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Development of Cementitious Grouts for the Incorporation of Radioactive Wastes. Part 2: Continuation of Cesium and Strontium Leach Studies

J. G. Moore

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Printed in the United States of America. Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road, Springfield, Virginia 22161
Price: Printed Copy $6.75; Microfiche $2.25

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ORNL-5142
(Part 2 of ORNL-4962)
Dist. Category UC-70

Contract No. W-7405-eng-26

CHEMICAL TECHNOLOGY DIVISION

DEVELOPMENT OF CEMENTITIOUS GROUTS FOR THE INCORPORATION OF RADIOACTIVE WASTES. PART 2: CONTINUATION OF CESIUM AND STRONTIUM LEACH STUDIES

J. G. Moore

Technicians:
P. C. Arwood
R. T. Jubin

SEPTEMBER 1976

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ABSTRACT

Additional leach studies were completed on the leachability of cesium and strontium from simulated hydrofracture grout. These studies followed the test method proposed by the International Atomic Energy Agency or a modification which exposed smaller specimens with a higher surface-to-volume ratio to a larger volume of leachant. The results showed that the amount of cesium or strontium leached from the grout varied directly with the degree of drying during curing and inversely with the time of curing. The leachability also depends on the composition of the leachant and varies in the order: distilled water > tap water > grout water. The total waste concentration had little effect on the leachability of either cesium or strontium.

The credibility of the laboratory results was substantiated by a short-term continuous leach test made on a fragment of a core sample of actual hydrofracture grout. The modified effective diffusivities (10^{-11} to 10^{-10} cm^2/sec) calculated from these limited data were comparable to those obtained from laboratory studies containing Grundite clay.

These tests also confirmed the effect of various clays on the leachability of cesium and the importance of leachant renewal frequency on the leach rate.

1. INTRODUCTION

This is the second report on studies made to determine the leachability of various radionuclides from cementitious grouts similar to those used in the Hydrofracture Facility at Oak Ridge National Laboratory (ORNL). This account will include results from studies which were continued as well as those from parametric studies which were initiated and completed since the last report. The format of the first report[1] will be used whenever possible, and some of the background or explanatory material previously used will be repeated as an aid to the reader.

The Hydrofracture facility has been used since 1966 for the disposal of intermediate-level waste (ILW). Hydrofracturing is a procedure whereby the radionuclides present in ILW are fixed in a cement matrix deep within a Conasauga shale bed formation located within the area.[2,3] The ILW is composed of a mixture of all the liquid wastes, other than process waste, that are produced in hot-cell, pilot-plant, and reactor operations, including relatively small volumes of organic reagents and solvents. The solution after concentration by evaporation may contain up to 2 Ci of beta-gamma activity per gallon. The major radionuclide is generally ^{137}Cs, while ^{90}Sr is present at a level of only 0.1 Ci/gal or less. The major alpha activity is ^{244}Cm with a maximum concentration of about 1 mCi/gal.[4] The waste is formed into a grout by blending it with a mixture of cementitious materials and selected clays. The grout is immediately injected 800 to 1000 ft underground into cracks produced in the shale formations by the pressure of the injected grout. Here the material solidifies, fixing the radionuclides. A safety analysis based on the development studies and actual waste injection experience concluded that the procedure is safe, presenting no significant hazard to the public or environment.[5] Since 1966, more than one million gallons of waste solution have been injected without serious difficulty.

A proposal was made to build a new facility that would have the capability of handling sludges and wastes with higher specific activities than described above. This proposal led to the resumption of a development program to resolve questions concerning the safety and environmental impact of the facility. One of these questions concerned how effectively the grouts would retain the radionuclides in the unlikely event they come in contact with water. Consequently, leach studies were undertaken to obtain such data.

The leachability of radionuclides from cement has been studied using a wide variety of methods.[6,7] To permit intercomparison of various products from different processes or different materials, the IAEA has proposed a standard method[8] of measuring and reporting the leaching, by water, of the radioactive components in solid waste products. Insofar as possible, this method was followed in the initial tests; however, this procedure was time-consuming and sometimes gave misleadingly low leach values. Most of the

studies presented in this report were made using small right circular cylinders (about 1.6 cm diam and from about 2.0 to 2.5 cm long). These have a higher surface-to-volume ratio than the IAEA specimens. In addition, all surfaces were exposed to the leachant (200 ml), which was changed one to four times a day. Since the primary purpose of these tests was to determine the influence of various parameters on the leachability of cesium and strontium from simulated hydrofracture grout, this method allowed a rapid accumulation of data and quickly established the trends of the leach effects. From these results, future longer-term tests may be designed to obtain data suitable for extrapolation to very long time periods.

2. EXPERIMENTAL METHODS AND MATERIALS

2.1 Test Materials

The grout used in the hydrofracture procedure is made by combining the desired volume of waste solution with a predetermined weight of dry solids. The dry solids consist of a mixture of type I Portland Cement,[9-12] fly ash, Attapulgite-150 clay, Grundite clay or suitable substitute, and a sugar. The recipe for the standard dry mixture is shown in Table 1. The fly ash, a pozzuolana, is a partial substitute for cement which can improve the retention of strontium. Attapulgite-150 is a drilling clay which suspends the cement and sorbs water, thus reducing phase separation. Grundite is an illite clay which has a high capacity for cesium. It was removed from the market during the early part of this work, and other cesium sorbents had to be substituted. The sugar (delta gluconolactone or CFR-1) is a retarder used to prevent the grout from setting or stiffening too rapidly. A simulated waste solution (Table 2) was used to prepare the grouts used in these leach studies. The composition is based on chemical analyses of actual waste solutions in ORNL storage tank W7. Where more concentrated waste solutions were used, they were simply prepared with 2 or 4 times the concentrations of the constituents in W-7. The simulated waste contained no radioactive material other than the tracer used to follow the isotope of interest during a leach test. The equivalent of about 0.01 Ci/gal of either ^{85}Sr or ^{137}Cs was added to the

Table 1. Composition of Dry Mix Used in Cementitious Grout Preparations

Constituent	Recipe[a] (parts by wt)	Composition[b] (wt %)
Cement[c]	2.5	38.5
Fly ash[d]	2.5	38.5
Attapulgite-150[e]	1.0	15.4
Grundite[f]	0.5	7.7

[a]CFR-1 or delta gluconolactone, a chemical that retards the setting of cement, is added to this formulation to the extent of 0.003 part by weight.

