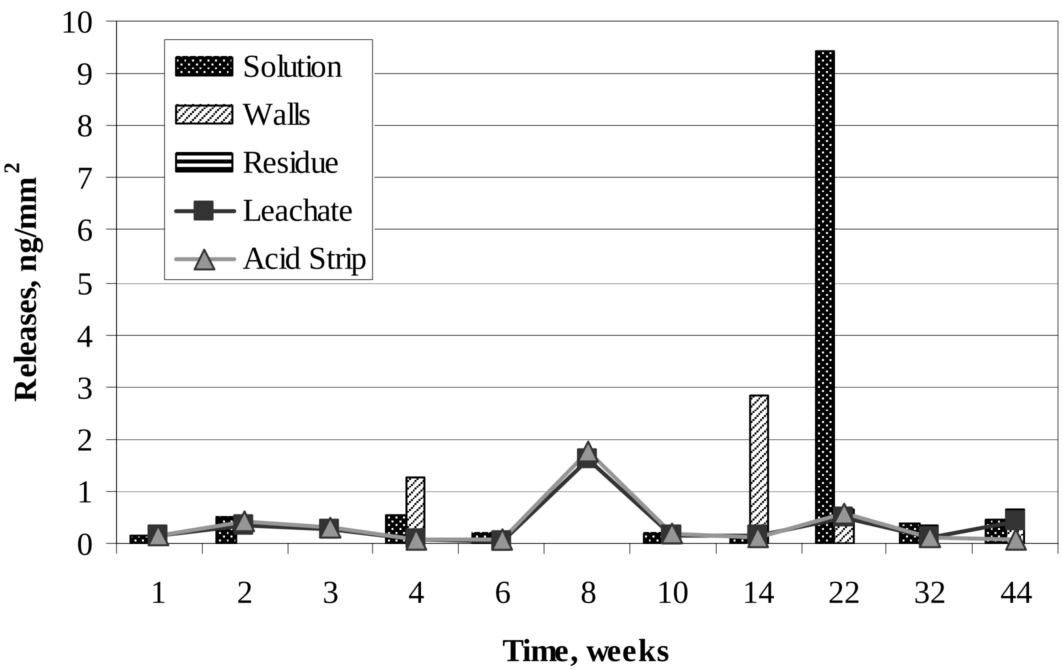


Figure E-276. Copper Present in Solution, on Walls, and in Residue from CJ13 Control and Average Detection Limits for Leachate and Acid Strip.

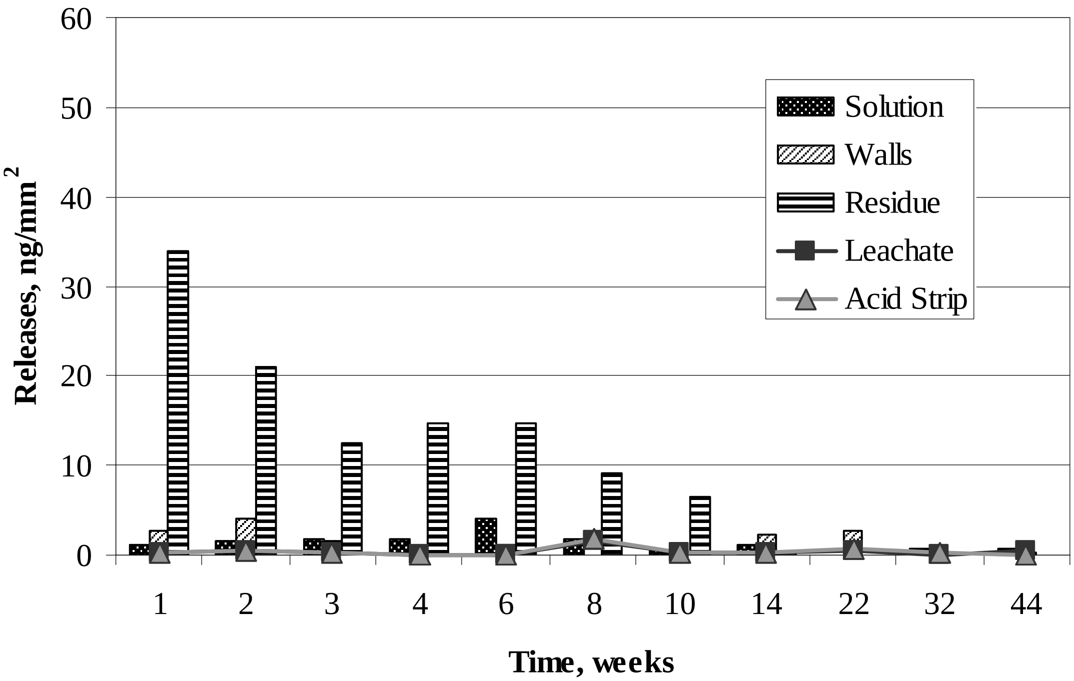


Figure E-277. Copper Releases in Solution, on Walls, and in Residue from Polished Sample 1 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

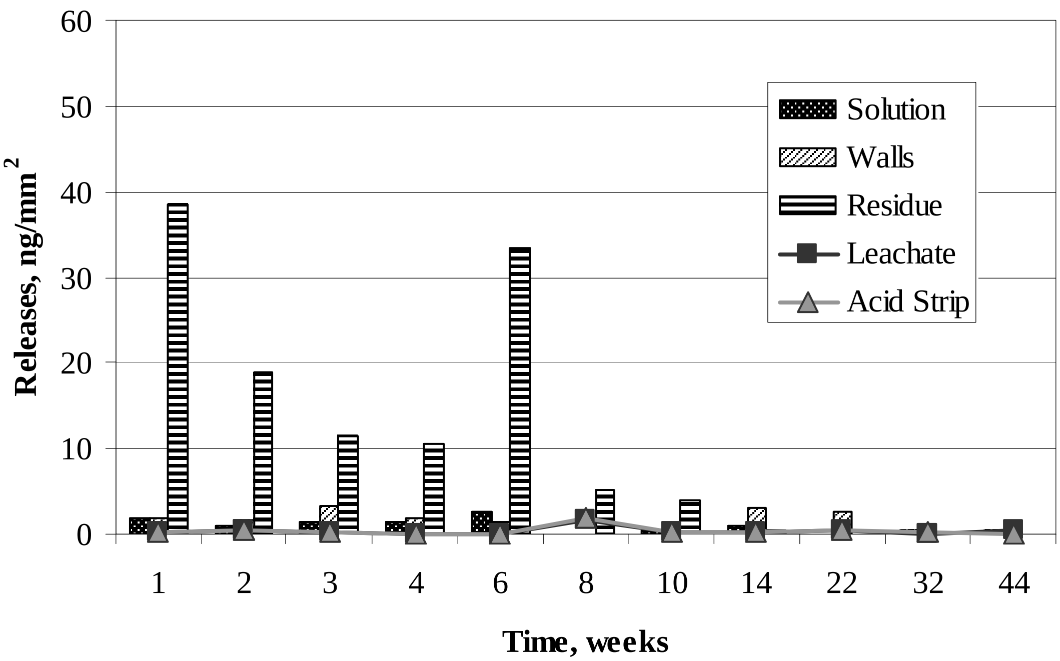


Figure E-278. Copper Releases in Solution, on Walls, and in Residue from Polished Sample 2 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

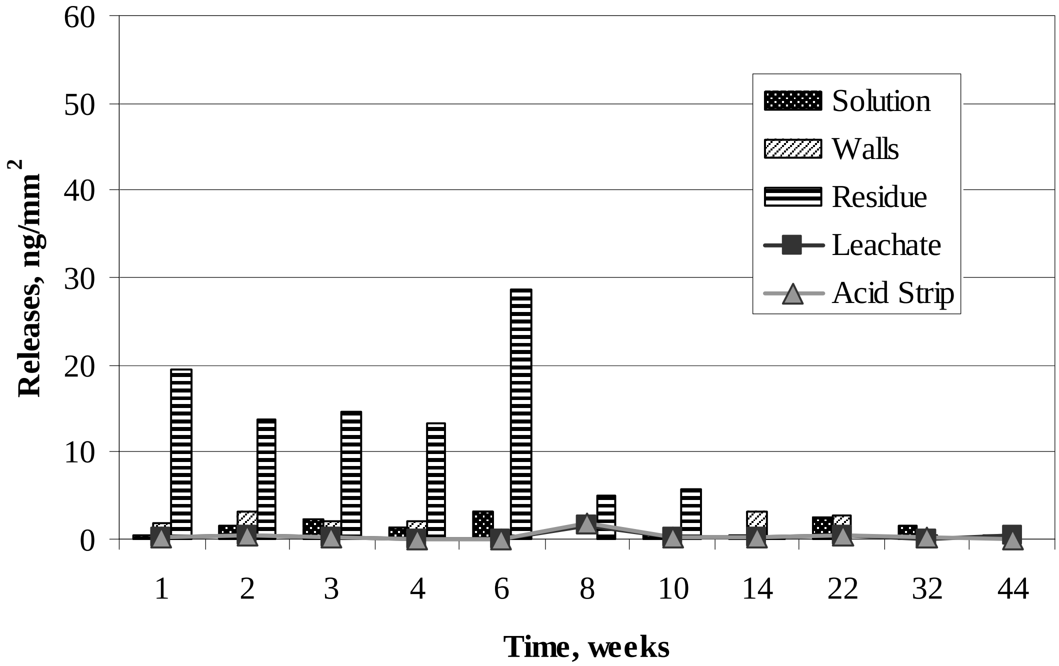


Figure E-279. Copper Releases in Solution, on Walls, and in Residue from Polished Sample 3 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

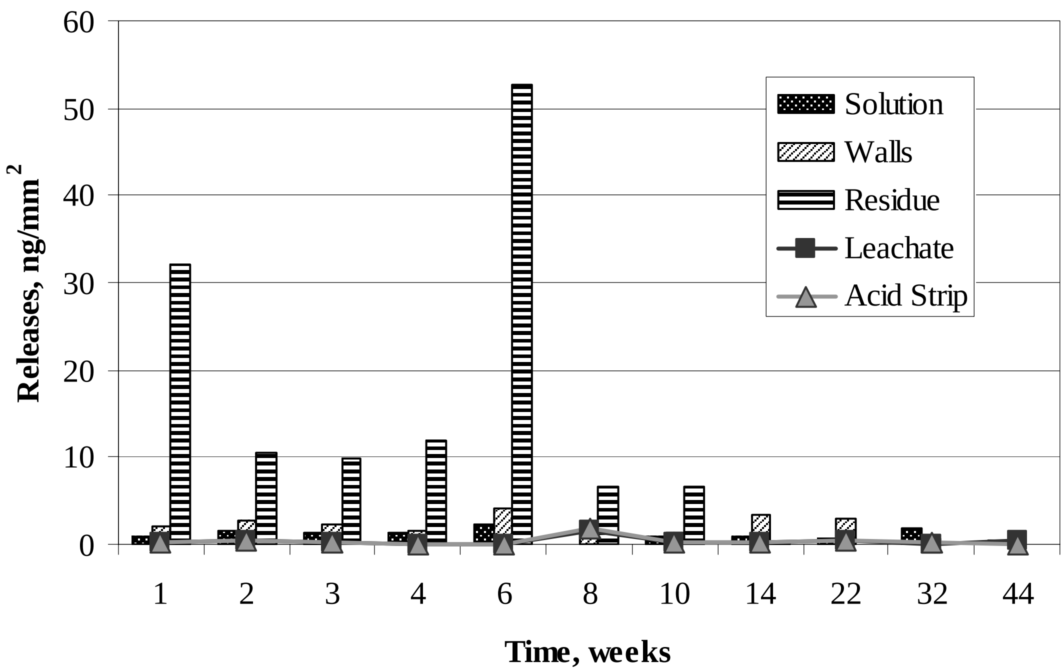


Figure E-280. Copper Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

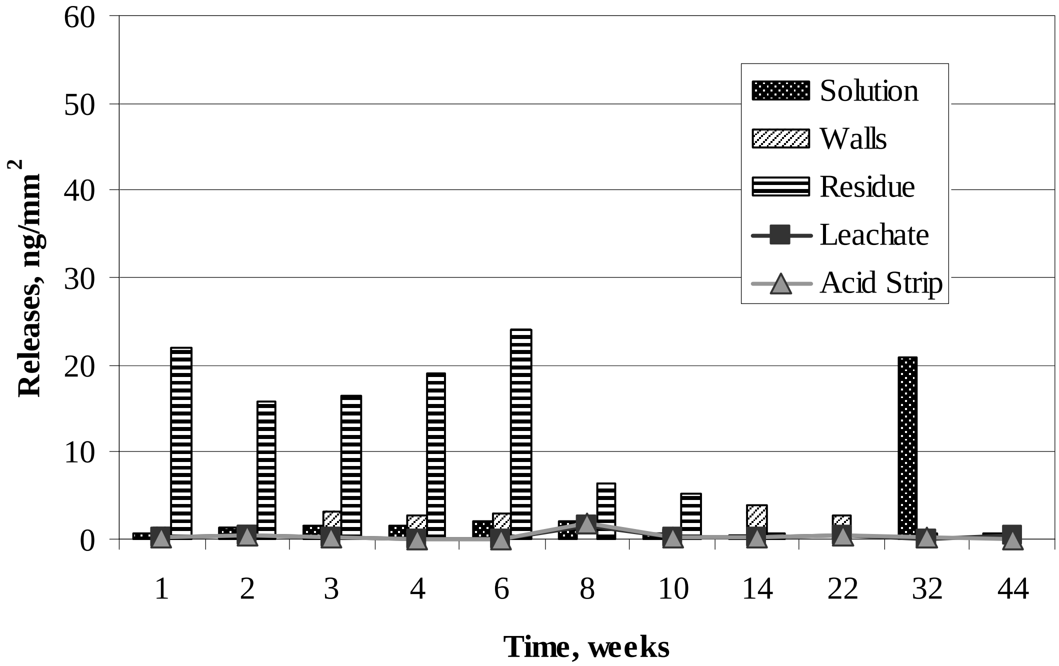


Figure E-281. Copper Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

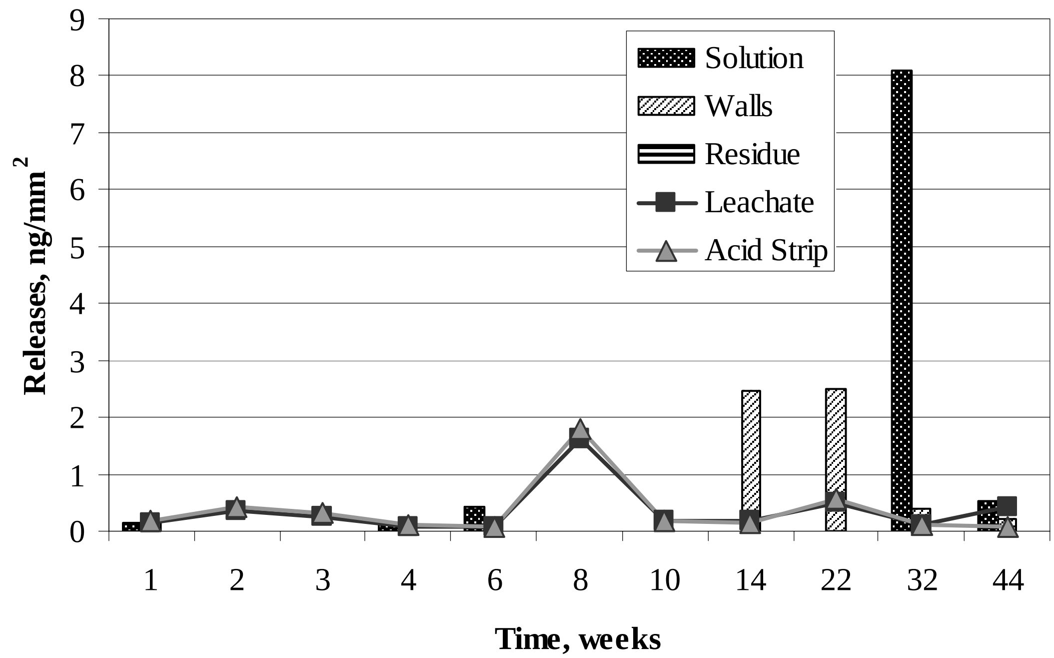


Figure E-282. Copper Present in Solution, on Walls, and in Residue from 10KCl Control and Average Detection Limits for Leachate and Acid Strip.

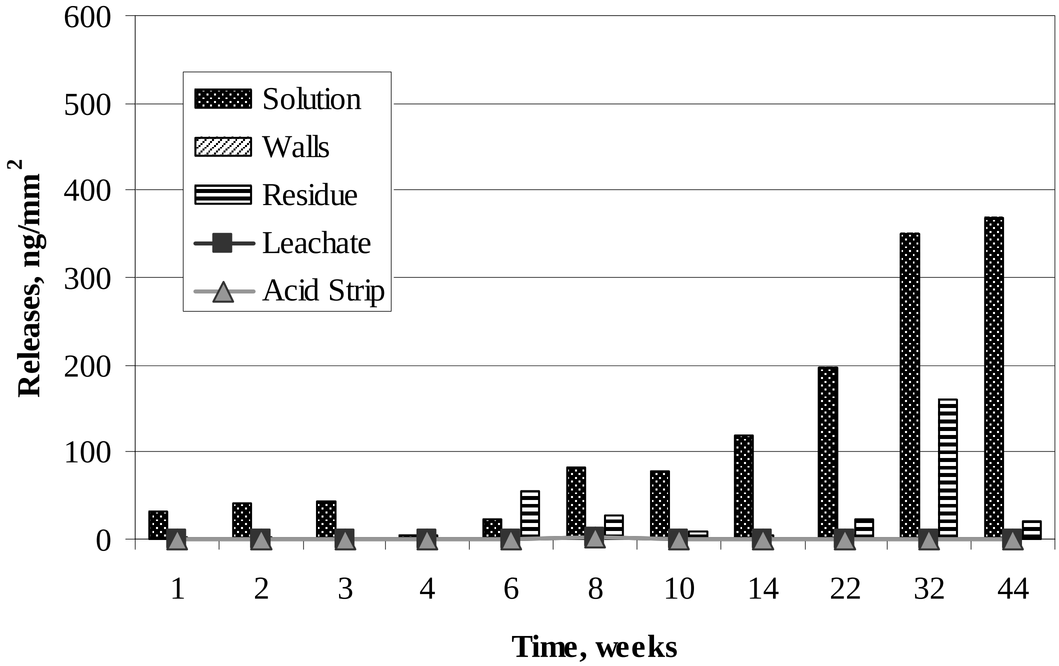


Figure E-283. Copper Releases in Solution, on Walls, and in Residue from Polished Sample 1 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

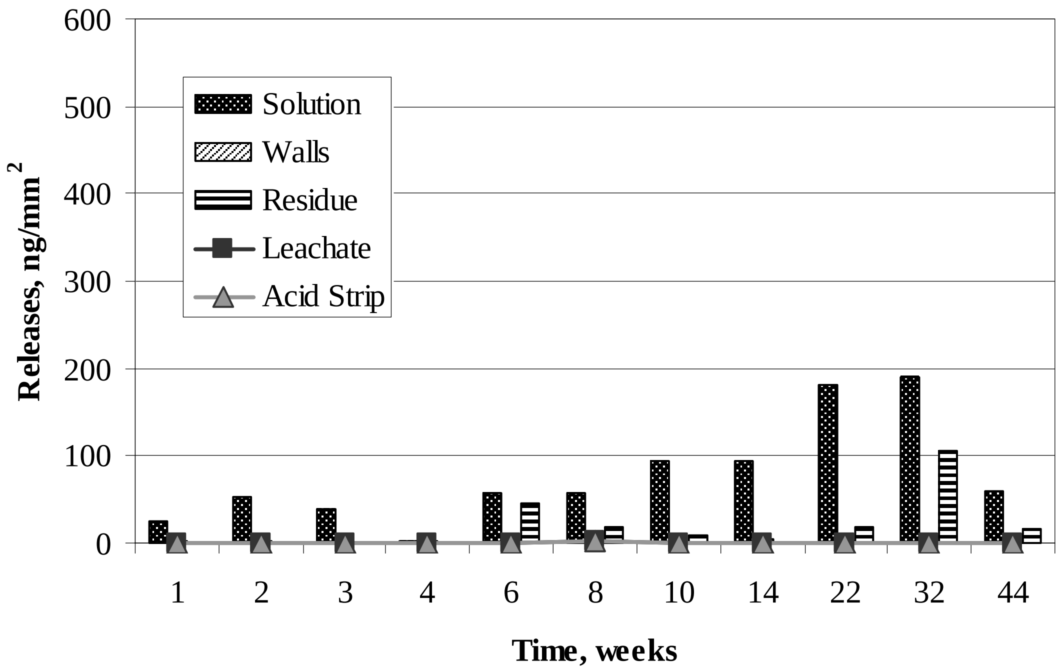


Figure E-284. Copper Releases in Solution, on Walls, and in Residue from Polished Sample 2 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

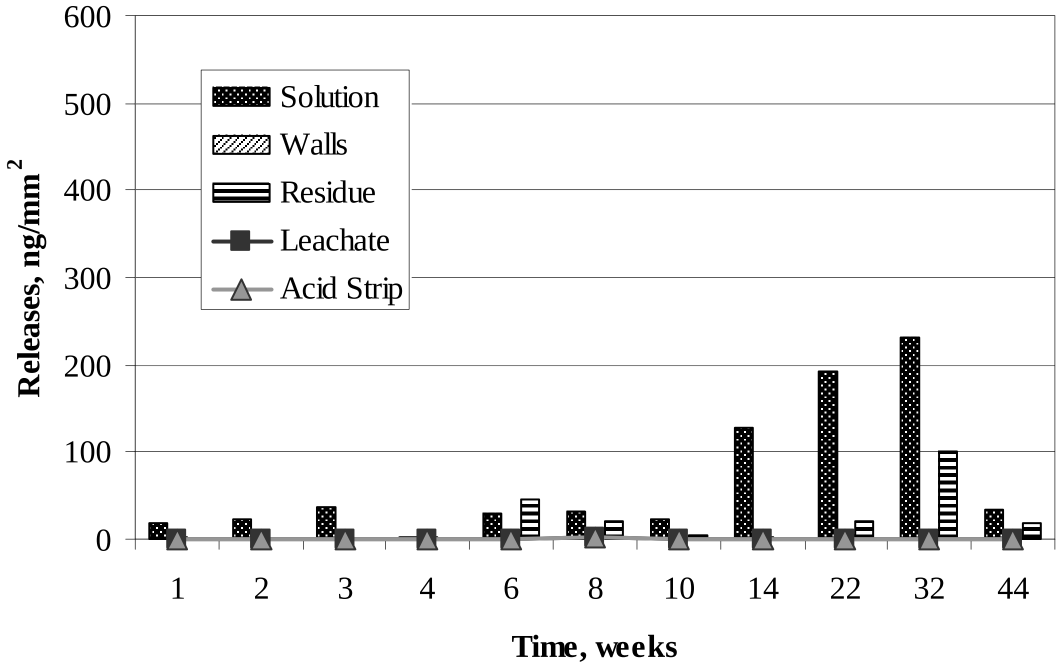


Figure E-285. Copper Releases in Solution, on Walls, and in Residue from Polished Sample 3 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

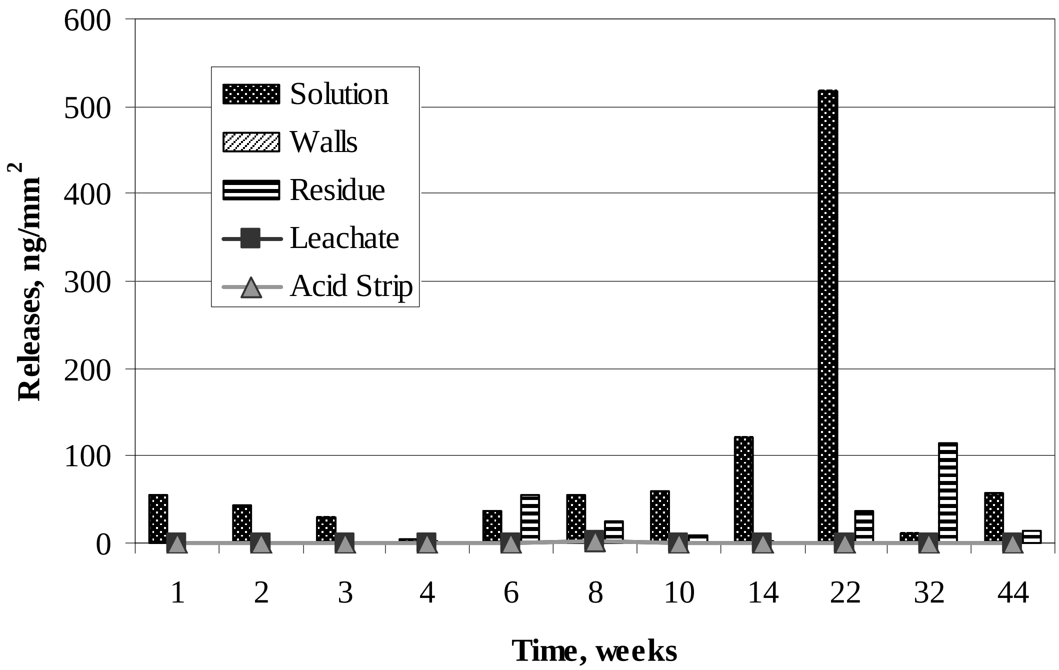


Figure E-286. Copper Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

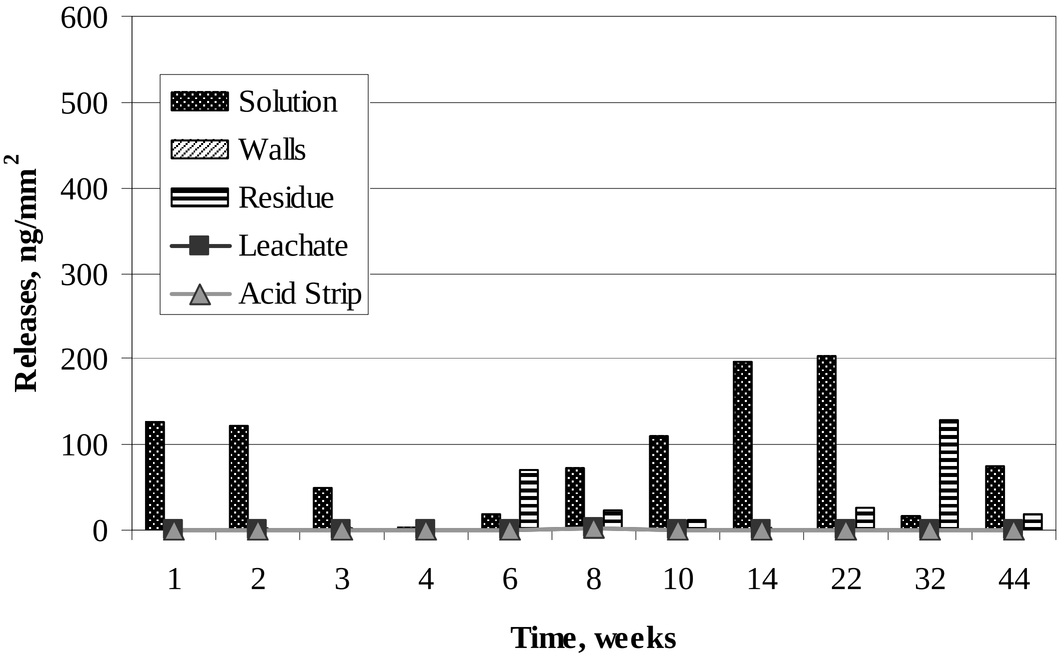


Figure E-287. Copper Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

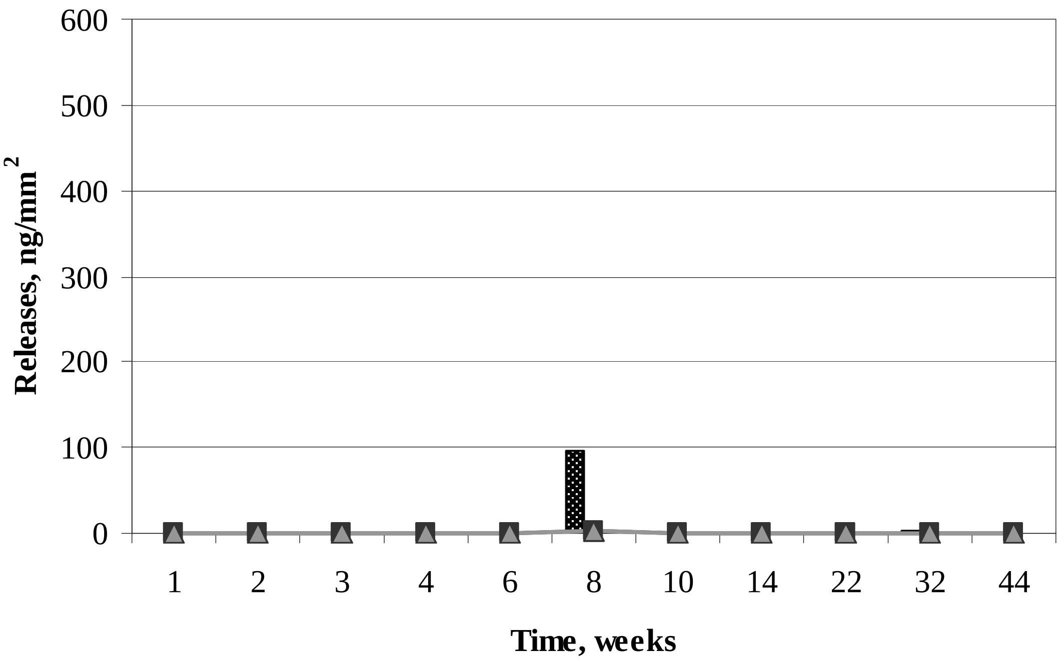


Figure E-288. Copper Present in Solution, on Walls, and in Residue from AJ13 Control and Average Detection Limits for Leachate and Acid Strip.

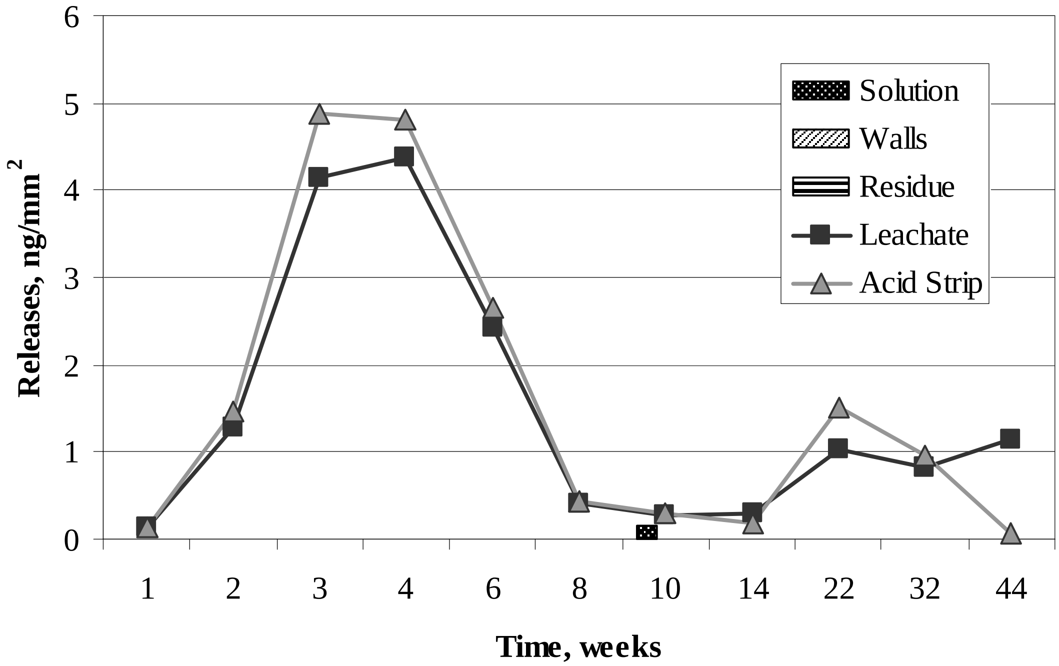


Figure E-289. Vanadium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

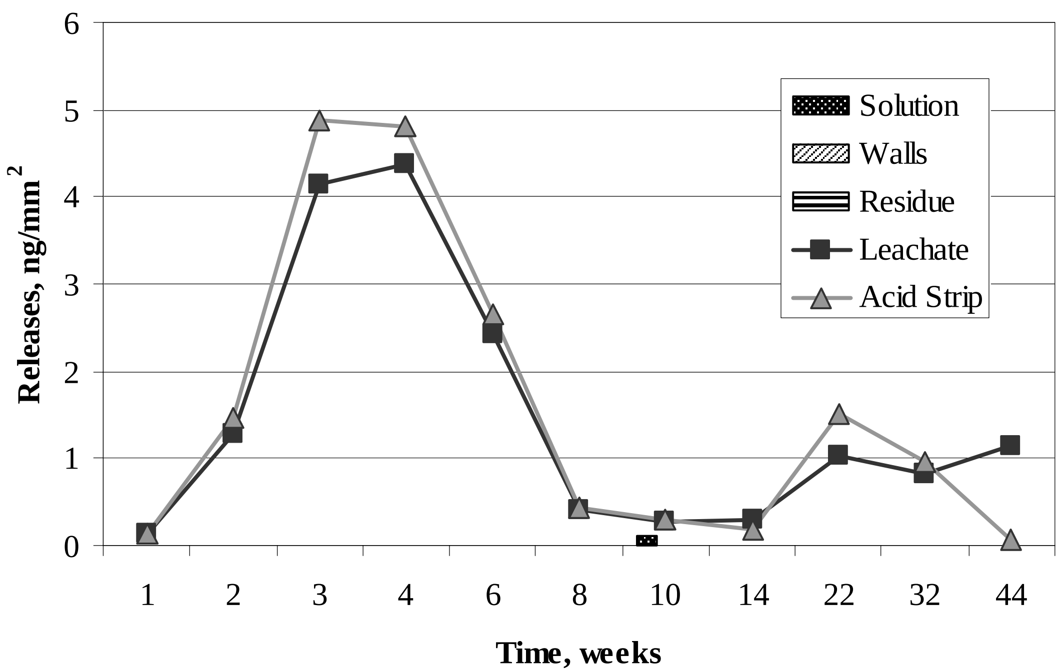


Figure E-290. Vanadium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

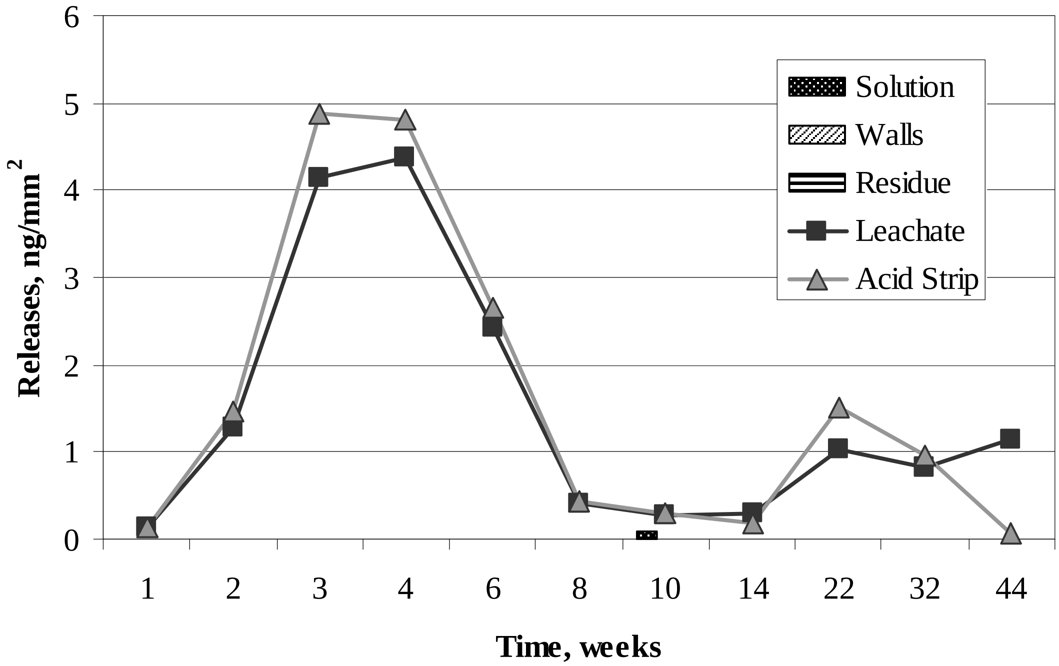


Figure E-291. Vanadium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

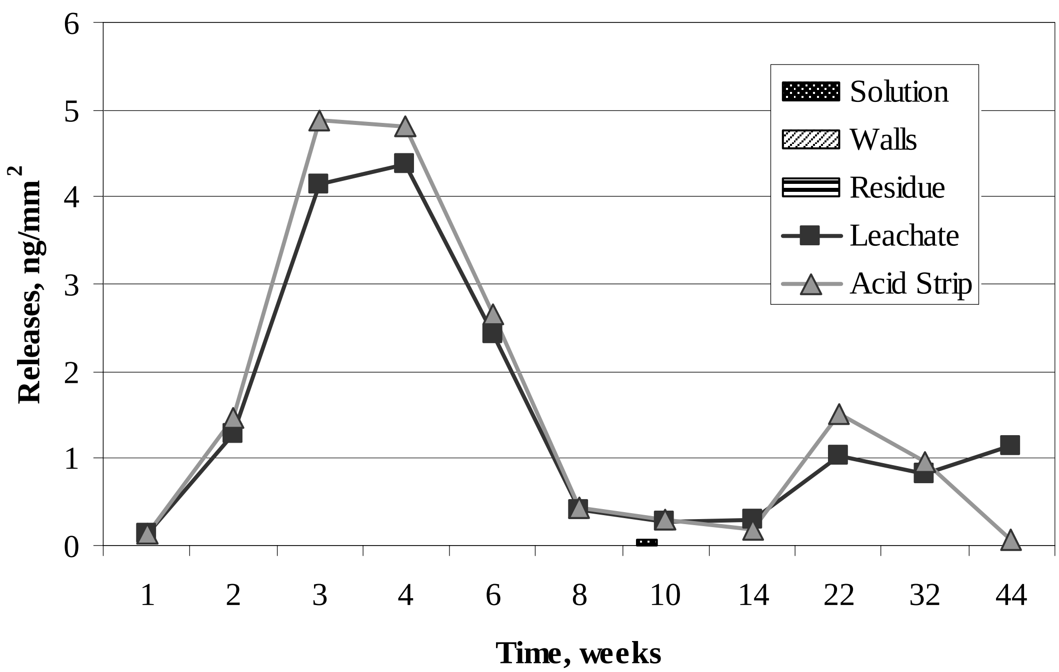


Figure E-292. Vanadium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

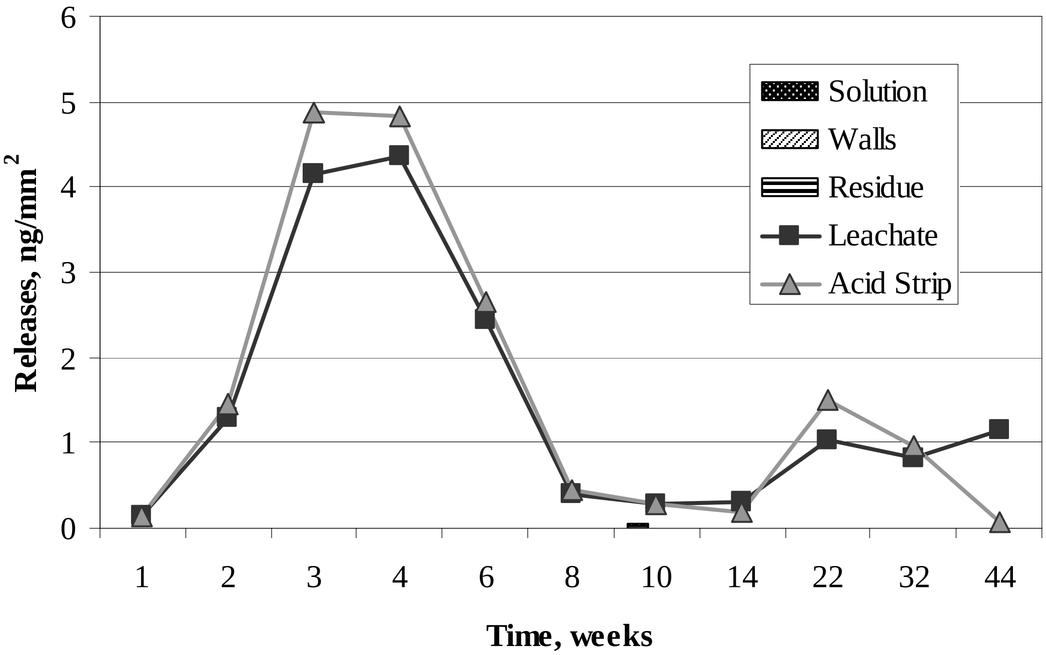


Figure E-293. Vanadium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in SJ13 and Average Detection Limits for Leachate and Acid Strip.

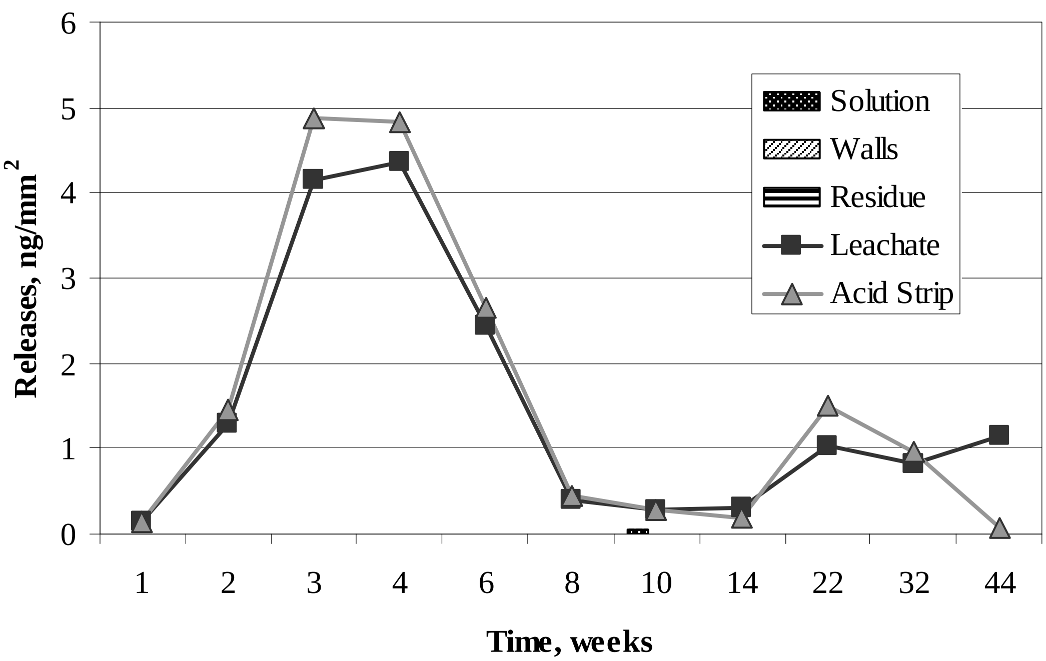


Figure E-294. Vanadium Present in Solution, on Walls, and in Residue from SJ13 Control and Average Detection Limits for Leachate and Acid Strip.

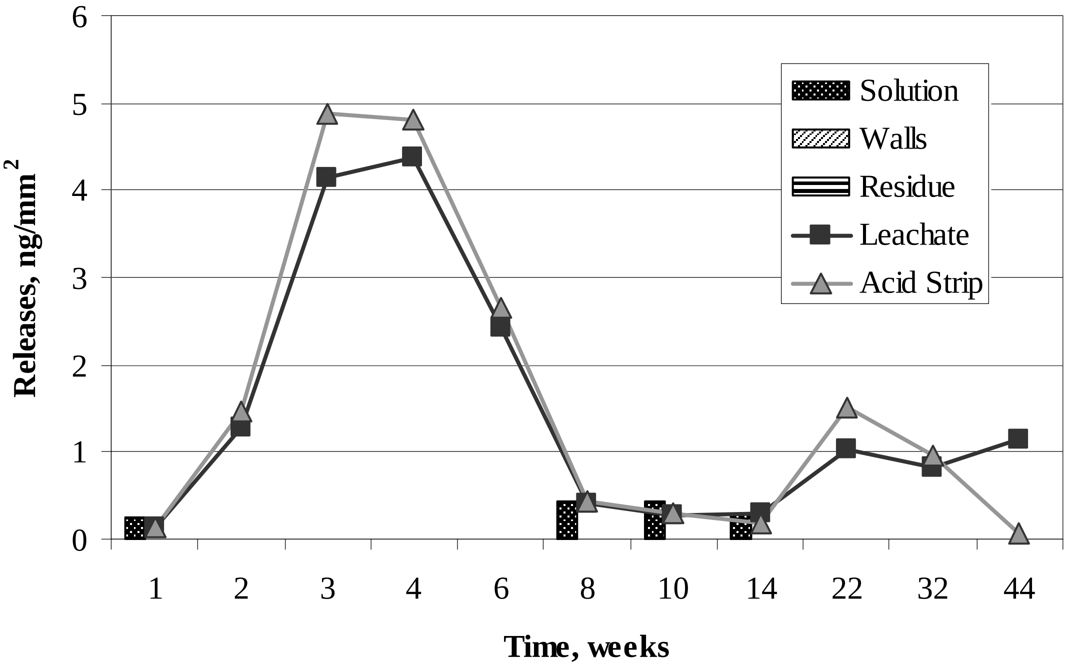


Figure E-295. Vanadium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

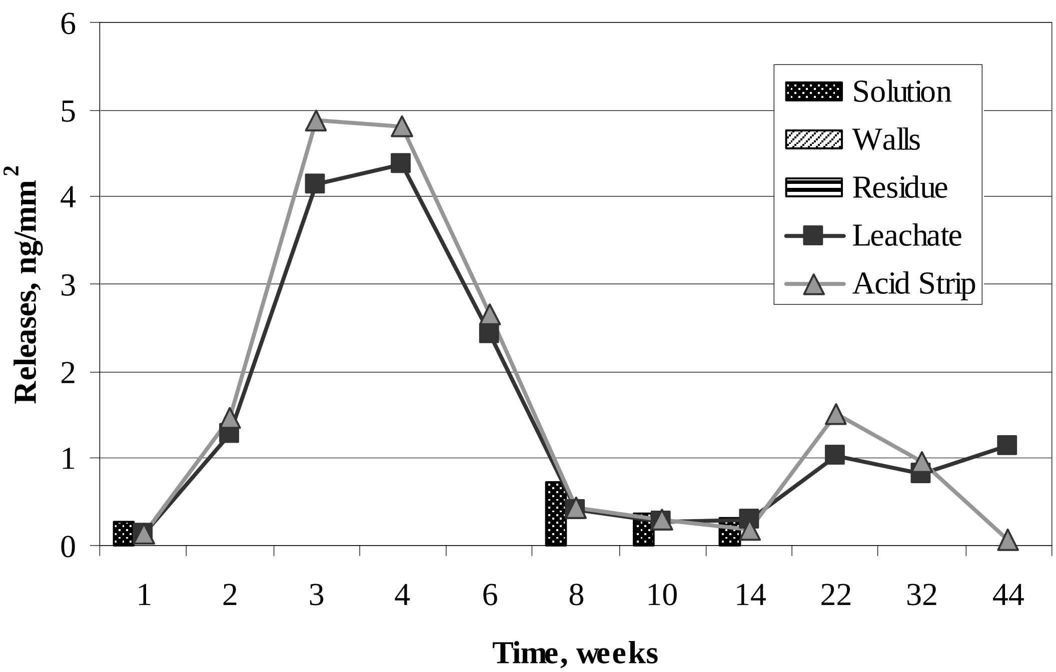


Figure E-296. Vanadium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

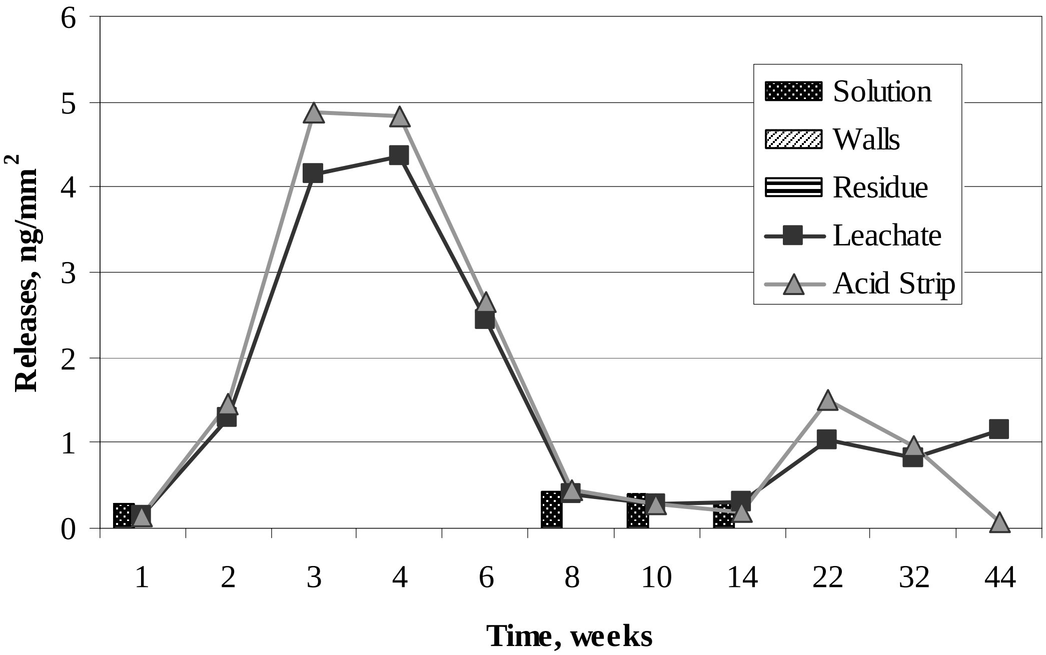


Figure E-297. Vanadium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

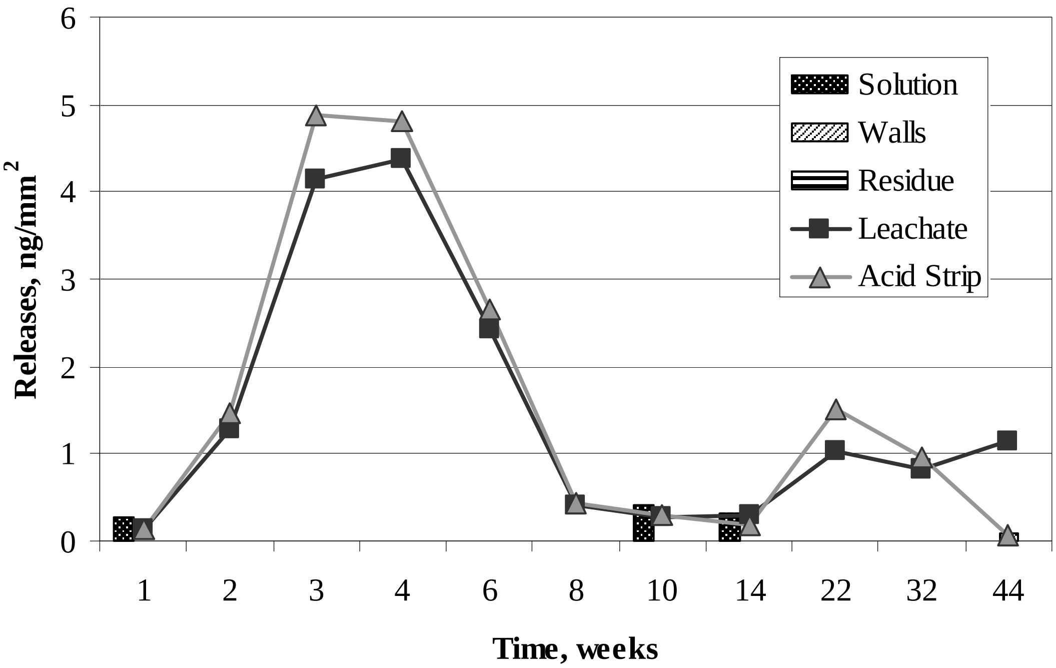


Figure E-298. Vanadium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

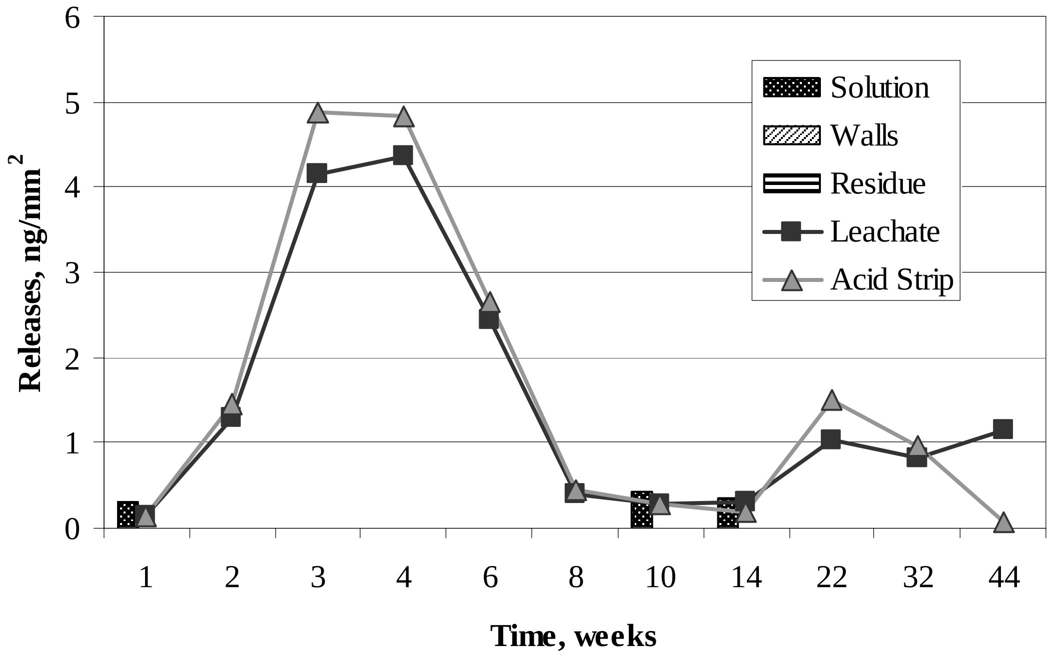


Figure E-299. Vanadium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in CJ13 and Average Detection Limits for Leachate and Acid Strip.

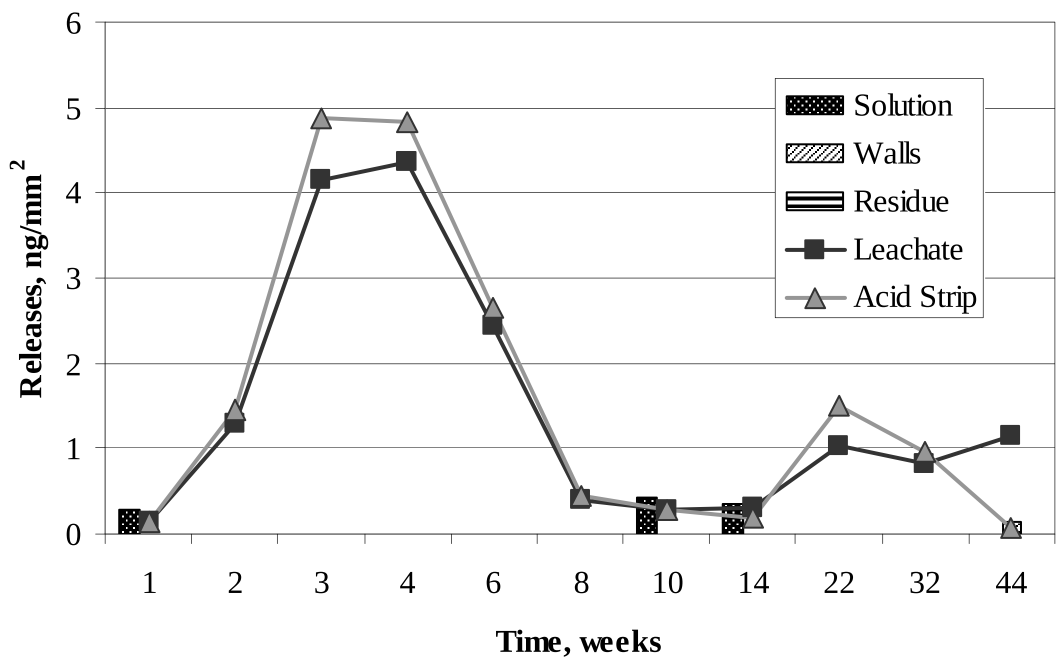


Figure E-300. Vanadium Present in Solution, on Walls, and in Residue from CJ13 Control and Average Detection Limits for Leachate and Acid Strip.

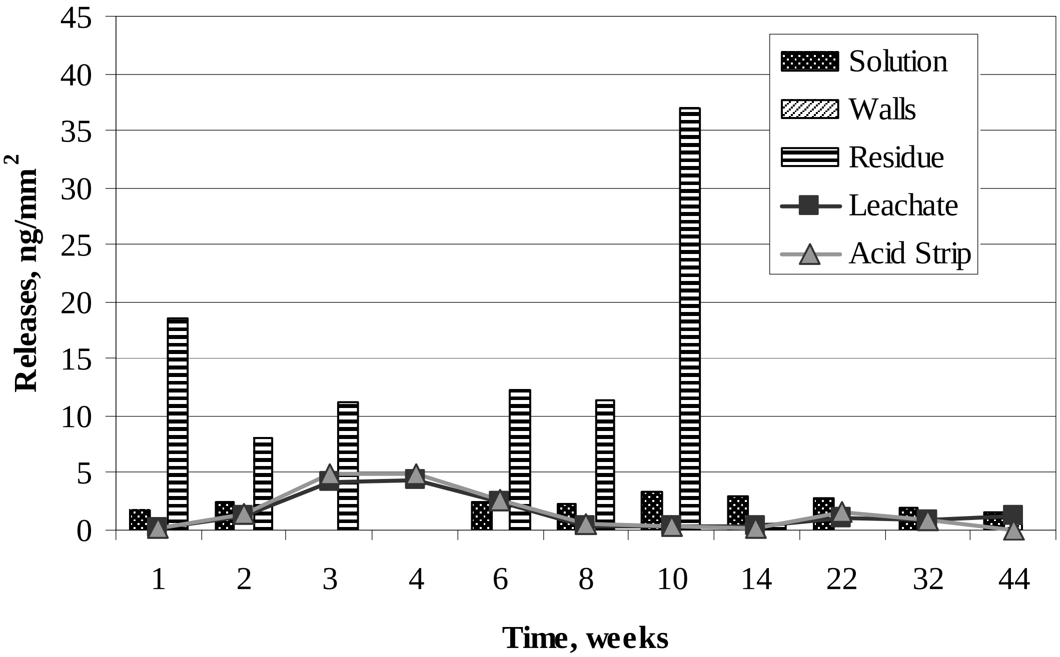


Figure E-301. Vanadium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

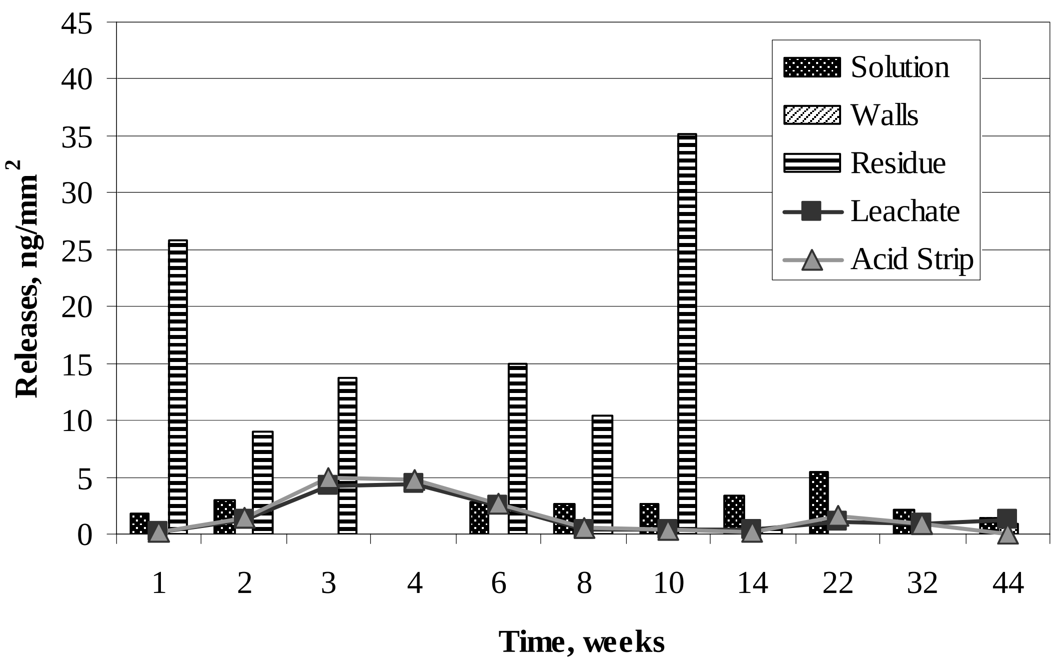


Figure E-302. Vanadium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

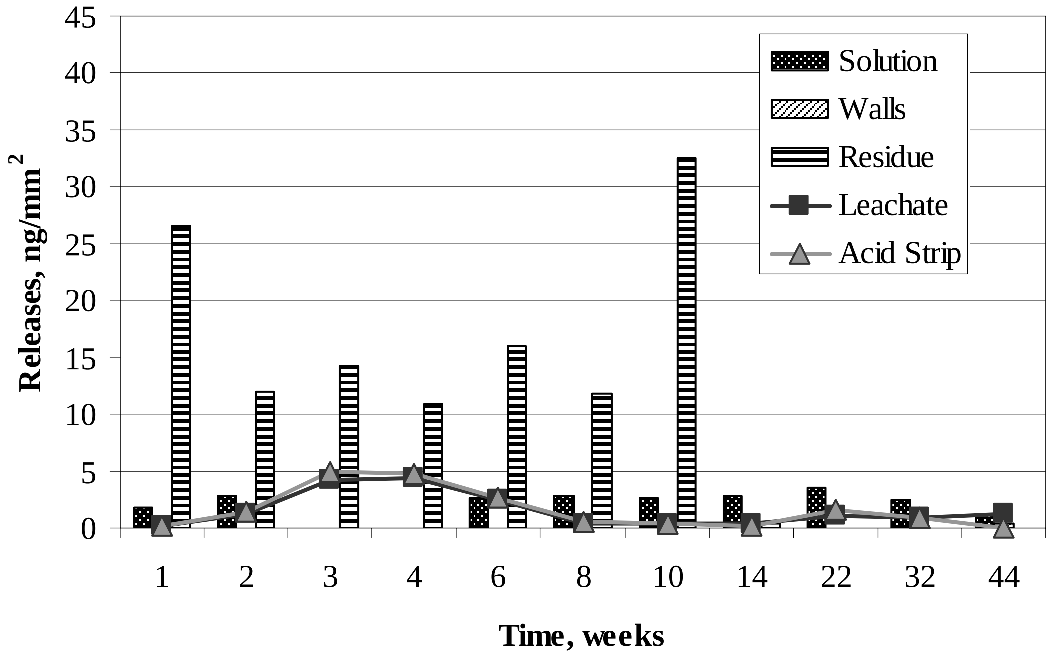


Figure E-303. Vanadium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

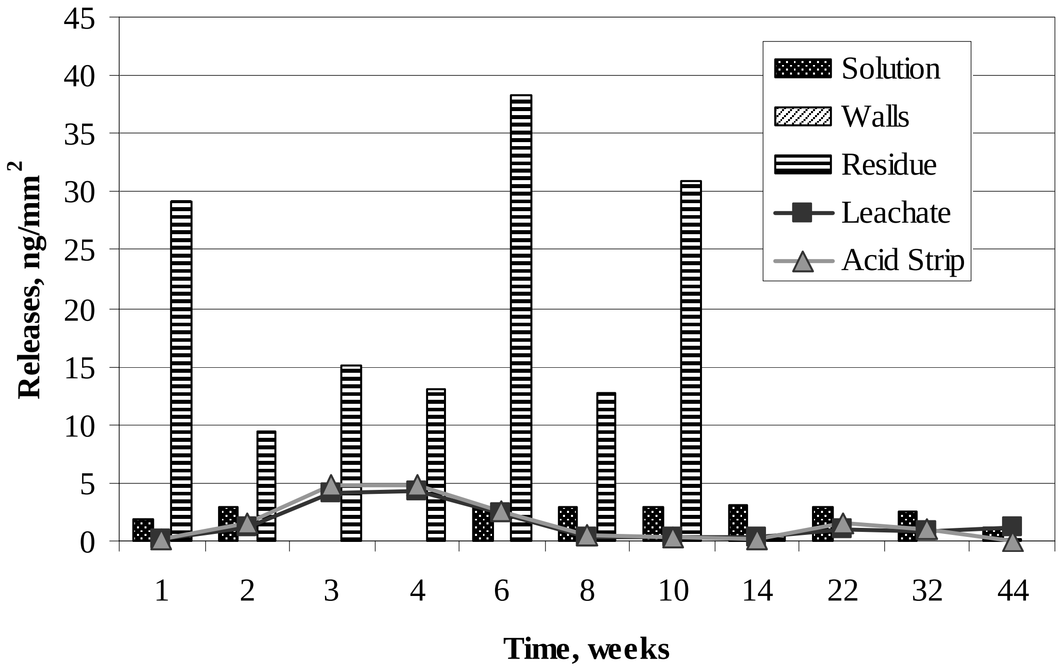


Figure E-304. Vanadium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

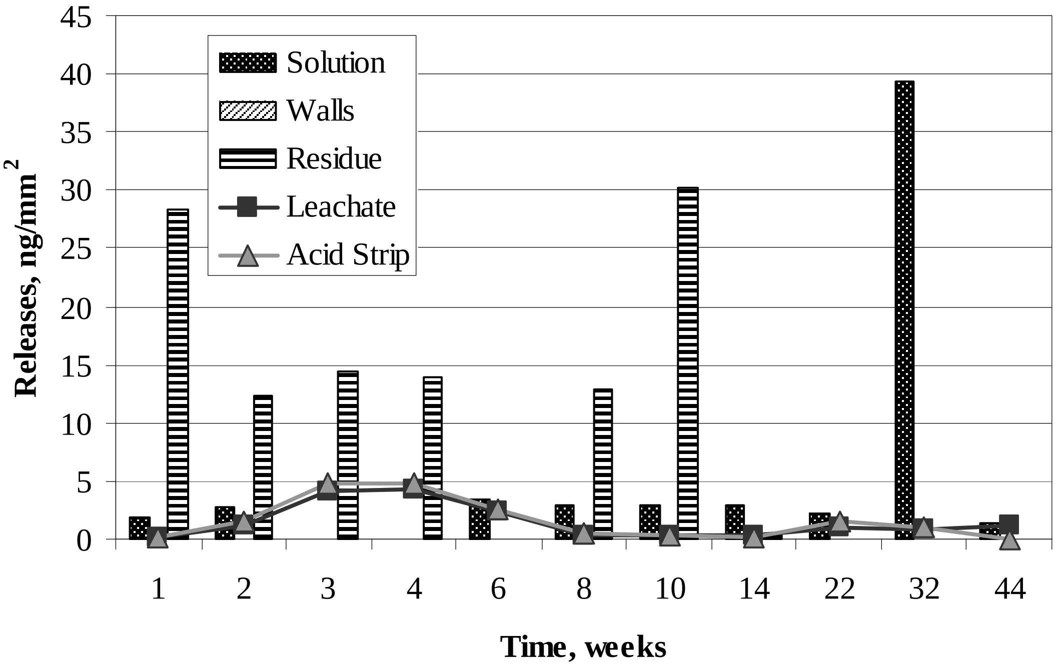


Figure E-305. Vanadium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in 10KCl and Average Detection Limits for Leachate and Acid Strip.

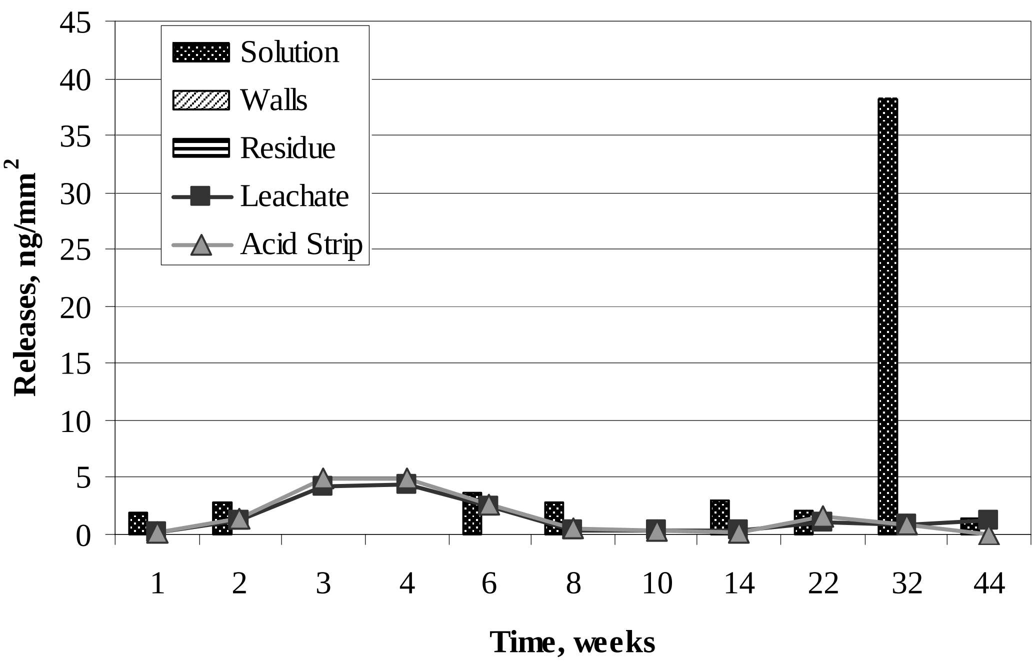


Figure E-306. Vanadium Present in Solution, on Walls, and in Residue from 10KCl Control and Average Detection limits for Leachate and Acid Strip.

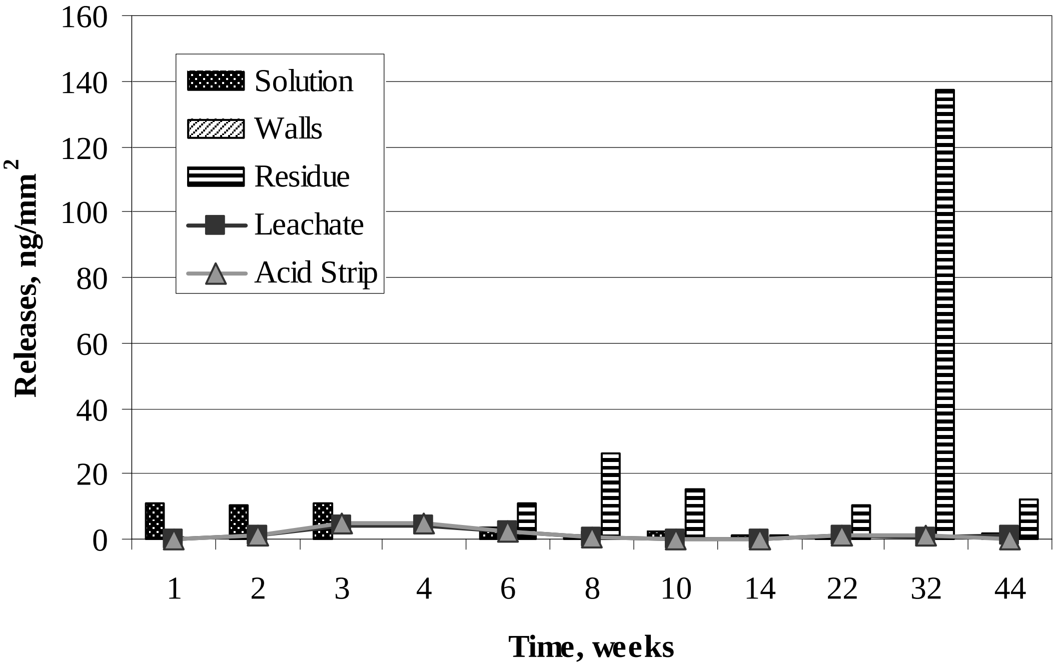


Figure E-307. Vanadium Releases in Solution, on Walls, and in Residue from Polished Sample 1 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

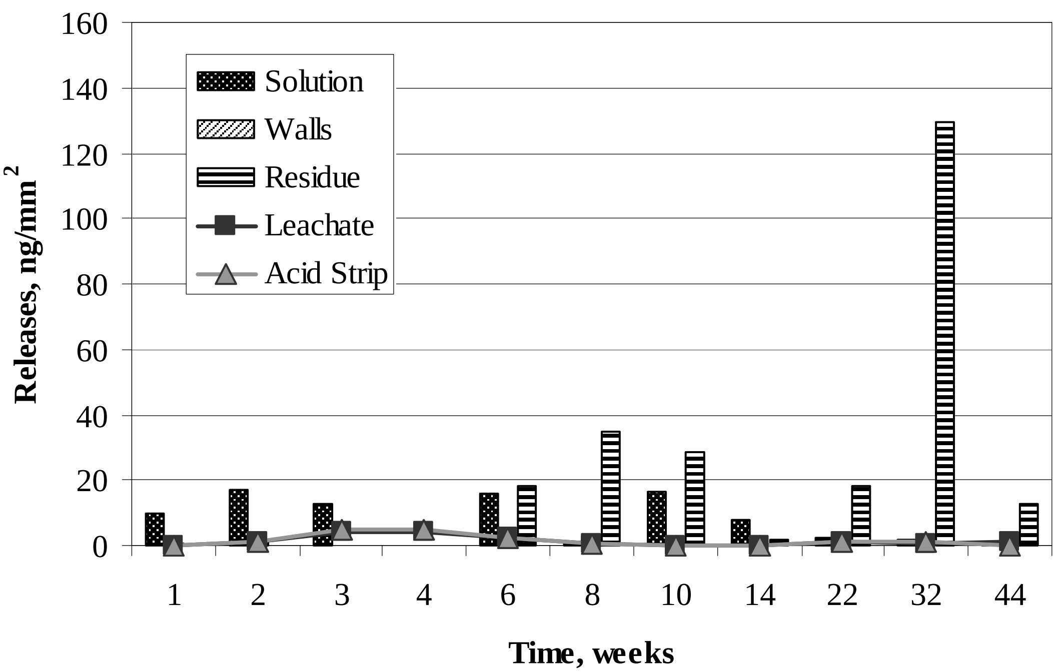


Figure E-308. Vanadium Releases in Solution, on Walls, and in Residue from Polished Sample 2 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

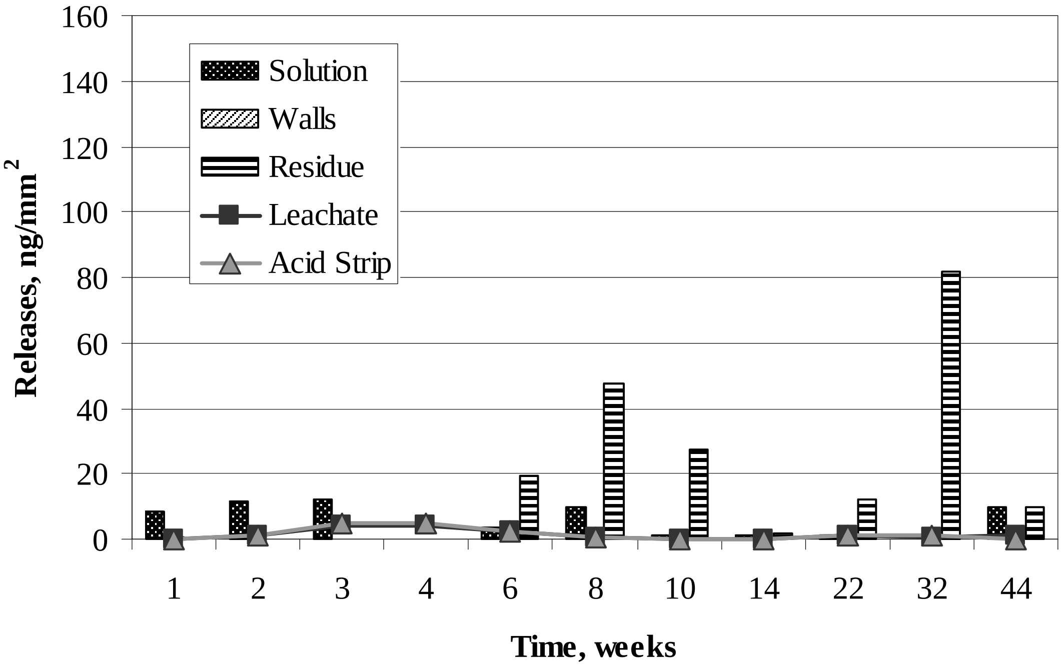


Figure E-309. Vanadium Releases in Solution, on Walls, and in Residue from Polished Sample 3 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

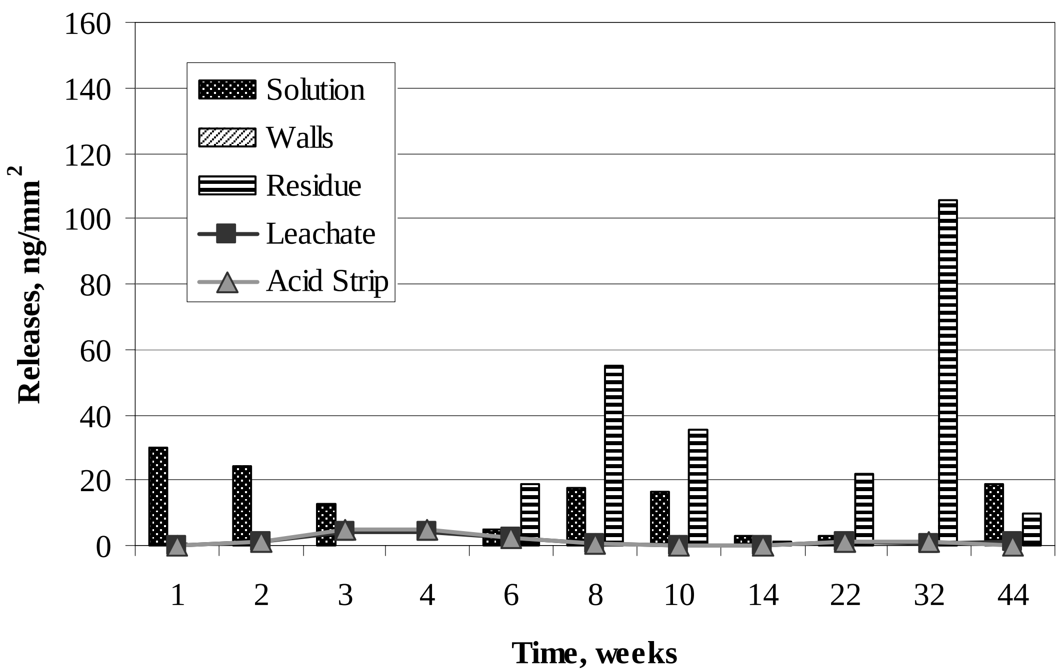


Figure E-310. Vanadium Releases in Solution, on Walls, and in Residue from Oxidized Sample 4 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

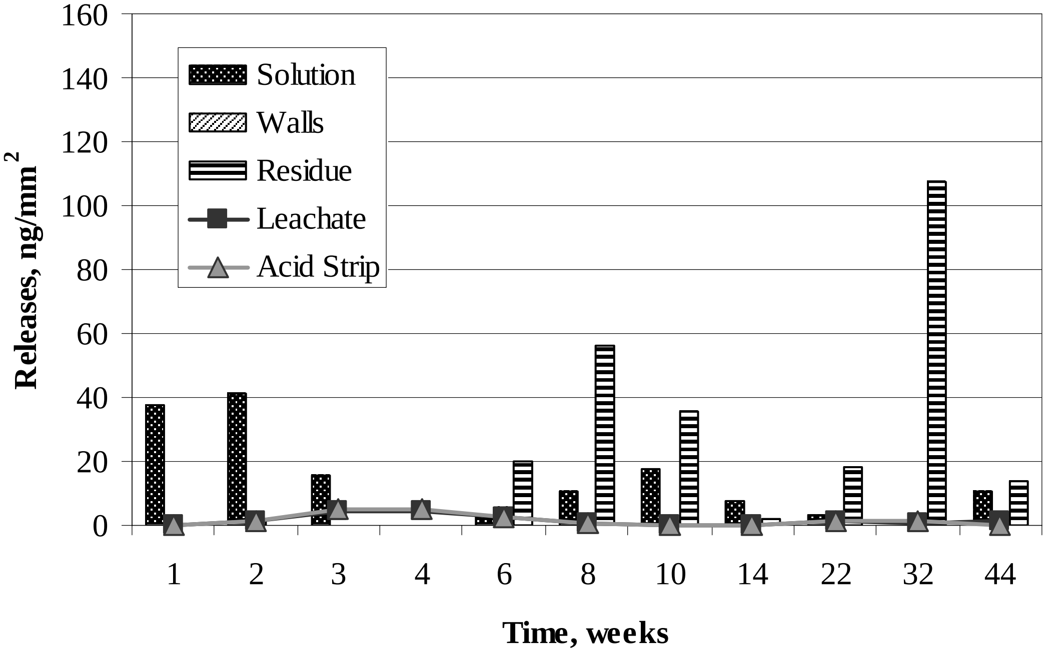


Figure E-311. Vanadium Releases in Solution, on Walls, and in Residue from Oxidized Sample 5 in AJ13 and Average Detection Limits for Leachate and Acid Strip.

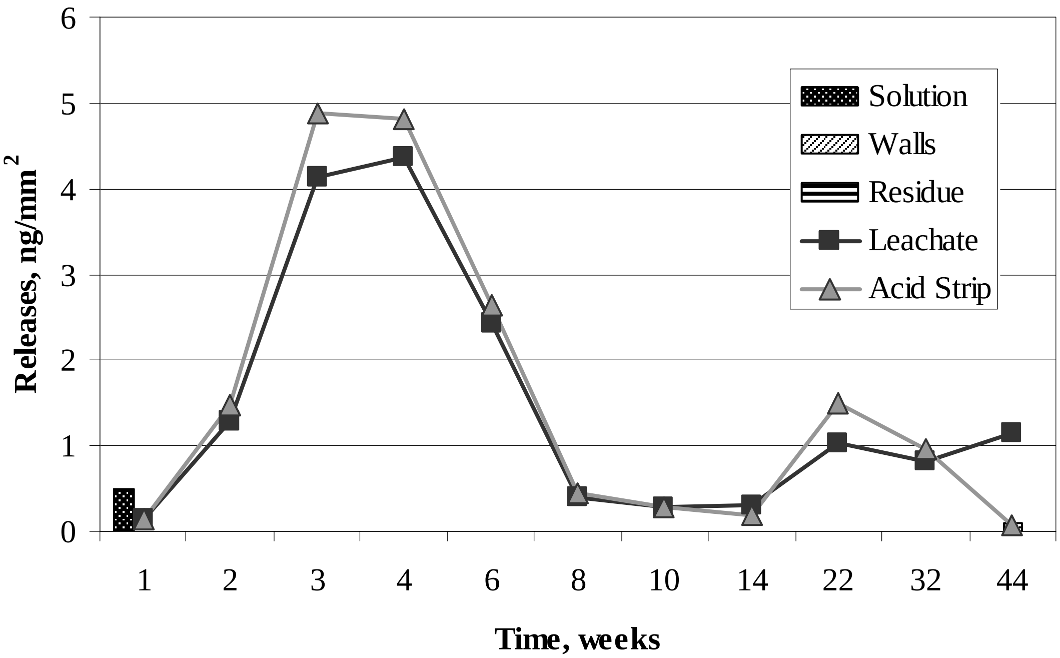


Figure E-312. Vanadium Present in Solution, on Walls, and in Residue from AJ13 Control and Average Detection Limits for Leachate and Acid Strip.

F. Raw Data

Table F-1. Leachate Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363K (90°C) Solution for 7 days.

		Major Elements				Noble Metal Fission Products					Minor Elements			
Expt. ID	Ingot ID	Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.0	2.0	2.0	0.012	0.015	0.005	0.006	0.006	0.079	0.029	0.003	0.14	0.13
SJ13-1-1	1	a	a	a	0.084	a	a	a	a	0.693	a	0.01	0.36	a
SJ13-1-2	2	a	a	a	0.105	a	a	a	a	0.448	a	0.01	0.24	a
SJ13-1-3	3	a	a	a	0.072	a	0.007	a	a	1.11	a	0.01	0.23	a
SJ13-1-4	4	a	a	a	0.093	a	a	a	a	0.874	a	a	0.24	a
SJ13-1-5	5	a	a	a	0.100	a	a	a	a	1.23	a	a	0.28	a
SJ13-1-6	control	a	a	a	0.132	a	a	a	a	0.332	a	a	a	a
CJ13-1-7	7	9.0	a	a	2.42	0.152	0.068	0.062	0.040	1.40	0.23	0.05	0.98	0.25
CJ13-1-8	8	8.9	a	a	2.65	0.158	0.069	0.071	0.045	1.89	0.25	0.06	1.21	0.27
CJ13-1-9	9	10.9	a	a	6.66	0.381	0.219	0.069	0.130	2.23	0.29	0.08	1.59	0.27
CJ13-1-10	10	a	a	a	1.29	0.021	0.044	0.070	0.031	0.930	0.23	0.04	1.04	0.28
CJ13-1-11	11	a	a	a	1.33	0.021	0.044	0.083	0.043	1.20	0.20	0.04	1.23	0.29
CJ13-1-12	control	a	a	a	1.05	a	0.033	0.021	a	0.723	0.06	0.02	0.15	0.29
10KCl-1-13	13	18.7	3.9	19.7	0.029	0.018	0.070	0.013	0.019	0.765	4.84	0.85	1.02	1.82
10KCl-1-14	14	11.9	3.0	13.9	0.029	a	0.066	0.011	a	2.56	3.78	0.68	1.83	1.83
10KCl-1-15	15	7.0	2.0	16.9	a	a	0.061	0.012	a	2.26	4.49	0.69	0.54	1.81
10KCl-1-16	16	29.7	4.0	25.7	a	0.018	0.050	0.020	0.026	2.22	4.21	0.81	0.94	1.82
10KCl-1-17	17	11.9	a	20.9	0.051	a	0.049	0.017	0.009	2.45	2.85	0.64	0.64	1.83
10KCl-1-18	control	a	a	a	a	a	0.045	0.016	a	0.373	0.03	0.01	0.16	1.88
AJ13-1-19	19	9527	2250	650	0.968	4.39	0.269	4.89	20.2	139	168	24.7	31.9	10.9
AJ13-1-20	20	7959	1955	489	0.846	2.81	0.200	2.99	12.8	126	137	21.3	25.6	9.78
AJ13-1-21	21	6169	1594	587	0.231	0.935	0.044	0.620	2.78	75.8	118	18.5	19.3	8.31
AJ13-1-22	22	10751	2824	1348.7	1.29	4.19	0.147	1.56	7.50	99.7	222	82.2	54.7	29.7
AJ13-1-23	23	12485	3316	1063.1	1.62	10.0	0.546	8.16	37.0	204	225	82.5	126	37.1
AJ13-1-24	control	2.0	a	a	0.112	0.032	a	0.009	0.030	3.92	0.49	0.04	1.10	0.50

[a] Element below detection limits of measuring instrument.

Table F-2. Acid Strip Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363 K (90°C) Solution for 7 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.3	2.3	2.3	0.014	0.017	0.006	0.007	0.007	0.091	0.033	0.003	0.16	0.15
SJ13-1-1AS	1	3.4	a	a	0.369	a	a	a	a	0.051	0.063	0.035	0.33	a
SJ13-1-2AS	2	a	a	a	0.321	a	a	a	a	a	0.047	0.005	a	a
SJ13-1-3AS	3	5.7	a	a	0.420	a	a	a	a	0.651	0.131	0.064	0.36	a
SJ13-1-4AS	4	a	a	a	0.387	a	a	a	a	0.132	0.079	0.006	0.33	a
SJ13-1-5AS	5	a	a	a	0.413	a	a	a	a	0.067	0.074	0.005	0.40	a
SJ13-1-6AS	control	3.4	a	a	0.497	a	a	a	a	0.178	0.036	a	a	a
CJ13-1-7AS	7	2.4	a	a	0.153	a	a	a	0.017	0.138	0.047	0.011	a	a
CJ13-1-8AS	8	9.4	a	a	0.185	a	0.006	a	0.008	0.584	0.135	0.014	0.24	a
CJ13-1-9AS	9	11.7	a	a	2.78	0.177	0.102	a	0.287	0.343	0.097	0.022	0.78	a
CJ13-1-10AS	10	a	a	a	0.026	a	a	a	a	0.048	0.054	a	a	a
CJ13-1-11AS	11	2.2	a	a	0.057	a	a	a	a	0.036	0.078	0.005	a	a
CJ13-1-12AS	control	a	a	a	0.037	a	a	a	a	0.046	a	a	a	a
10KCl-1-13AS	13	223	34.5	29.9	0.119	0.074	0.024	0.083	0.320	0.670	12.0	1.17	2.75	a
10KCl-1-14AS	14	254	39.1	26.8	0.069	0.048	0.020	0.046	0.176	0.336	9.90	1.06	1.96	a
10KCl-1-15AS	15	105	32.5	14.6	0.089	0.069	0.022	0.060	0.225	2.21	4.03	0.377	1.86	a
10KCl-1-16AS	16	192	16.6	48.7	0.066	0.039	0.009	0.035	0.136	1.10	8.99	1.56	1.98	a
10KCl-1-17AS	17	130	16.5	39.5	0.062	0.036	0.008	0.028	0.118	0.753	5.75	1.08	1.42	a
10KCl-1-18AS	control	a	a	a	0.052	a	a	a	a	a	a	a	0.20	a
AJ13-1-19AS	19	499	123	34.1	0.839	0.637	0.104	0.406	1.64	11.6	8.59	1.26	1.72	0.68
AJ13-1-20AS	20	365	102	21.9	5.21	2.05	0.278	0.501	2.31	15.5	6.16	0.892	1.15	0.68
AJ13-1-21AS	21	356	94.8	34.0	1.18	0.668	0.129	0.159	0.625	6.71	7.13	1.06	1.21	0.50
AJ13-1-22AS	22	267	68.7	29.8	1.04	0.532	0.094	0.113	0.497	5.91	5.38	0.897	0.66	0.52
AJ13-1-23AS	23	14.1	9.4	a	0.336	0.466	0.178	0.173	0.753	4.76	0.257	0.038	0.54	0.30
AJ13-1-24AS	control	a	a	a	0.700	0.075	a	a	0.011	0.133	a	0.007	a	a

[a]Element below detection limits of measuring instrument.

Table F-3. Residue Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363 K (90°C) Solution for 7 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits not available														
10KCl-1-13R	13	727.6	112.8	28.5	3.03	0.340	0.094	0.387	1.387	32.77	10.79	9.21	33.97	18.60
10KCl-1-14R	14	627.6	72.8	43.0	2.94	0.156	0.096	0.201	0.746	28.84	15.51	3.45	38.43	25.79
10KCl-1-15R	15	237.4	51.8	14.6	1.63	0.151	0.052	0.149	0.482	11.35	4.52	2.46	19.37	26.61
10KCl-1-16R	16	459.3	40.2	58.2	13.99	0.133	0.097	0.162	0.555	14.05	9.80	4.01	32.09	29.22
10KCl-1-17R	17	340.6	41.1	34.6	19.09	0.298	0.121	0.106	0.367	11.12	5.37	2.46	21.88	28.31

Table F-4. Leachate Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363K (90°C) Solution for 14 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		1.9	1.9	1.9	0.069	0.007	0.003	0.006	0.068	0.10	0.076	0.007	0.35	1.3
SJ13-2-25	1	a	a	a	0.117	a	0.005	a	a	0.65	a	a	a	a
SJ13-2-26	2	a	a	a	0.085	a	a	a	a	0.29	a	a	a	a
SJ13-2-27	3	a	a	a	0.096	a	0.010	a	a	1.18	a	a	a	a
SJ13-2-28	4	a	a	a	0.113	a	0.006	a	a	1.19	a	a	a	a
SJ13-2-29	5	a	a	a	a	a	a	a	a	1.11	a	a	a	a
SJ13-2-30	control	a	a	a	0.164	a	0.003	a	a	0.10	a	a	a	a
CJ13-2-31	7	6.1	a	a	3.16	0.219	0.066	0.030	a	0.58	0.153	0.032	0.37	a
CJ13-2-32	8	5.0	a	a	6.48	0.159	0.091	0.038	a	0.93	0.134	0.045	1.85	a
CJ13-2-33	9	6.0	a	a	6.91	0.182	0.093	0.035	a	0.81	0.164	0.052	1.05	a
CJ13-2-34	10	2.0	a	a	2.19	0.074	0.052	0.021	a	1.15	0.135	0.034	2.16	a
CJ13-2-35	11	2.0	a	a	6.44	0.078	0.085	0.021	a	0.75	0.120	0.035	a	a
CJ13-2-36	control	3.0	a	a	8.24	0.061	0.089	0.019	a	2.14	0.149	0.033	0.50	a
10KCl-2-37	13	8.0	3.0	24.9	a	0.013	0.060	0.009	a	0.94	9.83	2.016	1.58	2.4
10KCl-2-38	14	6.9	2.0	24.8	a	a	0.061	a	a	0.55	9.9	1.557	0.96	3.0
10KCl-2-39	15	7.0	a	24.9	a	0.011	0.064	0.009	a	1.62	9.37	1.812	1.58	2.9
10KCl-2-40	16	5.0	a	22.8	a	a	0.057	0.014	a	0.71	10.3	1.627	1.58	3.0
10KCl-2-41	17	7.0	a	20.0	a	0.009	0.068	0.011	a	22.5	8.34	1.427	1.42	2.8
10KCl-2-42	control	a	a	a	a	a	0.050	0.007	a	1.64	a	0.032	a	2.9
AJ13-2-43	19	9693	1769	594	0.575	3.15	0.172	2.87	12.1	111	178	30.7	40.3	10.2
AJ13-2-44	20	10082	2800	671	1.11	5.77	0.367	5.62	24.3	192	193	33.6	53.7	17.2
AJ13-2-45	21	9465	2120	857	0.552	2.79	0.112	1.33	6.13	91	183	33.0	23.9	11.7
AJ13-2-46	22	8376	2172	866	1.02	3.59	0.176	1.04	4.28	89	167	60.7	43.8	24.6
AJ13-2-47	23	12189	3372	843	1.83	14.9	1.06	13.7	57.1	242	232	82.9	121	41.2
AJ13-2-48	control	3.9	a	a	0.160	0.015	a	0.010	a	0.78	0.098	0.015	a	a

[a]Element below detection limits of measuring instrument.

Table F-5. Acid Strip Data (ng/mm²) from SS15ZR26 Specimens Immersed in 363 K (90°C) Solution for 14 days.