[b]CFR-1, added as a chemical retarder to setting, amounts to about 0.05 wt %.

[c]Portland Cement Type I (see refs. 9-12 and similar works on cement and concrete products for a description of chemical and physical properties).

[d]Fly ash (a pozzuolanic material) obtained from the coal-fired Kingston Steam Plant, Kingston, Tenn.

[e]Attapulgite-150 is the trade name of a clay product from the polygorskite group of clay minerals (with the general formula $5MgO \cdot 8SiO_2 \cdot 9H_2O$).

[f]Grundite is the trade name of a clay product from the illite group of clay minerals [with the general formula $(OH)_4K_x(Al_4 \cdot Fe_4 \cdot Mg_4 \cdot Mg_6)(Si_{8-x} \cdot Al_x)O_{20}$] from Grundy County, Ill.

Table 2. Composition and Properties of the Simulated Waste Solution Used in Cement Grout Preparations

	Concentration (g-mole/liter W-7[a])
Constituent	
Na^+	1.78
NH_4^+	0.003
Al^{3+}	0.0074
NO_3^-	0.835
OH^-	0.18
Cl^-	0.093
CO_3^{2-}	0.255
SO_4^{2-}	0.094
Property	
pH	11.52
Density, g/ml	1.085

[a]Each liter of solution was prepared with 68.85 g of $NaNO_3$, 27.0 g of Na_2CO_3, 13.35 g of Na_2SO_4, 7.2 g of NaOH, 5.44 g of NaCl, 2.78 g of $Al(NO_3)_3 \cdot 9H_2O$, and 0.24 g of NH_4NO_3.

simulated waste solutions immediately before preparation of a grout. In some of the parameter studies, up to 0.5 mg of nonradioactive strontium or cesium per cm^3 of grout was also added. Prior to the addition of the tracer solution, a sufficient quantity of tributylphosphate (TBP) was added to the waste to give a final concentration of 400 ppm. The TBP, in conjunction with the CFR-1, results in a relatively free release of air from the grout during stirring and thus prevents foaming.

The simulated waste containing appropriate amounts of TBP and CFR-1 was placed in a Waring blender. After addition of the desired tracer (with or without nonradioactive strontium or cesium), the blender was turned on for about 5 sec at 1000 to 2000 rpm. Samples of the resulting solution were then taken and were used as the feed in all subsequent activity determinations. Next, the blended dry mix was added to the waste over a period of 15 sec while stirring at 5000 rpm; then the resulting slurry was stirred for an additional 15 sec at the same speed. All of the leach specimens in these studies were prepared at a dry mix/waste solution ratio of 6 lb/gal.

2.2 Leach Test Method

The initial leach tests[1] were made using the procedure proposed by the IAEA.[8] To obtain faster results, most of the tests reported here used specimens with smaller volumes and higher surface-to-volume ratios. In addition, the entire surface area was exposed to a larger volume of leachant than used in the IAEA procedure. The specimens were made by casting grout in plastic molds or plastic test tubes. The completed specimens were 1.6 cm in diameter and either 2 or 2.5 cm long. These were "wet" cured by holding them in a closed bottle (slightly larger than the specimens) submerged in water for the desired length of time. The "dry" cured specimens were allowed to stand in a loosely closed plastic bag in a hood for the desired length of time.

After curing, each test specimen was placed in a holder of stainless steel wire mesh and immediately immersed in either 150 or 200 ml of leachant in a 250-ml stainless steel beaker. The beaker was enclosed in a plastic jar to minimize evaporation (Fig. 1). After the desired leach period, the leachate was removed, analyzed, and replaced with fresh leachant.