		Major Elements				Noble Metal Fission Products					Minor Elements			
Expt. ID	Ingot ID	Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.3	2.3	2.3	0.080	0.008	0.003	0.007	0.079	0.12	0.089	0.008	0.41	1.5
SJ13-2-25AS	1	2.3	a	a	0.840	0.038	0.006	a	a	0.20	a	0.010	1.38	a
SJ13-2-26AS	2	a	a	a	0.484	a	a	a	a	0.14	a	a	a	a
SJ13-2-27AS	3	2.1	a	a	1.97	0.155	0.021	a	a	0.32	a	a	a	a
SJ13-2-28AS	4	a	a	a	1.42	0.064	0.012	a	a	0.67	a	a	0.69	a
SJ13-2-29AS	5	a	a	a	0.693	0.034	0.006	a	a	0.35	a	a	9.36	a
SJ13-2-30AS	control	2.2	a	a	1.21	0.039	0.008	a	a	a	a	a	0.59	a
CJ13-2-31AS	7	a	a	a	a	0.024	0.004	a	a	0.08	a	a	a	a
CJ13-2-32AS	8	7.6	a	a	1.24	0.059	0.013	a	a	0.30	a	a	a	a
CJ13-2-33AS	9	6.8	a	a	3.51	0.039	0.024	a	a	0.34	a	a	a	a
CJ13-2-34AS	10	4.4	a	a	0.147	0.022	0.008	a	a	1.75	0.207	0.026	a	a
CJ13-2-35AS	11	5.6	a	a	0.903	0.027	0.010	a	a	0.33	a	a	a	a
CJ13-2-36AS	control	4.5	a	a	3.19	0.038	0.019	a	a	0.21	0.216	a	a	a
10KCl-2-37AS	13	187	49.9	18.8	0.652	0.058	0.026	0.057	0.256	0.43	10.3	0.946	3.91	a
10KCl-2-38AS	14	190	52.7	14.9	0.312	0.061	0.014	0.041	0.187	0.77	6.83	0.732	1.62	a
10KCl-2-39AS	15	221	27.3	18.2	0.853	0.128	0.032	0.042	0.187	1.14	9.80	1.03	3.26	a
10KCl-2-40AS	16	112	9.1	12.6	0.381	0.085	0.017	0.012	a	6.49	3.63	0.522	2.84	a
10KCl-2-41AS	17	109	26.3	12.6	a	0.057	0.012	0.061	0.262	0.99	3.98	0.466	1.69	a
10KCl-2-42AS	control	3.4	a	a	a	a	a	a	a	0.26	a	a	a	a
AJ13-2-43AS	19	406	89.4	24.1	0.407	1.09	0.177	0.586	2.51	14.9	9.23	1.37	1.95	a
AJ13-2-44AS	20	355	129	21.7	0.971	2.14	0.288	1.03	4.46	27.4	8.26	1.23	2.77	1.8
AJ13-2-45AS	21	191	45.3	16.3	0.361	0.692	0.069	0.178	0.766	5.62	4.68	0.719	0.66	a
AJ13-2-46AS	22	255	73.6	26.1	0.673	1.29	0.114	0.212	0.850	9.36	6.62	1.01	0.80	a
AJ13-2-47AS	23	392	127	27.4	1.09	1.57	0.290	0.558	2.43	21.3	9.29	1.39	2.20	1.6
AJ13-2-48AS	control	2.3	a	a	0.200	0.022	a	a	a	0.40	a	a	a	a

[a]Element below detection limits of measuring instrument.

Table F-6. Residue Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363 K (90°C) Solution for 14 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits not available														
10KCl-2-37R	13	518.4	88.68	30.88	8.89	0.23	0.09	0.18	0.66	11.06	12.00	5.34	21.03	8.10
10KCl-2-38R	14	695.8	174.6	24.92	9.25	0.31	0.09	0.23	0.81	19.59	8.44	13.18	18.94	8.97
10KCl-2-39R	15	380.6	69.58	25.47	6.34	0.15	0.16	0.16	0.46	18.25	7.27	5.26	13.73	11.94
10KCl-2-40R	16	192.4	13.14	11.41	15.35	0.08	0.24	0.18	0.03	23.06	3.08	4.48	10.65	9.44
10KCl-2-41R	17	354.3	108.2	16.73	24.01	0.49	0.22	1.61	0.62	30.60	4.36	3.56	15.86	12.32

Table F-7. Leachate Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363K (90°C) Solution for 21 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		1.9	1.9	1.9	0.056	0.042	0.037	0.044	0.20	0.22	0.14	0.016	0.25	4.1
SJ13-3-49	1	a	a	a	0.146	a	a	a	a	2.29	a	a	a	a
SJ13-3-50	2	a	a	a	0.076	a	a	a	a	2.77	a	0.080	a	a
SJ13-3-51	3	a	a	a	0.102	a	a	a	a	2.54	a	a	a	a
SJ13-3-52	4	a	a	a	0.103	a	a	a	a	4.28	a	a	a	a
SJ13-3-53	5	a	a	a	0.131	a	a	a	a	3.81	a	a	a	a
SJ13-3-54	control	a	a	a	0.132	a	a	a	a	1.97	a	a	a	a
CJ13-3-55	7	4.0	a	a	1.43	0.084	0.126	a	a	1.63	a	0.045	0.34	a
CJ13-3-56	8	3.0	a	a	1.96	0.145	0.133	a	a	2.72	a	0.053	0.73	a
CJ13-3-57	9	4.0	a	a	2.27	0.142	0.140	a	a	4.43	a	0.053	0.86	a
CJ13-3-58	10	2.0	a	a	1.16	a	0.094	a	a	3.16	a	0.037	1.01	a
CJ13-3-59	11	2.0	a	a	1.10	a	0.075	a	a	3.45	a	0.039	1.15	a
CJ13-3-60	control	3.0	a	a	1.55	0.109	0.111	a	a	2.61	a	0.046	a	a
10KCl-3-61	13	a	a	7.0	a	a	0.095	a	a	0.86	2.72	0.409	1.83	a
10KCl-3-62	14	3.0	a	25.8	a	a	0.112	a	a	0.46	12.7	1.9	1.47	a
10KCl-3-63	15	7.0	3.0	20.8	a	a	0.110	a	a	1.31	8.25	1.5	2.19	a
10KCl-3-64	16	9.0	3.0	22.0	a	a	0.090	a	a	1.41	7.01	1.4	1.43	a
10KCl-3-65	17	3.0	a	18.4	a	a	0.095	a	a	1.40	9.01	1.4	1.55	a
10KCl-3-66	control	a	a	a	a	a	0.089	a	a	0.26	a	0.047	a	a
AJ13-3-67	19	11567	2699	788	0.680	5.79	0.392	4.74	19.8	147	218	30	42.4	10.9
AJ13-3-68	20	9431	2763	623	0.980	4.63	0.241	2.55	12.0	196	166	23	39.5	12.6
AJ13-3-69	21	11388	2886	839	0.608	5.66	0.365	4.83	20.4	182	216	30	35.5	12.2
AJ13-3-70	22	10332	3090	99.4	0.686	2.90	0.202	1.47	6.66	139	214	30	29.1	12.7
AJ13-3-71	23	10731	3475	865	0.291	2.56	0.134	0.955	5.85	178	214	31	47.9	15.5
AJ13-3-72	control	4.9	a	a	0.133	a	a	a	a	a	a	a	a	a

[a]Element below detection limits of measuring instrument.

Table F-8. Acid Strip Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363 K (90°C) Solution for 21 days.

		Major Elements				Noble Metal Fission Products					Minor Elements			
Expt. ID	Ingot ID	Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.3	2.3	2.3	0.067	0.050	0.044	0.052	0.24	0.27	0.16	0.019	0.30	4.9
SJ13-3-49AS	1	5.9	a	a	0.380	a	a	a	a	0.85	a	a	a	a
SJ13-3-50AS	2	8.2	a	a	0.440	a	a	a	a	0.44	a	a	a	a
SJ13-3-51AS	3	4.6	a	a	0.452	a	a	a	a	0.28	a	a	1.12	a
SJ13-3-52AS	4	4.7	a	a	0.229	a	a	a	a	a	a	a	a	a
SJ13-3-53AS	5	4.6	a	a	0.357	a	a	a	a	0.44	a	a	a	a
SJ13-3-54AS	control	6.8	a	a	0.605	a	a	a	a	0.32	a	a	a	a
CJ13-3-55AS	7	2.3	a	a	a	a	a	a	a	0.30	a	a	a	a
CJ13-3-56AS	8	7.0	a	a	0.168	a	a	a	a	a	a	a	a	a
CJ13-3-57AS	9	7.0	a	a	0.147	a	a	a	a	a	a	a	a	a
CJ13-3-58AS	10	4.6	a	a	a	a	a	a	a	0.82	a	a	a	a
CJ13-3-59AS	11	3.5	a	a	a	a	a	a	a	1.26	a	a	a	a
CJ13-3-60AS	control	6.0	a	a	0.250	0.129	a	a	a	0.35	a	a	a	a
10KCl-3-61AS	13	29.3	a	a	0.128	0.049	a	a	a	a	0.23	0.058	1.47	a
10KCl-3-62AS	14	130	40.4	9.2	0.304	0.149	0.052	0.094	0.389	0.52	4.23	0.403	3.16	a
10KCl-3-63AS	15	94.8	17.6	8.2	0.200	0.097	a	a	a	0.52	4.84	0.379	2.08	a
10KCl-3-64AS	16	104	17.5	10.5	0.263	0.074	a	a	a	0.83	5.92	0.530	2.28	a
10KCl-3-65AS	17	110	27.7	9.2	0.556	0.159	a	0.054	0.255	0.44	4.15	0.438	3.10	a
10KCl-3-66AS	control	5.9	a	a	0.293	0.064	a	a	a	a	a	a	a	a
AJ13-3-67AS	19	601	138	37.8	0.640	0.945	0.309	0.463	1.96	13.0	12.8	1.80	3.16	a
AJ13-3-68AS	20	538	170	34.1	0.822	1.94	0.163	0.825	3.66	22.4	11.1	1.56	3.38	a
AJ13-3-69AS	21	388	104	24.5	0.414	1.15	0.303	0.565	2.36	15.3	8.25	1.20	1.70	a
AJ13-3-70AS	22	272	81.6	22.5	2.09	1.22	0.299	0.453	1.79	11.3	6.14	0.891	1.02	a
AJ13-3-71AS	23	332	104	23.1	0.479	0.816	0.140	0.179	0.828	9.79	7.23	1.02	1.97	a
AJ13-3-72AS	control	3.5	a	a	0.250	a	a	a	a	a	a	a	a	a

[a]Element below detection limits of measuring instrument.

Table F-9. Residue Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363 K (90ºC) Solution for 21 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		b	b	b	b	b	b	0.02	0.02	b	2.30	b	b	b
10KCl-3-61R	13	90.95	8.91	6.73	1.47	0.04	0.03	a	a	12.39	a	3.67	12.60	11.16
10KCl-3-62R	14	183.7	11.51	6.64	1.20	0.06	0.03	0.06	0.13	14.08	2.77	5.37	11.53	13.72
10KCl-3-63R	15	363.8	55.93	15.55	1.39	0.26	0.06	0.32	1.06	18.06	6.55	5.80	14.57	14.25
10KCl-3-64R	16	379.7	53.66	16.10	1.09	0.20	0.05	0.24	0.74	14.81	7.21	6.14	9.83	15.05
10KCl-3-65R	17	157.3	24.33	6.91	1.69	0.07	0.04	0.06	0.16	13.34	2.26	6.07	16.59	14.47

[a]Element below detection limits of measuring instrument.

[b]Detection Limits not available.

Table F-10. Leachate Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363K (90°C) Solution for 28 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.0	2.0	2.0	0.016	0.022	0.027	0.015	0.20	0.24	0.052	0.017	0.084	4.3
SJ13-4-73	1	2.0	a	a	0.123	a	a	a	a	1.23	0.074	a	0.813	a
SJ13-4-74	2	4.1	a	a	0.118	a	a	a	a	0.65	0.073	a	0.260	a
SJ13-4-75	3	a	a	a	0.114	a	a	a	a	0.32	a	a	0.147	a
SJ13-4-76	4	3.0	a	a	0.109	a	a	a	a	1.06	a	a	0.205	a
SJ13-4-77	5	a	a	a	0.096	a	a	a	a	0.41	a	a	a	a
SJ13-4-78	control	a	a	a	0.139	a	a	a	a	0.25	a	a	0.086	a
CJ13-4-79	7	4.1	a	a	1.49	0.069	0.079	0.023	a	1.90	0.071	0.027	0.409	a
CJ13-4-80	8	3.1	a	a	2.95	0.094	0.121	0.029	a	1.50	0.088	0.048	0.532	a
CJ13-4-81	9	3.1	a	a	1.70	0.067	0.143	0.033	a	0.64	0.105	0.058	0.551	a
CJ13-4-82	10	a	a	a	1.10	a	0.136	0.017	a	0.53	0.078	0.049	0.697	a
CJ13-4-83	11	2.0	a	a	1.36	0.031	0.154	0.032	a	0.81	0.088	0.053	0.788	a
CJ13-4-84	control	a	a	a	1.33	a	0.154	0.018	a	0.44	0.086	0.090	0.553	a
10KCl-4-85	13	a	a	10.1	0.026	a	0.174	a	a	1.69	3.46	0.555	1.81	a
10KCl-4-86	14	4.1	a	13.3	a	a	0.154	a	a	0.69	7.50	1.09	1.49	a
10KCl-4-87	15	4.1	a	16.3	a	a	0.197	a	a	0.65	9.09	1.30	1.33	a
10KCl-4-88	16	6.1	2.0	14.2	a	a	0.183	a	a	2.20	7.08	0.985	1.37	a
10KCl-4-89	17	3.0	a	20.2	a	a	0.162	a	a	0.49	10.09	1.55	1.64	a
10KCl-4-90	control	a	a	a	a	a	0.164	a	a	a	a	0.047	0.137	a
AJ13-4-91	19	12241	2661	819	0.940	0.05	0.029	0.303	1.26	0.36	308	2.27	4.21	a
AJ13-4-92	20	10035	3159	763	0.578	0.029	0.012	0.057	a	0.15	259	1.93	1.96	a
AJ13-4-93	21	10375	2197	906	0.426	0.021	a	0.033	a	0.09	275	2.04	3.32	a
AJ13-4-94	22	10086	3193	890	0.787	0.039	0.016	0.129	0.57	0.22	268	2.00	3.55	a
AJ13-4-95	23	11214	2909	902	2.37	0.119	0.012	0.111	0.47	0.18	304	2.23	2.63	a
AJ13-4-96	control	a	a	a	0.119	a	a	a	a	a	a	a	0.338	a

[a]Element below detection limits of measuring instrument.

Table F-11. Acid Strip Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363 K (90°C) Solution for 28 days.

		Major Elements				Noble Metal Fission Products					Minor Elements			
Expt. ID	Ingot ID	Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.2	2.2	2.2	0.018	0.025	0.030	0.017	0.22	0.27	0.058	0.019	0.095	4.8
SJ13-4-73AS	1	2.3	a	a	1.01	0.184	a	a	a	a	0.451	a	1.64	a
SJ13-4-74AS	2	6.6	a	a	0.487	0.028	a	a	a	a	0.156	a	1.23	a
SJ13-4-75AS	3	a	a	a	1.13	0.062	a	a	a	1.18	0.194	a	0.343	a
SJ13-4-76AS	4	a	a	a	3.57	0.035	a	a	a	a	0.094	a	0.301	a
SJ13-4-77AS	5	3.4	a	a	0.824	a	a	a	a	a	0.082	a	0.175	a
SJ13-4-78AS	control	3.2	a	a	1.05	0.050	a	a	a	a	a	a	0.416	a
CJ13-4-79AS	7	8.1	a	a	0.112	0.026	a	a	a	0.89	0.066	a	0.178	a
CJ13-4-80AS	8	3.3	a	a	0.264	0.039	a	a	a	a	a	a	0.109	a
CJ13-4-81AS	9	1.1	a	a	0.046	a	a	a	a	a	a	a	0.107	a
CJ13-4-82AS	10	a	a	a	0.069	a	a	a	a	a	a	a	0.154	a
CJ13-4-83AS	11	a	2.3	a	0.070	0.039	a	a	a	0.28	0.087	a	0.222	a
CJ13-4-84AS	control	2.2	a	a	0.057	a	a	a	a	a	a	0.059	1.25	a
10KCl-4-85AS	13	44.8	14.6	a	0.072	0.063	a	0.030	a	1.28	0.253	0.042	0.712	a
10KCl-4-86AS	14	87.1	12.6	4.6	0.124	0.048	a	0.023	a	0.33	1.85	0.205	1.75	a
10KCl-4-87AS	15	163	48.2	11.5	0.083	0.105	a	0.088	0.33	0.89	4.30	0.489	2.00	a
10KCl-4-88AS	16	128	27.9	8.9	0.070	0.051	a	0.041	a	0.74	2.18	0.343	1.54	a
10KCl-4-89AS	17	154	29.1	12.3	0.102	0.073	a	0.067	0.27	0.56	4.83	0.487	2.75	a
10KCl-4-90AS	control	a	a	a	0.094	a	a	a	a	a	a	a	a	a
AJ13-4-91AS	19	777	193	47.0	0.565	1.99	0.363	0.942	4.04	30.7	15.9	2.31	4.22	a
AJ13-4-92AS	20	431	133	28.2	1.12	1.92	0.284	0.487	2.20	20.0	9.31	1.34	1.46	a
AJ13-4-93AS	21	377	72.4	27.6	0.298	0.732	0.083	0.096	0.43	6.50	7.81	1.14	1.52	a
AJ13-4-94AS	22	343	101	25.3	0.474	0.920	0.171	0.590	2.34	10.7	8.02	1.15	2.04	a
AJ13-4-95AS	23	232	61.3	15.8	0.447	1.24	0.235	0.675	2.69	10.8	5.48	0.793	1.03	a
AJ13-4-96AS	control	a	a	a	0.165	a	a	a	a	a	a	a	0.129	a

[a]Element below detection limits of measuring instrument.

Table F-12. Residue Data (ng/mm^2) from SS15ZR 26 Specimens Immersed in 363 K (90°C) Solution for 28 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		b	b	4.50	b	0.05	b	0.03	0.45	b	b	b	b	10.00
10KCl-4-85R	13	175.1	6.46	a	1.85	a	0.14	a	a	202.4	3.68	23.15	14.64	a
10KCl-4-86R	14	130.5	8.09	5.09	1.00	a	0.08	a	a	125.5	2.61	9.50	10.50	a
10KCl-4-87R	15	201.9	25.01	7.00	1.02	0.10	0.11	0.08	a	189.2	5.68	7.73	13.23	10.82
10KCl-4-88R	16	166.4	20.87	7.00	0.75	0.08	0.09	0.07	a	146.4	3.62	9.41	11.87	13.05
10KCl-4-89R	17	144.6	12.64	a	1.22	0.06	0.08	0.06	a	160.5	4.08	6.87	18.96	13.87

[a]Element below detection limits of measuring instrument.

[b]Detection Limits not available.

Table F-13. Leachate Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363K (90°C) Solution for 42 days.

		Major Elements				Noble Metal Fission Products					Minor Elements			
Expt. ID	Ingot ID	Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.0	2.0	2.0	0.090	0.009	0.006	0.005	0.19	0.23	0.064	0.006	0.053	2.4
SJ13-6-97	1	a	a	a	a	a	a	a	a	0.79	a	a	0.216	a
SJ13-6-98	2	a	a	a	a	a	a	a	a	0.77	a	a	0.255	a
SJ13-6-99	3	a	a	a	0.109	a	a	a	a	0.69	a	a	0.162	a
SJ13-6-100	4	a	a	a	0.094	a	a	a	a	1.01	a	a	0.270	a
SJ13-6-101	5	a	a	a	0.175	a	a	a	a	0.32	a	a	0.125	a
SJ13-6-102	control	a	a	a	0.221	a	a	a	a	0.45	a	a	0.143	a
CJ13-6-103	7	a	a	a	1.74	0.068	0.095	0.032	a	0.48	a	0.033	0.264	a
CJ13-6-104	8	a	a	a	1.73	0.063	0.123	0.031	a	0.57	a	0.047	0.329	a
CJ13-6-105	9	a	a	a	1.54	0.048	0.124	0.031	a	6.14	0.077	0.050	0.683	a
CJ13-6-106	10	a	a	a	1.31	0.021	0.127	0.018	a	0.92	0.070	0.046	0.456	a
CJ13-6-107	11	a	a	a	1.08	0.013	0.113	0.018	a	2.08	a	0.043	0.775	a
CJ13-6-108	control	a	a	a	1.04	0.011	0.100	0.019	a	0.37	0.075	0.042	0.208	a
10KCl-6-109	13	5.1	a	13.3	a	a	0.153	0.006	a	16.6	7.65	1.011	4.09	2.5
10KCl-6-110	14	3.1	a	16.3	a	a	0.125	0.006	a	5.26	7.92	1.012	2.68	2.8
10KCl-6-111	15	4.1	a	10.2	a	a	0.115	a	a	4.43	4.00	0.621	3.24	2.7
10KCl-6-112	16	6.1	a	30.7	0.334	a	0.148	a	a	4.43	11.4	1.86	2.20	2.9
10KCl-6-113	17	5.1	a	39.0	a	a	0.117	a	a	3.53	13.7	2.14	2.02	3.5
10KCl-6-114	control	a	a	a	a	a	0.094	a	a	0.30	0.142	0.032	0.423	3.7
AJ13-6-115	19	18278	3716	1436	0.354	2.26	0.207	2.40	9.59	198	510	15.1	22.0	3.6
AJ13-6-116	20	15975	4176	1021	1.73	5.69	0.481	5.57	23.1	249	362	48.8	58.0	16.2
AJ13-6-117	21	20037	4027	1924	0.333	1.58	0.125	1.21	4.68	134	535	17.5	29.3	3.8
AJ13-6-118	22	18092	4728	1329	0.339	1.95	0.146	2.00	7.99	212	445	16.1	37.4	4.7
AJ13-6-119	23	19396	3618	1337	0.141	1.18	0.089	1.18	4.64	143	476	12.9	19.8	2.7
AJ13-6-120	control	6.1	a	a	0.174	a	a	a	a	0.77	0.125	0.011	0.541	a

[a]Element below detection limits of measuring instrument.

Table F-14. Acid Strip Data (ng/mm²) from SS15ZR26 Specimens Immersed in 363 K (90°C) Solution for 42 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.2	2.2	2.2	0.10	0.010	0.007	0.006	0.21	0.25	0.071	0.007	0.058	2.6
SJ13-6-97AS	1	a	a	a	0.61	a	0.008	a	a	a	a	0.009	0.317	a
SJ13-6-98AS	2	a	a	a	0.30	a	a	a	a	1.12	a	0.007	1.19	a
SJ13-6-99AS	3	a	a	a	0.26	a	a	a	a	a	a	0.008	0.199	a
SJ13-6-100AS	4	4.1	a	a	0.36	a	a	a	a	a	a	0.006	0.182	a
SJ13-6-101AS	5	29.8	a	a	0.47	a	a	a	a	a	0.180	a	0.132	a
SJ13-6-102AS	control	2.2	a	a	0.76	0.017	a	a	a	a	a	0.007	0.527	a
CJ13-6-103AS	7	2.2	a	a	0.14	0.022	a	a	a	0.51	0.100	0.008	0.220	a
CJ13-6-104AS	8	a	a	a	a	a	a	a	a	a	a	a	0.065	a
CJ13-6-105AS	9	4.4	a	a	a	a	a	a	a	0.74	a	0.014	4.92	a
CJ13-6-106AS	10	a	a	a	a	a	a	a	a	a	a	a	0.107	a
CJ13-6-107AS	11	2.1	a	a	a	a	a	a	a	a	a	a	0.120	a
CJ13-6-108AS	control	a	a	a	a	a	a	a	a	a	a	a	a	a
10KCl-6-109AS	13	79.1	11	2.1	a	0.024	0.008	0.010	a	0.96	0.473	0.089	1.07	a
10KCl-6-110AS	14	95.2	20	4.6	0.12	0.047	0.012	0.031	a	0.45	1.21	0.177	1.36	a
10KCl-6-111AS	15	25.8	8.6	a	a	0.023	a	0.008	a	a	0.312	0.049	0.657	a
10KCl-6-112AS	16	253	50	29.5	a	0.072	0.028	0.103	0.39	0.65	9.61	1.21	4.23	a
10KCl-6-113AS	17	264	41	23.9	0.13	0.089	0.021	0.084	0.33	0.77	6.76	0.840	2.86	a
10KCl-6-114AS	control	5.6	a	a	a	a	a	a	a	a	a	a	0.165	a
AJ13-6-115AS	19	980	470	50.1	0.70	1.67	0.500	1.86	7.81	31.3	14.5	2.12	3.25	3.7
AJ13-6-116AS	20	559	204	31.3	1.05	3.05	0.347	1.39	6.12	32.2	10.2	1.48	1.77	3.0
AJ13-6-117AS	21	911	298	76.6	0.36	0.563	0.227	0.469	2.06	9.44	18.2	2.71	4.54	a
AJ13-6-118AS	22	869	322	56.5	0.79	2.69	0.306	2.01	8.39	30.2	15.9	2.33	5.47	3.2
AJ13-6-119AS	23	1200	580	55.2	0.73	2.84	0.400	2.31	9.88	54.0	16.8	2.42	3.87	5.6
AJ13-6-120AS	control	a	a	a	0.20	a	a	a	a	a	a	a	a	a

[a]Element below detection limits of measuring instrument.

Table F-15. Residue Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363 K (90ºC) Solution for 42 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits not available														
10KCl-6-109R	13	140.1	13.19	92.77	1.14	0.07	0.07	0.04	a	62.30	1.62	8.28	14.69	12.23
10KCl-6-110R	14	131.9	17.51	71.85	1.22	0.07	0.03	0.06	a	15.05	3.67	7.28	33.33	14.92
10KCl-6-111R	15	47.29	a	69.12	0.83	a	0.01	a	a	10.19	1.03	4.87	28.69	15.92
10KCl-6-112R	16	170.1	17.96	66.39	0.68	0.04	0.03	0.04	a	11.82	3.88	7.00	52.75	38.38
10KCl-6-113R	17	224.6	27.29	98.68	0.80	0.07	0.02	0.08	a	12.46	3.57	7.55	24.06	a
AJ13-6-115R	19	3547.1	1236.9	545.7	1.19	1.60	0.25	2.10	5.99	58.66	27.38	9.50	55.48	11.01
AJ13-6-116R	20	2296.5	736.7	586.6	1.01	1.19	0.16	1.19	3.62	66.39	21.74	8.50	45.48	18.44
AJ13-6-117R	21	3365.2	1118.7	532.1	0.75	1.00	0.12	0.81	2.24	39.61	27.69	8.78	45.93	19.51
AJ13-6-118R	22	3001.4	1045.9	591.2	0.76	1.07	0.13	1.06	2.99	55.48	26.88	8.32	54.12	19.20
AJ13-6-119R	23	3137.8	809.5	654.8	1.33	0.70	0.11	0.77	2.21	81.86	28.97	9.69	69.12	20.30

[a]Element below detection limits of measuring instrument.

Table F-16. Leachate Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363K (90°C) Solution for 56 days.

		Major Elements				Noble Metal Fission Products					Minor Elements			
Expt. ID	Ingot ID	Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.0	2.0	2.0	0.007	0.010	0.008	0.006	0.24	0.073	0.063	0.009	1.6	0.40
SJ13-8-121	1	a	a	a	0.096	a	a	a	a	0.336	a	a	a	a
SJ13-8-122	2	a	a	a	0.116	a	a	a	a	0.092	a	a	a	a
SJ13-8-123	3	a	a	a	0.125	a	a	a	a	0.809	a	a	a	a
SJ13-8-124	4	a	a	a	0.077	a	a	a	a	0.154	a	a	a	a
SJ13-8-125	5	a	a	a	0.082	a	a	a	a	0.104	a	a	a	a
SJ13-8-126	control	a	a	a	0.143	a	a	a	a	a	a	a	a	a
CJ13-8-127	7	a	a	a	1.32	0.030	0.061	0.009	a	0.624	a	0.015	a	0.43
CJ13-8-128	8	a	a	a	1.31	0.029	0.068	0.010	a	1.06	a	0.023	a	0.73
CJ13-8-129	9	a	a	a	1.37	0.029	0.075	0.012	a	0.886	0.078	0.028	2.4	0.43
CJ13-8-130	10	a	a	a	1.10	a	0.065	a	a	0.732	a	0.020	a	a
CJ13-8-131	11	a	a	a	1.13	a	0.064	a	a	1.39	a	0.020	a	a
CJ13-8-132	control	a	a	a	1.08	a	0.060	a	a	0.421	a	0.020	a	a
10KCl-8-133	13	a	3.1	17.4	0.017	a	0.112	0.008	a	2.70	6.03	0.975	1.7	2.36
10KCl-8-134	14	a	a	6.1	0.008	a	0.118	0.006	a	1.26	2.51	0.371	a	2.61
10KCl-8-135	15	a	a	4.2	0.138	a	0.110	a	a	1.13	1.41	0.256	a	2.82
10KCl-8-136	16	a	8.2	16.3	0.009	0.013	0.149	0.011	a	4.50	6.53	1.20	a	2.93
10KCl-8-137	17	a	a	11.3	0.012	a	0.118	0.007	a	1.91	5.68	0.839	2.1	2.88
10KCl-8-138	control	a	a	a	a	a	0.101	a	a	0.602	a	0.027	a	2.87
AJ13-8-139	19	12690	823	1309	0.165	0.719	0.219	1.44	5.43	4.27	470	72.6	81.8	1.51
AJ13-8-140	20	15960	600	1281	0.137	0.635	0.205	1.50	5.49	2.02	442	50.5	58.1	1.14
AJ13-8-1	21	18155	3002	1461	0.084	0.188	0.085	0.310	1.02	75.4	417	51.1	32.6	9.47
AJ13-8-2	22	19492	4363	1791	0.700	3.31	0.139	1.55	6.99	137	462	49.5	54.0	17.7
AJ13-8-3	23	15703	3141	1700	1.35	5.82	0.333	3.72	16.7	98.6	494	60.3	72.5	10.6
AJ13-8-4	control	a	a	a	0.639	4.71	0.477	5.29	21.2	0.127	a	62.3	96.5	a

[a]Element below detection limits of measuring instrument.

Table F-17. Acid Strip Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363 K (90°C) Solution for 56 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.2	2.2	2.2	0.008	0.011	0.009	0.007	0.27	0.081	0.070	0.010	1.8	0.44
SJ13-8-121AS	1	a	a	a	0.261	a	a	a	a	a	a	a	a	a
SJ13-8-122AS	2	a	a	a	0.318	a	a	a	a	a	0.093	a	a	a
SJ13-8-123AS	3	a	a	a	0.231	a	a	a	a	a	a	a	a	a
SJ13-8-124AS	4	a	a	a	0.351	a	a	a	a	a	a	a	a	a
SJ13-8-125AS	5	a	a	a	0.308	a	a	a	a	a	a	a	a	a
SJ13-8-126AS	control	a	a	a	0.563	a	a	a	a	a	a	0.011	a	a
CJ13-8-127AS	7	a	a	a	0.034	a	a	a	a	a	a	a	a	a
CJ13-8-128AS	8	a	a	a	0.022	a	a	a	a	a	a	a	a	a
CJ13-8-129AS	9	a	a	a	0.116	a	a	a	a	0.509	a	0.013	a	a
CJ13-8-130AS	10	a	a	a	0.061	a	0.013	a	a	a	a	a	a	a
CJ13-8-131AS	11	a	a	a	0.025	a	a	a	a	0.149	a	a	a	a
CJ13-8-132AS	control	a	a	a	0.023	a	a	a	a	a	a	a	a	a
10KCl-8-133AS	13	34.6	13.4	3.4	0.023	0.024	a	0.016	a	0.249	1.59	0.144	a	a
10KCl-8-134AS	14	20.6	6.9	a	0.018	0.024	a	0.011	a	0.127	0.317	0.039	a	a
10KCl-8-135AS	15	10.3	2.3	a	0.039	0.014	a	a	a	0.108	a	a	a	a
10KCl-8-136AS	16	61.4	23.7	7.5	0.026	0.072	0.014	0.080	0.31	0.461	3.87	0.299	1.8	a
10KCl-8-137AS	17	67.7	21.1	6.7	0.061	0.045	a	0.040	a	0.328	1.79	0.228	a	a
10KCl-8-138AS	control	a	a	a	0.012	a	a	a	a	a	a	a	a	a
AJ13-8-139AS	19	951	386	15.7	0.487	0.493	0.349	2.47	10.1	5.54	5.48	0.819	a	2.34
AJ13-8-140AS	20	1928	578	52.0	0.943	0.361	0.345	1.97	8.27	5.95	18.4	2.77	1.9	3.00
AJ13-8-1AS	21	282	112	16.5	0.332	0.819	0.137	0.275	1.26	11.2	4.73	0.733	a	1.41
AJ13-8-2AS	22	525	166	44.8	0.339	0.579	0.185	0.302	1.38	8.73	11.6	1.80	2.1	1.05
AJ13-8-3AS	23	620	227	51.6	0.353	0.623	0.477	0.816	3.41	9.73	15.6	2.36	3.7	1.50
AJ13-8-4AS	control	a	a	a	0.149	a	a	a	a	0.103	a	a	a	a

[a]Element below detection limits of measuring instrument.

Table F-18. Residue Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363 K (90ºC) Solution for 56 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits not available														
10KCl-8-133R	13	119.1	21.33	4.91	1.96	0.07	a	0.06	a	19.58	2.18	2.73	9.22	11.46
10KCl-8-134R	14	37.70	a	a	1.06	a	a	a	a	9.44	0.74	2.43	5.14	10.45
10KCl-8-135R	15	25.69	a	a	0.90	a	a	a	a	8.35	a	3.26	4.94	11.75
10KCl-8-136R	16	150.1	18.28	5.73	1.06	0.08	a	0.12	a	10.72	2.72	2.98	6.58	12.79
10KCl-8-137R	17	88.22	19.05	6.37	1.17	0.05	a	0.05	a	8.28	1.39	2.38	6.45	12.96
AJ13-8-139R	19	3801.7	715.3	182.4	2.30	2.06	0.24	2.61	7.18	53.67	55.38	15.06	26.94	26.53
AJ13-8-140R	20	3483.4	464.8	188.7	2.05	0.82	0.14	1.00	2.87	33.20	58.35	14.00	19.31	34.52
AJ13-8-1R	21	3033.2	754.0	224.2	1.75	1.56	0.10	0.75	2.16	55.54	54.92	9.43	21.40	47.69
AJ13-8-2R	22	3628.9	1282.4	246.5	2.02	2.34	0.22	2.15	5.89	87.96	59.72	13.40	24.83	55.00
AJ13-8-3R	23	3774.4	1227.8	259.7	2.20	2.31	0.22	2.18	5.60	84.49	63.25	14.08	22.87	56.53

[a]Element below detection limits of measuring instrument.

Table F-19. Leachate Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363K (90°C) Solution for 70 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.0	2.0	2.0	0.010	0.008	0.004	0.003	0.24	0.052	0.087	0.090	0.10	0.024
SJ13-10-141	1	a	a	a	0.210	a	a	a	a	0.234	a	a	a	0.161
SJ13-10-142	2	a	a	a	0.101	a	a	a	a	a	a	a	a	0.108
SJ13-10-143	3	a	a	a	0.072	a	a	a	a	0.057	a	a	a	0.087
SJ13-10-144	4	a	a	a	0.115	a	a	a	a	0.065	a	a	a	0.065
SJ13-10-145	5	a	a	a	0.071	a	a	a	a	0.066	a	a	a	0.047
SJ13-10-146	control	a	a	a	0.185	a	a	a	a	a	a	a	a	0.037
CJ13-10-147	7	a	a	a	0.943	0.018	0.079	0.005	a	0.329	a	a	0.18	0.429
CJ13-10-148	8	a	a	a	0.991	0.020	0.116	0.009	a	0.343	a	a	0.23	0.376
CJ13-10-149	9	a	a	a	1.17	0.026	0.153	0.008	a	0.629	a	a	0.20	0.395
CJ13-10-150	10	a	a	a	1.03	0.010	0.149	0.004	a	0.321	a	a	0.20	0.419
CJ13-10-151	11	a	a	a	0.945	0.009	0.143	0.004	a	0.353	a	a	0.26	0.416
CJ13-10-152	control	a	a	a	0.716	a	0.122	0.004	a	0.294	a	a	0.17	0.414
10KCl-10-153	13	a	a	6.2	0.034	a	0.118	a	a	0.735	2.34	0.32	0.46	3.26
10KCl-10-154	14	a	a	6.1	a	a	0.139	0.003	a	1.45	1.75	0.23	0.52	2.63
10KCl-10-155	15	a	2.1	a	a	a	0.146	a	a	0.951	0.36	a	0.39	2.72
10KCl-10-156	16	a	5.2	14.5	a	a	0.187	0.004	a	3.90	5.69	0.75	0.91	2.96
10KCl-10-157	17	a	a	21.6	a	a	0.148	0.004	a	1.65	7.91	1.09	0.63	2.84
10KCl-10-158	control	a	a	a	a	a	a	a	a	0.050	a	a	a	a
AJ13-10-159	19	13849	1247	1279	0.308	0.906	0.329	2.16	8.17	5.72	440	49.4	77.8	2.53
AJ13-10-160	20	18248	5005	1249	8.32	6.14	0.509	3.96	19.0	191	407	47.3	93.3	16.5
AJ-13-10-5	21	18130	1057	1410	a	a	0.012	0.050	0.076	0.366	438	49.3	23.3	1.09
AJ-13-10-6	22	18672	4360	1581	1.39	6.94	0.430	3.26	14.2	98.6	432	50.6	59.1	16.6
AJ-13-10-7	23	18723	4908	1449	1.17	7.72	0.562	7.05	28.6	128	436	51.9	110	17.3
AJ-13-10-8	control	a	a	a	0.107	a	a	a	a	0.060	a	a	a	a

[a]Element below detection limits of measuring instrument.

Table F-20. Acid Strip Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363 K (90ºC) Solution for 70 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.2	2.2	2.2	0.011	0.009	0.004	0.003	0.27	0.056	0.094	0.10	0.11	0.027
SJ13-10-141AS	1	4.3	a	a	0.202	a	a	a	a	0.117	a	a	0.33	a
SJ13-10-142AS	2	2.8	a	a	0.347	a	a	a	a	a	a	a	a	a
SJ13-10-143AS	3	3.4	a	a	0.259	a	a	a	a	0.062	a	a	a	a
SJ13-10-144AS	4	a	a	a	0.379	a	a	a	a	a	a	a	a	a
SJ13-10-145AS	5	3.6	a	a	0.317	a	a	a	a	0.085	a	a	a	a
SJ13-10-146AS	control	3.4	a	a	0.464	a	a	a	a	0.066	a	a	a	a
CJ13-10-147AS	7	a	a	a	0.037	0.019	0.008	0.006	a	0.080	a	a	a	a
CJ13-10-148AS	8	a	a	a	0.032	a	a	a	a	a	a	a	0.42	a
CJ13-10-149AS	9	a	a	a	0.031	a	a	a	a	a	a	a	a	a
CJ13-10-150AS	10	a	a	a	0.026	a	a	a	a	a	a	a	a	a
CJ13-10-151AS	11	4.9	a	a	0.027	a	a	a	a	a	a	a	a	a
CJ13-10-152AS	control	2.7	a	a	0.046	a	a	a	a	a	a	a	a	a
10KCl-10-153AS	13	17.5	6.6	a	0.042	0.016	a	0.010	a	0.256	0.30	a	a	a
10KCl-10-154AS	14	13.5	6.8	a	0.017	0.032	a	0.019	a	0.213	0.15	a	0.29	a
10KCl-10-155AS	15	a	a	a	a	a	a	a	a	a	a	a	a	a
10KCl-10-156AS	16	62.2	28.4	5.5	0.060	0.067	a	0.065	0.21	0.536	1.56	0.16	1.46	a
10KCl-10-157AS	17	76.8	9.9	6.6	0.017	0.022	a	0.019	a	0.392	1.56	0.18	1.05	a
10KCl-10-158AS	control	a	a	a	a	a	a	a	a	0.185	a	a	a	a
AJ13-10-159AS	19	624	255	12.2	0.555	0.404	0.220	1.87	7.72	6.55	3.52	0.48	0.91	1.66
AJ13-10-160AS	20	209	91.1	12.9	0.447	0.774	0.117	0.445	1.97	10.7	3.35	0.49	1.02	0.86
AJ13-10-5AS	21	788	156	38.1	0.365	0.121	0.046	0.151	0.65	2.10	10.2	1.48	0.78	1.74
AJ13-10-6AS	22	285	88.3	19.0	0.289	0.401	0.166	0.160	0.69	5.97	4.67	0.65	1.89	0.61
AJ13-10-7AS	23	593	195	43.9	0.329	0.741	0.204	0.918	3.70	10.6	11.3	1.68	3.58	1.27
AJ13-10-8AS	control	a	a	a	0.138	a	a	a	a	0.050	a	a	a	a

[a]Element below detection limits of measuring instrument.

Table F-21. Residue Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363 K (90°C) Solution for 70 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits not available														
10KCl-10-153R	13	80.49	4.77	a	0.78	a	a	a	a	4.37	2.28	20.67	6.37	36.94
10KCl-10-154R	14	43.52	a	a	0.94	a	a	a	a	2.26	1.07	14.26	3.87	35.18
10KCl-10-155R	15	54.57	a	a	1.16	a	a	a	a	2.66	2.05	16.02	5.75	32.55
10KCl-10-156R	16	86.40	9.78	4.73	0.67	a	a	a	a	3.23	2.50	16.63	6.72	30.95
10KCl-10-157R	17	98.68	6.91	5.28	0.64	a	a	a	a	6.16	2.42	15.61	5.26	30.19
AJ13-10-159R	19	1887.2	422.9	78.67	1.12	1.29	0.15	1.81	5.47	35.13	24.00	22.01	9.12	15.27
AJ13-10-160R	20	1414.3	513.9	81.86	3.62	1.36	0.13	0.96	2.59	49.61	23.00	23.19	8.83	28.45
AJ-13-10-5R	21	1614.4	157.3	102.3	0.59	0.14	a	0.07	a	7.18	27.81	19.40	4.34	27.67
AJ-13-10-6R	22	1596.2	554.8	111.0	0.81	1.31	0.09	0.74	2.25	39.97	26.31	17.93	9.20	35.42
AJ-13-10-7R	23	1787.2	627.6	97.77	0.58	1.44	0.13	1.38	4.08	51.09	26.30	17.60	10.98	35.66

[a]Element below detection limits of measuring instrument.

Table F-22. Leachate Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363K (90°C) Solution for 98 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.0	2.0	2.0	0.017	0.011	0.009	0.005	0.15	0.043	0.108	0.089	0.17	0.29
SJ13-14-9	1	a	a	a	0.057	a	a	a	a	0.345	a	a	a	a
SJ13-14-10	2	a	a	a	0.055	a	a	a	a	0.170	a	a	a	a
SJ13-14-11	3	a	a	a	0.055	a	a	a	a	0.179	a	a	0.24	a
SJ13-14-12	4	a	a	a	0.037	a	a	a	a	0.122	a	a	a	a
SJ13-14-13	5	2.0	a	a	0.055	a	a	a	a	0.417	a	a	a	a
SJ13-14-14	control	a	a	a	0.121	a	a	a	a	0.159	a	a	0.14	a
CJ13-14-15	7	a	a	a	0.951	a	0.046	0.009	a	0.646	a	a	0.13	0.29
CJ13-14-16	8	a	a	a	0.999	a	0.065	0.007	a	0.441	a	a	0.19	0.32
CJ13-14-17	9	a	a	a	1.64	0.017	0.089	0.009	a	0.523	a	a	0.25	0.32
CJ13-14-18	10	a	a	a	0.953	a	0.056	a	a	0.302	a	a	a	0.33
CJ13-14-19	11	a	a	a	1.10	a	0.089	0.042	0.146	0.382	a	a	0.17	0.34
CJ13-14-20	control	a	a	a	6.50	0.632	0.165	0.081	0.415	0.460	a	a	0.17	0.36
10KCl-14-21	13	a	a	7.1	0.026	a	0.182	0.020	a	0.735	3.05	0.44	1.19	2.92
10KCl-14-22	14	a	a	a	0.014	a	0.184	0.013	a	1.97	0.57	a	0.91	3.32
10KCl-14-23	15	a	3.2	a	0.018	a	0.142	0.017	a	1.021	0.28	a	0.54	2.75
10KCl-14-24	16	a	4.6	7.9	a	a	0.166	0.005	a	4.67	3.57	0.51	0.87	3.02
10KCl-14-25	17	a	7.9	15.7	a	a	0.160	0.005	a	4.42	3.87	0.72	0.47	2.98
10KCl-14-26	control	a	a	a	a	a	0.119	a	a	0.473	a	a	a	2.90
AJ13-14-27	19	7082	818	2703	0.127	0.874	0.195	2.76	12.6	7.88	886	94.1	119	1.29
AJ13-14-28	20	4974	3728	2774	19.3	4.80	0.637	8.10	37.6	49.6	788	94.7	94.7	8.14
AJ13-14-29	21	5756	1490	3633	0.309	1.56	0.248	4.65	21.9	8.05	1004	115	128	1.21
AJ13-14-30	22	4999	1744	2972	0.539	1.76	0.120	2.10	8.18	10.9	713	84.8	122	2.94
AJ13-14-31	23	4646	3334	2479	3.13	4.19	0.338	7.73	34.0	43.4	707	84.5	195	7.63
AJ13-14-32	control	a	a	a	0.120	a	a	a	a	0.049	a	a	0.27	a

[a] Element below detection limits of measuring instrument.

Table F-23. Acid Strip Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363 K (90°C) Solution for 98 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.3	2.3	2.3	0.535	0.031	0.030	0.115	0.12	0.044	0.12	0.125	0.12	0.18
SJ13-14-9AS	1	3.1	a	a	0.438	a	a	a	a	0.258	a	a	4.296	a
SJ13-14-10AS	2	18.2	a	a	0.374	a	a	a	a	0.170	a	a	3.222	a
SJ13-14-11AS	3	10.1	a	a	0.239	a	a	a	a	a	a	a	3.338	a
SJ13-14-12AS	4	17.2	a	a	0.398	a	a	a	a	0.068	a	a	2.712	a
SJ13-14-13AS	5	4.7	a	a	0.257	a	a	a	a	a	a	a	2.825	a
SJ13-14-14AS	control	24.7	a	a	0.501	a	a	a	a	0.177	0.139	a	3.096	a
CJ13-14-15AS	7	18.9	a	a	0.029	0.019	a	a	a	0.204	0.102	a	2.860	a
CJ13-14-16AS	8	16.4	a	a	a	a	a	a	a	0.183	a	a	3.090	a
CJ13-14-17AS	9	13.3	a	a	0.177	0.035	a	a	a	0.194	0.106	a	2.771	a
CJ13-14-18AS	10	a	a	a	a	a	a	a	a	a	a	a	2.723	a
CJ13-14-19AS	11	a	a	a	0.027	a	a	0.010	a	a	a	a	2.977	a
CJ13-14-20AS	control	a	a	a	0.380	0.588	a	0.062	0.264	a	a	a	2.819	a
10KCl-14-21AS	13	24.9	7.8	a	0.307	0.070	0.022	0.063	0.263	0.170	0.158	a	2.279	a
10KCl-14-22AS	14	2.6	a	a	0.115	0.012	a	0.029	a	0.047	a	a	2.927	a
10KCl-14-23AS	15	7.1	5.8	a	0.091	0.022	0.013	0.048	a	0.148	a	a	3.242	a
10KCl-14-24AS	16	23.5	7.0	a	0.133	0.020	a	0.008	a	0.262	a	a	3.336	a
10KCl-14-25AS	17	80.7	34.0	5.9	0.044	0.077	a	0.092	0.325	0.863	2.185	0.159	3.829	a
10KCl-14-26AS	control	14.1	a	a	a	a	a	a	a	a	a	a	2.469	a
AJ13-14-27AS	19	1393.0	324.3	83.6	0.598	0.168	0.377	1.817	7.645	0.785	21.063	3.031	4.692	a
AJ13-14-28AS	20	160.8	131.9	31.0	3.315	0.405	0.328	1.153	4.613	4.834	7.329	1.079	3.482	a
AJ13-14-29AS	21	991.6	407.1	58.5	0.175	0.243	0.140	2.451	10.892	1.475	13.310	1.941	3.305	a
AJ13-14-30AS	22	147.1	72.3	28.8	0.192	0.115	0.069	0.185	0.756	1.037	6.082	0.888	2.167	a
AJ13-14-31AS	23	145.9	86.5	26.9	0.390	0.238	0.094	0.702	2.754	2.107	6.957	1.018	2.897	a
AJ13-14-32AS	control	a	a	a	0.320	a	a	a	a	a	a	a	a	a

[a]Element below detection limits of measuring instrument.

Table F-24. Acid Strip Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363 K (90°C) Solution for 98 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits not available														
10KCl-14-21R	13	38.93	a	a	0.02	a	0.00	0.00	a	0.06	0.02	0.09	0.30	0.50
10KCl-14-22R	14	41.43	a	a	0.02	a	0.00	a	a	0.04	0.01	0.12	0.36	0.51
10KCl-14-23R	15	30.70	a	a	0.02	a	0.00	a	a	0.04	0.01	0.15	0.30	0.42
10KCl-14-24R	16	72.76	4.55	a	0.03	a	0.00	a	a	0.05	0.02	0.15	0.32	0.49
10KCl-14-25R	17	247.8	42.84	8.23	0.03	0.00	0.00	0.00	0.01	0.11	0.07	0.16	0.60	0.50
AJ13-14-27R	19	2014.6	311.5	93.68	0.05	0.04	0.00	0.05	0.16	0.93	1.05	0.37	0.55	1.47
AJ13-14-28R	20	3979.1	1032.3	100.5	0.64	0.12	0.02	0.10	0.29	3.19	1.03	0.43	0.44	1.63
AJ13-14-29R	21	7457.9	1355.2	146.4	0.03	0.13	0.01	0.14	0.43	2.80	1.52	0.48	0.65	1.55
AJ13-14-30R	22	4533.9	1136.9	119.1	0.14	0.09	0.01	0.07	0.21	2.33	1.08	0.41	0.52	1.52
AJ13-14-31R	23	3678.9	1018.6	89.13	0.07	0.10	0.01	0.09	0.26	3.41	0.94	0.38	0.66	1.58

[a]Element below detection limits of measuring instrument.

Table F-25. Leachate Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363K (90°C) Solution for 154 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.0	2.0	2.0	0.016	0.024	0.018	0.023	0.047	0.9	0.56	0.070	0.48	1.0
SJ13-22-33	1	a	a	a	0.055	a	a	a	a	a	a	a	a	a
SJ13-22-34	2	a	a	a	0.077	a	a	a	a	a	a	a	a	a
SJ13-22-35	3	a	a	a	0.062	a	a	a	a	a	a	a	a	a
SJ13-22-36	4	a	a	a	0.081	a	a	a	a	a	a	a	a	a
SJ13-22-40	5	a	a	a	0.113	a	a	a	a	a	a	a	a	a
SJ13-22-41	control	a	a	a	0.121	a	a	a	a	a	a	a	a	a
CJ13-22-42	7	a	a	a	1.34	a	0.050	a	a	a	a	a	a	a
CJ13-22-43	8	a	a	a	1.44	a	0.050	0.027	0.148	a	a	a	a	a
CJ13-22-44	9	a	a	a	1.24	a	0.069	0.043	0.264	a	a	a	a	a
CJ13-22-45	10	a	a	a	1.008	a	0.027	a	0.072	a	a	a	a	a
CJ13-22-46	11	a	a	a	1.13	a	0.029	a	0.137	a	a	a	a	a
CJ13-22-47	control	a	a	a	1.15	a	0.039	0.089	0.446	a	a	a	9.41	a
10KCl-22-48	13	a	a	9.1	a	a	0.030	a	a	a	3.91	0.556	a	2.9
10KCl-22-49	14	4.0	6.0	6.0	a	a	0.030	0.025	0.064	2.05	1.90	0.274	a	5.4
10KCl-22-50	15	a	8.1	a	a	a	0.031	0.041	0.046	3.40	a	a	2.58	3.6
10KCl-22-52	16	5.0	8.1	4.0	a	a	0.038	0.076	0.164	4.60	1.17	0.236	0.6	2.9
10KCl-22-53	17	a	2.0	6.1	a	a	0.028	a	0.035	8.51	1.84	0.252	a	2.2
10KCl-22-54	control	a	a	a	a	a	a	a	a	a	a	a	a	2.1
AJ13-22-55	19	3195	1346	4743	0.101	0.802	0.069	2.83	14.9	3.08	1330	191	196	0.33
AJ13-22-56	20	1434	3188	4321	3.07	1.91	0.386	5.30	24.3	21.5	1108	161	182	2.62
AJ13-22-57	21	1512	1925	5803	0.327	2.28	0.307	7.60	39.1	16.8	1356	196	193	1.46
AJ13-22-58	22	1607	3688	5761	0.623	3.04	0.390	8.63	36.4	29.2	1393	198	517	3.18
AJ13-22-59	23	1625	3346	4102	2.54	2.41	0.349	5.37	24.4	36.3	1063	152	203	2.96
AJ13-22-60	control	a	a	a	0.092	a	a	a	a	a	a	a	a	a

[a]Element below detection limits of measuring instrument.

Table F-26. Acid Strip Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363 K (90°C) Solution for 154 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.3	2.3	2.3	0.02	0.03	0.02	0.03	0.03	1.3	0.66	0.08	0.57	1.5
SJ13-22-33AS	1	a	a	a	0.45	a	a	a	a	a	a	a	a	a
SJ13-22-34AS	2	a	a	a	0.37	a	a	a	0.07	a	a	a	a	a
SJ13-22-35AS	3	a	a	a	0.35	a	a	a	a	a	a	a	a	a
SJ13-22-36AS	4	a	a	a	0.57	a	a	a	a	a	a	a	a	a
SJ13-22-40AS	5	3.4	a	a	0.70	a	a	a	a	a	a	a	a	a
SJ13-22-41AS	control	a	a	a	0.56	a	a	a	a	a	a	a	a	a
CJ13-22-42AS	7	a	a	a	0.05	a	a	a	a	a	a	a	a	a
CJ13-22-43AS	8	a	a	a	0.11	a	a	a	0.08	a	a	a	a	a
CJ13-22-44AS	9	a	a	a	0.07	a	a	0.06	0.21	a	a	a	a	a
CJ13-22-45AS	10	a	a	a	0.04	a	a	a	0.05	a	a	a	2.5	a
CJ13-22-46AS	11	a	a	a	0.04	a	a	a	0.06	a	a	a	a	a
CJ13-22-47AS	control	a	a	a	0.19	a	a	0.12	0.32	a	a	a	0.7	a
10KCl-22-48AS	13	7.0	a	a	a	a	a	a	0.04	a	a	a	2.6	a
10KCl-22-49AS	14	15.9	4.5	a	a	a	a	a	a	a	a	a	2.6	a
10KCl-22-50AS	15	a	a	a	a	a	a	a	a	a	a	a	2.6	a
10KCl-22-52AS	16	23.4	14.1	a	a	a	a	a	0.09	a	a	a	2.9	a
10KCl-22-53AS	17	11.3	4.5	a	a	a	a	a	a	a	a	a	2.8	a
10KCl-22-54AS	control	a	a	2.4	a	a	a	a	a	a	a	a	2.5	a
AJ13-22-55AS	19	431.0	168.9	92.0	0.33	0.10	0.13	1.19	5.38	a	22.95	3.23	3.8	a
AJ13-22-56AS	20	115.5	102.0	48.2	16.37	0.38	0.17	0.73	2.96	a	10.77	1.54	2.2	a
AJ13-22-57AS	21	187.8	131.4	117.5	0.14	0.12	0.07	0.51	2.39	a	24.09	3.41	3.5	a
AJ13-22-58AS	22	194.3	138.0	67.8	0.73	0.17	0.11	0.57	2.38	a	14.37	2.01	5.4	a
AJ13-22-59AS	23	148.9	126.4	63.2	1.10	0.21	0.09	0.62	2.55	a	15.12	2.12	2.9	a
AJ13-22-60AS	control	a	a	a	0.08	a	a	a	a	a	a	a	a	a

[a]Element below detection limits of measuring instrument.

Table F-27. Residue Data (ng/mm²) from SS15ZR26 Specimens Immersed in 363 K (90ºC) Solution for 154 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits not available														
AJ13-22-55R	19	59573	9050	809	1.20	5.08	0.32	5.13	17.6	128	50.7	9.38	23.9	10.2
AJ13-22-56R	20	60937	14552	759	24.6	7.91	0.65	5.58	19.2	239	43.1	8.49	18.9	18.3
AJ13-22-57R	21	70487	11869	869	1.71	5.99	0.26	3.76	12.2	147	44.4	8.51	21.6	12.1
AJ13-22-58R	22	73215	17644	728	1.90	7.90	0.37	5.33	16.9	278	39.6	8.66	37.7	21.7
AJ13-22-59R	23	62301	15189	991	8.40	7.01	0.40	5.03	15.7	292	57.0	12.4	26.2	18.4

Table F-28. Leachate Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363K (90°C) Solution for 224 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.0	2.0	2.0	1.2	0.018	0.017	0.023	0.032	0.40	0.10	0.021	0.10	0.80
SJ13-32-1	1	a	a	a	a	a	a	a	a	a	a	a	0.24	a
SJ13-32-2	2	a	a	a	a	a	a	a	a	a	a	a	0.23	a
SJ13-32-3	3	a	a	a	a	a	a	a	a	a	a	a	0.22	a
SJ13-32-4	4	a	a	a	a	a	a	a	a	a	a	a	0.36	a
SJ13-32-5	5	a	a	a	a	a	a	a	a	a	a	a	0.32	a
SJ13-32-161	control	a	a	a	a	a	a	a	a	a	a	a	0.90	a
CJ13-32-41	7	a	a	a	a	a	0.037	a	a	0.51	a	0.023	0.32	a
CJ13-32-42	8	a	a	a	a	a	0.046	a	a	0.48	a	0.025	0.39	a
CJ13-32-43	9	a	a	a	a	a	0.051	a	a	0.56	a	0.029	0.44	a
CJ13-32-44	10	a	a	a	a	a	0.027	a	a	0.59	a	0.026	0.46	a
CJ13-32-45	11	a	a	a	a	a	0.026	a	a	0.57	a	0.024	0.41	a
CJ13-32-162	control	a	a	a	a	a	0.026	a	a	0.79	a	0.036	0.39	a
10KCl-32-81	13	a	a	4.0	a	a	0.024	a	a	0.59	1.54	0.212	0.58	1.93
10KCl-32-82	14	a	a	3.0	a	a	0.021	a	a	1.09	1.84	0.157	0.48	2.13
10KCl-32-83	15	a	3.0	4.0	a	a	0.028	a	a	1.35	1.36	0.205	1.49	2.40
10KCl-32-84	16	34.1	24.1	8.0	a	0.150	0.065	0.160	0.574	6.15	3.44	0.467	1.76	2.56
10KCl-32-85	17	2.0	a	12.0	a	a	0.671	a	a	65.3	87.1	11.7	20.8	39.41
10KCl-32-163	control	a	a	a	a	a	a	a	a	a	a	a	8.10	38.19
AJ13-32-121	19	2813	4709	5035	0.98	2.01	0.205	8.31	40.8	10.0	1198	241	351	a
AJ13-32-122	20	1569	3780	4921	7.95	2.19	0.248	9.51	46.9	13.3	1211	233	190	1.66
AJ13-32-123	21	1508	1304	5817	a	1.41	0.088	4.59	25.3	7.3	1218	243	231	a
AJ13-32-124	22	2896	3357	5302	0.63	2.60	0.159	4.71	21.5	13.4	1096	10.8	12.1	a
AJ13-32-125	23	2922	3500	5042	10.6	1.74	0.185	6.53	31.2	8.8	1007	10.04	16.3	a
AJ13-32-164	control	a	a	a	a	a	a	a	a	a	0.15	0.025	1.72	a

[a]Element below detection limits of measuring instrument.

Table F-29. Acid Strip Data (ng/mm²) from SS15ZR26 Specimens Immersed in 363 K (90°C) Solution for 224 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.4	2.4	2.4	1.4	0.021	0.020	0.027	0.038	0.48	0.12	0.025	0.12	0.96
SJ13-32-1AS	1	a	a	a	a	a	a	a	a	a	0.17	a	0.64	a
SJ13-32-2AS	2	a	a	a	a	a	a	a	a	a	a	a	0.29	a
SJ13-32-3AS	3	a	a	2.4	a	a	a	a	a	a	a	a	0.28	a
SJ13-32-4AS	4	a	a	a	a	a	a	a	a	a	a	a	0.46	a
SJ13-32-5AS	5	a	a	a	a	a	a	a	a	a	a	a	0.45	a
SJ13-32-161AS	control	a	a	a	a	a	a	a	a	a	a	a	0.69	a
CJ13-32-41AS	7	a	a	3.7	a	a	a	a	a	a	a	a	0.29	a
CJ13-32-42AS	8	a	a	a	a	a	a	a	a	a	a	a	0.23	a
CJ13-32-43AS	9	a	a	a	a	a	a	a	a	a	a	a	0.27	a
CJ13-32-44AS	10	a	a	a	a	a	a	a	a	a	a	a	0.28	a
CJ13-32-45AS	11	a	a	a	a	a	a	a	a	a	a	a	0.44	a
CJ13-32-162AS	control	2.4	a	3.6	a	a	a	a	a	a	a	a	0.34	a
10KCl-32-81AS	13	6.0	a	a	a	a	a	a	a	a	a	a	0.19	a
10KCl-32-82AS	14	4.8	a	a	a	a	a	a	a	a	a	a	0.34	a
10KCl-32-83AS	15	5.0	a	a	a	a	a	a	a	a	a	a	0.41	a
10KCl-32-84AS	16	29.6	13.7	a	a	0.030	a	0.038	0.153	0.93	a	a	0.60	a
10KCl-32-85AS	17	32.7	6.8	a	a	a	a	a	0.045	0.92	a	a	0.59	a
10KCl-32-163AS	control	a	a	a	a	a	a	a	a	a	a	a	0.37	a
AJ13-32-121AS	19	119.4	87.2	62.1	a	0.027	0.049	0.296	1.134	1.40	16.72	2.39	8.60	a
AJ13-32-122AS	20	77.6	84.9	47.3	4.7	0.243	0.070	0.657	2.559	1.07	13.46	1.88	5.54	a
AJ13-32-123AS	21	117.6	51.8	82.3	a	0.024	a	0.236	0.929	a	19.41	2.73	4.82	a
AJ13-32-124AS	22	154.7	124.4	118.8	a	0.092	0.047	0.306	1.300	1.13	29.59	4.16	9.69	a
AJ13-32-125AS	23	118.9	80.0	59.5	1.2	0.077	0.023	0.338	1.353	0.71	15.48	2.20	6.26	a
AJ13-32-164AS	control	a	a	a	a	a	a	a	a	a	a	a	0.29	a

[a]Element below detection limits of measuring instrument.

Table F-30. Residue (ng/mm^2) from SS15ZR26 Specimens Immersed in 363 K (90ºC) Solution for 224 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits not available														
AJ13-32-121R	19	71396	13324	13324	60.7	39.3	3.0	37.8	142	1092	325	65.5	161	137
AJ13-32-122R	20	83220	20418	20418	98.6	38.9	3.2	28.5	112	1475	330	71.9	105	130
AJ13-32-123R	21	73215	11414	11414	50.5	19.3	1.0	15.8	64.8	499	318	71.1	101	81.8
AJ13-32-124R	22	68213	16553	16553	23.6	30.0	2.2	19.4	69.3	1013	300	70.9	113	106
AJ13-32-125R	23	68668	16644	16644	134.4	38.1	2.1	28.4	98.5	1204	284	66.1	129	108

Table F-31. Leachate Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363K (90°C) Solution for 308 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.0	2.0	2.0	0.020	0.020	0.020	0.031	0.031	0.51	0.31	0.020	0.41	1.1
SJ13-44-6	1	a	a	a	0.085	a	a	a	a	a	a	a	a	a
SJ13-44-7	2	a	a	a	0.108	a	a	a	a	a	a	a	a	a
SJ13-44-8	3	a	a	a	0.106	a	a	a	a	a	a	a	a	a
SJ13-44-9	4	a	a	a	0.111	a	a	a	a	a	a	a	a	a
SJ13-44-10	5	a	a	a	0.160	a	a	a	a	a	a	a	a	a
SJ13-44-165	control	a	a	a	0.322	a	a	a	a	1.04	a	a	a	a
CJ13-44-46	7	a	a	a	1.48	a	0.053	a	a	0.61	a	0.021	a	a
CJ13-44-47	8	a	a	a	1.47	a	0.049	a	a	0.98	a	0.021	a	a
CJ13-44-48	9	a	a	a	1.32	a	0.051	a	a	1.02	a	a	a	a
CJ13-44-49	10	a	a	a	1.61	a	0.037	0.033	0.041	1.44	a	a	a	a
CJ13-44-50	11	a	a	a	1.83	a	0.038	0.045	0.061	1.17	a	0.022	0.48	a
CJ13-44-166	control	a	a	a	1.22	a	0.044	0.035	0.049	1.30	a	0.025	0.45	a
10KCl-44-86	13	a	a	6.0	0.028	a	0.058	a	a	1.09	2.03	0.268	0.58	1.5
10KCl-44-87	14	a	a	a	a	a	0.052	a	a	1.54	0.82	0.112	0.45	1.3
10KCl-44-88	15	a	21.9	a	a	a	0.068	a	a	9.91	a	0.035	0.39	1.3
10KCl-44-89	16	a	9.7	4.1	0.035	a	0.128	a	a	18.6	0.89	0.157	0.46	1.3
10KCl-44-90	17	2.3	4.2	2.3	0.025	a	0.065	a	a	13.9	1.00	0.169	0.61	1.3
10KCl-44-167	control	a	a	a	a	a	0.037	a	a	a	a	a	0.53	1.4
AJ13-44-126	19	9364	5766	7555	1.06	2.01	0.164	4.34	19.6	16.9	2078	289	358	1.5
AJ13-44-127	20	3730	3811	7035	0.955	2.89	0.361	6.83	30.2	21.5	2006	50.2	57.8	1.1
AJ13-44-128	21	4546	2598	8230	0.207	1.61	0.177	6.18	33.0	7.01	2184	51.1	32.6	9.5
AJ13-44-129	22	1730	1667	6072	0.186	0.953	0.066	2.85	13.3	5.41	1784	50.8	55.5	18.2
AJ13-44-130	23	2283	3910	6597	1.36	0.739	0.045	1.84	7.43	6.57	1970	60.3	72.5	11
AJ13-44-168	control	a	a	5.0	0.209	a	a	a	a	a	a	0.027	0.50	a

[a]Element below detection limits of measuring instrument.

Table F-32. Acid Strip Data (ng/mm^2) from SS15ZR26 Specimens Immersed in 363 K (90°C) Solution for 308 days.

		Major Elements				Noble Metal Fission Products					Minor Elements			
Expt. ID	Ingot ID	Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.0	2.0	2.0	0.02	0.04	0.03	0.03	0.04	0.06	0.05	0.03	0.06	0.06
SJ13-44-6AS	1	a	a	a	0.38	a	a	a	a	a	a	a	0.29	a
SJ13-44-7AS	2	a	a	a	0.23	a	a	a	a	a	a	a	0.30	a
SJ13-44-8AS	3	a	a	3.2	0.30	a	a	a	a	a	a	a	0.29	a
SJ13-44-9AS	4	a	a	a	0.37	a	a	a	a	a	a	a	0.33	a
SJ13-44-10AS	5	3.1	a	3.8	0.44	a	a	a	a	0.11	a	a	17.46	a
SJ13-44-165AS	control	a	a	4.4	0.42	a	a	a	a	a	0.06	a	0.66	a
CJ13-44-46AS	7	a	a	4.8	0.09	a	a	a	a	a	a	a	0.29	a
CJ13-44-47AS	8	5.9	a	a	0.05	a	a	a	a	0.10	a	a	0.63	a
CJ13-44-48AS	9	a	a	3.4	0.05	a	a	a	a	0.19	a	a	0.23	a
CJ13-44-49AS	10	a	a	a	0.05	a	a	a	a	0.08	a	a	0.20	0.09
CJ13-44-50AS	11	a	a	a	0.06	a	a	a	a	a	a	a	0.18	a
CJ13-44-166AS	control	3.2	a	a	0.26	a	a	a	a	0.08	a	a	0.67	0.13
10KCl-44-86AS	13	2.8	a	a	0.13	a	a	a	a	0.10	0.06	a	0.27	1.00
10KCl-44-87AS	14	3.6	a	a	0.06	a	a	a	a	0.10	a	a	0.24	0.85
10KCl-44-88AS	15	a	a	a	0.09	a	a	a	a	0.12	a	a	0.20	0.32
10KCl-44-89AS	16	11.6	4.6	a	0.06	a	a	a	a	0.29	0.07	a	0.34	0.16
10KCl-44-90AS	17	9.4	4.4	a	0.05	a	a	a	a	0.22	a	a	0.32	a
10KCl-44-167AS	control	a	a	a	a	a	a	a	a	a	a	a	0.19	a
AJ13-44-126AS	19	428.0	195.8	108.3	2.45	0.40	0.25	1.06	4.63	5.18	25.73	3.62	5.12	0.43
AJ13-44-127AS	20	549.3	192.0	60.4	9.21	0.58	1.14	0.98	3.55	5.89	14.74	2.09	2.88	0.43
AJ13-44-128AS	21	390.1	191.3	216.2	0.20	0.29	0.36	1.22	5.79	2.24	45.22	6.47	7.62	0.18
AJ13-44-129AS	22	215.6	101.7	100.5	2.43	0.24	0.29	0.84	3.73	2.48	23.86	3.44	4.27	0.22
AJ13-44-130AS	23	907.7	293.2	91.0	2.23	0.75	0.15	1.02	4.47	17.12	22.48	3.16	5.11	1.05
AJ13-44-168AS	control	a	a	a	0.08	a	a	a	a	0.09	a	a	0.16	0.09

[a]Element below detection limits of measuring instrument.

Table F-33. Residue (ng/mm^2) from SS15ZR26 Specimens Immersed in 363 K (90°C) Solution for 308 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits not available														
AJ13-44-126R	19	85493	23101	2383	2.32	4.58	0.22	3.67	15.67	153.9	58.07	11.01	21.21	12.26
AJ13-44-127R	20	90041	23283	2192	4.15	4.81	0.40	4.10	15.88	164.6	54.05	10.57	15.06	13.11
AJ13-44-128R	21	86403	15962	2715	0.94	3.30	0.18	2.94	13.07	85.99	59.88	11.56	18.18	9.60
AJ13-44-129R	22	82765	18145	2055	1.61	3.48	0.21	2.83	12.16	100.7	44.65	8.31	13.18	9.70
AJ13-44-130R	23	89131	24147	2233	8.94	5.12	0.24	4.61	18.38	184.4	54.90	10.30	19.69	13.92

G. Detection Limits

Table G-1. Iron Detection Limits in Leachate Data (ng/mm^2).

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	1.97	1.96	1.97	2.01	2.01	2.03	2.03	1.97	2.00	2.06	2.06
2	1.97	1.97	1.94	2.03	2.02	2.03	2.03	1.94	2.07	2.03	2.07
3	1.97	1.97	1.96	2.00	2.02	2.04	2.04	1.95	2.00	2.03	2.06
4	1.97	1.96	1.97	2.01	2.01	2.02	2.04	1.96	1.99	2.03	2.05
5	1.97	1.97	1.97	2.02	2.01	2.01	2.03	1.96	2.00	2.04	2.06
SJ13 control	1.98	1.97	1.98	2.03	2.02	2.02	2.04	1.96	2.00	2.04	2.05
7	2.00	2.04	1.98	2.03	2.04	2.03	2.10	1.98	2.02	2.09	2.10
8	2.00	1.99	2.00	2.05	2.03	2.05	2.09	1.98	2.03	2.07	2.09
9	2.00	2.00	2.00	2.05	2.03	2.05	2.09	1.97	2.02	2.07	2.10
10	1.99	1.99	1.99	2.03	2.04	2.05	2.10	1.97	2.03	2.07	2.10
11	2.09	2.00	2.00	2.05	2.05	2.03	2.08	1.97	2.03	2.07	2.10
CJ13 control	1.99	1.98	2.00	2.04	2.05	2.04	2.09	1.97	2.03	2.09	2.12
13	1.98	2.00	1.79	2.03	2.04	2.05	2.06	1.99	2.02	1.99	2.07
14	2.00	1.98	2.00	2.05	2.03	2.02	2.05	1.98	2.01	2.00	2.09
15	2.00	1.99	2.00	2.04	2.04	2.10	2.06	1.98	2.02	2.00	2.10
16	1.99	1.98	1.99	2.03	2.05	2.04	2.07	1.98	2.01	2.01	2.09
17	1.99	2.00	2.00	2.02	2.05	2.05	2.06	1.98	2.02	2.00	2.10
10KCl control	1.99	1.98	2.00	2.03	2.02	2.03	2.07	1.98	2.01	2.00	2.09
19	1.96	1.97	1.98	2.02	2.01	2.01	2.11	1.94	1.83	2.04	2.06
20	1.97	1.96	1.97	2.03	2.02	2.03	2.13	1.95	1.83	2.04	2.08
21	1.98	1.95	1.96	2.03	2.00	2.03	2.12	1.95	1.88	2.04	2.09
22	1.97	1.96	1.97	2.03	2.00	1.98	2.12	1.95	1.90	2.05	2.09
23	1.96	1.97	1.97	2.02	2.01	2.00	2.12	1.94	1.74	2.03	2.06
AJ13 control	1.97	1.94	1.96	2.02	2.02	1.97	2.12	1.95	1.98	2.07	2.08
Average	1.99	1.98	1.97	2.03	2.03	2.03	2.08	1.96	1.98	2.04	2.08
Standard Deviation	0.03	0.02	0.04	0.01	0.02	0.03	0.03	0.02	0.08	0.03	0.02

Table G-2. Iron Detection Limits in Acid Strip Data (ng/mm^2).

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	2.29	2.25	2.35	2.27	2.33	2.10	2.28	2.28	2.27	2.23	2.29
2	2.30	2.31	2.35	2.22	2.23	2.30	2.28	2.34	2.30	2.53	2.38
3	2.28	2.08	2.32	2.30	2.25	2.14	2.24	2.23	2.52	2.44	2.44
4	2.01	2.21	2.33	2.26	2.07	2.24	2.21	2.30	2.29	2.30	2.44
5	2.22	2.27	2.31	2.28	2.21	2.24	2.08	2.24	2.27	2.53	2.31
SJ13 control	2.28	2.23	2.28	2.14	2.21	2.28	2.27	2.24	2.30	2.44	2.51
7	2.38	2.28	2.33	2.33	2.24	2.17	2.18	2.23	2.28	2.49	2.44
8	2.34	2.16	2.32	2.22	2.18	2.24	2.26	2.27	2.52	2.45	2.48
9	2.34	2.28	2.33	2.25	2.20	2.20	2.19	2.24	2.36	2.49	2.29
10	2.24	2.20	2.32	2.24	2.15	2.17	2.27	2.25	2.27	2.49	2.26
11	2.23	2.24	2.33	2.30	2.13	2.24	2.20	2.31	2.22	2.46	2.36
CJ13 control	2.14	2.24	2.40	2.23	2.25	2.21	2.30	2.28	2.31	2.38	2.46
13	2.30	2.22	2.25	2.24	2.14	2.24	2.19	2.27	2.34	2.40	2.42
14	2.23	2.29	2.31	2.29	2.32	2.29	2.25	2.27	2.27	2.38	2.52
15	2.24	2.28	2.34	2.30	2.15	2.30	2.18	2.27	2.33	2.52	2.38
16	2.21	2.28	2.33	2.23	2.11	2.15	2.18	2.27	2.34	2.28	2.40
17	2.20	2.29	2.31	2.24	2.17	2.22	2.20	2.25	2.26	2.26	2.20
10KCl control	2.24	2.27	2.36	2.19	2.24	2.32	2.19	2.32	2.36	2.34	2.46
19	2.35	2.29	2.22	2.19	2.28	2.24	2.23	2.23	2.33	2.39	2.46
20	2.31	2.28	2.35	2.17	2.32	2.17	2.14	2.22	2.24	2.43	2.29
21	2.34	2.32	2.34	2.30	2.22	2.20	2.12	2.22	2.30	2.35	2.48
22	2.29	2.27	2.36	2.30	2.17	2.24	2.23	2.21	2.30	2.24	2.42
23	2.34	2.28	2.31	2.11	2.12	2.20	2.20	2.19	2.26	2.05	2.28
AJ13 control	2.34	2.26	2.31	2.20	2.22	2.27	2.26	2.23	2.30	2.46	2.54
Average	2.27	2.25	2.32	2.24	2.20	2.22	2.21	2.26	2.31	2.39	2.40
Standard Deviation	0.08	0.05	0.04	0.05	0.07	0.05	0.05	0.04	0.07	0.12	0.09

Table G-3. Chromium Detection Limits for Leachate Data (ng/mm^2).

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	1.97	1.96	1.97	2.01	2.01	2.03	2.03	1.97	2.00	2.06	2.06
2	1.97	1.97	1.94	2.03	2.02	2.03	2.03	1.94	2.07	2.03	2.07
3	1.97	1.97	1.96	2.00	2.02	2.04	2.04	1.95	2.00	2.03	2.06
4	1.97	1.96	1.97	2.01	2.01	2.02	2.04	1.96	1.99	2.03	2.05
5	1.97	1.97	1.97	2.02	2.01	2.01	2.03	1.96	2.00	2.04	2.06
SJ13 control	1.98	1.97	1.98	2.03	2.02	2.02	2.04	1.96	2.00	2.04	2.05
7	2.00	2.04	1.98	2.03	2.04	2.03	2.10	1.98	2.02	2.09	2.10
8	2.00	1.99	2.00	2.05	2.03	2.05	2.09	1.98	2.03	2.07	2.09
9	2.00	2.00	2.00	2.05	2.03	2.05	2.09	1.97	2.02	2.07	2.10
10	1.99	1.99	1.99	2.03	2.04	2.05	2.10	1.97	2.03	2.07	2.10
11	2.09	2.00	2.00	2.05	2.05	2.03	2.08	1.97	2.03	2.07	2.10
CJ13 control	1.99	1.98	2.00	2.04	2.05	2.04	2.09	1.97	2.03	2.09	2.12
13	1.98	2.00	1.79	2.03	2.04	2.05	2.06	1.99	2.02	1.99	2.07
14	2.00	1.98	2.00	2.05	2.03	2.02	2.05	1.98	2.01	2.00	2.09
15	2.00	1.99	2.00	2.04	2.04	2.10	2.06	1.98	2.02	2.00	2.10
16	1.99	1.98	1.99	2.03	2.05	2.04	2.07	1.98	2.01	2.01	2.09
17	1.99	2.00	2.00	2.02	2.05	2.05	2.06	1.98	2.02	2.00	2.10
10KCl control	1.99	1.98	2.00	2.03	2.02	2.03	2.07	1.98	2.01	2.00	2.09
19	1.96	1.97	1.98	2.02	2.01	2.01	2.11	1.94	1.83	2.04	2.06
20	1.97	1.96	1.97	2.03	2.02	2.03	2.13	1.95	1.83	2.04	2.08
21	1.98	1.95	1.96	2.03	2.00	2.03	2.12	1.95	1.88	2.04	2.09
22	1.97	1.96	1.97	2.03	2.00	1.98	2.12	1.95	1.90	2.05	2.09
23	1.96	1.97	1.97	2.02	2.01	2.00	2.12	1.94	1.74	2.03	2.06
AJ13 control	1.97	1.94	1.96	2.02	2.02	1.97	2.12	1.95	1.98	2.07	2.08
Average	1.99	1.98	1.97	2.03	2.03	2.03	2.08	1.96	1.98	2.04	2.08
Standard Deviation	0.03	0.02	0.04	0.01	0.02	0.03	0.03	0.02	0.08	0.03	0.02

Table G-4. Chromium Detection Limits for Acid Strip Data (ng/mm^2).

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	2.29	2.25	2.35	2.27	2.33	2.10	2.28	2.28	2.27	2.23	2.29
2	2.30	2.31	2.35	2.22	2.23	2.30	2.28	2.34	2.30	2.53	2.38
3	2.28	2.08	2.32	2.30	2.25	2.14	2.24	2.23	2.52	2.44	2.44
4	2.01	2.21	2.33	2.26	2.07	2.24	2.21	2.30	2.29	2.30	2.44
5	2.22	2.27	2.31	2.28	2.21	2.24	2.08	2.24	2.27	2.53	2.31
SJ13 control	2.28	2.23	2.28	2.14	2.21	2.28	2.27	2.24	2.30	2.44	2.51
7	2.38	2.28	2.33	2.33	2.24	2.17	2.18	2.23	2.28	2.49	2.44
8	2.34	2.16	2.32	2.22	2.18	2.24	2.26	2.27	2.52	2.45	2.48
9	2.34	2.28	2.33	2.25	2.20	2.20	2.19	2.24	2.36	2.49	2.29
10	2.24	2.20	2.32	2.24	2.15	2.17	2.27	2.25	2.27	2.49	2.26
11	2.23	2.24	2.33	2.30	2.13	2.24	2.20	2.31	2.22	2.46	2.36
CJ13 control	2.14	2.24	2.40	2.23	2.25	2.21	2.30	2.28	2.31	2.38	2.46
13	2.30	2.22	2.25	2.24	2.14	2.24	2.19	2.27	2.34	2.40	2.42
14	2.23	2.29	2.31	2.29	2.32	2.29	2.25	2.27	2.27	2.38	2.52
15	2.24	2.28	2.34	2.30	2.15	2.30	2.18	2.27	2.33	2.52	2.38
16	2.21	2.28	2.33	2.23	2.11	2.15	2.18	2.27	2.34	2.28	2.40
17	2.20	2.29	2.31	2.24	2.17	2.22	2.20	2.25	2.26	2.26	2.20
10KCl control	2.24	2.27	2.36	2.19	2.24	2.32	2.19	2.32	2.36	2.34	2.46
19	2.35	2.29	2.22	2.19	2.28	2.24	2.23	2.23	2.33	2.39	2.46
20	2.31	2.28	2.35	2.17	2.32	2.17	2.14	2.22	2.24	2.43	2.29
21	2.34	2.32	2.34	2.30	2.22	2.20	2.12	2.22	2.30	2.35	2.48
22	2.29	2.27	2.36	2.30	2.17	2.24	2.23	2.21	2.30	2.24	2.42
23	2.34	2.28	2.31	2.11	2.12	2.20	2.20	2.19	2.26	2.05	2.28
AJ13 control	2.34	2.26	2.31	2.20	2.22	2.27	2.26	2.23	2.30	2.46	2.54
Average	2.27	2.25	2.32	2.24	2.20	2.22	2.21	2.26	2.31	2.39	2.40
Standard Deviation	0.08	0.05	0.04	0.05	0.07	0.05	0.05	0.04	0.07	0.12	0.09

Table G-5. Nickel Detection Limits for Leachate Data (ng/mm²).

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	1.97	1.96	1.97	2.01	2.01	2.03	2.03	1.97	2.00	2.06	2.06
2	1.97	1.97	1.94	2.03	2.02	2.03	2.03	1.94	2.07	2.03	2.07
3	1.97	1.97	1.96	2.00	2.02	2.04	2.04	1.95	2.00	2.03	2.06
4	1.97	1.96	1.97	2.01	2.01	2.02	2.04	1.96	1.99	2.03	2.05
5	1.97	1.97	1.97	2.02	2.01	2.01	2.03	1.96	2.00	2.04	2.06
SJ13 control	1.98	1.97	1.98	2.03	2.02	2.02	2.04	1.96	2.00	2.04	2.05
7	2.00	2.04	1.98	2.03	2.04	2.03	2.10	1.98	2.02	2.09	2.10
8	2.00	1.99	2.00	2.05	2.03	2.05	2.09	1.98	2.03	2.07	2.09
9	2.00	2.00	2.00	2.05	2.03	2.05	2.09	1.97	2.02	2.07	2.10
10	1.99	1.99	1.99	2.03	2.04	2.05	2.10	1.97	2.03	2.07	2.10
11	2.09	2.00	2.00	2.05	2.05	2.03	2.08	1.97	2.03	2.07	2.10
CJ13 control	1.99	1.98	2.00	2.04	2.05	2.04	2.09	1.97	2.03	2.09	2.12
13	1.98	2.00	1.79	2.03	2.04	2.05	2.06	1.99	2.02	1.99	2.07
14	2.00	1.98	2.00	2.05	2.03	2.02	2.05	1.98	2.01	2.00	2.09
15	2.00	1.99	2.00	2.04	2.04	2.10	2.06	1.98	2.02	2.00	2.10
16	1.99	1.98	1.99	2.03	2.05	2.04	2.07	1.98	2.01	2.01	2.09
17	1.99	2.00	2.00	2.02	2.05	2.05	2.06	1.98	2.02	2.00	2.10
10KCl control	1.99	1.98	2.00	2.03	2.02	2.03	2.07	1.98	2.01	2.00	2.09
19	1.96	1.97	1.98	2.02	2.01	2.01	2.11	1.94	1.83	2.04	2.06
20	1.97	1.96	1.97	2.03	2.02	2.03	2.13	1.95	1.83	2.04	2.08
21	1.98	1.95	1.96	2.03	2.00	2.03	2.12	1.95	1.88	2.04	2.09
22	1.97	1.96	1.97	2.03	2.00	1.98	2.12	1.95	1.90	2.05	2.09
23	1.96	1.97	1.97	2.02	2.01	2.00	2.12	1.94	1.74	2.03	2.06
AJ13 control	1.97	1.94	1.96	2.02	2.02	1.97	2.12	1.95	1.98	2.07	2.08
Average	1.99	1.98	1.97	2.03	2.03	2.03	2.08	1.96	1.98	2.04	2.08
Standard Deviation	0.03	0.02	0.04	0.01	0.02	0.03	0.03	0.02	0.08	0.03	0.02

Table G-6. Nickel Detection Limits for Acid Strip Data (ng/mm^2).

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	2.29	2.25	2.35	2.27	2.33	2.10	2.28	2.28	2.27	2.23	2.29
2	2.30	2.31	2.35	2.22	2.23	2.30	2.28	2.34	2.30	2.53	2.38
3	2.28	2.08	2.32	2.30	2.25	2.14	2.24	2.23	2.52	2.44	2.44
4	2.01	2.21	2.33	2.26	2.07	2.24	2.21	2.30	2.29	2.30	2.44
5	2.22	2.27	2.31	2.28	2.21	2.24	2.08	2.24	2.27	2.53	2.31
SJ13 control	2.28	2.23	2.28	2.14	2.21	2.28	2.27	2.24	2.30	2.44	2.51
7	2.38	2.28	2.33	2.33	2.24	2.17	2.18	2.23	2.28	2.49	2.44
8	2.34	2.16	2.32	2.22	2.18	2.24	2.26	2.27	2.52	2.45	2.48
9	2.34	2.28	2.33	2.25	2.20	2.20	2.19	2.24	2.36	2.49	2.29
10	2.24	2.20	2.32	2.24	2.15	2.17	2.27	2.25	2.27	2.49	2.26
11	2.23	2.24	2.33	2.30	2.13	2.24	2.20	2.31	2.22	2.46	2.36
CJ13 control	2.14	2.24	2.40	2.23	2.25	2.21	2.30	2.28	2.31	2.38	2.46
13	2.30	2.22	2.25	2.24	2.14	2.24	2.19	2.27	2.34	2.40	2.42
14	2.23	2.29	2.31	2.29	2.32	2.29	2.25	2.27	2.27	2.38	2.52
15	2.24	2.28	2.34	2.30	2.15	2.30	2.18	2.27	2.33	2.52	2.38
16	2.21	2.28	2.33	2.23	2.11	2.15	2.18	2.27	2.34	2.28	2.40
17	2.20	2.29	2.31	2.24	2.17	2.22	2.20	2.25	2.26	2.26	2.20
10KCl control	2.24	2.27	2.36	2.19	2.24	2.32	2.19	2.32	2.36	2.34	2.46
19	2.35	2.29	2.22	2.19	2.28	2.24	2.23	2.23	2.33	2.39	2.46
20	2.31	2.28	2.35	2.17	2.32	2.17	2.14	2.22	2.24	2.43	2.29
21	2.34	2.32	2.34	2.30	2.22	2.20	2.12	2.22	2.30	2.35	2.48
22	2.29	2.27	2.36	2.30	2.17	2.24	2.23	2.21	2.30	2.24	2.42
23	2.34	2.28	2.31	2.11	2.12	2.20	2.20	2.19	2.26	2.05	2.28
AJ13 control	2.34	2.26	2.31	2.20	2.22	2.27	2.26	2.23	2.30	2.46	2.54
Average	2.27	2.25	2.32	2.24	2.20	2.22	2.21	2.26	2.31	2.39	2.40
Standard Deviation	0.08	0.05	0.04	0.05	0.07	0.05	0.05	0.04	0.07	0.12	0.09

Table G-7. Zirconium Detection Limits for Leachate Data (ng/mm^2).

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.02	0.02	1.24	0.02
2	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.02	0.02	1.22	0.02
3	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.02	0.02	1.22	0.02
4	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.02	0.02	1.22	0.02
5	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.02	0.02	1.22	0.02
SJ13 control	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.02	0.02	1.22	0.02
7	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.02	0.02	1.25	0.02
8	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.02	0.02	1.24	0.02
9	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.02	0.02	1.24	0.02
10	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.02	0.02	1.24	0.02
11	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.02	0.02	1.24	0.02
CJ13 control	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.02	0.02	1.26	0.02
13	0.01	0.07	0.05	0.02	0.09	0.01	0.01	0.01	0.02	1.20	0.02
14	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.01	0.02	1.20	0.02
15	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.01	0.02	1.20	0.02
16	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.01	0.02	1.20	0.02
17	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.01	0.02	1.20	0.02
10KCl control	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.01	0.02	1.20	0.02
19	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.01	0.01	1.22	0.02
20	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.01	0.01	1.22	0.02
21	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.01	0.01	1.22	0.02
22	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.01	0.01	1.23	0.02
23	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.01	0.01	1.22	0.02
AJ13 control	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.01	0.02	1.24	0.02
Average	0.01	0.07	0.06	0.02	0.09	0.01	0.01	0.02	0.02	1.22	0.02
Standard Deviation	0.0002	0.001	0.001	0.0001	0.001	0.0001	0.002	0.003	0.001	0.02	0.0002

Table G-8. Zirconium Detection Limits for Acid Strip Data (ng/mm^2).

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.01	0.08	0.07	0.02	0.11	0.01	0.01	0.02	0.02	1.34	0.02
2	0.01	0.08	0.07	0.02	0.10	0.01	0.01	0.02	0.02	1.52	0.02
3	0.01	0.07	0.07	0.02	0.10	0.01	0.01	0.02	0.02	1.46	0.02
4	0.01	0.08	0.07	0.02	0.09	0.01	0.01	0.02	0.02	1.38	0.02
5	0.01	0.08	0.07	0.02	0.10	0.01	0.01	0.02	0.02	1.52	0.02
SJ13 control	0.01	0.08	0.07	0.02	0.10	0.01	0.01	0.02	0.02	1.47	0.03
7	0.01	0.08	0.07	0.02	0.10	0.01	0.01	0.02	0.02	1.50	0.02
8	0.01	0.08	0.07	0.02	0.10	0.01	0.01	0.02	0.02	1.47	0.02
9	0.01	0.08	0.07	0.02	0.10	0.01	0.01	0.02	0.02	1.49	0.02
10	0.01	0.08	0.07	0.02	0.10	0.01	0.01	0.02	0.02	1.49	0.02
11	0.01	0.08	0.07	0.02	0.10	0.01	0.01	0.02	0.02	1.48	0.02
CJ13 control	0.01	0.08	0.07	0.02	0.10	0.01	0.01	0.02	0.02	1.43	0.02
13	0.01	0.08	0.07	0.02	0.10	0.01	0.02	0.02	0.02	1.44	0.02
14	0.01	0.08	0.07	0.02	0.11	0.01	0.02	0.02	0.02	1.43	0.03
15	0.01	0.08	0.07	0.02	0.10	0.01	0.02	0.02	0.02	1.51	0.02
16	0.01	0.08	0.07	0.02	0.10	0.01	0.02	0.02	0.02	1.37	0.02
17	0.01	0.08	0.07	0.02	0.10	0.01	0.02	0.02	0.02	1.35	0.02
10KCl control	0.01	0.08	0.07	0.02	0.10	0.01	0.02	1.85	0.02	1.40	0.02
19	0.01	0.08	0.06	0.02	0.10	0.01	0.02	1.78	0.02	1.43	0.02
20	0.01	0.08	0.07	0.02	0.11	0.01	0.02	1.77	0.02	1.46	0.02
21	0.01	0.08	0.07	0.02	0.10	0.01	0.01	1.77	0.02	1.41	0.02
22	0.01	0.08	0.07	0.02	0.10	0.01	0.02	1.77	0.02	1.34	0.02
23	0.01	0.08	0.07	0.02	0.10	0.01	0.02	1.76	0.02	1.23	0.02
AJ13 control	0.01	0.08	0.07	0.02	0.10	0.01	0.02	1.79	0.02	1.47	0.03
Average	0.01	0.08	0.07	0.02	0.10	0.01	0.01	0.54	0.02	1.43	0.02
Standard Deviation	0.0005	0.002	0.001	0.0004	0.003	0.0002	0.002	0.82	0.001	0.07	0.001

Table G-9. Niobium Detection Limits for Leachate Data (ng/mm^2).

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02
2	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02
3	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02
4	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02
5	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02
SJ13 control	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02
7	0.02	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02
8	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02
9	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02
10	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02
11	0.02	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02
CJ13 control	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02
13	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02
14	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02
15	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02
16	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02
17	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02
10KCl control	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02
19	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02
20	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02
21	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02
22	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02
23	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02
AJ13 control	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02
Average	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.02
Standard Deviation	0.0002	0.0001	0.001	0.0001	0.0001	0.0001	0.0001	0.003	0.01	0.0003	0.0002

Table G-10. Niobium Detection Limits for Acid Strip Data (ng/mm^2).

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.02	0.01	0.05	0.03	0.01	0.01	0.01	0.02	0.03	0.02	0.05
2	0.02	0.01	0.05	0.02	0.01	0.01	0.01	0.02	0.03	0.02	0.05
3	0.02	0.01	0.05	0.03	0.01	0.01	0.01	0.02	0.03	0.02	0.05
4	0.02	0.01	0.05	0.02	0.01	0.01	0.01	0.02	0.03	0.02	0.05
5	0.02	0.01	0.05	0.03	0.01	0.01	0.01	0.02	0.03	0.02	0.05
SJ13 control	0.02	0.01	0.05	0.02	0.01	0.01	0.01	0.02	0.03	0.02	0.05
7	0.02	0.01	0.05	0.03	0.01	0.01	0.01	0.02	0.03	0.02	0.05
8	0.02	0.01	0.05	0.02	0.01	0.01	0.01	0.02	0.03	0.02	0.05
9	0.02	0.01	0.05	0.02	0.01	0.01	0.01	0.02	0.03	0.02	0.05
10	0.02	0.01	0.05	0.02	0.01	0.01	0.01	0.02	0.03	0.02	0.05
11	0.02	0.01	0.05	0.03	0.01	0.01	0.01	0.02	0.03	0.02	0.05
CJ13 control	0.02	0.01	0.05	0.02	0.01	0.01	0.01	0.02	0.03	0.02	0.05
13	0.02	0.01	0.05	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.05
14	0.02	0.01	0.05	0.03	0.01	0.01	0.01	0.01	0.03	0.02	0.05
15	0.02	0.01	0.05	0.03	0.01	0.01	0.01	0.01	0.03	0.02	0.05
16	0.02	0.01	0.05	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.05
17	0.02	0.01	0.05	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.04
10KCl control	0.02	0.01	0.05	0.02	0.01	0.01	0.01	0.08	0.03	0.02	0.05
19	0.02	0.01	0.05	0.02	0.01	0.01	0.01	0.07	0.03	0.02	0.05
20	0.02	0.01	0.05	0.02	0.01	0.01	0.01	0.07	0.03	0.02	0.05
21	0.02	0.01	0.05	0.03	0.01	0.01	0.01	0.07	0.03	0.02	0.05
22	0.02	0.01	0.05	0.03	0.01	0.01	0.01	0.07	0.03	0.02	0.05
23	0.02	0.01	0.05	0.02	0.01	0.01	0.01	0.07	0.03	0.02	0.05
AJ13 control	0.02	0.01	0.05	0.02	0.01	0.01	0.01	0.07	0.03	0.02	0.05
Average	0.02	0.01	0.05	0.02	0.01	0.01	0.01	0.03	0.03	0.02	0.05
Standard Deviation	0.001	0.0002	0.001	0.001	0.0003	0.0003	0.0002	0.03	0.001	0.001	0.002

Table G-11. Paladium Detection Limits for Leachate Data (ng/mm^2)

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.005	0.003	0.04	0.03	0.01	0.01	0.004	0.01	0.02	0.02	0.02
2	0.005	0.003	0.04	0.03	0.01	0.01	0.004	0.01	0.02	0.02	0.02
3	0.005	0.003	0.04	0.03	0.01	0.01	0.004	0.01	0.02	0.02	0.02
4	0.005	0.003	0.04	0.03	0.01	0.01	0.004	0.01	0.02	0.02	0.02
5	0.005	0.003	0.04	0.03	0.01	0.01	0.004	0.01	0.02	0.02	0.02
SJ13 control	0.005	0.003	0.04	0.03	0.01	0.01	0.004	0.01	0.02	0.02	0.02
7	0.01	0.003	0.04	0.03	0.01	0.01	0.004	0.01	0.02	0.02	0.02
8	0.005	0.003	0.04	0.03	0.01	0.01	0.004	0.01	0.02	0.02	0.02
9	0.005	0.003	0.04	0.03	0.01	0.01	0.004	0.01	0.02	0.02	0.02
10	0.005	0.003	0.04	0.03	0.01	0.01	0.004	0.01	0.02	0.02	0.02
11	0.005	0.003	0.04	0.03	0.01	0.01	0.004	0.01	0.02	0.02	0.02
CJ13 control	0.005	0.003	0.04	0.03	0.01	0.01	0.004	0.01	0.02	0.02	0.02
13	0.005	0.003	0.03	0.03	0.01	0.01	0.01	0.01	0.02	0.02	0.02
14	0.005	0.003	0.04	0.03	0.01	0.01	0.01	0.01	0.02	0.02	0.02
15	0.005	0.003	0.04	0.03	0.01	0.01	0.01	0.01	0.02	0.02	0.02
16	0.005	0.003	0.04	0.03	0.01	0.01	0.01	0.01	0.02	0.02	0.02
17	0.005	0.003	0.04	0.03	0.01	0.01	0.01	0.01	0.02	0.02	0.02
10KCl control	0.005	0.003	0.04	0.03	0.01	0.01	0.01	0.01	0.02	0.02	0.02
19	0.005	0.003	0.04	0.03	0.01	0.01	0.01	0.01	0.01	0.02	0.02
20	0.005	0.003	0.04	0.03	0.01	0.01	0.01	0.01	0.01	0.02	0.02
21	0.005	0.003	0.04	0.03	0.01	0.01	0.01	0.01	0.01	0.02	0.02
22	0.005	0.003	0.04	0.03	0.01	0.01	0.01	0.01	0.01	0.02	0.02
23	0.005	0.003	0.04	0.03	0.01	0.01	0.01	0.01	0.01	0.02	0.02
AJ13 control	0.005	0.003	0.04	0.03	0.01	0.01	0.01	0.01	0.02	0.02	0.02
Average	0.005	0.003	0.04	0.03	0.01	0.01	0.01	0.01	0.02	0.02	0.02
Standard Deviation	0.000	0.000	0.001	0.0002	0.0000	0.0001	0.002	0.002	0.01	0.0002	0.0002

Table G-12. Paladium Detection Limits for Acid Strip Data (ng/mm^2).