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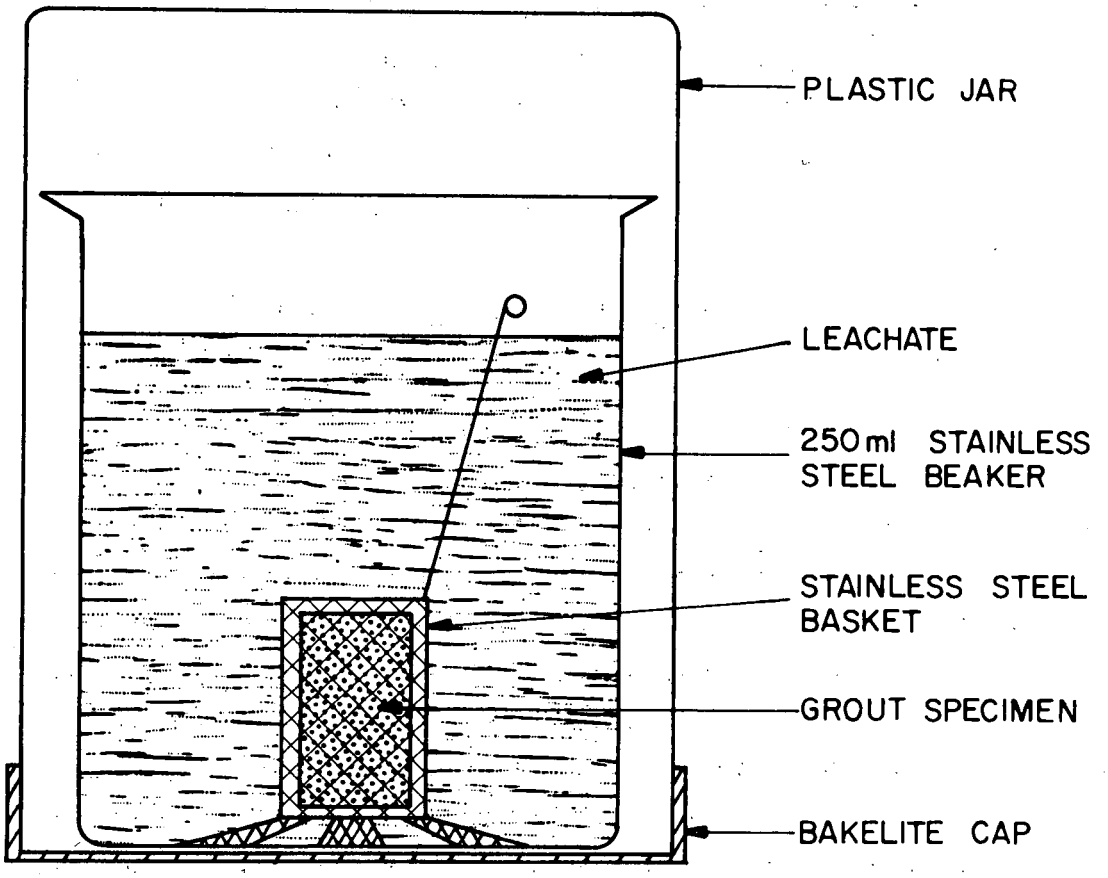

Fig. 1. Schematic of Modified IAEA Leach Test Setup.

The sixty-two leach tests, which were carried out at room temperature, are briefly described in Table 3.

2.3 Analytical Methods

Samples of all feed and leachate solutions containing ^{85}Sr or ^{137}Cs were analyzed with a Nuclear Chicago Automatic Gamma Well System, model 8725. The samples were counted by utilizing the narrow differential mode in which the response from a small section of the isotope's characteristic energy spectrum is measured. The section is determined by the base setting of the instrument. Each time analyses were made, the base setting was adjusted for the maximum output obtained when counting an appropriate dilution of one of the feed solutions used in the grout preparations. Each leachate sample and its corresponding feed sample were then counted at this base setting and the fraction of the element in question that was removed from the grout by the leachate calculated from these data.

3. RESULTS AND DISCUSSION OF IAEA LEACH TESTS

Three cesium leach tests which used the IAEA test method were continued to determine the effect of long-term leaching with tap water. The complete data are located in Tables A-1 and A-2 in the Appendix. The results in these tables and those which follow (obtained using the ORNL test method and discussed in Sect. 4) are presented as incremental fraction leached (a_n/A_o) during each leachant renewal period (t_n) and as cumulative fraction leached ($\Sigma\ a_n/A_o$) vs cumulative leaching time ($\Sigma\ t_n$). The results are presented in this and the next section as plots of the product of the cumulative fraction leached and the volume-to-surface ratio [($\Sigma\ a_n/A_o$) (V/S)] vs cumulative leaching time, where V is the volume of the specimen in cm^3 and S is the surface area exposed to leachate in cm^2. The ordinate of each plot is converted to fraction leached by multiplying by the exposed surface/volume ratio listed in the corresponding data tables in the Appendix.

3.1 Effect of Long-Term Curing

Of the IAEA leach tests that were continued, one used a specimen (M74-12) that was allowed to cure in high humidity for 52 weeks prior to leaching. The leachate was changed daily (except weekends) for 1 year

Table 3. Description of Cementitious Grout Specimens Prepared for Leaching Studies

Grout No.	Type of Simulated Waste	Radioactivity in Specimen: Isotope	Radioactivity in Specimen: Init. Conc. ($\sim\mu Ci/cm^3$)	Nonradioactive Carrier Added to Grout (mg/cm^3)	Curing Time Before Leaching[a] (days)	Nominal Frequency of Leachate Removal per Day	Type of Water Leachate	Length of Run (days)	Remarks
M73-93C	W-7	^{137}Cs	3	0	28	1	tap	550	
M74-12	W-7	^{137}Cs	1.4	0	365	1	tap	364	
M74-22A	W-7	^{137}Cs	6	0	10	2[b]	tap	18	No Grundite present.
M74-22B	W-7	^{137}Cs	6	0	10	2[b]	tap	18	Grundite present.
M74-22C	W-7	^{137}Cs	6	0	10	2[b]	tap	18	Conasauga I shale.[c]
M74-22E	W-7	^{137}Cs	6	0	10	2[b]	tap	18	Conasauga II shale, coarse.[d]
M74-22F	W-7	^{137}Cs	6	0	10	2[b]	tap	18	Richards Brick Co. - Shale dust.
M74-22G	W-7	^{137}Cs	6	0	10	2[b]	tap	18	Amaco pottery clay.
M74-27A1	W-7	^{137}Cs	6	0	60	1	tap	10	Longer cured specimen 22A.
M74-27A2	W-7	^{137}Cs	6	0	60	2	tap	10	Longer cured specimen 22A.
M74-27A4	W-7	^{137}Cs	6	0	60	4	tap	10	Longer cured specimen 22A.
M74-27B-1a	W-7	^{137}Cs	6	0	60	1	tap	10	Longer cured specimen 22B.
M74-27B-1b	W-7	^{137}Cs	6	0	60	1	tap	10	Longer cured specimen 22B.
M74-27B-1c	W-7	^{137}Cs	6	0	60	1	tap	10	Longer cured specimen 22B.
M74-27B-2	W-7	^{137}Cs	6	0	60	2	tap	10	Longer cured specimen 22B.