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.01	0.003	0.04	0.03	0.01	0.01	0.005	0.01	0.02	0.02	0.03
2	0.01	0.003	0.04	0.03	0.01	0.01	0.005	0.01	0.02	0.02	0.04
3	0.01	0.003	0.04	0.03	0.01	0.01	0.004	0.01	0.03	0.02	0.04
4	0.01	0.003	0.04	0.03	0.01	0.01	0.004	0.01	0.02	0.02	0.04
5	0.01	0.003	0.04	0.03	0.01	0.01	0.004	0.01	0.02	0.02	0.03
SJ13 control	0.01	0.003	0.04	0.03	0.01	0.01	0.005	0.01	0.02	0.02	0.04
7	0.01	0.003	0.04	0.03	0.01	0.01	0.004	0.01	0.02	0.02	0.04
8	0.01	0.003	0.04	0.03	0.01	0.01	0.005	0.01	0.03	0.02	0.04
9	0.01	0.003	0.04	0.03	0.01	0.01	0.004	0.01	0.02	0.02	0.03
10	0.01	0.003	0.04	0.03	0.01	0.01	0.005	0.01	0.02	0.02	0.03
11	0.01	0.003	0.04	0.03	0.01	0.01	0.004	0.01	0.02	0.02	0.04
CJ13 control	0.01	0.003	0.05	0.03	0.01	0.01	0.005	0.01	0.02	0.02	0.04
13	0.01	0.003	0.04	0.03	0.01	0.01	0.01	0.01	0.02	0.02	0.04
14	0.01	0.003	0.04	0.03	0.01	0.01	0.01	0.01	0.02	0.02	0.04
15	0.01	0.003	0.04	0.03	0.01	0.01	0.01	0.01	0.02	0.02	0.04
16	0.01	0.003	0.04	0.03	0.01	0.01	0.01	0.01	0.02	0.02	0.04
17	0.01	0.003	0.04	0.03	0.01	0.01	0.01	0.01	0.02	0.02	0.03
10KCl control	0.01	0.003	0.04	0.03	0.01	0.01	0.01	0.08	0.02	0.02	0.04
19	0.01	0.003	0.04	0.03	0.01	0.01	0.01	0.07	0.02	0.02	0.04
20	0.01	0.003	0.04	0.03	0.01	0.01	0.01	0.07	0.02	0.02	0.03
21	0.01	0.003	0.04	0.03	0.01	0.01	0.01	0.07	0.02	0.02	0.04
22	0.01	0.003	0.04	0.03	0.01	0.01	0.01	0.07	0.02	0.02	0.04
23	0.01	0.003	0.04	0.03	0.01	0.01	0.01	0.07	0.02	0.02	0.03
AJ13 control	0.01	0.003	0.04	0.03	0.01	0.01	0.01	0.07	0.02	0.02	0.04
Average	0.01	0.003	0.04	0.03	0.01	0.01	0.01	0.03	0.02	0.02	0.04
Standard Deviation	0.0002	0.0001	0.001	0.001	0.0002	0.0002	0.002	0.03	0.001	0.001	0.001

Table G-13. Ruthenium Detection Limits for Leachate Data (ng/mm^2).

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.01	0.07	0.21	0.20	0.19	0.24	0.24	0.12	0.03	0.03	0.03
2	0.01	0.07	0.20	0.20	0.19	0.24	0.24	0.12	0.03	0.03	0.03
3	0.01	0.07	0.21	0.20	0.19	0.24	0.24	0.12	0.03	0.03	0.03
4	0.01	0.07	0.21	0.20	0.19	0.24	0.24	0.12	0.03	0.03	0.03
5	0.01	0.07	0.21	0.20	0.19	0.24	0.24	0.12	0.03	0.03	0.03
SJ13 control	0.01	0.07	0.21	0.20	0.19	0.24	0.24	0.12	0.03	0.03	0.03
7	0.01	0.07	0.21	0.20	0.19	0.24	0.25	0.12	0.03	0.03	0.03
8	0.01	0.07	0.21	0.20	0.19	0.25	0.25	0.12	0.03	0.03	0.03
9	0.01	0.07	0.21	0.21	0.19	0.25	0.25	0.12	0.03	0.03	0.03
10	0.01	0.07	0.21	0.20	0.19	0.25	0.25	0.12	0.03	0.03	0.03
11	0.01	0.07	0.21	0.20	0.19	0.24	0.25	0.12	0.03	0.03	0.03
CJ13 control	0.01	0.07	0.21	0.20	0.19	0.24	0.25	0.12	0.03	0.03	0.03
13	0.01	0.07	0.19	0.20	0.19	0.25	0.19	0.18	0.03	0.03	0.03
14	0.01	0.07	0.21	0.20	0.19	0.24	0.18	0.18	0.03	0.03	0.03
15	0.01	0.07	0.21	0.20	0.19	0.25	0.19	0.18	0.03	0.03	0.03
16	0.01	0.07	0.21	0.20	0.19	0.25	0.19	0.18	0.03	0.03	0.03
17	0.01	0.07	0.21	0.20	0.19	0.25	0.19	0.18	0.03	0.03	0.03
10KCl control	0.01	0.07	0.21	0.20	0.19	0.24	0.19	0.18	0.03	0.03	0.03
19	0.01	0.07	0.21	0.20	0.19	0.24	0.19	0.17	0.12	0.03	0.03
20	0.01	0.07	0.21	0.20	0.19	0.24	0.19	0.18	0.12	0.03	0.03
21	0.01	0.07	0.21	0.20	0.19	0.24	0.19	0.18	0.12	0.03	0.03
22	0.01	0.07	0.21	0.20	0.19	0.24	0.19	0.18	0.12	0.03	0.03
23	0.01	0.07	0.21	0.20	0.19	0.24	0.19	0.17	0.11	0.03	0.03
AJ13 control	0.01	0.07	0.21	0.20	0.19	0.24	0.19	0.18	0.03	0.03	0.03
Average	0.01	0.07	0.21	0.20	0.19	0.24	0.22	0.15	0.05	0.03	0.03
Standard Deviation	0.0001	0.001	0.005	0.001	0.002	0.003	0.03	0.03	0.04	0.0005	0.0003

Table G-14. Ruthenium Detection Limits for Acid Strip Data (ng/mm^2).

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.01	0.08	0.25	0.23	0.22	0.25	0.27	0.14	0.03	0.04	0.05
2	0.01	0.08	0.25	0.22	0.21	0.28	0.27	0.14	0.03	0.04	0.05
3	0.01	0.07	0.24	0.23	0.21	0.26	0.27	0.13	0.04	0.04	0.05
4	0.01	0.08	0.24	0.23	0.20	0.27	0.27	0.14	0.03	0.04	0.05
5	0.01	0.08	0.24	0.23	0.21	0.27	0.25	0.13	0.03	0.04	0.05
SJ13 control	0.01	0.08	0.24	0.21	0.21	0.27	0.27	0.13	0.03	0.04	0.05
7	0.01	0.08	0.24	0.23	0.21	0.26	0.26	0.13	0.03	0.04	0.05
8	0.01	0.08	0.24	0.22	0.21	0.27	0.27	0.14	0.04	0.04	0.05
9	0.01	0.08	0.24	0.22	0.21	0.26	0.26	0.13	0.03	0.04	0.05
10	0.01	0.08	0.24	0.22	0.20	0.26	0.27	0.14	0.03	0.04	0.05
11	0.01	0.08	0.24	0.23	0.20	0.27	0.26	0.14	0.03	0.04	0.05
CJ13 control	0.01	0.08	0.25	0.22	0.21	0.27	0.28	0.14	0.03	0.04	0.05
13	0.01	0.08	0.24	0.22	0.20	0.27	0.20	0.20	0.03	0.04	0.05
14	0.01	0.08	0.24	0.23	0.22	0.27	0.20	0.20	0.03	0.04	0.05
15	0.01	0.08	0.25	0.23	0.20	0.28	0.20	0.20	0.03	0.04	0.05
16	0.01	0.08	0.24	0.22	0.20	0.26	0.20	0.20	0.03	0.04	0.05
17	0.01	0.08	0.24	0.22	0.21	0.27	0.20	0.20	0.03	0.04	0.04
10KCl control	0.01	0.08	0.25	0.22	0.21	0.28	0.20	0.02	0.03	0.04	0.05
19	0.01	0.08	0.23	0.22	0.22	0.27	0.20	0.02	0.03	0.04	0.05
20	0.01	0.08	0.25	0.22	0.22	0.26	0.19	0.02	0.03	0.04	0.05
21	0.01	0.08	0.25	0.23	0.21	0.26	0.19	0.02	0.03	0.04	0.05
22	0.01	0.08	0.25	0.23	0.21	0.27	0.20	0.02	0.03	0.04	0.05
23	0.01	0.08	0.24	0.21	0.20	0.26	0.20	0.02	0.03	0.03	0.05
AJ13 control	0.01	0.08	0.24	0.22	0.21	0.27	0.20	0.02	0.03	0.04	0.05
Average	0.01	0.08	0.24	0.22	0.21	0.27	0.23	0.12	0.03	0.04	0.05
Standard Deviation	0.0002	0.002	0.004	0.01	0.01	0.01	0.04	0.07	0.001	0.002	0.002

Table G-15. Rhodium Detection Limits for Leachate Data (ng/mm^2).

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.01	0.01	0.04	0.02	0.01	0.01	0.003	0.01	0.02	0.02	0.03
2	0.01	0.01	0.04	0.02	0.01	0.01	0.003	0.01	0.02	0.02	0.03
3	0.01	0.01	0.04	0.02	0.01	0.01	0.003	0.01	0.02	0.02	0.03
4	0.01	0.01	0.04	0.02	0.01	0.01	0.003	0.01	0.02	0.02	0.03
5	0.01	0.01	0.04	0.02	0.01	0.01	0.003	0.01	0.02	0.02	0.03
SJ13 control	0.01	0.01	0.04	0.02	0.01	0.01	0.003	0.01	0.02	0.02	0.03
7	0.01	0.01	0.04	0.02	0.01	0.01	0.003	0.01	0.02	0.02	0.03
8	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.02	0.02	0.03
9	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.02	0.02	0.03
10	0.01	0.01	0.04	0.02	0.01	0.01	0.003	0.01	0.02	0.02	0.03
11	0.01	0.01	0.04	0.02	0.01	0.01	0.003	0.01	0.02	0.02	0.03
CJ13 control	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.02	0.02	0.03
13	0.01	0.01	0.04	0.02	0.01	0.01	0.003	0.003	0.02	0.02	0.03
14	0.01	0.01	0.04	0.02	0.01	0.01	0.003	0.003	0.02	0.02	0.03
15	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.003	0.02	0.02	0.03
16	0.01	0.01	0.04	0.02	0.01	0.01	0.003	0.003	0.02	0.02	0.03
17	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.003	0.02	0.02	0.03
10KCl control	0.01	0.01	0.04	0.02	0.01	0.01	0.003	0.003	0.02	0.02	0.03
19	0.01	0.01	0.04	0.02	0.01	0.01	0.003	0.003	0.02	0.02	0.03
20	0.01	0.01	0.04	0.02	0.01	0.01	0.003	0.003	0.02	0.02	0.03
21	0.01	0.01	0.04	0.02	0.01	0.01	0.003	0.003	0.02	0.02	0.03
22	0.01	0.01	0.04	0.02	0.005	0.01	0.003	0.003	0.02	0.02	0.03
23	0.01	0.01	0.04	0.02	0.01	0.01	0.003	0.003	0.02	0.02	0.03
AJ13 control	0.01	0.01	0.04	0.02	0.01	0.01	0.003	0.003	0.02	0.02	0.03
Average	0.01	0.01	0.04	0.02	0.01	0.01	0.003	0.005	0.02	0.02	0.03
Standard Deviation	0.0001	0.0001	0.001	0.0001	0.0000	0.0001	0.0001	0.002	0.002	0.0003	0.0003

Table G-16. Rhodium Detection Limits for Acid Strip Data (ng/mm^2)

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.03
2	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.04
3	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.04
4	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.04
5	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.03
SJ13 control	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.04
7	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.04
8	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.04
9	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.03
10	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.03
11	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.04
CJ13 control	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.04
13	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.003	0.03	0.03	0.04
14	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.003	0.03	0.03	0.04
15	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.003	0.03	0.03	0.04
16	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.003	0.03	0.03	0.04
17	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.003	0.03	0.03	0.03
10KCl control	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.39	0.03	0.03	0.04
19	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.38	0.03	0.03	0.04
20	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.38	0.03	0.03	0.03
21	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.38	0.03	0.03	0.04
22	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.38	0.03	0.03	0.04
23	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.37	0.03	0.02	0.03
AJ13 control	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.38	0.03	0.03	0.04
Average	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.12	0.03	0.03	0.04
Standard Deviation	0.0002	0.0002	0.001	0.0004	0.0002	0.0002	0.0001	0.17	0.001	0.001	0.001

Table G-17. Molybdenum Detection Limits for Leachate Data (ng/mm^2).

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.03
2	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.04
3	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.04
4	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.04
5	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.03
SJ13 control	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.04
7	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.04
8	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.04
9	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.03
10	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.03
11	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.04
CJ13 control	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.01	0.03	0.03	0.04
13	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.003	0.03	0.03	0.04
14	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.003	0.03	0.03	0.04
15	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.003	0.03	0.03	0.04
16	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.003	0.03	0.03	0.04
17	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.003	0.03	0.03	0.03
10KCl control	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.39	0.03	0.03	0.04
19	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.38	0.03	0.03	0.04
20	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.38	0.03	0.03	0.03
21	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.38	0.03	0.03	0.04
22	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.38	0.03	0.03	0.04
23	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.37	0.03	0.02	0.03
AJ13 control	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.38	0.03	0.03	0.04
Average	0.01	0.01	0.05	0.02	0.01	0.01	0.003	0.12	0.03	0.03	0.04
Standard Deviation	0.0002	0.0002	0.001	0.0004	0.0002	0.0002	0.0001	0.17	0.001	0.001	0.001

Table G-18. Molybdenum Detection Limits for Acid Strip Data (ng/mm^2)

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.09	0.12	0.27	0.27	0.27	0.08	0.06	0.06	1.25	0.45	0.07
2	0.09	0.12	0.27	0.27	0.26	0.08	0.06	0.07	1.27	0.51	0.07
3	0.09	0.11	0.27	0.28	0.26	0.08	0.06	0.06	1.39	0.49	0.07
4	0.08	0.11	0.27	0.27	0.24	0.08	0.06	0.06	1.26	0.46	0.07
5	0.09	0.12	0.27	0.27	0.25	0.08	0.05	0.06	1.25	0.51	0.07
SJ13 control	0.09	0.11	0.26	0.26	0.25	0.08	0.06	0.06	1.27	0.49	0.08
7	0.10	0.12	0.27	0.28	0.26	0.08	0.06	0.06	1.25	0.50	0.07
8	0.09	0.11	0.27	0.27	0.25	0.08	0.06	0.06	1.39	0.49	0.07
9	0.09	0.12	0.27	0.27	0.25	0.08	0.06	0.06	1.30	0.50	0.07
10	0.09	0.11	0.27	0.27	0.25	0.08	0.06	0.06	1.25	0.50	0.07
11	0.09	0.12	0.27	0.28	0.24	0.08	0.06	0.06	1.22	0.49	0.07
CJ13 control	0.09	0.12	0.28	0.27	0.26	0.08	0.06	0.06	1.27	0.48	0.07
13	0.09	0.11	0.26	0.27	0.25	0.08	0.03	0.04	1.29	0.48	0.07
14	0.09	0.12	0.27	0.28	0.27	0.08	0.03	0.04	1.25	0.48	0.08
15	0.09	0.12	0.27	0.28	0.25	0.08	0.03	0.04	1.28	0.50	0.07
16	0.09	0.12	0.27	0.27	0.24	0.08	0.03	0.04	1.29	0.46	0.07
17	0.09	0.12	0.27	0.27	0.25	0.08	0.03	0.04	1.24	0.45	0.07
10KCl control	0.09	0.12	0.27	0.26	0.26	0.08	0.03	0.02	1.30	0.47	0.07
19	0.09	0.12	0.26	0.26	0.26	0.08	0.03	0.01	1.28	0.48	0.07
20	0.09	0.12	0.27	0.26	0.27	0.08	0.03	0.01	1.23	0.49	0.07
21	0.09	0.12	0.27	0.28	0.26	0.08	0.03	0.01	1.27	0.47	0.07
22	0.09	0.12	0.27	0.28	0.25	0.08	0.03	0.01	1.26	0.45	0.07
23	0.09	0.12	0.27	0.25	0.24	0.08	0.03	0.01	1.24	0.41	0.07
AJ13 control	0.09	0.12	0.27	0.26	0.26	0.08	0.04	0.01	1.27	0.49	0.08
Average	0.09	0.12	0.27	0.27	0.25	0.08	0.05	0.04	1.27	0.48	0.07
Standard Deviation	0.003	0.003	0.004	0.01	0.01	0.002	0.01	0.02	0.04	0.02	0.003

Table G-19. Manganese Detection Limits for Leachate Data (ng/mm^2)

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.03	0.08	0.14	0.05	0.06	0.06	0.09	0.09	0.57	0.10	0.31
2	0.03	0.08	0.14	0.05	0.06	0.06	0.09	0.09	0.59	0.10	0.31
3	0.03	0.08	0.14	0.05	0.06	0.06	0.09	0.09	0.57	0.10	0.31
4	0.03	0.08	0.14	0.05	0.06	0.06	0.09	0.09	0.57	0.10	0.31
5	0.03	0.08	0.14	0.05	0.06	0.06	0.09	0.09	0.57	0.10	0.31
SJ13 control	0.03	0.08	0.14	0.05	0.06	0.06	0.09	0.09	0.57	0.10	0.31
7	0.03	0.08	0.14	0.05	0.07	0.06	0.09	0.09	0.58	0.10	0.32
8	0.03	0.08	0.14	0.05	0.07	0.06	0.09	0.09	0.58	0.10	0.31
9	0.03	0.08	0.14	0.05	0.06	0.06	0.09	0.09	0.57	0.10	0.32
10	0.03	0.08	0.14	0.05	0.07	0.06	0.09	0.09	0.58	0.10	0.31
11	0.03	0.08	0.14	0.05	0.07	0.06	0.09	0.09	0.58	0.10	0.31
CJ13 control	0.03	0.08	0.14	0.05	0.07	0.06	0.09	0.09	0.58	0.10	0.32
13	0.03	0.08	0.12	0.05	0.07	0.06	0.13	0.13	0.58	0.10	0.31
14	0.03	0.08	0.14	0.05	0.07	0.06	0.13	0.13	0.57	0.10	0.31
15	0.03	0.08	0.14	0.05	0.07	0.07	0.13	0.13	0.57	0.10	0.31
16	0.03	0.08	0.14	0.05	0.07	0.06	0.13	0.13	0.57	0.10	0.31
17	0.03	0.08	0.14	0.05	0.07	0.06	0.13	0.13	0.57	0.10	0.31
10KCl control	0.03	0.08	0.14	0.05	0.06	0.06	0.13	0.13	0.57	0.10	0.31
19	0.03	0.08	0.14	0.05	0.06	0.06	0.14	0.13	0.52	0.10	0.31
20	0.03	0.08	0.14	0.05	0.06	0.06	0.14	0.13	0.52	0.10	0.31
21	0.03	0.08	0.14	0.05	0.06	0.06	0.14	0.13	0.54	0.10	0.31
22	0.03	0.08	0.14	0.05	0.06	0.06	0.14	0.13	0.54	0.10	0.31
23	0.03	0.08	0.14	0.05	0.06	0.06	0.14	0.13	0.50	0.10	0.31
AJ13 control	0.03	0.08	0.14	0.05	0.06	0.06	0.14	0.13	0.56	0.10	0.31
Average	0.03	0.08	0.14	0.05	0.06	0.06	0.11	0.11	0.56	0.10	0.31
Standard Deviation	0.0004	0.001	0.003	0.0003	0.001	0.001	0.02	0.02	0.02	0.001	0.003

Table G-20. Manganese Detection Limits for Acid Strip Data (ng/mm^2)

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.03	0.09	0.16	0.06	0.07	0.07	0.10	0.10	0.65	0.11	0.06
2	0.03	0.09	0.16	0.06	0.07	0.07	0.10	0.10	0.66	0.13	0.06
3	0.03	0.08	0.16	0.06	0.07	0.07	0.10	0.10	0.72	0.12	0.06
4	0.03	0.09	0.16	0.06	0.07	0.07	0.09	0.10	0.65	0.11	0.06
5	0.03	0.09	0.16	0.06	0.07	0.07	0.09	0.10	0.65	0.13	0.06
SJ13 control	0.03	0.09	0.16	0.06	0.07	0.07	0.10	0.10	0.66	0.12	0.06
7	0.03	0.09	0.16	0.06	0.07	0.07	0.09	0.10	0.65	0.12	0.06
8	0.03	0.09	0.16	0.06	0.07	0.07	0.10	0.10	0.72	0.12	0.06
9	0.03	0.09	0.16	0.06	0.07	0.07	0.09	0.10	0.67	0.12	0.06
10	0.03	0.09	0.16	0.06	0.07	0.07	0.10	0.10	0.65	0.12	0.06
11	0.03	0.09	0.16	0.06	0.07	0.07	0.09	0.10	0.63	0.12	0.06
CJ13 control	0.03	0.09	0.17	0.06	0.07	0.07	0.10	0.10	0.66	0.12	0.06
13	0.03	0.09	0.16	0.06	0.07	0.07	0.14	0.15	0.67	0.12	0.06
14	0.03	0.09	0.16	0.06	0.07	0.07	0.15	0.15	0.65	0.12	0.06
15	0.03	0.09	0.16	0.06	0.07	0.07	0.14	0.15	0.66	0.13	0.06
16	0.03	0.09	0.16	0.06	0.07	0.07	0.14	0.15	0.67	0.11	0.06
17	0.03	0.09	0.16	0.06	0.07	0.07	0.14	0.15	0.64	0.11	0.06
10KCl control	0.03	0.09	0.17	0.06	0.07	0.07	0.14	0.14	0.67	0.12	0.06
19	0.03	0.09	0.16	0.06	0.07	0.07	0.14	0.13	0.66	0.12	0.06
20	0.03	0.09	0.16	0.06	0.07	0.07	0.14	0.13	0.64	0.12	0.06
21	0.03	0.09	0.16	0.06	0.07	0.07	0.14	0.13	0.66	0.12	0.06
22	0.03	0.09	0.17	0.06	0.07	0.07	0.15	0.13	0.66	0.11	0.06
23	0.03	0.09	0.16	0.05	0.07	0.07	0.14	0.13	0.64	0.10	0.06
AJ13 control	0.03	0.09	0.16	0.06	0.07	0.07	0.15	0.13	0.66	0.12	0.06
Average	0.03	0.09	0.16	0.06	0.07	0.07	0.12	0.12	0.66	0.12	0.06
Standard Deviation	0.001	0.002	0.003	0.001	0.002	0.002	0.02	0.02	0.02	0.01	0.002

Table G-21. Cobalt Detection Limits for Leachate Data (ng/mm^2)

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.003	0.01	0.02	0.02	0.01	0.01	0.09	0.07	0.07	0.02	0.02
2	0.003	0.01	0.02	0.02	0.01	0.01	0.09	0.07	0.07	0.02	0.02
3	0.003	0.01	0.02	0.02	0.01	0.01	0.09	0.07	0.07	0.02	0.02
4	0.003	0.01	0.02	0.02	0.01	0.01	0.09	0.07	0.07	0.02	0.02
5	0.003	0.01	0.02	0.02	0.01	0.01	0.09	0.07	0.07	0.02	0.02
SJ13 control	0.003	0.01	0.02	0.02	0.01	0.01	0.09	0.07	0.07	0.02	0.02
7	0.003	0.01	0.02	0.02	0.01	0.01	0.09	0.07	0.07	0.02	0.02
8	0.003	0.01	0.02	0.02	0.01	0.01	0.09	0.07	0.07	0.02	0.02
9	0.003	0.01	0.02	0.02	0.01	0.01	0.09	0.07	0.07	0.02	0.02
10	0.003	0.01	0.02	0.02	0.01	0.01	0.09	0.07	0.07	0.02	0.02
11	0.003	0.01	0.02	0.02	0.01	0.01	0.09	0.07	0.07	0.02	0.02
CJ13 control	0.003	0.01	0.02	0.02	0.01	0.01	0.09	0.07	0.07	0.02	0.02
13	0.003	0.01	0.01	0.02	0.01	0.01	0.11	0.11	0.07	0.02	0.02
14	0.003	0.01	0.02	0.02	0.01	0.01	0.11	0.11	0.07	0.02	0.02
15	0.003	0.01	0.02	0.02	0.01	0.01	0.11	0.11	0.07	0.02	0.02
16	0.003	0.01	0.02	0.02	0.01	0.01	0.11	0.11	0.07	0.02	0.02
17	0.003	0.01	0.02	0.02	0.01	0.01	0.11	0.11	0.07	0.02	0.02
10KCl control	0.003	0.01	0.02	0.02	0.01	0.01	0.11	0.11	0.07	0.02	0.02
19	0.003	0.01	0.02	0.02	0.01	0.01	0.12	0.11	0.07	0.02	0.02
20	0.003	0.01	0.02	0.02	0.01	0.01	0.12	0.11	0.06	0.02	0.02
21	0.003	0.01	0.02	0.02	0.01	0.01	0.12	0.11	0.07	0.02	0.02
22	0.003	0.01	0.02	0.02	0.01	0.01	0.12	0.11	0.07	0.02	0.02
23	0.003	0.01	0.02	0.02	0.01	0.01	0.12	0.11	0.06	0.02	0.02
AJ13 control	0.003	0.01	0.02	0.02	0.01	0.01	0.12	0.11	0.07	0.02	0.02
Average	0.003	0.01	0.02	0.02	0.01	0.01	0.10	0.09	0.07	0.02	0.02
Standard Deviation	0.0000	0.0001	0.0003	0.0001	0.0000	0.0001	0.01	0.02	0.003	0.0003	0.0002

Table G-22. Cobalt Detection Limits for Acid Strip Data (ng/mm^2)

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.003	0.01	0.02	0.02	0.01	0.01	0.10	0.08	0.08	0.02	0.03
2	0.003	0.01	0.02	0.02	0.01	0.01	0.10	0.08	0.08	0.03	0.04
3	0.003	0.01	0.02	0.02	0.01	0.01	0.10	0.08	0.09	0.03	0.04
4	0.003	0.01	0.02	0.02	0.01	0.01	0.10	0.08	0.08	0.02	0.04
5	0.003	0.01	0.02	0.02	0.01	0.01	0.09	0.08	0.08	0.03	0.03
SJ13 control	0.003	0.01	0.02	0.02	0.01	0.01	0.10	0.08	0.08	0.03	0.04
7	0.004	0.01	0.02	0.02	0.01	0.01	0.10	0.08	0.08	0.03	0.04
8	0.004	0.01	0.02	0.02	0.01	0.01	0.10	0.08	0.09	0.03	0.04
9	0.004	0.01	0.02	0.02	0.01	0.01	0.10	0.08	0.08	0.03	0.03
10	0.003	0.01	0.02	0.02	0.01	0.01	0.10	0.08	0.08	0.03	0.03
11	0.003	0.01	0.02	0.02	0.01	0.01	0.10	0.08	0.08	0.03	0.04
CJ13 control	0.003	0.01	0.02	0.02	0.01	0.01	0.10	0.08	0.08	0.02	0.04
13	0.003	0.01	0.02	0.02	0.01	0.01	0.12	0.12	0.08	0.03	0.04
14	0.003	0.01	0.02	0.02	0.01	0.01	0.12	0.12	0.08	0.03	0.04
15	0.003	0.01	0.02	0.02	0.01	0.01	0.12	0.13	0.08	0.03	0.04
16	0.003	0.01	0.02	0.02	0.01	0.01	0.12	0.12	0.08	0.02	0.04
17	0.003	0.01	0.02	0.02	0.01	0.01	0.12	0.12	0.08	0.02	0.03
10KCl control	0.003	0.01	0.02	0.02	0.01	0.01	0.12	0.21	0.08	0.02	0.04
19	0.004	0.01	0.02	0.02	0.01	0.01	0.12	0.20	0.08	0.03	0.04
20	0.003	0.01	0.02	0.02	0.01	0.01	0.12	0.20	0.08	0.03	0.03
21	0.004	0.01	0.02	0.02	0.01	0.01	0.12	0.20	0.08	0.02	0.04
22	0.003	0.01	0.02	0.02	0.01	0.01	0.12	0.20	0.08	0.02	0.04
23	0.004	0.01	0.02	0.02	0.01	0.01	0.12	0.20	0.08	0.02	0.03
AJ13 control	0.004	0.01	0.02	0.02	0.01	0.01	0.12	0.20	0.08	0.03	0.04
Average	0.003	0.01	0.02	0.02	0.01	0.01	0.11	0.13	0.08	0.03	0.04
Standard Deviation	0.0001	0.0002	0.0003	0.0005	0.0002	0.0002	0.01	0.05	0.003	0.001	0.001

Table G-23. Copper Detection Limits and Leachate Data (ng/mm^2)

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.14	0.35	0.26	0.09	0.05	1.62	0.10	0.12	0.49	0.10	0.41
2	0.14	0.36	0.25	0.09	0.05	1.62	0.10	0.12	0.51	0.10	0.41
3	0.14	0.35	0.25	0.09	0.05	1.63	0.10	0.12	0.49	0.10	0.41
4	0.14	0.35	0.26	0.09	0.05	1.61	0.10	0.12	0.49	0.10	0.41
5	0.14	0.35	0.26	0.09	0.05	1.60	0.10	0.12	0.49	0.10	0.41
SJ13 control	0.14	0.35	0.26	0.09	0.05	1.62	0.10	0.12	0.49	0.10	0.41
7	0.14	0.37	0.26	0.09	0.05	1.63	0.10	0.12	0.50	0.10	0.42
8	0.14	0.36	0.26	0.09	0.05	1.64	0.10	0.12	0.50	0.10	0.42
9	0.14	0.36	0.26	0.09	0.05	1.64	0.10	0.12	0.49	0.10	0.42
10	0.14	0.36	0.26	0.09	0.05	1.64	0.10	0.12	0.50	0.10	0.42
11	0.15	0.36	0.26	0.09	0.05	1.63	0.10	0.12	0.50	0.10	0.42
CJ13 control	0.14	0.36	0.26	0.09	0.05	1.63	0.10	0.12	0.50	0.10	0.42
13	0.14	0.36	0.23	0.09	0.05	1.64	0.24	0.23	0.49	0.10	0.41
14	0.14	0.36	0.26	0.09	0.05	1.62	0.24	0.23	0.49	0.10	0.42
15	0.14	0.36	0.26	0.09	0.05	1.68	0.24	0.23	0.49	0.10	0.42
16	0.14	0.36	0.26	0.09	0.05	1.63	0.24	0.23	0.49	0.10	0.42
17	0.14	0.36	0.26	0.09	0.05	1.64	0.24	0.23	0.49	0.10	0.42
10KCl control	0.14	0.36	0.26	0.09	0.05	1.63	0.24	0.23	0.49	0.10	0.42
19	0.14	0.35	0.26	0.09	0.05	1.61	0.24	0.22	0.45	0.10	0.41
20	0.14	0.35	0.26	0.09	0.05	1.63	0.25	0.22	0.45	0.10	0.42
21	0.14	0.35	0.26	0.09	0.05	1.62	0.24	0.22	0.46	0.10	0.42
22	0.14	0.35	0.26	0.09	0.05	1.58	0.24	0.22	0.47	0.10	0.42
23	0.14	0.35	0.26	0.09	0.05	1.60	0.24	0.22	0.43	0.10	0.41
AJ13 control	0.14	0.35	0.25	0.09	0.05	1.58	0.24	0.22	0.48	0.10	0.42
Average	0.14	0.36	0.26	0.09	0.05	1.62	0.17	0.17	0.48	0.10	0.42
Standard Deviation	0.002	0.004	0.01	0.001	0.0004	0.02	0.07	0.06	0.02	0.001	0.004

Table G-24. Copper Detection Limits for Acid Strip Data (ng/mm^2)

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.16	0.41	0.31	0.10	0.06	1.68	0.11	0.14	0.56	0.11	0.07
2	0.16	0.42	0.31	0.09	0.06	1.84	0.11	0.14	0.56	0.13	0.07
3	0.16	0.37	0.30	0.10	0.06	1.71	0.11	0.13	0.62	0.12	0.07
4	0.14	0.40	0.30	0.10	0.05	1.79	0.11	0.14	0.56	0.11	0.07
5	0.16	0.41	0.30	0.10	0.06	1.79	0.10	0.13	0.56	0.13	0.07
SJ13 control	0.16	0.40	0.30	0.09	0.06	1.82	0.11	0.13	0.56	0.12	0.08
7	0.17	0.41	0.30	0.10	0.06	1.73	0.11	0.13	0.56	0.12	0.07
8	0.16	0.39	0.30	0.09	0.06	1.79	0.11	0.14	0.62	0.12	0.07
9	0.16	0.41	0.30	0.10	0.06	1.76	0.11	0.13	0.58	0.12	0.07
10	0.16	0.40	0.30	0.10	0.06	1.74	0.11	0.14	0.56	0.12	0.07
11	0.16	0.40	0.30	0.10	0.06	1.80	0.11	0.14	0.54	0.12	0.07
CJ13 control	0.15	0.40	0.31	0.09	0.06	1.77	0.12	0.14	0.57	0.12	0.07
13	0.16	0.40	0.29	0.10	0.06	1.79	0.25	0.26	0.57	0.12	0.07
14	0.16	0.41	0.30	0.10	0.06	1.83	0.26	0.26	0.56	0.12	0.08
15	0.16	0.41	0.30	0.10	0.06	1.84	0.25	0.26	0.57	0.13	0.07
16	0.15	0.41	0.30	0.09	0.06	1.72	0.25	0.26	0.57	0.11	0.07
17	0.15	0.41	0.30	0.10	0.06	1.78	0.25	0.26	0.55	0.11	0.07
10KCl control	0.16	0.41	0.31	0.09	0.06	1.86	0.25	0.01	0.58	0.12	0.07
19	0.16	0.41	0.29	0.09	0.06	1.79	0.26	0.01	0.57	0.12	0.07
20	0.16	0.41	0.31	0.09	0.06	1.73	0.25	0.01	0.55	0.12	0.07
21	0.16	0.42	0.30	0.10	0.06	1.76	0.24	0.01	0.56	0.12	0.07
22	0.16	0.41	0.31	0.10	0.06	1.79	0.26	0.01	0.56	0.11	0.07
23	0.16	0.41	0.30	0.09	0.06	1.76	0.25	0.01	0.55	0.10	0.07
AJ13 control	0.16	0.41	0.30	0.09	0.06	1.82	0.26	0.01	0.56	0.12	0.08
Average	0.16	0.41	0.30	0.10	0.06	1.78	0.18	0.12	0.57	0.12	0.07
Standard Deviation	0.01	0.01	0.005	0.002	0.002	0.04	0.07	0.09	0.02	0.01	0.003

Table G-25. Vanadium Detection Limits for Leachate Data (ng/mm^2)

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.13	1.27	4.13	4.33	2.41	0.41	0.02	0.10	1.30	0.82	1.13
2	0.13	1.28	4.08	4.36	2.42	0.41	0.02	0.10	1.35	0.81	1.14
3	0.13	1.28	4.11	4.30	2.43	0.41	0.02	0.10	1.30	0.81	1.13
4	0.13	1.27	4.13	4.33	2.42	0.40	0.02	0.10	1.30	0.81	1.13
5	0.13	1.28	4.14	4.34	2.41	0.40	0.02	0.10	1.30	0.81	1.13
SJ13 control	0.13	1.28	4.15	4.37	2.43	0.40	0.02	0.10	1.30	0.82	1.13
7	0.13	1.33	4.16	4.36	2.44	0.41	0.03	0.10	1.31	0.83	1.16
8	0.13	1.29	4.21	4.40	2.44	0.41	0.03	0.10	1.32	0.83	1.15
9	0.13	1.30	4.21	4.41	2.44	0.41	0.03	0.10	1.31	0.83	1.16
10	0.13	1.29	4.18	4.37	2.45	0.41	0.03	0.10	1.32	0.83	1.15
11	0.14	1.30	4.19	4.41	2.46	0.41	0.02	0.10	1.32	0.83	1.15
CJ13 control	0.13	1.29	4.21	4.38	2.46	0.41	0.03	0.10	1.32	0.84	1.17
13	0.13	1.30	3.75	4.36	2.45	0.41	0.51	0.50	1.31	0.80	1.14
14	0.13	1.29	4.19	4.40	2.44	0.40	0.51	0.50	1.31	0.80	1.15
15	0.13	1.29	4.21	4.38	2.45	0.42	0.52	0.50	1.31	0.80	1.15
16	0.13	1.29	4.19	4.36	2.46	0.41	0.52	0.50	1.31	0.80	1.15
17	0.13	1.30	4.21	4.35	2.46	0.41	0.51	0.49	1.31	0.80	1.15
10KCl control	0.13	1.28	4.19	4.36	2.43	0.41	0.52	0.50	1.31	0.80	1.15
19	0.13	1.28	4.15	4.35	2.41	0.40	0.53	0.48	0.01	0.82	1.14
20	0.13	1.27	4.13	4.37	2.43	0.41	0.53	0.49	0.01	0.82	1.14
21	0.13	1.27	4.12	4.37	2.40	0.41	0.53	0.49	0.01	0.81	1.15
22	0.13	1.27	4.13	4.36	2.40	0.40	0.53	0.49	0.01	0.82	1.15
23	0.13	1.28	4.14	4.34	2.41	0.40	0.53	0.49	0.01	0.81	1.13
AJ13 control	0.13	1.26	4.12	4.34	2.43	0.39	0.53	0.49	1.29	0.83	1.14
Average	0.13	1.29	4.14	4.36	2.43	0.41	0.27	0.29	1.04	0.82	1.14
Standard Deviation	0.002	0.01	0.09	0.03	0.02	0.01	0.25	0.20	0.54	0.01	0.01

Table G-26. Vanadium Detection Limits for Acid Strip Data (ng/mm^2)

Sample #	1	2	3	4	6	8	10	14	22	32	44
1	0.15	1.47	4.94	4.89	2.79	0.42	0.03	0.11	1.47	0.89	0.07
2	0.15	1.50	4.93	4.76	2.68	0.46	0.03	0.12	1.50	1.01	0.07
3	0.15	1.35	4.88	4.94	2.70	0.43	0.03	0.11	1.64	0.98	0.07
4	0.13	1.43	4.88	4.86	2.49	0.45	0.03	0.11	1.49	0.92	0.07
5	0.14	1.47	4.84	4.90	2.65	0.45	0.03	0.11	1.47	1.01	0.07
SJ13 control	0.15	1.45	4.78	4.60	2.65	0.46	0.03	0.11	1.50	0.98	0.08
7	0.15	1.48	4.89	5.00	2.69	0.43	0.03	0.11	1.48	1.00	0.07
8	0.15	1.41	4.87	4.77	2.62	0.45	0.03	0.11	1.64	0.98	0.07
9	0.15	1.48	4.90	4.84	2.63	0.44	0.03	0.11	1.53	1.00	0.07
10	0.15	1.43	4.86	4.82	2.58	0.43	0.03	0.11	1.48	1.00	0.07
11	0.15	1.45	4.89	4.95	2.55	0.45	0.03	0.11	1.44	0.99	0.07
CJ13 control	0.14	1.46	5.04	4.80	2.70	0.44	0.03	0.11	1.50	0.95	0.07
13	0.15	1.44	4.73	4.82	2.56	0.45	0.55	0.57	1.52	0.96	0.07
14	0.15	1.49	4.85	4.93	2.79	0.46	0.56	0.57	1.47	0.95	0.08
15	0.15	1.48	4.92	4.93	2.58	0.46	0.55	0.57	1.51	1.01	0.07
16	0.14	1.49	4.90	4.80	2.53	0.43	0.55	0.57	1.52	0.91	0.07
17	0.14	1.49	4.85	4.81	2.61	0.44	0.55	0.56	1.47	0.90	0.07
10KCl control	0.15	1.47	4.96	4.70	2.69	0.46	0.55	0.01	1.53	0.93	0.07
19	0.15	1.49	4.67	4.70	2.74	0.45	0.56	0.01	1.51	0.96	0.07
20	0.15	1.48	4.93	4.66	2.78	0.43	0.54	0.01	1.46	0.97	0.07
21	0.15	1.51	4.90	4.94	2.66	0.44	0.53	0.01	1.50	0.94	0.07
22	0.15	1.47	4.97	4.94	2.61	0.45	0.56	0.01	1.49	0.90	0.07
23	0.15	1.48	4.86	4.54	2.55	0.44	0.55	0.01	1.47	0.82	0.07
AJ13 control	0.15	1.47	4.85	4.74	2.67	0.45	0.57	0.01	1.50	0.98	0.08
Average	0.15	1.46	4.88	4.82	2.65	0.44	0.29	0.18	1.50	0.96	0.07
Standard Deviation	0.01	0.03	0.08	0.12	0.08	0.01	0.27	0.21	0.05	0.05	0.003

H. Sample Releases

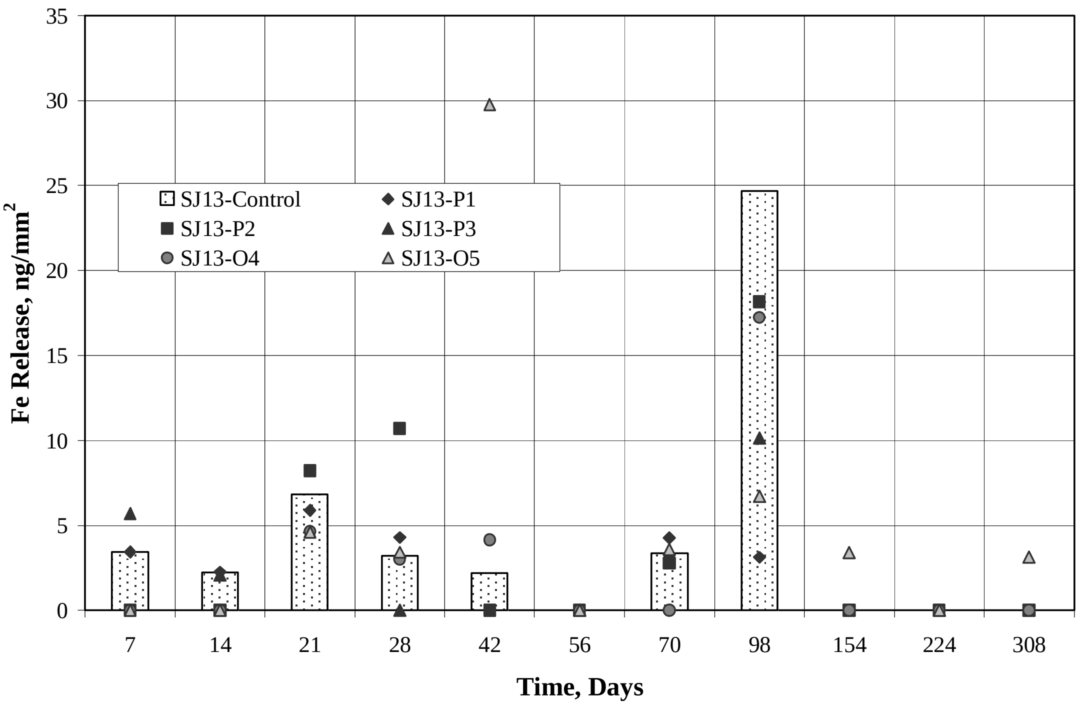


Figure H-1. Iron Releases in SJ13 solution at 90ºC.

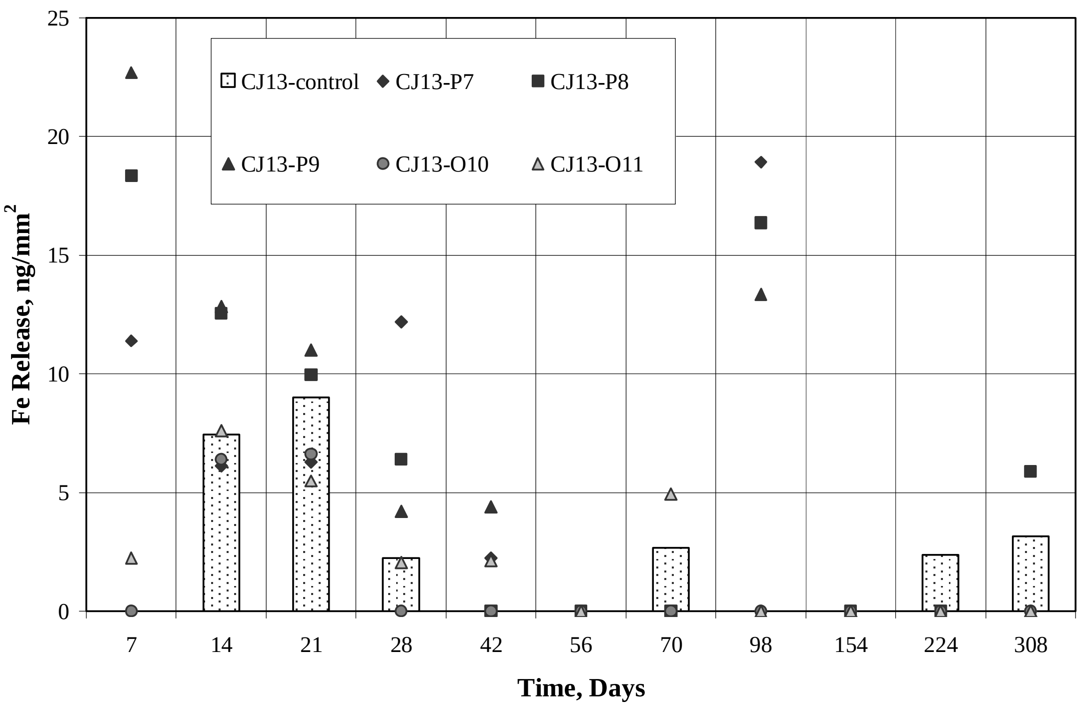


Figure H-2. Iron Releases in CJ13 solution at 90ºC.

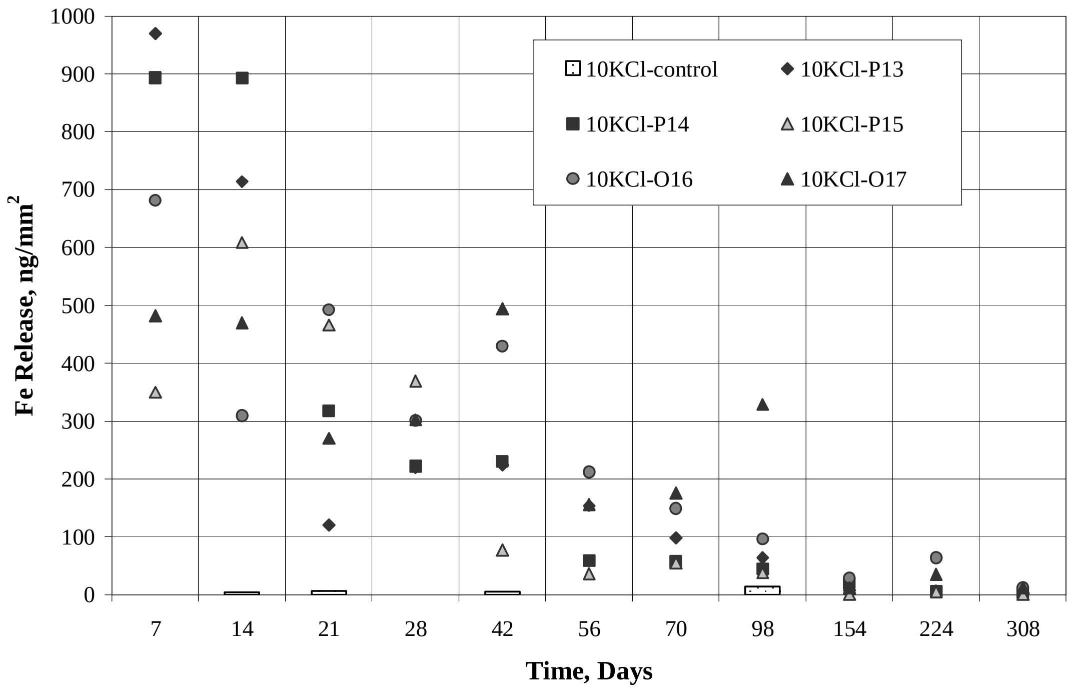


Figure H-3. Iron Releases in 10KCl solution at 90ºC.

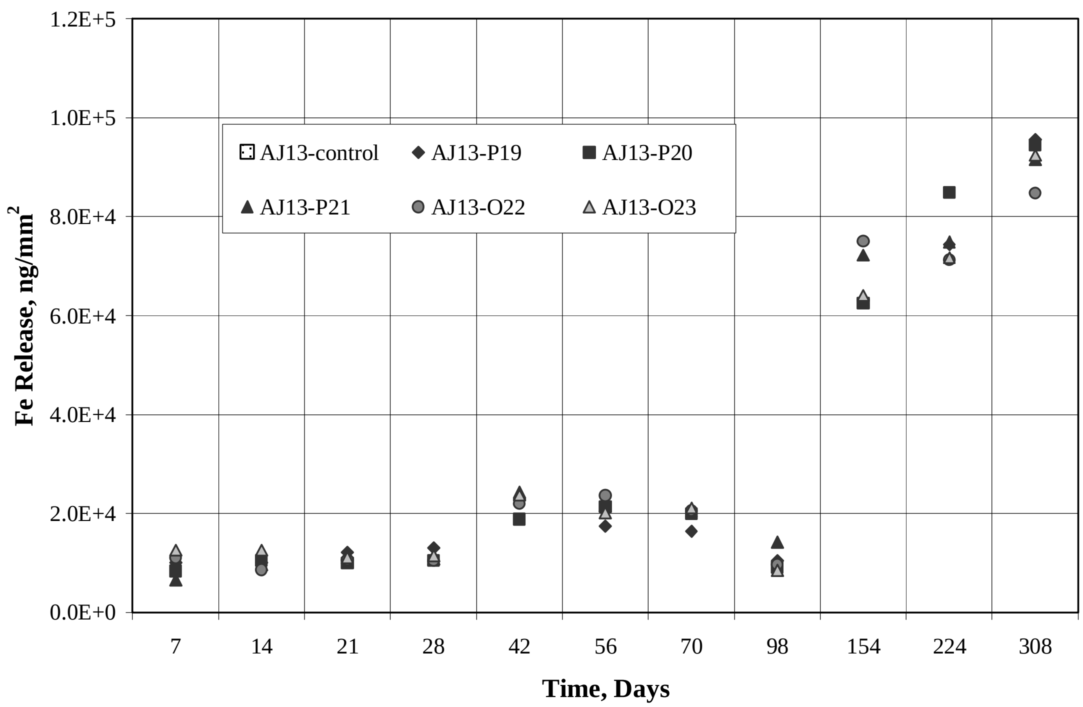


Figure H-4. Iron Releases in AJ13 solution at 90ºC.

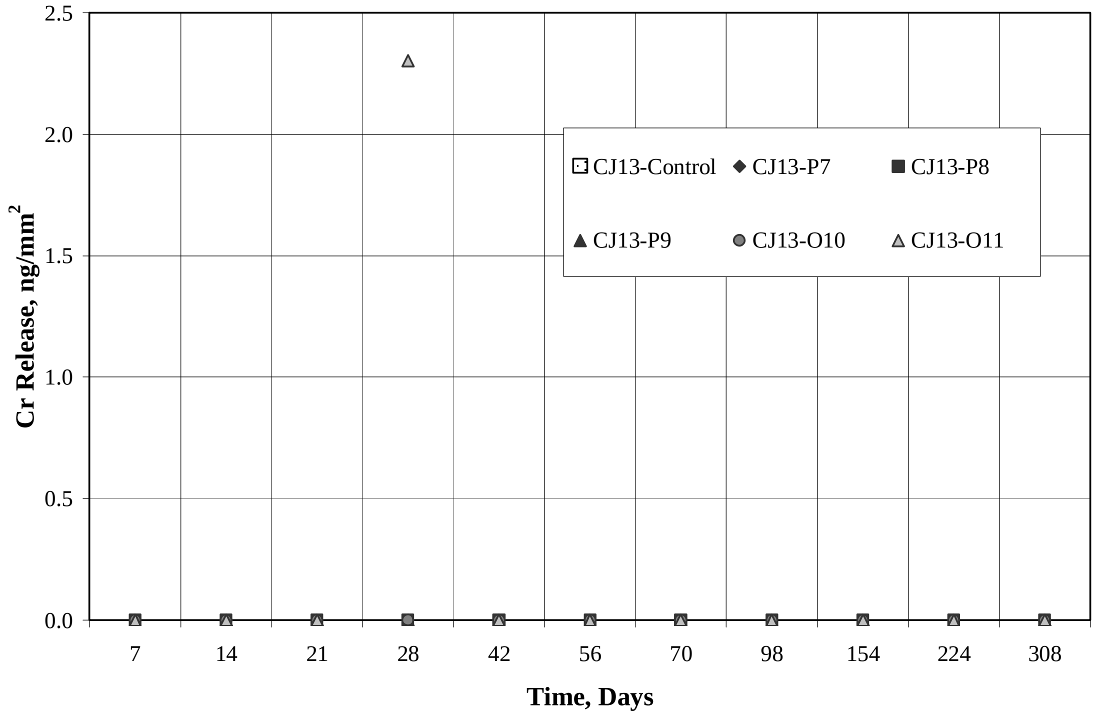


Figure H-5. Chromium Releases in CJ13 solution at 90°C.

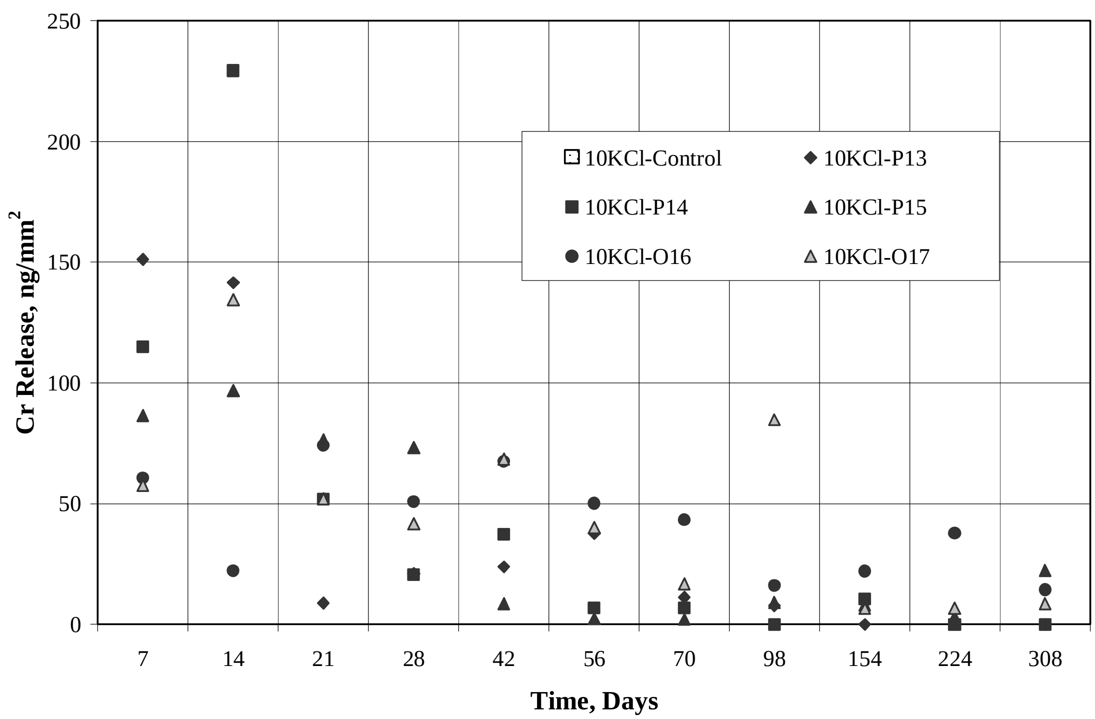


Figure H-6. Chromium Releases in 10KCl solution at 90°C.

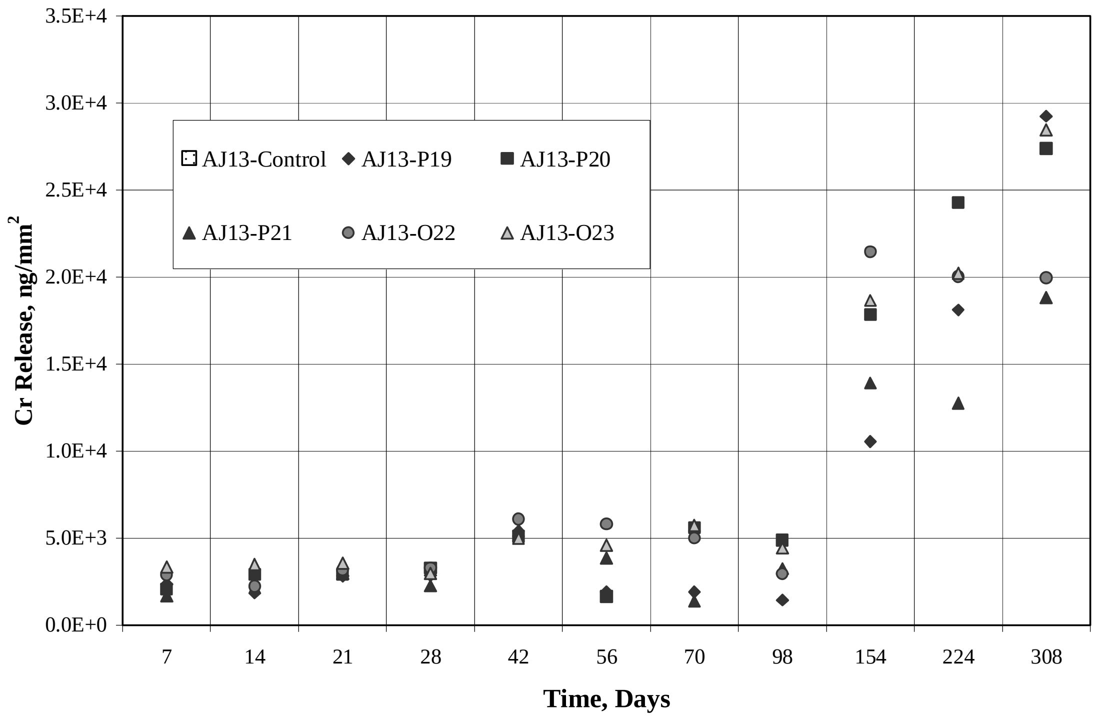


Figure H-7. Chromium Releases in AJ13 solution at 90ºC.

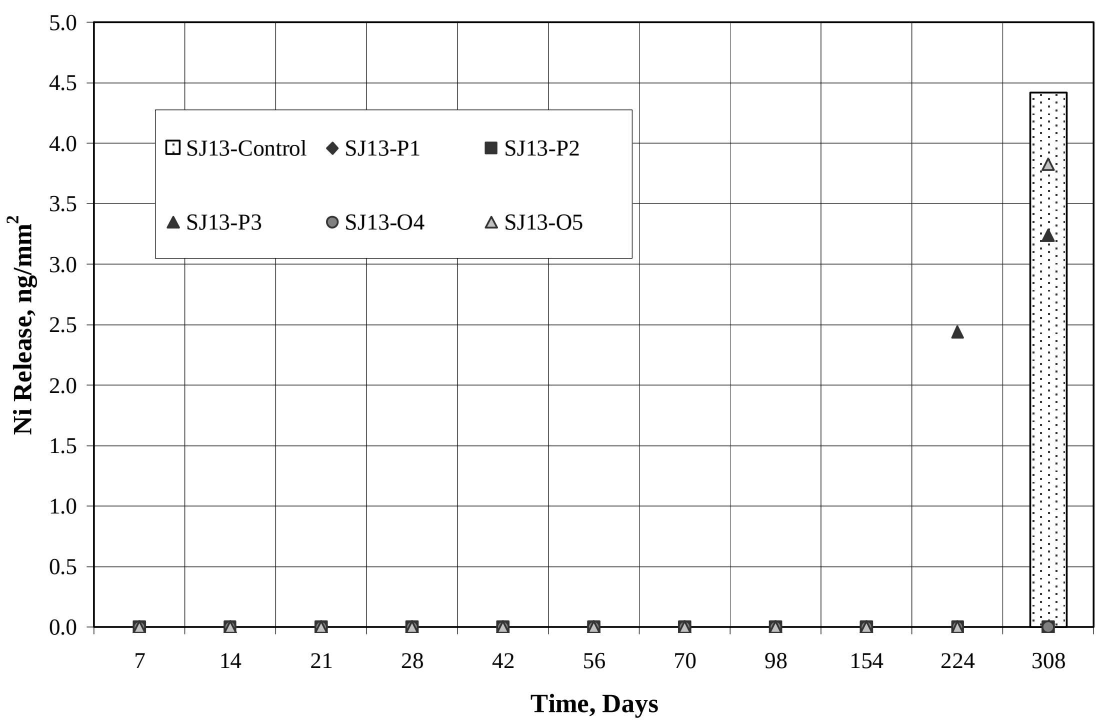


Figure H-8. Nickel Releases in SJ13 solution at 90ºC.

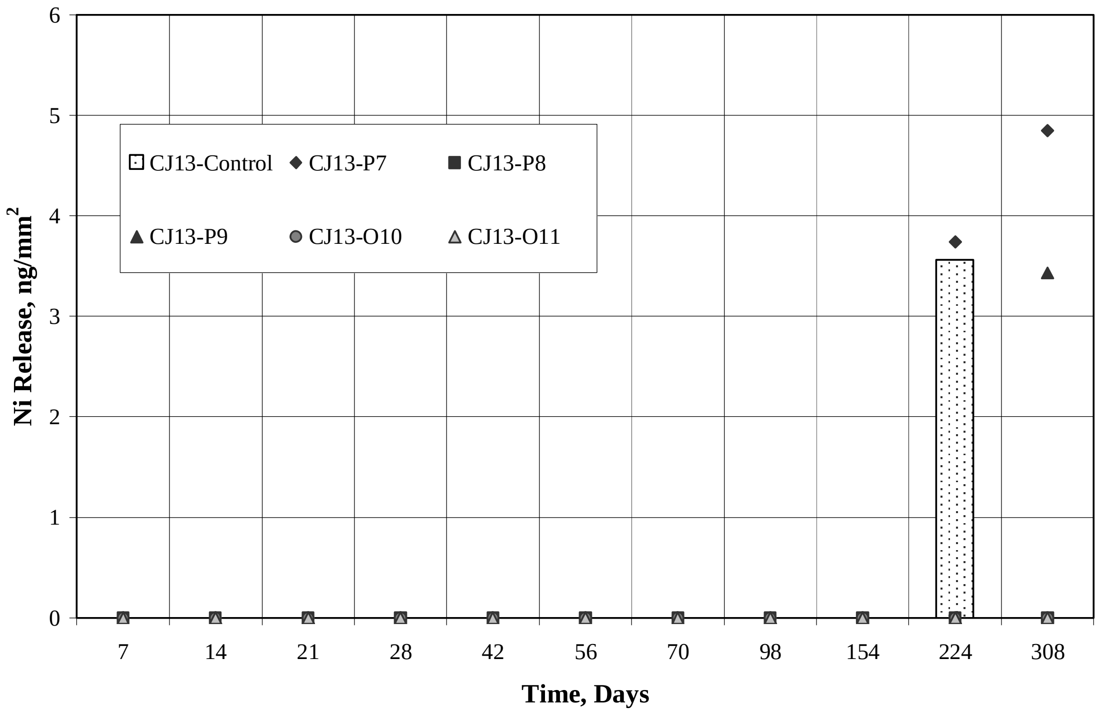


Figure H-9. Nickel Releases in CJ13 solution at 90ºC.

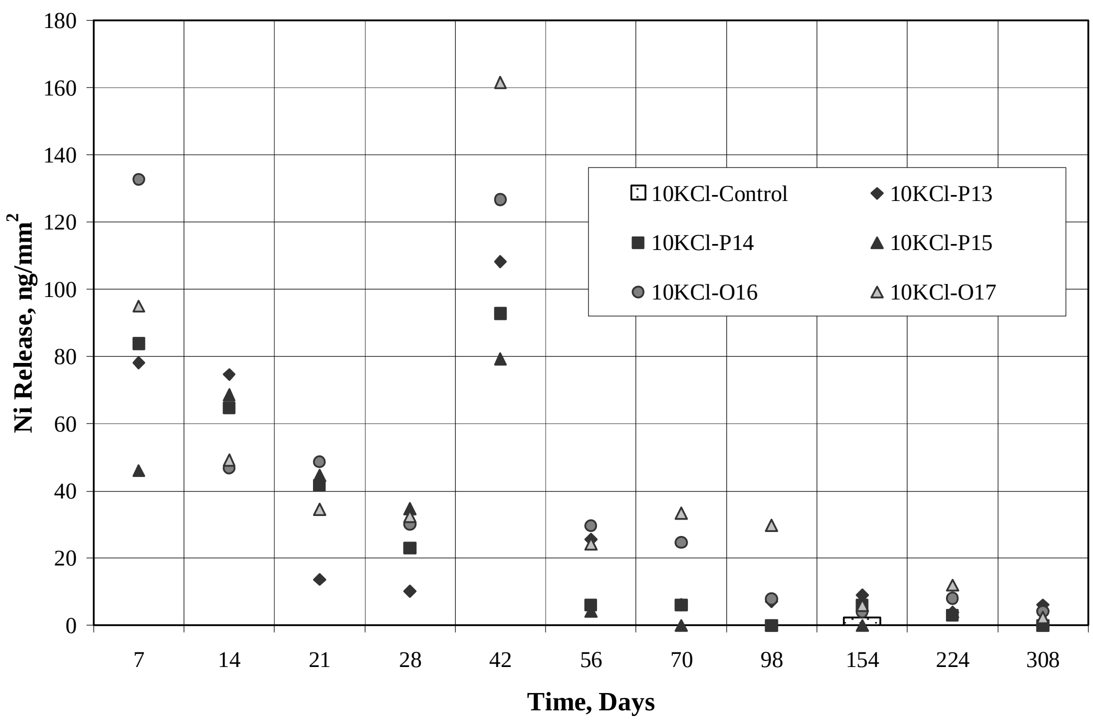


Figure H-10. Nickel Releases in 10KCl solution at 90ºC.

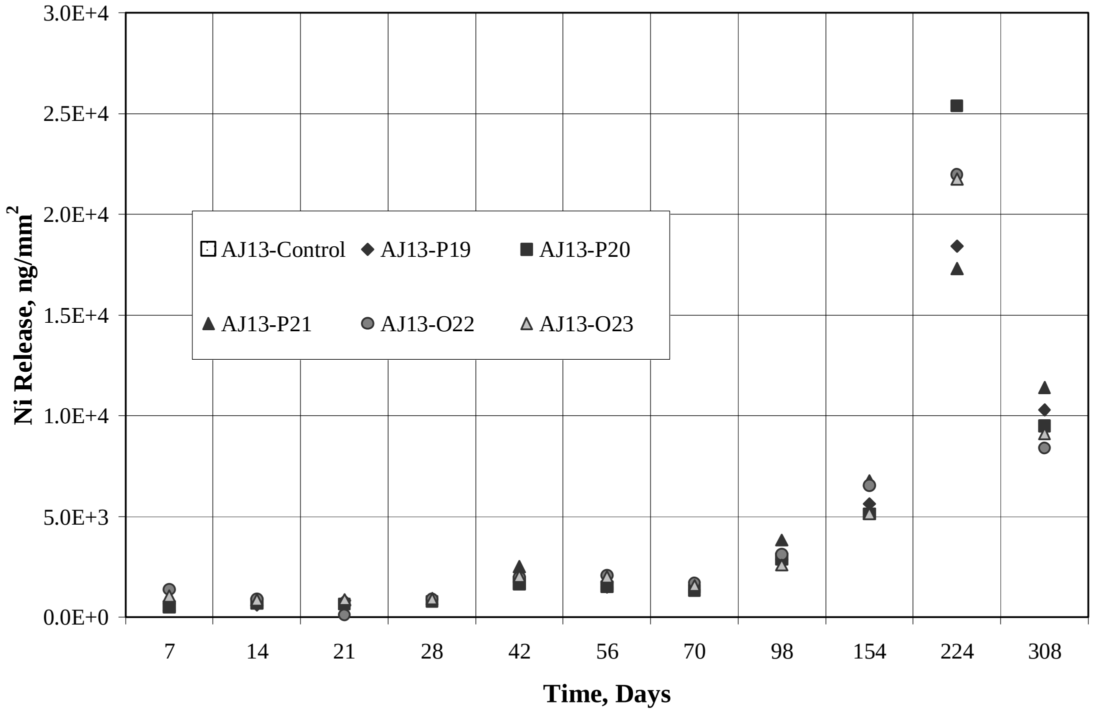


Figure H-11. Nickel Releases in AJ13 solution at 90°C.

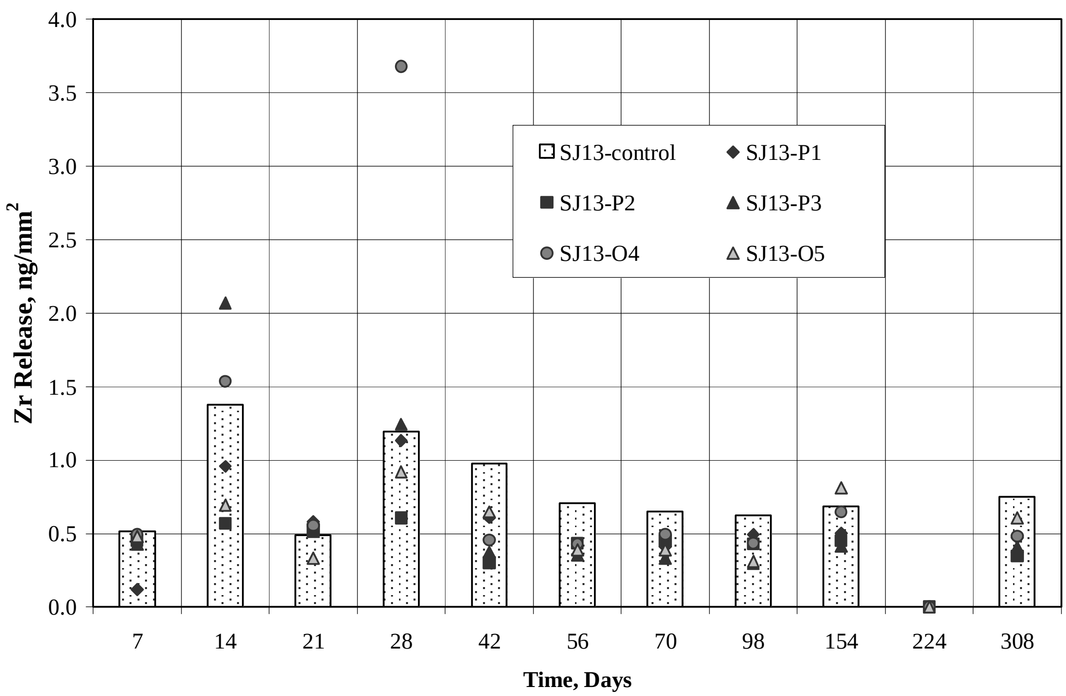


Figure H-12. Zirconium Releases in SJ13 solution at 90°C.

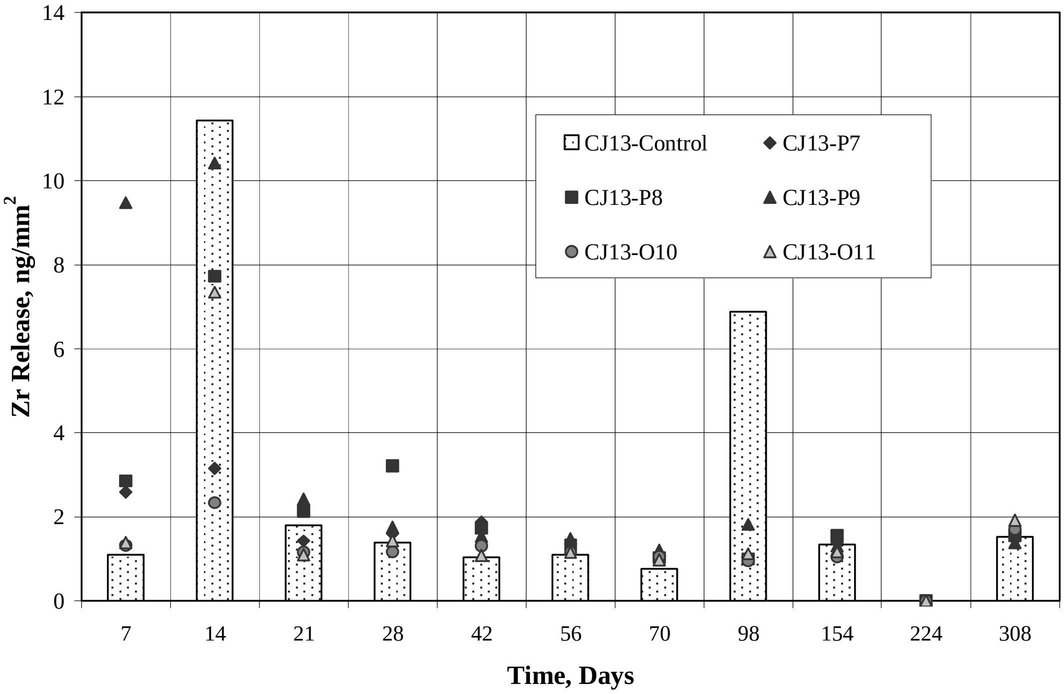


Figure H-13. Zirconium Releases in CJ13 solution at 90ºC.

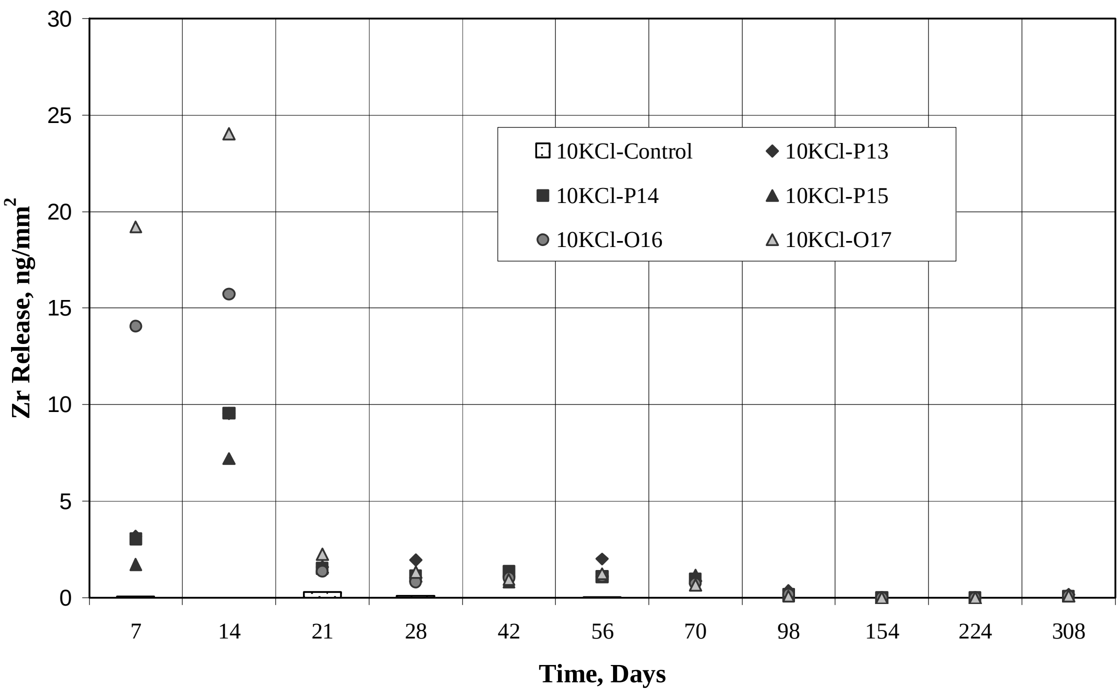


Figure H-14. Zirconium Releases in 10KCl solution at 90ºC.

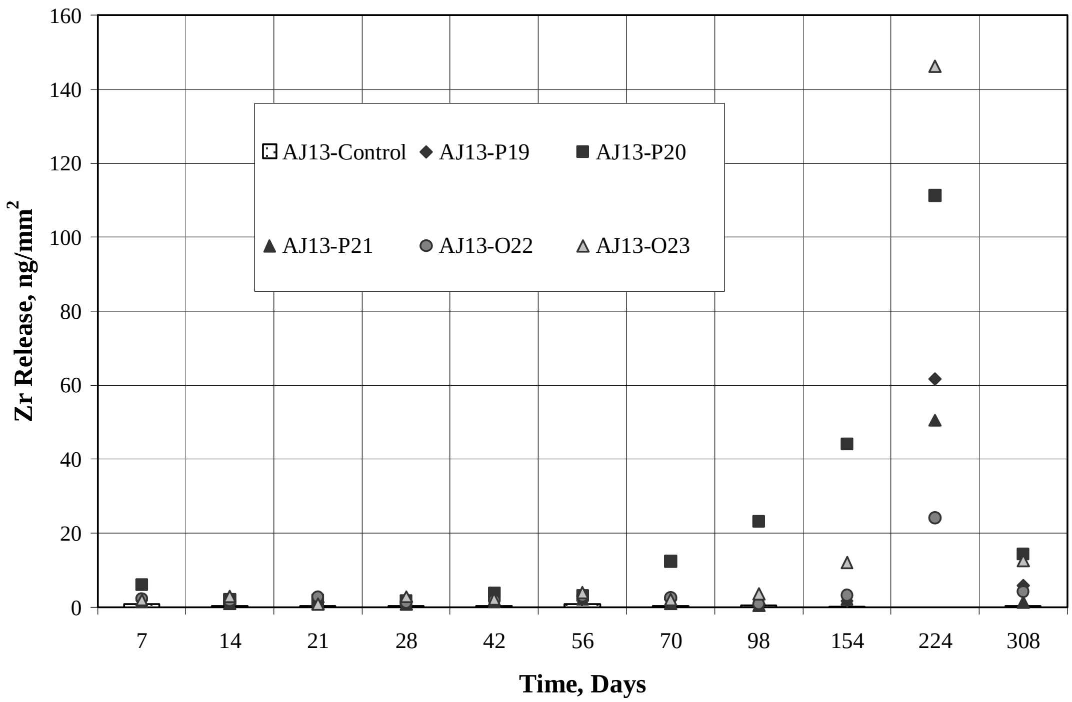


Figure H-15. Zirconium Releases in AJ13 solution at 90ºC.

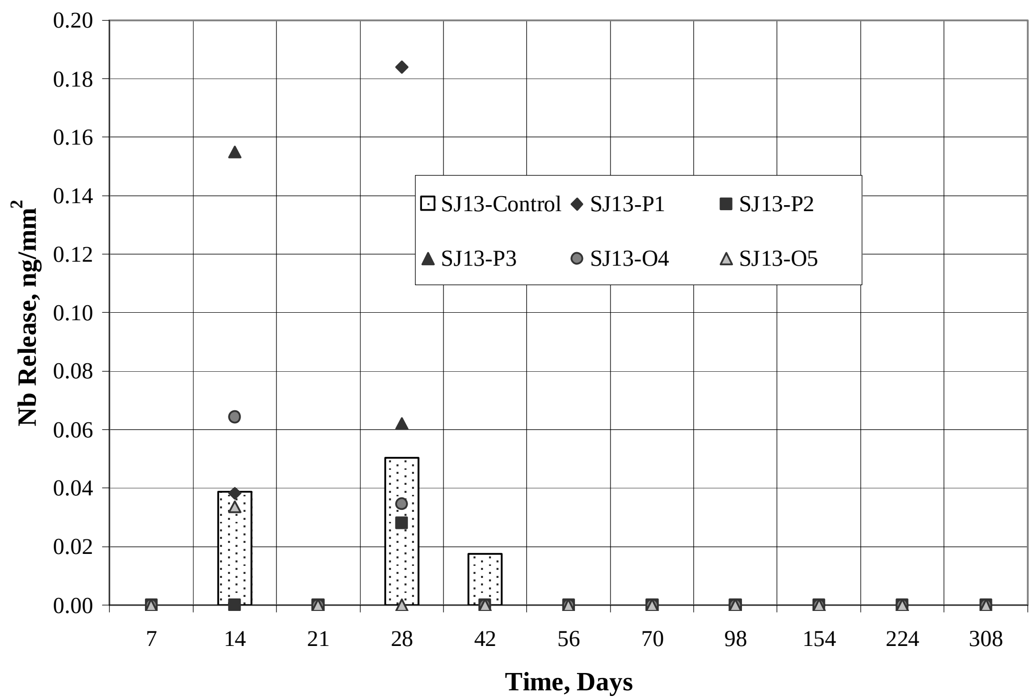


Figure H-16. Niobium Releases in SJ13 solution at 90ºC.

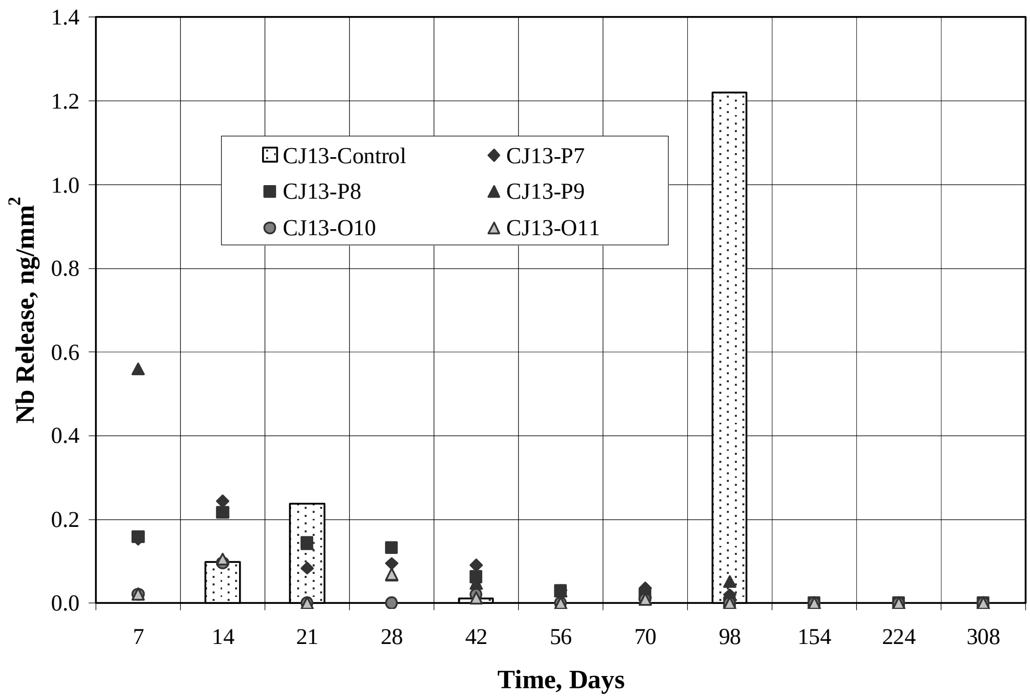


Figure H-17. Niobium Releases in CJ13 solution at 90°C.

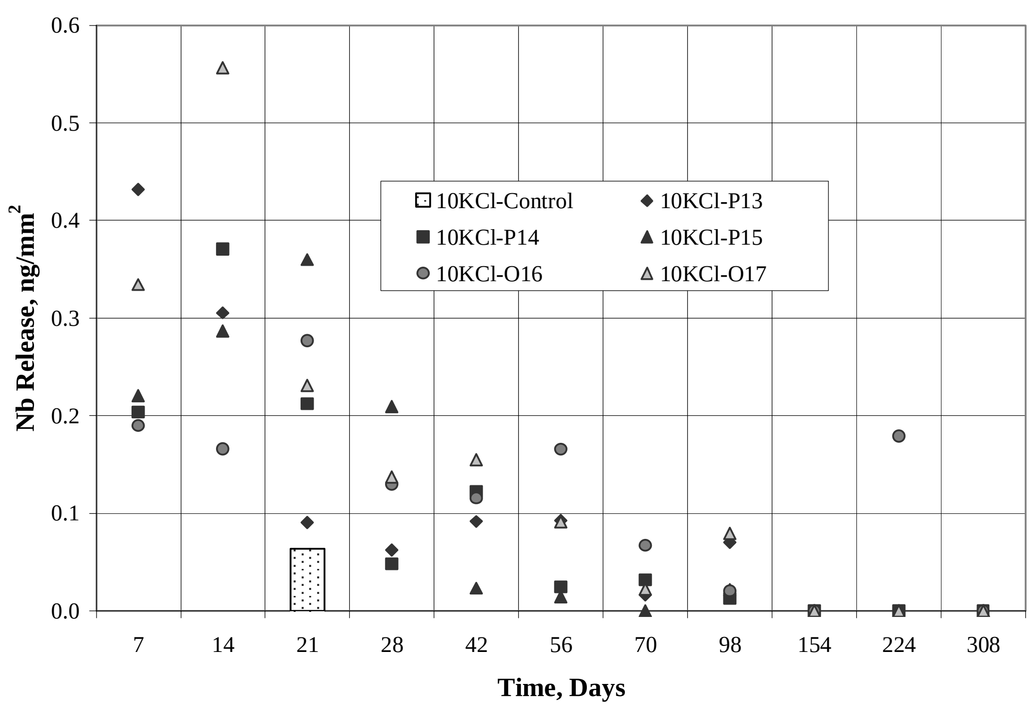


Figure H-18. Niobium Releases in 10KCl solution at 90°C.

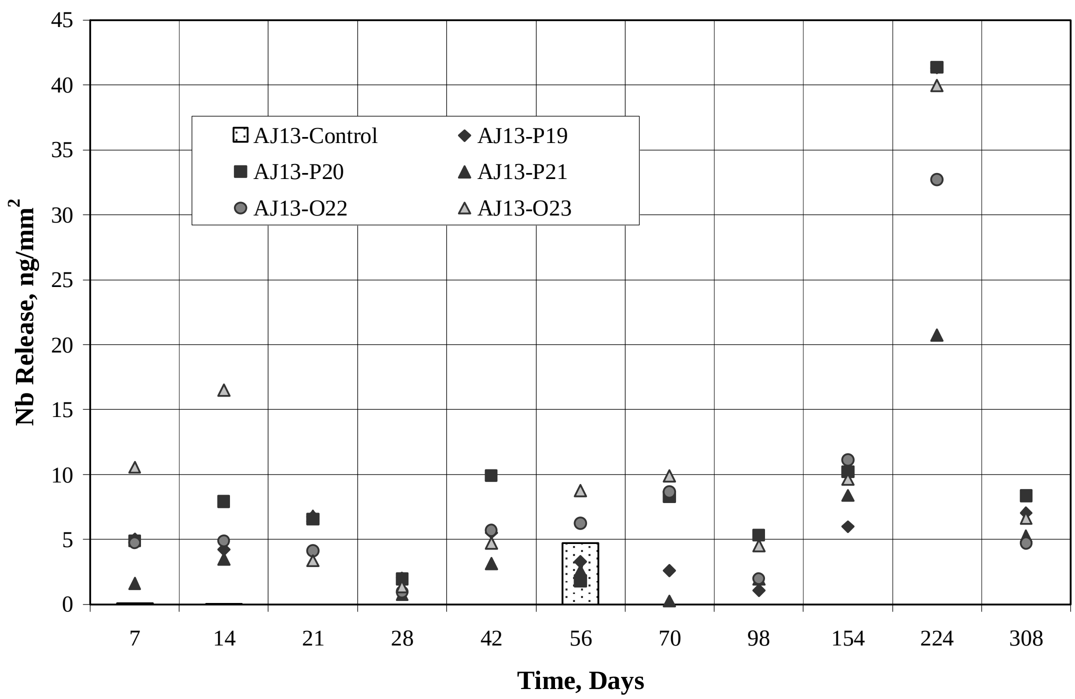


Figure H-19. Niobium Releases in AJ13 solution at 90ºC.

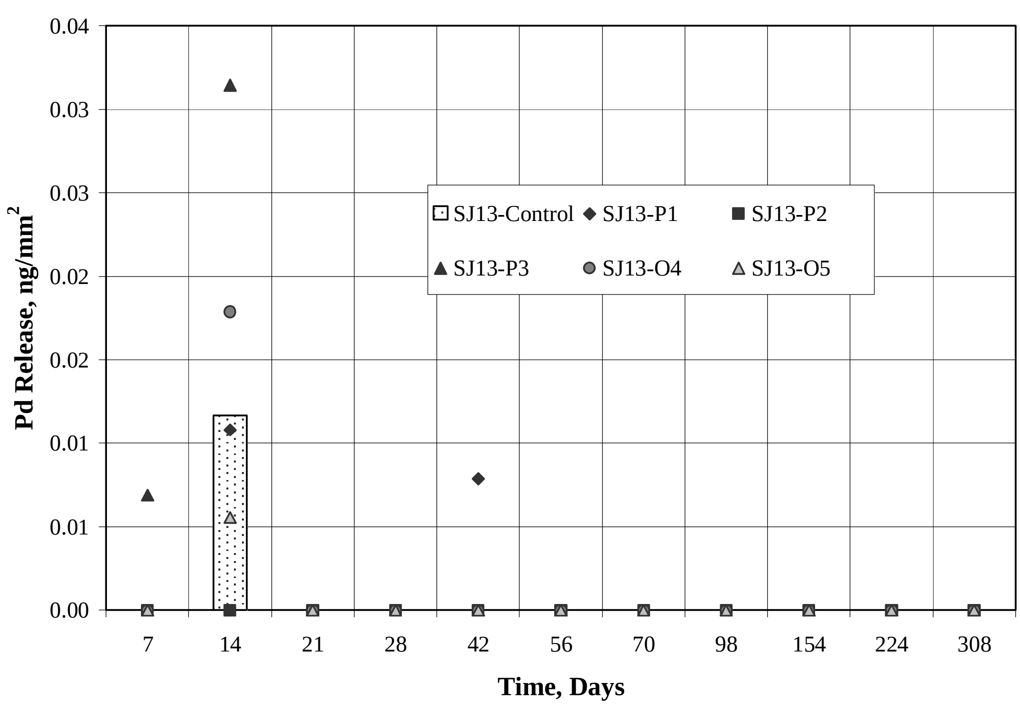


Figure H-20. Paladium Releases in SJ13 solution at 90ºC.

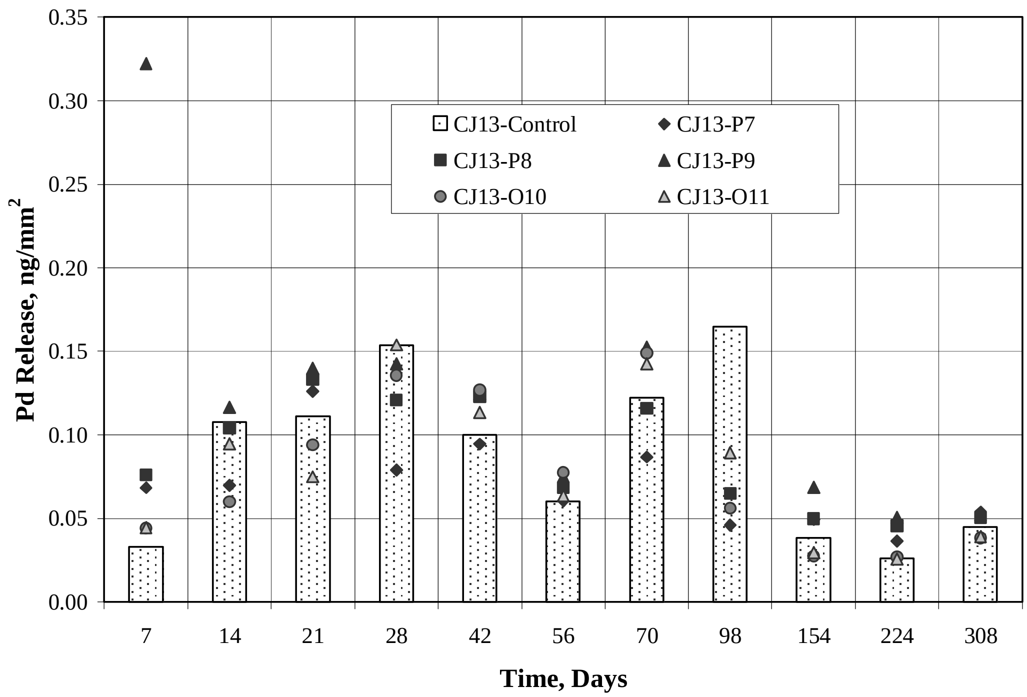


Figure H-21. Paladium Releases in CJ13 solution at 90ºC.

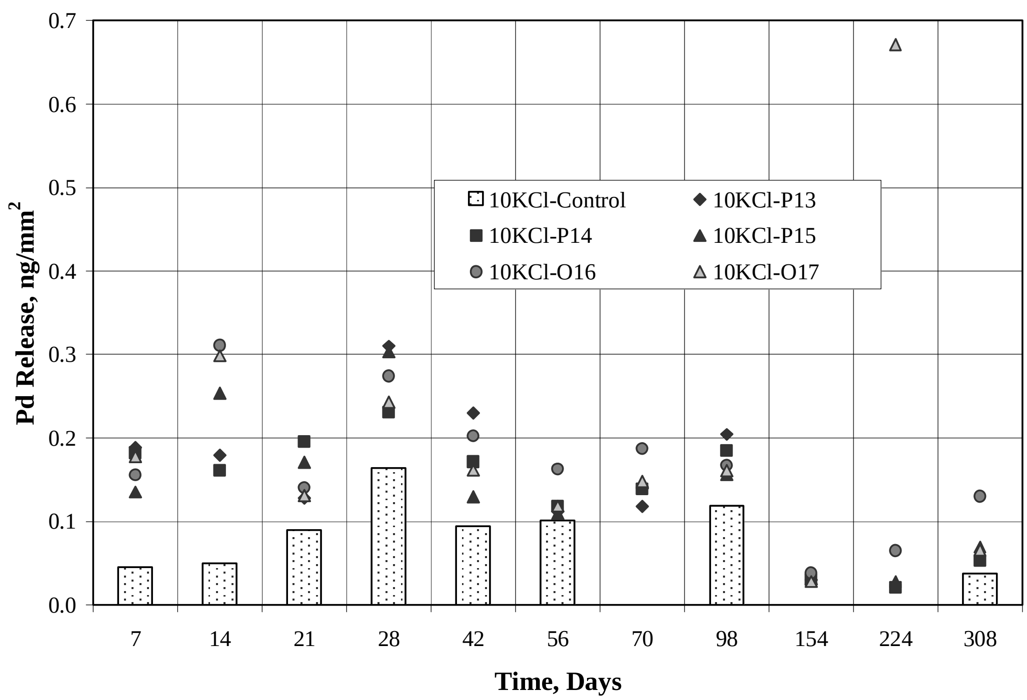


Figure H-22. Paladium Releases in 10KCl solution at 90ºC.

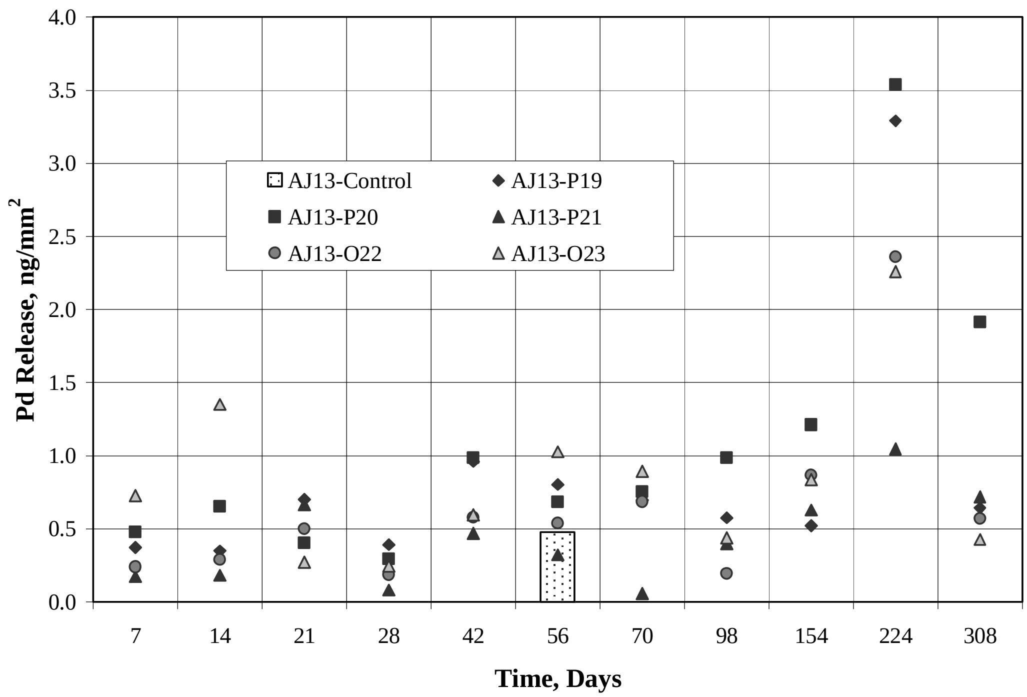


Figure H-23. Paladium Releases in AJ13 solution at 90°C.

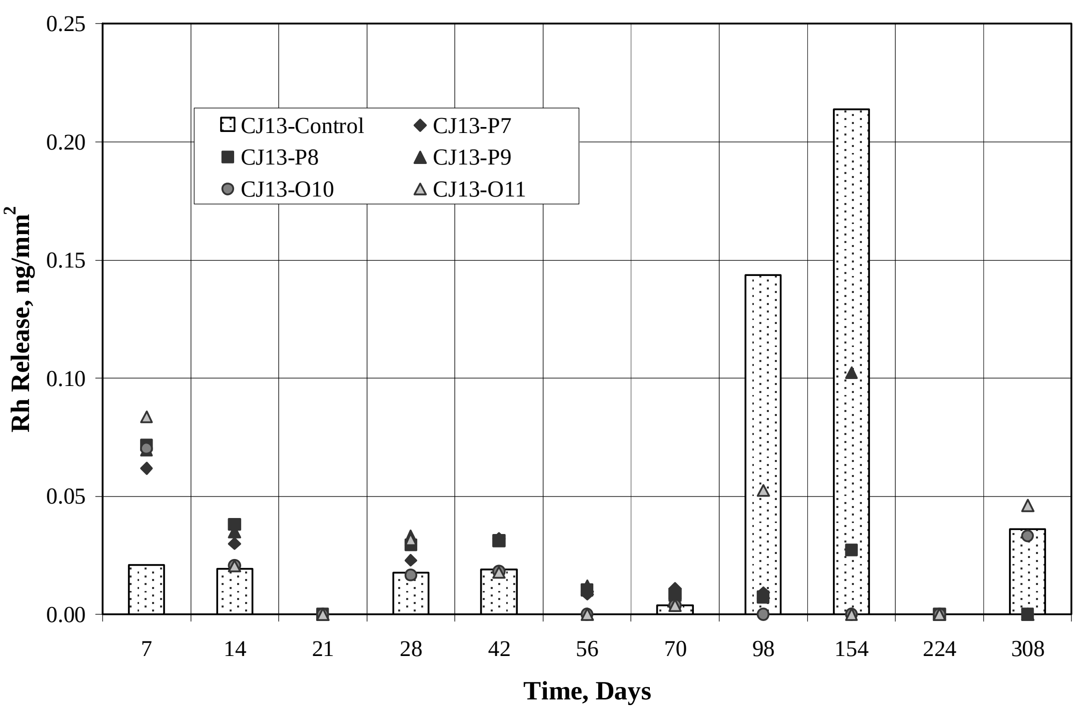


Figure H-24. Rhodium Releases in CJ13 solution at 90°C.

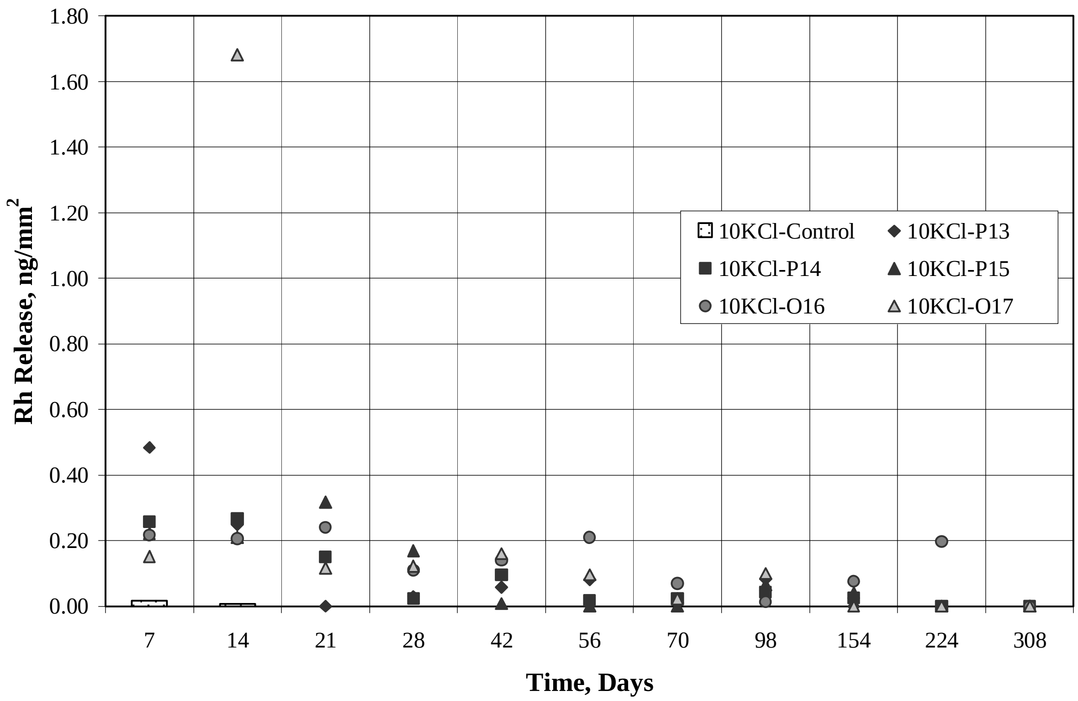


Figure H-25. Rhodium Releases in 10KCl solution at 90ºC.

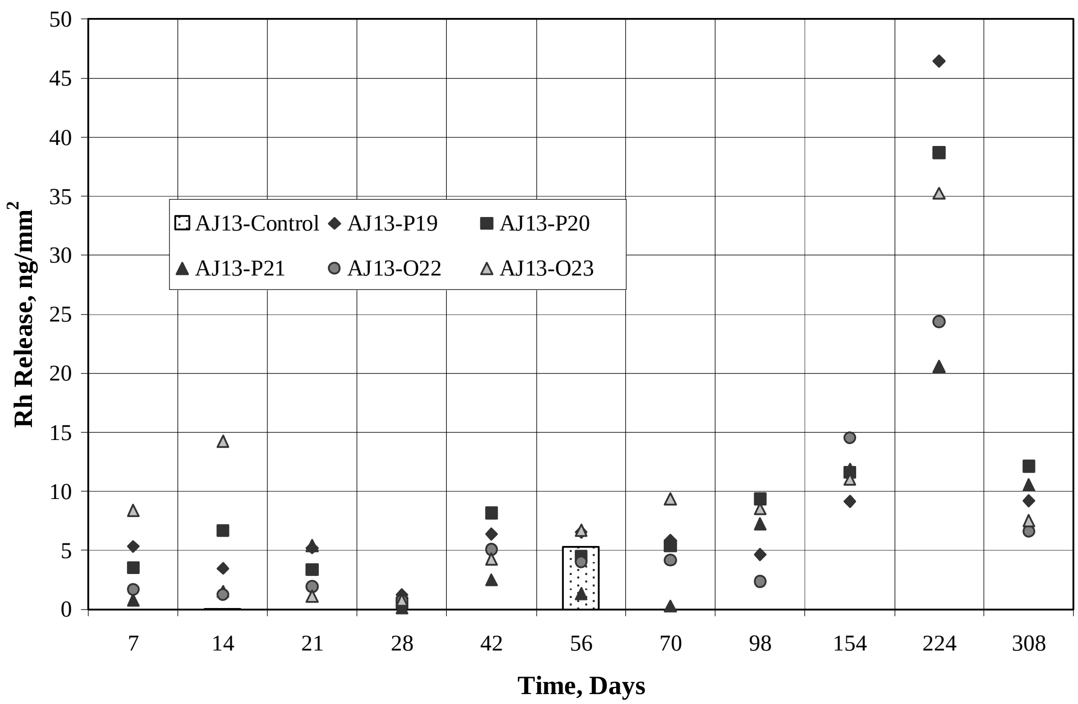


Figure H-26. Rhodium Releases in AJ13 solution at 90ºC.

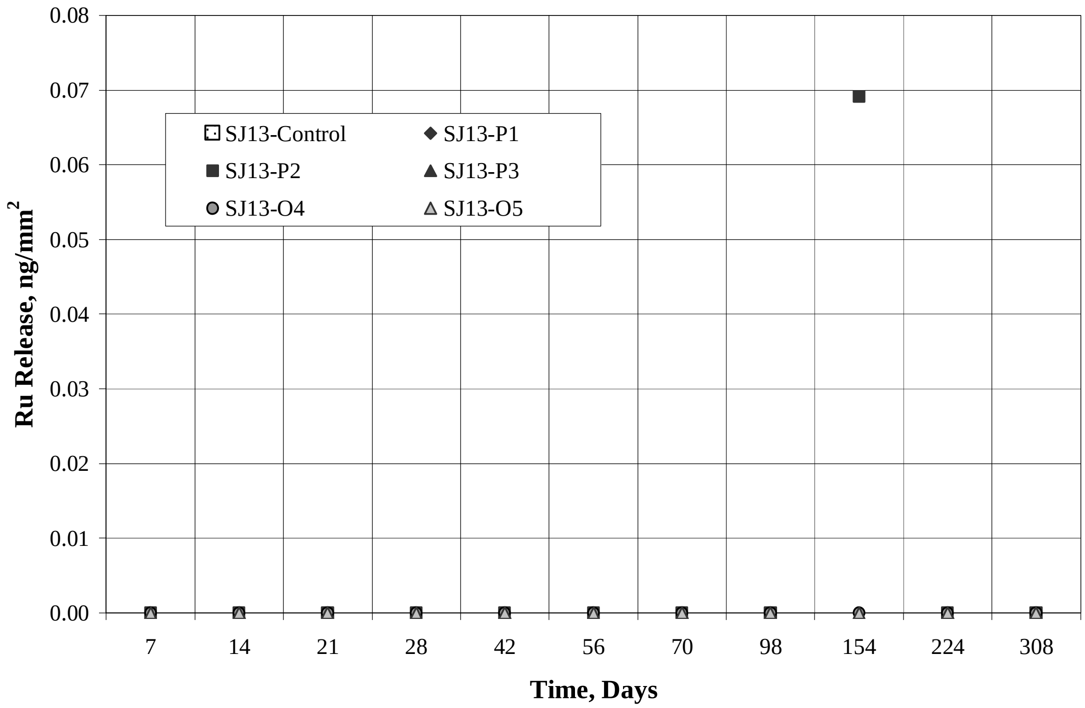


Figure H-27. Ruthenium Releases in SJ13 solution at 90°C.

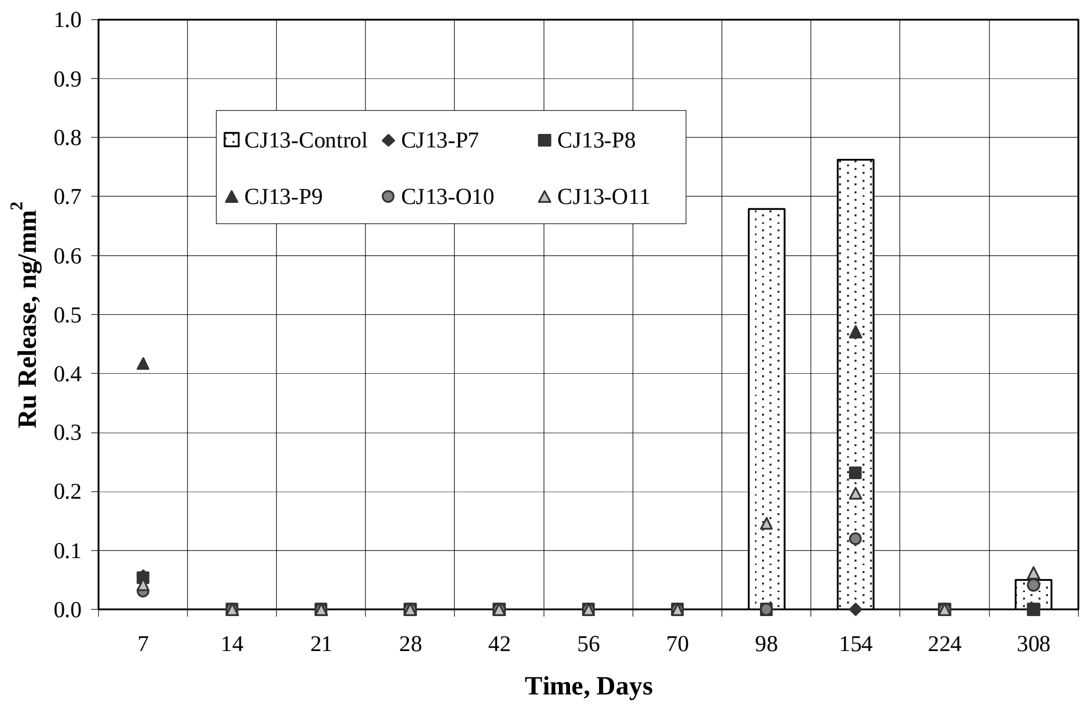


Figure H-28. Ruthenium Releases in CJ13 solution at 90°C.

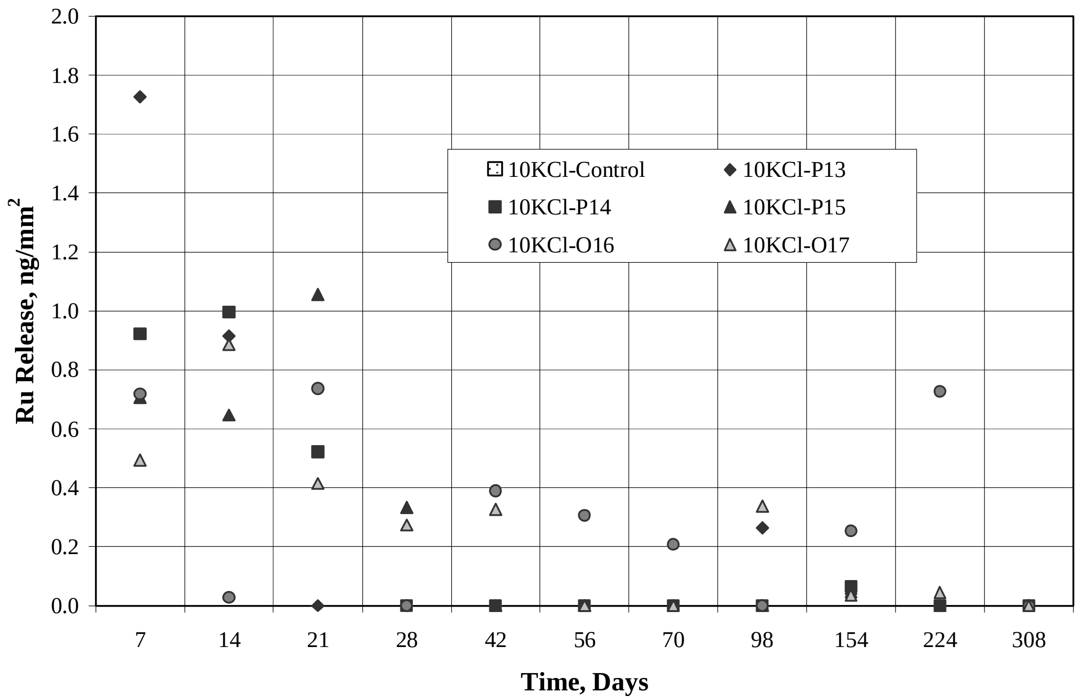


Figure H-29. Ruthenium Releases in 10KCl solution at 90ºC.

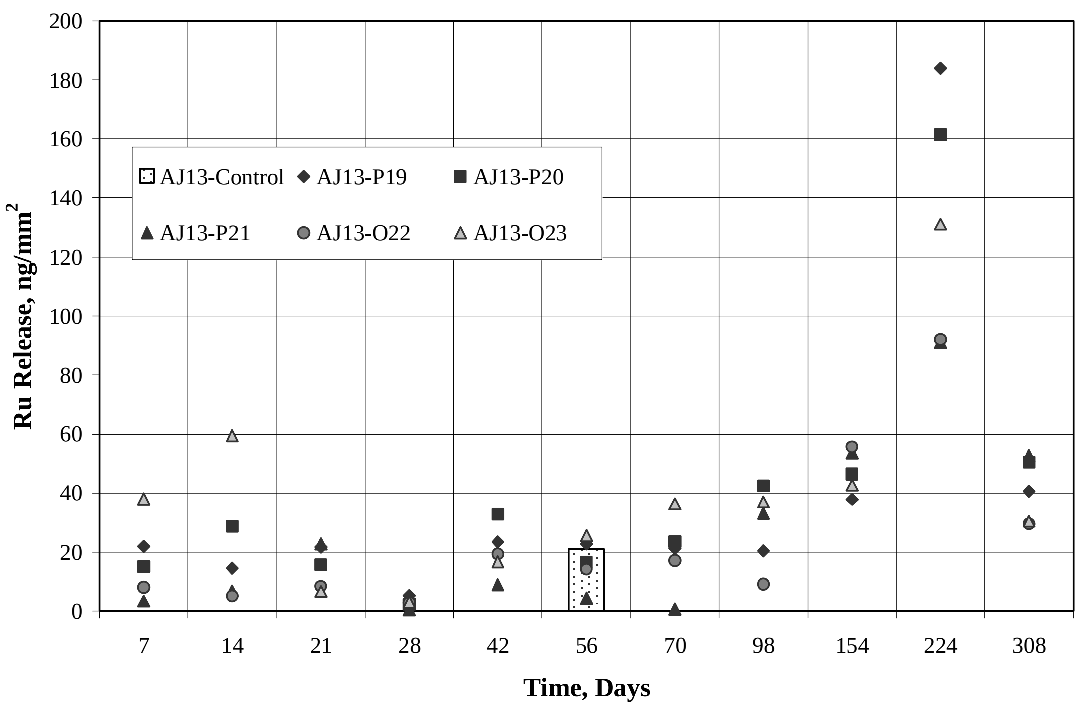


Figure H-30. Ruthenium Releases in AJ13 solution at 90ºC.

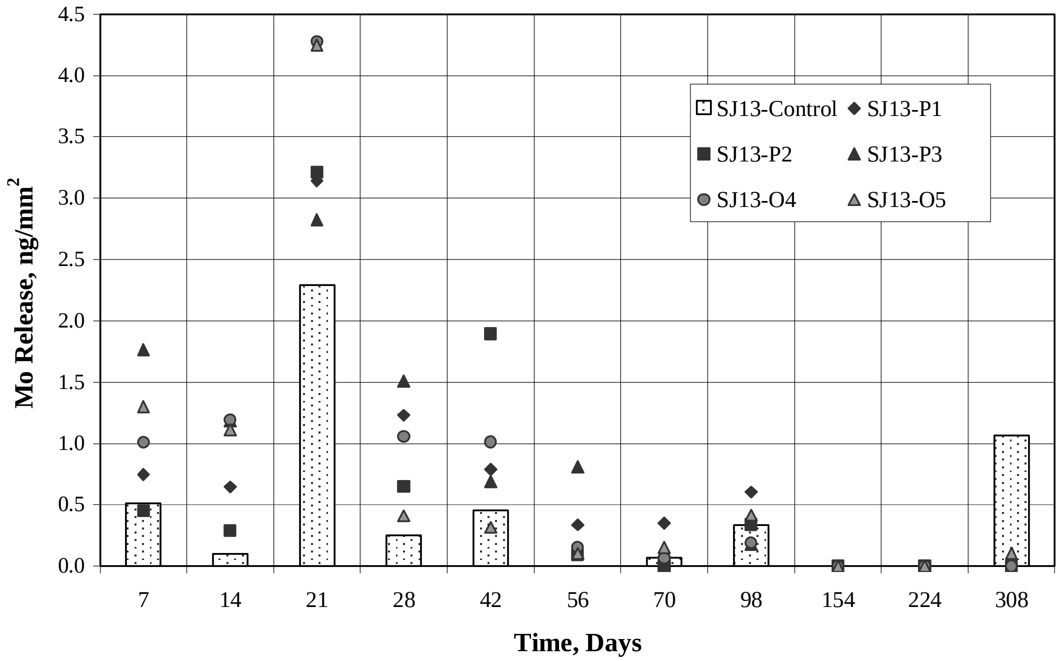


Figure H-31. Molybdenum Releases in SJ13 solution at 90ºC.

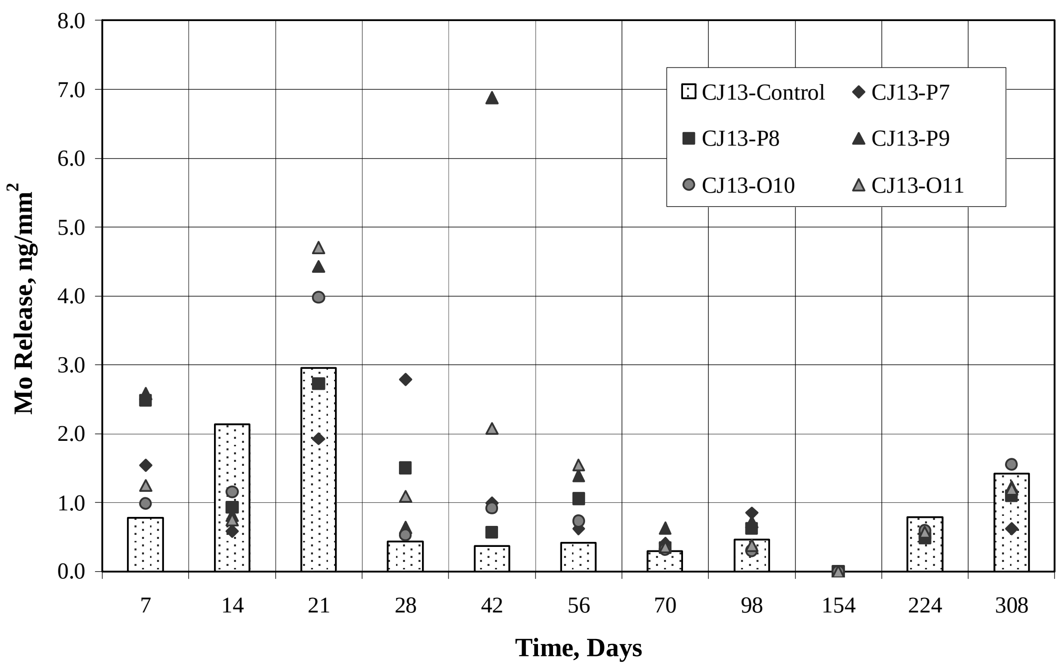


Figure H-32. Molybdenum Releases in CJ13 solution at 90ºC.

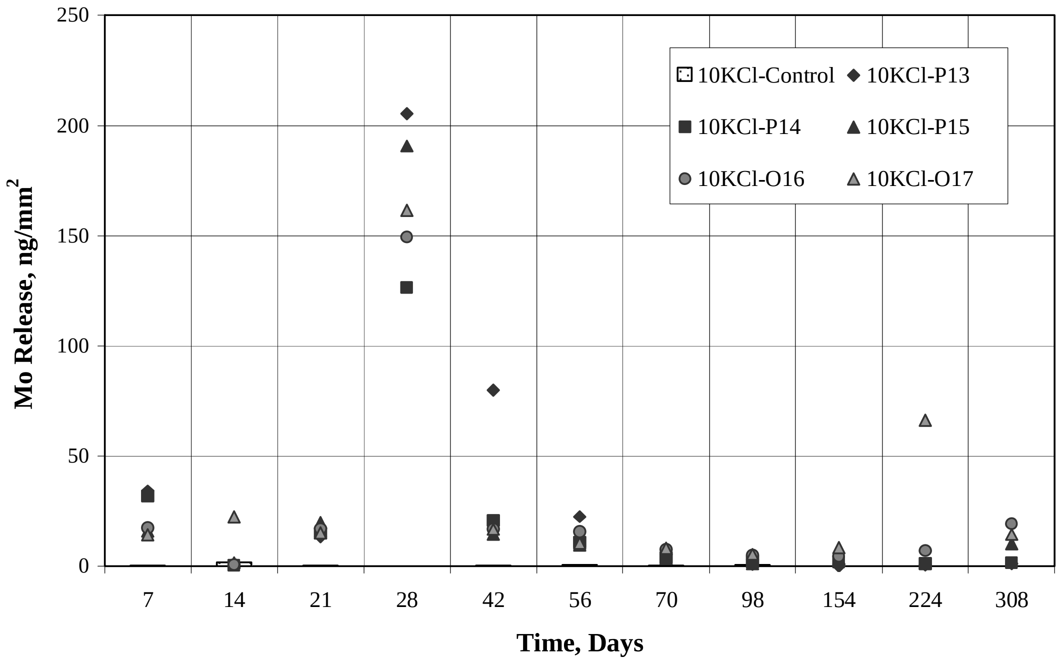


Figure H-33. Molybdenum Releases in 10KCl solution at 90ºC.

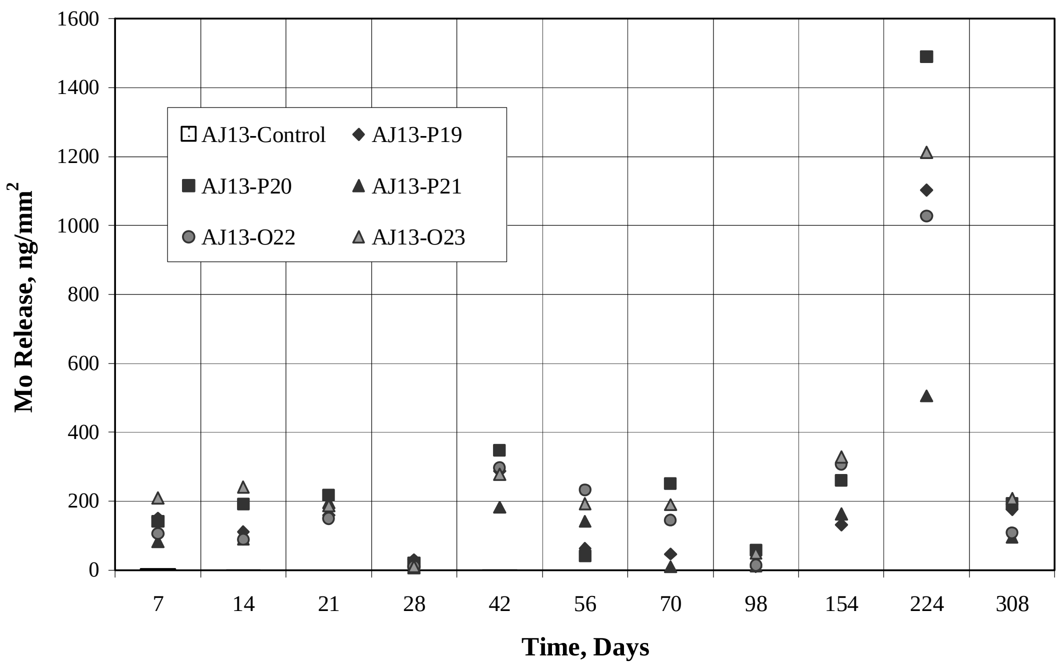


Figure H-34. Molybdenum Releases in AJ13 solution at 90ºC.

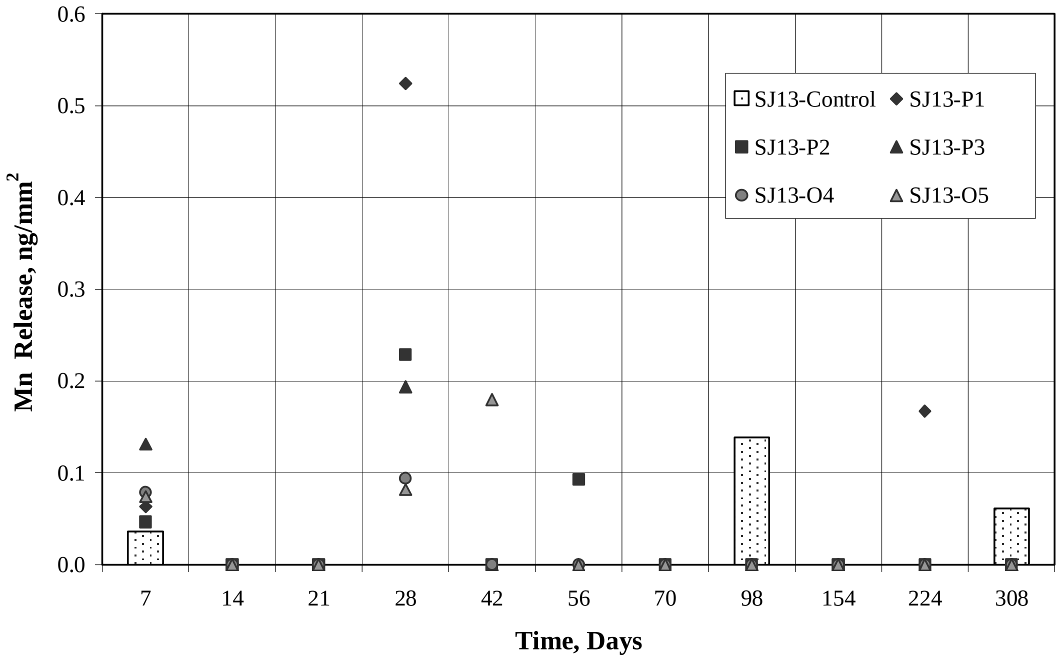


Figure H-35. Manganese Releases in SJ13 solution at 90ºC.

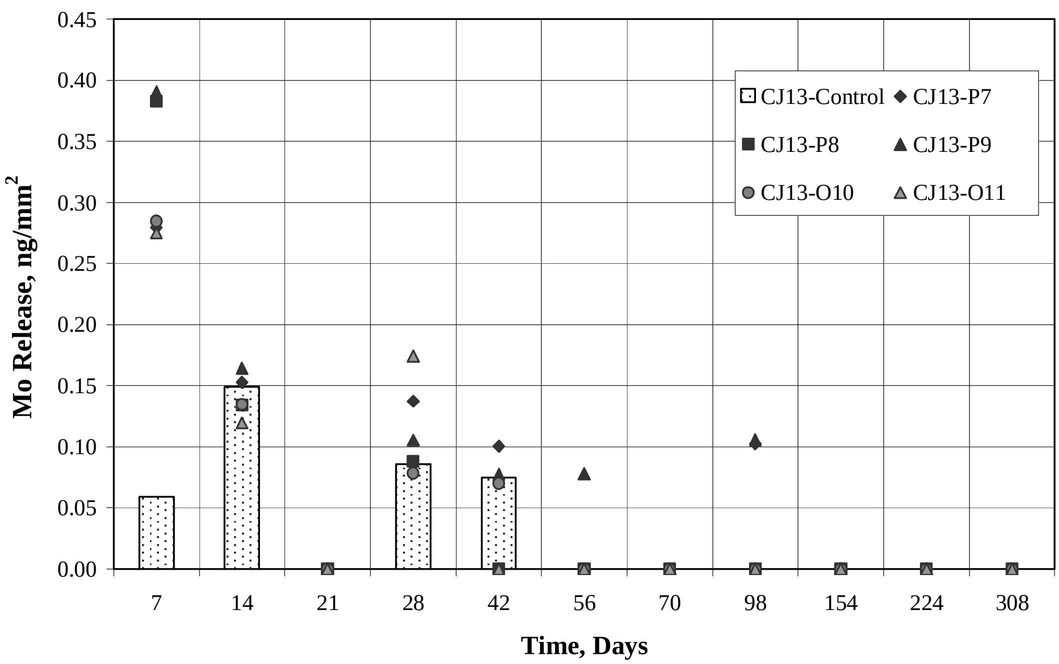


Figure H-36. Manganese Releases in CJ13 solution at 90ºC.

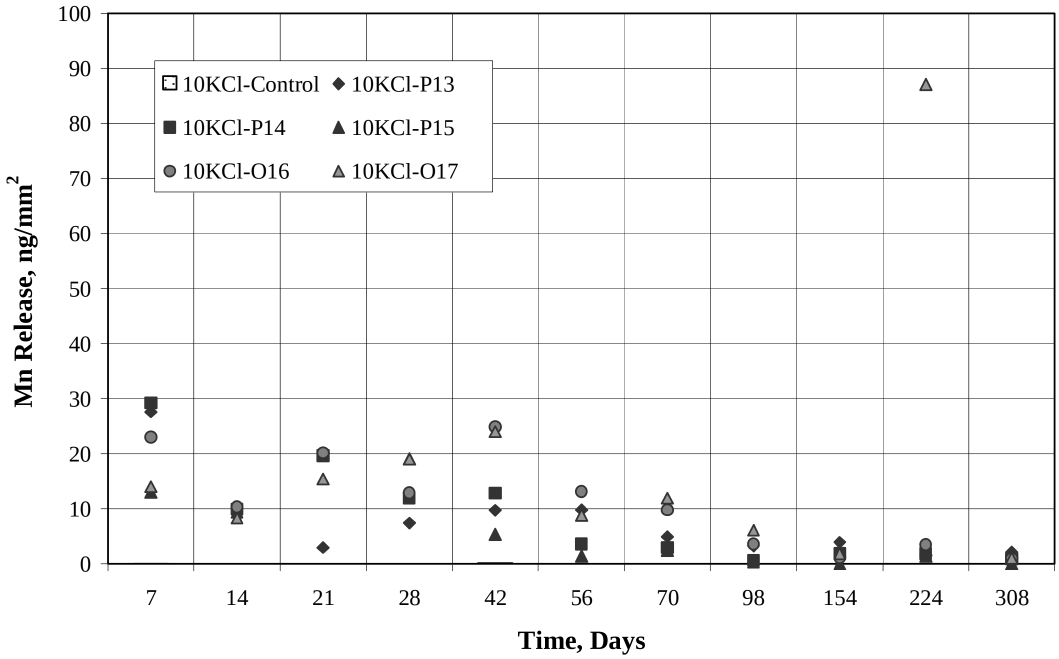


Figure H-37. Manganese Releases in 10KCl solution at 90ºC.

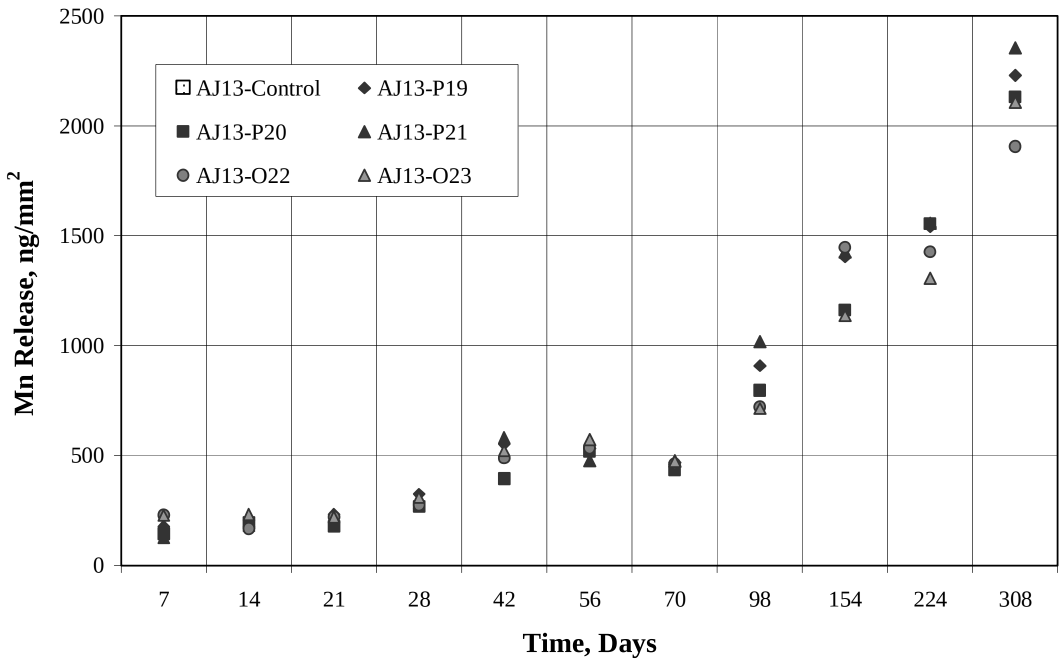


Figure H-38. Manganese Releases in AJ13 solution at 90ºC.

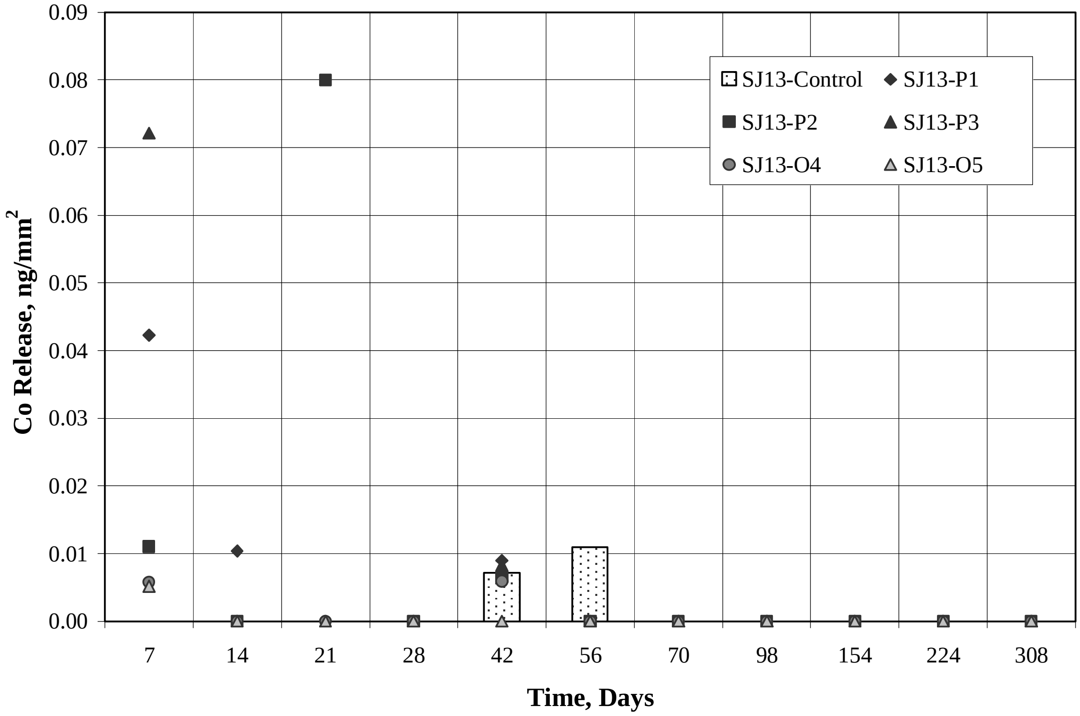


Figure H-39. Cobalt Releases in SJ13 solution at 90°C.

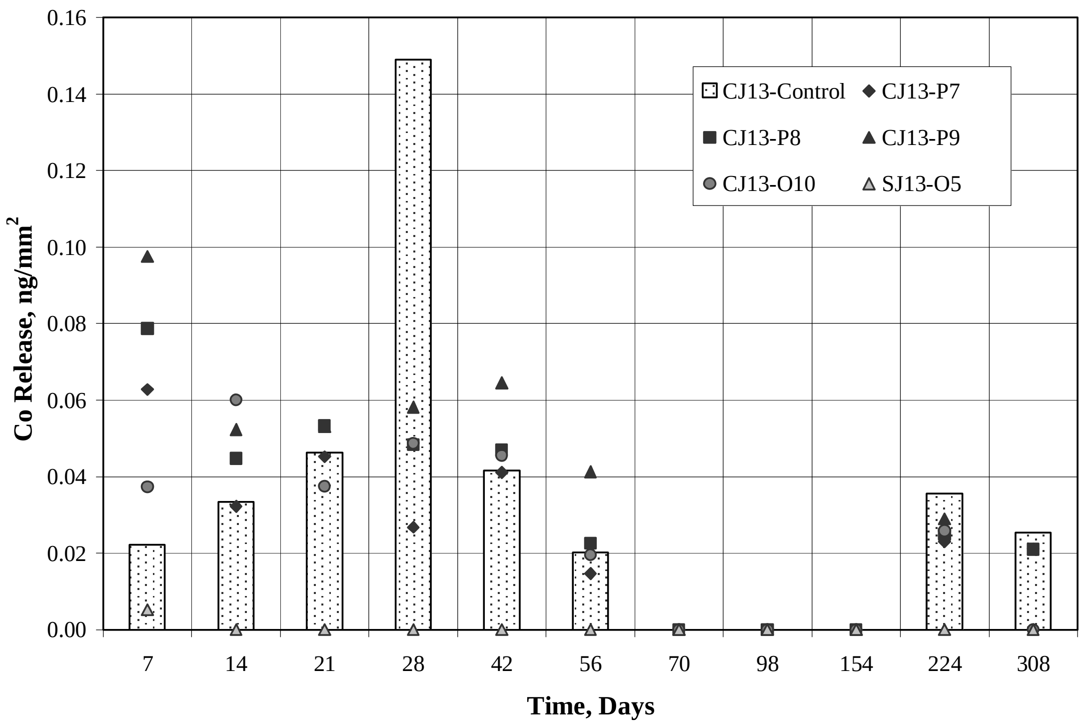


Figure H-40. Cobalt Releases in CJ13 solution at 90°C.

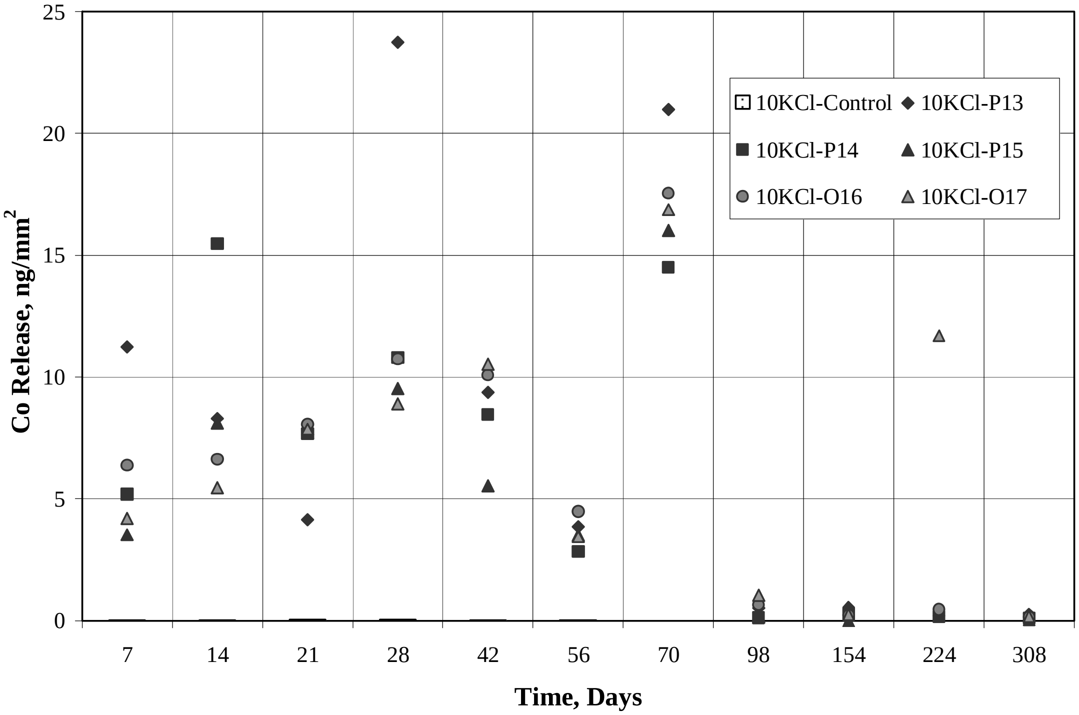


Figure H-41. Cobalt Releases in 10KCl solution at 90ºC.

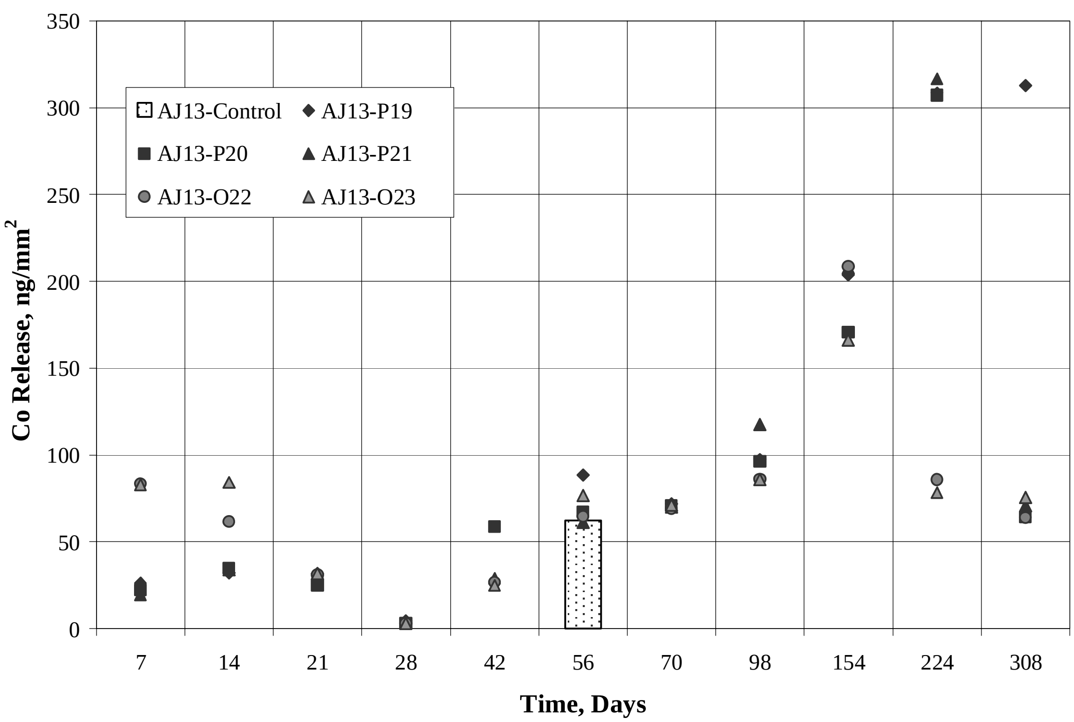


Figure H-42. Cobalt Releases in AJ13 solution at 90ºC.

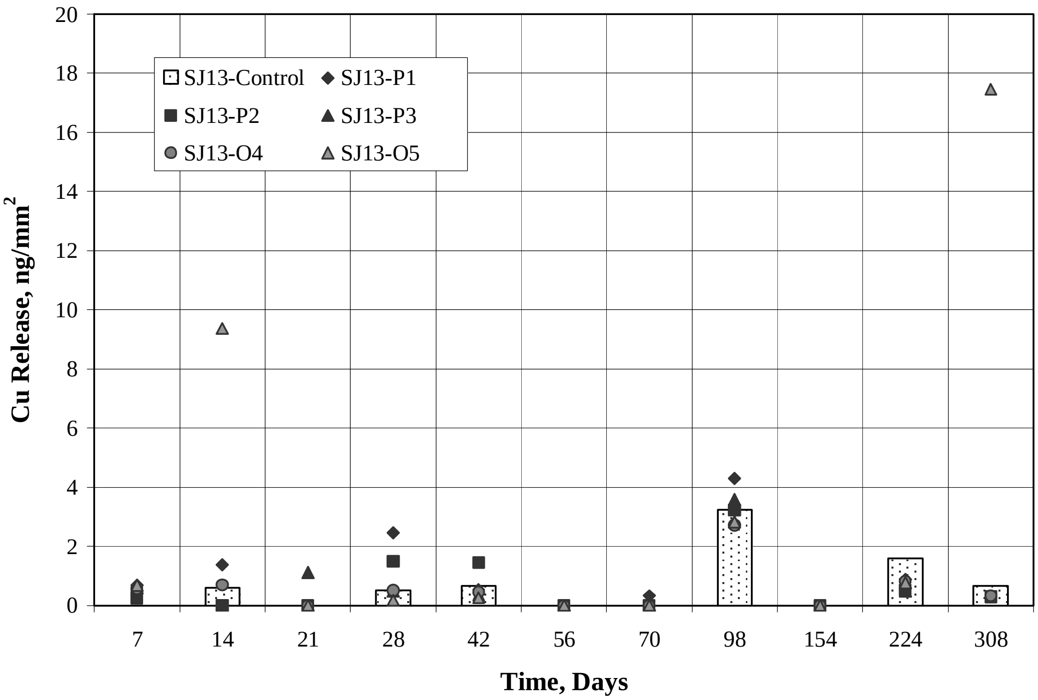


Figure H-43. Copper Releases in SJ13 solution at 90°C.

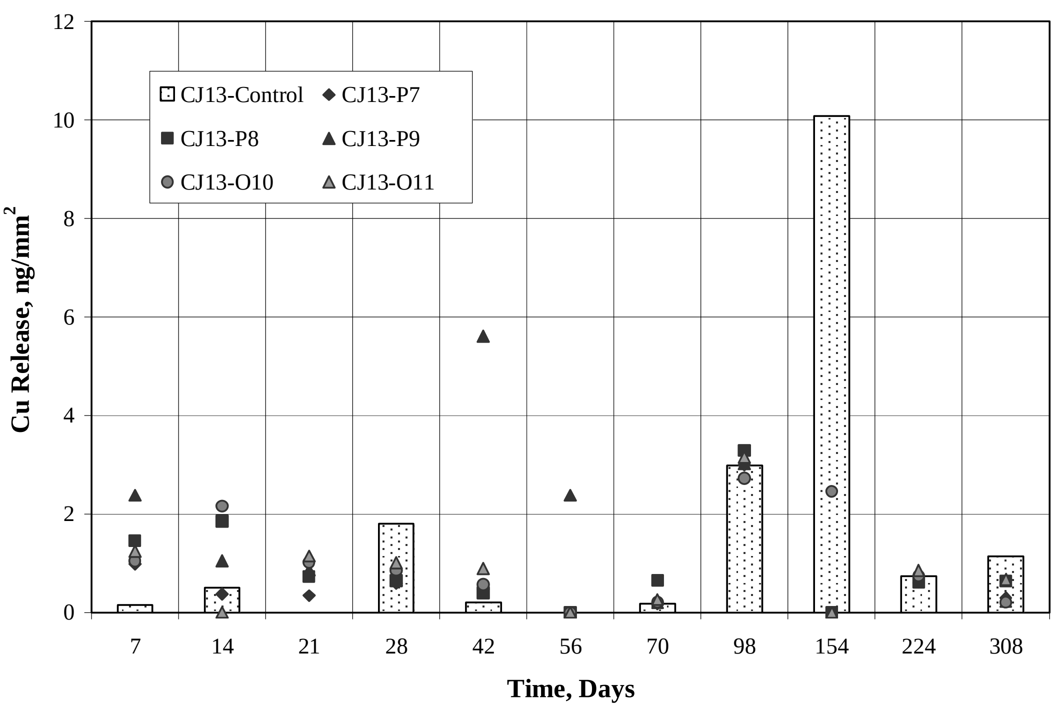


Figure H-44. Copper Releases in CJ13 solution at 90°C.

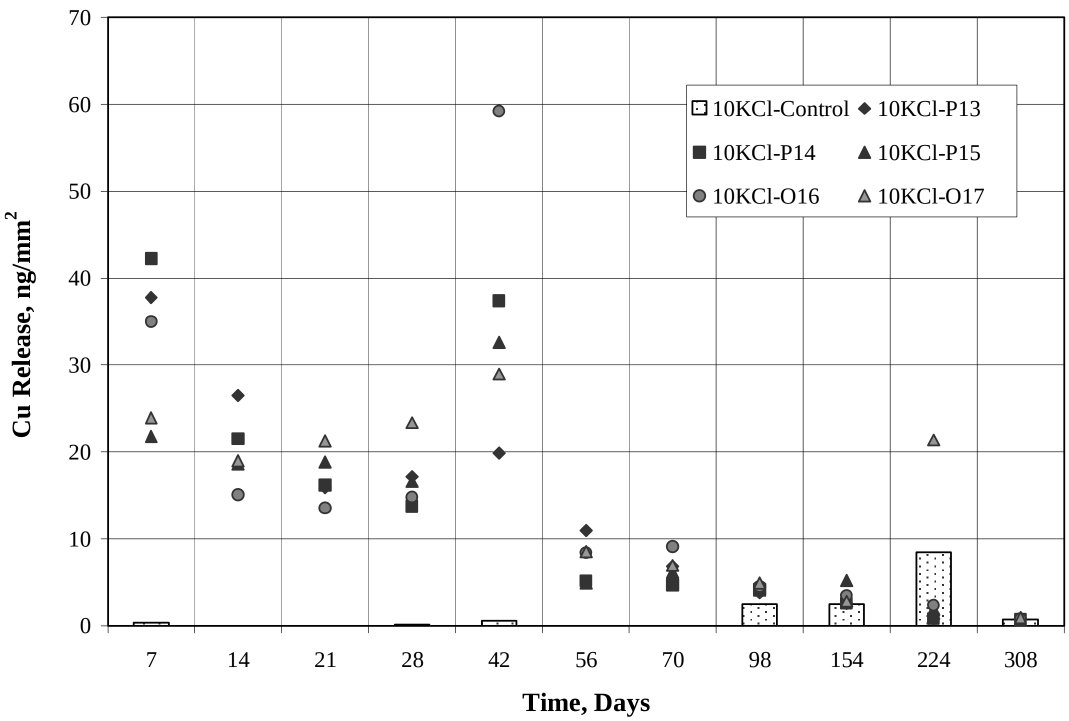


Figure H-45. Copper Releases in 10KCl solution at 90ºC.

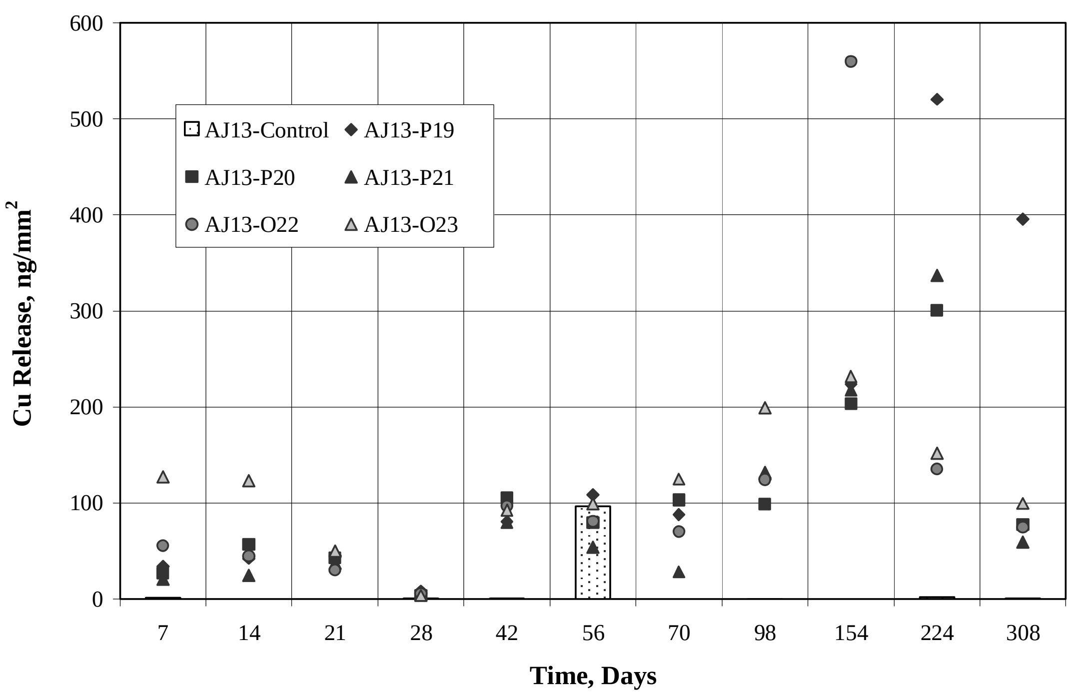


Figure H-46. Copper Releases in AJ13 solution at 90ºC.

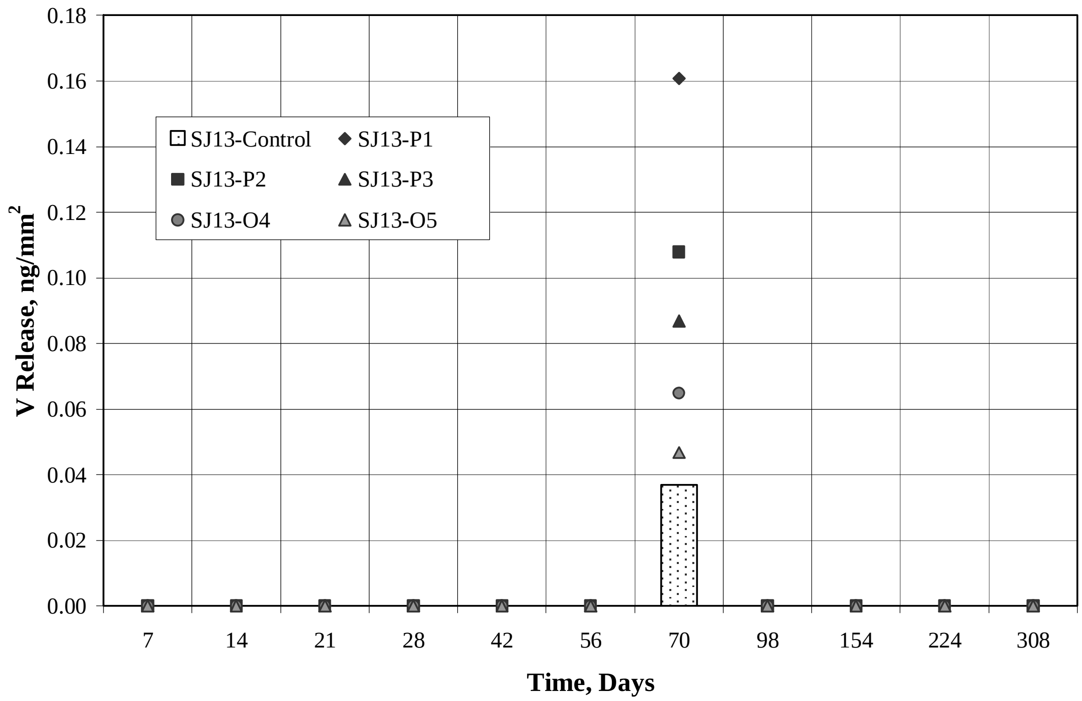


Figure H-47. Vanadium Releases in SJ13 solution at 90°C.

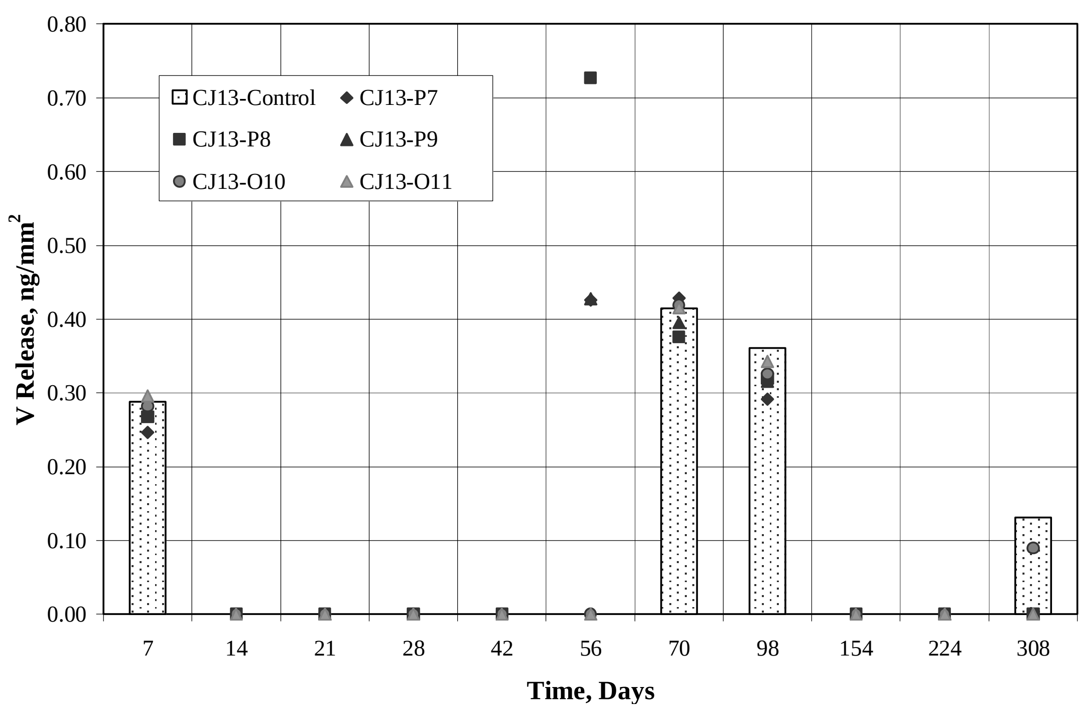


Figure H-48. Vanadium Releases in CJ13 solution at 90°C.

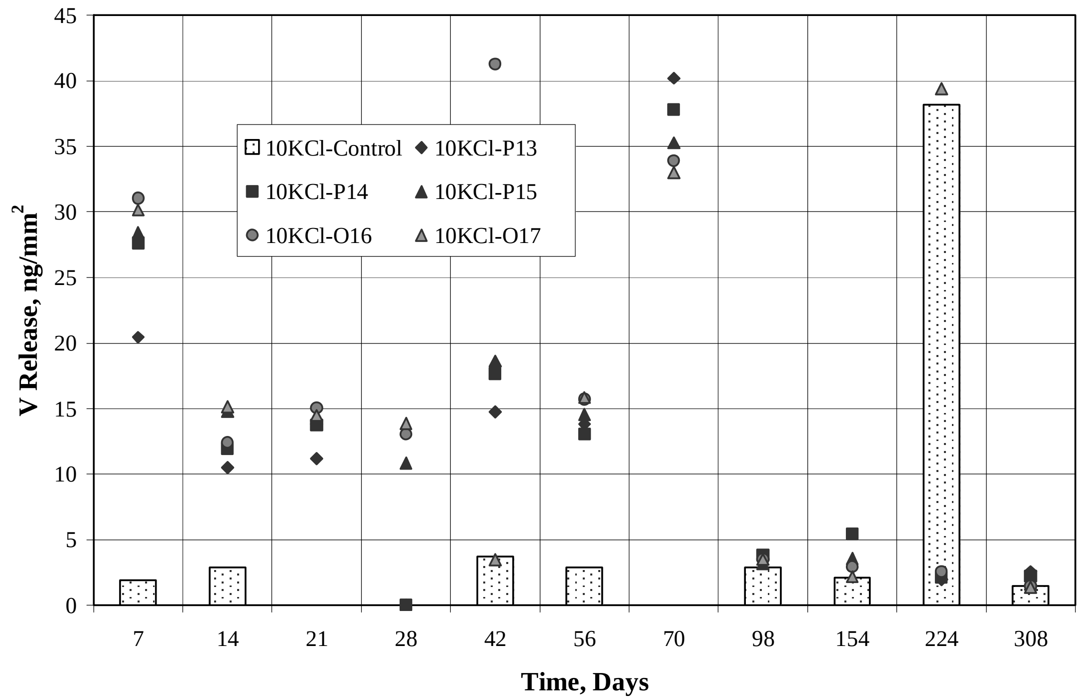


Figure H-49. Vanadium Releases in 10KCl solution at 90ºC.

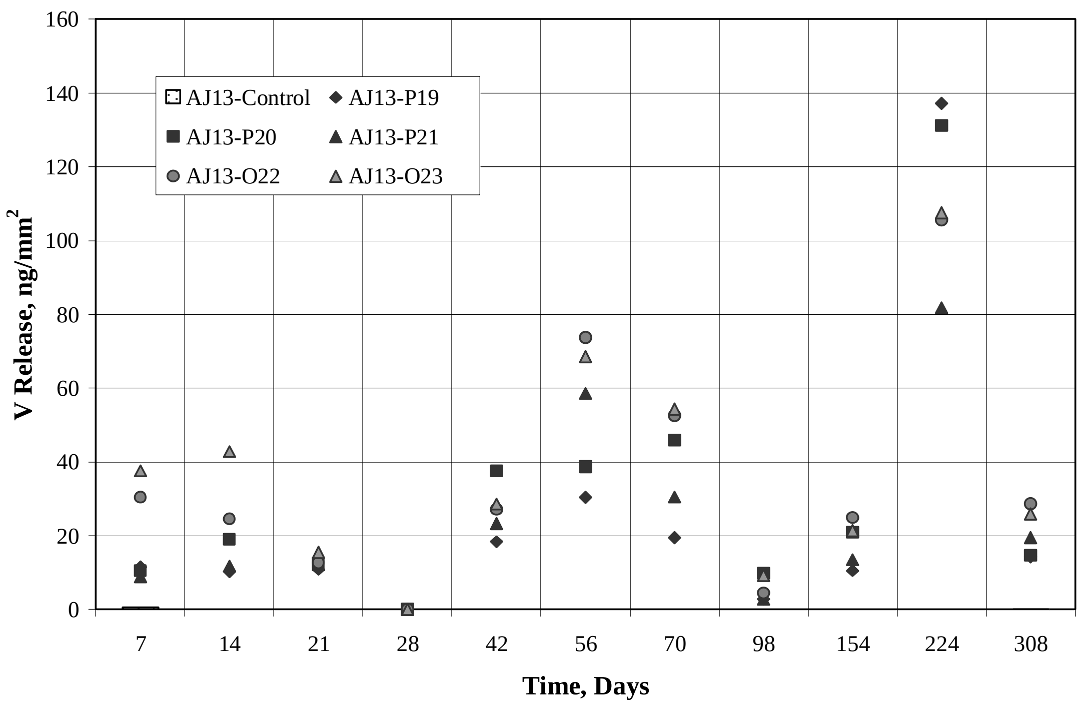


Figure H-50. Vanadium Releases in AJ13 solution at 90ºC.

J. Supplementary Tests—Releases and Detection Limits

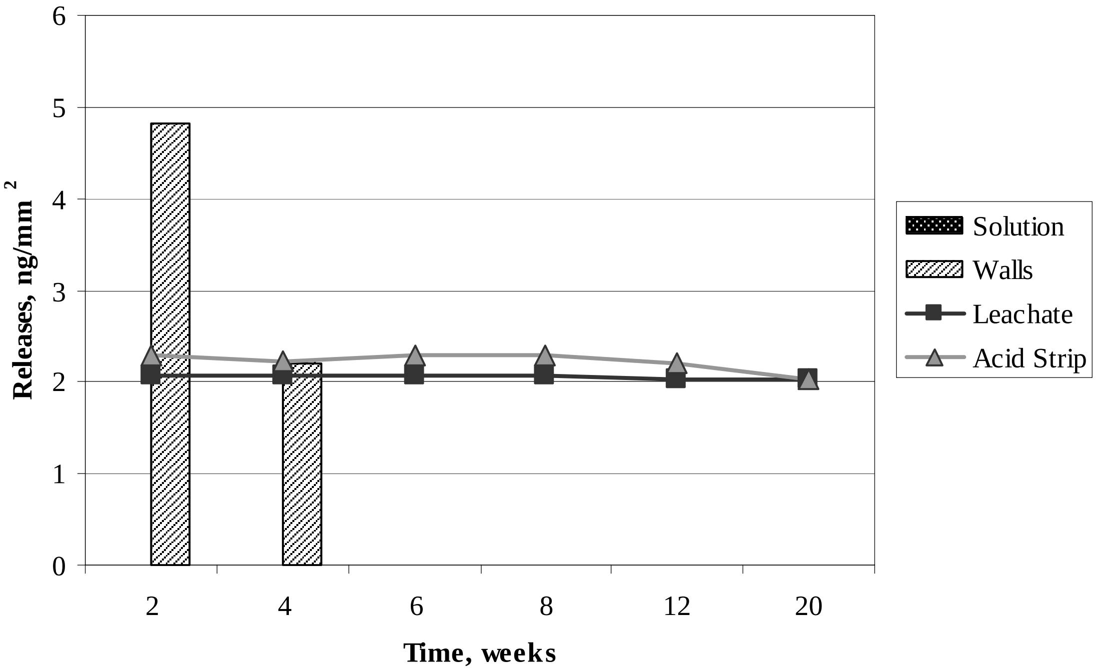


Figure J-1. Iron Releases in Solution and on Walls from Polished Sample 25 in 1KCl Solution at 90ºC and Average Detection Limits for Leachate and Acid Strip.

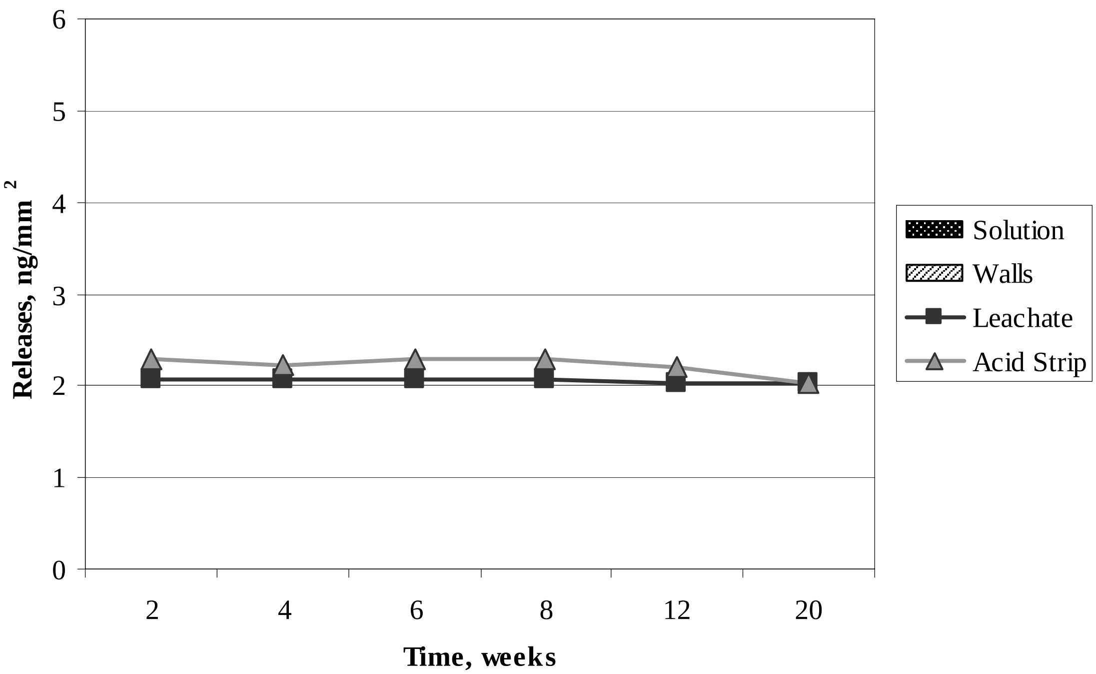


Figure J-2. Iron Present in Solutions and on Walls in 1KCl Solution Control at 90ºC and Average Detection Limits for Leachate and Acid Strip.

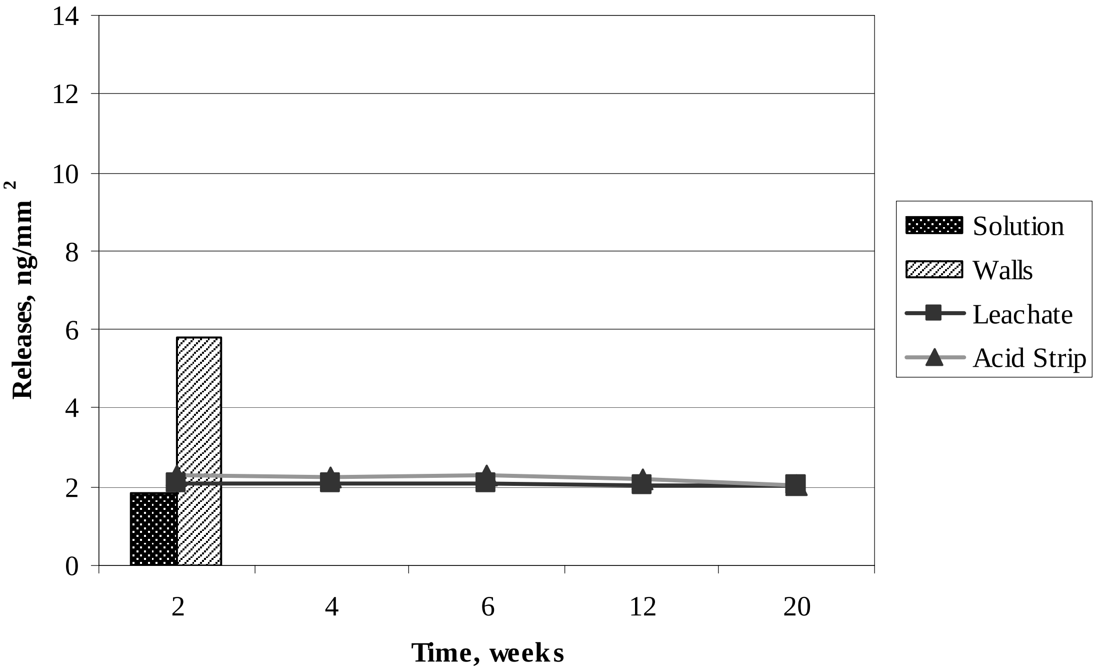


Figure J-3. Iron Releases in Solution and on Walls from Polished Sample 27 in 1KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

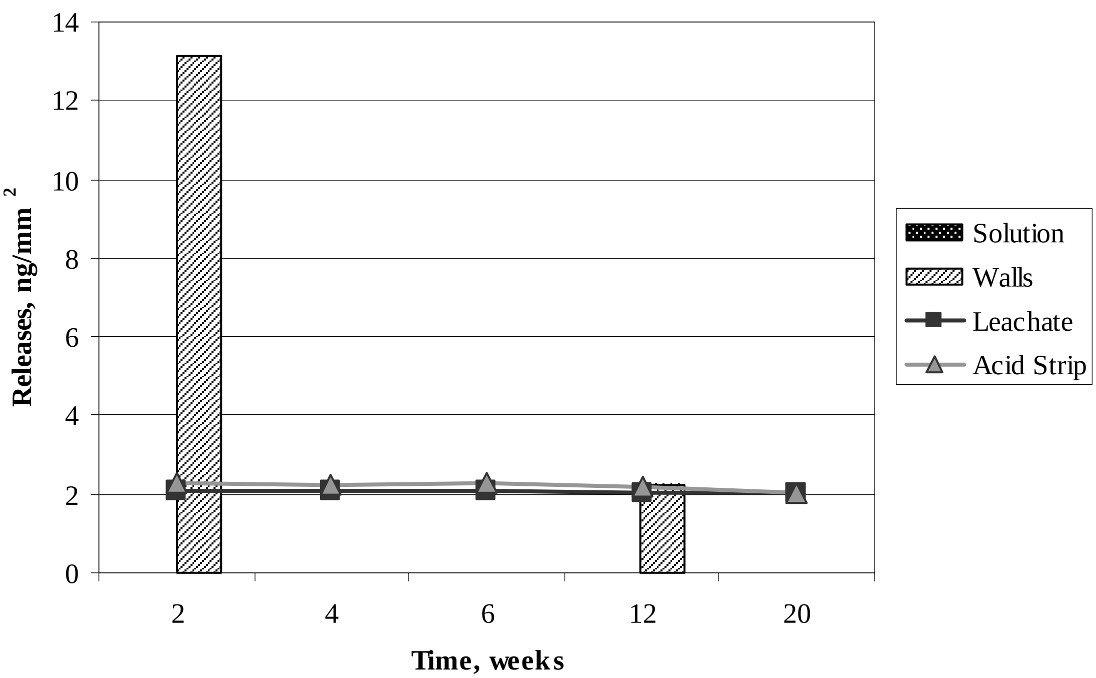


Figure J-4. Iron Present in Solution and on Walls for 1KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

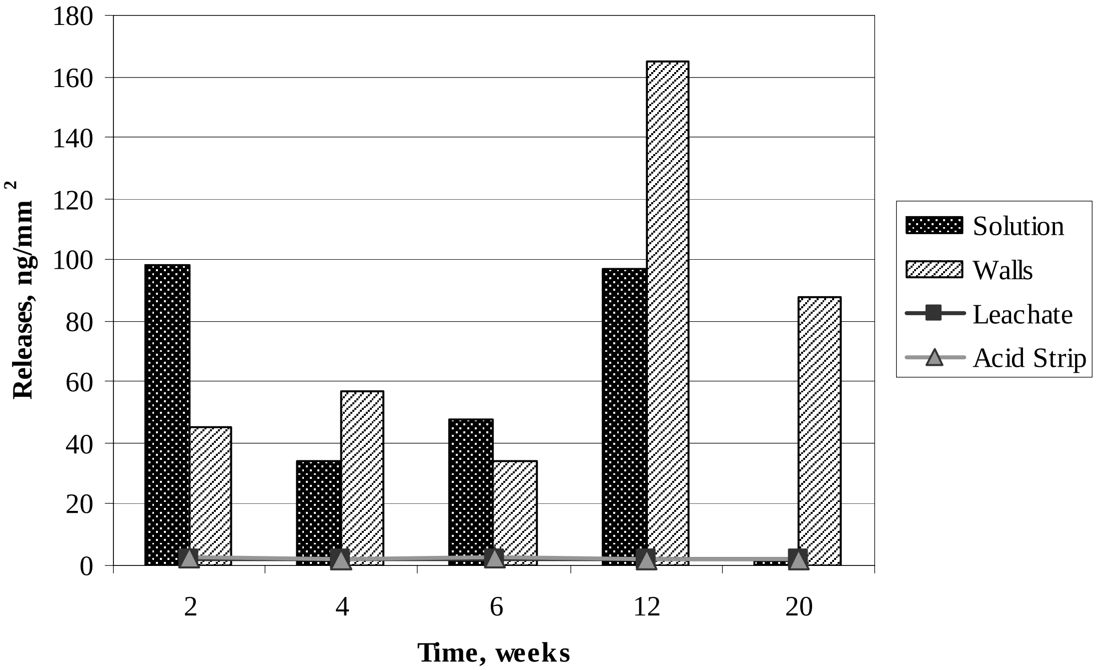


Figure J-5. Iron Releases in Solution and on Walls from Polished Sample 29 in 10KCl at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

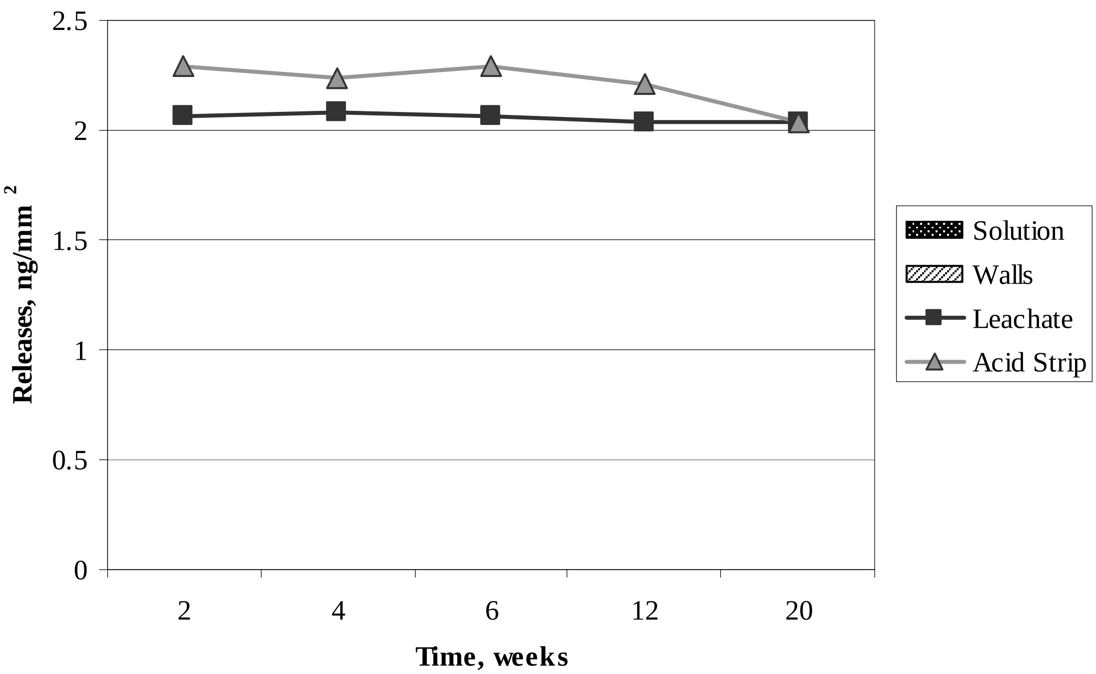


Figure J-6. Iron Present in Solution and on Walls for 10KCl Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

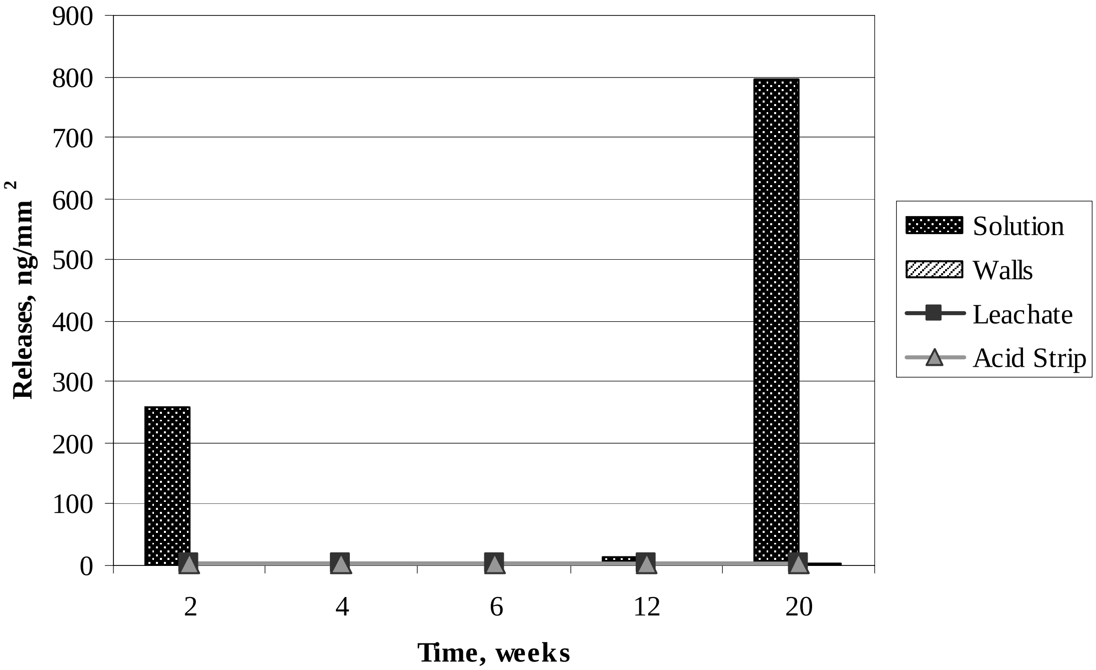


Figure J-7. Iron Releases in Solution and on Walls from Polished Sample 31 in AJ13 pH=2 at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

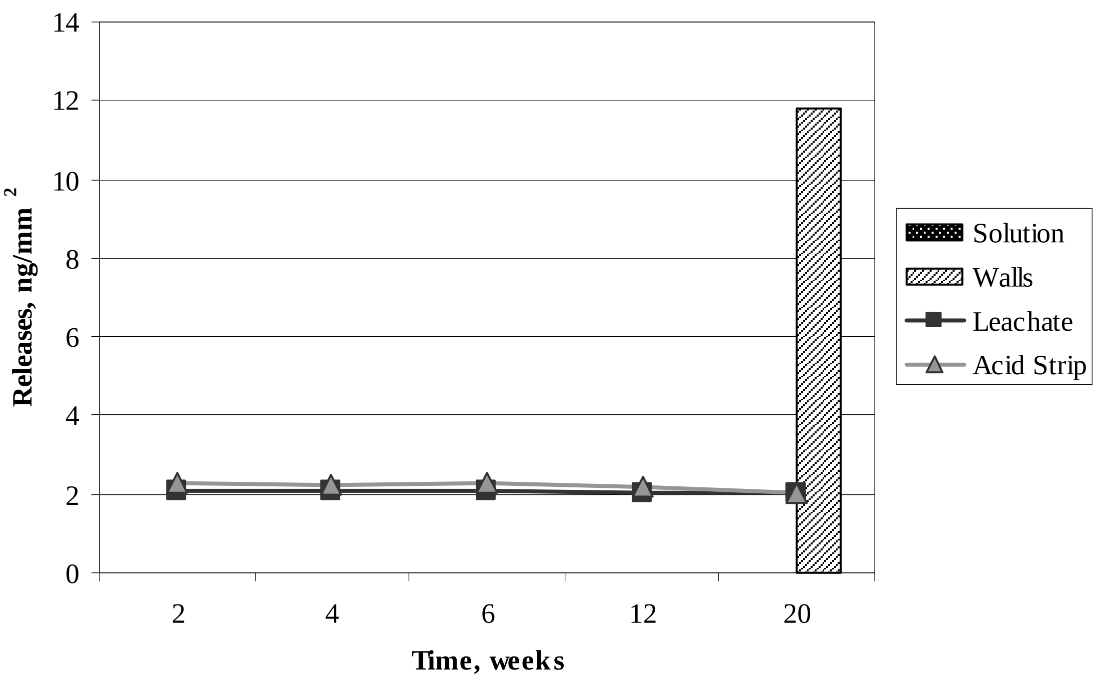


Figure J-8. Iron Present in Solution and on Walls for AJ13 pH=2 at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

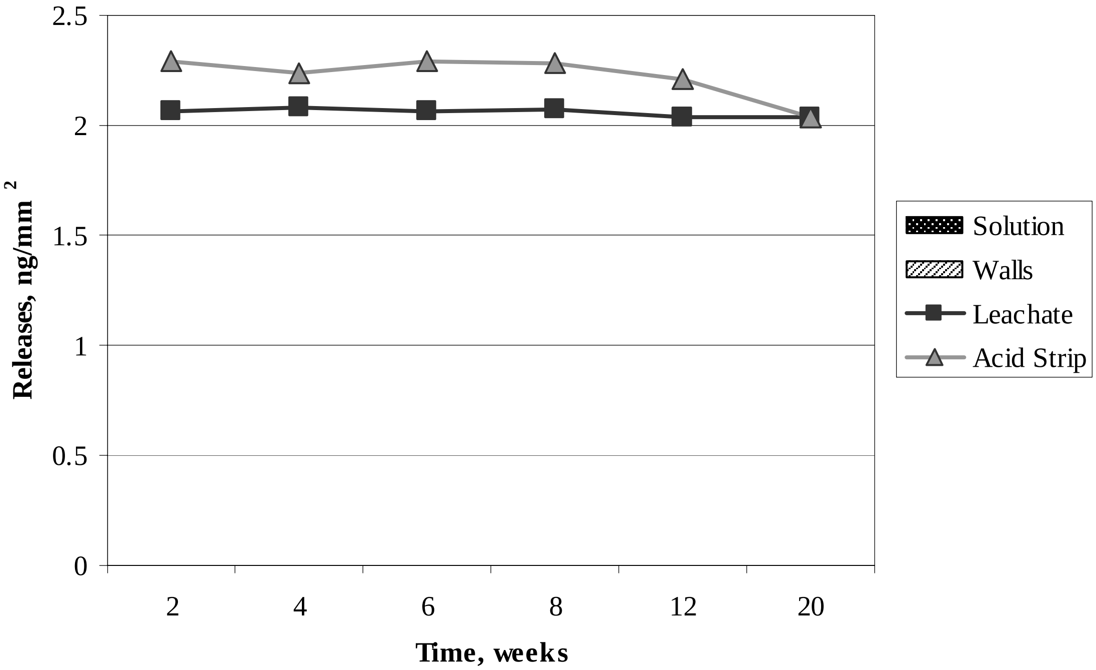


Figure J-9. Chromium Releases in Solution and on Walls from Polished Sample 25 in 1KCl at 90ºC and Average Detection Limits for Leachate and Acid Strip.

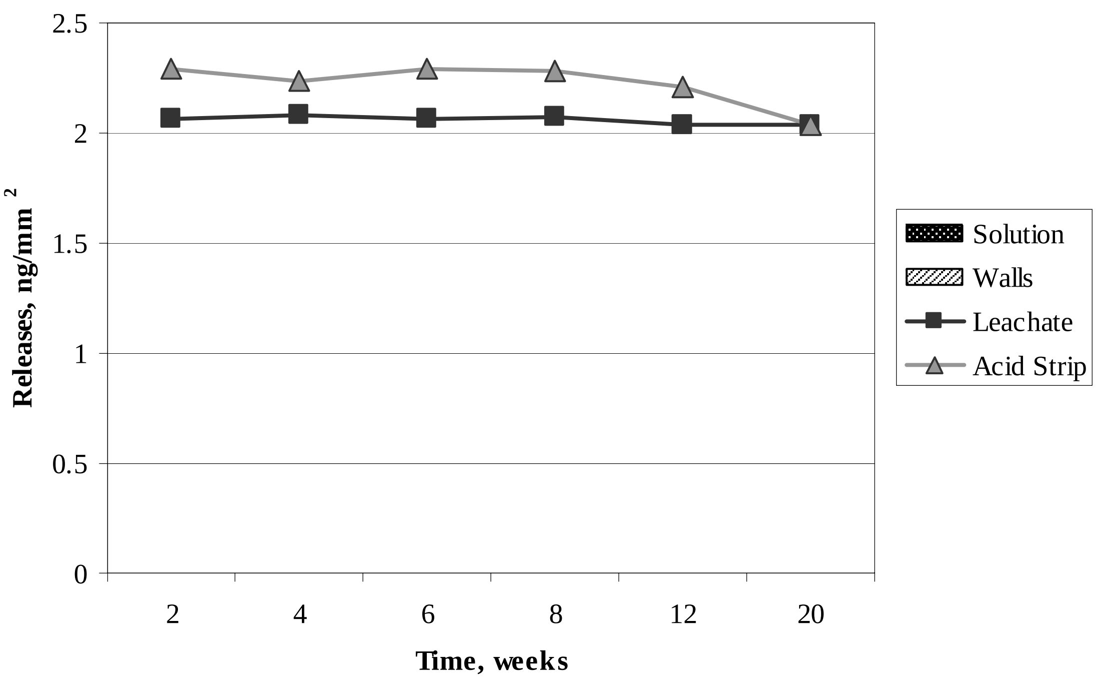


Figure J-10. Chromium Present in Solution and on Walls from 1KCl Control at 90ºC and Average Detection Limits for Leachate and Acid Strip.