Table 3. (Continued)

Grout No.	Type of Simulated Waste	Radioactivity in Specimen		Nonradioactive Carrier Added to Grout (mg/cm^3)	Curing Time Before Leaching[a] (days)	Nominal Frequency of Leachate Removal per Day	Type of Water Leachate	Length of Run (days)	Remarks
		Isotope	Init. Conc. ($\sim\mu Ci/cm^3$)						
M74-27B-4	W-7	^{137}Cs	6	0	60	4	tap	10	Longer cured specimen 22B.
M74-27C-1	W-7	^{137}Cs	6	0	60	1	tap	10	Longer cured specimen 22C.
M74-27C-2a	W-7	^{137}Cs	6	0	60	2	tap	10	Longer cured specimen 22C.
M74-27C-2b	W-7	^{137}Cs	6	0	60	2	tap	10	Longer cured specimen 22C.
M74-27C-2c	W-7	^{137}Cs	6	0	60	2	tap	10	Longer cured specimen 22C.
M74-27C-4	W-7	^{137}Cs	6	0	60	4	tap	10	Longer cured specimen 22C.
M74-27D-1	W-7	^{137}Cs	6	0	60	1	tap	10	Longer cured specimen 22G.
M74-27D-2	W-7	^{137}Cs	6	0	60	2	tap	10	Longer cured specimen 22G.
M74-27D-4a	W-7	^{137}Cs	6	0	60	4	tap	10	Longer cured specimen 22G.
M74-27D-4b	W-7	^{137}Cs	6	0	60	4	tap	10	Longer cured specimen 22G.
M74-27D-4c	W-7	^{137}Cs	6	0	60	4	tap	10	Longer cured specimen 22G.
M74-29-1XA	W-7	^{137}Cs	5	0	28	1	tap	10	Amaco pottery clay.
M74-29-1XB	W-7	^{137}Cs	5	0	28	1	tap	10	Amaco pottery clay.
M74-29-2XA	2XW-7	^{137}Cs	5	0	28	1	tap	10	Amaco pottery clay.
M74-29-2XB	2XW-7	^{137}Cs	5	0	28	1	tap	10	Amaco pottery clay.
M74-29-4XA	4XW-7	^{137}Cs	5	0	28	1	tap	10	Amaco pottery clay.

Table 3. (Continued)

Grout No.	Type of Simulated Waste	Radioactivity in Specimen: Isotope	Radioactivity in Specimen: Init. Conc. ($\sim\mu Ci/cm^3$)	Nonradioactive Carrier Added to Grout (mg/cm^3)	Curing Time Before Leaching[a] (days)	Nominal Frequency of Leachate Removal per Day	Type of Water Leachate	Length of Run (days)	Remarks
M74-29-4XB	4XW-7	^{137}Cs	5	0	28	1	tap	10	Amaco pottery clay.
M75-3A	W-7	^{85}Sr	3	0.5	28	1	tap	46	Conasauga shale (0.5 part).[d]
M75-3B	W-7	^{85}Sr	3	0.5	28	1	tap	25	Same as 3A but poor sample.
M75-4B	W-7	^{85}Sr	3	0.5	28	1	tap	60	Conasauga shale (1 part).[d]
M75-4C	W-7	^{85}Sr	3	0.5	28	1	grout	53	Same grout as 4B.
M75-5	2XW-7	^{85}Sr	3	0.5	28	1	tap	60	Conasauga shale (1 part).[d]
M75-6	W-7	^{137}Cs	2	0.5	28	1	tap	144	Grundite (0.5 part).
M75-7A	W-7	^{137}Cs	2	0.5	28	1	tap	25	Conasauga shale (0.5 part).[d]
M75-7B	W-7	^{137}Cs	2	0.5	28	1	tap	95	Duplicate of 7A.
M75-7C	W-7	^{137}Cs	2	0.5	28	1	tap	25	Duplicate of 7A.
M75-7D	W-7	^{137}Cs	2	0.5	28	1	grout	53	Same grout as 7A.
M75-8A	W-7	^{137}Cs	2	0.5	28	1	tap	95	Conasauga shale (1 part).[d]
M75-9A	W-7	^{85}Sr	2	0.35	28	1	tap	25	Conasauga shale (0.5 part).[d]
M75-9B	W-7	^{85}Sr	2	0.35	28	1	stored tap	123	Same grout as 9A.
M75-9C	W-7	^{85}Sr	2	0.35	28	1	stored distilled	123	Same grout as 9A.
M75-10	W-7	^{85}Sr	2	0	28	1	tap	67	Conasauga shale (0.5 part).[d]

Table 3. (Continued)