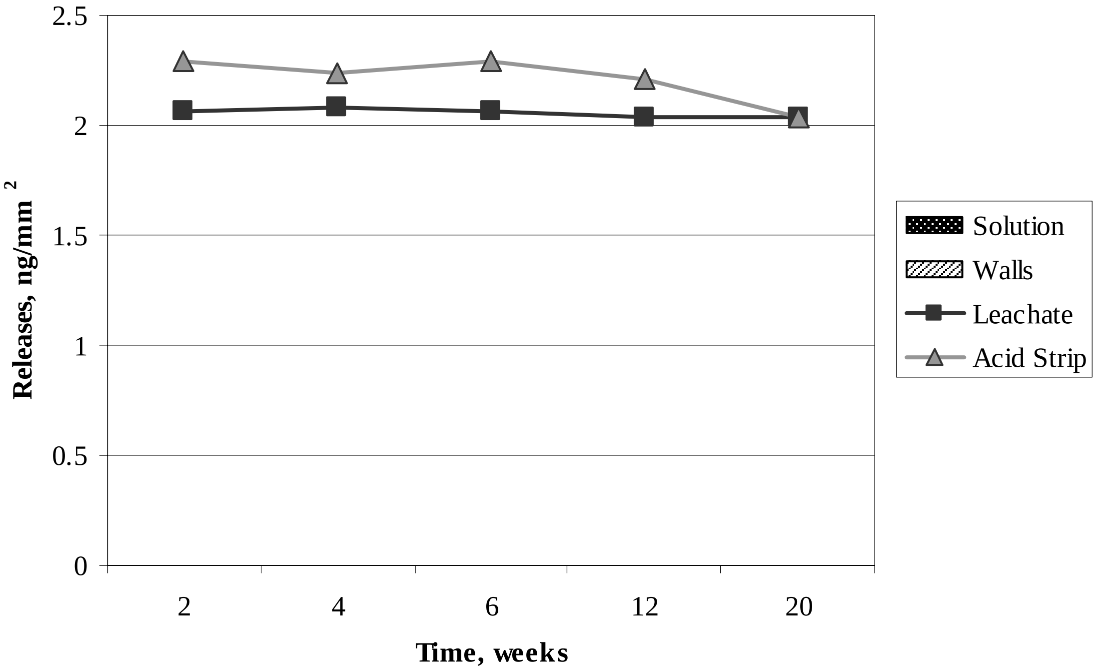


Figure J-11. Chromium Releases in Solution, on Walls, and in Residue from Polished Sample 27 in 1KCl at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

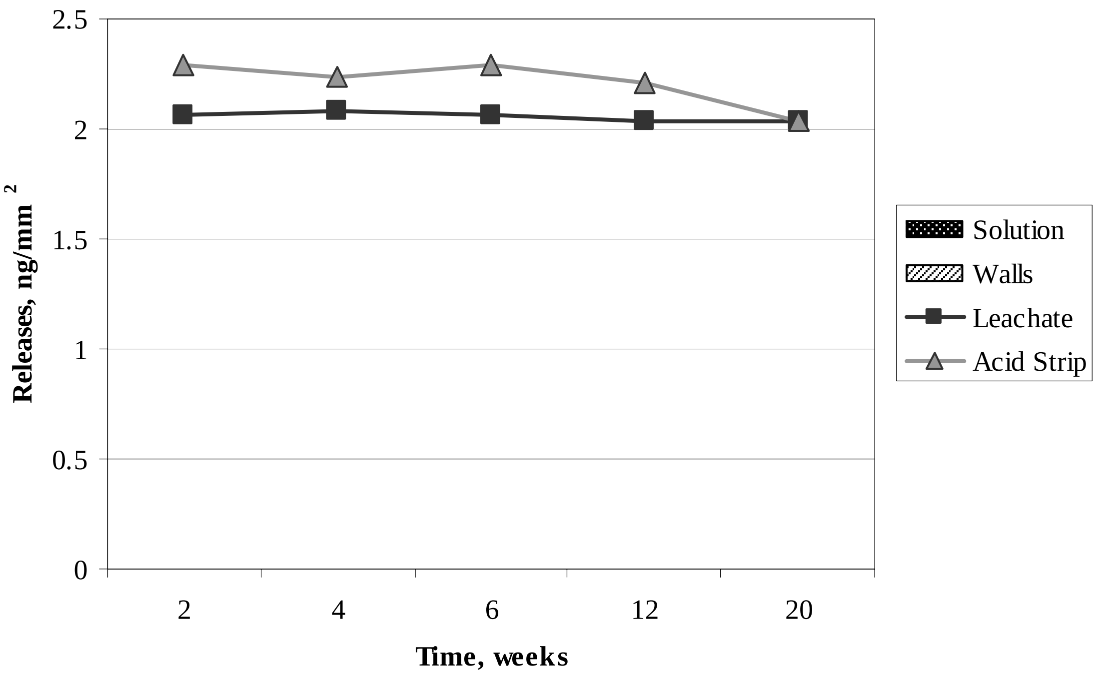


Figure J-12. Chromium Present in Solution and on Walls from 1KCl Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

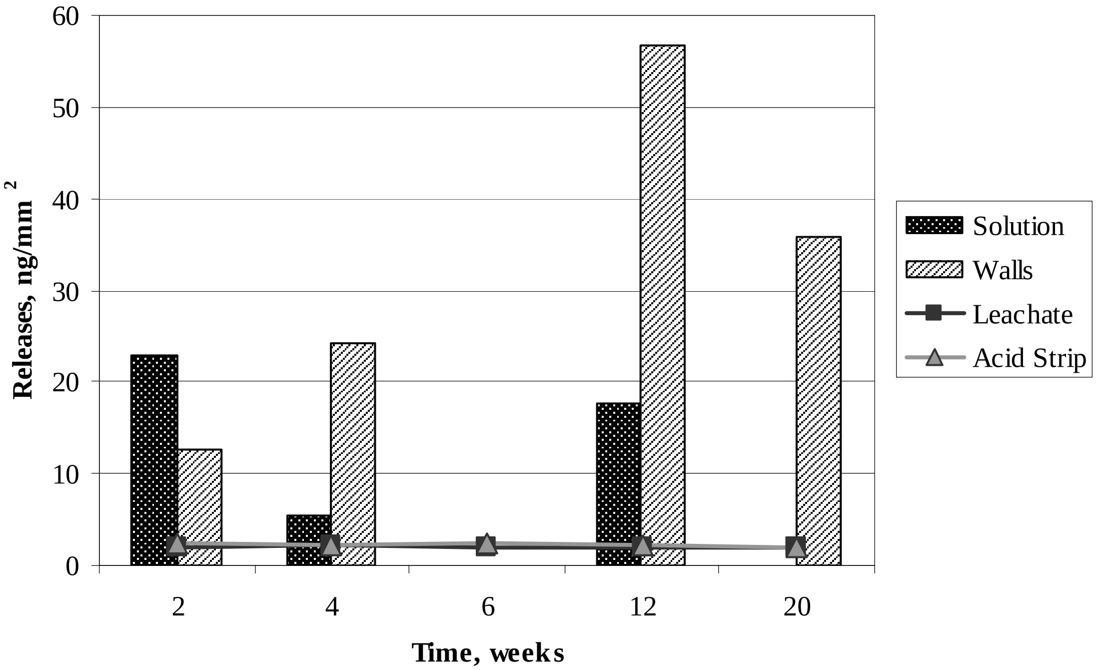


Figure J-13. Chromium Releases in Solution and on Walls from Polished Sample 29 in 10KCl at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

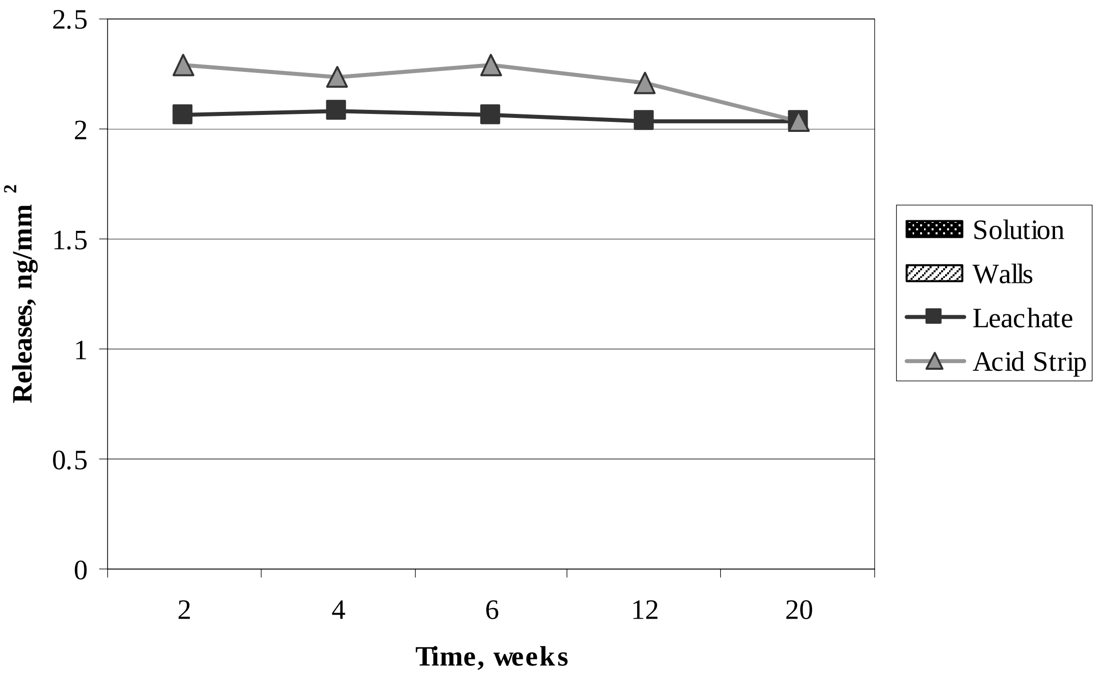


Figure J-14. Chromium Present in Solution and on Walls from 10KCl Control and Average Detection Limits for Leachate and Acid Strip Data.

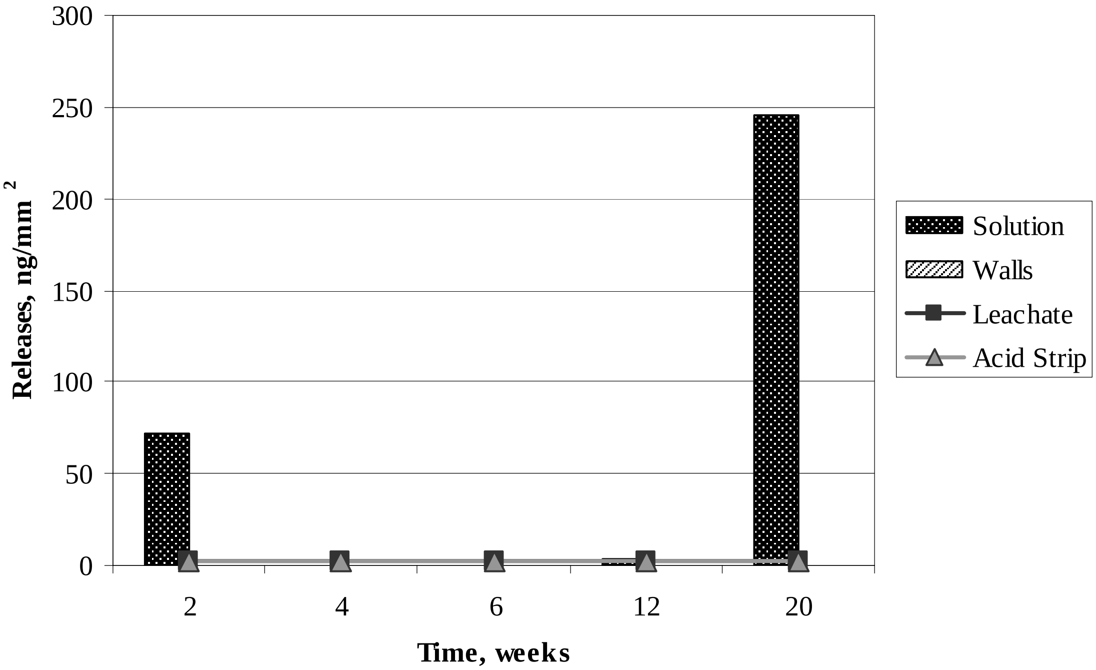


Figure J-15. Chromium Releases in Solution and on Walls from Polished Sample 31 in AJ13 at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

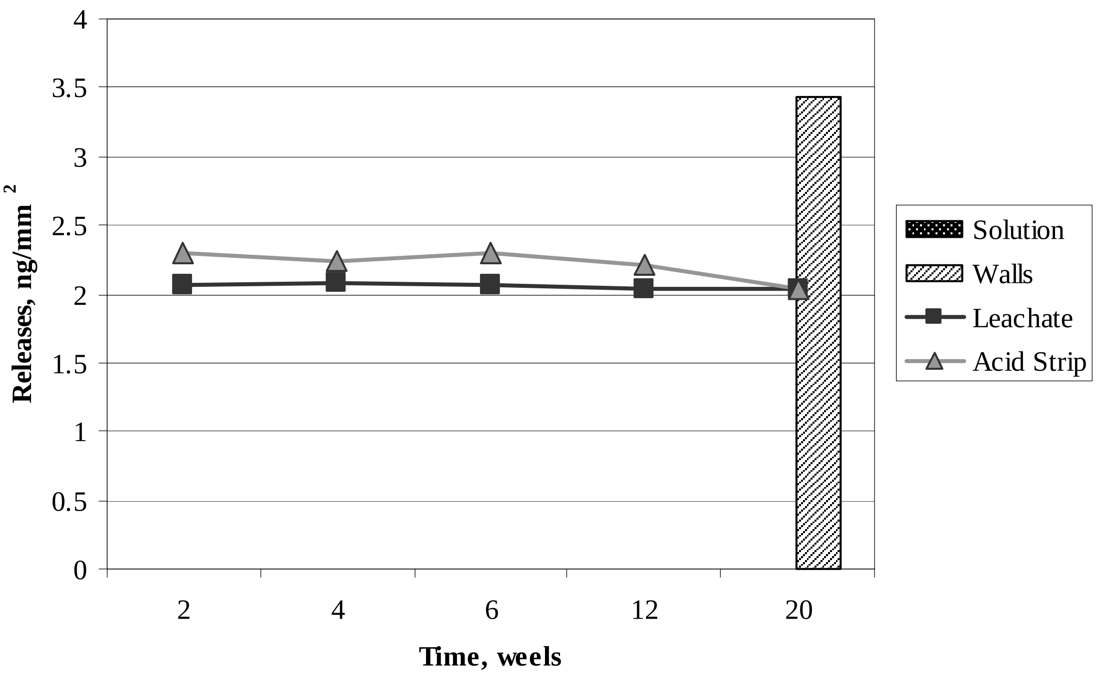


Figure J-16. Chromium Present in Solution and on Walls from AJ13 Control at Room Temperature and Average Leachate and Acid Strip Data.

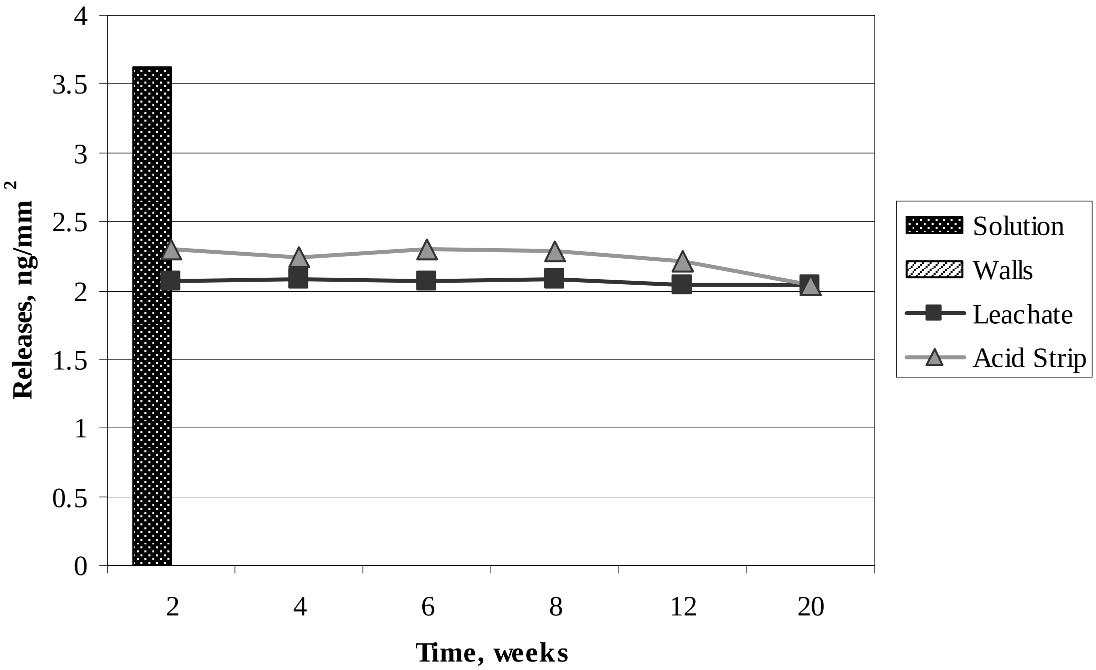


Figure J-17. Nickel Releases in Solution and on Walls from Polished Sample 25 in 1KCl Solution at 90ºC and Average Detection Limits for Leachate and Acid Strip.

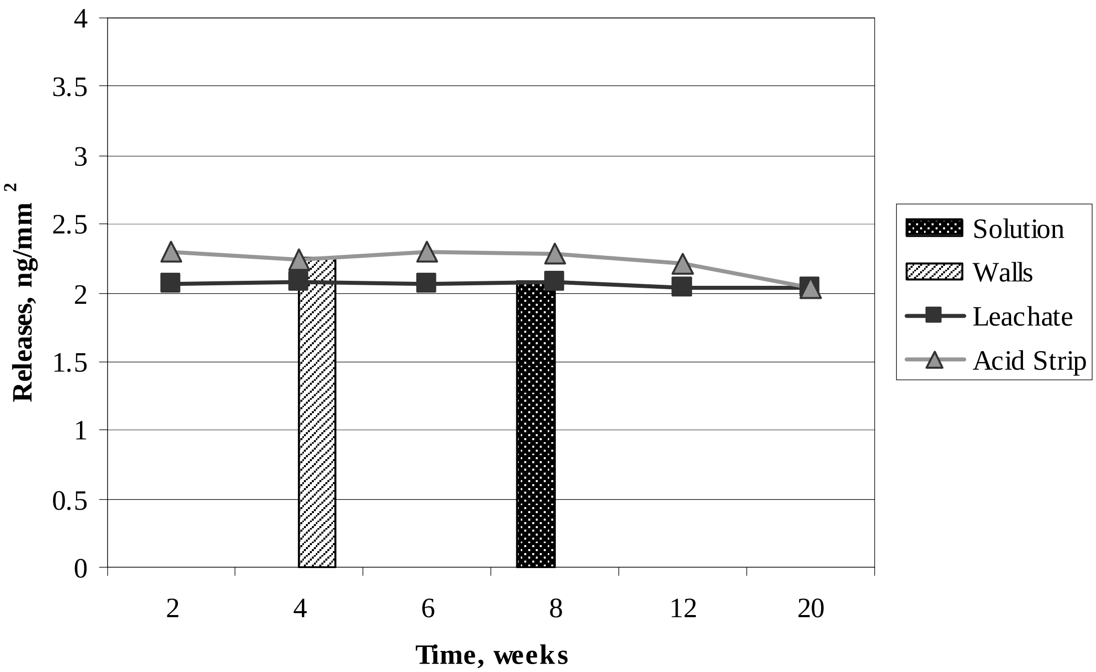
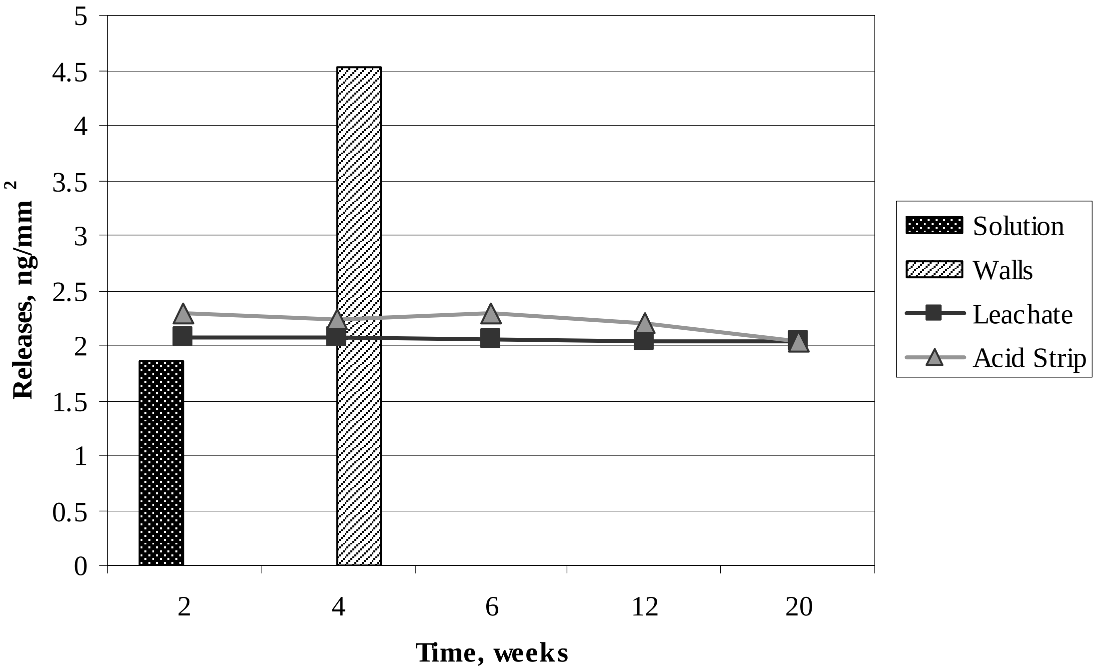


Figure J-18. Nickel Present in Solutions and on Walls in 1KCl Solution Control at 90ºC and Average Detection Limits for Leachate and Acid Strip.



F Figure J-19. Nickel Releases in Solution and on Walls from Polished Sample 27 in 1KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

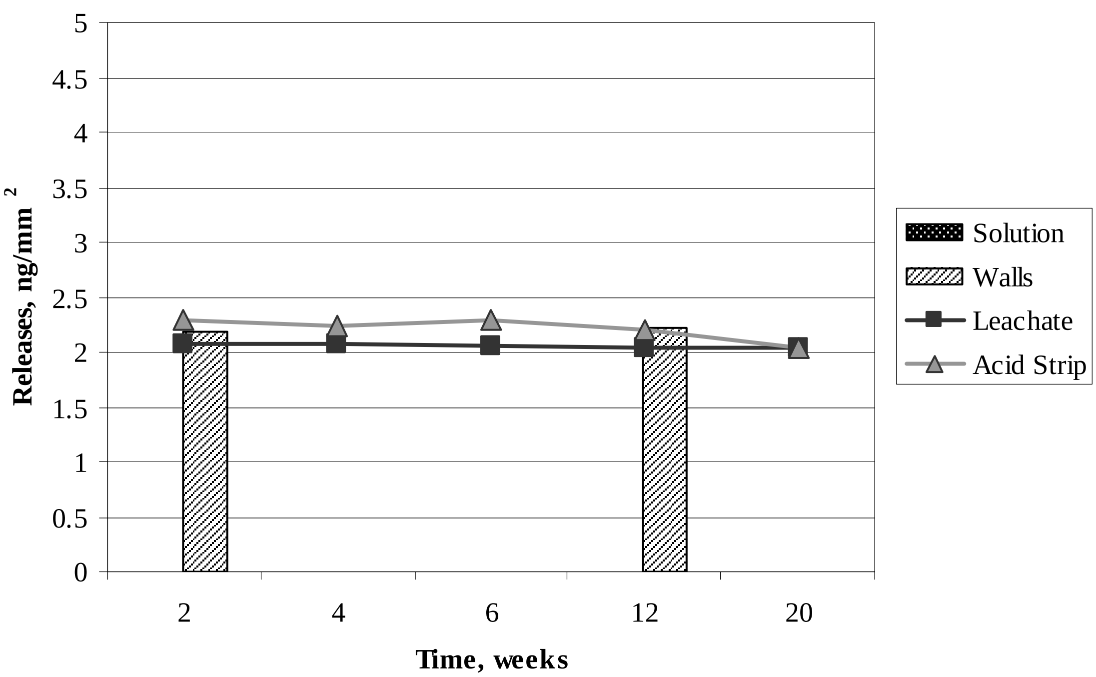


Figure J-20. Nickel Present in Solutions and on Walls in 1KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

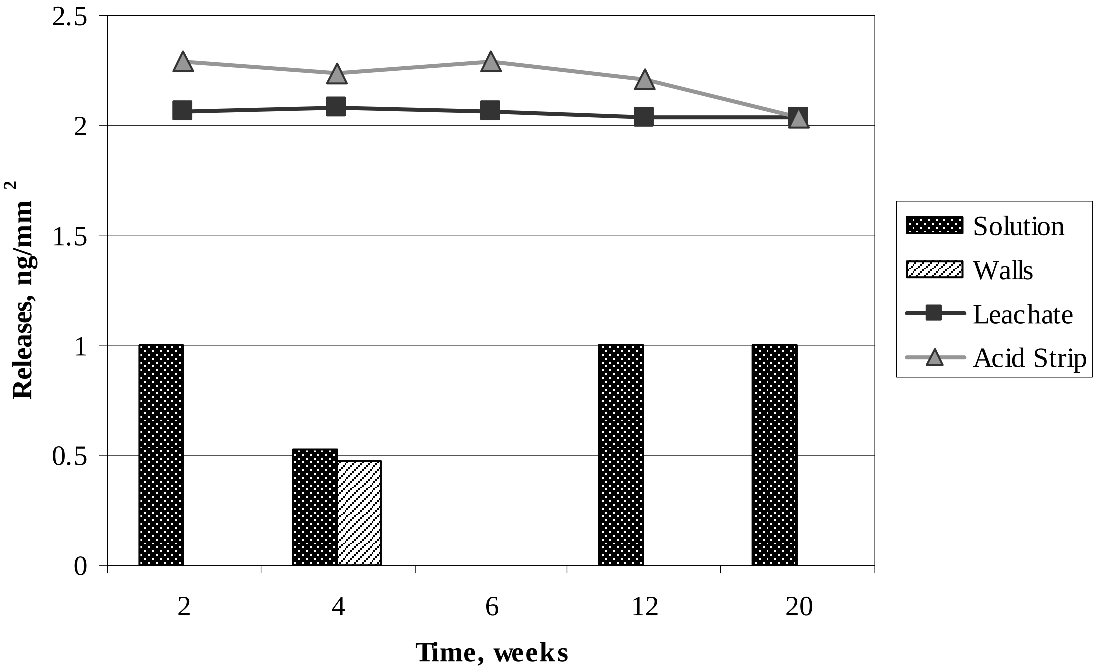


Figure J-21. Nickel Releases in Solution and on Walls from Polished Sample 29 in 10KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

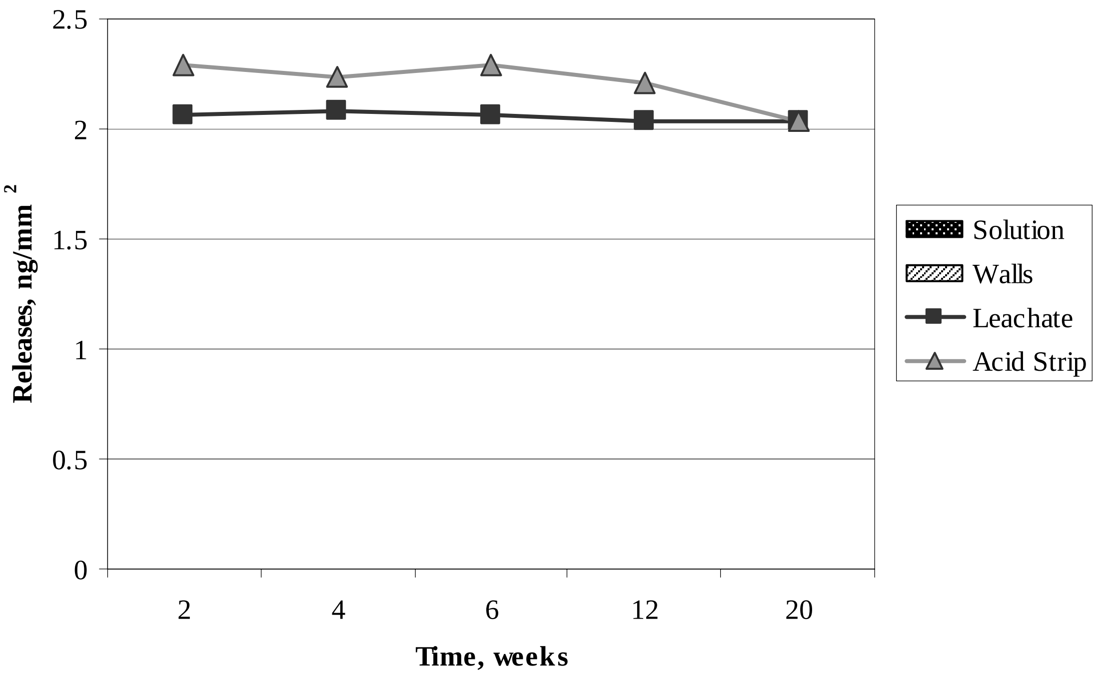


Figure J-22. Nickel Present in Solutions and on Walls in 10KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

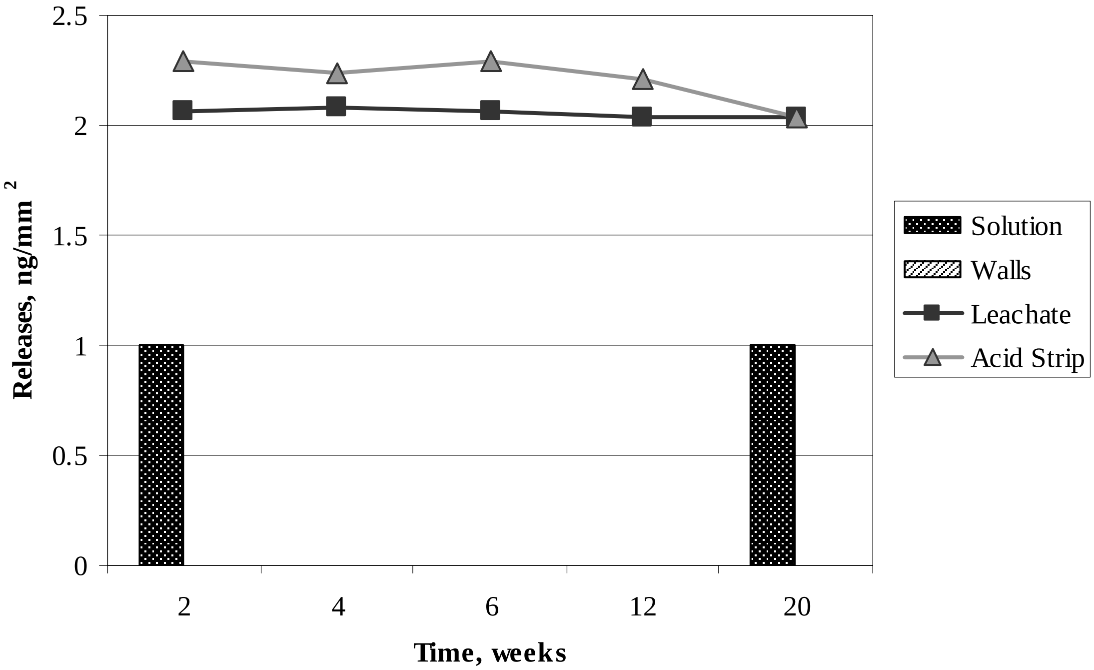


Figure J-23. Nickel Releases in Solution and on Walls from Polished Sample 31 in AJ13 Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

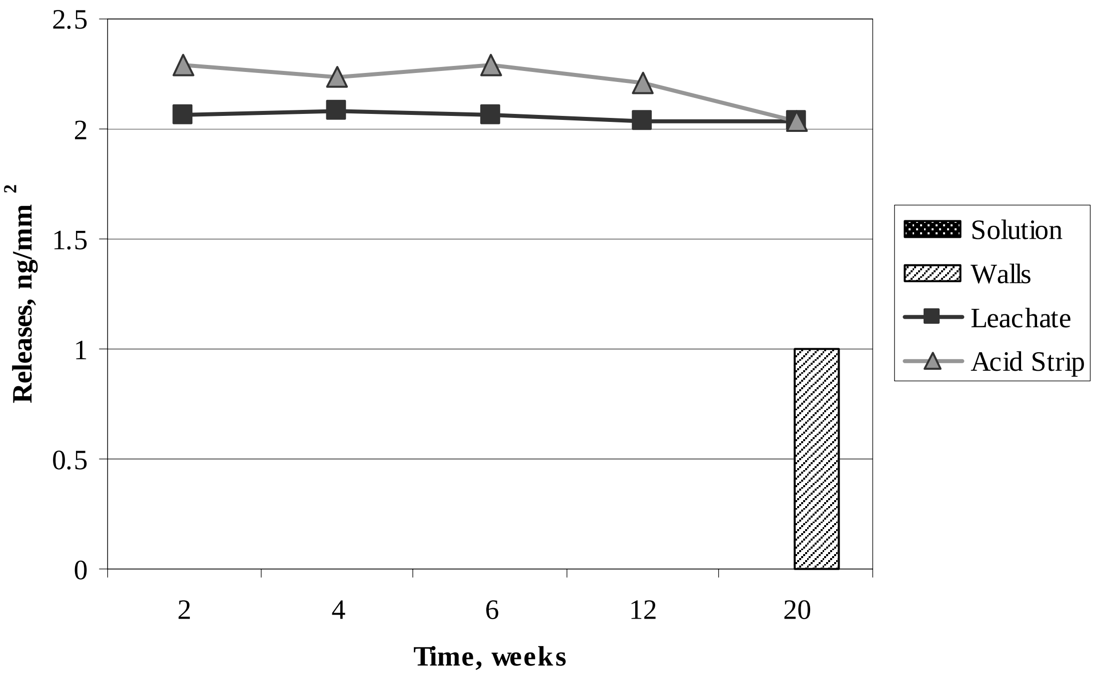


Figure J-24. Nickel Present in Solutions and on Walls in AJ13 Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

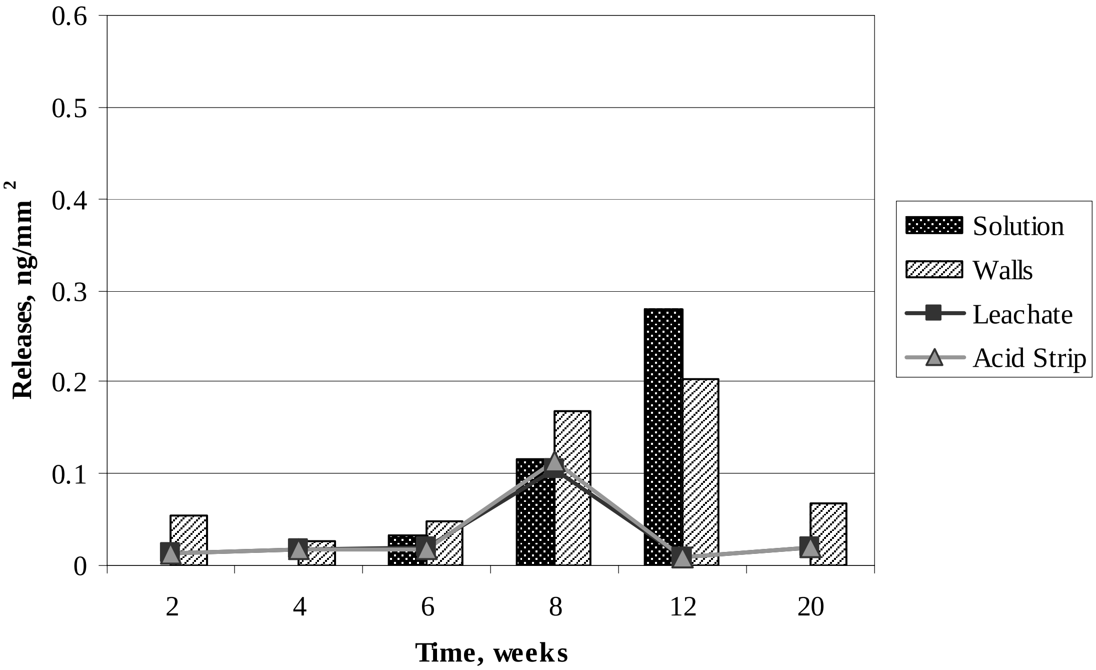


Figure J-25. Zirconium Releases in Solution and on Walls from Polished Sample 25 in 1KCl Solution at 90ºC and Average Detection Limits for Leachate and Acid Strip.

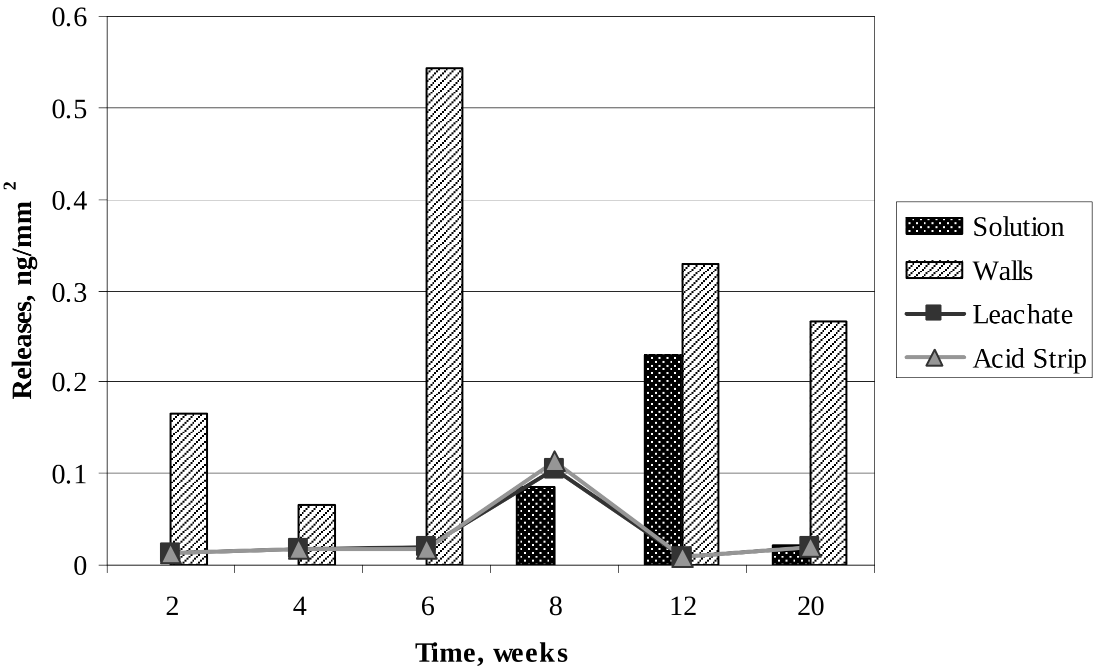


Figure J-26. Zirconium Present in Solutions and on Walls in 1KCl Solution Control at 90ºC and Average Detection Limits for Leachate and Acid Strip.

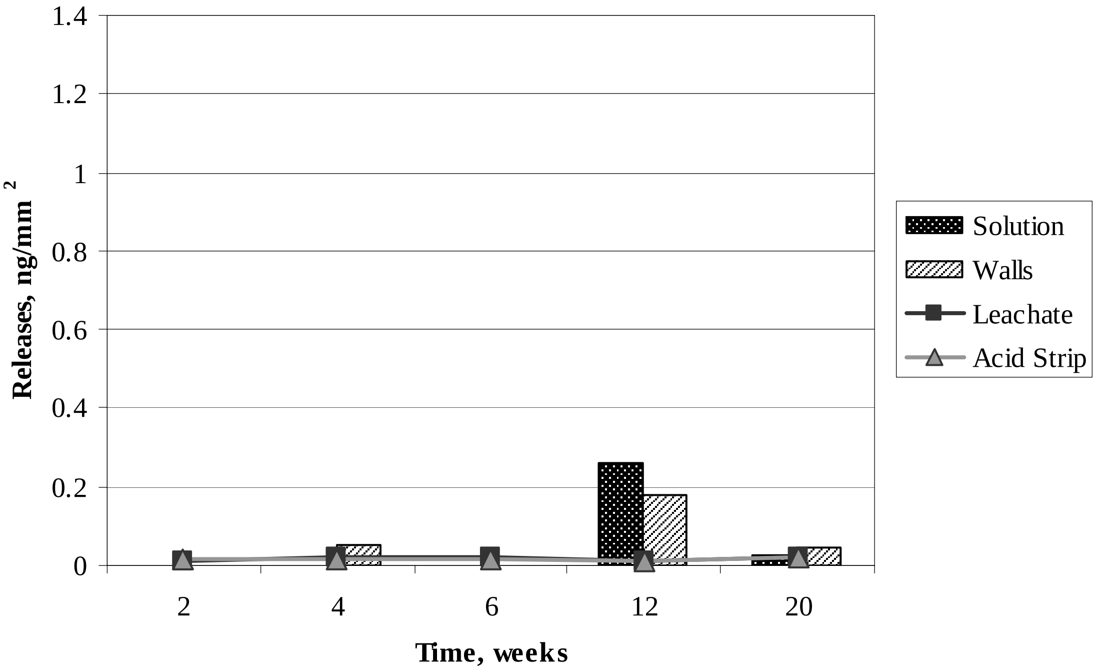


Figure J-27. Zirconium Releases in Solution and on Walls from Polished Sample 27 in 1KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

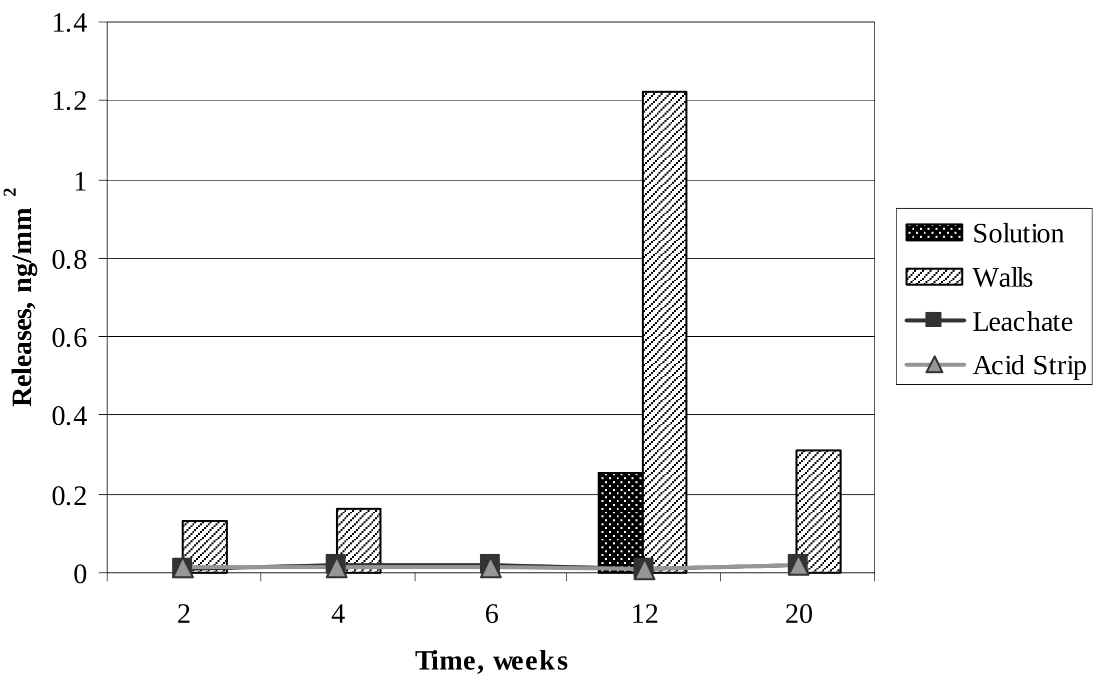


Figure J-28. Zirconium Present in Solutions and on Walls in 1KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

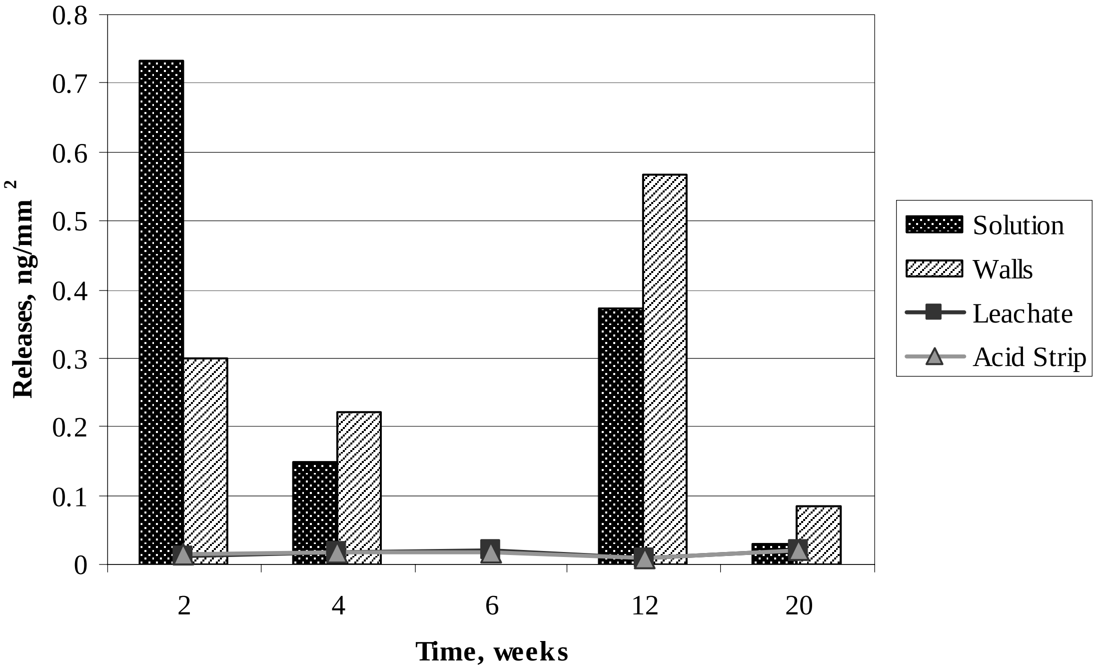


Figure J-29. Zirconium Releases in Solution and on Walls from Polished Sample 29 in 10KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

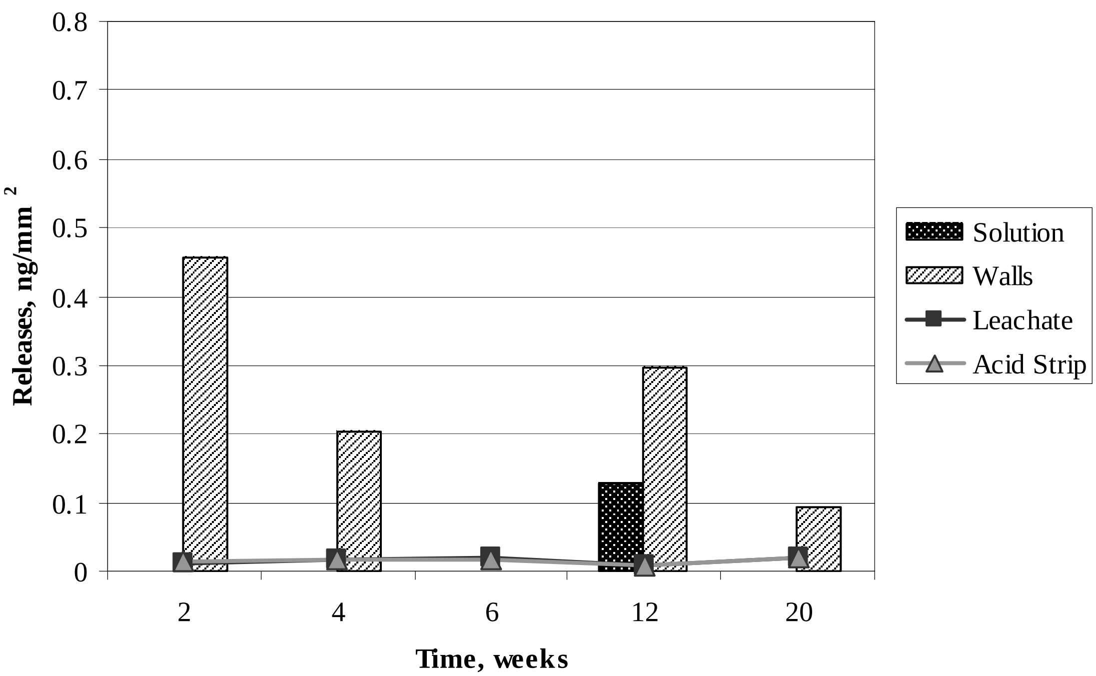


Figure J-30. Zirconium Present in Solutions and on Walls in 10KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

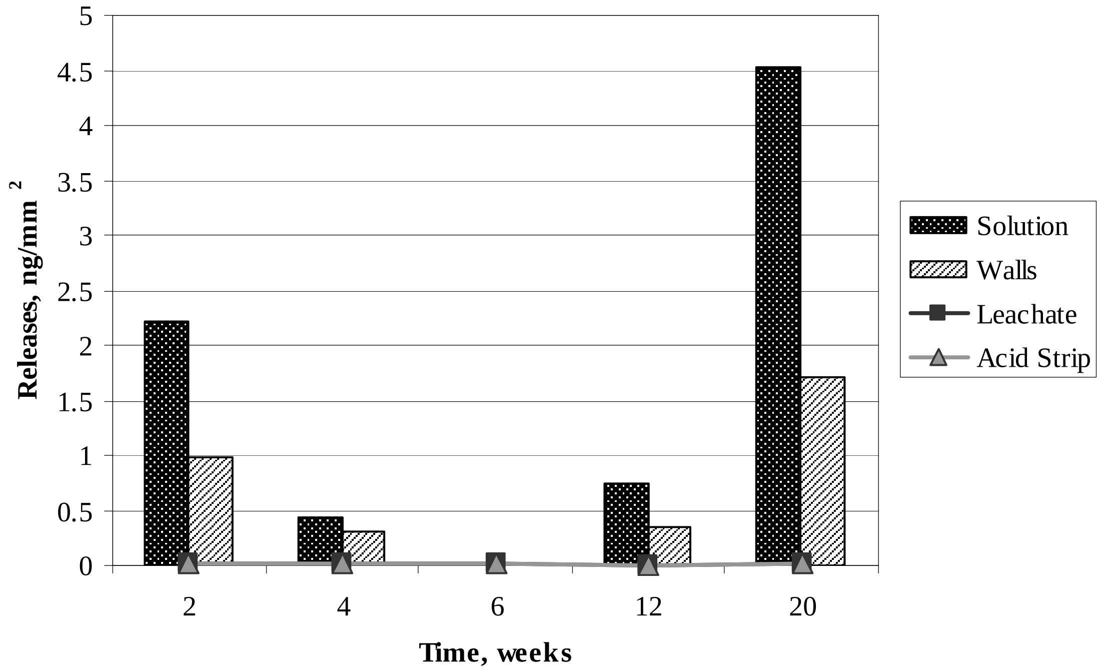


Figure J-31. Zirconium Releases in Solution and on Walls from Polished Sample 31 in AJ13 Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

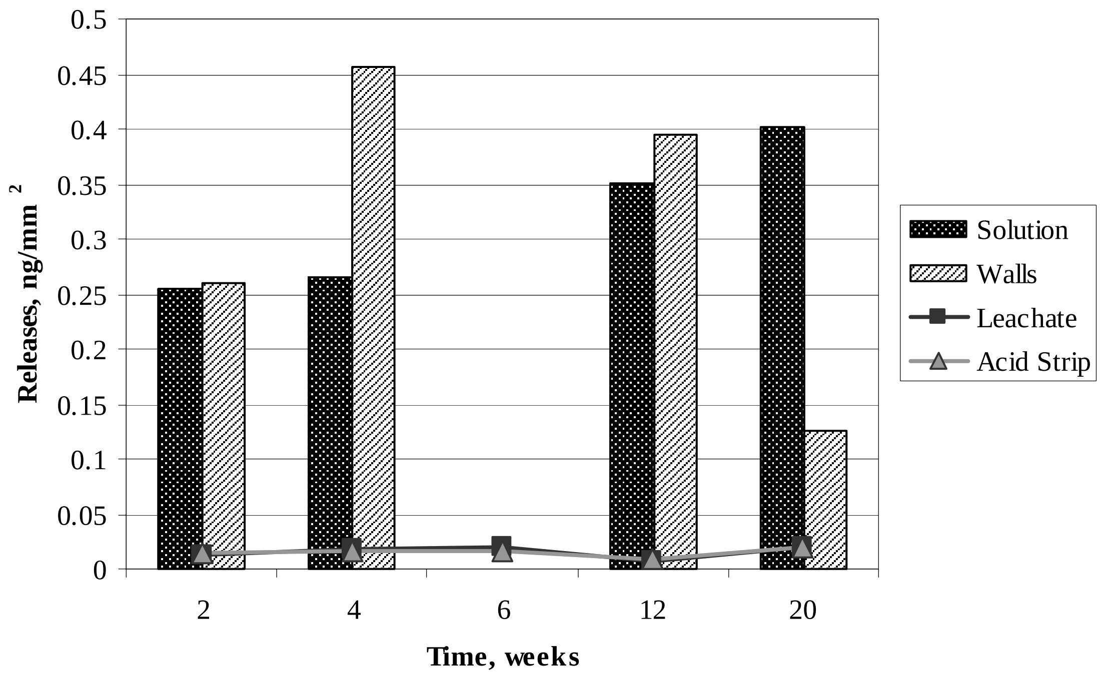


Figure J-32. Zirconium Present in Solutions and on Walls in AJ13 Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

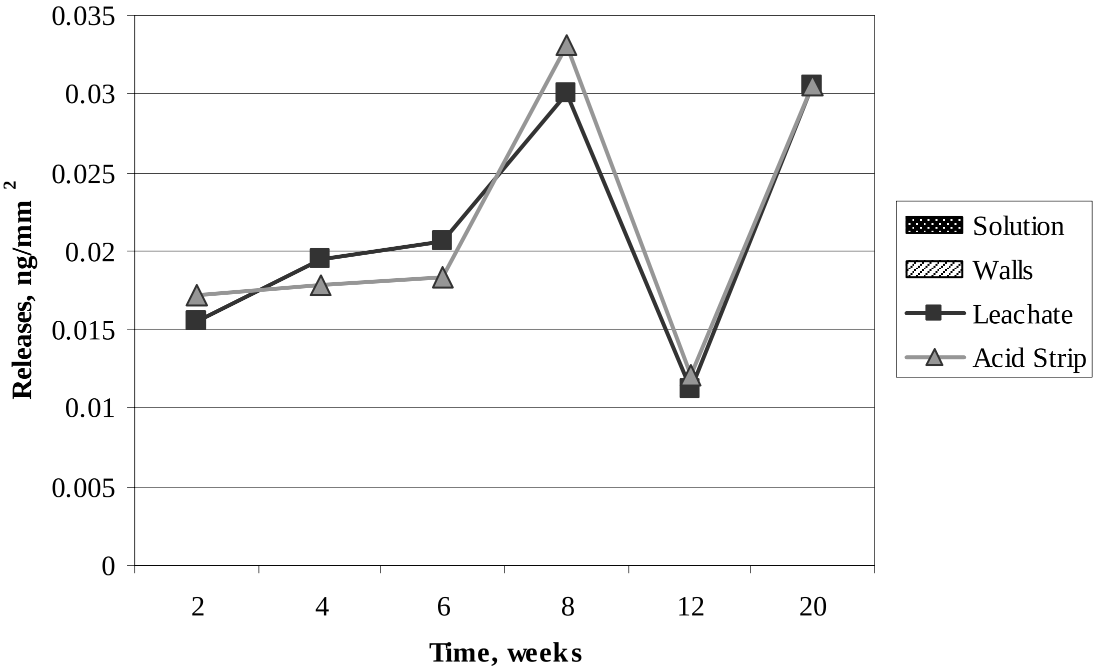


Figure J-33. **Niobium Releases in Solution and on Walls from Polished Sample 25 in 1KCl Solution at 90°C and Average Detection Limits for Leachate and Acid Strip.**

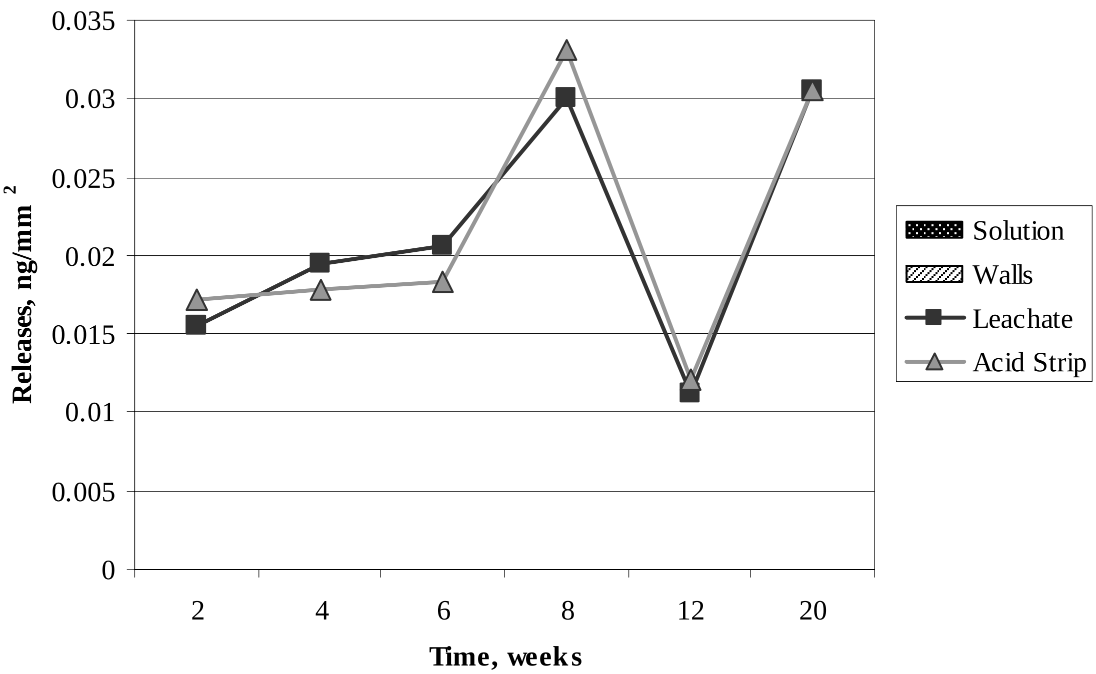


Figure J-34. **Niobium Present in Solutions and on Walls in 1KCl Solution Control at 90°C and Average Detection Limits for Leachate and Acid Strip.**

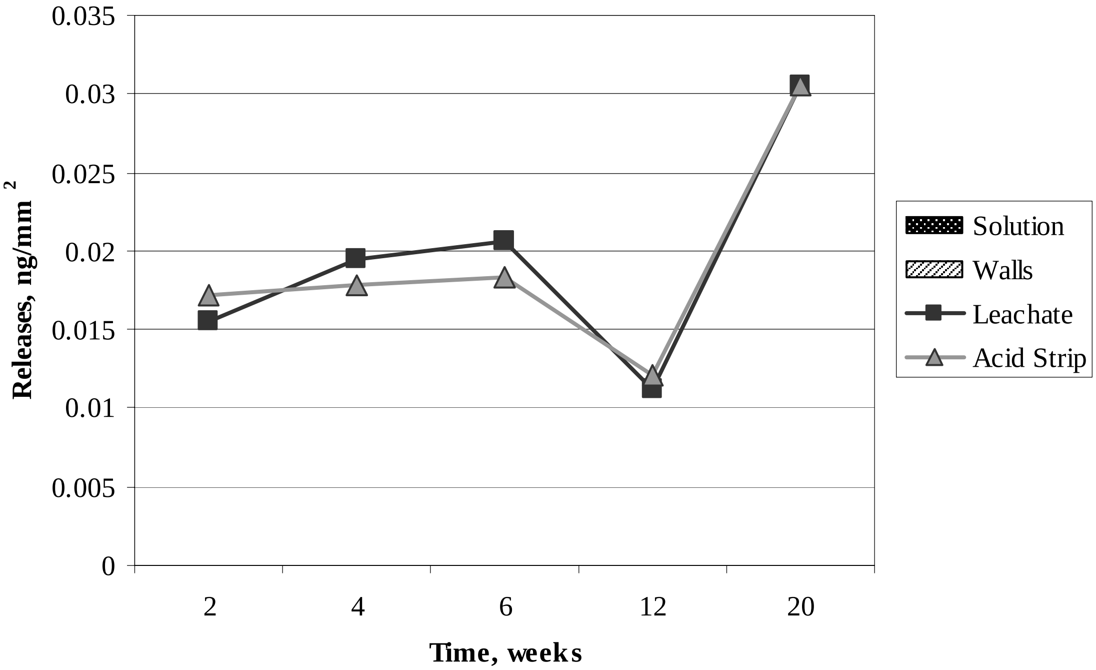


Figure J-35. Niobium Releases in Solution and on Walls from Polished Sample 27 in 1KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

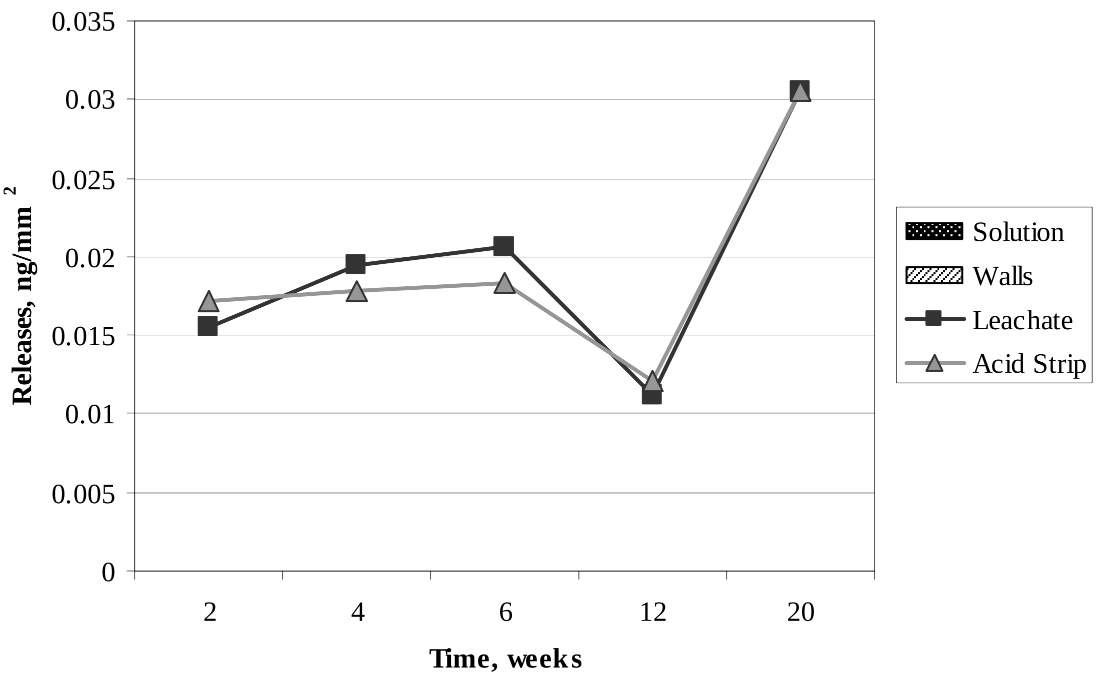


Figure J-36. Niobium Present in Solutions and on Walls in 1KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

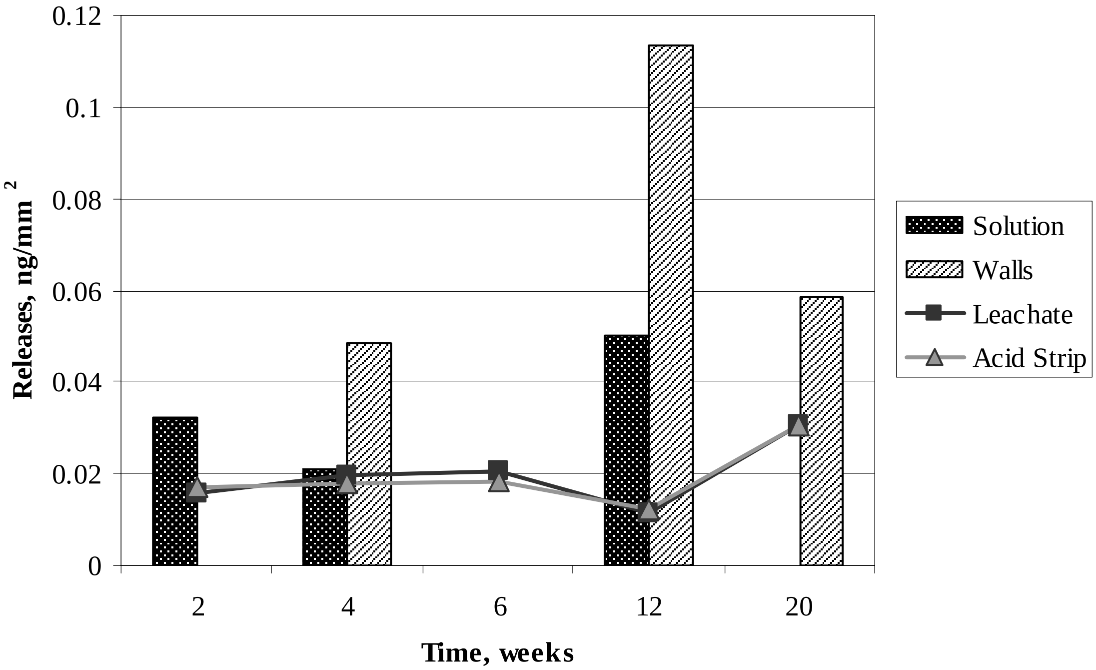


Figure J-37. Niobium Releases in Solution and on Walls from Polished Sample 29 in 10KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

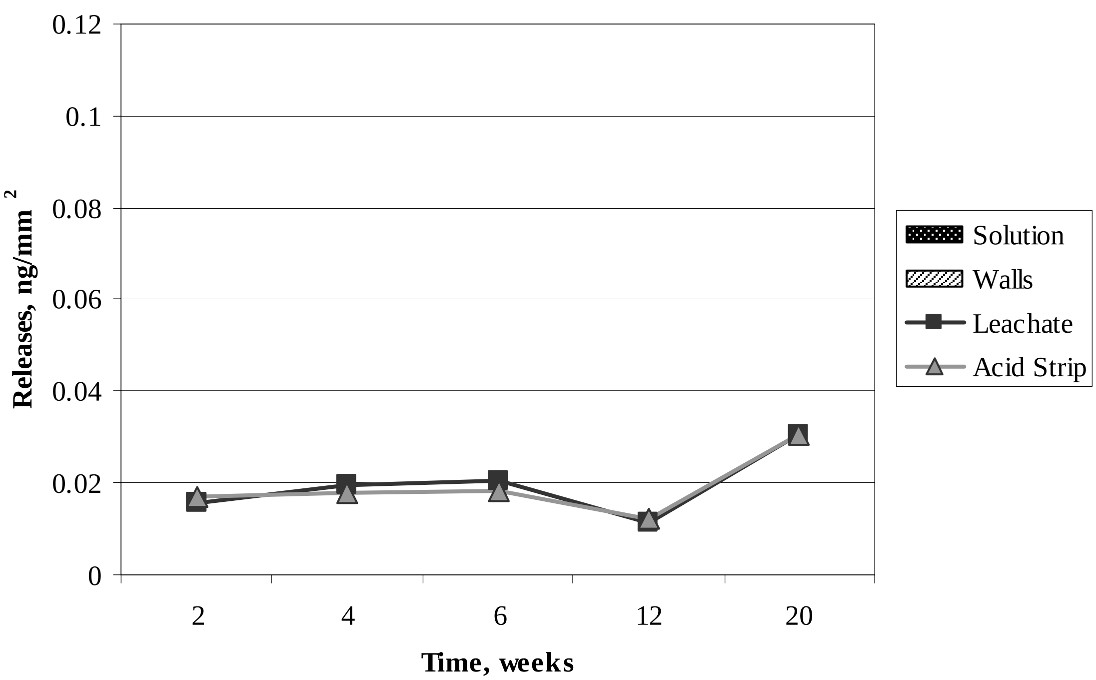


Figure J-38. Niobium Present in Solutions and on Walls in 10KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

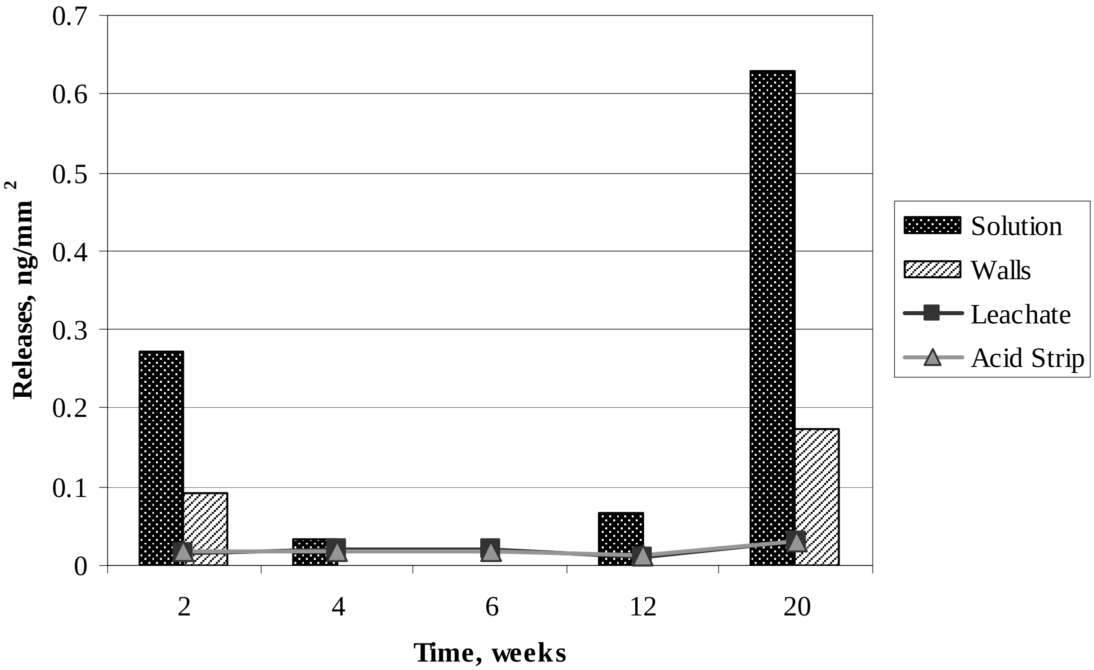


Figure J-39. Niobium Releases in Solution and on Walls from Polished Sample 31 in AJ13 Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

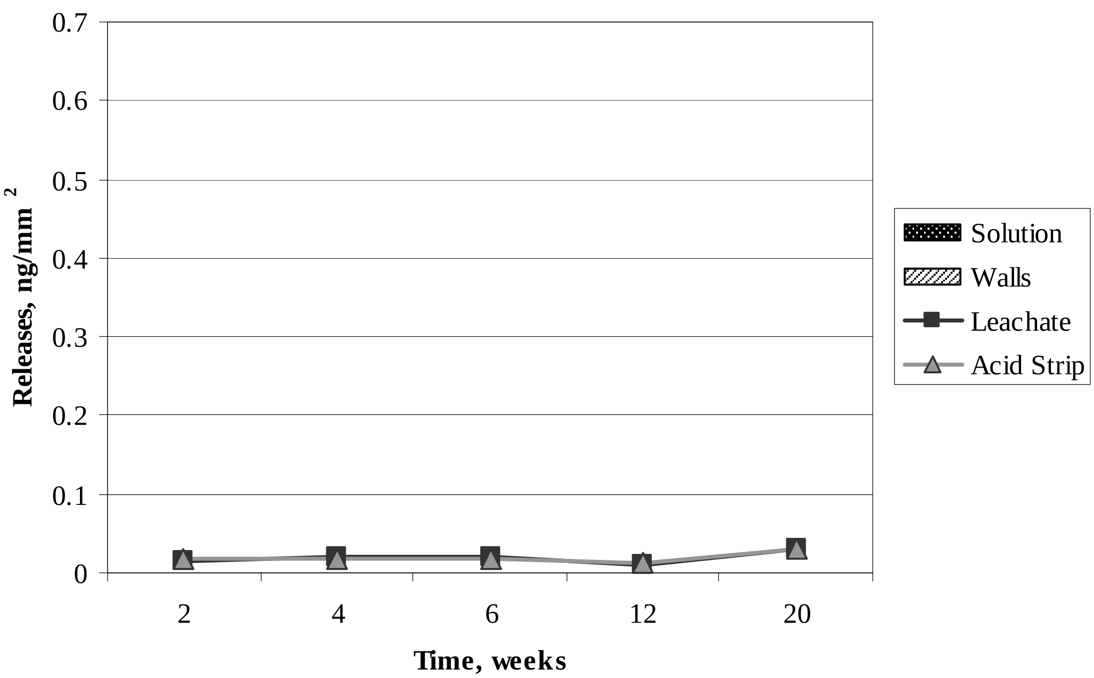


Figure J-40. Niobium Present in Solutions and on Walls in AJ13 Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

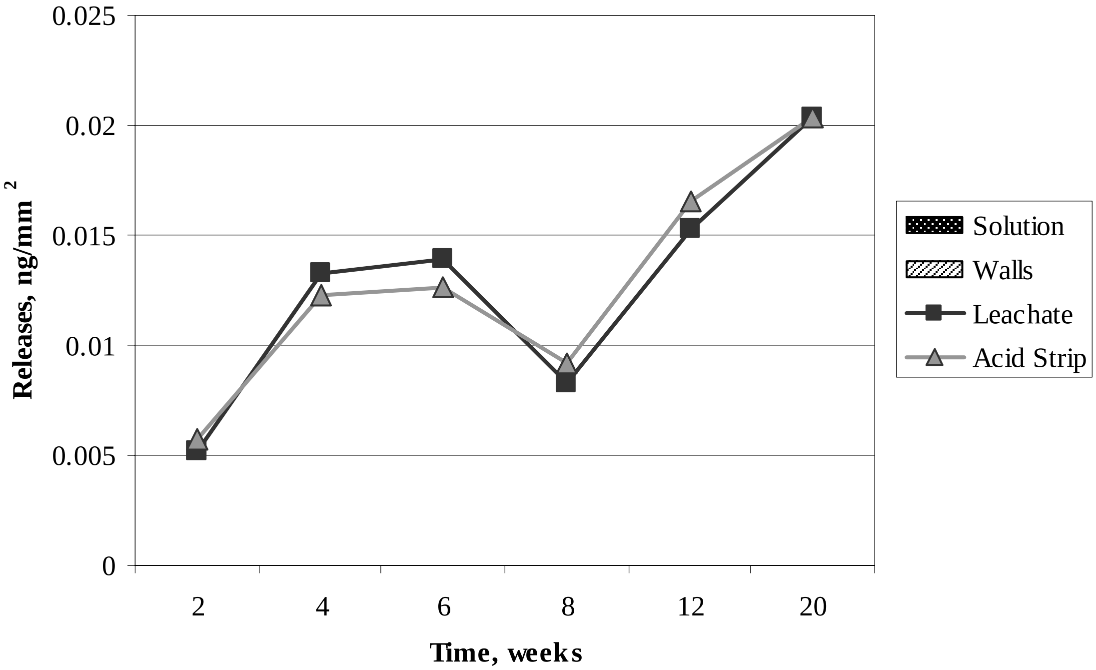


Figure J-41. Palladium Releases in Solution and on Walls from Polished Sample 25 in 1KCl Solution at 90ºC and Average Detection Limits for Leachate and Acid Strip.

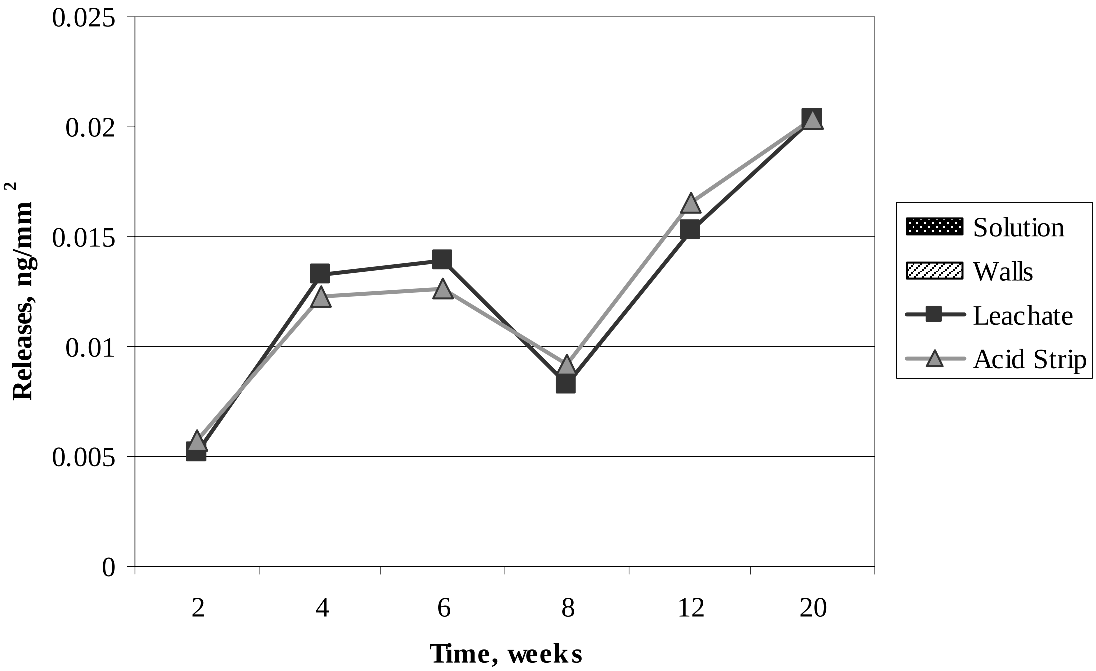


Figure J-42. Palladium Present in Solutions and on Walls in 1KCl Solution Control at 90ºC and Average Detection Limits for Leachate and Acid Strip.

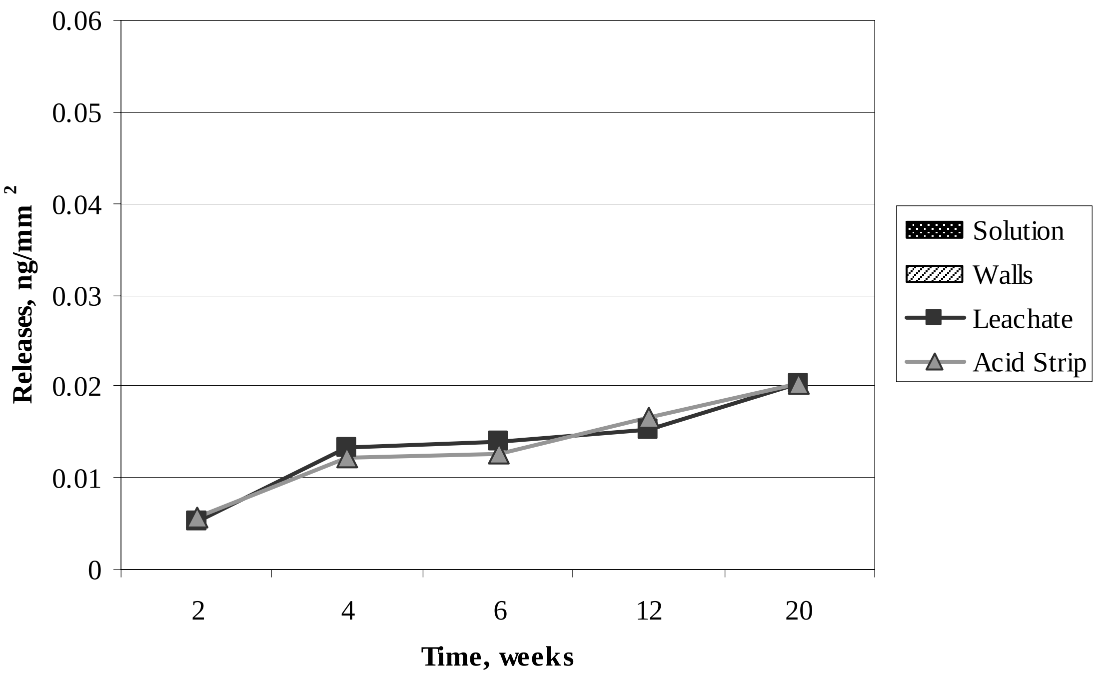


Figure J-43. Palladium Releases in Solution and on Walls from Polished Sample 27 in 1KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

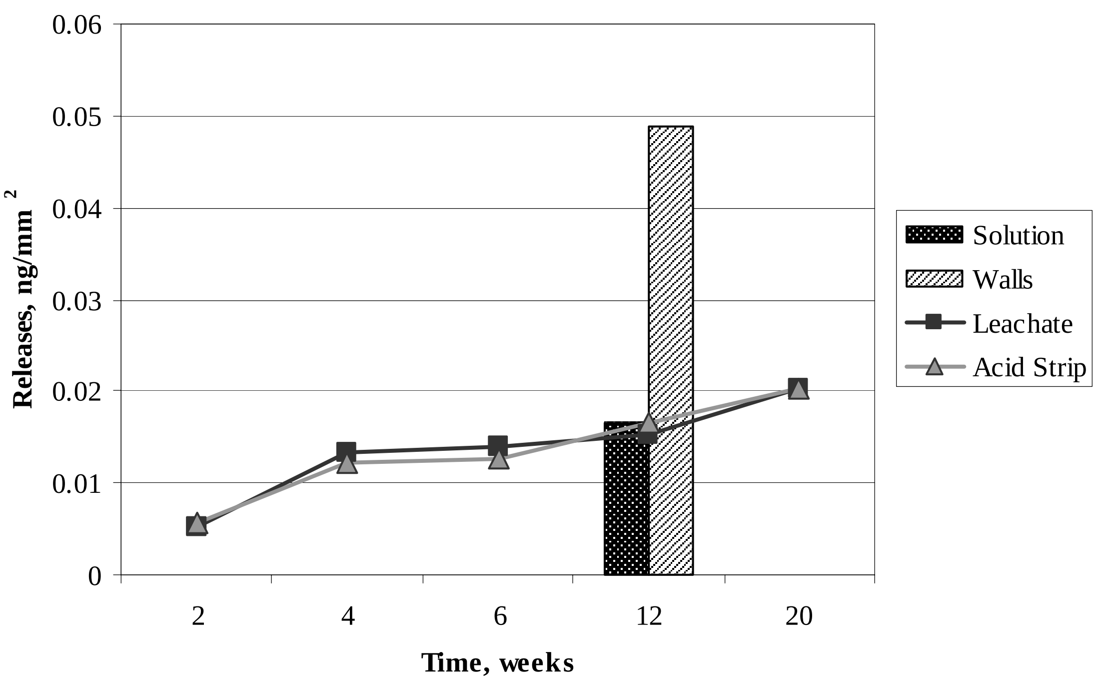


Figure J-44. Palladium Present in Solutions and on Walls in 1KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

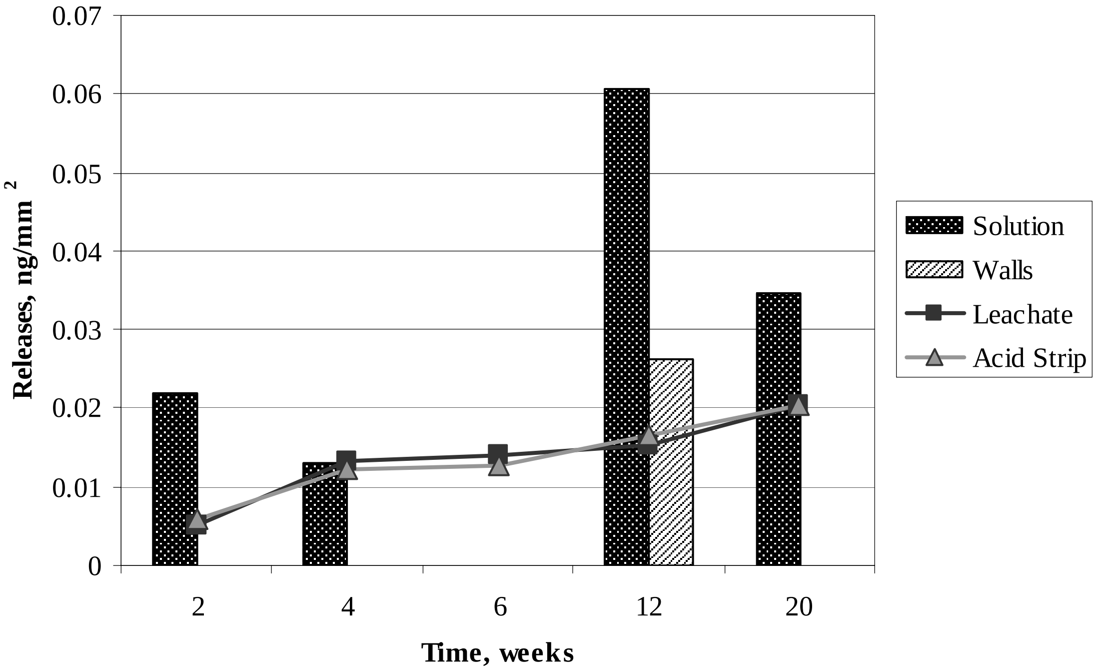


Figure J-45. Palladium Releases in Solution and on Walls from Polished Sample 29 in 10KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

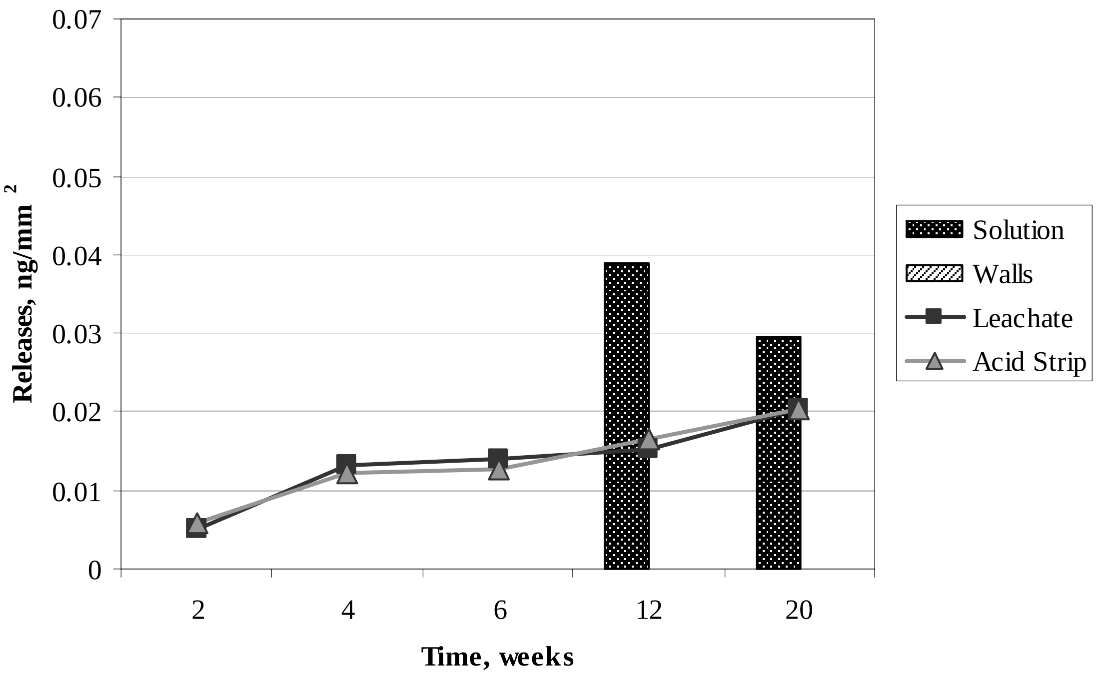


Figure J-46. Palladium Present in Solutions and on Walls in 10KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

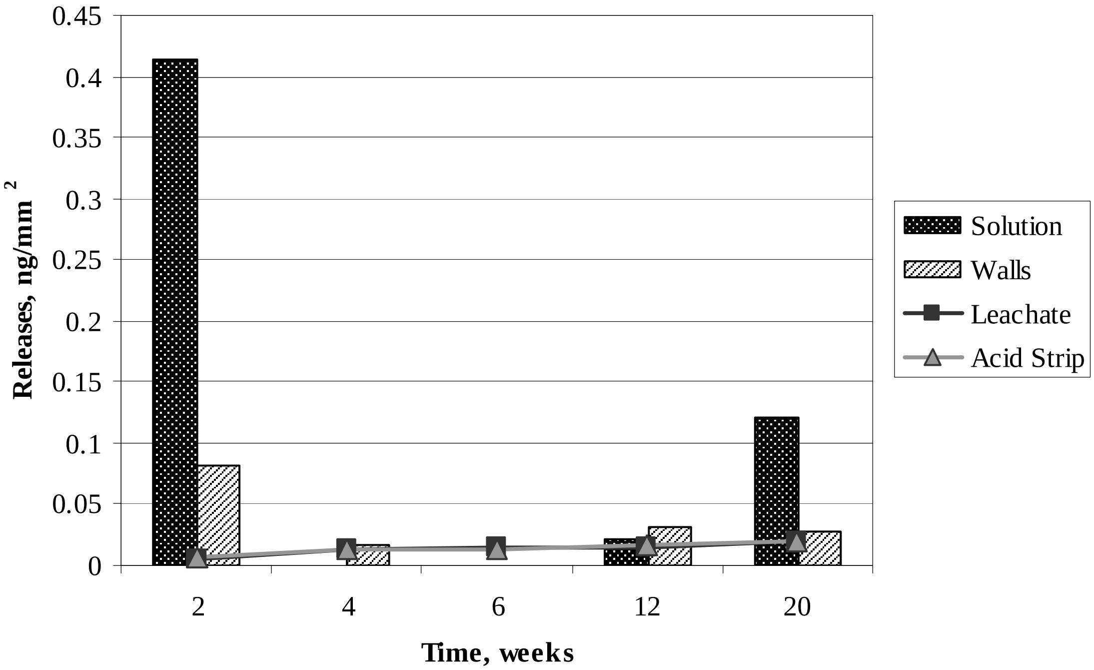


Figure J-47. Palladium Releases in Solution and on Walls from Polished Sample 31 in AJ13 Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

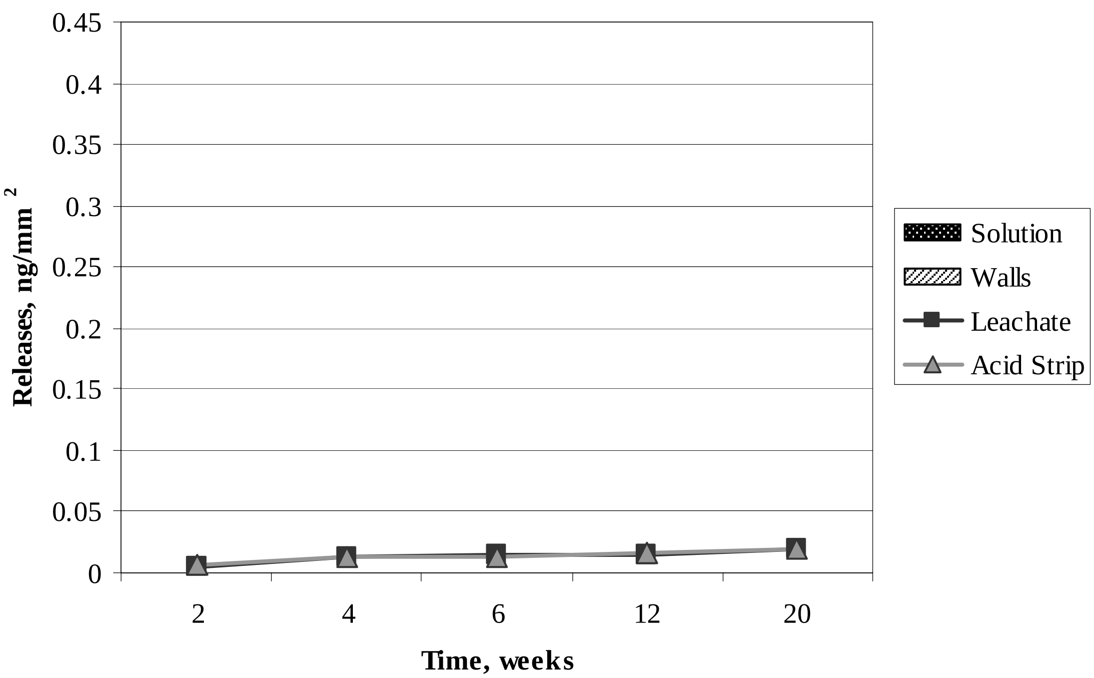


Figure J-48. Palladium Present in Solutions and on Walls in AJ13 Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

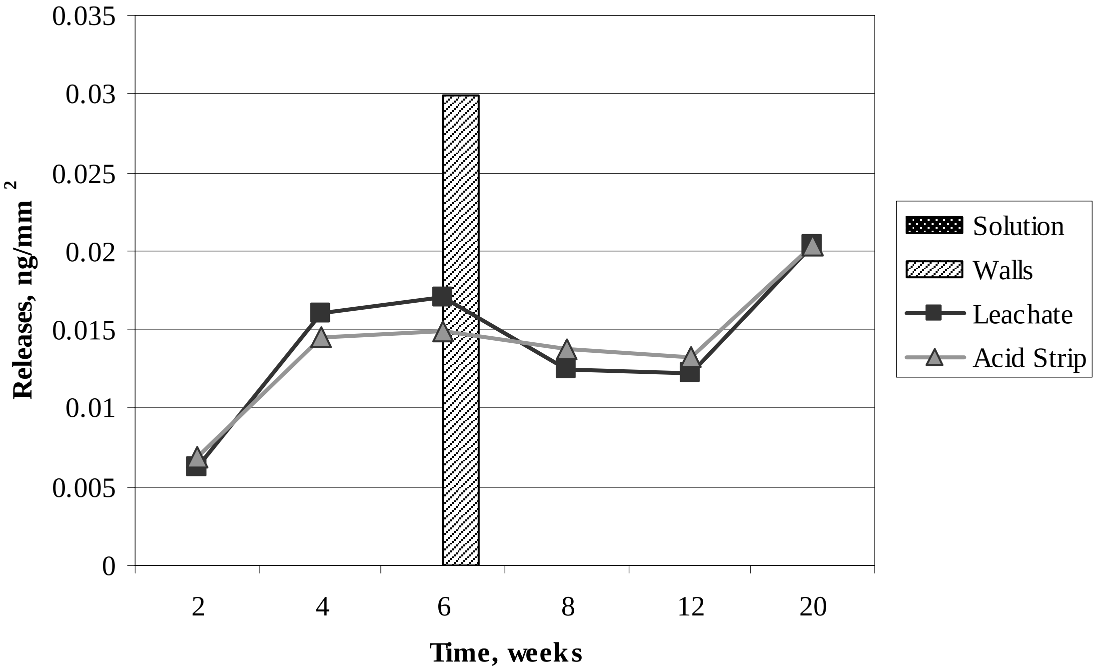


Figure J-49. Rhodium Releases in Solution and on Walls from Polished Sample 25 in 1KCl Solution at 90ºC and Average Detection Limits for Leachate and Acid Strip.

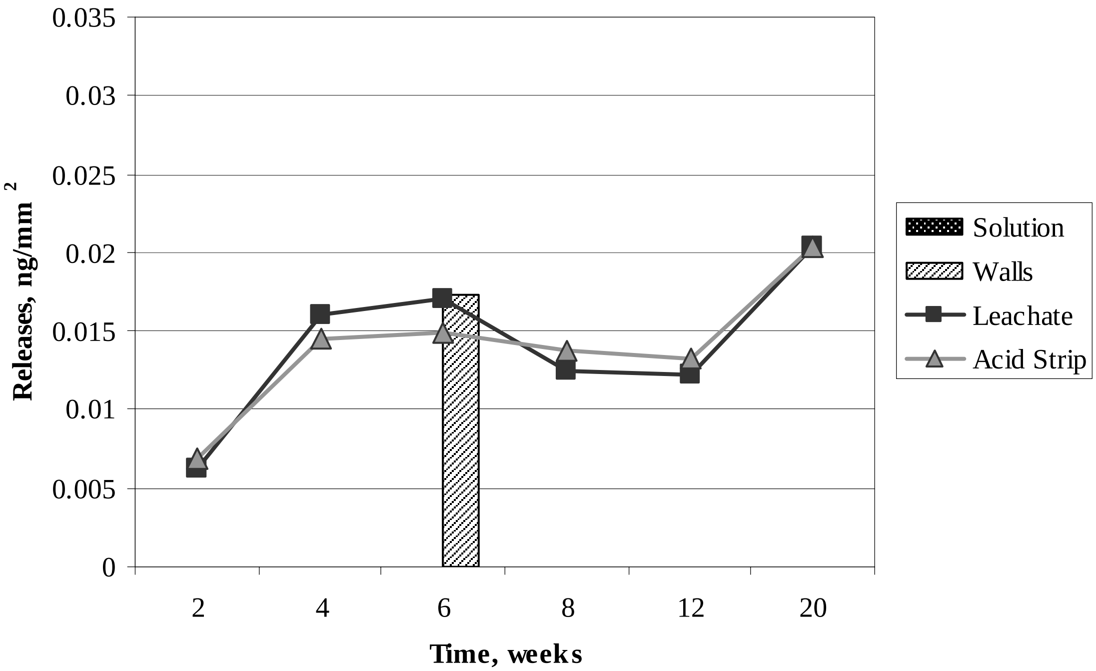


Figure J-50. Rhodium Present in Solutions and on Walls in 1KCl Solution Control at 90ºC and Average Detection Limits for Leachate and Acid Strip.

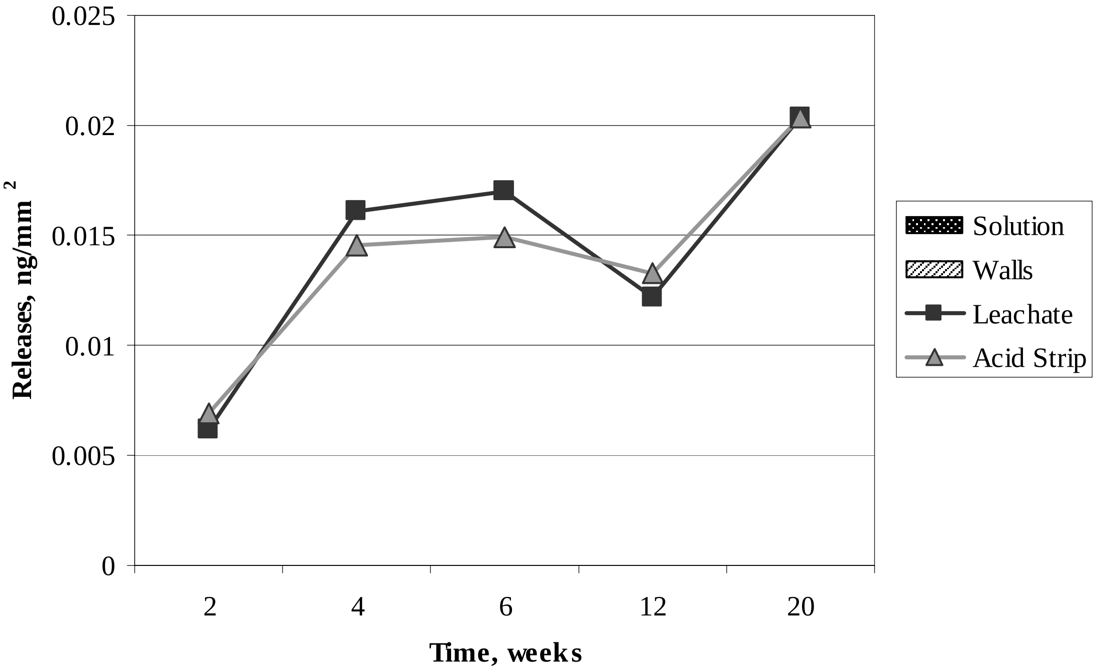


Figure J-51. Rhodium Releases in Solution and on Walls from Polished Sample 27 in 1KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

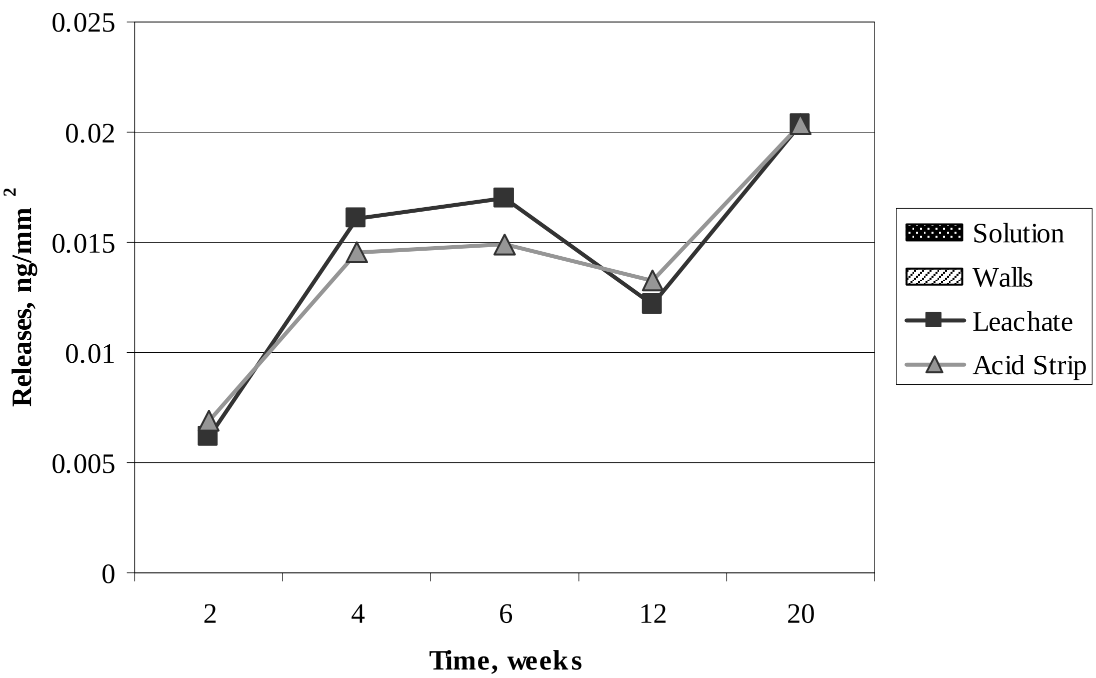


Figure J-52. Rhodium Present in Solutions and on Walls in 1KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

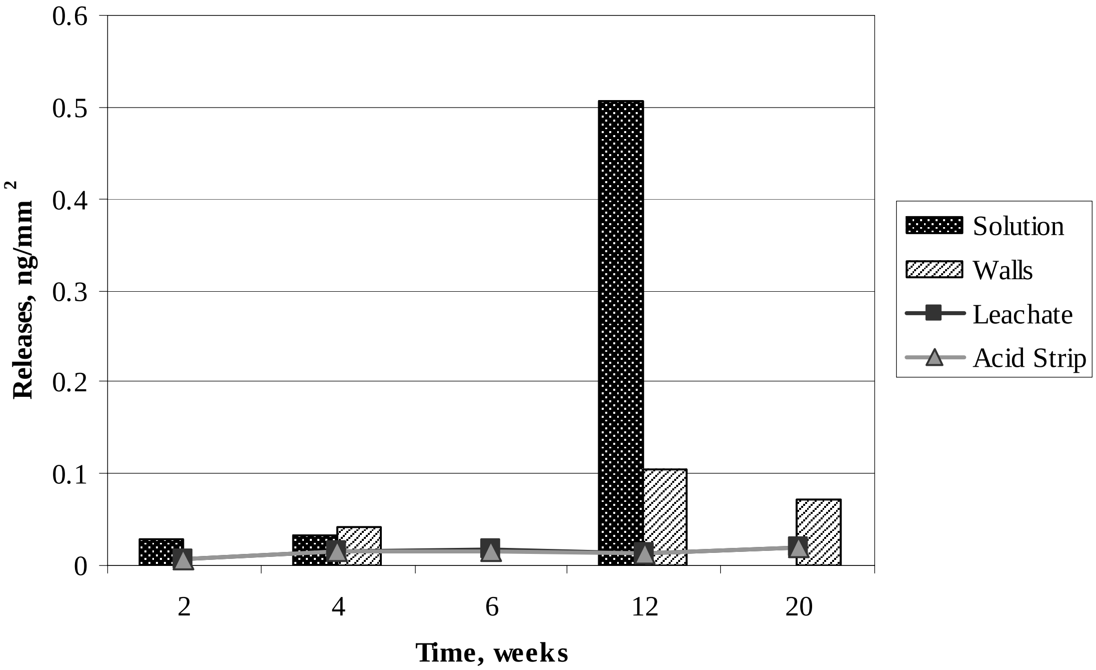


Figure J-53. Rhodium Releases in Solution and on Walls from Polished Sample 29 in 10KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

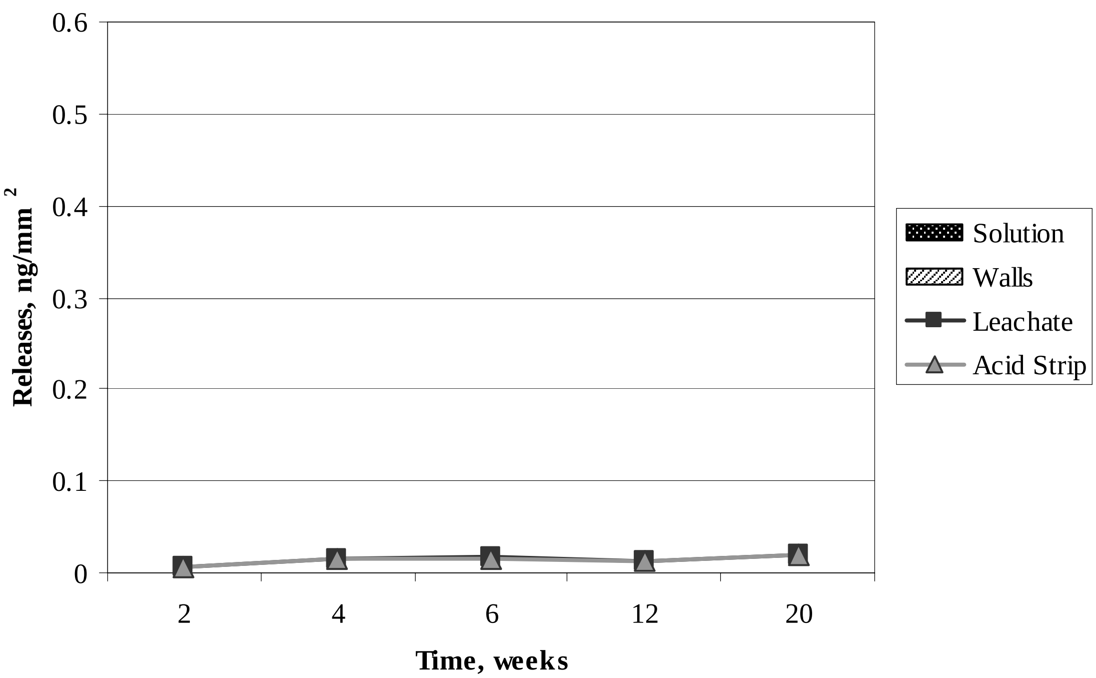


Figure J-54. Rhodium Present in Solutions and on Walls in 10KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

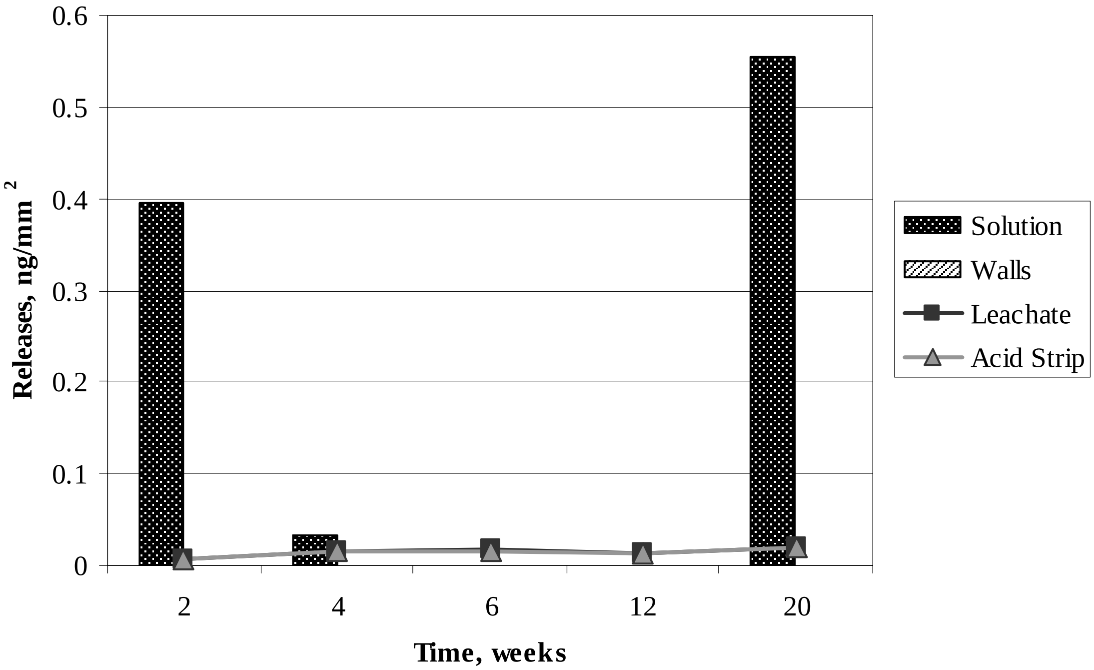


Figure J-55. Rhodium Releases in Solution and on Walls from Polished Sample 31 in AJ13 Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

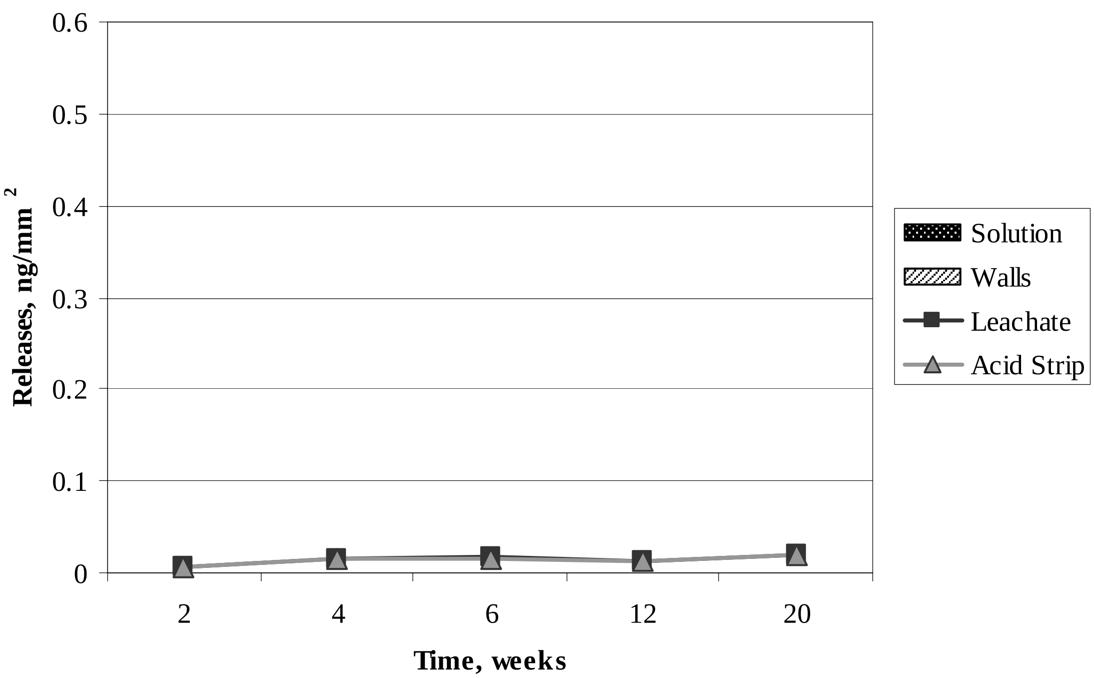


Figure J-56. Rhodium Present in Solutions and on Walls in AJ13 Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

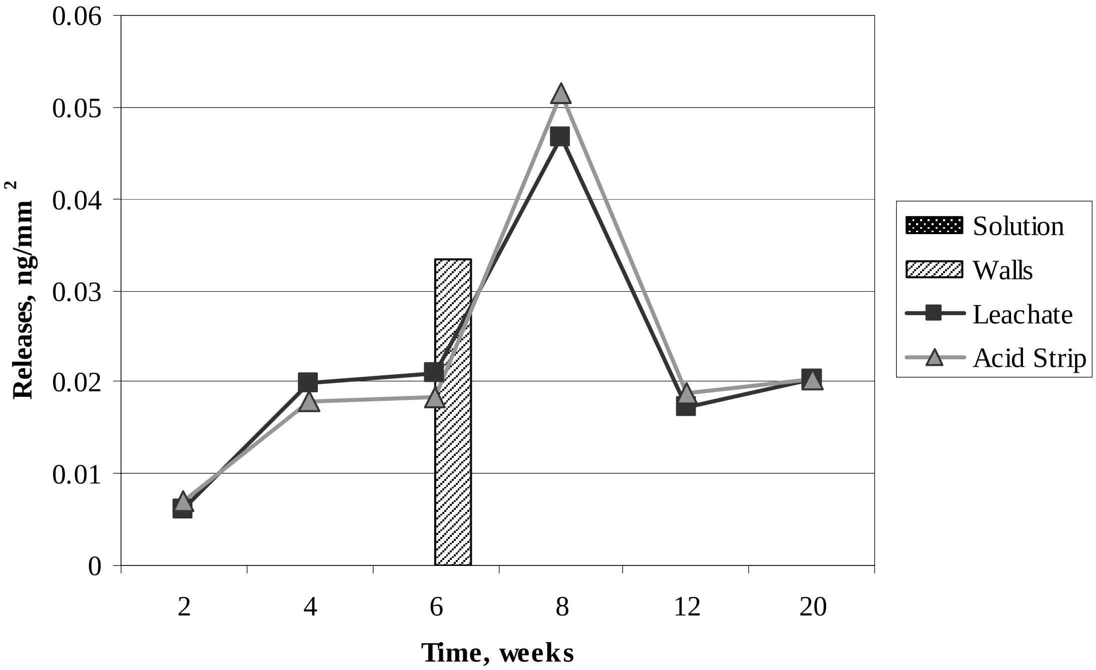


Figure J-57. Ruthenium Releases in Solution and on Walls from Polished Sample 25 in 1KCl Solution at 90ºC and Average Detection Limits for Leachate and Acid Strip.

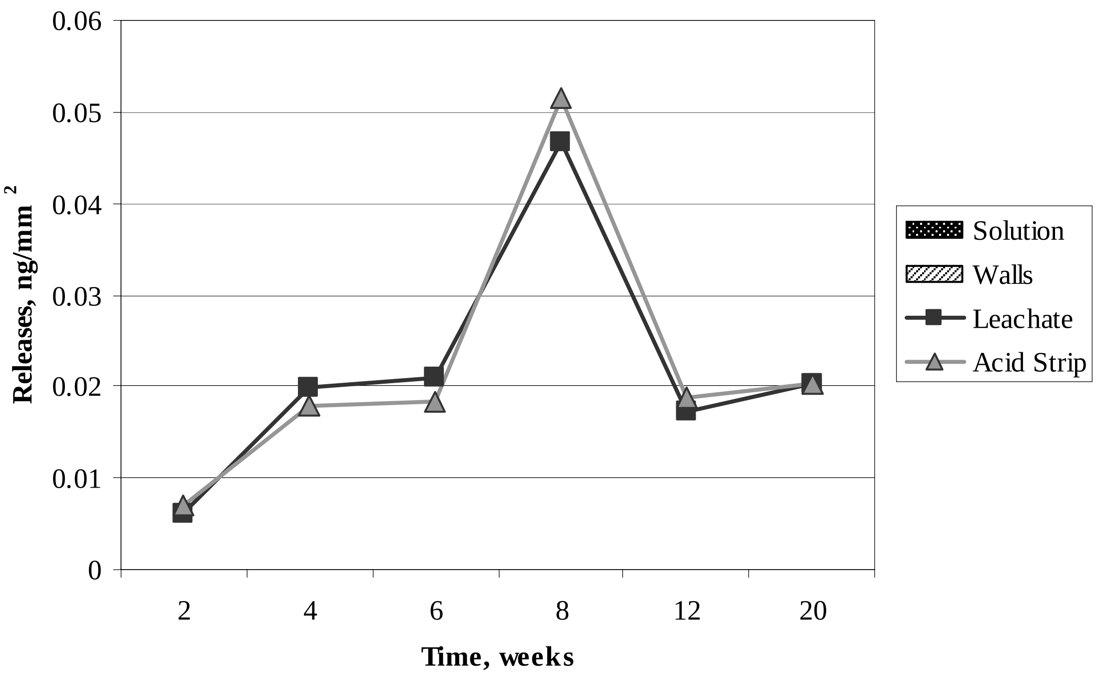


Figure J-58. Ruthenium Present in Solutions and on Walls in 1KCl Solution Control at 90ºC and Average Detection Limits for Leachate and Acid Strip.

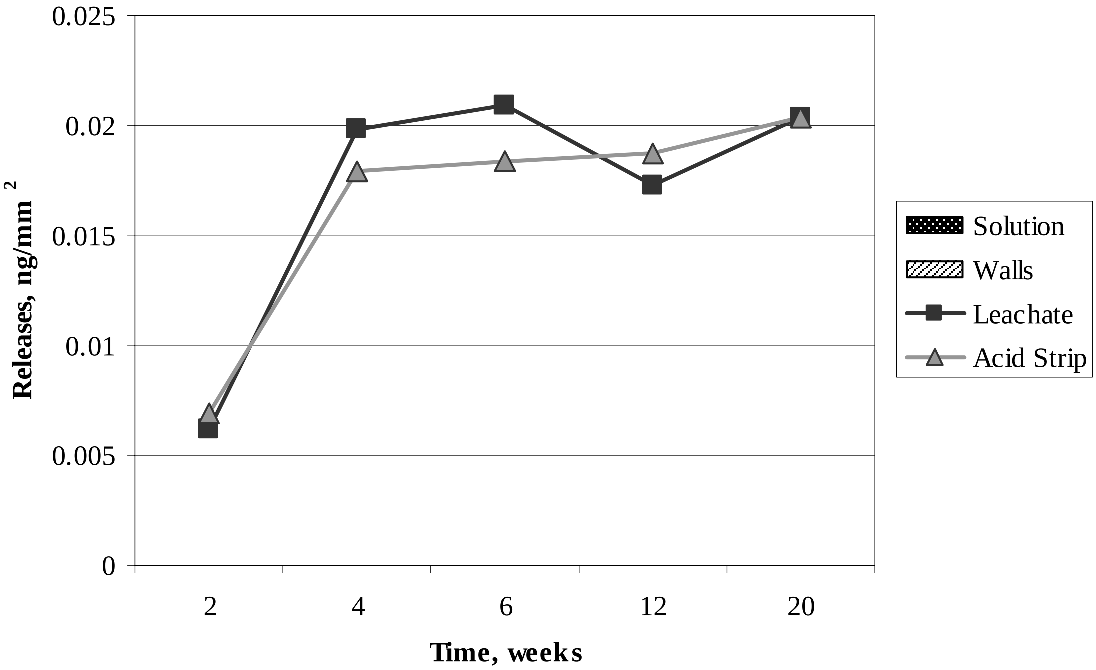


Figure J-59. Ruthenium Releases in Solution and on Walls from Polished Sample 27 in 1KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

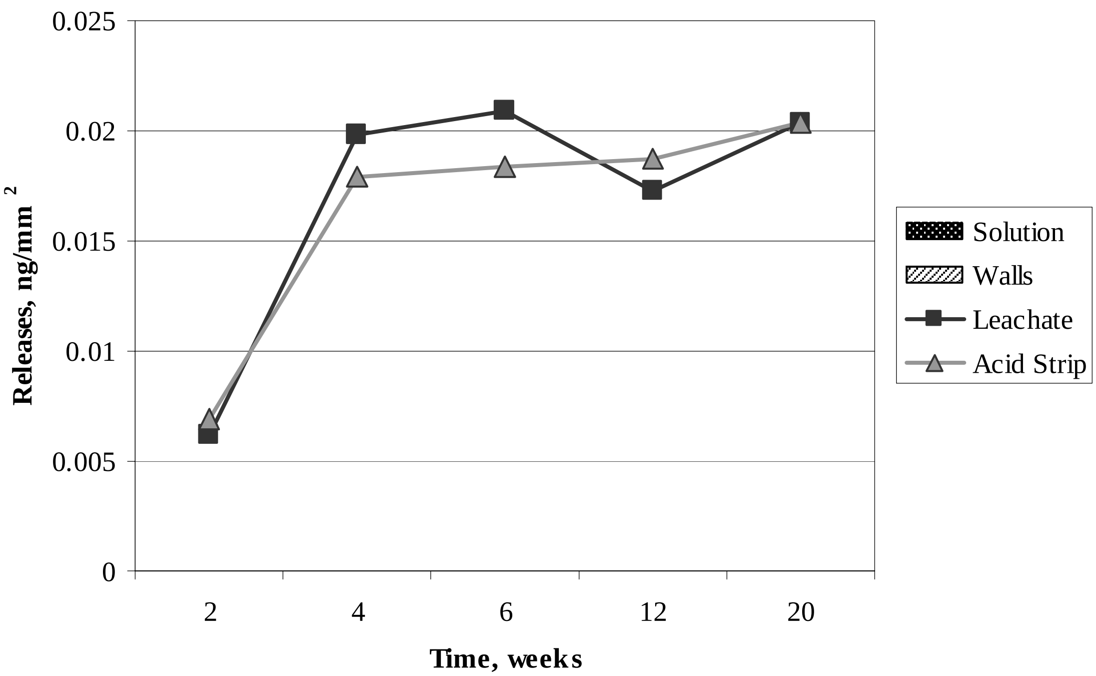


Figure J-60. Ruthenium Present in Solutions and on Walls in 1KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

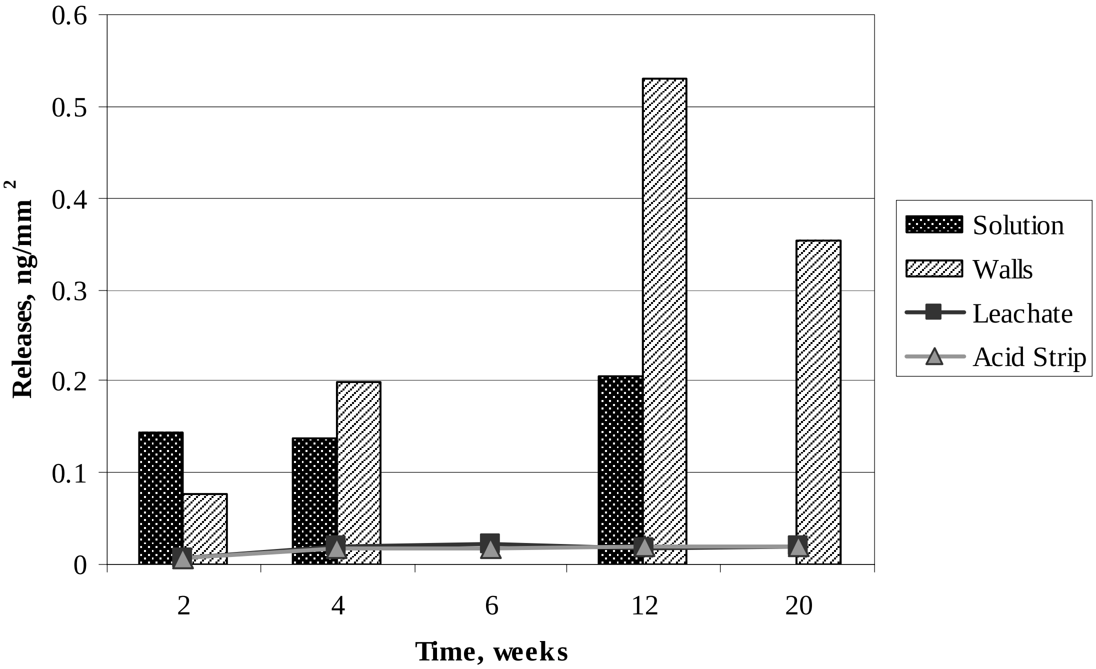


Figure J-61. Ruthenium Releases in Solution and on Walls from Polished Sample 29 in 10KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

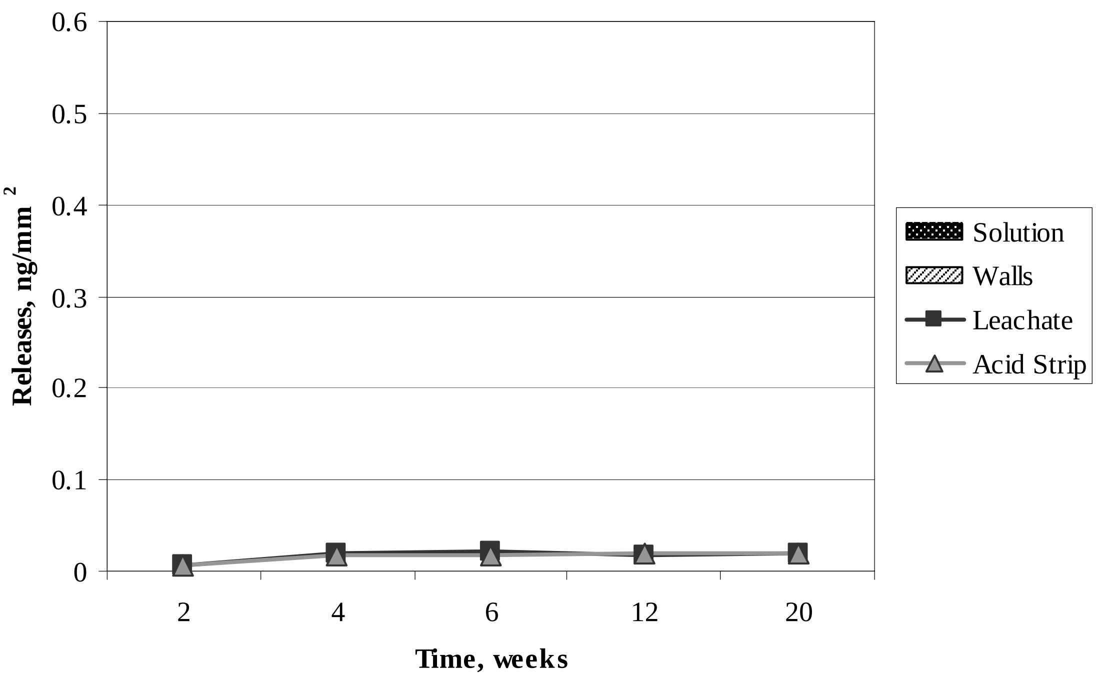


Figure J-62. Ruthenium Present in Solutions and on Walls in 10KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

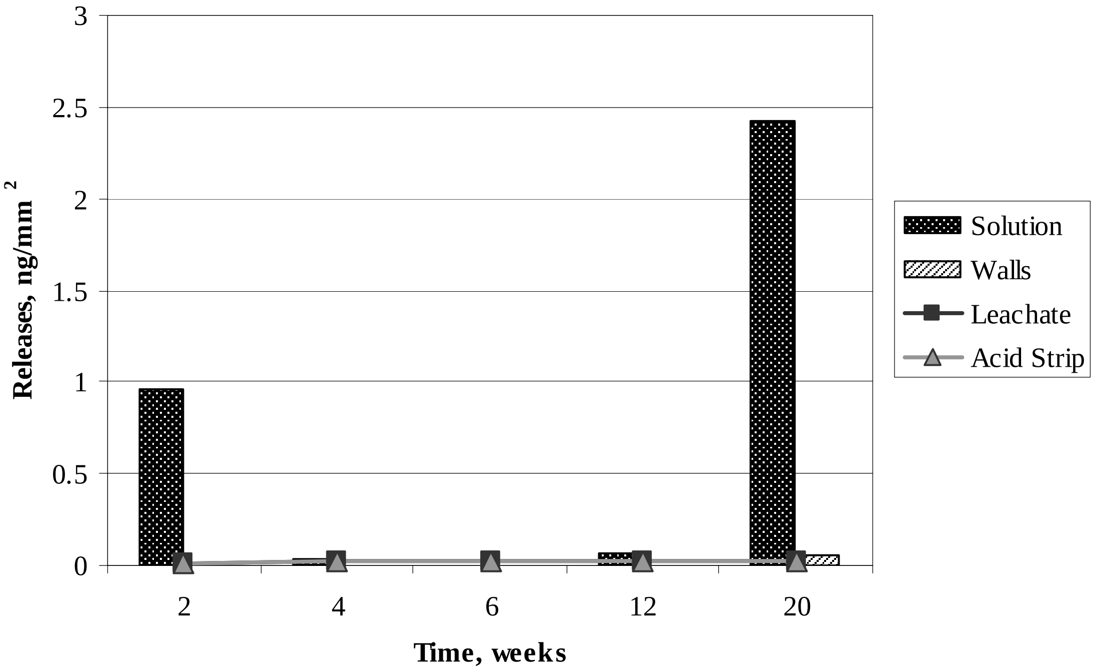


Figure J-63. Ruthenium Releases in Solution and on Walls from Polished Sample 31 in AJ13 Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

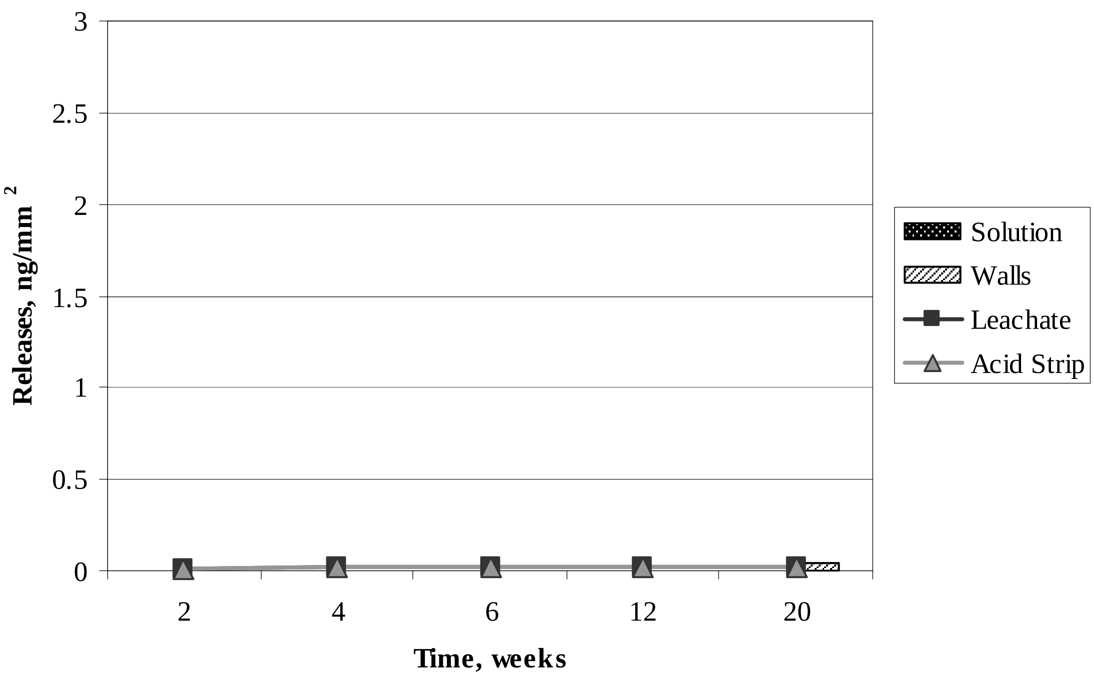


Figure J-64. Ruthenium Present in Solutions and on Walls in AJ13 Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

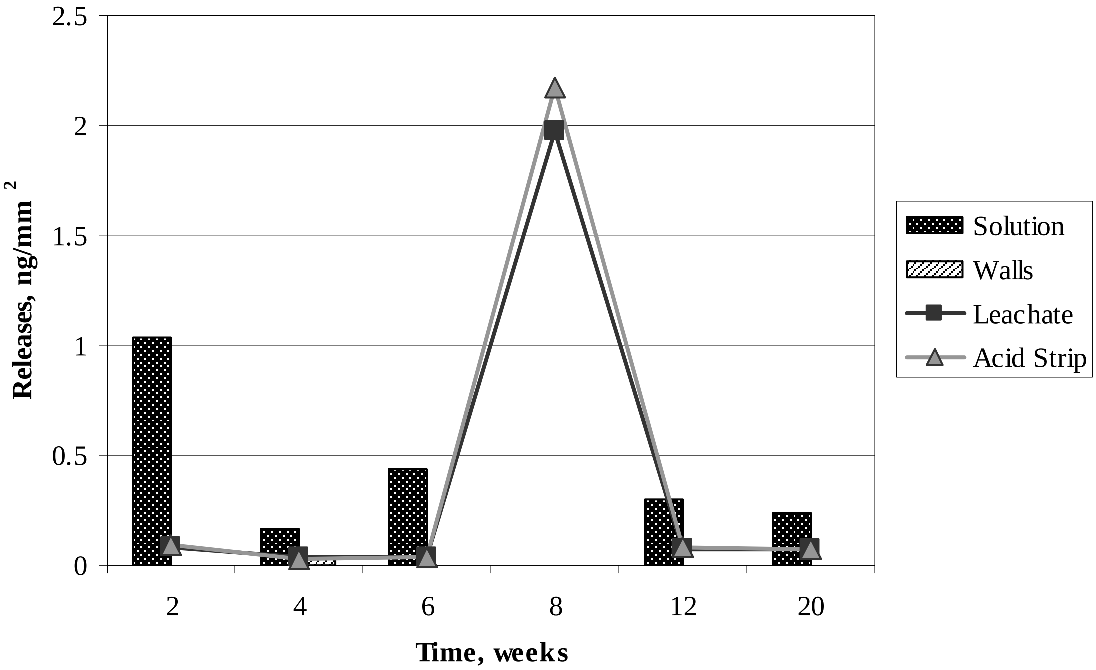


Figure J-65. Molybdenum Releases in Solution and on Walls from Polished Sample 25 in 1KCl Solution at 90ºC and Average Detection Limits for Leachate and Acid Strip.

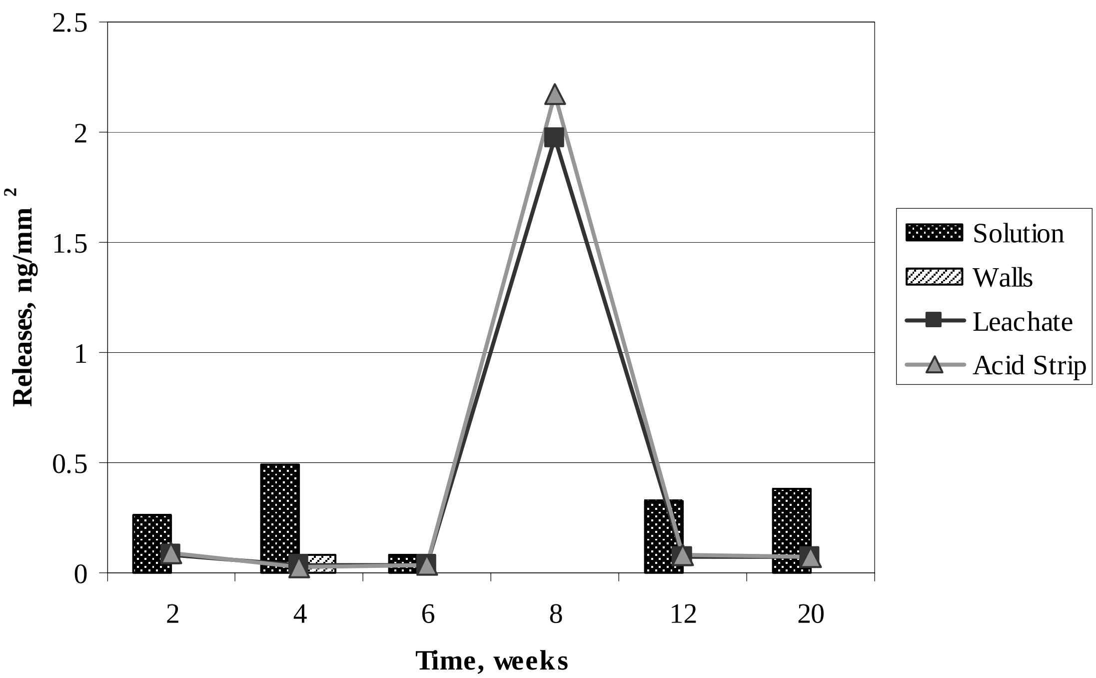


Figure J-66. Molybdenum Present in Solutions and on Walls in 1KCl Solution Control at 90ºC and Average Detection Limits for Leachate and Acid Strip.

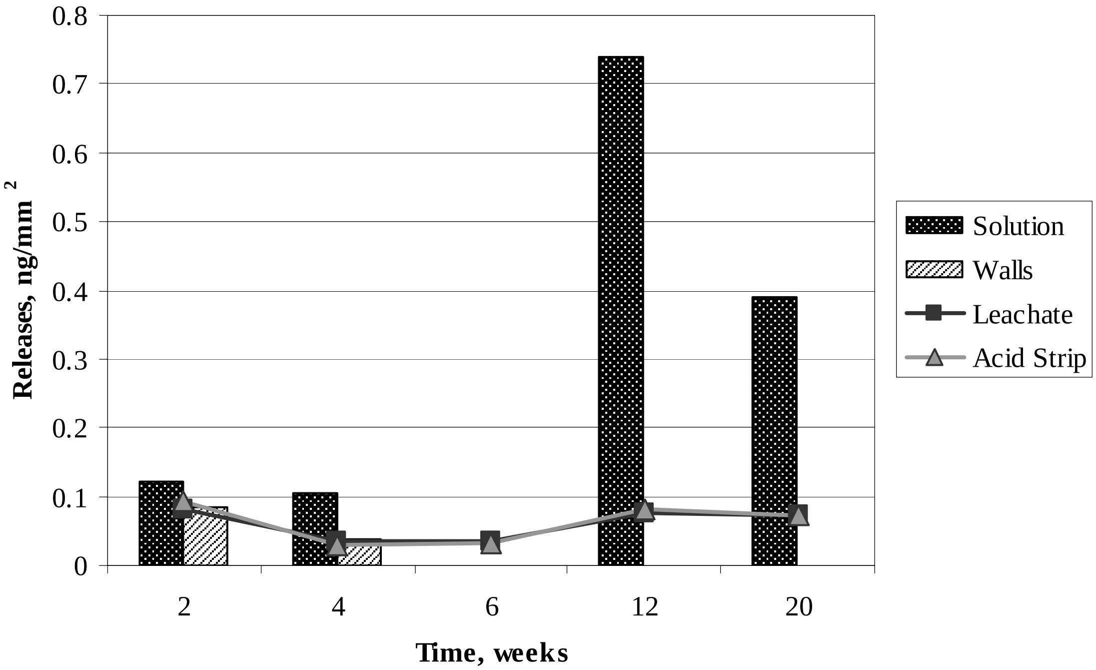


Figure J-67. Molybdenum Releases in Solution and on Walls from Polished Sample 27 in 1KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

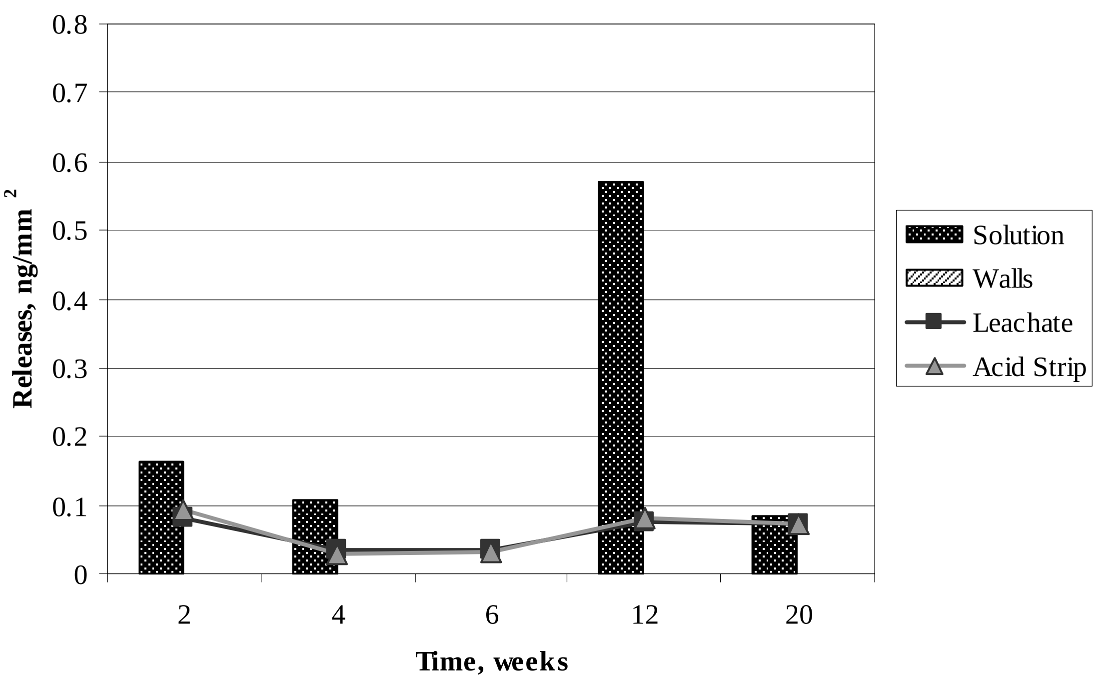


Figure J-68. Molybdenum Present in Solutions and on Walls in 1KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

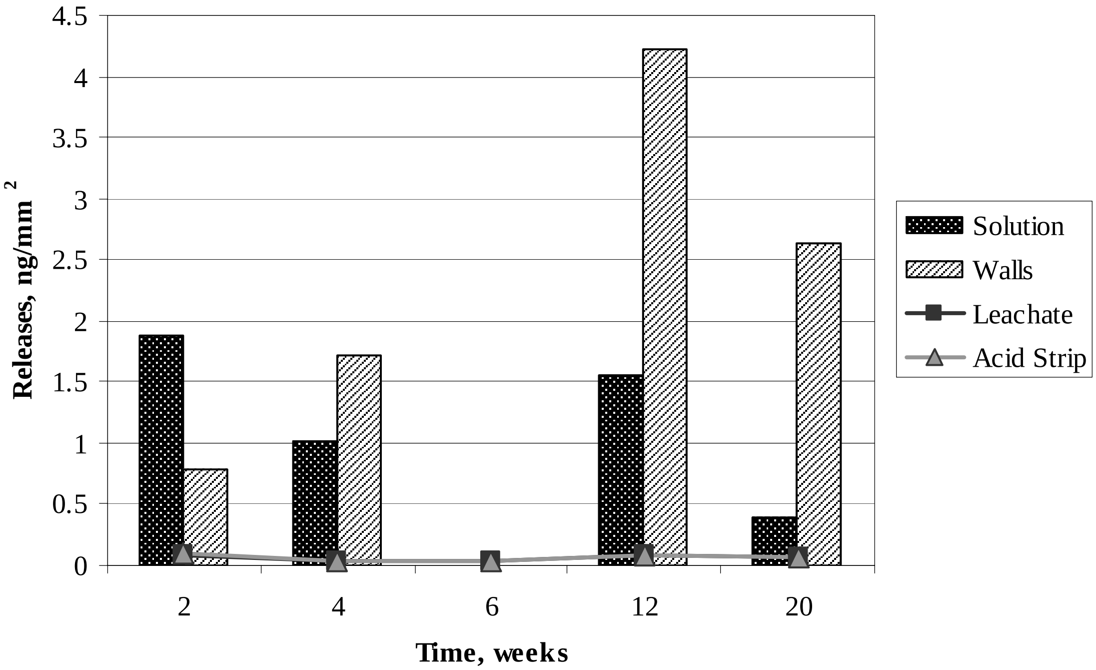


Figure J-69. Moybdenum Releases in Solution and on Walls from Polished Sample 29 in 10KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

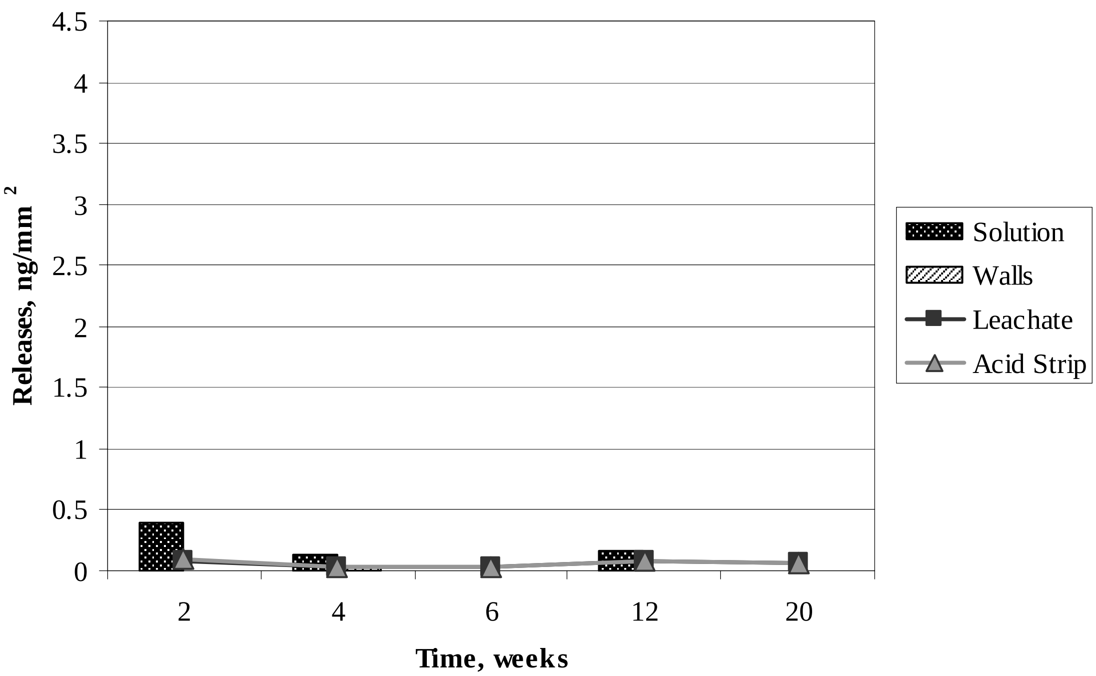


Figure J-70. Molybdenum Present in Solutions and on Walls in 10KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

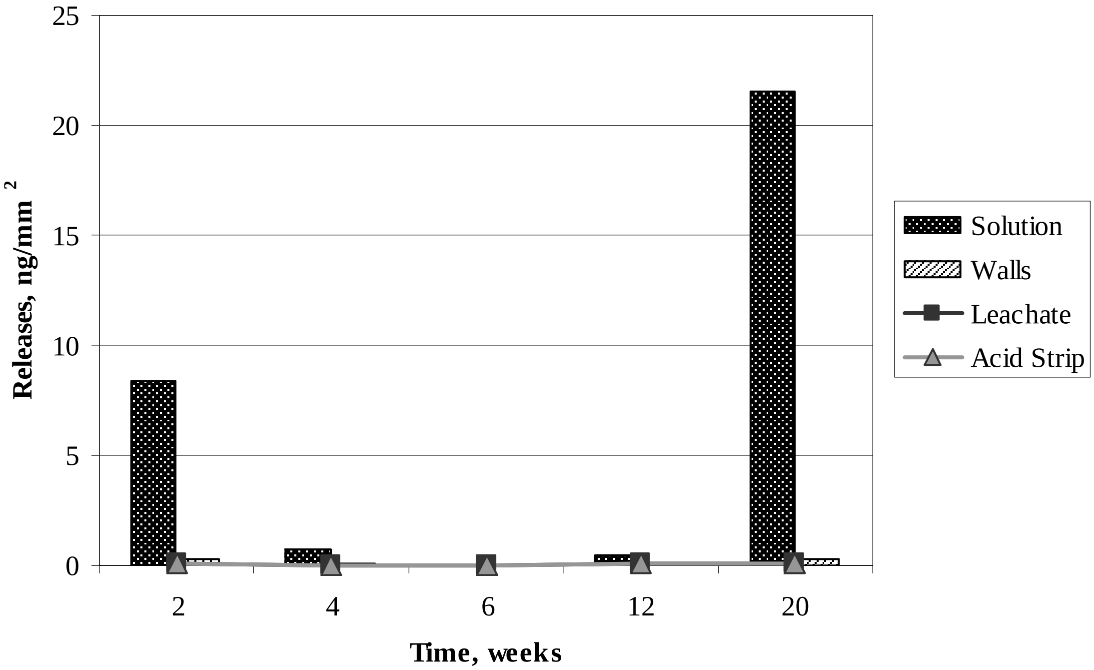


Figure J-71. Molybdenum Releases in Solution and on Walls from Polished Sample 31 in AJ13 Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

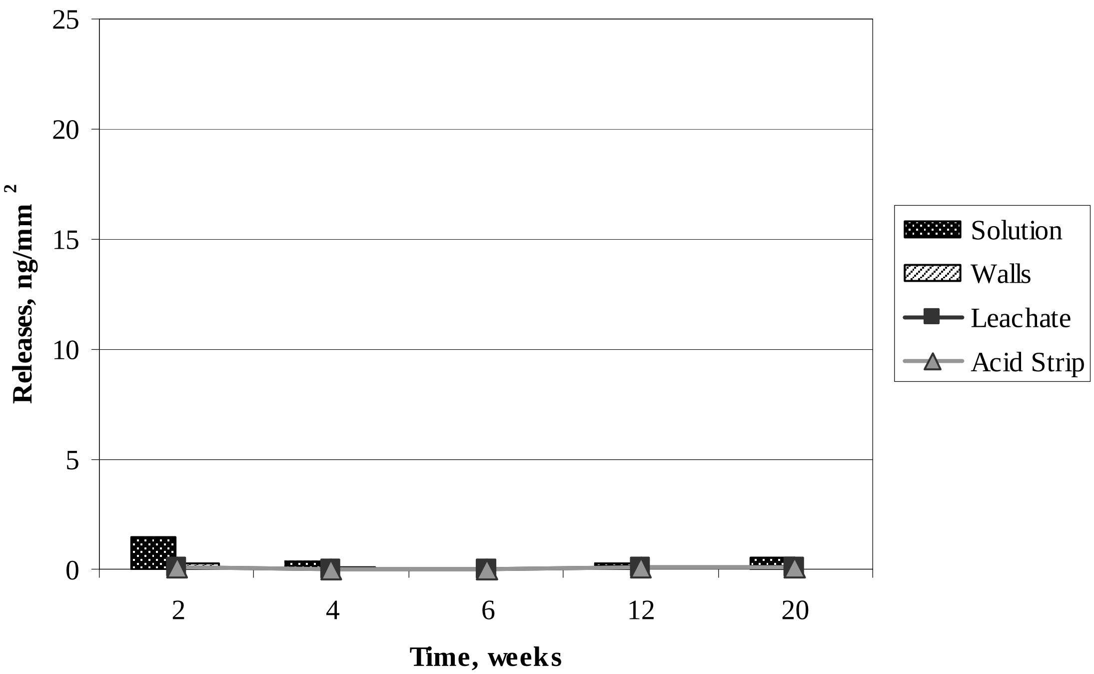


Figure J-72. Molybdenum Present in Solutions and on Walls in AJ13 Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

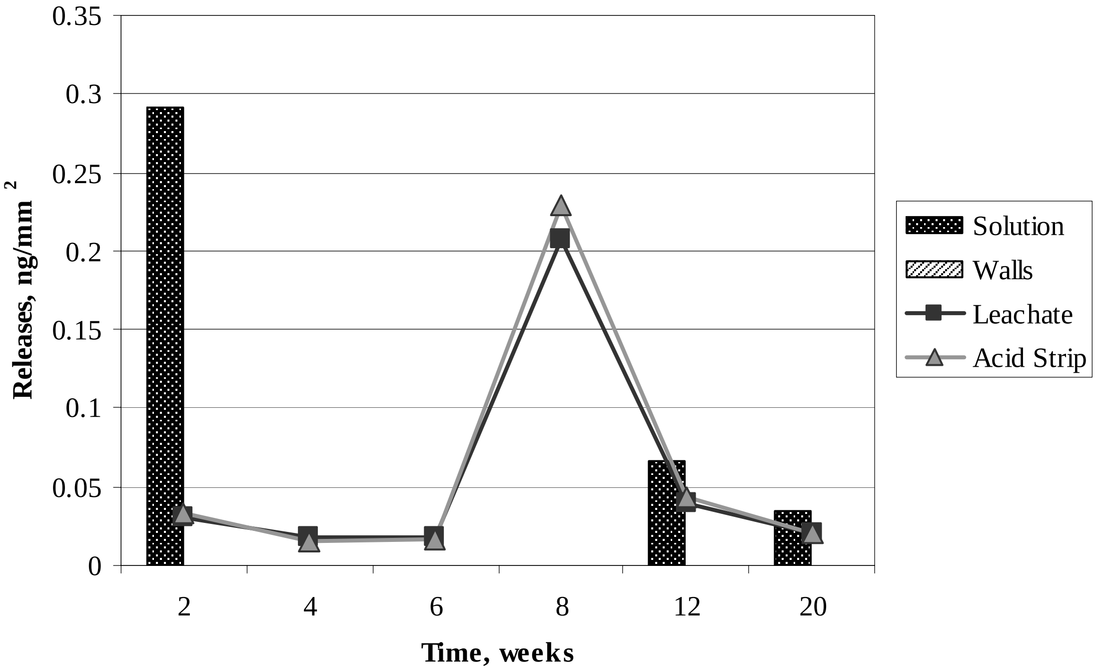


Figure J-73. Manganese Releases in Solution and on Walls from Polished Sample 25 in 1KCl Solution at 90ºC and Average Detection Limits for Leachate and Acid Strip.

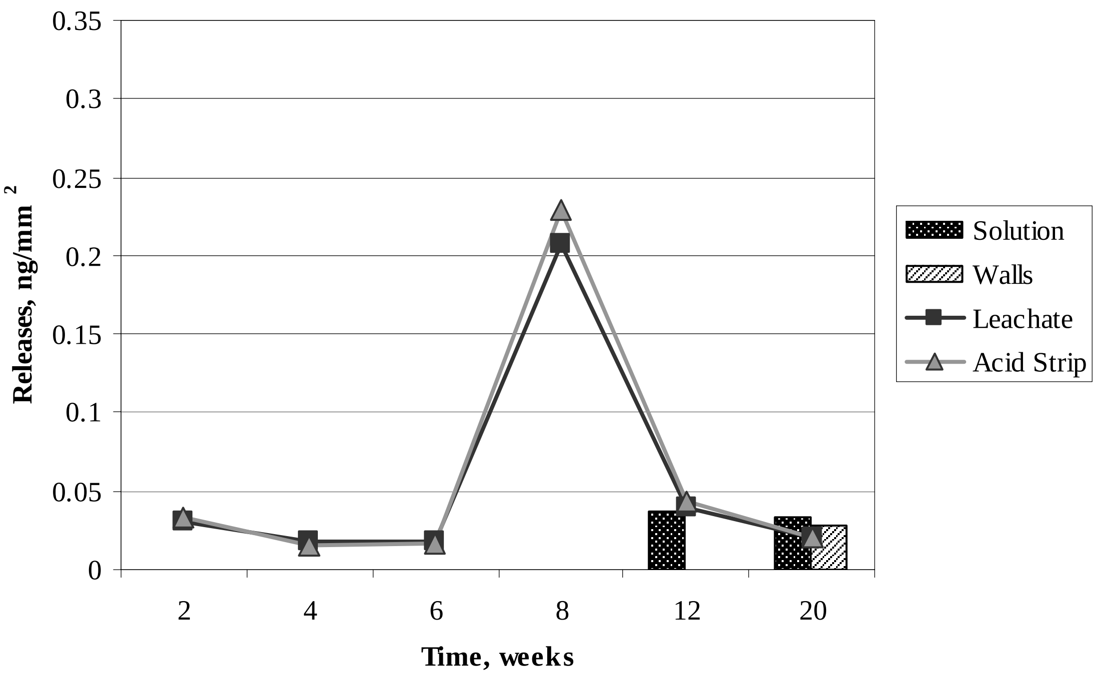


Figure J-74. Manganese Present in Solutions and on Walls in 1KCl Solution Control at 90ºC and Average Detection Limits for Leachate and Acid Strip.

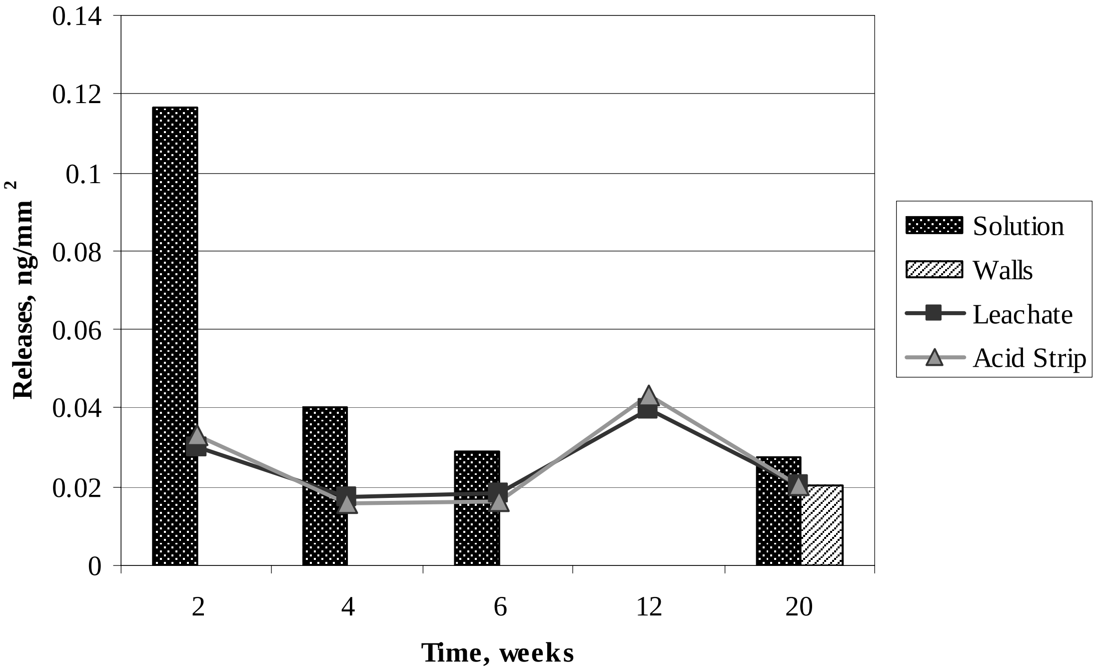


Figure J-75. Manganese Releases in Solution and on Walls from Polished Sample 27 in 1KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

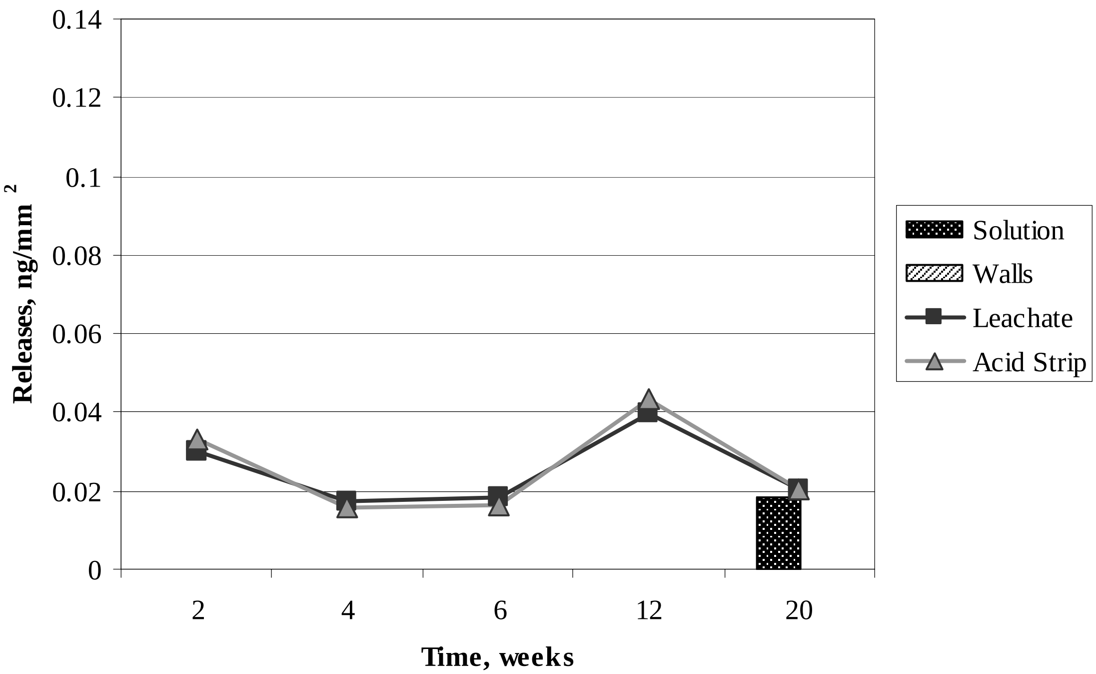


Figure J-76. Manganese Present in Solutions and on Walls in 1KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

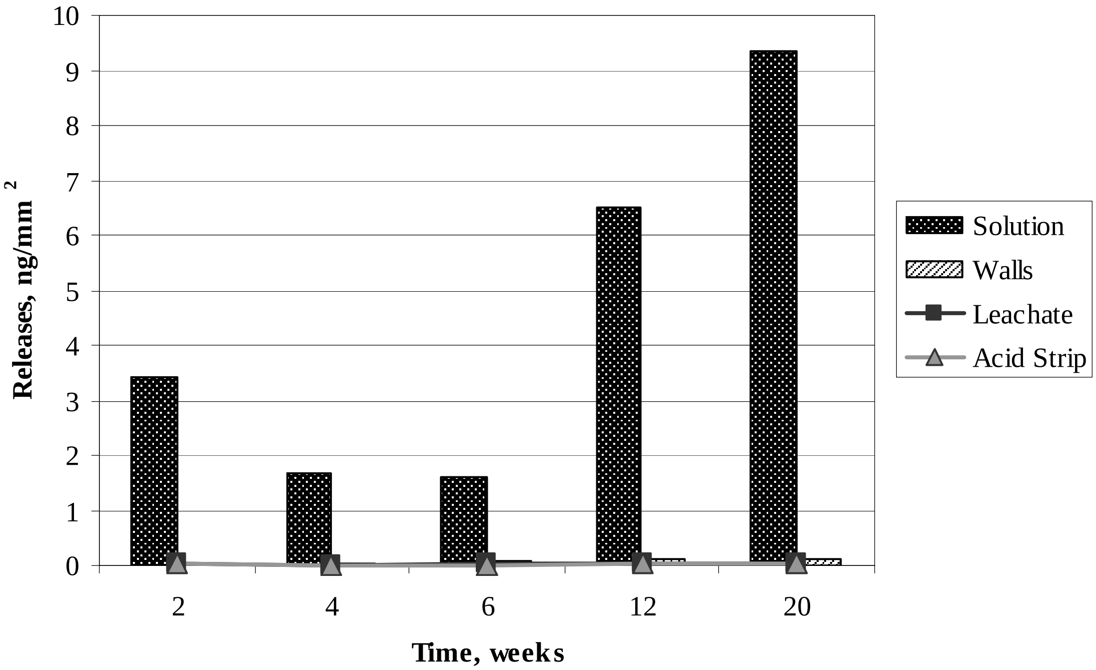


Figure J-77. Manganese Releases in Solution and on Walls from Polished Sample 29 in 10KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

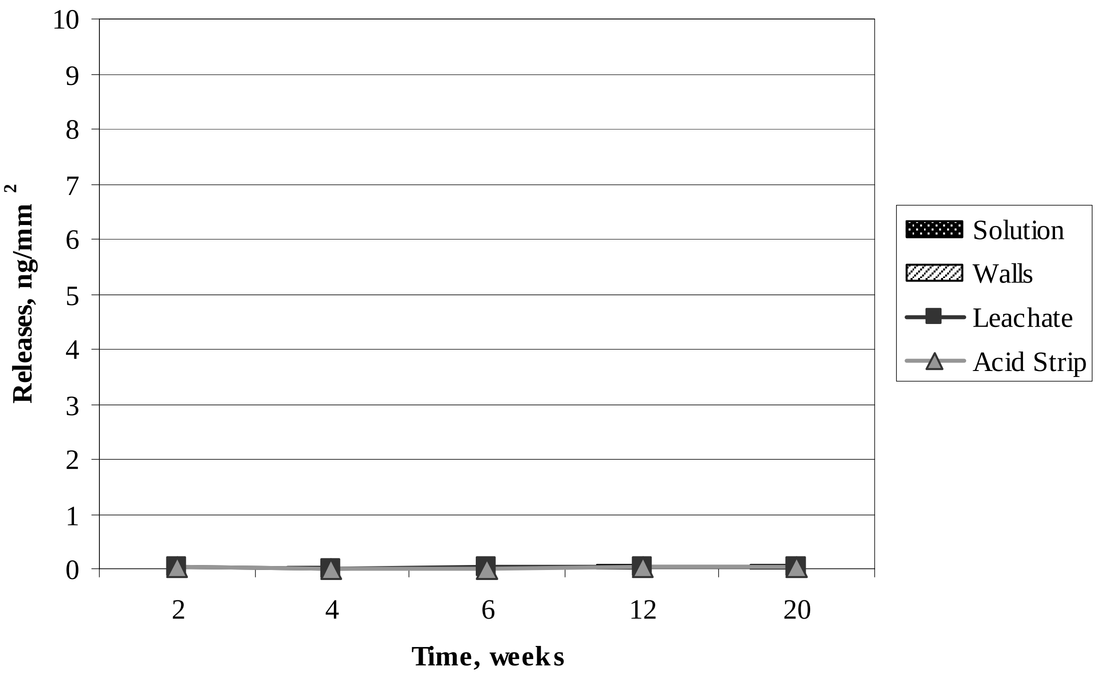


Figure J-78. Manganese Present in Solutions and on Walls in 10KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

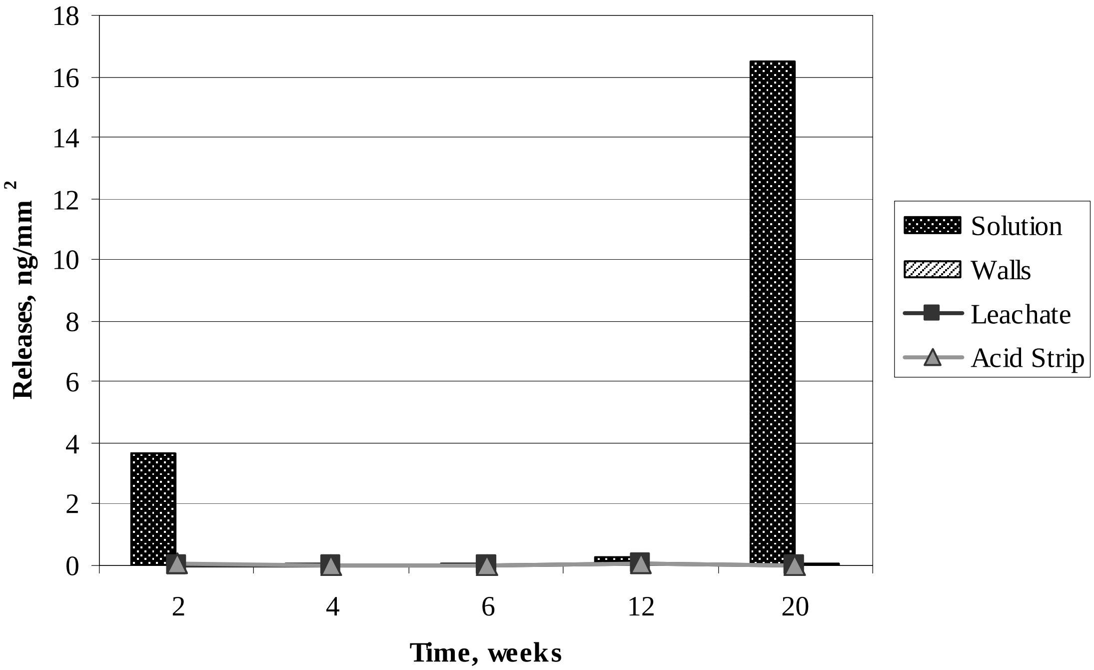


Figure J-79. Manganese Releases in Solution and on Walls from Polished Sample 31 in AJ13 Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

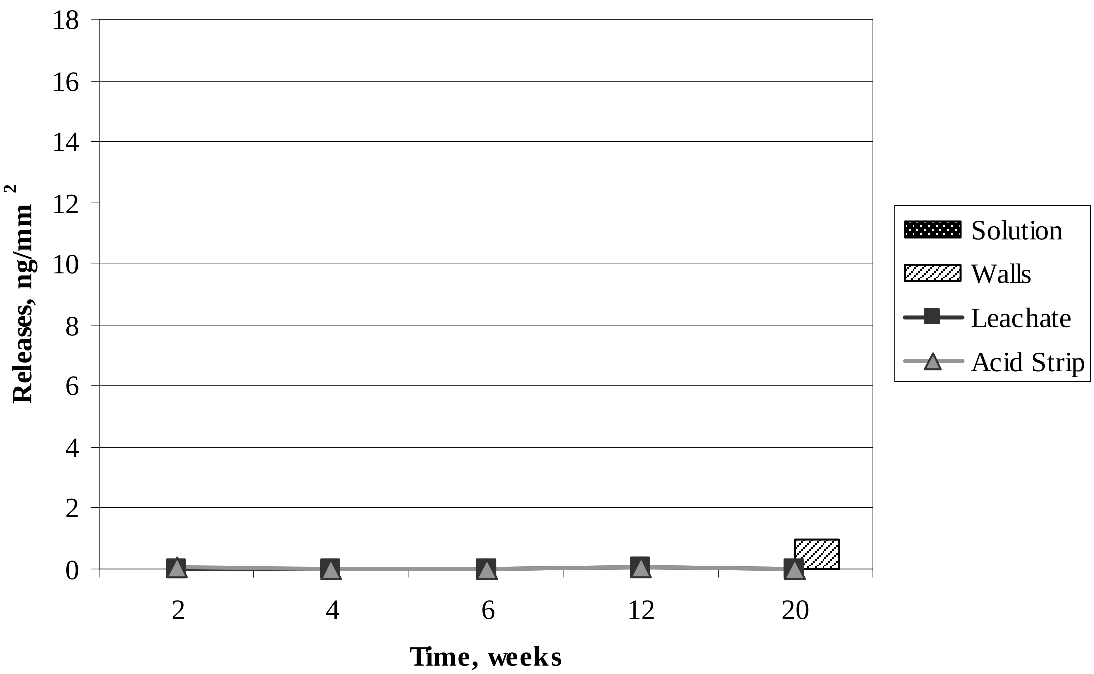


Figure J-80. Manganese Present in Solutions and on Walls in AJ13 Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

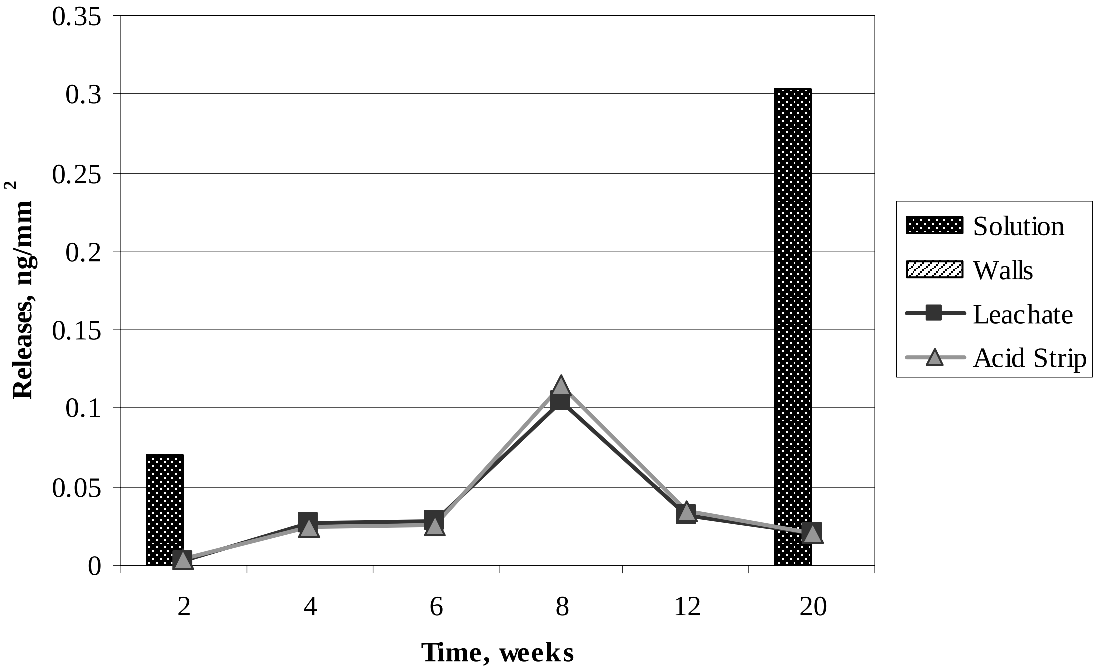


Figure J-81. Cobalt Releases in Solution and on Walls from Polished Sample 25 in 1KCl Solution at 90ºC and Average Detection Limits for Leachate and Acid Strip.

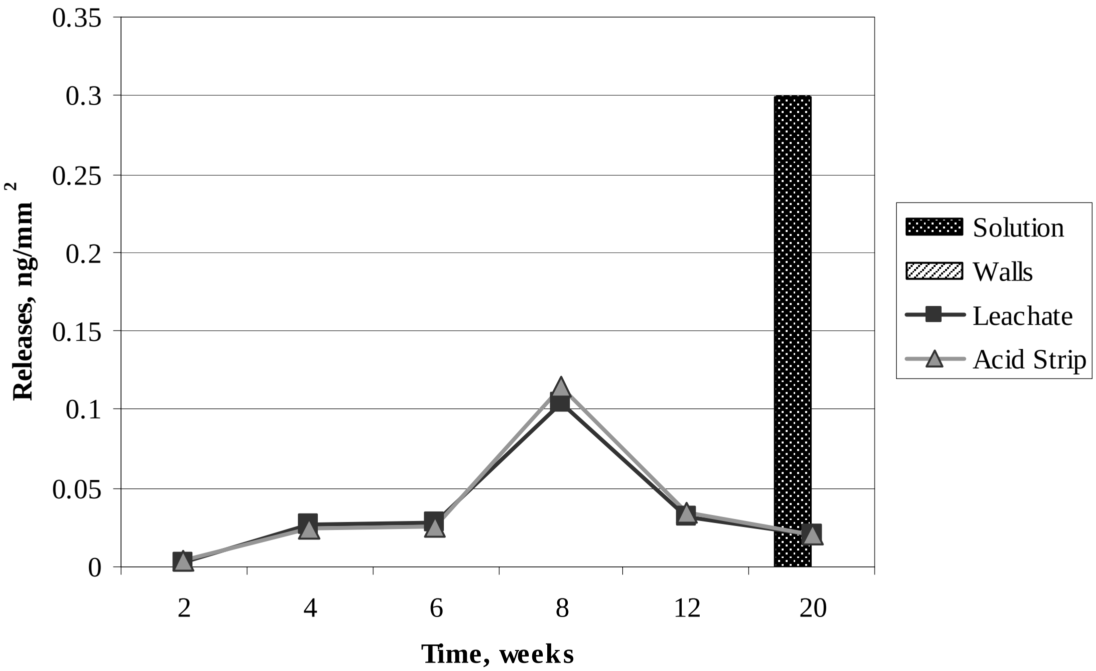


Figure J-82. Cobalt Present in Solutions and on Walls in 1KCl Solution Control at 90ºC and Average Detection Limits for Leachate and Acid Strip.

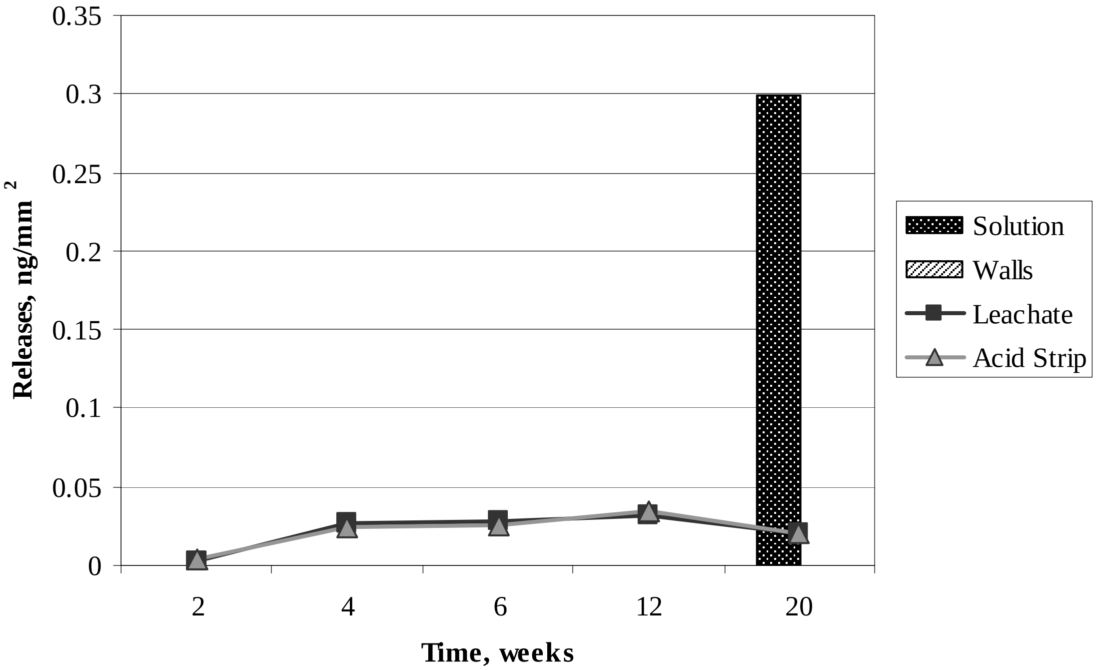


Figure J-83. Cobalt Releases in Solution and on Walls from Polished Sample 27 in 1KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

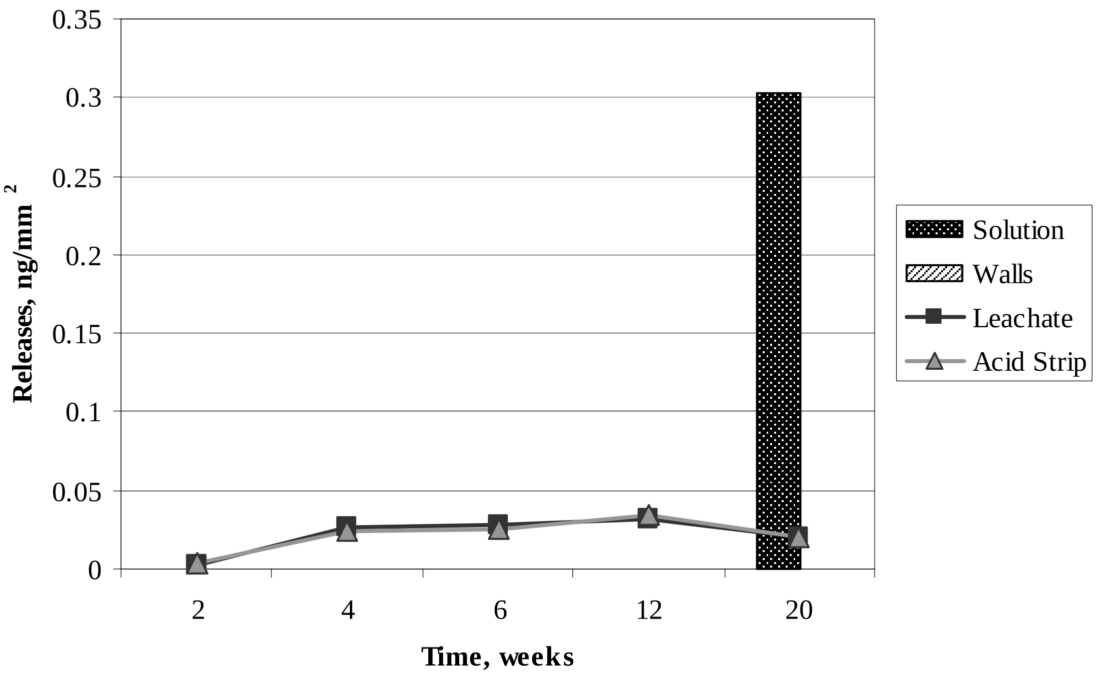


Figure J-84. Cobalt Present in Solutions and on Walls in 1KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

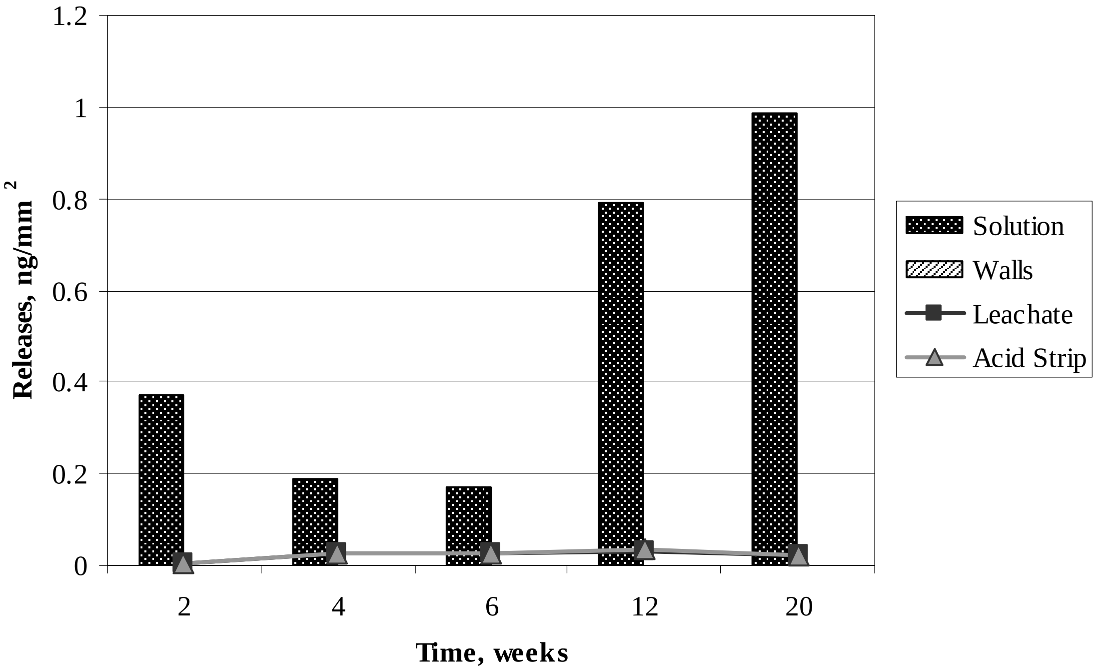


Figure J-85. Cobalt Releases in Solution and on Walls from Polished Sample 29 in 10KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

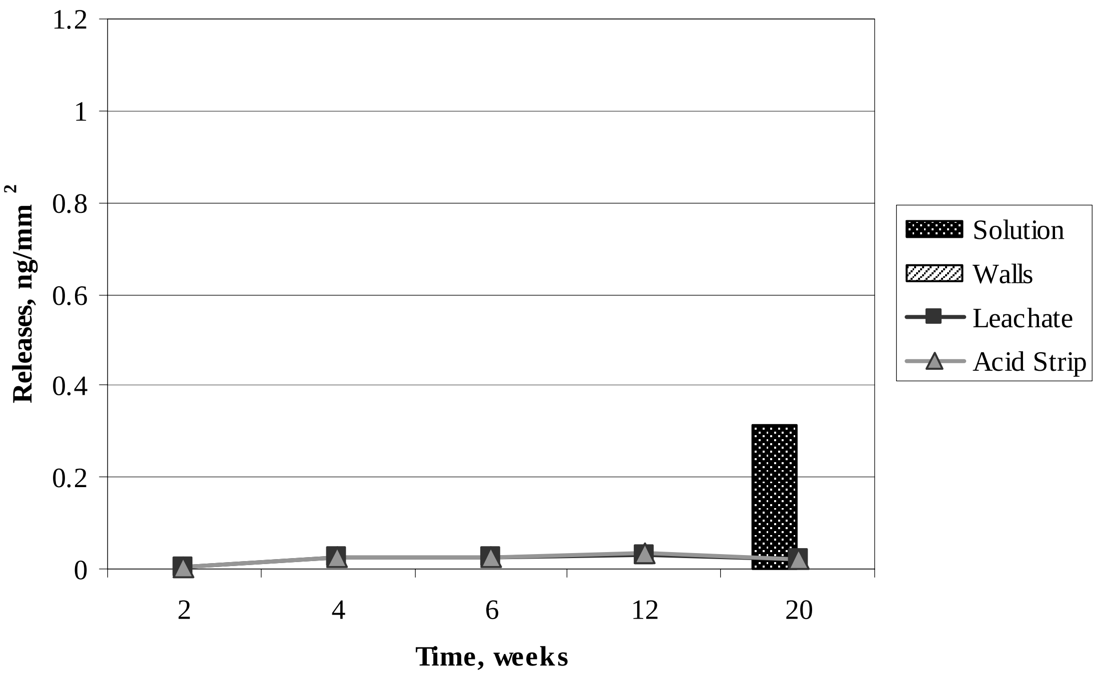


Figure J-86. Cobalt Present in Solutions and on Walls in 10KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

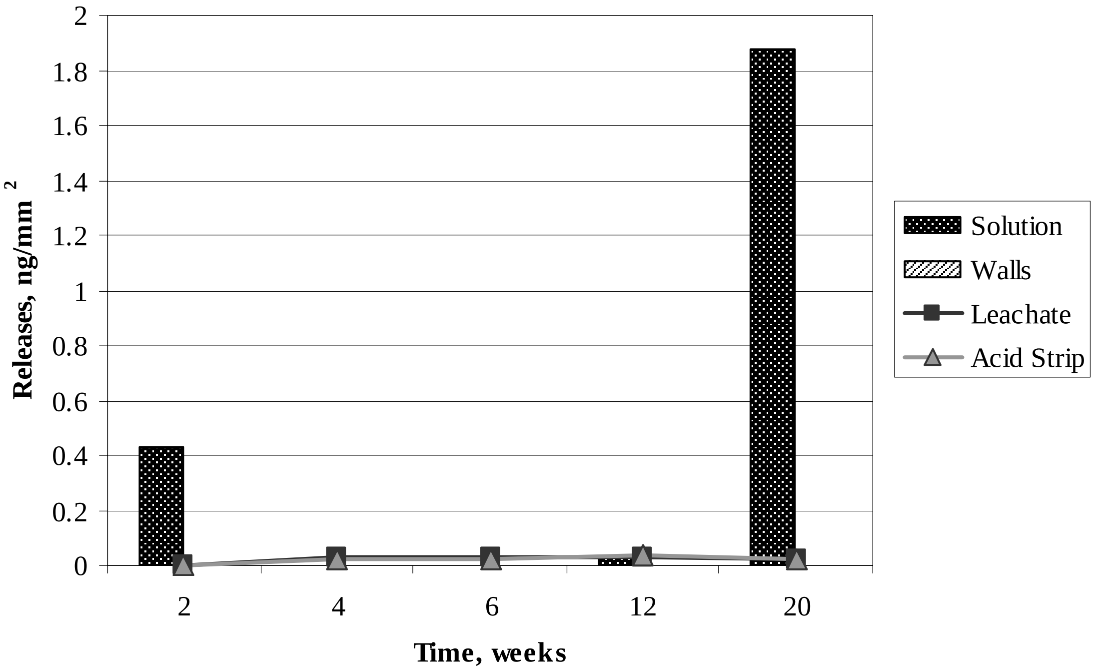


Figure J-87. Cobalt Releases in Solution and on Walls from Polished Sample 31 in AJ13 Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

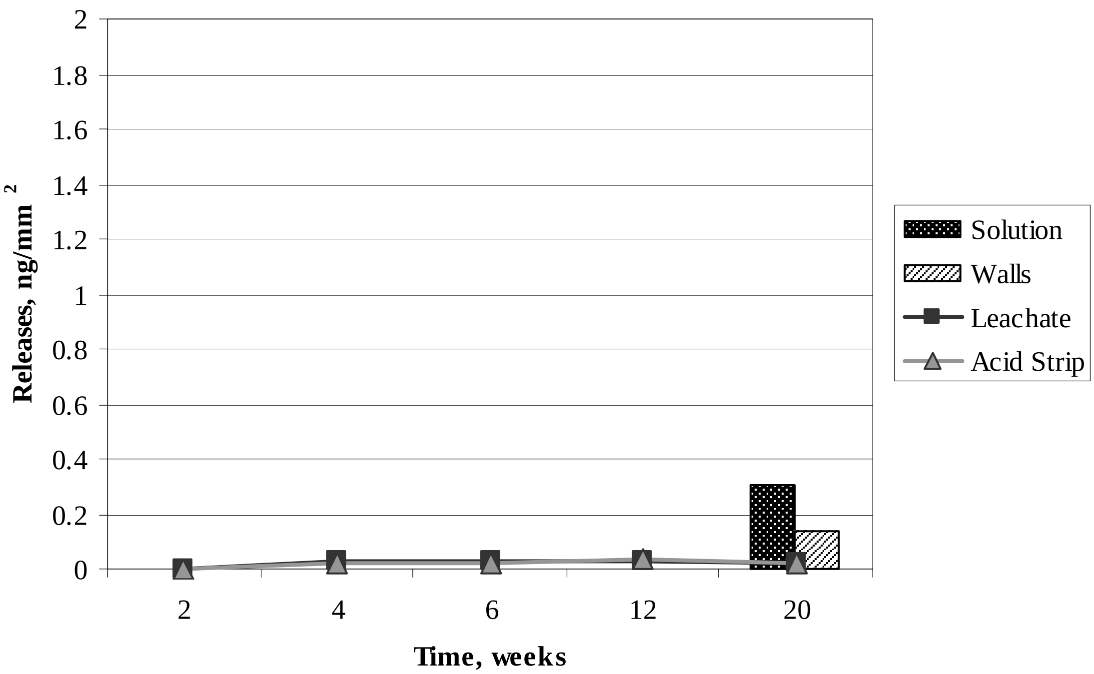


Figure J-88. Cobalt Present in Solutions and on Walls in AJ13 Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

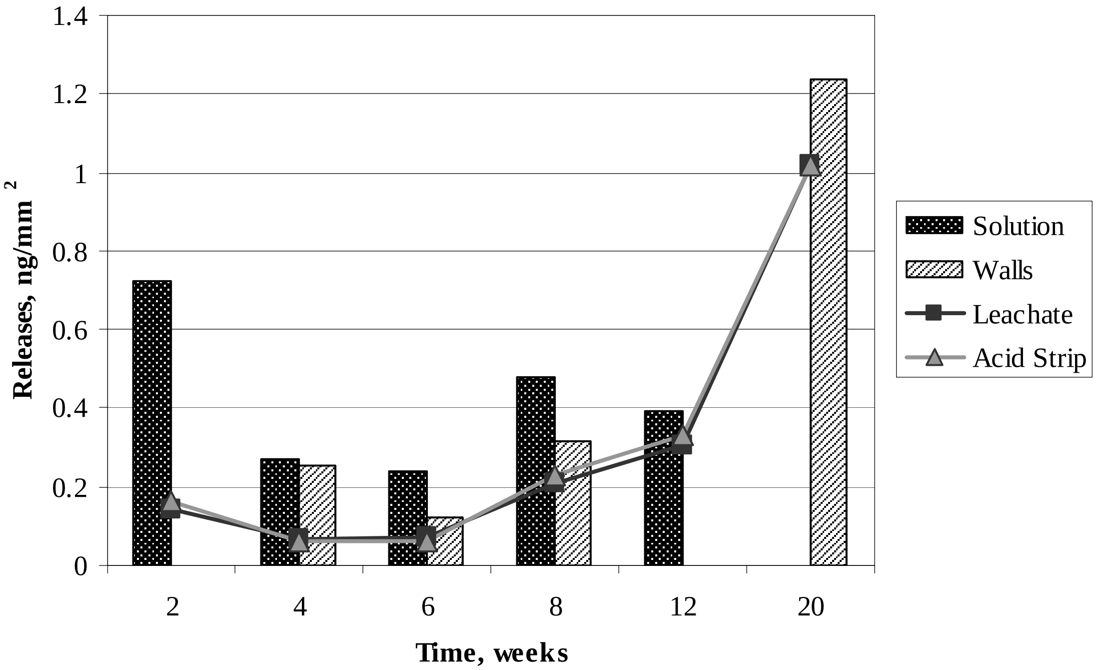


Figure J-89. Copper Releases in Solution and on Walls from Polished Sample 25 in 1KCl Solution at 90ºC and Average Detection Limits for Leachate and Acid Strip.

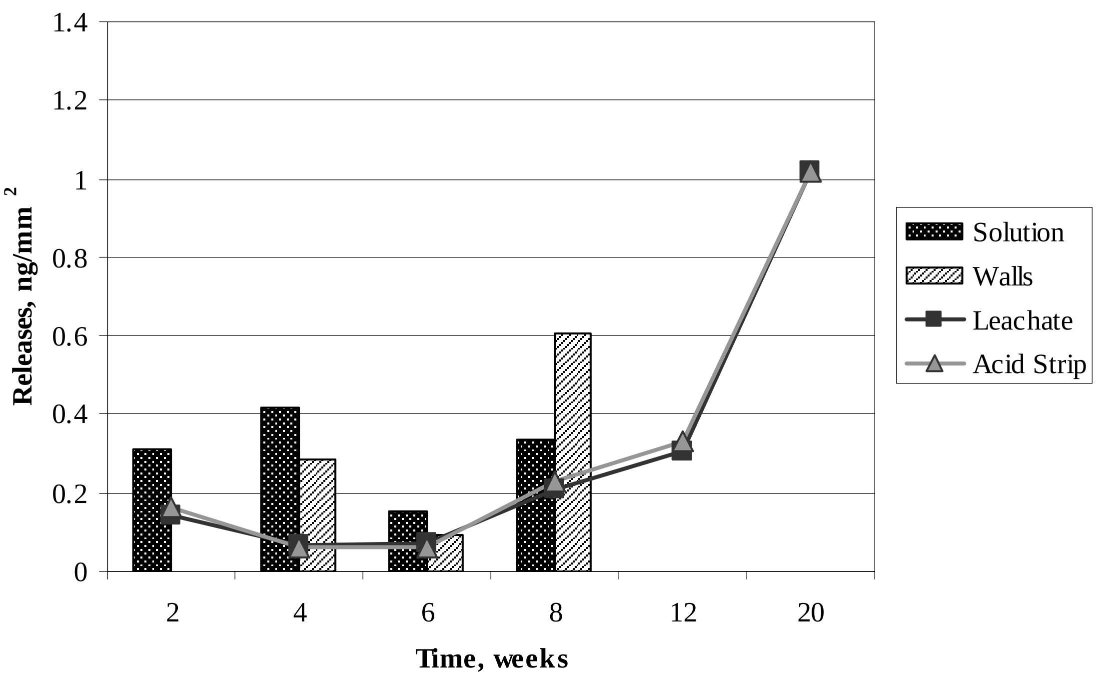


Figure J-90. Copper Present in Solutions and on Walls in 1KCl Solution Control at 90ºC and Average Detection Limits for Leachate and Acid Strip.