Grout No.	Type of Simulated Waste	Radioactivity in Specimen Isotope	Radioactivity in Specimen Init. Conc. ($\sim\mu Ci/cm^3$)	Nonradioactive Carrier Added to Grout (mg/cm^3)	Curing Time Before Leaching[a] (days)	Nominal Frequency of Leachate Removal per Day	Type of Water Leachage	Length of Run (days)	Remarks
M75-12A	W-7	^{137}Cs	3	0.5	28	1	tap	88	Conasauga shale (0.5 part).[d]
M75-12B	W-7	^{137}Cs	3	0.5	28	1	distilled	60	Same grout as 12A.
M75-12C	W-7	^{137}Cs	3	0.5	28*	1	tap	88	Same grout as 12A.
M75-13	W-7	^{137}Cs	2	0	28	1	tap	60	Conasauga shale (0.5 part).[d]
M75-15	W-7	^{137}Cs	2	0.5	56	1	tap	88	Longer cured specimen 6.
M75-16A	W-7	^{85}Sr	2	0.35	56	1	tap	95	Longer cured specimen 9A.
M75-16B	W-7	^{85}Sr	2	0.35	56	1	distilled	95	Longer cured specimen 9A.
M75-17A	W-7	^{137}Cs	3	0.5	56	1	tap	60	Longer cured specimen 12A.
M75-17B	W-7	^{137}Cs	3	0.5	56*	1	tap	60	Longer cured specimen 12A.
M75-20A	W-7	^{85}Sr	1	0.35	112	1	tap	60	Longer cured specimen 9A.
M75-20B	W-7	^{85}Sr	1	0.35	112	1	distilled	60	Longer cured specimen 9A.
M75-21A	W-7	^{85}Sr	1	0	112	1	tap	60	Longer cured specimen 10.
M75-21B	W-7	^{85}Sr	1	0	112	1	tap	60	Duplicate of 21A.
M75-23A	W-7	^{137}Cs	3	0.5	112	1	tap	60	Longer cured specimen 12A.
M75-23B	W-7	^{137}Cs	3	0.5	112	1	tap	60	Duplicate of 23A.

[a]All specimens were cured "wet" except those marked * which were cured "dry."

[b]Twice daily for ten days, then daily for the time remaining.

[c]Local Pumpkin Valley Conasauga Shale.

[d]Local Rutledge Conasauga Shale.

during the leaching process. A comparison of these data with data obtained from a specimen cured 4 weeks (M73-93C) shows that after 1 year, the cumulative fraction of cesium leached is less for the long cured specimen, but after about 100 days the leach rates for the two specimens are approximately the same as indicated by the fact that the two sets of data are parallel after the first 100 days (Fig. 2). The decrease in leachability during the early part of the leach test may be due to some surface change that is not as yet understood or the continued curing that occurred during leaching. It will be shown later in Sect. 4.7 that curing plays a complicated role in the leachability of hydrofracture grout. The curing conditions as well as the curing time affect the amount of material leached from a specimen.

3.2 Comparison of Long-Term IAEA Tests with Theoretical Expressions

Previous results showed that data for the leaching of cesium from 28-day-cured IAEA specimens could be fitted to the following equation:

$$\left(\frac{\Sigma\, a_n}{A_o}\right)\left(\frac{V}{S}\right) = 2\left(\frac{D_e}{\pi}\right)^{1/2} t^{1/2}\,, \qquad (1)$$

where $\Sigma\, a_n/A_o$ is the cumulative fraction of the species that has left the medium in time t (sec), D_e is a modified effective diffusivity (cm^2/sec), V is the volume of the specimen (cm^3), and S is the surface area exposed to the leachate (cm^2). After 144 days of leaching, the fit was excellent for M73-93C.[1] Longer-term leach data show that this equation continues to provide a reasonably good explanation of the leach behavior of these specimens. In this test, the leachate was replaced twice daily during the first two months and after that daily except during weekends. The M73-93C specimen has completed 550 days. The previously reported D_e's after 144 days of leaching was 1.2×10^{-9} cm^2/sec. Fig. 3 shows the data points for 550 days of leaching compared with the predicted curve using the D_e value obtained from the first 144 days of data. The predicted amount leached after 550 days is about 5% higher than the actual value obtained. The calculated D_e using all the data is 1.09×10^{-9} cm^2/sec and yields predicted values within 0.5% of the actual value at 550 days (Fig. 4). The shift to the right at around 360 days was due to the leachate being left in contact

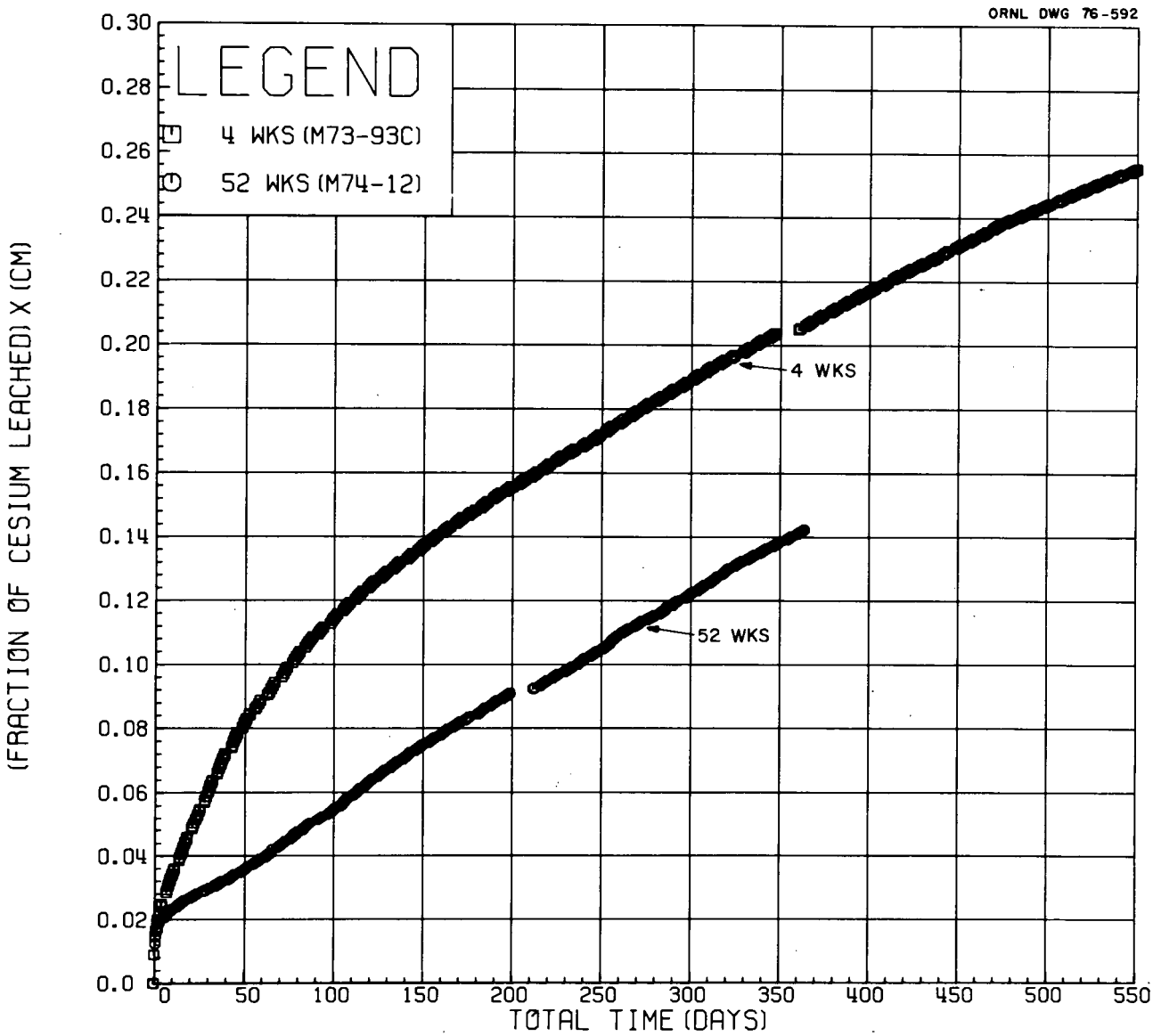

Fig. 2. Effect of Long-Term "Wet" Curing on the Leachability of Cesium from Grundite Containing Grouts with Tap Water. (M73-93C was cured 4 weeks and M74-12 was cured 52 weeks prior to leaching. The data points are given in A-1 and A-2 of Appendix A.)