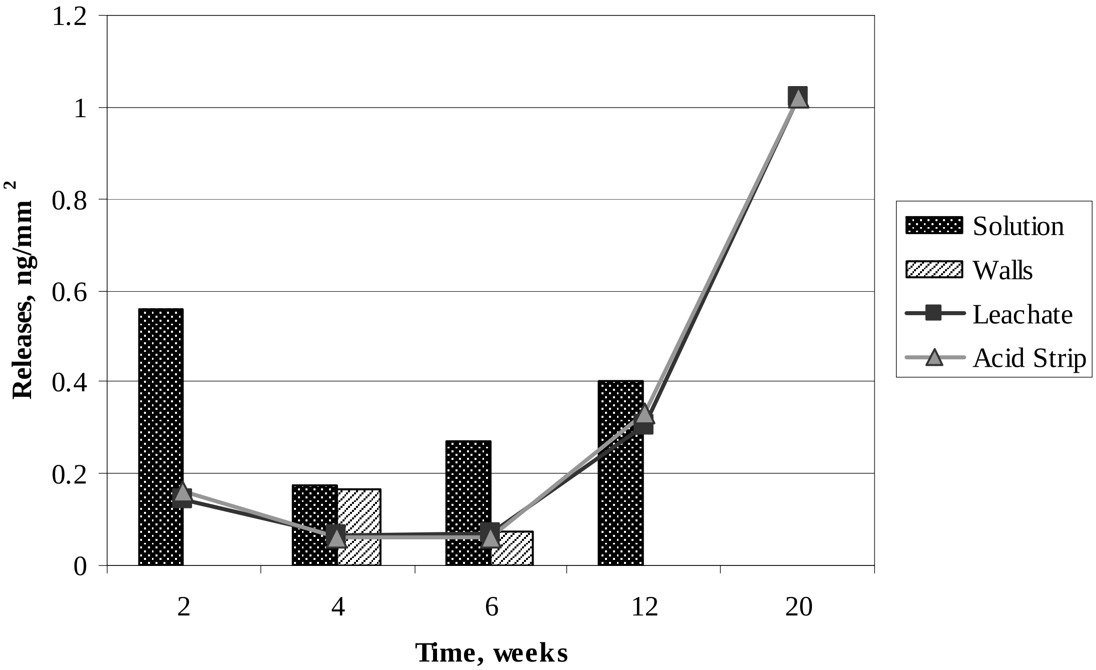


Figure J-91. Copper Releases in Solution and on Walls from Polished Sample 27 in 1KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

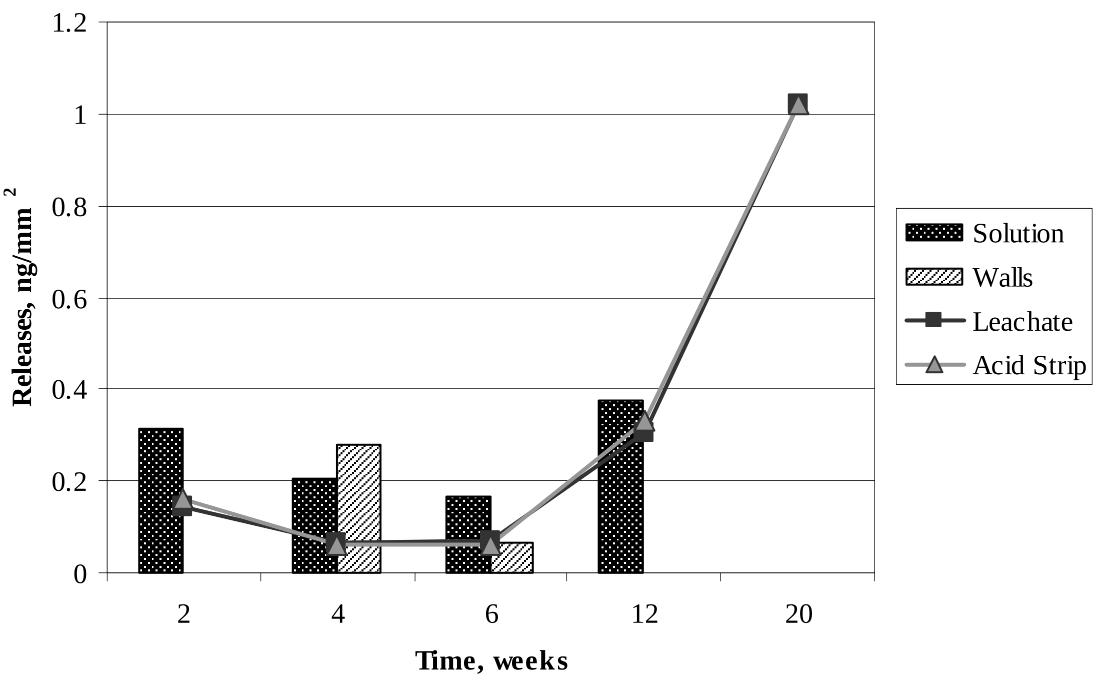


Figure J-92. Copper Present in Solutions and on Walls in 1KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

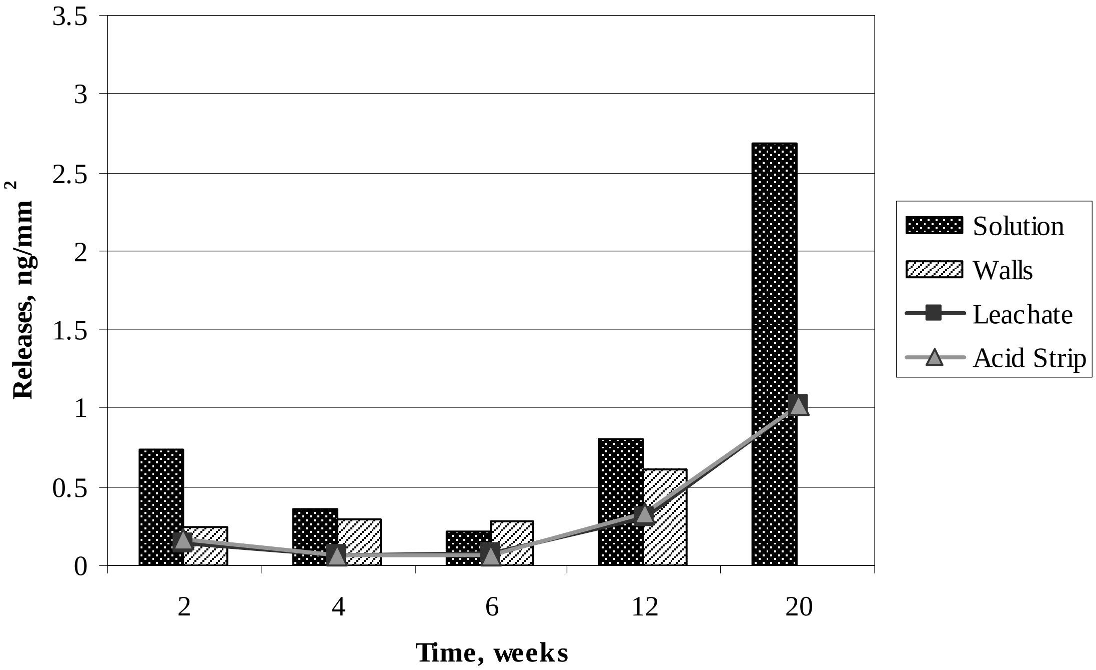


Figure J-93. Copper Releases in Solution and on Walls from Polished Sample 29 in 10KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

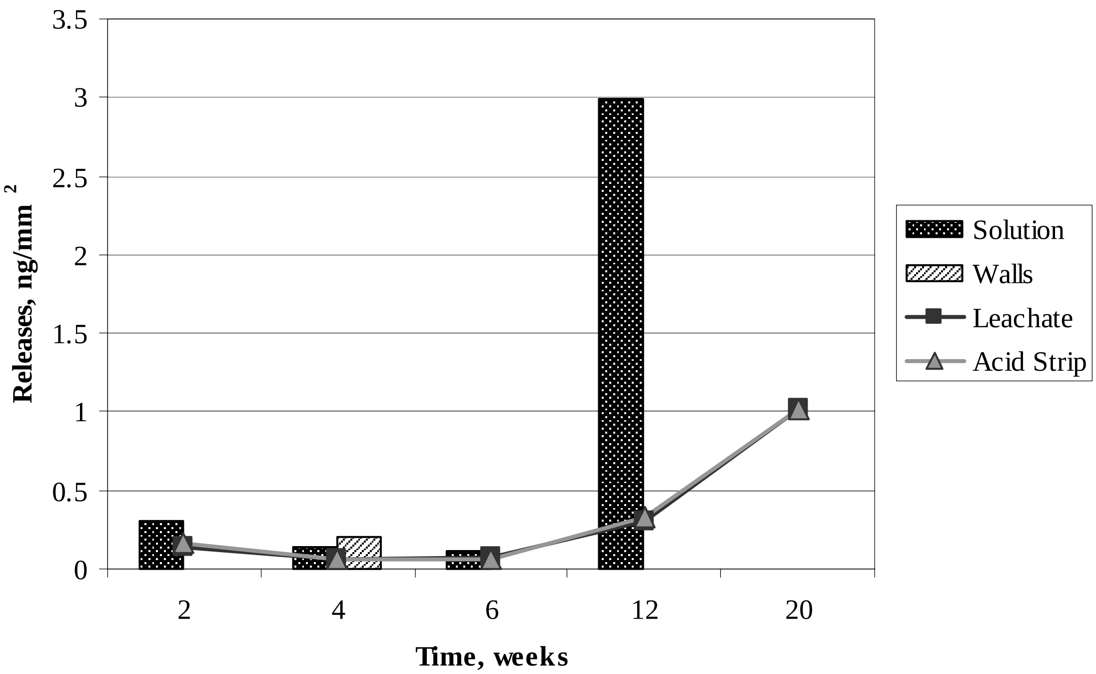


Figure J-94. Copper Present in Solutions and on Walls in 10KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

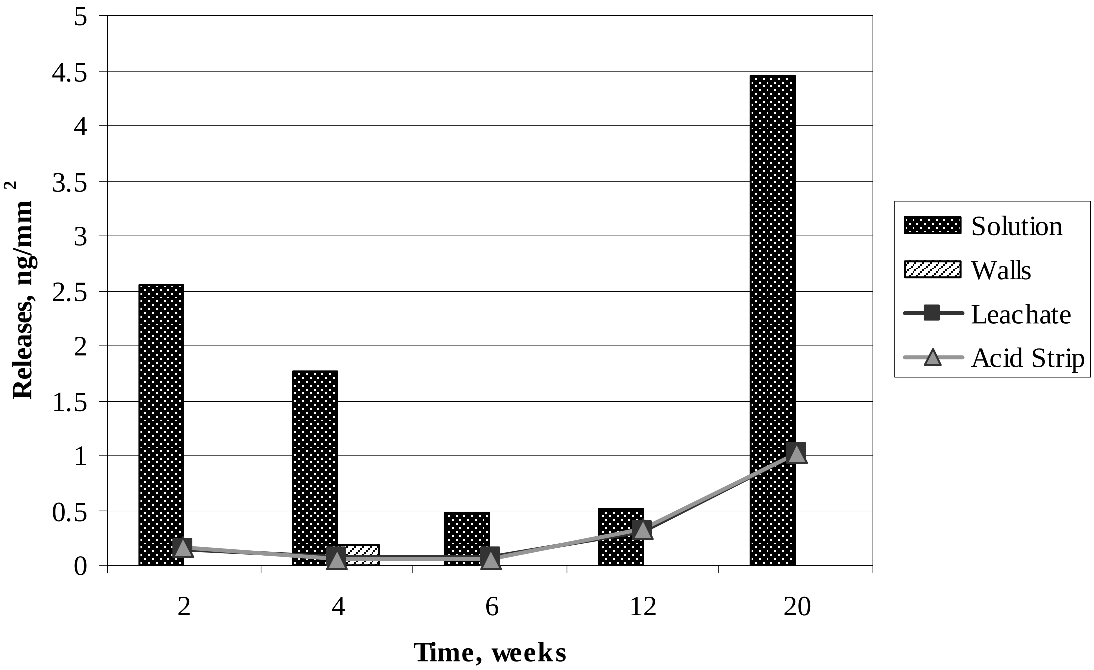


Figure J-95. Copper Releases in Solution and on Walls from Polished Sample 31 in AJ13 Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

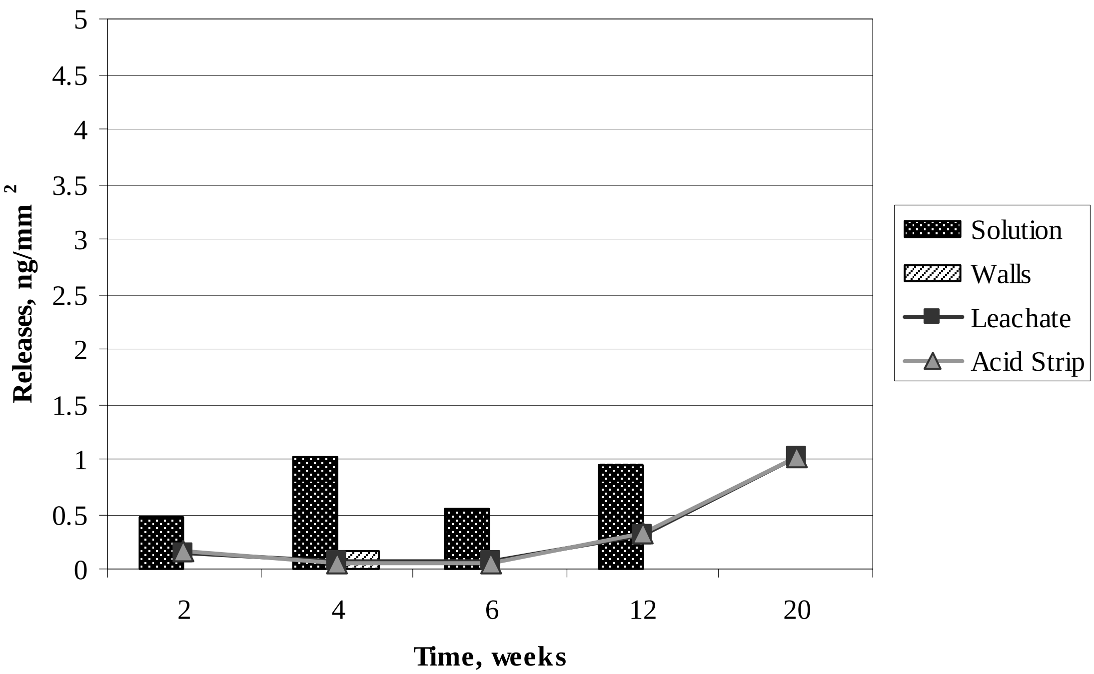


Figure J-96. Copper Present in Solutions and on Walls in AJ13 Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

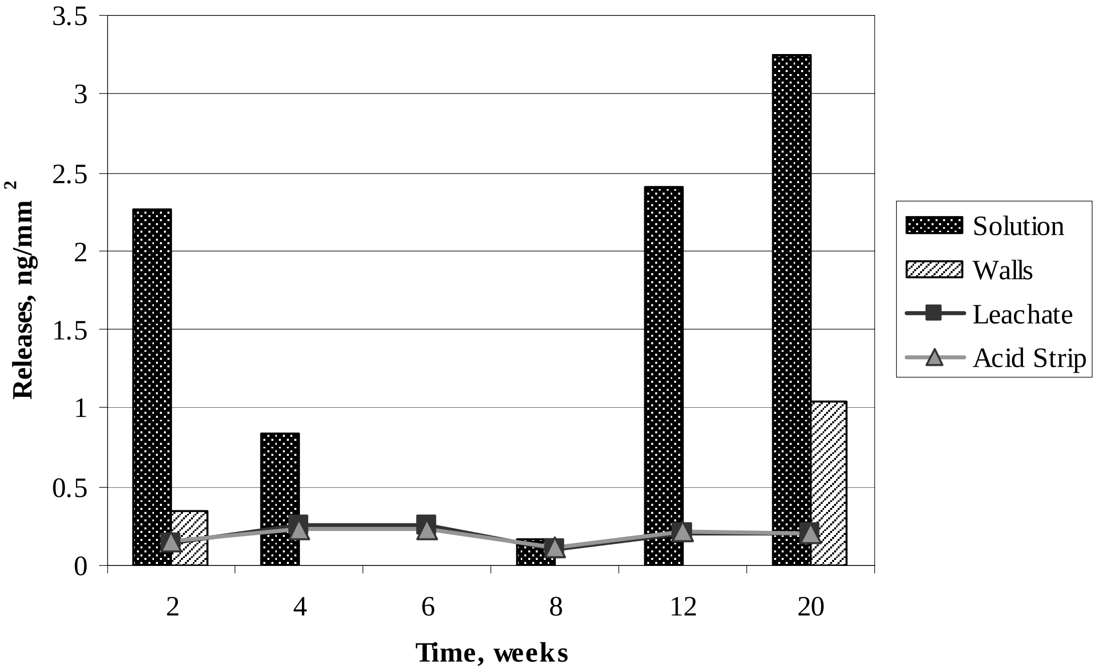


Figure J-97. Vanadium Releases in Solution and on Walls from Polished Sample 25 in 1KCl Solution at 90ºC and Average Detection Limits for Leachate and Acid Strip.

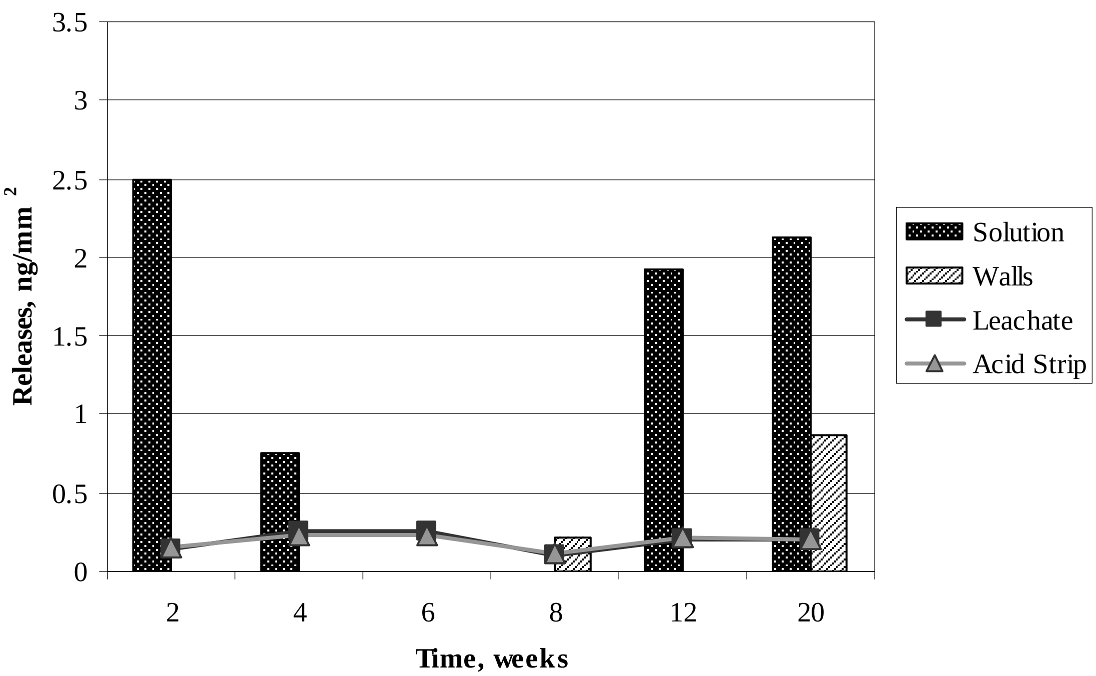


Figure J-98. Vanadium Present in Solutions and on Walls in 1KCl Solution Control at 90ºC and Average Detection Limits for Leachate and Acid Strip.

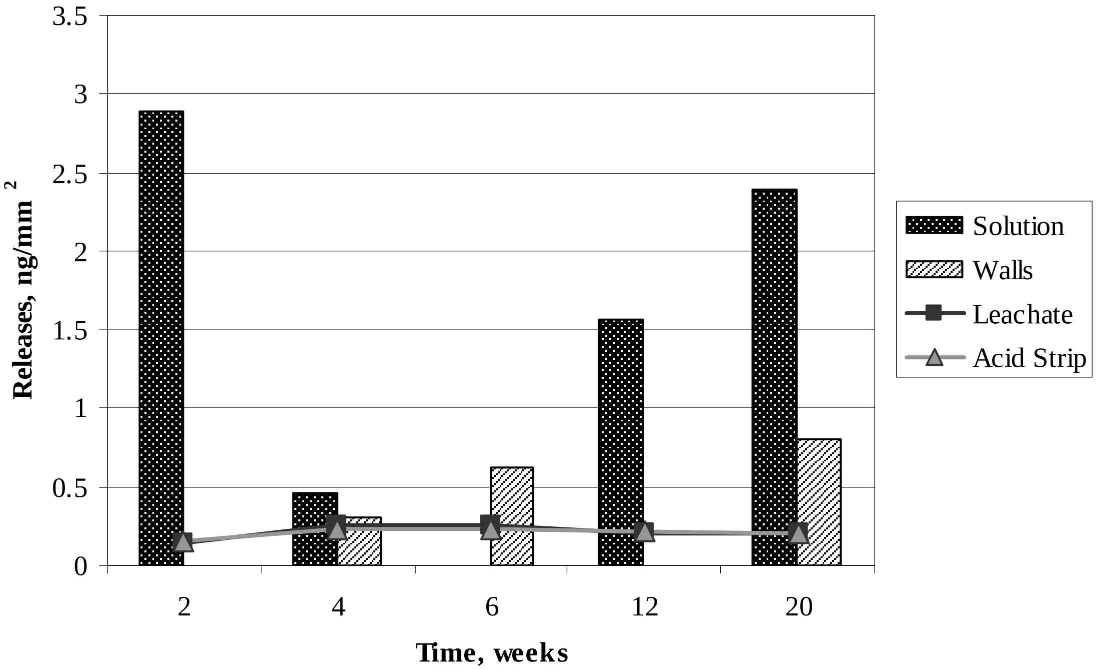


Figure J-99. Vanadium Releases in Solution and on Walls from Polished Sample 27 in 1KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

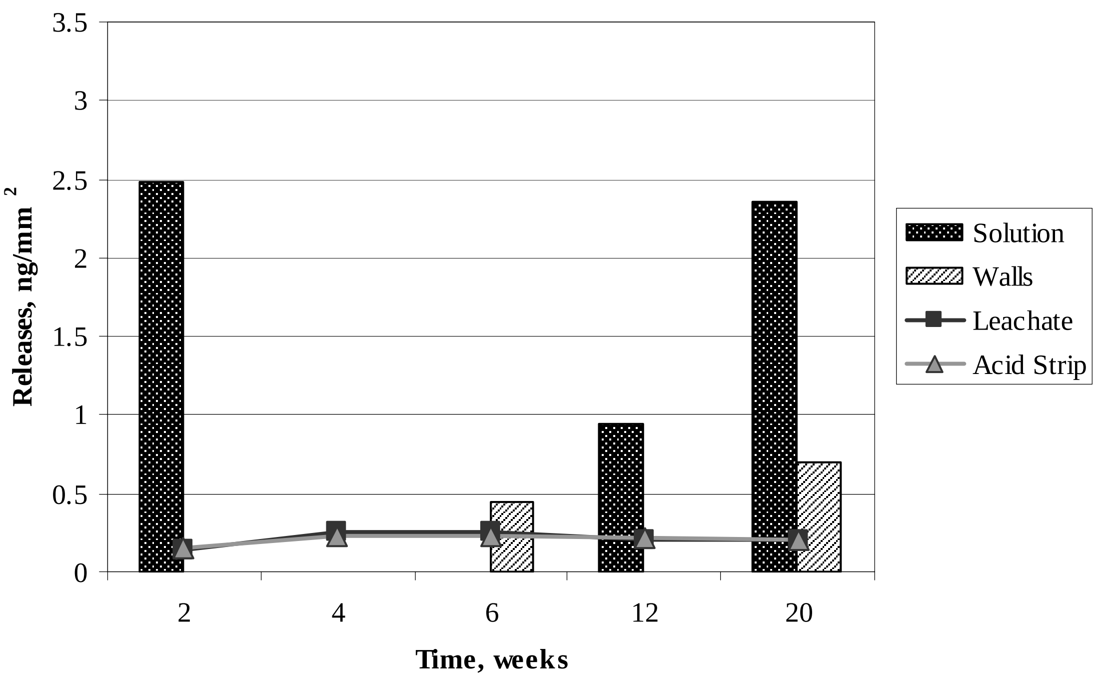


Figure J-100. Vanadium Present in Solutions and on Walls in 1KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

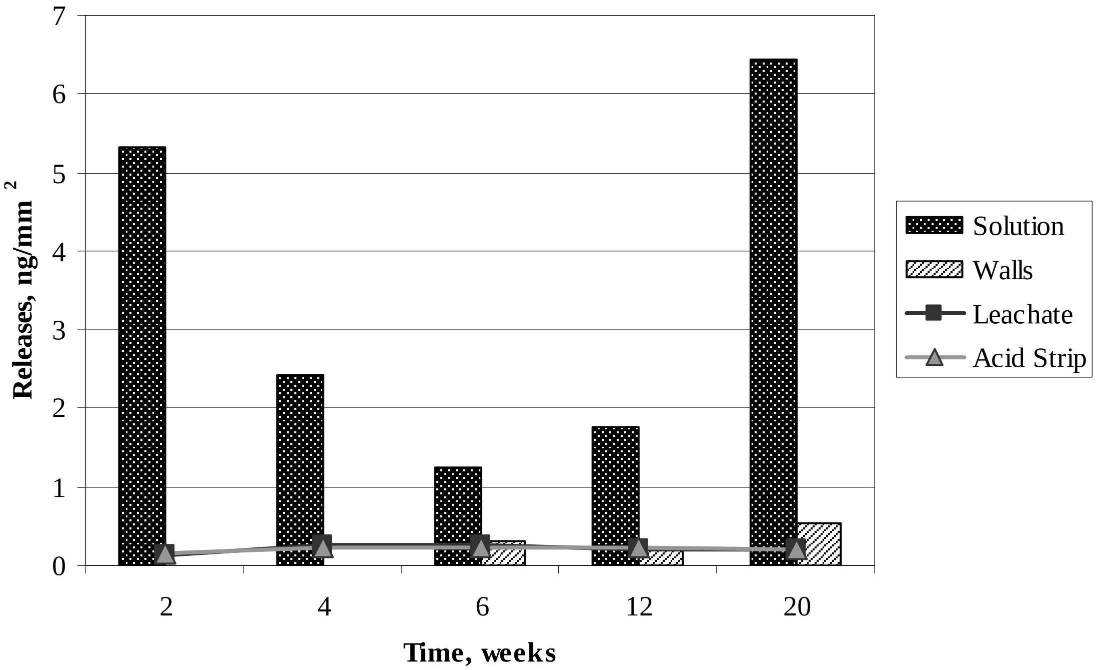


Figure J-101. Vanadium Releases in Solution and on Walls from Polished Sample 29 in 10KCl Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

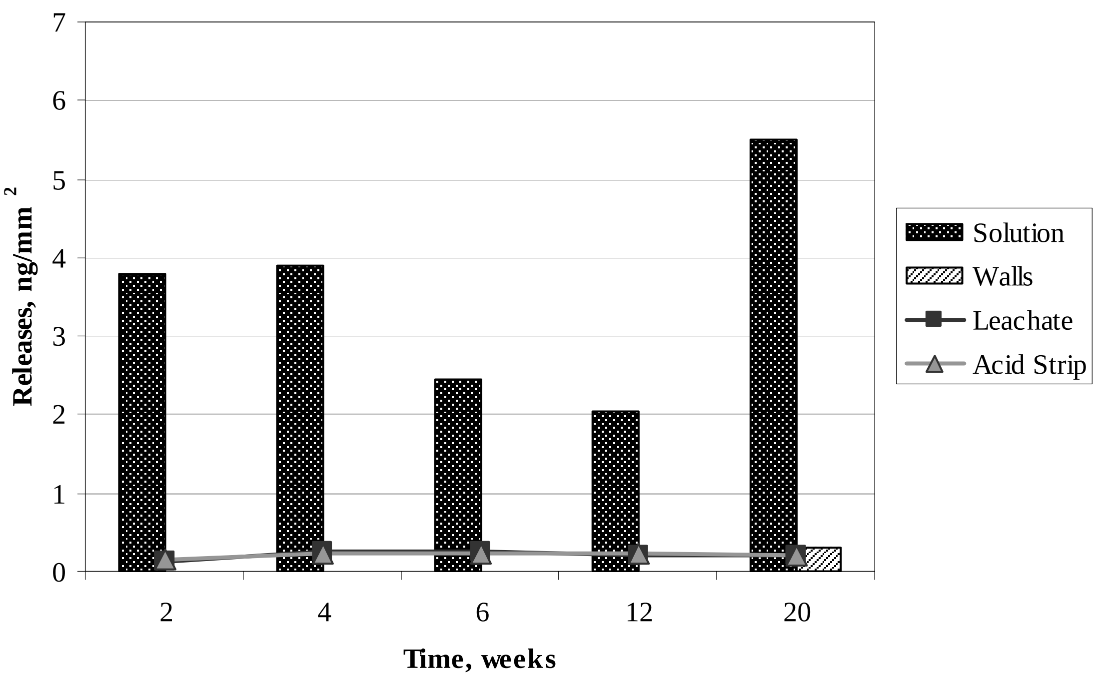


Figure J-102. Vanadium Present in Solutions and on Walls in 10KCl Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

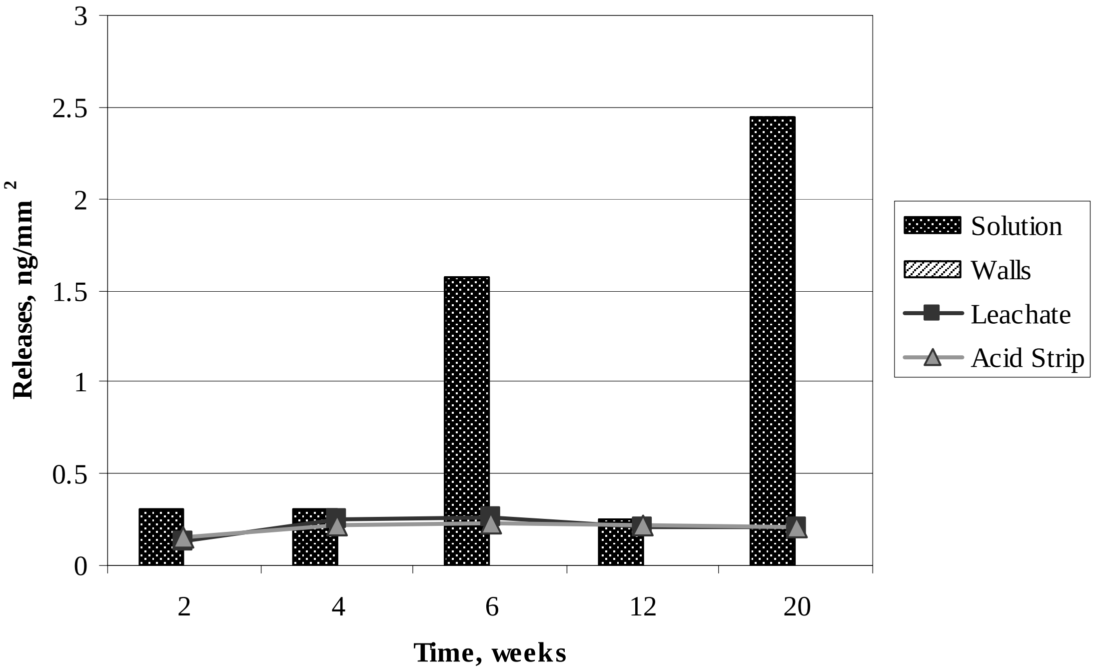


Figure J-103. Vanadium Releases in Solution and on Walls from Polished Sample 31 in AJ13 Solution at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

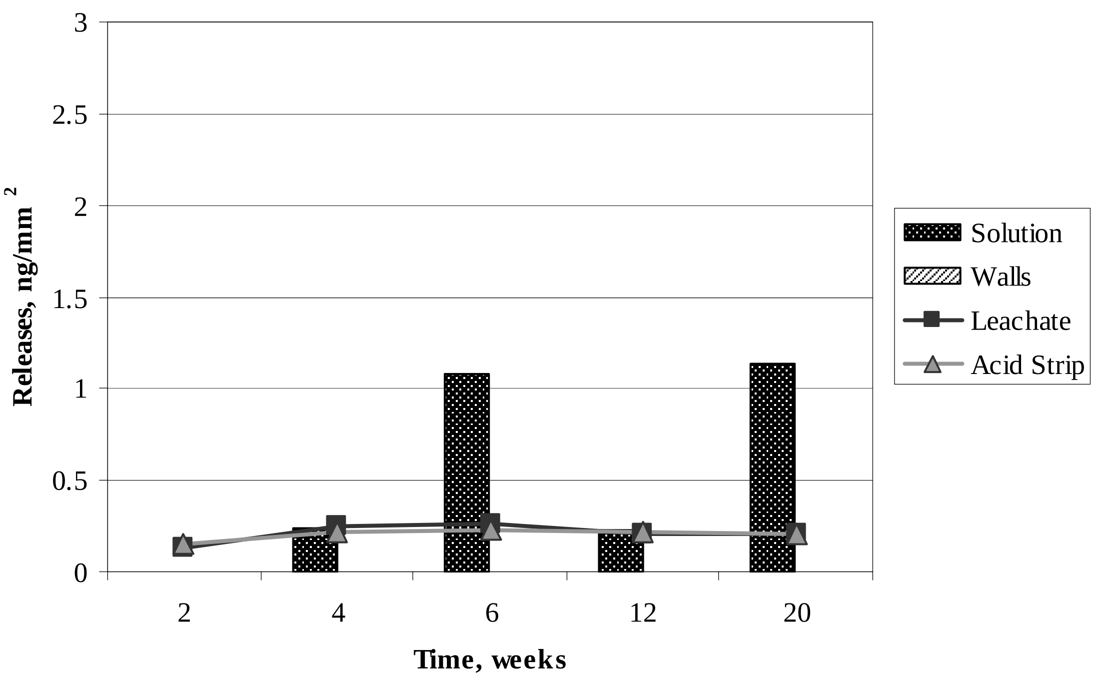


Figure J-104. Vanadium Present in Solutions and on Walls in AJ13 Solution Control at Room Temperature and Average Detection Limits for Leachate and Acid Strip.

K. Supplementary Tests—Raw Data

Table K-1. Leachate data (ng/mm^2) from SS15ZR26 specimens immersed in room temperature solution for 14 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.07	2.07	2.07	0.01	0.02	0.01	0.01	0.01	0.08	0.03	0.00	0.14	0.13
1KCl90-2-328	25	a	a	3.63	a	a	a	a	a	1.03	0.29	0.07	0.73	2.27
1KCl90-2-388	control	a	a	a	a	a	a	a	a	0.27	a	a	0.31	2.49
1KClRT-2-329	27	1.85	a	1.85	a	a	a	a	a	0.12	0.12	a	0.56	2.88
1KClRT-2-389	control	a	a	a	a	a	a	a	a	0.16	a	a	0.32	2.48
10KClRT-2-353	29	98.30	22.91	12.41	0.73	0.03	0.02	0.03	0.14	1.89	3.41	0.37	0.74	5.32
10KClRT-2-390	control	a	a	a	a	a	a	a	a	0.40	a	a	0.30	3.80
AJ13pH=2RT-2-278	31	257.14	72.00	27.12	2.23	0.27	0.41	0.39	0.96	8.34	3.67	0.43	2.55	0.30
AJ13pH=2RT-2-391	control	a	a	a	0.25	a	a	a	a	1.43	a	a	0.47	a

[a]Element below detectablility limits of measuring instrument.

Table K-2. Acid Strip data (ng/mm^2) from SS15ZR26 specimens immersed in room temperature solution for 14 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.29	2.29	2.29	0.01	0.02	0.01	0.01	0.01	0.09	0.03	0.003	0.16	0.15
1KCl90-2-328AS	25	4.83	a	a	0.05	a	a	a	a	a	a	a	a	0.34
1KCl90-2-388AS	control	a	a	a	0.17	a	a	a	a	a	a	a	a	a
1KClRT-2-329AS	27	5.83	a	a	a	a	a	a	a	0.08	a	a	a	a
1KClRT-2-389AS	control	13.12	a	2.19	0.13	a	a	a	a	a	a	a	a	a
10KClRT-2-353AS	29	45.01	12.56	a	0.30	a	a	a	0.08	0.79	a	a	0.24	a
10KClRT-2-390AS	control	a	a	a	0.46	a	a	a	a	a	a	a	a	a
AJ13pH=2RT-2-278AS	31	a	a	a	0.99	0.09	0.08	a	a	0.28	a	a	a	a
AJ13pH=2RT-2-391AS	control	a	a	a	0.26	a	a	a	a	0.30	a	a	a	a

[a]Element below detectablility limits of measuring instrument.

Table K-3. Leachate data (ng/mm^2) from SS15ZR26 specimens immersed in room temperature solution for 28 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.08	2.08	2.08	0.02	0.02	0.01	0.02	0.02	0.03	0.02	0.03	0.07	0.25
1KCl90-4-330	25	a	a	a	a	a	a	a	a	0.16	a	a	0.27	0.84
1KCl90-4-392	control	a	a	a	a	a	a	a	a	0.49	a	a	0.42	0.75
1KClRT-4-331	27	a	a	a	a	a	a	a	a	0.10	0.04	a	0.17	0.46
1KClRT-4-393	control	a	a	a	a	a	a	a	a	0.11	a	a	0.20	a
10KClRT-4-354	29	34.00	5.51	3.68	0.15	0.02	0.01	0.03	0.14	1.02	1.68	0.19	0.36	2.42
10KClRT-4-394	control	a	a	a	a	a	a	a	a	0.14	0.02	a	0.14	3.91
AJ13pH=2RT-4-279	31	2.79	a	a	0.44	0.03	a	0.03	0.03	0.68	0.08	a	1.76	0.31
AJ13pH=2RT-4-395	control	a	a	a	0.27	a	a	a	a	0.37	0.02	a	1.02	0.24

[a]Element below detectablility limits of measuring instrument.

Table K-4. Acid Strip data (ng/mm^2) from SS15ZR26 specimens immersed in room temperature solution for 28 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.24	2.24	2.24	0.02	0.02	0.01	0.01	0.02	0.03	0.02	0.02	0.06	0.22
1KCl90-4-330AS	25	2.21	a	a	0.03	a	a	a	a	0.04	a	a	0.26	a
1KCl90-4-392AS	control	a	a	2.26	0.07	a	a	a	a	0.08	a	a	0.29	a
1KClRT-4-331AS	27	a	a	4.54	0.05	a	a	a	a	0.04	a	a	0.17	0.30
1KClRT-4-393AS	control	a	a	a	0.16	a	a	a	a	a	a	a	0.28	a
10KClRT-4-354AS	29	57.25	24.22	3.30	0.22	0.05	a	0.04	0.20	1.73	0.03	a	0.29	a
10KClRT-4-394AS	control	a	a	a	0.20	a	a	a	a	0.03	a	a	0.20	a
AJ13pH=2RT-4-279AS	31	a	a	a	0.31	a	0.02	a	a	0.07	a	a	0.19	a
AJ13pH=2RT-4-395AS	control	a	a	a	0.46	a	a	a	a	0.07	a	a	0.16	a

[a]Element below detectablility limits of measuring instrument.

Table K-5. Leachate data (ng/mm^2) from SS15ZR26 specimens immersed in room temperature solution for 42 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.06	2.06	2.06	0.02	0.02	0.01	0.02	0.02	0.04	0.02	0.03	0.07	0.26
1KCl90-6-332	25	0	0	0	0.0329	0	0	0	0	0.4372	0	0	0.2397	0
1KCl90-6-396	control	0	0	0	0	0	0	0	0	0.0784	0	0	0.1517	0
1KClRT-6-333	27	0	0	0	0.0154	0	0	0	0	0.7086	0.0288	0	0.2698	0
1KClRT-6-397	control	0	0	0	0	0	0	0	0	0.0454	0	0	0.1653	0
10KClRT-6-355	29	47.742	10.379	5.1894	0.0488	0.0187	0.0156	0.0259	0.1017	0.7348	1.5879	0.1723	0.2117	1.2454
10KClRT-6-398	control	0	0	0	0	0	0	0	0	0.0703	0.0217	0	0.1158	2.4512
AJ13pH=2RT-6-280	31	4.1032	0	0	0.4893	0.0277	0	0.0236	0.0215	0.1744	0.0657	0	0.4739	1.5695
AJ13pH=2RT-6-399	control	0	0	0	0.2313	0	0	0	0	0.0596	0	0	0.5398	1.0795

[a]Element below detectablility limits of measuring instrument.

Table K-6. Acid Strip data (ng/mm^2) from SS15ZR26 specimens immersed in room temperature solution for 42 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.29	2.29	2.29	0.02	0.02	0.01	0.01	0.02	0.03	0.02	0.03	0.06	0.23
1KCl90-6-332AS	25	a	a	a	0.05	a	a	0.03	0.03	a	a	a	0.12	a
1KCl90-6-396AS	control	a	a	a	0.54	a	a	0.02	a	a	a	a	0.09	a
1KClRT-6-333AS	27	a	a	a	0.06	a	a	a	a	0.21	a	a	0.07	0.63
1KClRT-6-397AS	control	a	a	a	0.11	a	a	a	a	a	a	a	0.06	0.45
10KClRT-6-355AS	29	34.01	14.74	a	0.08	0.03	a	0.04	0.17	1.08	0.06	a	0.28	0.32
10KClRT-6-398AS	control	a	a	a	0.04	a	a	a	a	a	a	a	a	a
AJ13pH=2RT-6-280AS	31	a	a	a	0.14	a	a	a	a	a	a	a	a	a
AJ13pH=2RT-6-399AS	control	a	a	a	0.16	a	a	a	a	a	a	a	a	a

[a]Element below detectablility limits of measuring instrument.

Table K-7. Leachate data (ng/mm^2) from SS15ZR26 specimens immersed in room temperature solution for 56 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.08	2.08	2.08	0.10	0.03	0.01	0.01	0.05	1.97	0.21	0.10	0.21	0.10
1KCl90-6-332	25	a	a	a	0.12	a	a	a	a	a	a	a	0.48	0.17
1KCl90-6-396	control	a	a	2.08	0.09	a	a	a	a	a	a	a	0.34	a

[a]Element below detectablility limits of measuring instrument.

Table K-8. Acid Strip data (ng/mm^2) from SS15ZR26 specimens immersed in room temperature solution for 56 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.29	2.29	2.29	0.11	0.03	0.01	0.01	0.05	2.17	0.23	0.11	0.23	0.11
1KCl90-6-332AS	25	a	a	a	0.17	a	a	a	a	a	a	a	0.32	a
1KCl90-6-396AS	control	a	a	a	a	a	a	a	a	a	a	a	0.60	0.21

[a]Element below detectablility limits of measuring instrument.

Table K-9. Leachate data (ng/mm^2) from SS15ZR26 specimens immersed in room temperature solution for 84 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.04	2.04	2.04	0.01	0.01	0.02	0.01	0.02	0.08	0.04	0.03	0.31	0.20
1KCl90-12-336	25	a	a	a	0.28	a	a	a	a	0.30	0.07	a	0.39	2.40
1KCl90-12-388	control	a	a	a	0.23	a	a	a	a	0.33	0.04	a	a	1.93
1KClRT-12-335	27	a	a	a	0.26	a	a	a	a	0.74	a	a	0.40	1.57
1KClRT-12-376	control	a	a	a	0.26	a	0.02	a	a	0.57	a	a	0.38	0.95
10KClRT-12-356	29	97.17	17.76	15.67	0.37	0.05	0.06	0.51	0.21	1.55	6.52	0.79	0.80	1.74
10KClRT-12-377	control	a	a	a	0.13	a	0.04	a	a	0.17	0.07	a	2.99	2.03
AJ13pH=2RT-12-281	31	12.42	3.10	a	0.75	0.07	0.02	a	0.07	0.42	0.23	0.03	0.51	0.26
AJ13pH=2RT-12-378	control	a	a	a	0.35	a	a	a	a	0.25	a	a	0.94	0.23

[a]Element below detectablility limits of measuring instrument.

Table K-10. Acid Strip data (ng/mm2) from SS15ZR26 specimens immersed in room temperature solution for 84 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.21	2.21	2.21	0.01	0.01	0.02	0.01	0.02	0.08	0.04	0.03	0.33	0.22
1KCl90-12-336AS	25	a	a	a	0.20	a	a	a	a	a	a	a	a	a
1KCl90-12-388AS	control	a	a	a	0.33	a	a	a	a	a	a	a	a	a
1KClRT-12-335AS	27	a	a	a	0.18	a	a	a	a	a	a	a	a	a
1KClRT-12-376AS	control	2.22	a	2.22	1.22	a	0.05	a	a	a	a	a	a	a
10KClRT-12-356AS	29	164.79	56.75	a	0.57	0.11	0.03	0.10	0.53	4.22	0.12	a	0.61	0.22
10KClRT-12-377AS	control	a	a	a	0.30	a	a	a	a	a	a	a	a	a
AJ13pH=2RT-12-281AS	31	2.01	a	a	0.35	a	0.03	a	a	a	a	a	a	a
AJ13pH=2RT-12-378AS	control	a	a	a	0.39	a	a	a	a	a	a	a	a	a

[a]Element below detectablility limits of measuring instrument.

Table K-11. Leachate data (ng/mm^2) from SS15ZR26 specimens immersed in room temperature solution for 140 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.04	2.04	2.04	0.02	0.03	0.02	0.02	0.02	0.07	0.02	0.02	1.02	0.20
1KCl90-12-336	25	a	a	a	a	a	a	a	a	0.24	0.03	0.30	a	3.25
1KCl90-12-388	control	a	a	a	0.02	a	a	a	a	0.38	0.03	0.30	a	2.13
1KClRT-12-335	27	a	a	a	0.02	a	a	a	a	0.39	0.03	0.30	a	2.40
1KClRT-12-376	control	a	a	a	a	a	a	a	a	0.08	0.02	0.30	a	2.35
10KClRT-12-356	29	2.10	a	23.80	0.03	a	0.03	a	a	0.39	9.34	0.98	2.69	6.45
10KClRT-12-377	control	a	a	a	a	a	0.03	a	a	a	0.09	0.31	a	5.50
AJ13pH=2RT-12-281	31	794.69	245.49	57.40	4.53	0.63	0.12	0.55	2.42	21.53	16.50	1.88	4.46	2.44
AJ13pH=2RT-12-378	control	a	a	a	0.40	a	a	a	a	0.51	0.03	0.31	a	1.13

[a]Element below detectablility limits of measuring instrument.

Table K-12. Acid Strip data (ng/mm^2) from SS15ZR26 specimens immersed in room temperature solution for 140 days.

Expt. ID	Ingot ID	Major Elements				Noble Metal Fission Products					Minor Elements			
		Fe	Cr	Ni	Zr	Nb	Pd	Rh	Ru	Mo	Mn	Co	Cu	V
Detection Limits		2.04	2.04	2.04	0.02	0.03	0.02	0.02	0.02	0.07	0.02	0.02	1.02	0.20
1KCl90-20-337AS	25	a	a	a	0.07	a	a	a	a	a	a	a	1.24	1.04
1KCl90-20-389AS	control	a	a	a	0.27	a	a	a	a	a	0.03	a	a	0.86
1KClRT-20-338AS	27	a	a	a	0.04	a	a	a	a	a	0.02	a	a	0.80
1KClRT-20-390AS	control	a	a	a	0.31	a	a	a	a	a	a	a	a	0.70
10KClRT-20-357AS	29	87.93	35.87	a	0.08	0.06	a	0.07	0.35	2.63	0.10	a	a	0.52
10KClRT-20-391AS	control	a	a	a	0.09	a	a	a	a	a	a	a	a	0.31
AJ13pH=2RT20-282AS	31	2.31	a	a	1.71	0.17	0.03	a	0.06	0.30	0.06	a	a	a
AJ13Ph=2RT-20-392AS	control	11.83	3.43	2.81	0.12	a	a	a	0.04	a	1.01	0.14	a	a

[a]Element below detectablility limits of measuring instrument.

L. Supplementary Tests—Detection Limits

Table L-1. Iron Detection Limits in Leachate Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	2.05	2.07	2.06	2.07	2.06	2.02
1KCl90 Control	2.08	2.06	2.06	2.08	1.78	1.99
27	2.07	2.07	2.06	a	2.07	2.00
1KClRT control	2.06	2.04	2.07	a	2.07	2.02
29	2.08	2.15	2.08	a	2.09	2.10
10KClRT control	2.07	2.09	2.07	a	2.10	2.08
31	2.06	2.07	2.05	a	2.07	2.05
AJ13pH=2RT Control	2.06	2.07	2.06	a	2.06	2.06
Average	2.07	2.08	2.06	2.08	2.04	2.04
Standard Deviation	0.01	0.03	0.01	0.01	0.11	0.04

[a]Sample not terminated

Table L-2. Iron Detection Limits in Acid Strip Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	2.41	2.21	2.30	2.17	2.29	2.02
1KCl90 Control	2.40	2.26	2.31	2.40	2.28	1.99
27	2.33	2.27	2.31	a	2.24	2.00
1KClRT control	2.19	2.23	2.29	a	2.22	2.02
29	2.09	2.20	2.27	a	2.18	2.10
10KClRT control	2.26	2.24	2.32	a	2.14	2.08
31	2.38	2.25	2.22	a	2.01	2.05
AJ13pH=2RT Control	2.28	2.23	2.30	a	2.27	2.06
Average	2.29	2.24	2.29	2.29	2.21	2.04
Standard Deviation	0.11	0.02	0.03	0.16	0.09	0.04

[a]Sample not terminated

Table L-3. Chromium Detection Limits in Leachate Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	2.05	2.07	2.06	2.07	2.06	2.02
1KCl90 Control	2.08	2.06	2.06	2.08	1.78	1.99
27	2.07	2.07	2.06	a	2.07	2.00
1KClRT control	2.06	2.04	2.07	a	2.07	2.02
29	2.08	2.15	2.08	a	2.09	2.10
10KClRT control	2.07	2.09	2.07	a	2.10	2.08
31	2.06	2.07	2.05	a	2.07	2.05
AJ13pH=2RT Control	2.06	2.07	2.06	a	2.06	2.06
Average	2.07	2.08	2.06	2.08	2.04	2.04
Standard Deviation	0.01	0.03	0.01	0.01	0.11	0.04

[a]Sample not terminated

Table L-4. Chromium Detection Limits in Acid Strip Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	2.41	2.21	2.30	2.17	2.29	2.02
1KCl90 Control	2.40	2.26	2.31	2.40	2.28	1.99
27	2.33	2.27	2.31	a	2.24	2.00
1KClRT control	2.19	2.23	2.29	a	2.22	2.02
29	2.09	2.20	2.27	a	2.18	2.10
10KClRT control	2.26	2.24	2.32	a	2.14	2.08
31	2.38	2.25	2.22	a	2.01	2.05
AJ13pH=2RT Control	2.28	2.23	2.30	a	2.27	2.06
Average	2.29	2.24	2.29	2.29	2.21	2.04
Standard Deviation	0.11	0.02	0.03	0.16	0.09	0.04

[a]Sample not terminated

Table L-5. Nickel Detection Limits in Leachate Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	2.05	2.07	2.06	2.07	2.06	2.02
1KCl90 Control	2.08	2.06	2.06	2.08	1.78	1.99
27	2.07	2.07	2.06	a	2.07	2.00
1KClRT control	2.06	2.04	2.07	a	2.07	2.02
29	2.08	2.15	2.08	a	2.09	2.10
10KClRT control	2.07	2.09	2.07	a	2.10	2.08
31	2.06	2.07	2.05	a	2.07	2.05
AJ13pH=2RT Control	2.06	2.07	2.06	a	2.06	2.06
Average	2.07	2.08	2.06	2.08	2.04	2.04
Standard Deviation	0.01	0.03	0.01	0.01	0.11	0.04

[a]Sample not terminated

Table L-6. Nickel Detection Limits in Acid Strip Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	2.41	2.21	2.30	2.17	2.29	2.02
1KCl90 Control	2.40	2.26	2.31	2.40	2.28	1.99
27	2.33	2.27	2.31	a	2.24	2.00
1KClRT control	2.19	2.23	2.29	a	2.22	2.02
29	2.09	2.20	2.27	a	2.18	2.10
10KClRT control	2.26	2.24	2.32	a	2.14	2.08
31	2.38	2.25	2.22	a	2.01	2.05
AJ13pH=2RT Control	2.28	2.23	2.30	a	2.27	2.06
Average	2.29	2.24	2.29	2.29	2.21	2.04
Standard Deviation	0.11	0.02	0.03	0.16	0.09	0.04

[a]Sample not terminated

Table L-7. Zirconium Detection Limits in Leachate Data (ng/mm2).

Sample #	2	4	6	8	12	20
25	0.01	0.02	0.03	0.10	0.01	0.02
1KCl90 Control	0.01	0.02	0.03	0.10	0.01	0.02
27	0.01	0.03	0.02	a	0.01	0.02
1KClRT control	0.01	0.02	0.02	a	0.01	0.02
29	0.01	0.02	0.02	a	0.01	0.02
10KClRT control	0.01	0.02	0.02	a	0.01	0.02
31	0.01	0.02	0.02	a	0.01	0.02
AJ13pH=2RT Control	0.01	0.02	0.02	a	0.01	0.02
Average	0.01	0.02	0.02	0.10	0.01	0.02
Standard Deviation	0.00	0.01	0.01	0.00	0.00	0.00

[a]Sample not terminated

Table L-8. Zirconium Detection Limits in Acid Strip Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	0.01	0.02	0.02	0.11	0.01	0.02
1KCl90 Control	0.01	0.02	0.02	0.12	0.01	0.02
27	0.01	0.02	0.02	a	0.01	0.02
1KClRT control	0.01	0.02	0.02	a	0.01	0.02
29	0.01	0.02	0.02	a	0.01	0.02
10KClRT control	0.01	0.02	0.02	a	0.01	0.02
31	0.01	0.02	0.02	a	0.01	0.02
AJ13pH=2RT Control	0.01	0.02	0.02	a	0.01	0.02
Average	0.01	0.02	0.02	0.11	0.01	0.02
Standard Deviation	0.00	0.00	0.00	0.01	0.00	0.00

[a]Sample not terminated

Table L-9. Niobium Detection Limits in Leachate Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	0.02	0.02	0.03	0.03	0.01	0.03
1KCl90 Control	0.02	0.02	0.03	0.03	0.01	0.03
27	0.02	0.03	0.02	a	0.01	0.03
1KClRT control	0.02	0.02	0.02	a	0.01	0.03
29	0.02	0.02	0.02	a	0.01	0.03
10KClRT control	0.02	0.02	0.02	a	0.01	0.03
31	0.02	0.02	0.02	a	0.01	0.03
AJ13pH=2RT Control	0.02	0.02	0.02	a	0.01	0.03
Average	0.02	0.02	0.02	0.03	0.01	0.03
Standard Deviation	0.00	0.01	0.01	0.00	0.00	0.00

[a]Sample not terminated

Table L-10. Niobium Detection Limits in Acid Strip Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	0.02	0.02	0.02	0.03	0.01	0.03
1KCl90 Control	0.02	0.02	0.02	0.03	0.01	0.03
27	0.02	0.02	0.02	a	0.01	0.03
1KClRT control	0.02	0.02	0.02	a	0.01	0.03
29	0.02	0.02	0.02	a	0.01	0.03
10KClRT control	0.02	0.02	0.02	a	0.01	0.03
31	0.02	0.02	0.02	a	0.01	0.03
AJ13pH=2RT Control	0.02	0.02	0.02	a	0.01	0.03
Average	0.02	0.02	0.02	0.03	0.01	0.03
Standard Deviation	0.00	0.00	0.00	0.00	0.00	0.00

[a]Sample not terminated

Table L-11. Paladium Detection Limits in Leachate Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	0.01	0.01	0.02	0.01	0.02	0.02
1KCl90 Control	0.01	0.01	0.02	0.01	0.01	0.02
27	0.01	0.02	0.01	a	0.02	0.02
1KClRT control	0.01	0.01	0.01	a	0.02	0.02
29	0.01	0.01	0.01	a	0.02	0.02
10KClRT control	0.01	0.01	0.01	a	0.02	0.02
31	0.01	0.01	0.01	a	0.02	0.02
AJ13pH=2RT Control	0.01	0.01	0.01	a	0.02	0.02
Average	0.01	0.01	0.01	0.01	0.02	0.02
Standard Deviation	0.00	0.00	0.00	0.00	0.00	0.00

[a]Sample not terminated

Table L-12. Paladium Detection Limits in Acid Strip Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	0.01	0.01	0.01	0.01	0.02	0.02
1KCl90 Control	0.01	0.01	0.01	0.01	0.02	0.02
27	0.01	0.01	0.01	a	0.02	0.02
1KClRT control	0.01	0.01	0.01	a	0.02	0.02
29	0.01	0.01	0.01	a	0.02	0.02
10KClRT control	0.01	0.01	0.01	a	0.02	0.02
31	0.01	0.01	0.01	a	0.02	0.02
AJ13pH=2RT Control	0.01	0.01	0.01	a	0.02	0.02
Average	0.01	0.01	0.01	0.01	0.02	0.02
Standard Deviation	0.00	0.00	0.00	0.00	0.00	0.00

[a]Sample not terminated

Table L-13. Rhodium Detection Limits in Leachate Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	0.01	0.02	0.03	0.01	0.01	0.02
1KCl90 Control	0.01	0.02	0.03	0.01	0.01	0.02
27	0.01	0.03	0.01	a	0.01	0.02
1KClRT control	0.01	0.01	0.01	a	0.01	0.02
29	0.01	0.01	0.01	a	0.01	0.02
10KClRT control	0.01	0.01	0.01	a	0.01	0.02
31	0.01	0.01	0.01	a	0.01	0.02
AJ13pH=2RT Control	0.01	0.01	0.01	a	0.01	0.02
Average	0.01	0.02	0.02	0.01	0.01	0.02
Standard Deviation	0.00	0.00	0.01	0.00	0.00	0.00

[a]Sample not terminated

Table L-14. Rhodium Detection Limits in Acid Strip Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	0.01	0.01	0.01	0.01	0.01	0.02
1KCl90 Control	0.01	0.01	0.02	0.01	0.01	0.02
27	0.01	0.01	0.02	a	0.01	0.02
1KClRT control	0.01	0.01	0.01	a	0.01	0.02
29	0.01	0.01	0.01	a	0.01	0.02
10KClRT control	0.01	0.01	0.02	a	0.01	0.02
31	0.01	0.01	0.01	a	0.01	0.02
AJ13pH=2RT Control	0.01	0.01	0.01	a	0.01	0.02
Average	0.01	0.01	0.01	0.01	0.01	0.02
Standard Deviation	0.00	0.00	0.00	0.00	0.00	0.00

[a]Sample not terminated

Table L-15. Ruthenium Detection Limits in Leachate Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	0.01	0.02	0.03	0.05	0.02	0.02
1KCl90 Control	0.01	0.02	0.03	0.05	0.02	0.02
27	0.01	0.03	0.02	a	0.02	0.02
1KClRT control	0.01	0.02	0.02	a	0.02	0.02
29	0.01	0.02	0.02	a	0.02	0.02
10KClRT control	0.01	0.02	0.02	a	0.02	0.02
31	0.01	0.02	0.02	a	0.02	0.02
AJ13pH=2RT Control	0.01	0.02	0.02	a	0.02	0.02
Average	0.01	0.02	0.02	0.05	0.02	0.02
Standard Deviation	0.00	0.01	0.01	0.00	0.00	0.00

[a]Sample not terminated

Table L-16. Ruthenium Detection Limits in Acid Strip Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	0.01	0.02	0.02	0.05	0.02	0.02
1KCl90 Control	0.01	0.02	0.02	0.05	0.02	0.02
27	0.01	0.02	0.02	a	0.02	0.02
1KClRT control	0.01	0.02	0.02	a	0.02	0.02
29	0.01	0.02	0.02	a	0.02	0.02
10KClRT control	0.01	0.02	0.02	a	0.02	0.02
31	0.01	0.02	0.02	a	0.02	0.02
AJ13pH=2RT Control	0.01	0.02	0.02	a	0.02	0.02
Average	0.01	0.02	0.02	0.05	0.02	0.02
Standard Deviation	0.00	0.00	0.00	0.00	0.00	0.00

[a]Sample not terminated

Table L-17. Molybdenum Detection Limits in Leachate Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	0.08	0.04	0.06	1.97	0.08	0.07
1KCl90 Control	0.08	0.04	0.06	1.98	0.07	0.07
27	0.08	0.06	0.03	a	0.08	0.07
1KClRT control	0.08	0.03	0.03	a	0.08	0.07
29	0.08	0.03	0.03	a	0.08	0.07
10KClRT control	0.08	0.03	0.03	a	0.08	0.07
31	0.08	0.03	0.03	a	0.08	0.07
AJ13pH=2RT Control	0.08	0.03	0.03	a	0.08	0.07
Average	0.08	0.03	0.04	1.97	0.08	0.07
Standard Deviation	0.00	0.01	0.01	0.01	0.00	0.00

[a]Sample not terminated

Table L-18. Molybdenum Detection Limits in Acid Strip Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	0.10	0.03	0.03	2.06	0.09	0.07
1KCl90 Control	0.10	0.03	0.03	2.28	0.09	0.07
27	0.09	0.03	0.03	a	0.08	0.07
1KClRT control	0.09	0.03	0.03	a	0.08	0.07
29	0.08	0.03	0.03	a	0.08	0.07
10KClRT control	0.09	0.03	0.03	a	0.08	0.07
31	0.10	0.03	0.03	a	0.08	0.07
AJ13pH=2RT Control	0.09	0.03	0.03	a	0.09	0.07
Average	0.09	0.03	0.03	2.17	0.08	0.07
Standard Deviation	0.00	0.00	0.00	0.15	0.00	0.00

[a]Sample not terminated

Table L-19. Manganese Detection Limits in Leachate Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	0.03	0.02	0.03	0.21	0.04	0.02
1KCl90 Control	0.03	0.02	0.03	0.21	0.03	0.02
27	0.03	0.03	0.01	a	0.04	0.02
1KClRT control	0.03	0.01	0.01	a	0.04	0.02
29	0.03	0.02	0.01	a	0.04	0.02
10KClRT control	0.03	0.01	0.01	a	0.04	0.02
31	0.03	0.01	0.01	a	0.04	0.02
AJ13pH=2RT Control	0.03	0.01	0.01	a	0.04	0.02
Average	0.03	0.02	0.02	0.21	0.04	0.02
Standard Deviation	0.00	0.01	0.01	0.00	0.00	0.00

[a]Sample not terminated

Table L-20. Manganese Detection Limits in Acid Strip Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	0.04	0.02	0.02	0.22	0.04	0.02
1KCl90 Control	0.03	0.02	0.02	0.24	0.04	0.02
27	0.03	0.02	0.02	a	0.04	0.02
1KClRT control	0.03	0.02	0.02	a	0.04	0.02
29	0.03	0.02	0.02	a	0.04	0.02
10KClRT control	0.03	0.02	0.02	a	0.04	0.02
31	0.03	0.02	0.02	a	0.04	0.02
AJ13pH=2RT Control	0.03	0.02	0.02	a	0.04	0.02
Average	0.03	0.02	0.02	0.23	0.04	0.02
Standard Deviation	0.00	0.00	0.00	0.02	0.00	0.00

[a]Sample not terminated

Table L-21. Cobalt Detection Limits in Leachate Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	0.00	0.03	0.04	0.10	0.03	0.02
1KCl90 Control	0.00	0.03	0.04	0.10	0.03	0.02
27	0.00	0.04	0.02	a	0.03	0.02
1KClRT control	0.00	0.02	0.02	a	0.03	0.02
29	0.00	0.02	0.02	a	0.03	0.02
10KClRT control	0.00	0.02	0.02	a	0.03	0.02
31	0.00	0.02	0.02	a	0.03	0.02
AJ13pH=2RT Control	0.00	0.02	0.02	a	0.03	0.02
Average	0.00	0.03	0.03	0.10	0.03	0.02
Standard Deviation	0.00	0.01	0.01	0.00	0.00	0.00

[a]Sample not terminated

Table L-22. Cobalt Detection Limits in Acid Strip Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	0.00	0.02	0.03	0.11	0.04	0.02
1KCl90 Control	0.00	0.02	0.03	0.12	0.04	0.02
27	0.00	0.02	0.03	a	0.03	0.02
1KClRT control	0.00	0.02	0.03	a	0.03	0.02
29	0.00	0.02	0.02	a	0.03	0.02
10KClRT control	0.00	0.02	0.03	a	0.03	0.02
31	0.00	0.02	0.02	a	0.03	0.02
AJ13pH=2RT Control	0.00	0.02	0.03	a	0.04	0.02
Average	0.00	0.02	0.03	0.11	0.03	0.02
Standard Deviation	0.00	0.00	0.00	0.01	0.00	0.00

[a]Sample not terminated

Table L-23. Copper Detection Limits in Leachate Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	0.14	0.07	0.11	0.21	0.31	1.01
1KCl90 Control	0.15	0.07	0.11	0.21	0.27	1.00
27	0.15	0.11	0.06	a	0.31	1.00
1KClRT control	0.14	0.06	0.06	a	0.31	1.01
29	0.15	0.06	0.06	a	0.31	1.05
10KClRT control	0.15	0.06	0.06	a	0.32	1.04
31	0.14	0.06	0.06	a	0.31	1.03
AJ13pH=2RT Control	0.14	0.06	0.06	a	0.31	1.03
Average	0.14	0.07	0.07	0.21	0.31	1.02
Standard Deviation	0.00	0.02	0.03	0.00	0.02	0.02

[a]Sample not terminated

Table L-24. Copper Detection Limits in Acid Strip Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	0.17	0.06	0.06	0.22	0.34	1.01
1KCl90 Control	0.17	0.06	0.06	0.24	0.34	1.00
27	0.16	0.06	0.06	a	0.34	1.00
1KClRT control	0.15	0.06	0.06	a	0.33	1.01
29	0.15	0.06	0.06	a	0.33	1.05
10KClRT control	0.16	0.06	0.06	a	0.32	1.04
31	0.17	0.06	0.06	a	0.30	1.03
AJ13pH=2RT Control	0.16	0.06	0.06	a	0.34	1.03
Average	0.16	0.06	0.06	0.23	0.33	1.02
Standard Deviation	0.01	0.00	0.00	0.02	0.01	0.02

[a]Sample not terminated

Table L-25. Vanadium Detection Limits in Leachate Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	0.13	0.26	0.41	0.10	0.21	0.20
1KCl90 Control	0.14	0.26	0.41	0.10	0.18	0.20
27	0.13	0.43	0.21	a	0.21	0.20
1KClRT control	0.13	0.20	0.21	a	0.21	0.20
29	0.14	0.21	0.21	a	0.21	0.21
10KClRT control	0.13	0.21	0.21	a	0.21	0.21
31	0.13	0.21	0.21	a	0.21	0.21
AJ13pH=2RT Control	0.13	0.21	0.21	a	0.21	0.21
Average	0.13	0.25	0.26	0.10	0.20	0.20
Standard Deviation	0.00	0.08	0.10	0.00	0.01	0.00

[a]Sample not terminated

Table L-26. Vanadium Detection Limits in Acid Strip Data (ng/mm^2).

Sample #	2	4	6	8	12	20
25	0.16	0.22	0.23	0.11	0.23	0.20
1KCl90 Control	0.16	0.23	0.23	0.12	0.23	0.20
27	0.15	0.23	0.23	a	0.22	0.20
1KClRT control	0.14	0.22	0.23	a	0.22	0.20
29	0.14	0.22	0.23	a	0.22	0.21
10KClRT control	0.15	0.22	0.23	a	0.21	0.21
31	0.15	0.22	0.22	a	0.20	0.21
AJ13pH=2RT Control	0.15	0.22	0.23	a	0.23	0.21
Average	0.15	0.22	0.23	0.11	0.22	0.20
Standard Deviation	0.01	0.00	0.00	0.01	0.01	0.00

[a]Sample not terminated

M. Supplementary Tests—Sample Releases

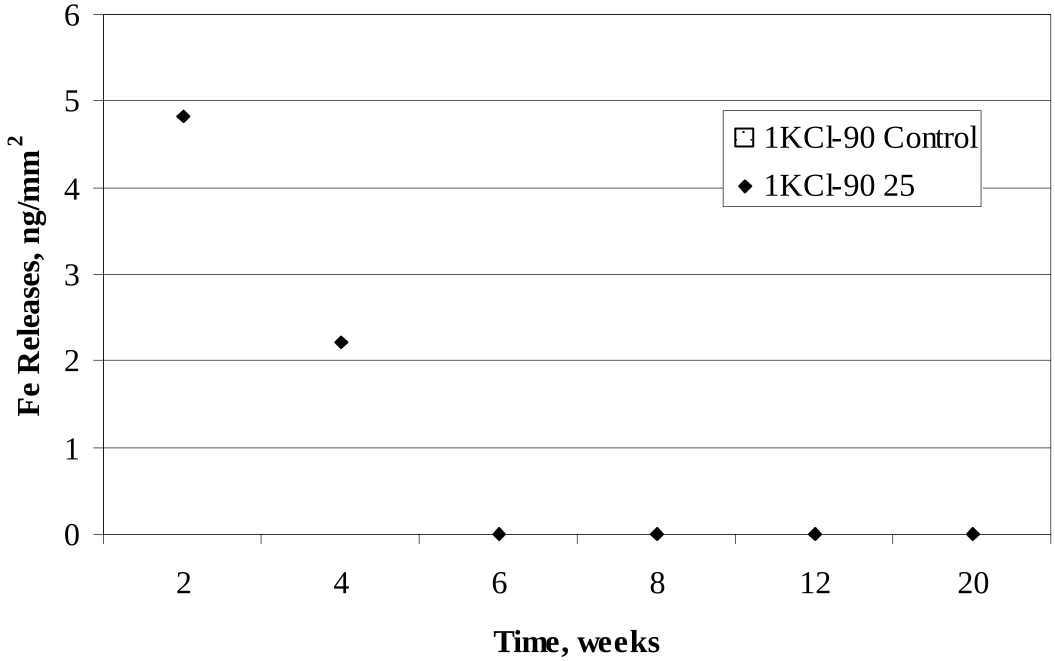


Figure M-1. Iron Releases in 1KCl solution at 90ºC.

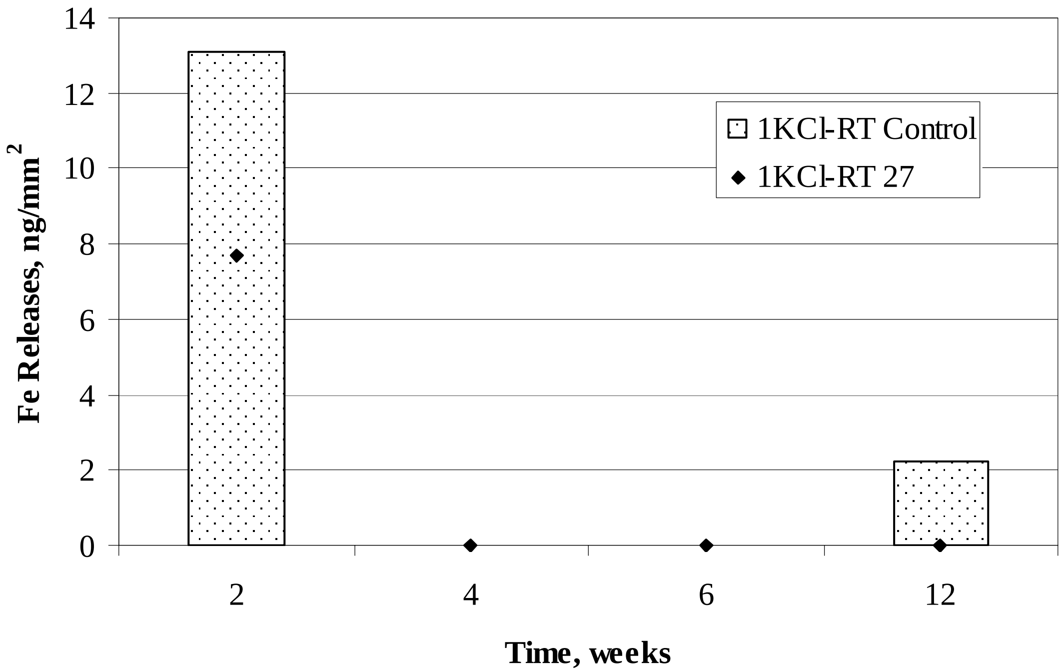


Figure M-2. Iron Releases in 1KCl solution at room temperature.

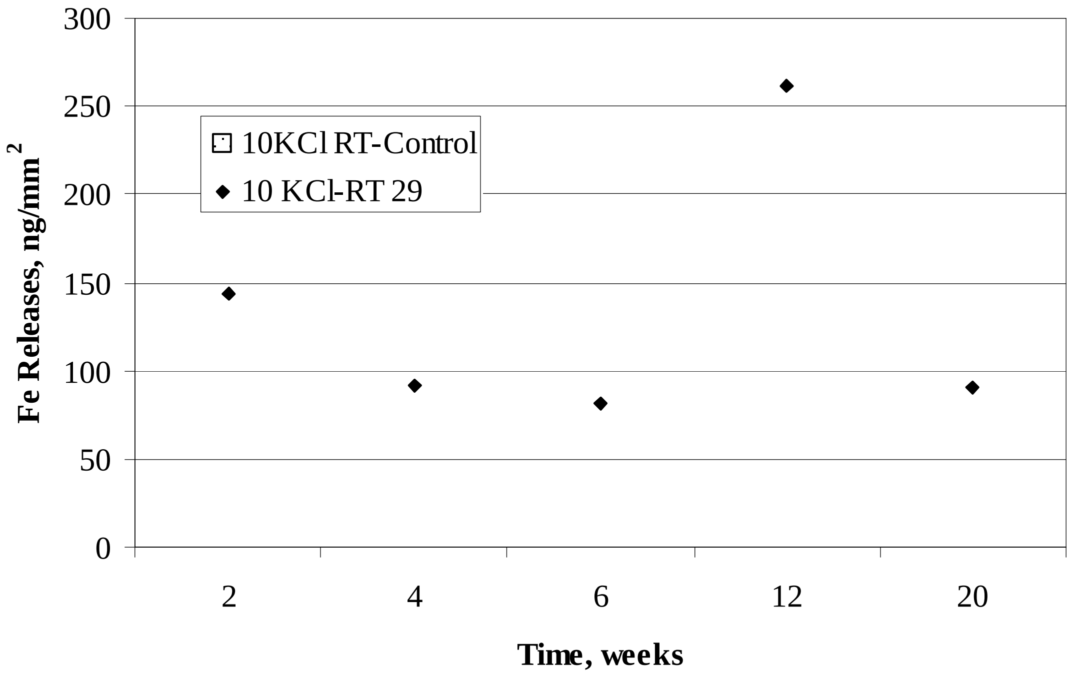


Figure M-3. Iron Releases in 10KCl Solution at room temperature.

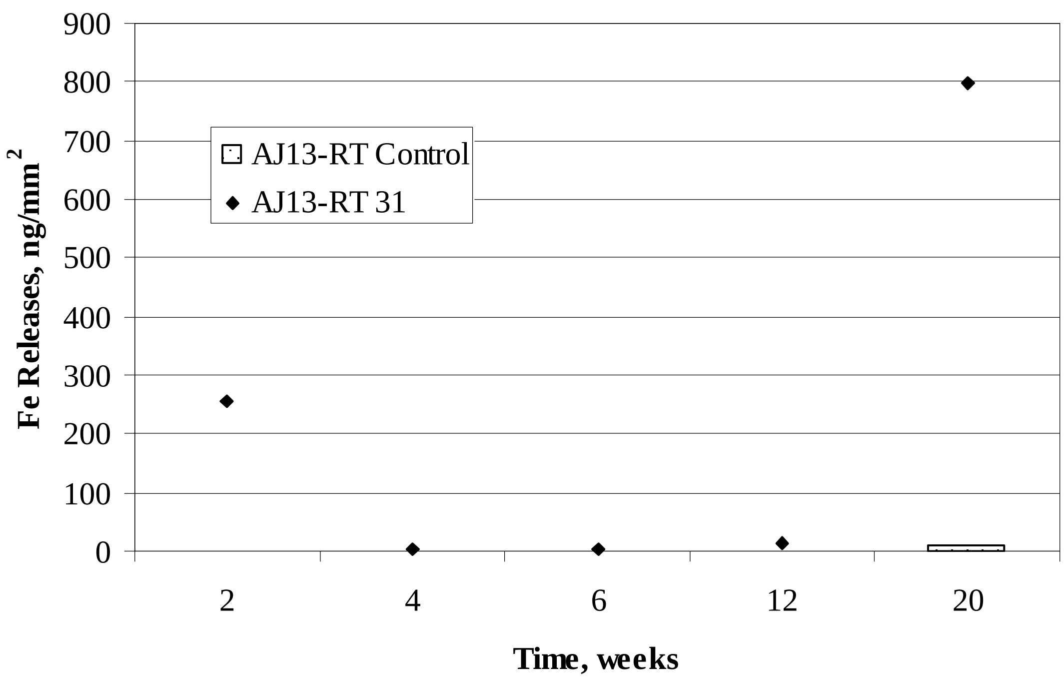


Figure M-4. Iron Releases in AJ13 Solution at room temperature.

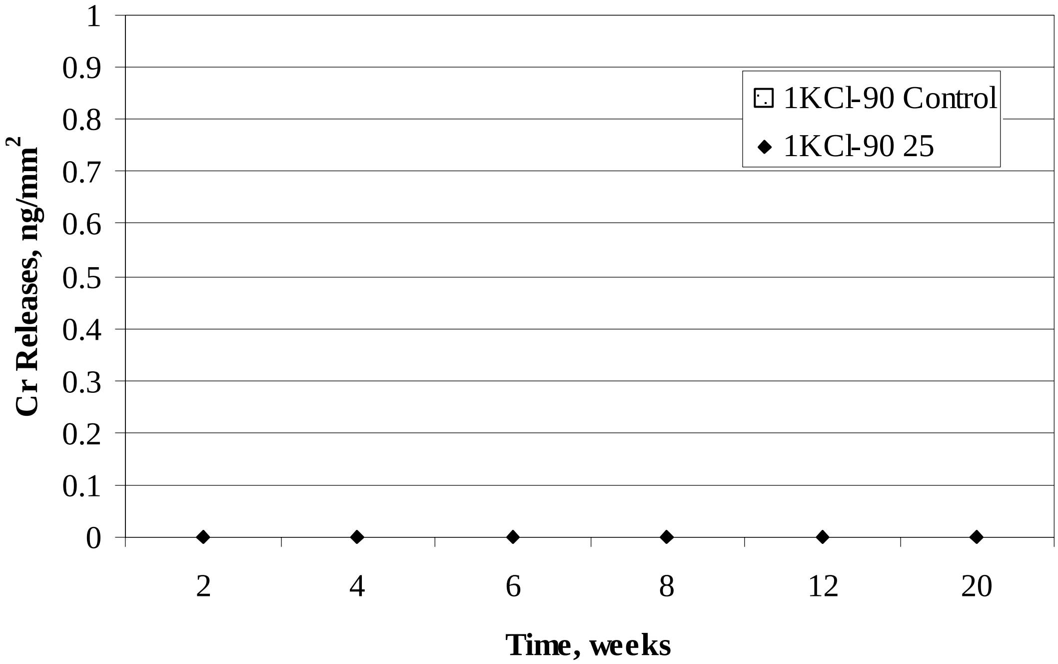


Figure M-5. Chromium Releases in 1KCl solution at 90°C.

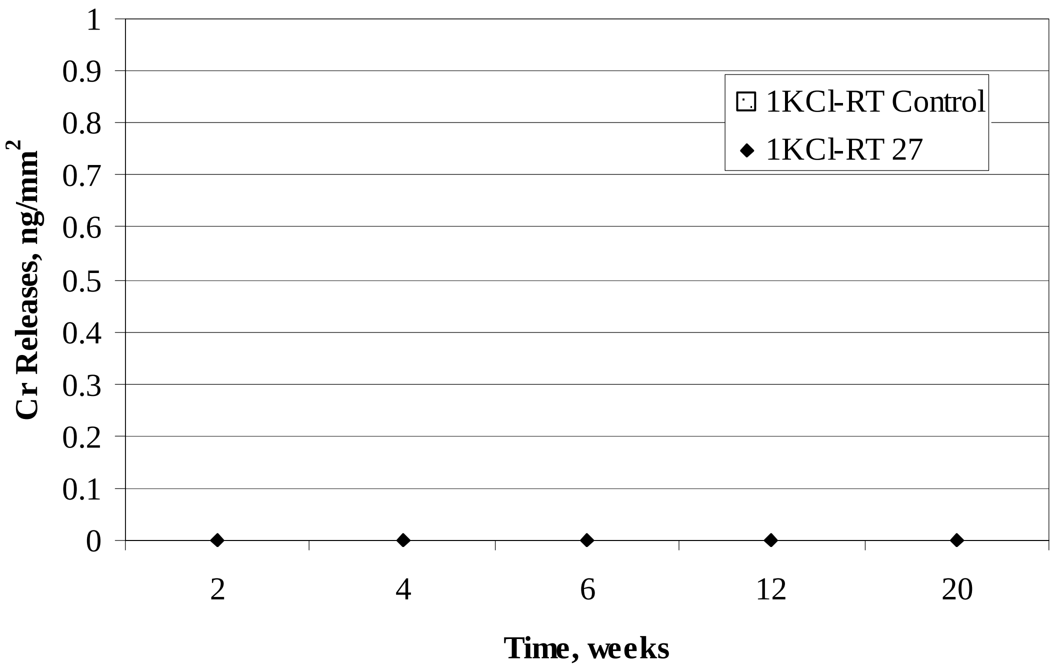


Figure M-6. Chromium Releases in 1KCl solution at room temperature.

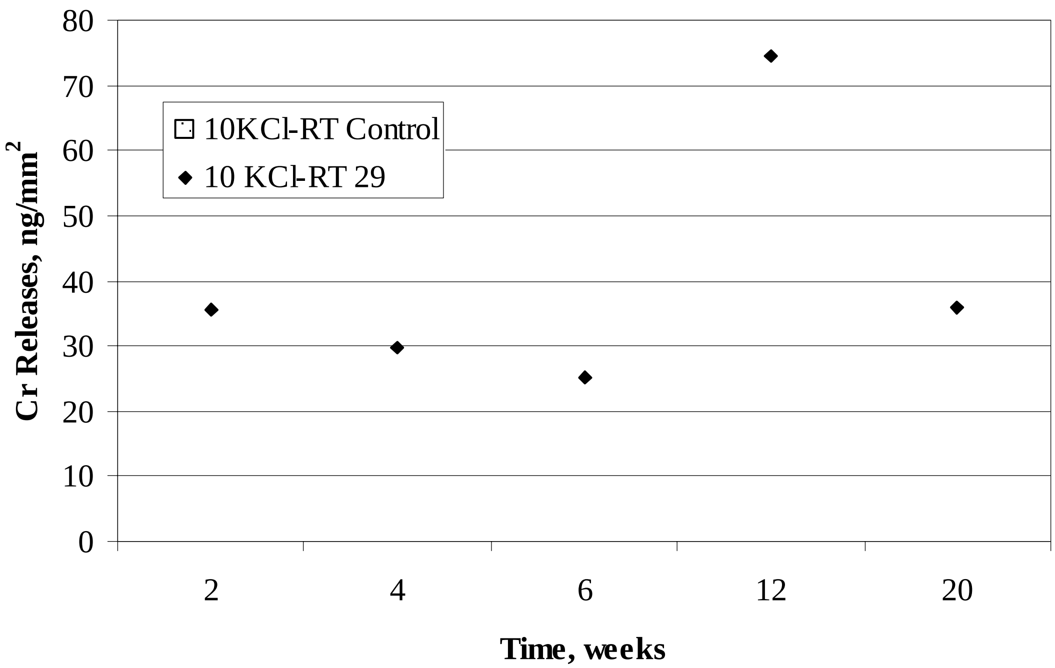


Figure M-7. Chromium Releases in 10KCl solution at room temperature.

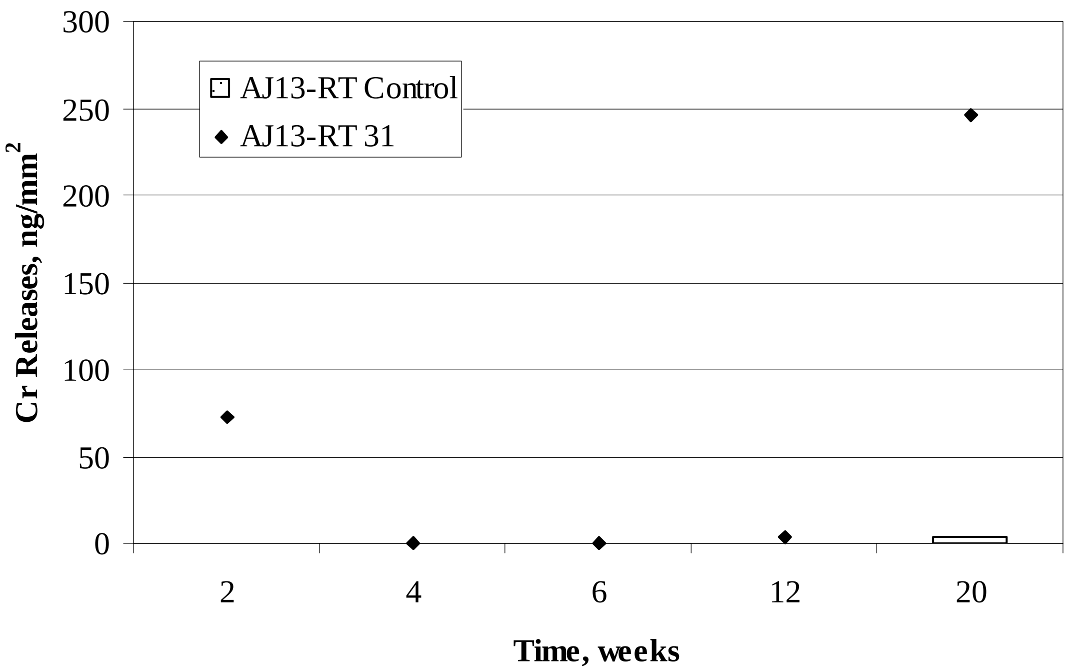


Figure M-8. Chromium Releases in AJ13 solution at room temperature.

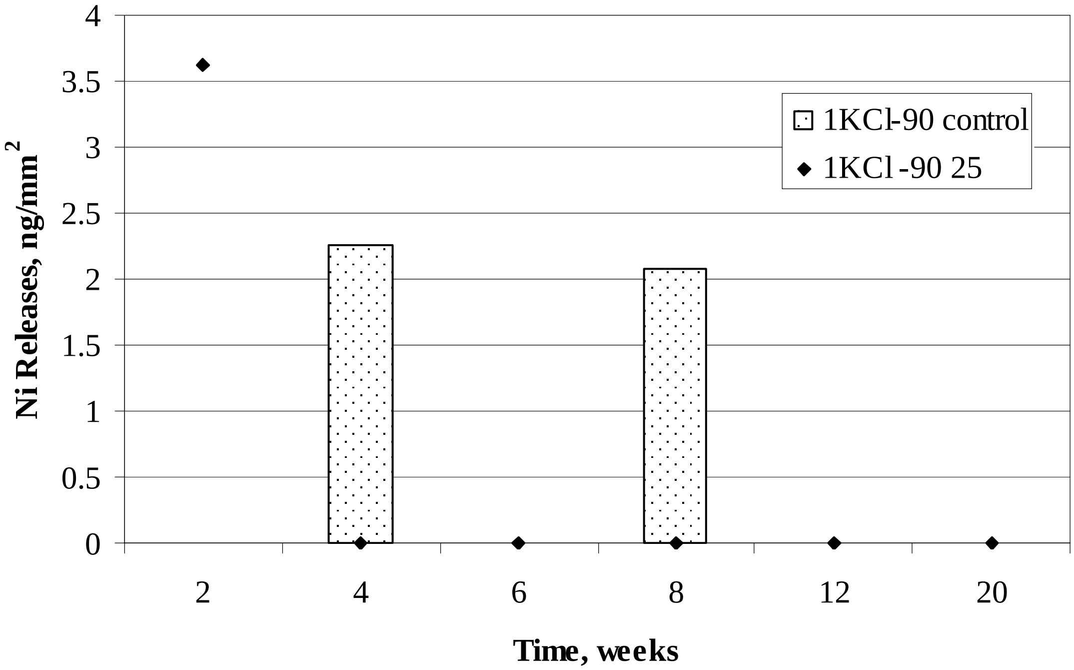


Figure M-9. Nickel Releases in 1KCl solution at 90°C.

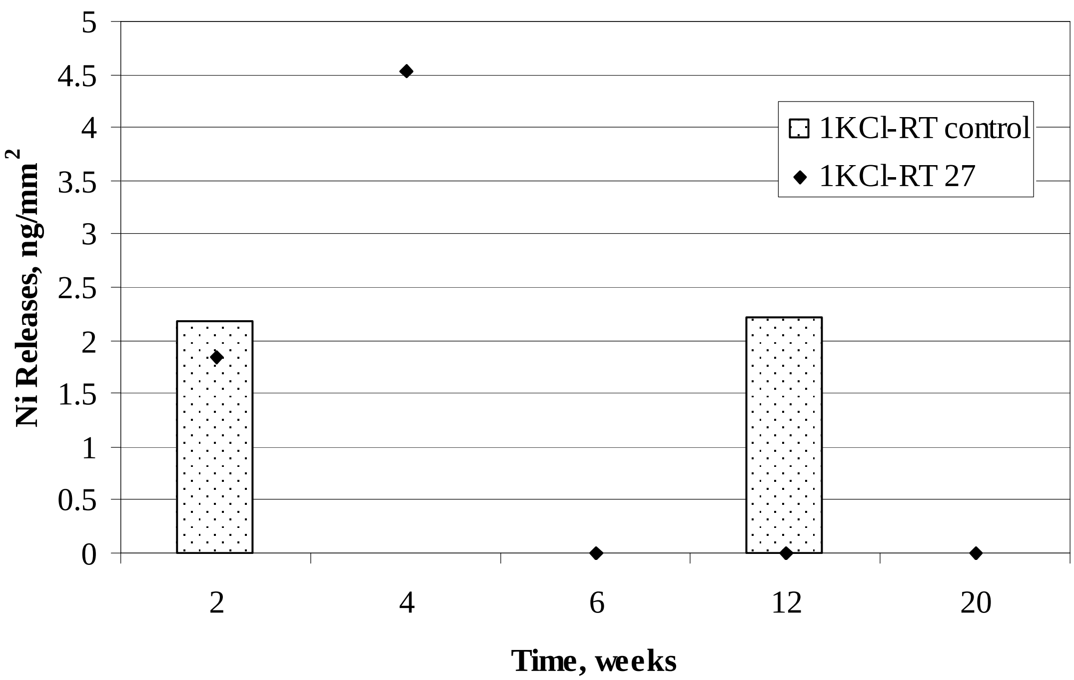


Figure M-10. Nickel Releases in 1KCl solution at room temperature.

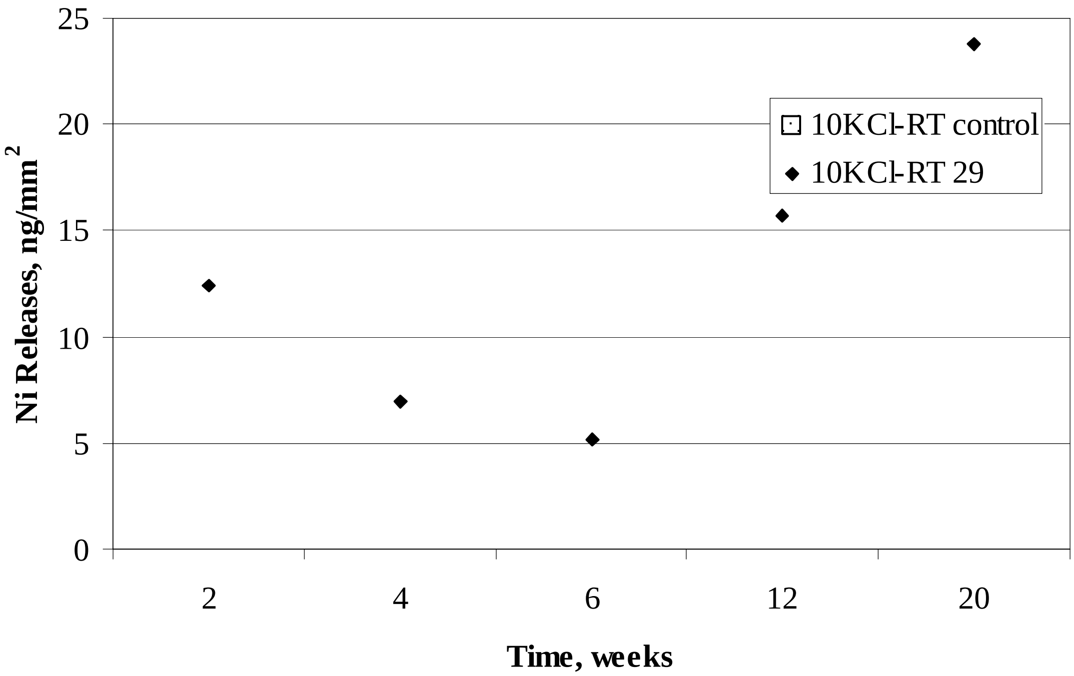


Figure M-11. Nickel Releases in 10KCl solution at room temperature.

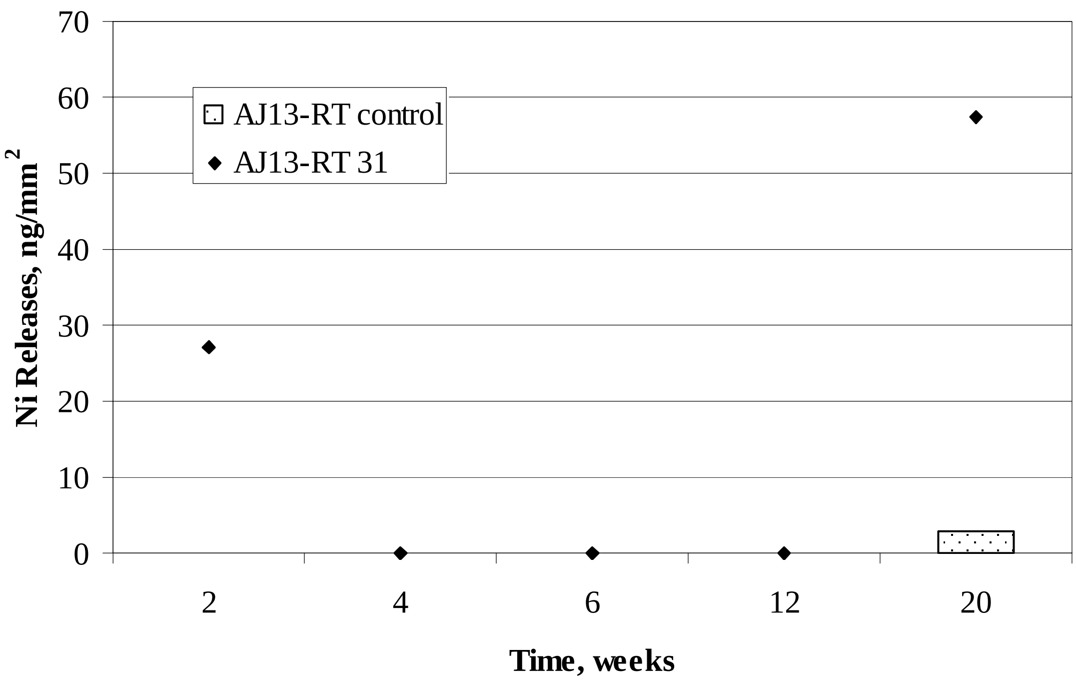


Figure M-12. Nickel Releases in AJ13 solution at room temperature.