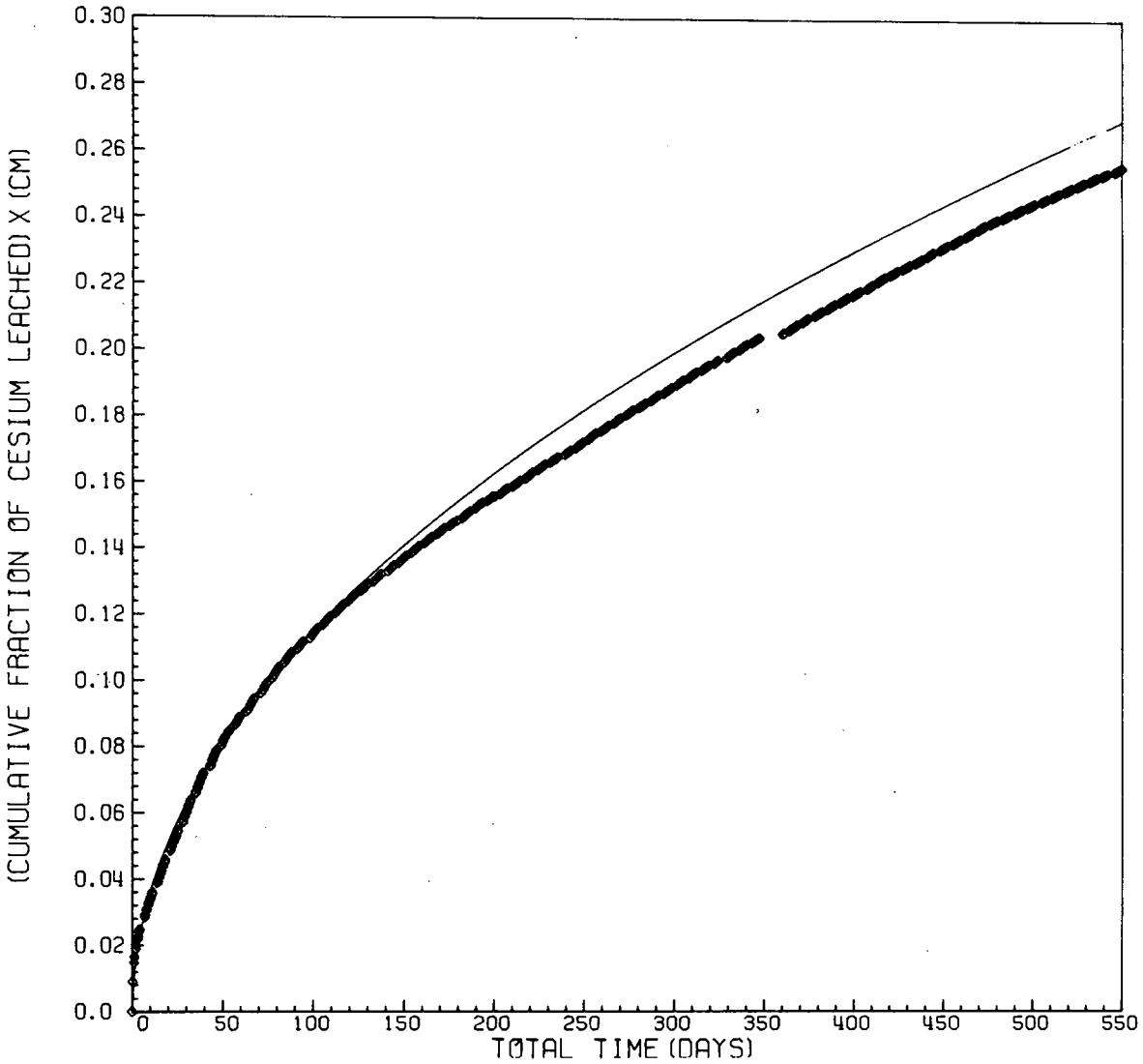

Fig. 3. Comparison of the Cumulative Fraction of Cesium Leached from Cementitious Grout M73-93C to That Predicted by an Equation Based on Transport Phenomena. [Theoretical curve calculated using Eq. (1) with D_e = 1.2×10^{-9} cm^2/sec.]

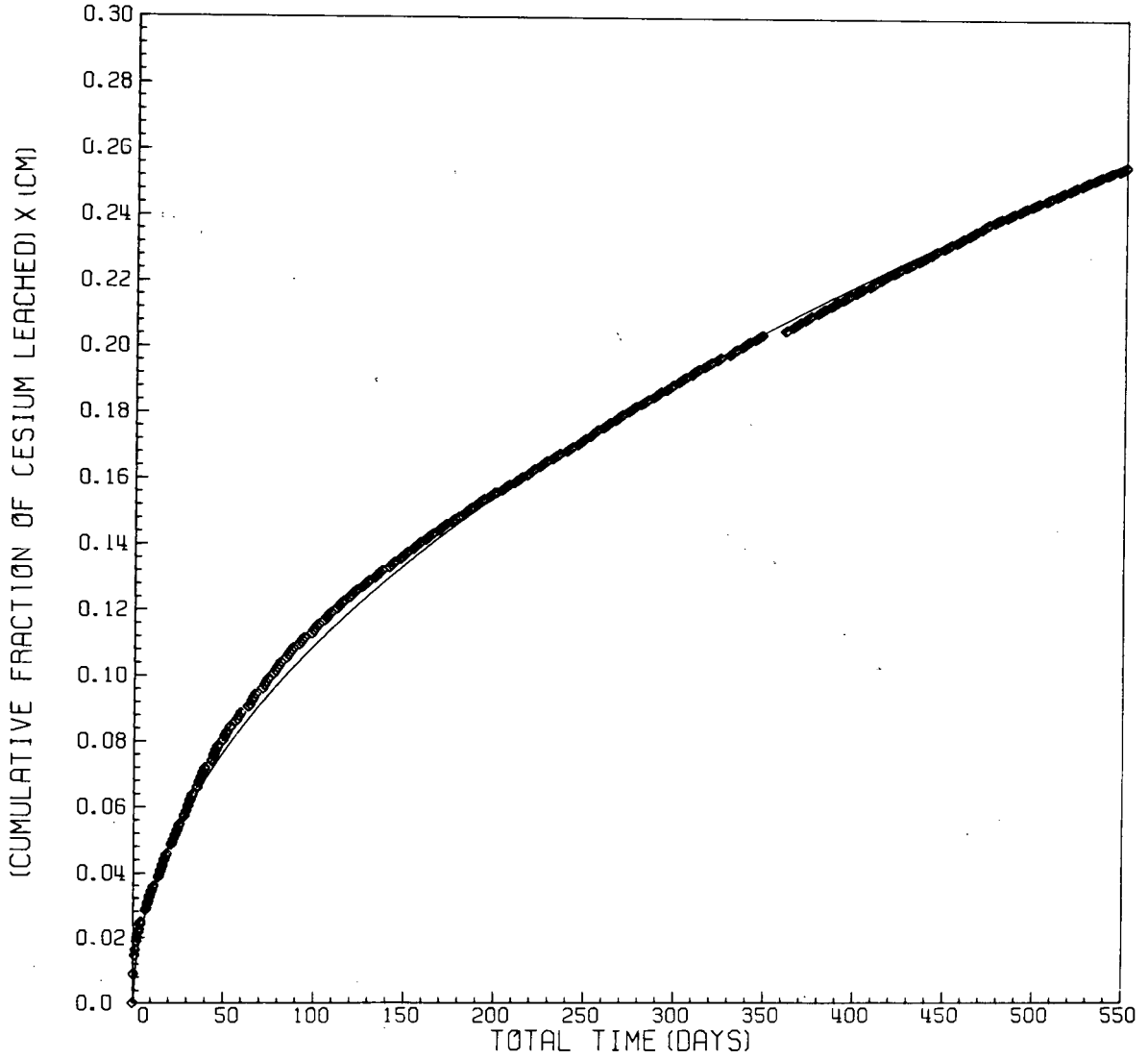

Fig. 4. Comparison of the Cumulative Fraction of Cesium Leached from Cementitious Grout M73-93C to That Predicted by an Equation Based on Transport Phenomena. [Theoretical curve calculated using Eq. (1) with D_e = 1.09×10^{-9} $cm^2/sec.$]

with the specimen 10 days prior to being changed. It was pointed out in the previous report that longer leaching periods cause the leach curve to shift to the right.[1]

4. RESULTS AND DISCUSSION OF STUDIES USING THE ORNL LEACH TEST METHOD

4.1 Replication of Results

Replication of strontium and cesium leach results using the ORNL leach test method was excellent. The results shown in Fig. 5 represents strontium leach data from two different specimens made from the same grout. These results show the maximum difference observed between any of the strontium duplicate specimens studied. Only about 25% more strontium was leached from M75-3B in 25 days than from M75-3A. This may be due to the slightly higher surface area of 3B since a cursory visual examination prior to leaching showed that the surface of 3B was ragged and contained several holes 1 to 2 mm in diameter, whereas the surface of 3A was smooth and had few flaws. In most of the strontium cases studied, the surfaces of duplicate samples were good and their corresponding leach data essentially identical (Fig. 6).