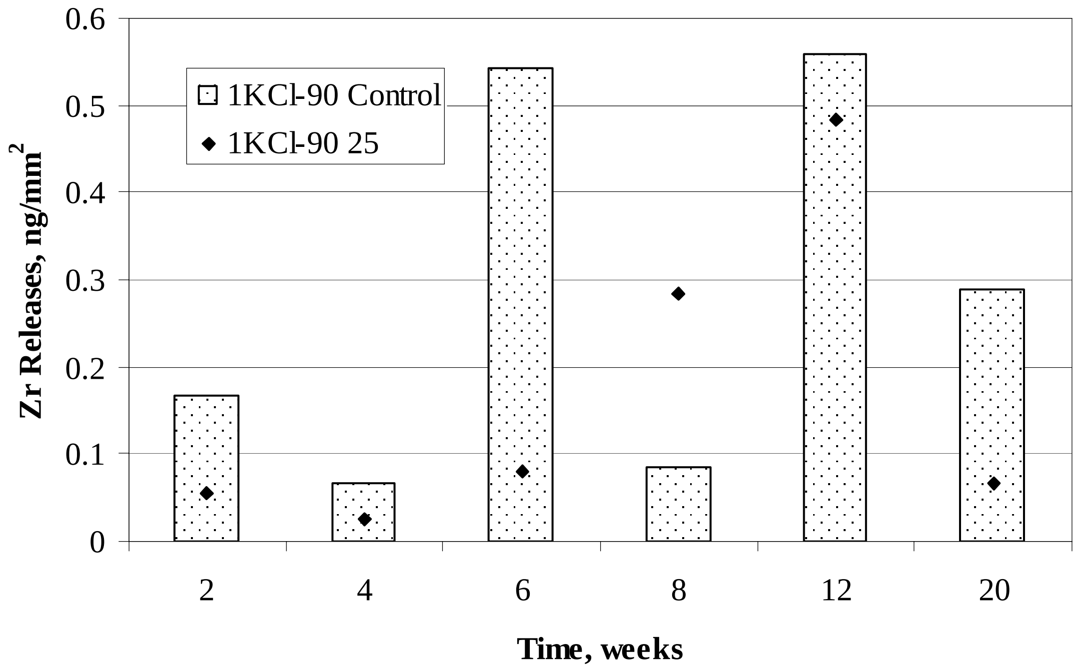


Figure M-13. Zirconium Releases in 1KCl solution at 90°C.

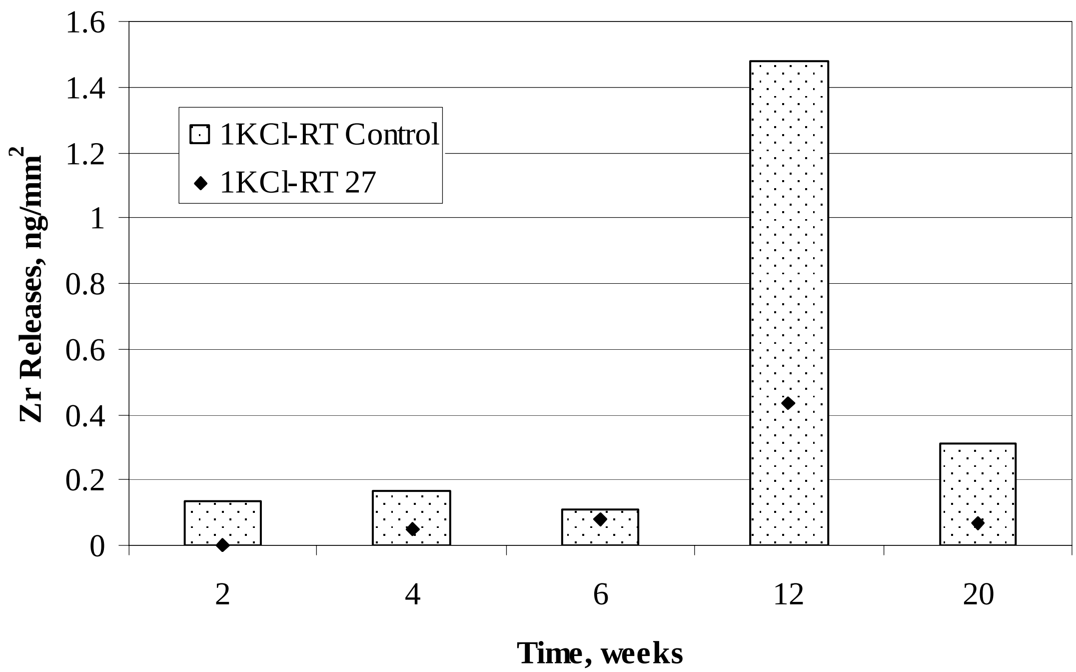


Figure M-14. Zirconium Releases in 1KCl solution at room temperature.

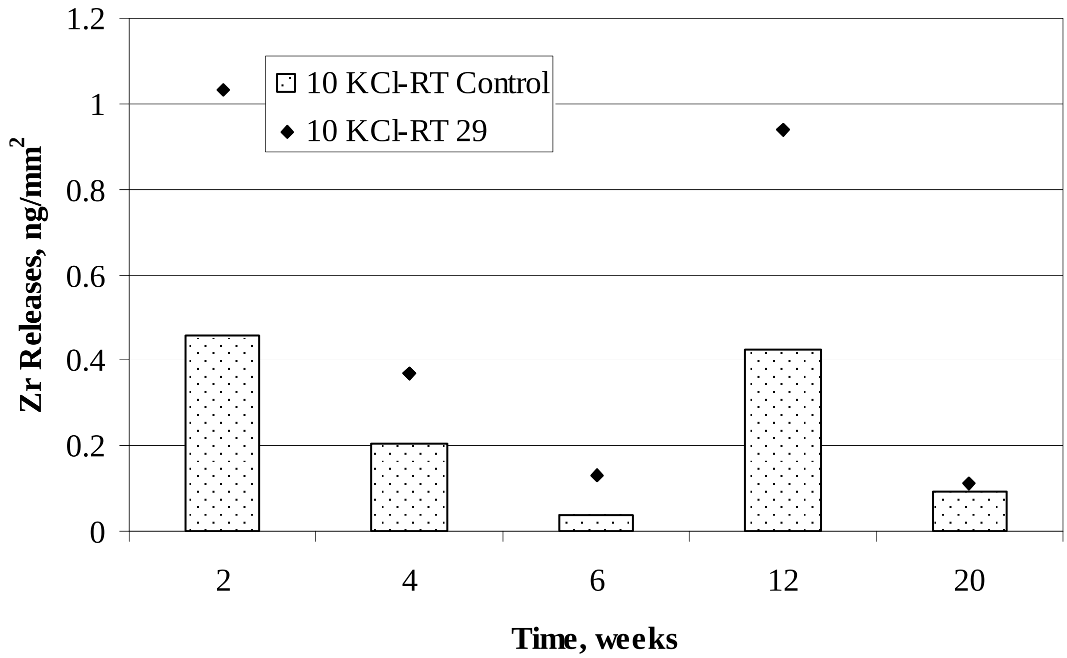


Figure M-15. Zirconium Releases in 10KCl solution at room temperature.

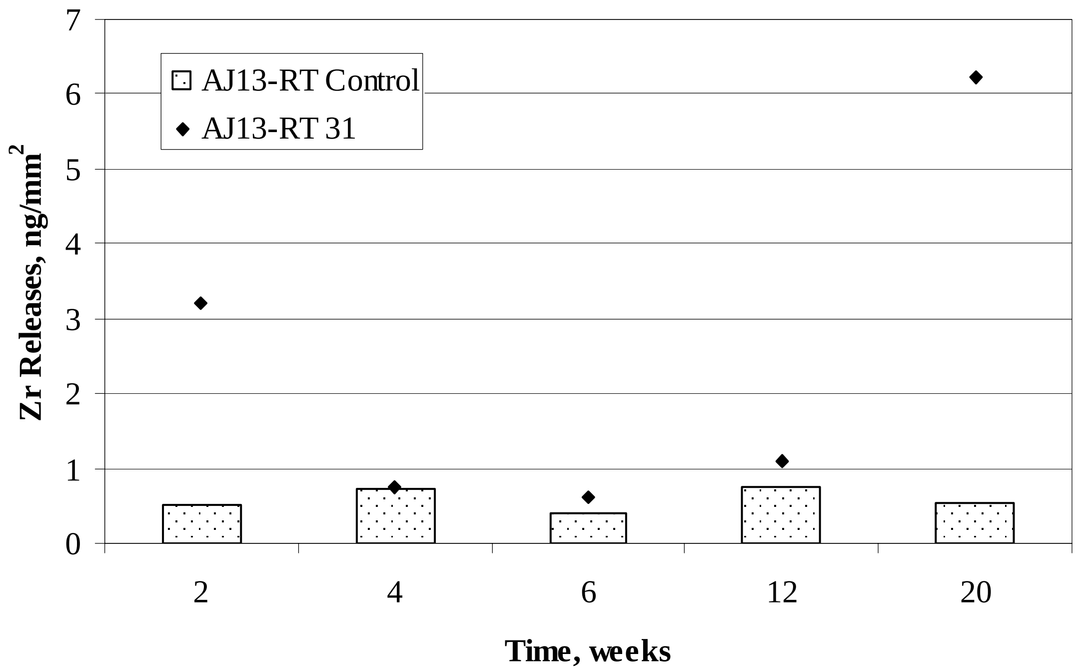


Figure M-16. Zirconium Releases in AJ13 solution at room temperature.

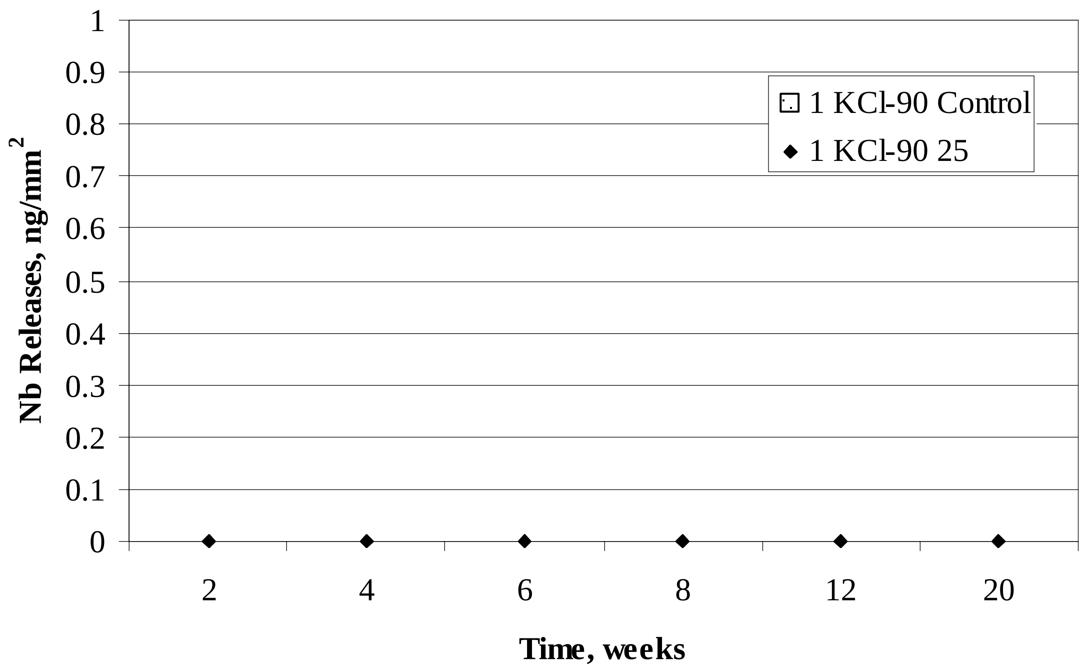


Figure M-17. Niobium Releases in 1KCl solution at 90°C.

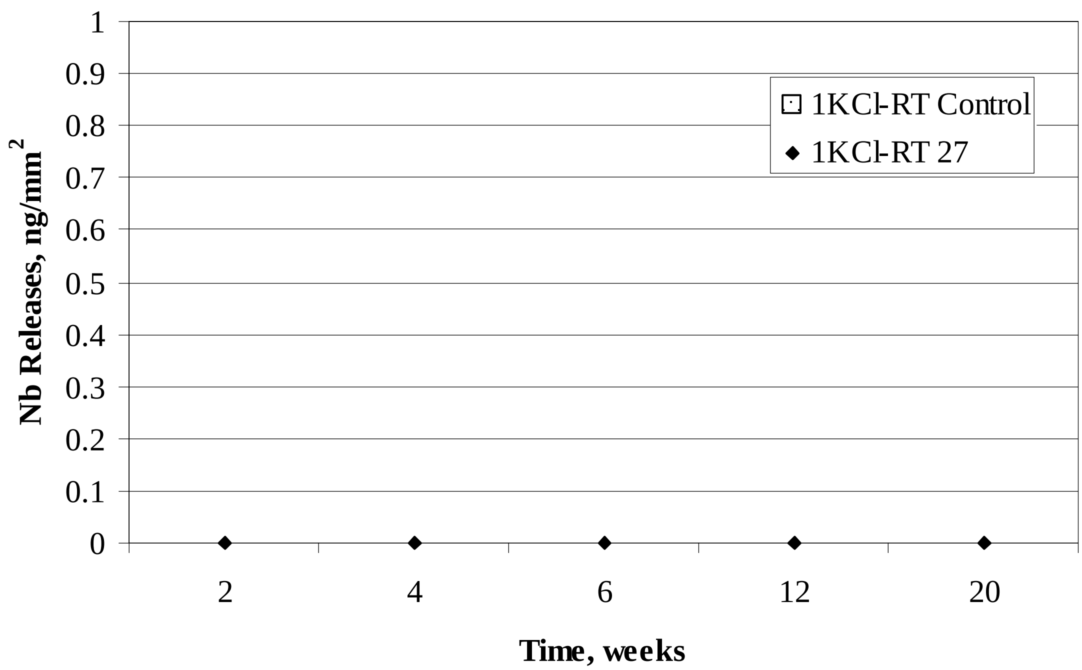


Figure M-18. Niobium Releases in 1KCl solution at room temperature.

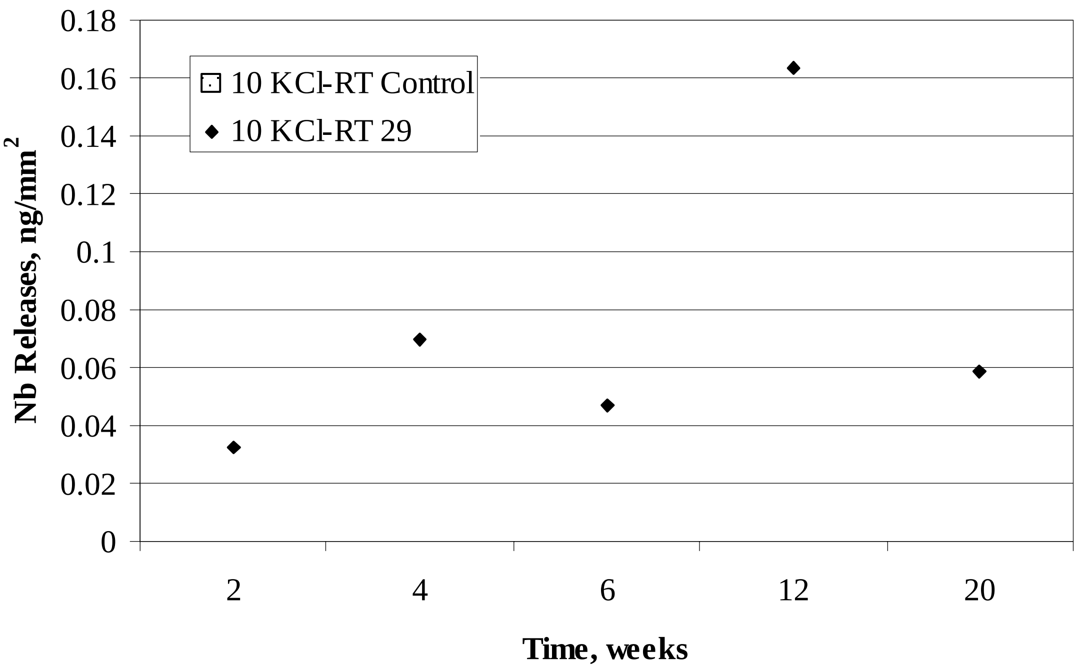


Figure M-19. Niobium Releases in 10KCl solution at room temperature.

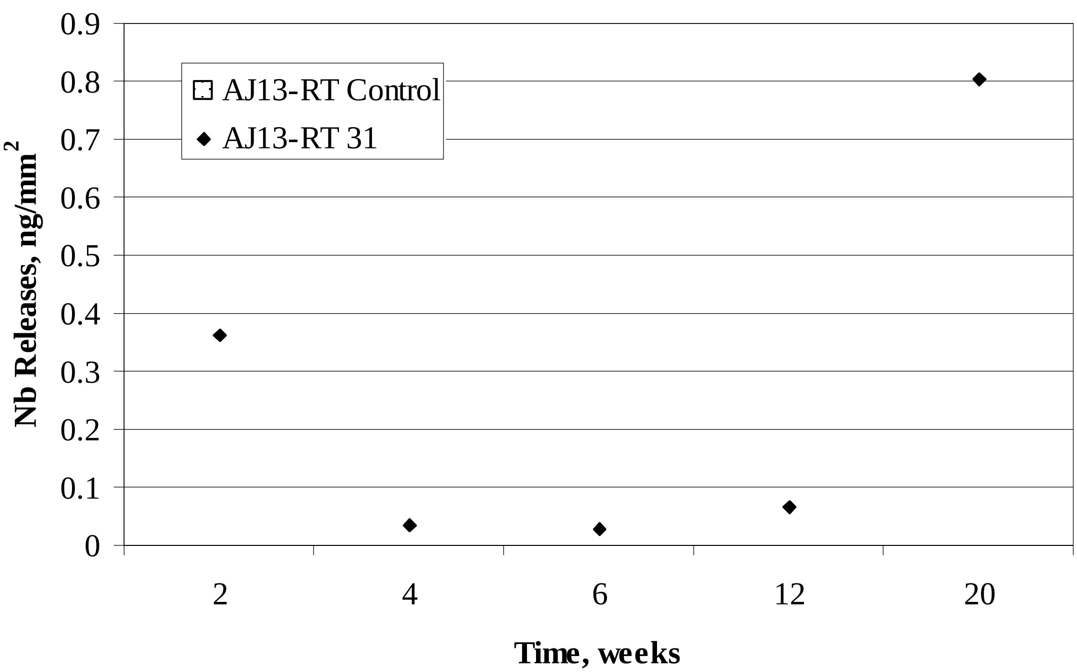


Figure M-20. Niobium Releases in AJ13 solution at room temperature.

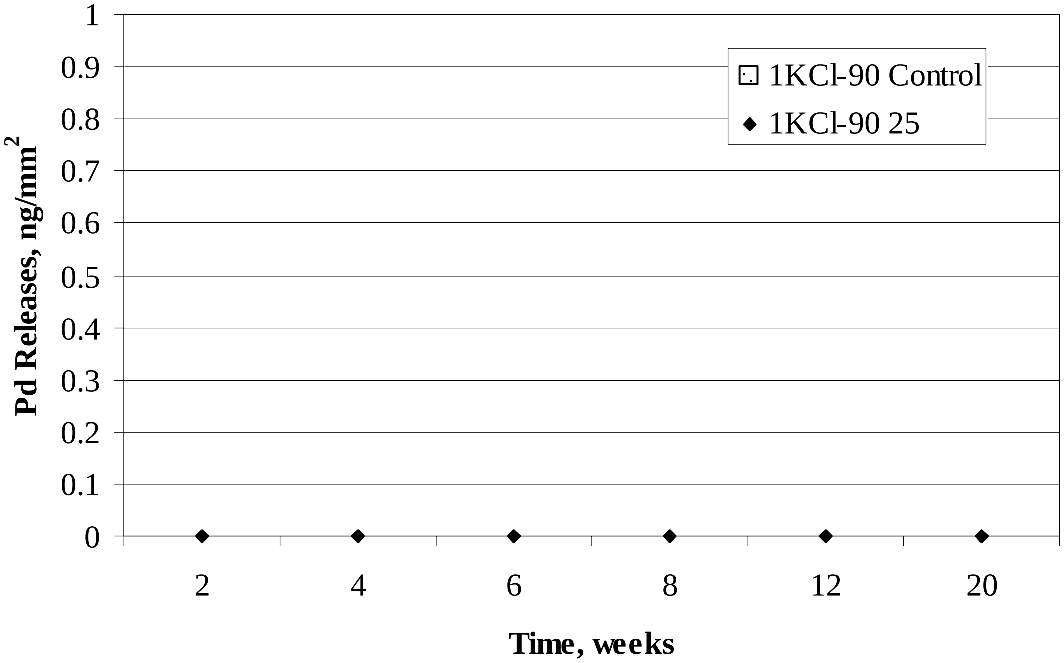


Figure M-21. Palladium Releases in 1KCl solution at 90ºC.

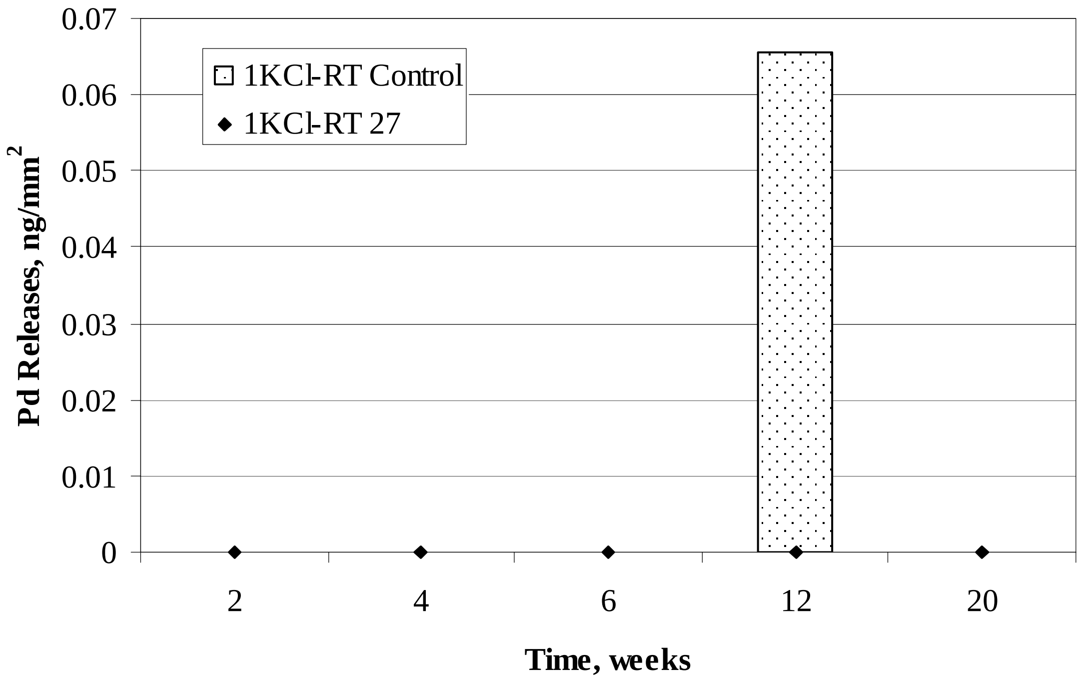


Figure M-22. Palladium Releases in 1KCl solution at room temperature.

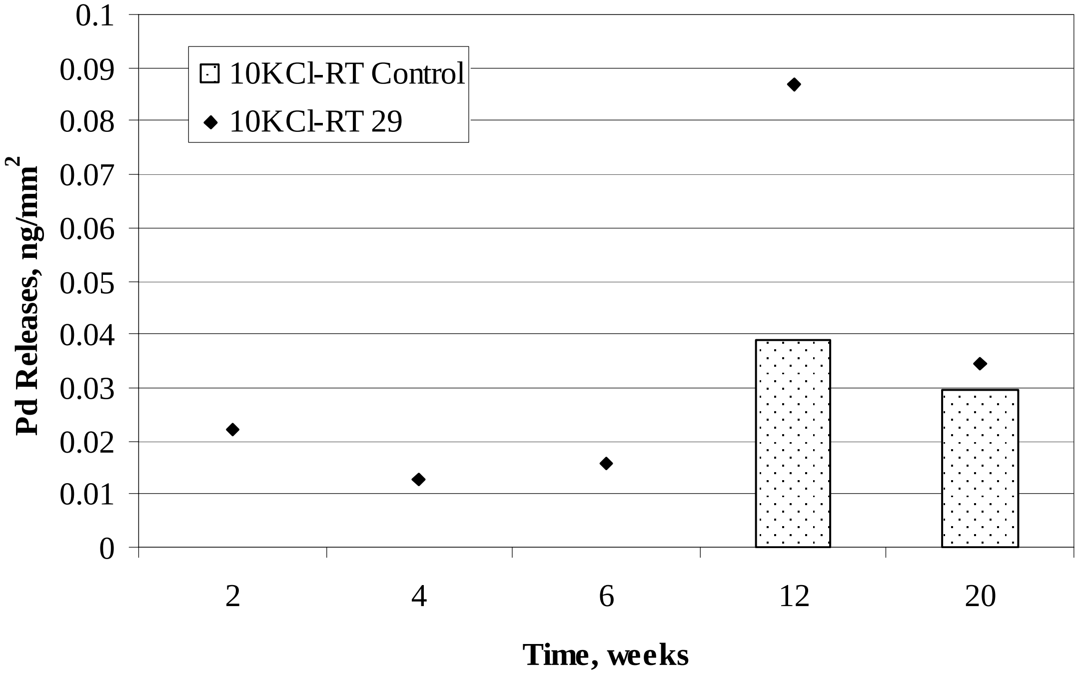


Figure M-23. Palladium Releases in 10KCl solution at room temperature.

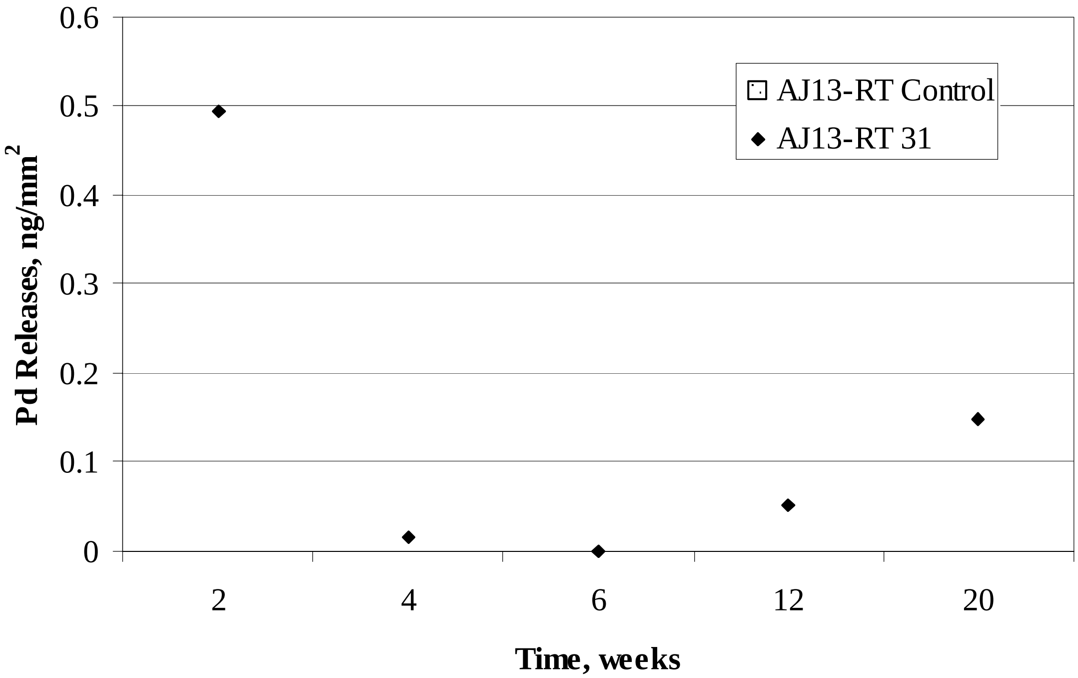


Figure M-24. Palladium Releases in AJ13 solution at room temperature.

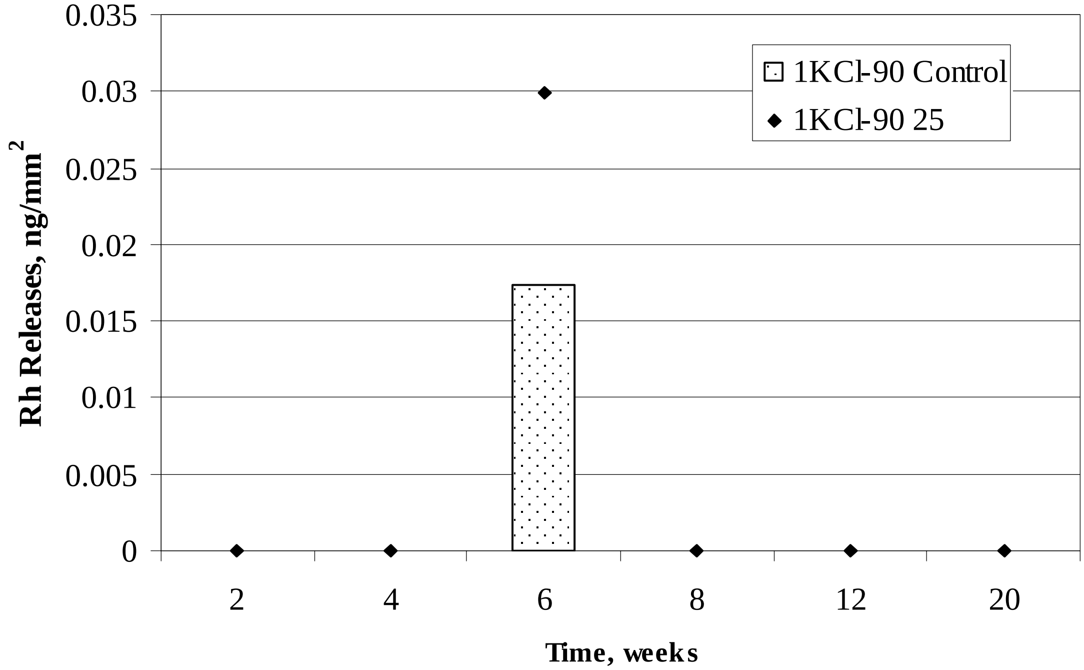


Figure M-25. Rhodium Releases in 1KCl solution at 90ºC.

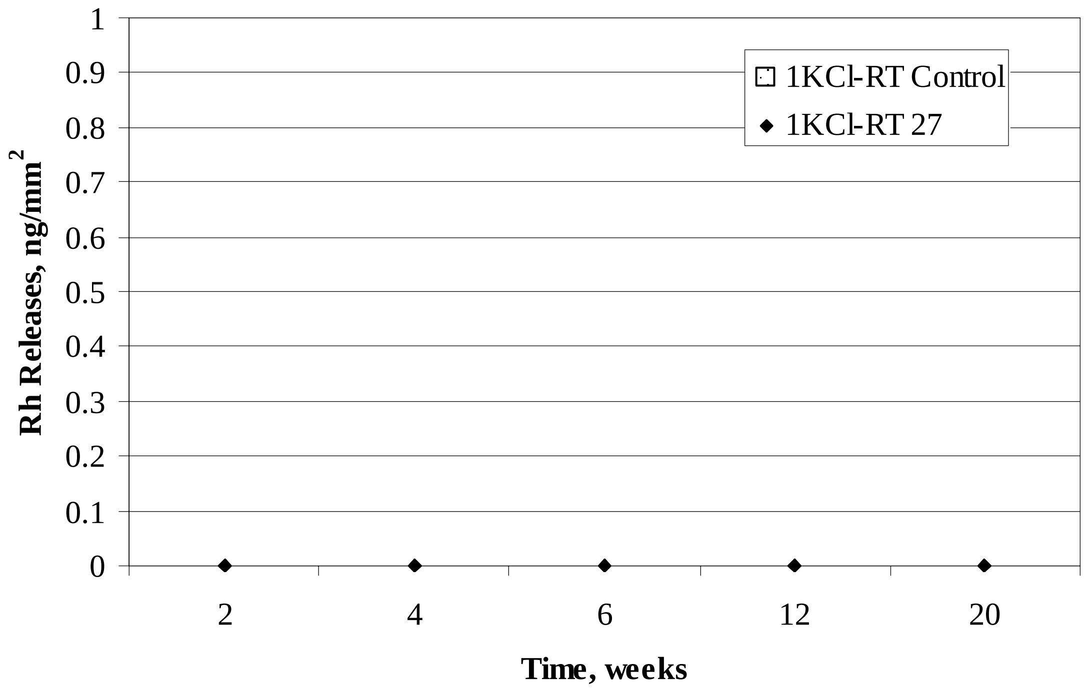


Figure M-26. Rhodium Releases in 1KCl solution at room temperature.

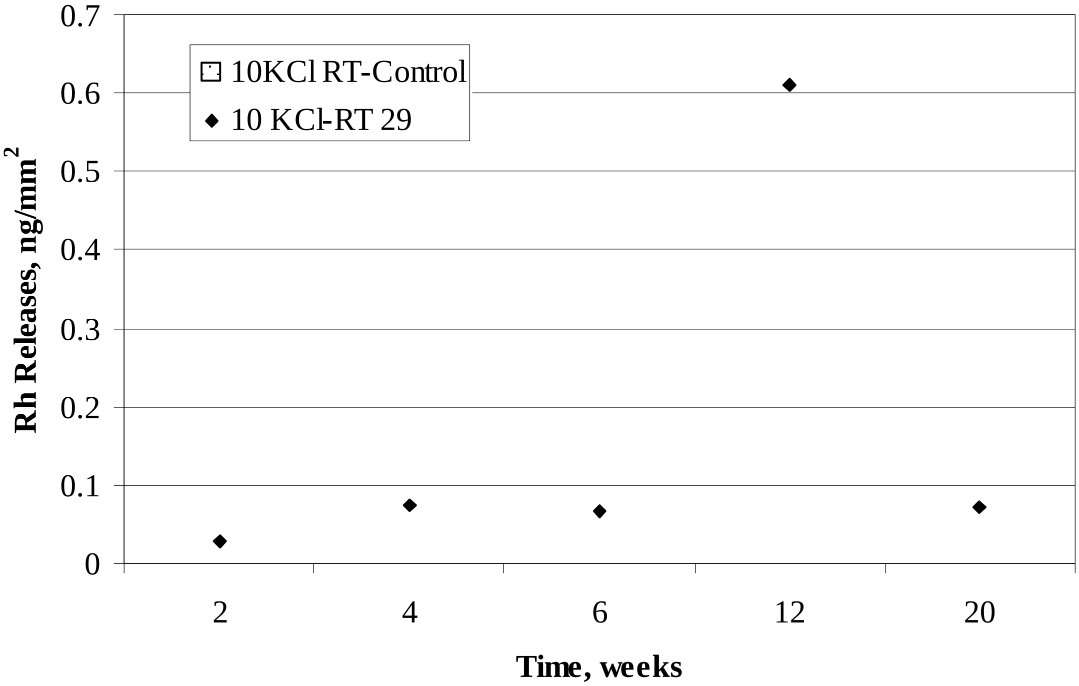


Figure M-27. Rhodium Releases in 10KCl solution at room temperature.

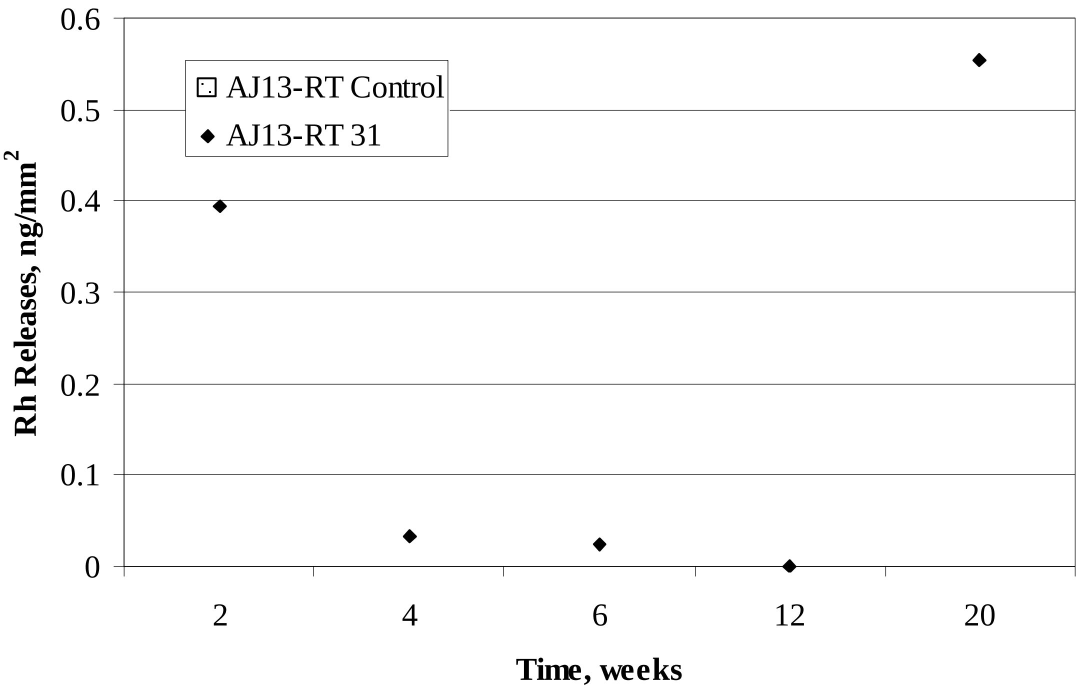


Figure M-28. Rhodium Releases in AJ13 solution at room temperature.

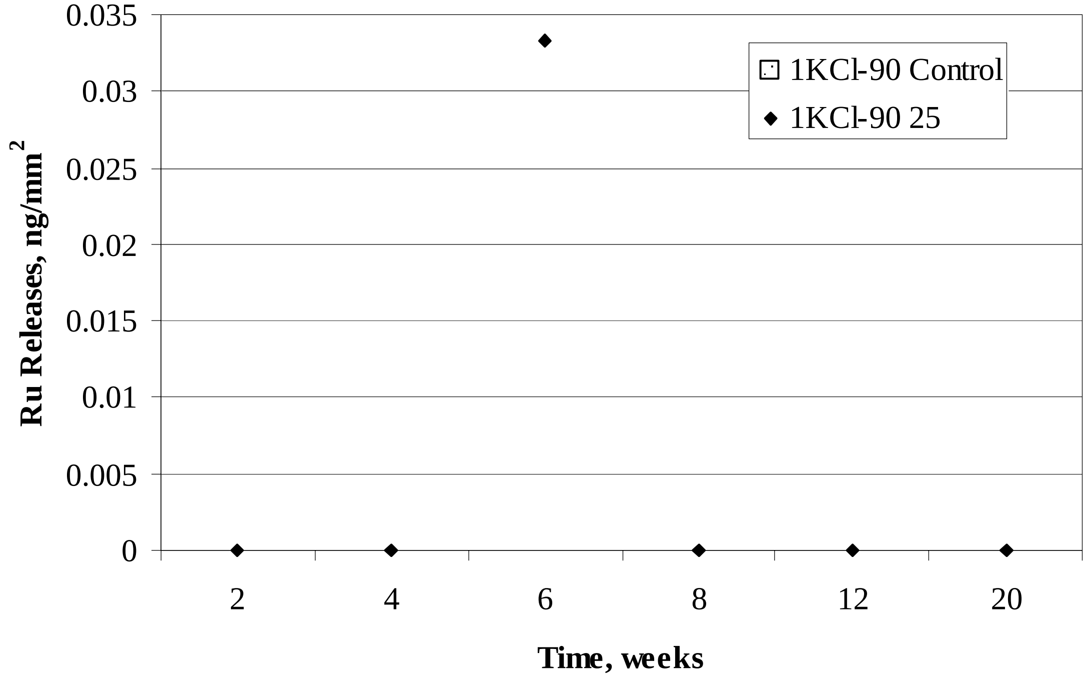


Figure M-29. Ruthenium Releases in 1KCl solution at 90ºC.

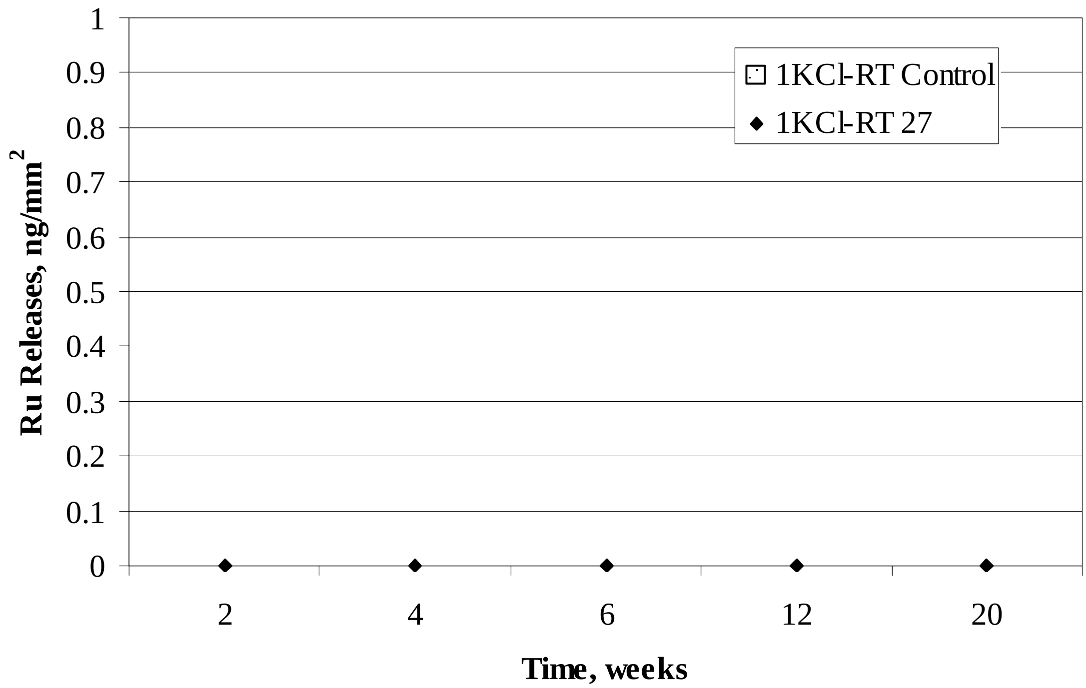


Figure M-30. Ruthenium Releases in 1KCl solution at room temperature.

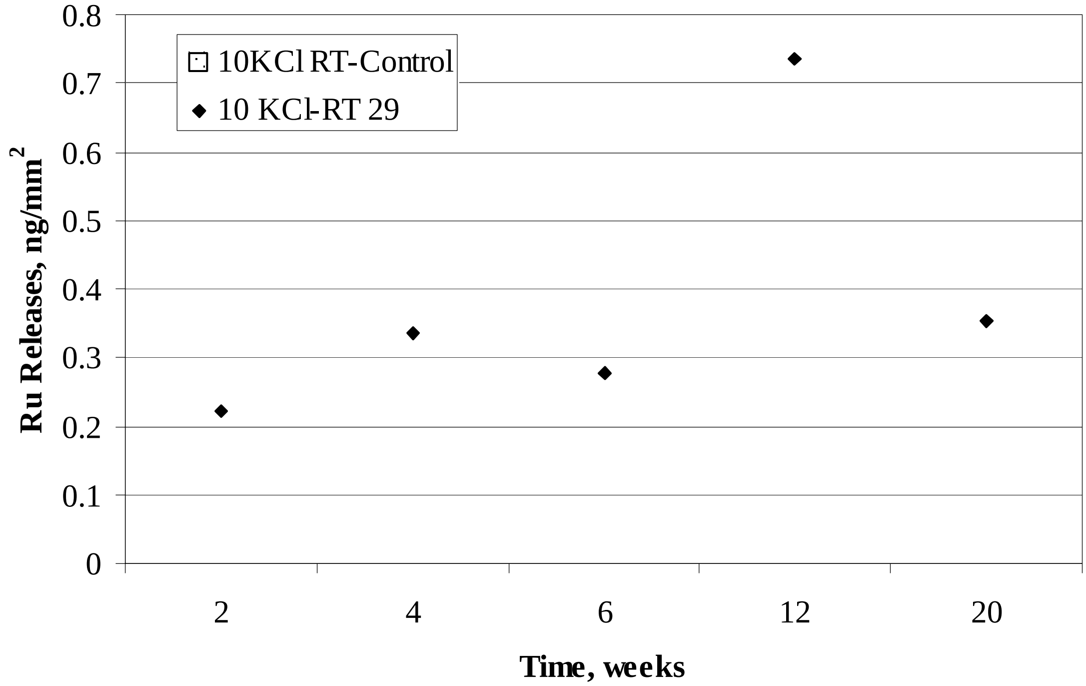


Figure M-31. Ruthenium Releases in 10KCl solution at room temperature.

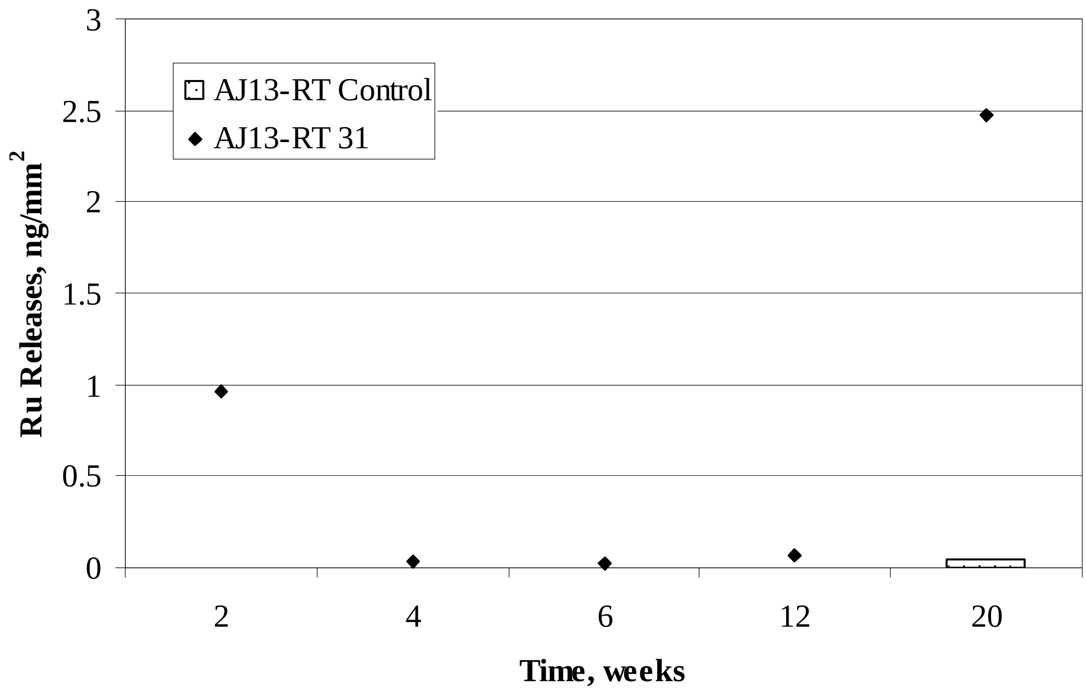


Figure M-32. Ruthenium Releases in AJ13 solution at room temperature.

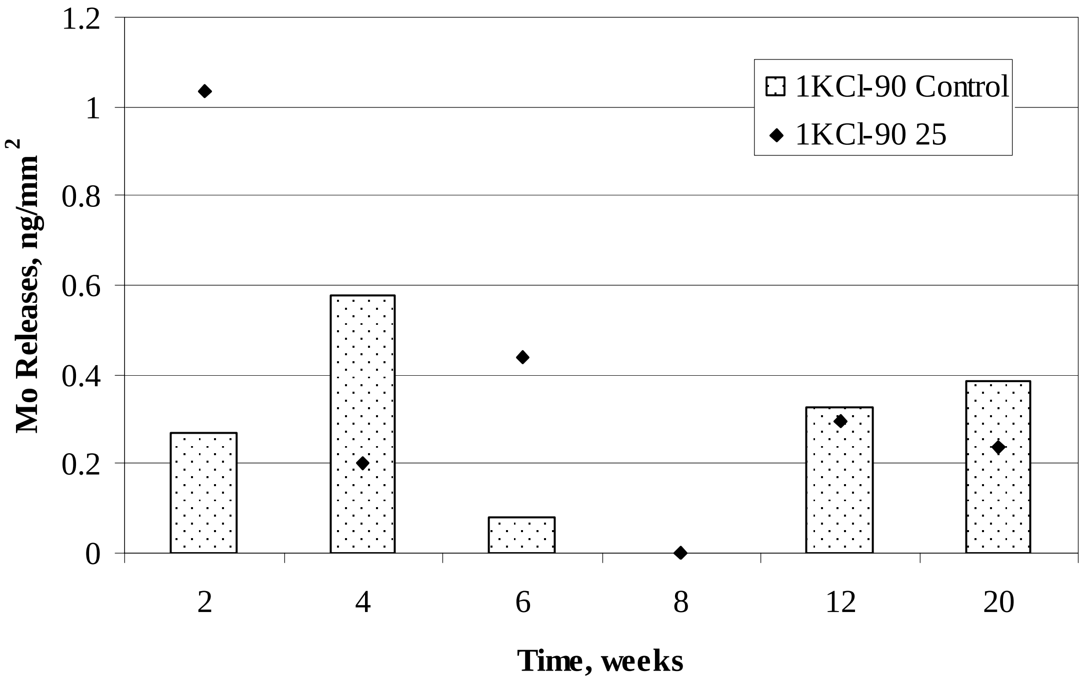


Figure M-33. Molybdenum Releases in 1KCl solution at 90ºC.

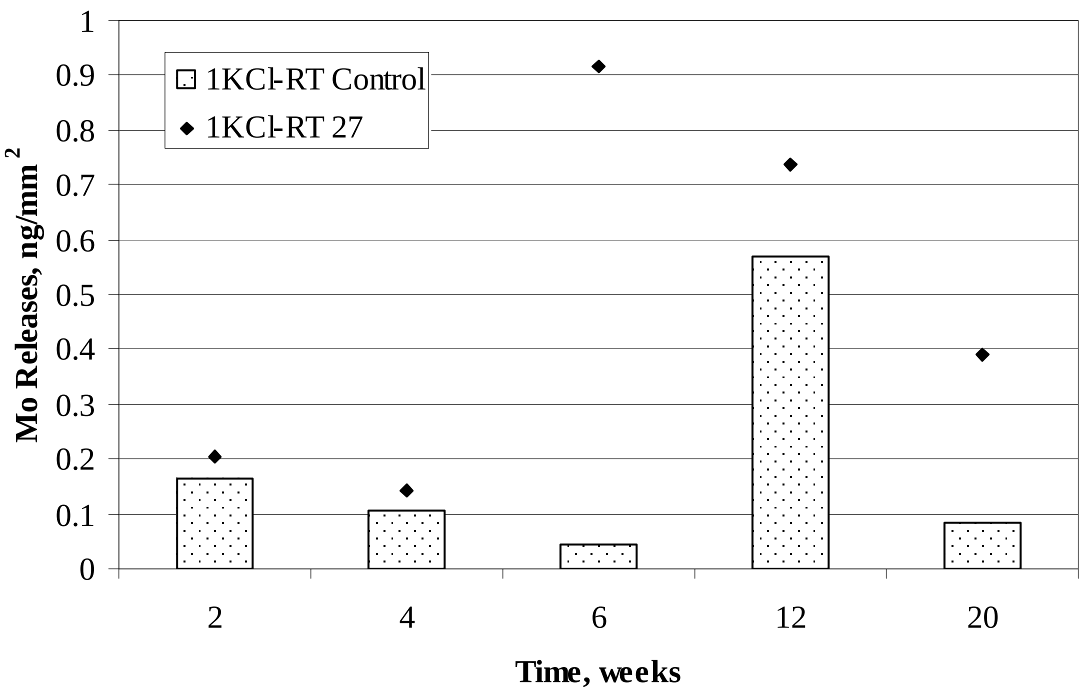


Figure M-34. Molybdenum Releases in 1KCl solution at room temperature.

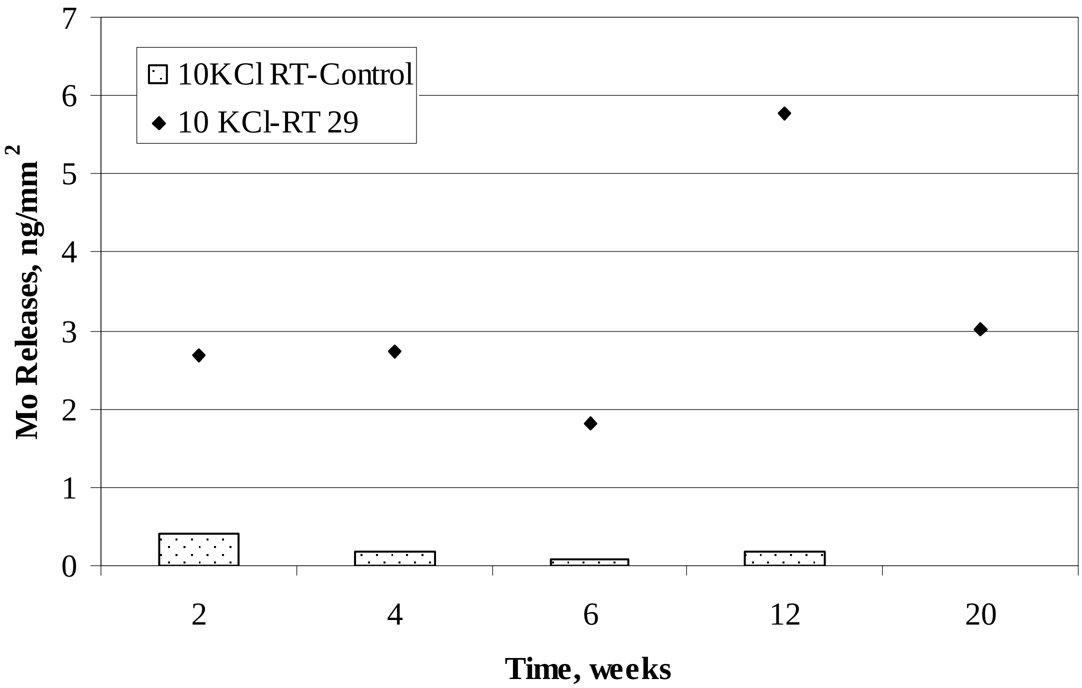


Figure M-35. Molybdenum Releases in 10KCl solution at room temperature.

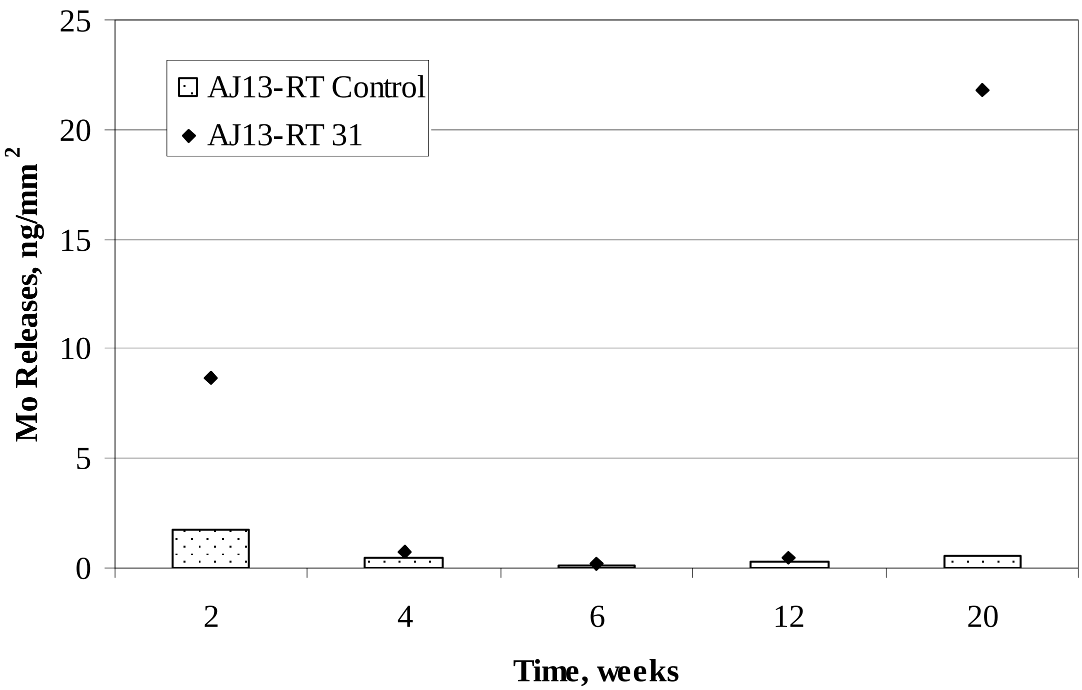


Figure M-36. Molybdenum Releases in AJ13 solution at room temperature.

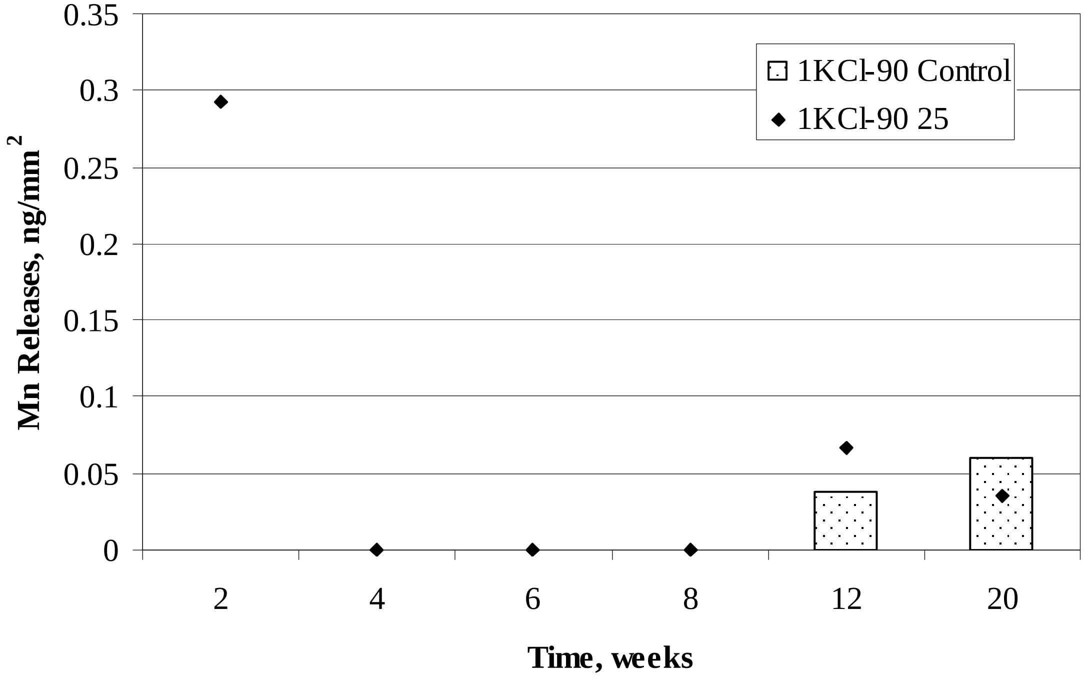


Figure M-37. Manganese Releases in 1KCl solution at 90ºC.

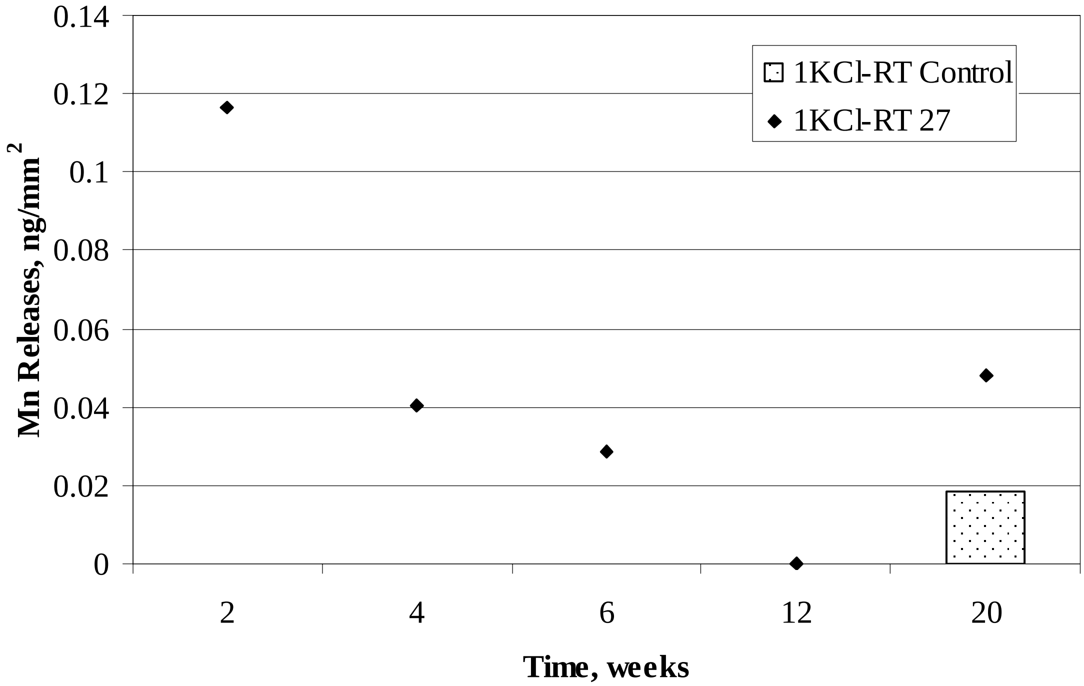


Figure M-38. Manganese Releases in 1KCl solution at room temperature.

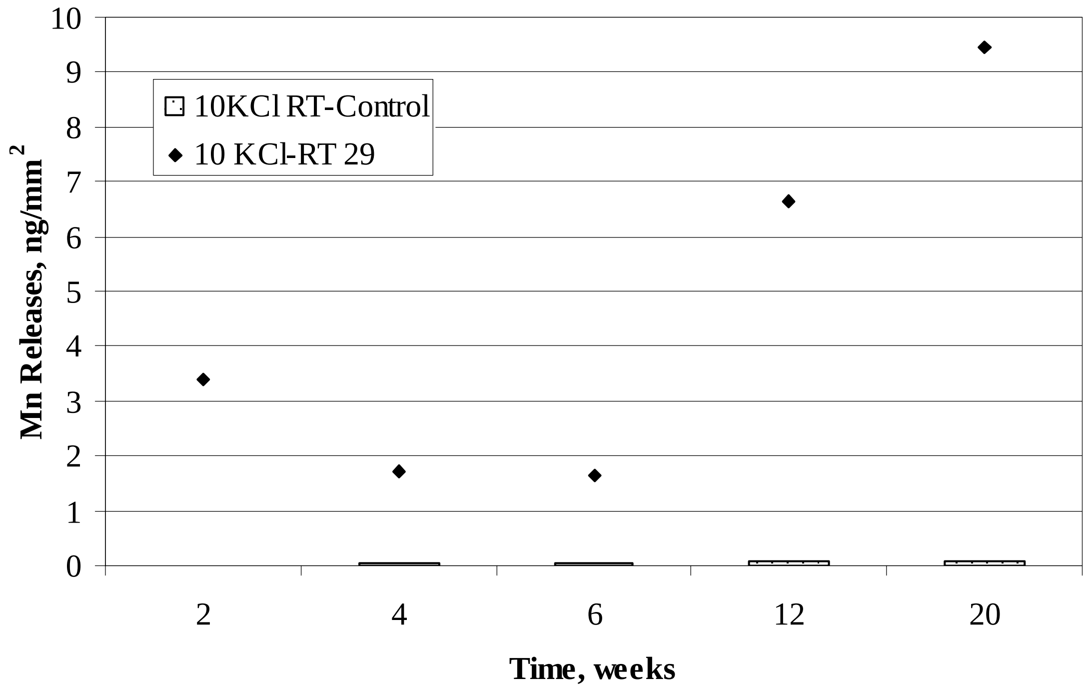


Figure M-39. Manganese Releases in 10KCl solution at room temperature.

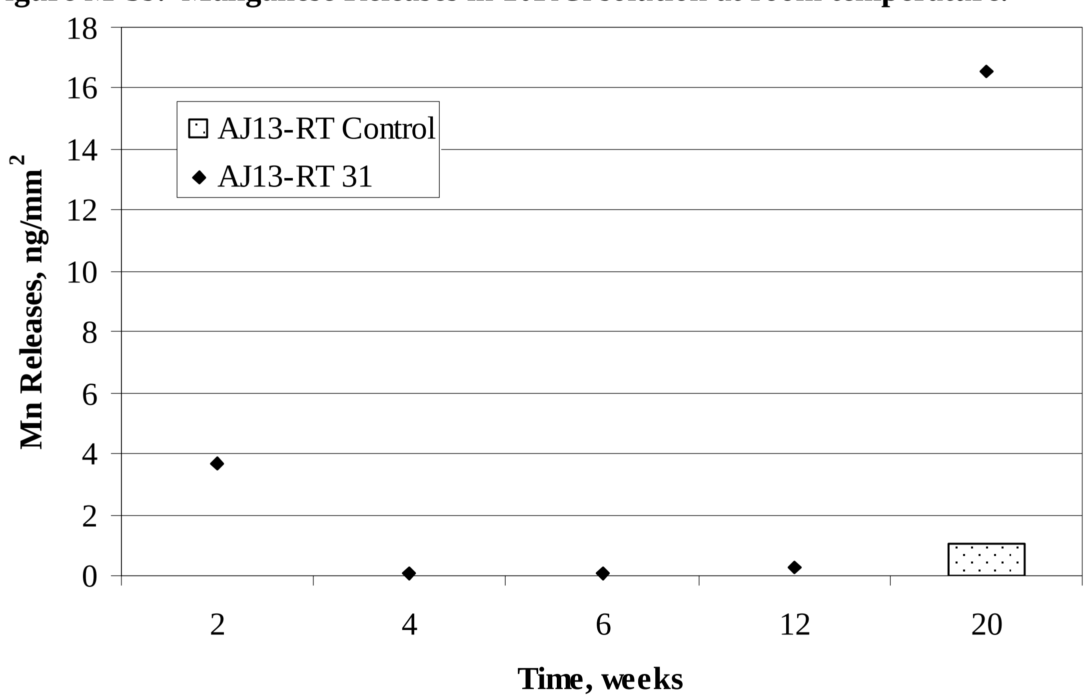


Figure M-40. Manganese Releases in AJ13 solution at room temperature.

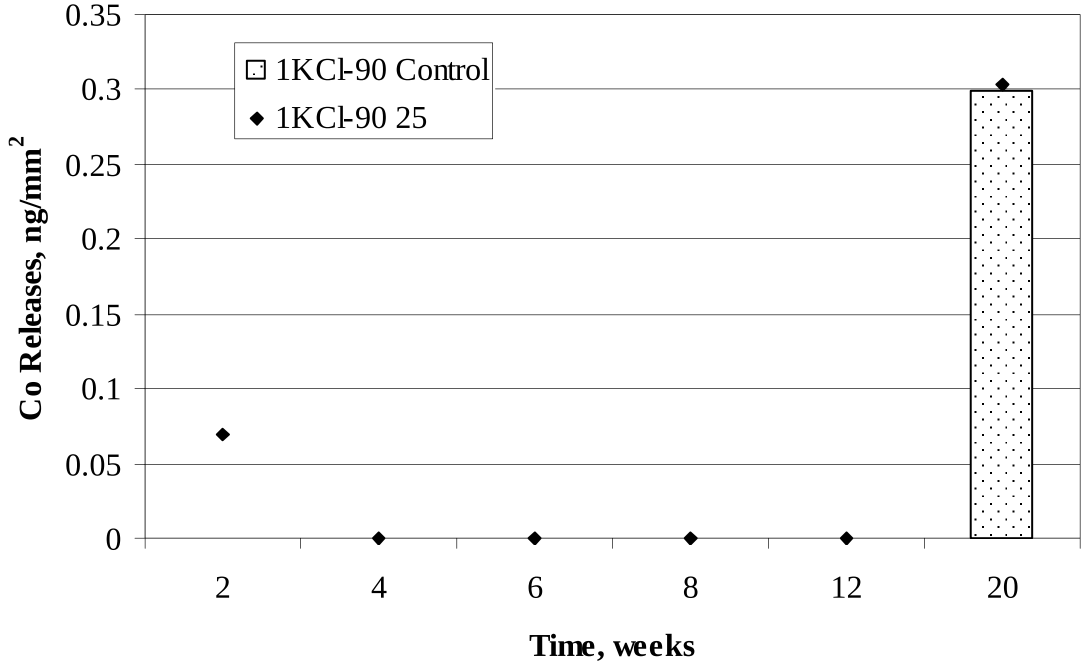


Figure M-41. Cobalt Releases in 1KCl solution at 90°C.

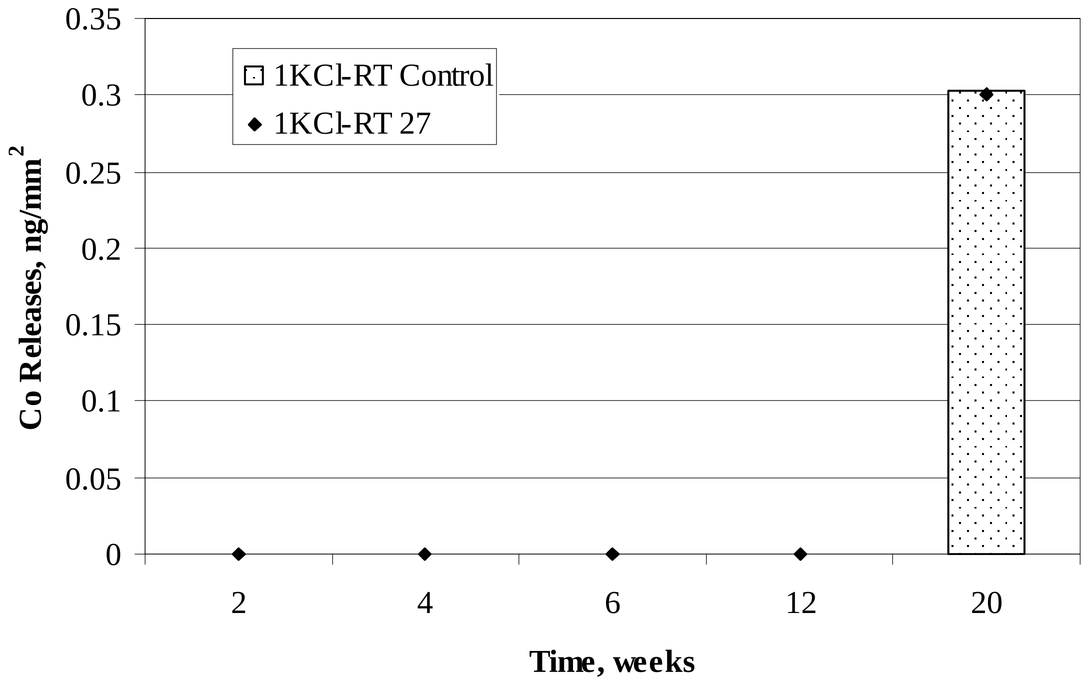


Figure M-42. Cobalt Releases in 1KCl solution at room temperature.

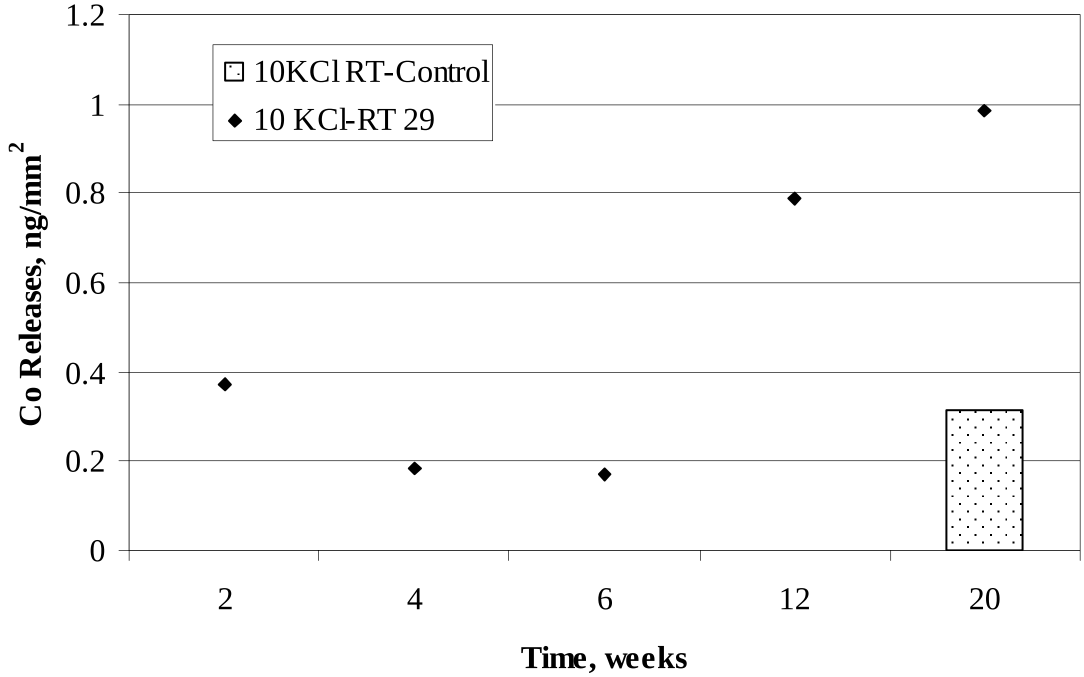


Figure M-43. Cobalt Releases in 10KCl solution at room temperature.

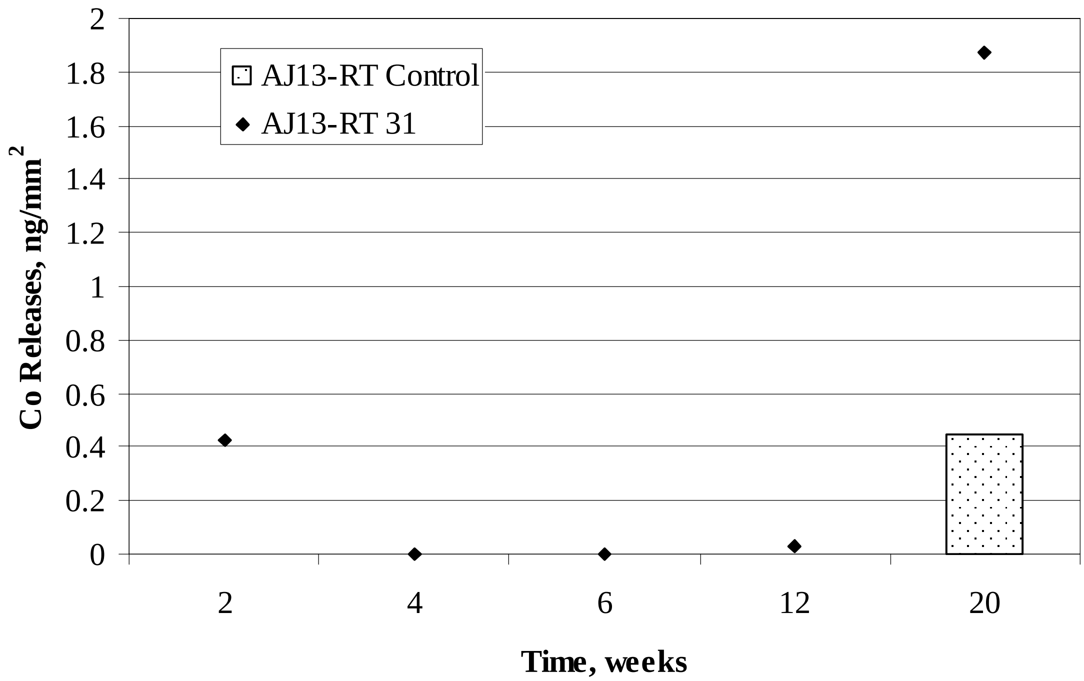


Figure M-44. Cobalt Releases in AJ13 solution at room temperature.

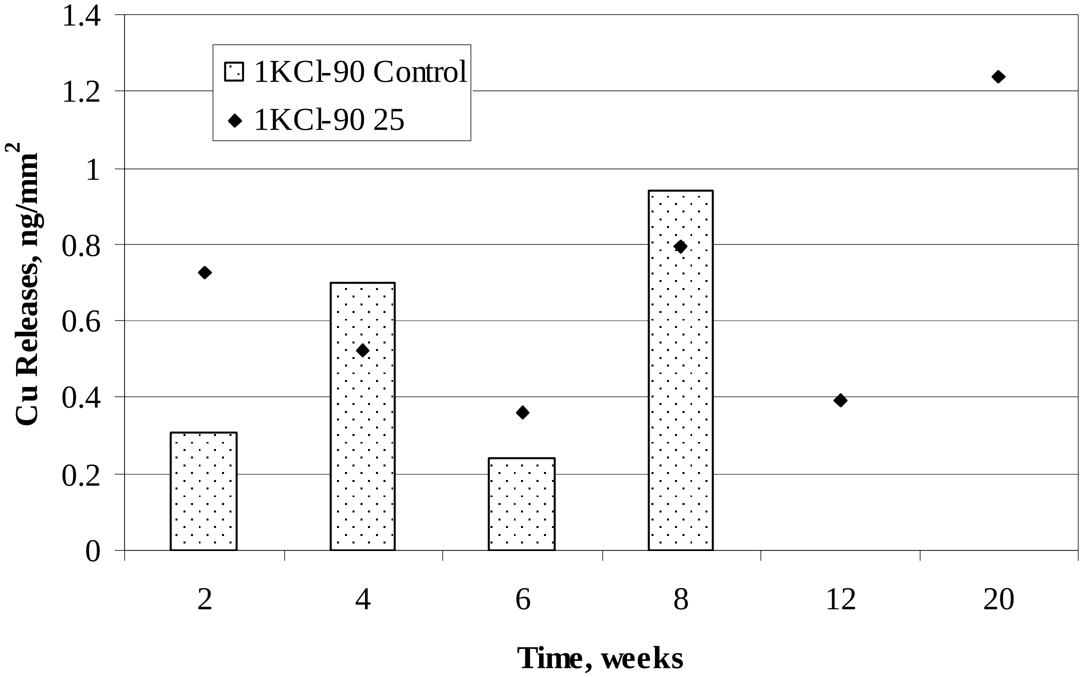


Figure M-45. Copper Releases in 1KCl solution at 90°C.

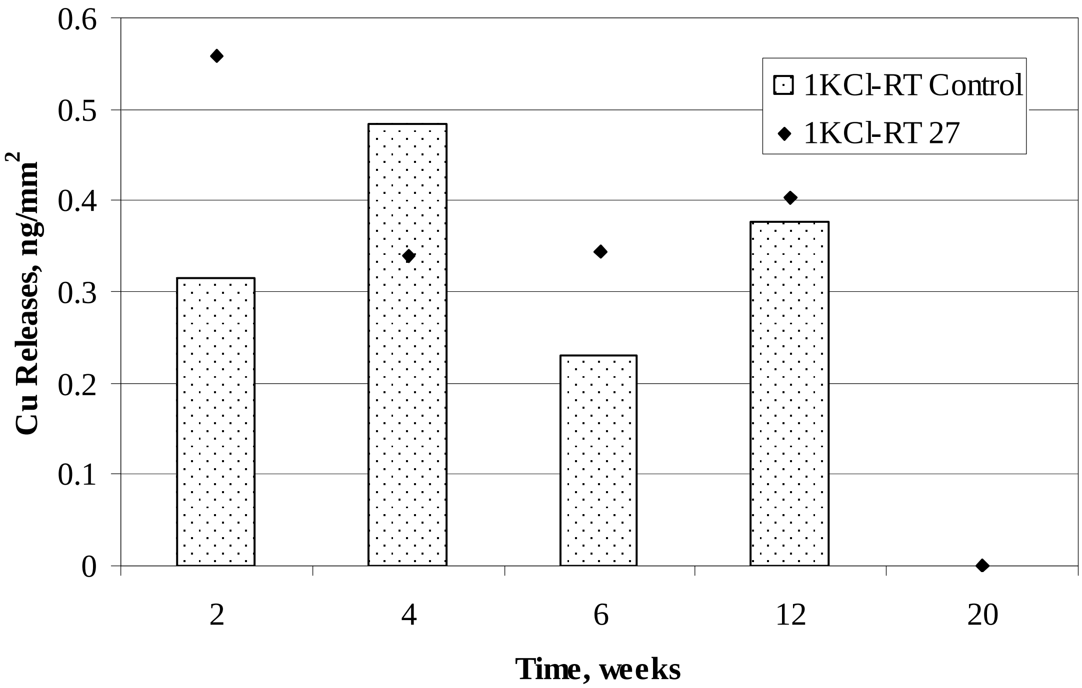


Figure M-46. Copper Releases in 1KCl solution at room temperature.

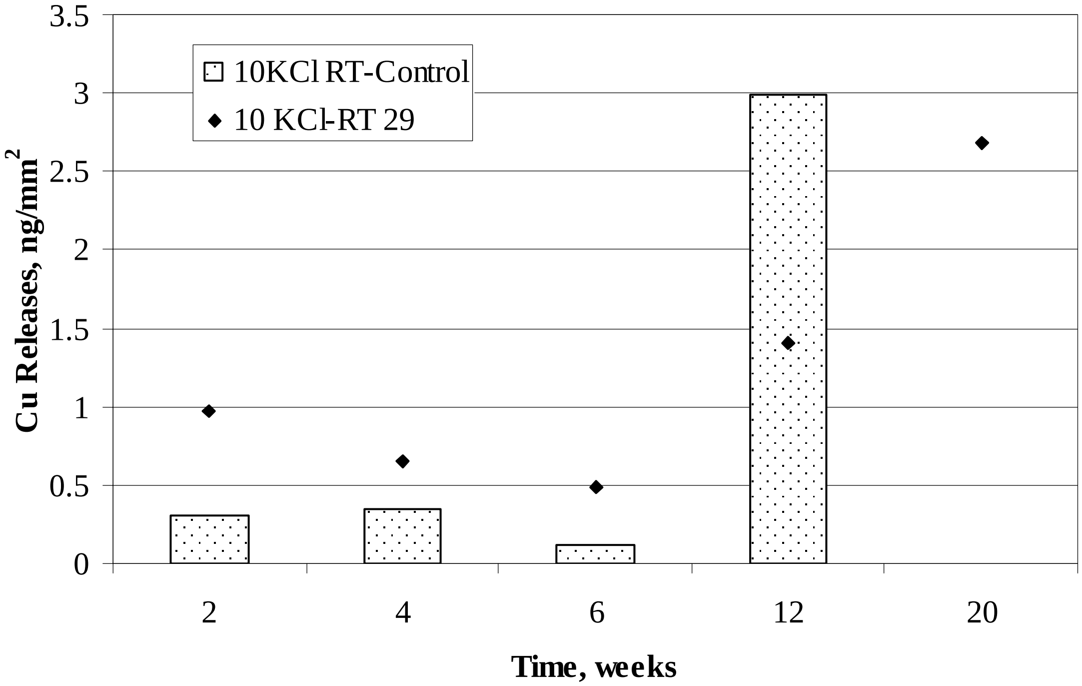


Figure M-47. Copper Releases in 10KCl solution at room temperature.

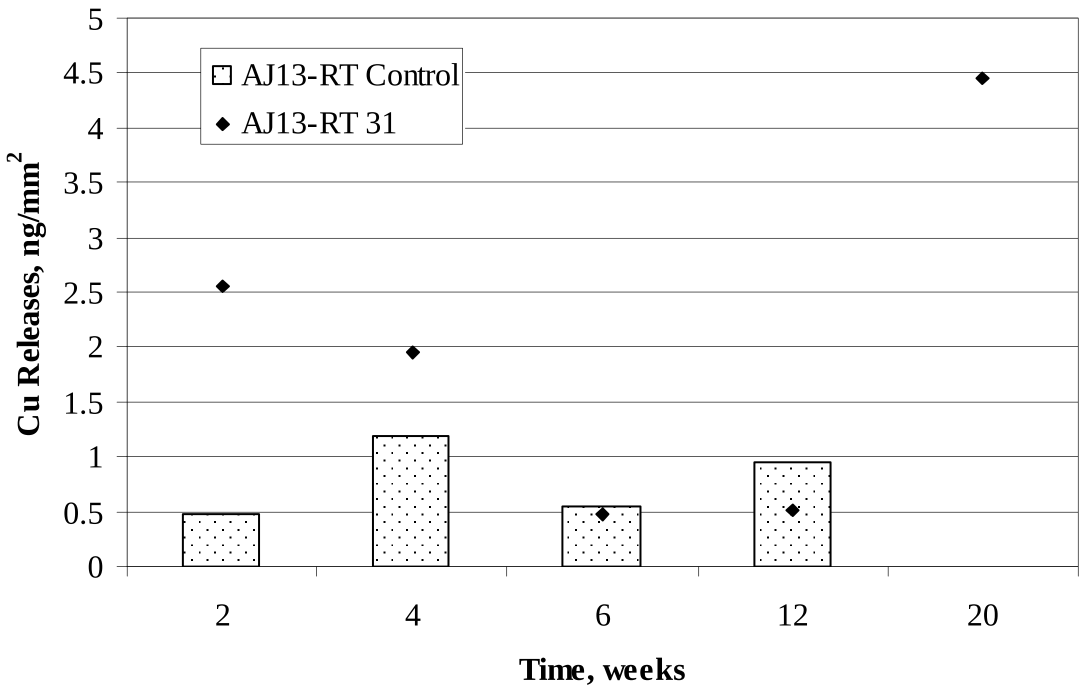


Figure M-48. Copper Releases in AJ13 solution at room temperature.

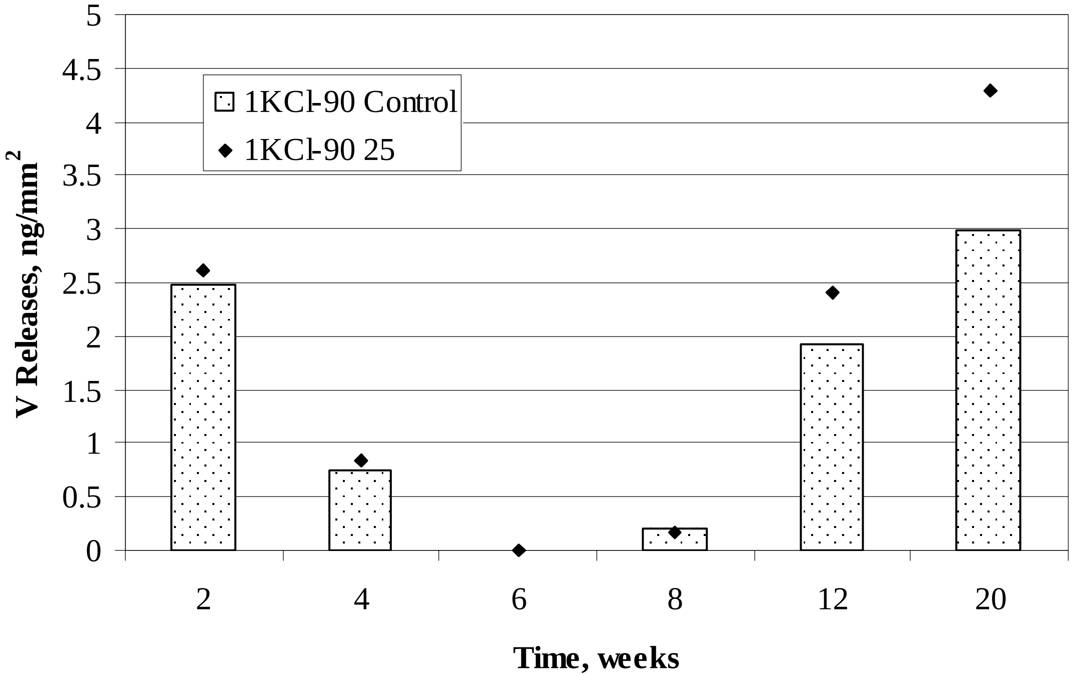


Figure M-49. Vanadium Releases in 1KCl solution at 90°C.

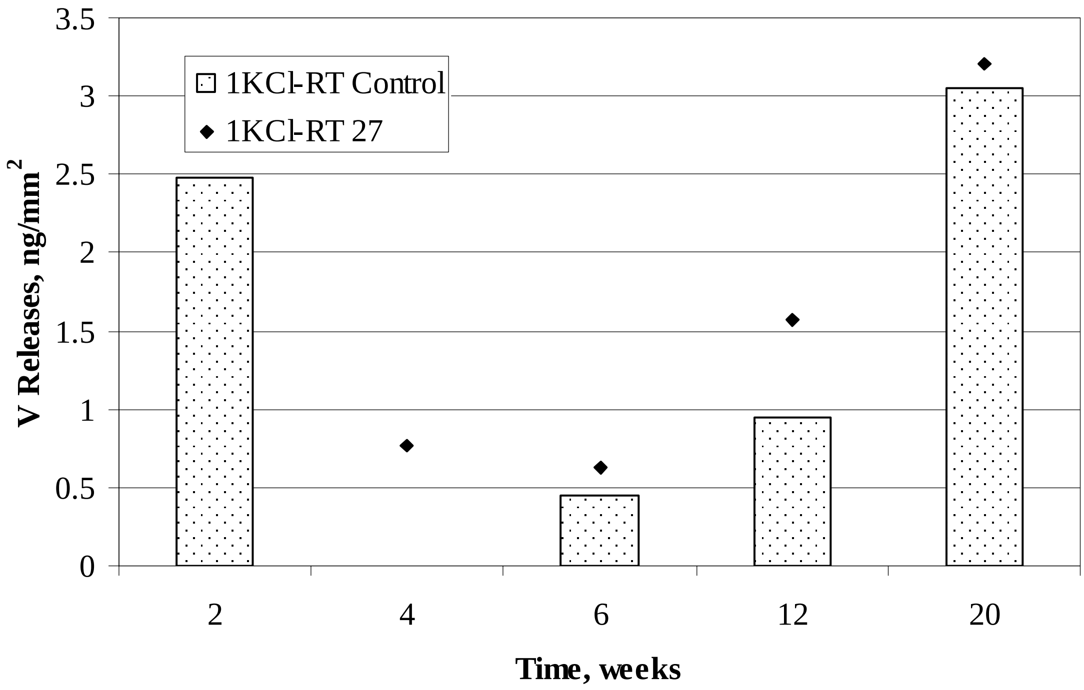


Figure M-50. Vanadium Releases in 1KCl solution at room temperature.

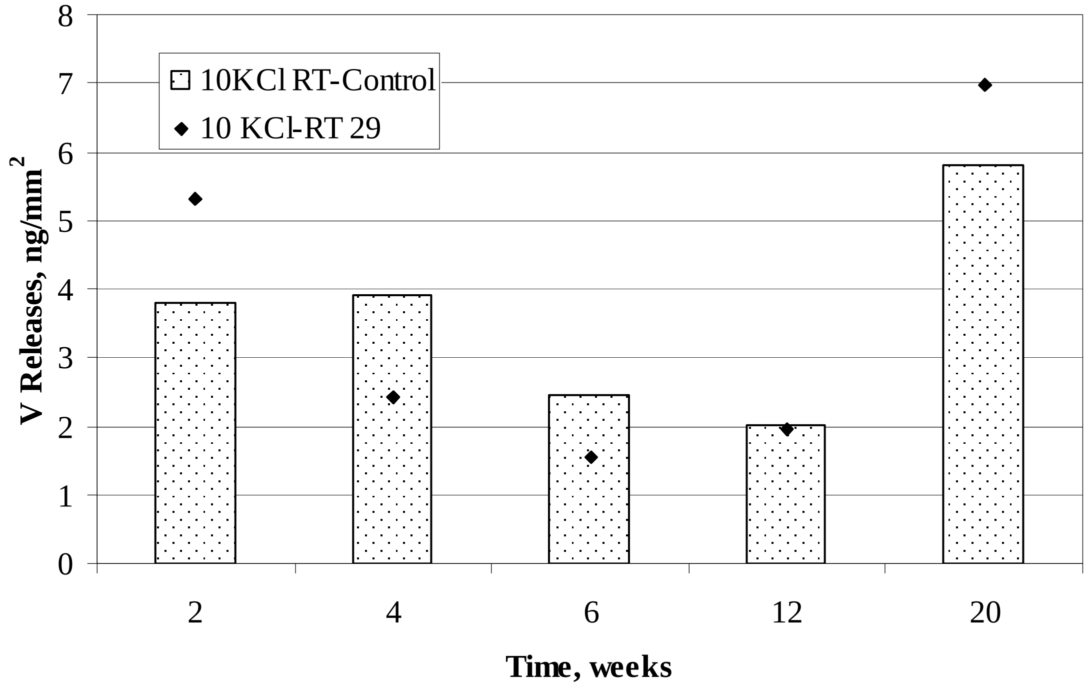


Figure M-51. Vanadium Releases in 10KCl solution at room temperature.

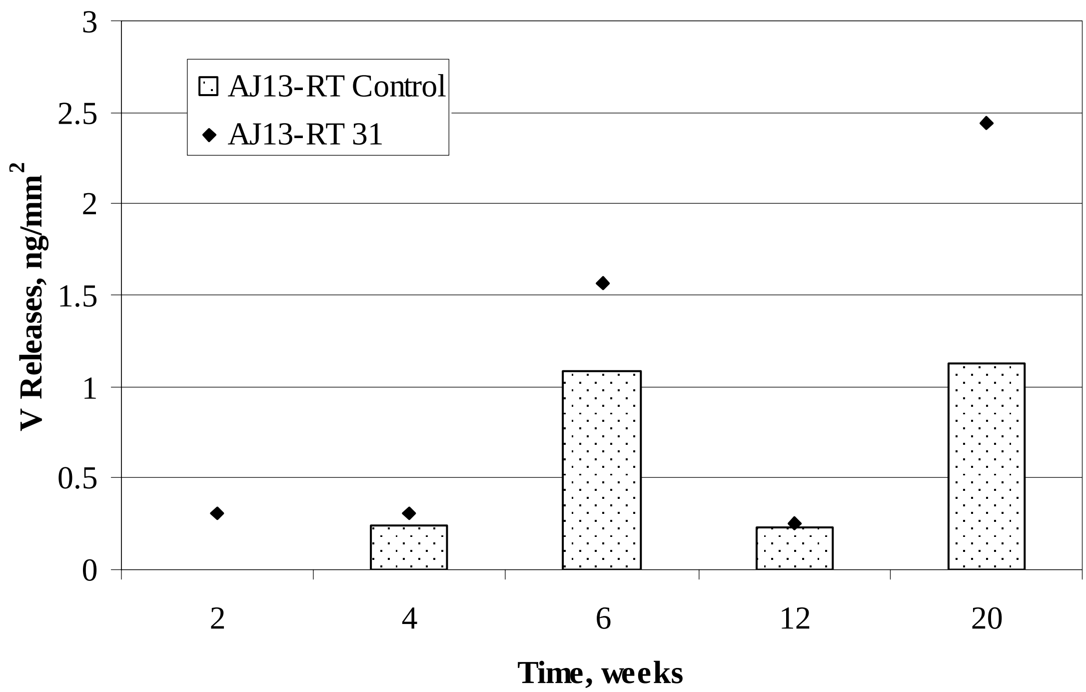


Figure M-52. Vanadium Releases in AJ13 solution at room temperature.

N. Normalized Loss Formula with No Correction for Blanks

Used for Comparing Fe Normalized Loss with High Level Glass Waste

$$NL_i = \frac{\left[\frac{(C_i d_i V_i) + (C_i V_i)_{AS}}{V_i} + C_R\right] * V_i * 0.001}{A * f_i}$$

NL_i = Normalized Loss (g/m^2)
C_i = Concentration of ith element in solution (µg/L)
d_i = dilution factor for test solution containing ith element (because solution is acidified)
V_i = Volume of test solution containing ith element (mL)
AS= Acid Strip (refers to elemental concentration and volume of acid strip solutions)
A = area of specimen (mm^2)
f_i = fraction of ith element in specimen
C_R = Concentration of ith element in residue (µg /L)

Notes:
1. The 1st term in the equation gives the elemental content in the test and acid strip solutions.
3. The multiplication factor 0.001 is used to convert the normalized loss value to g/m^2.

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