The results from cesium duplicate samples were as good or better than those from the strontium tests. Fig. 7 shows the results from 4 specimens, 3 prepared from one batch of grout (M75-7A, M75-7B and M75-7C) and another duplicate specimen (M75-12A) made from a different batch of grout. There was only 6 to 8% difference observed in the total amount leached from each of the specimens. The data obtained from the strontium and cesium specimens show that, with careful preparation and curing, results from replicate tests using the ORNL test method should vary a maximum of only 10 to 25%.

4.2 Evaluation of Cesium Sorbents

Grundite, an illitic clay, was used in the past to retain cesium in the grouts utilized in the hydrofracture disposal procedure. Just prior to these studies, Grundite was removed from the market and it was necessary to find other materials that would retain cesium in the grouts. Two of the materials examined, pottery clay and Conasauga shale, were much better than Grundite in retaining cesium. Although the Conasauga shale had the

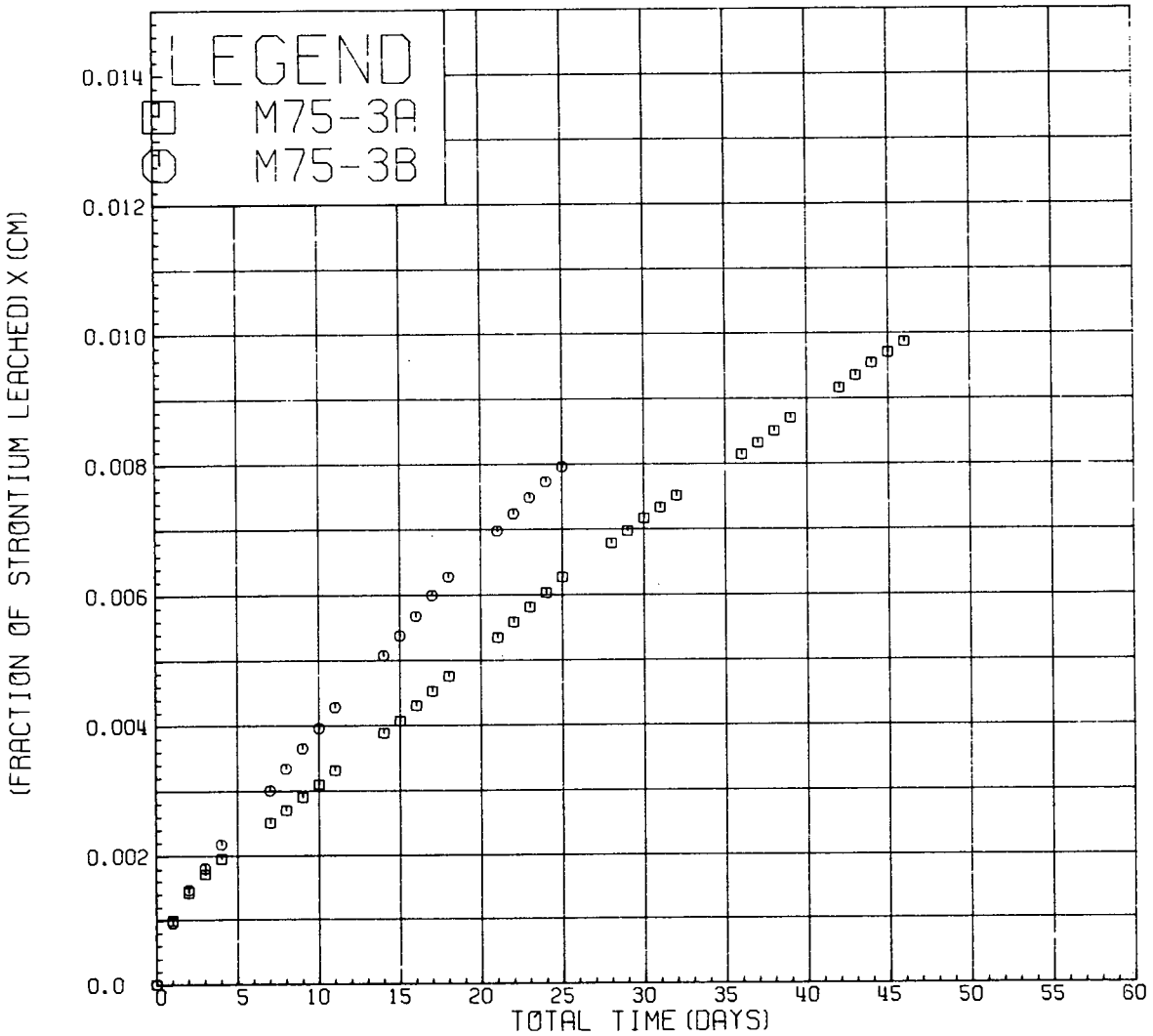

Fig. 5. Comparison of Strontium Leach Results from Specimens Made from the Same Grout. (The grout was made from a dry mix containing 7.7 wt % Conasauga shale and W-7 simulated waste solution. The specimens were cured 28 days prior to leaching with tap water. The data points are given in Tables A-39 and A-40 of Appendix A.)

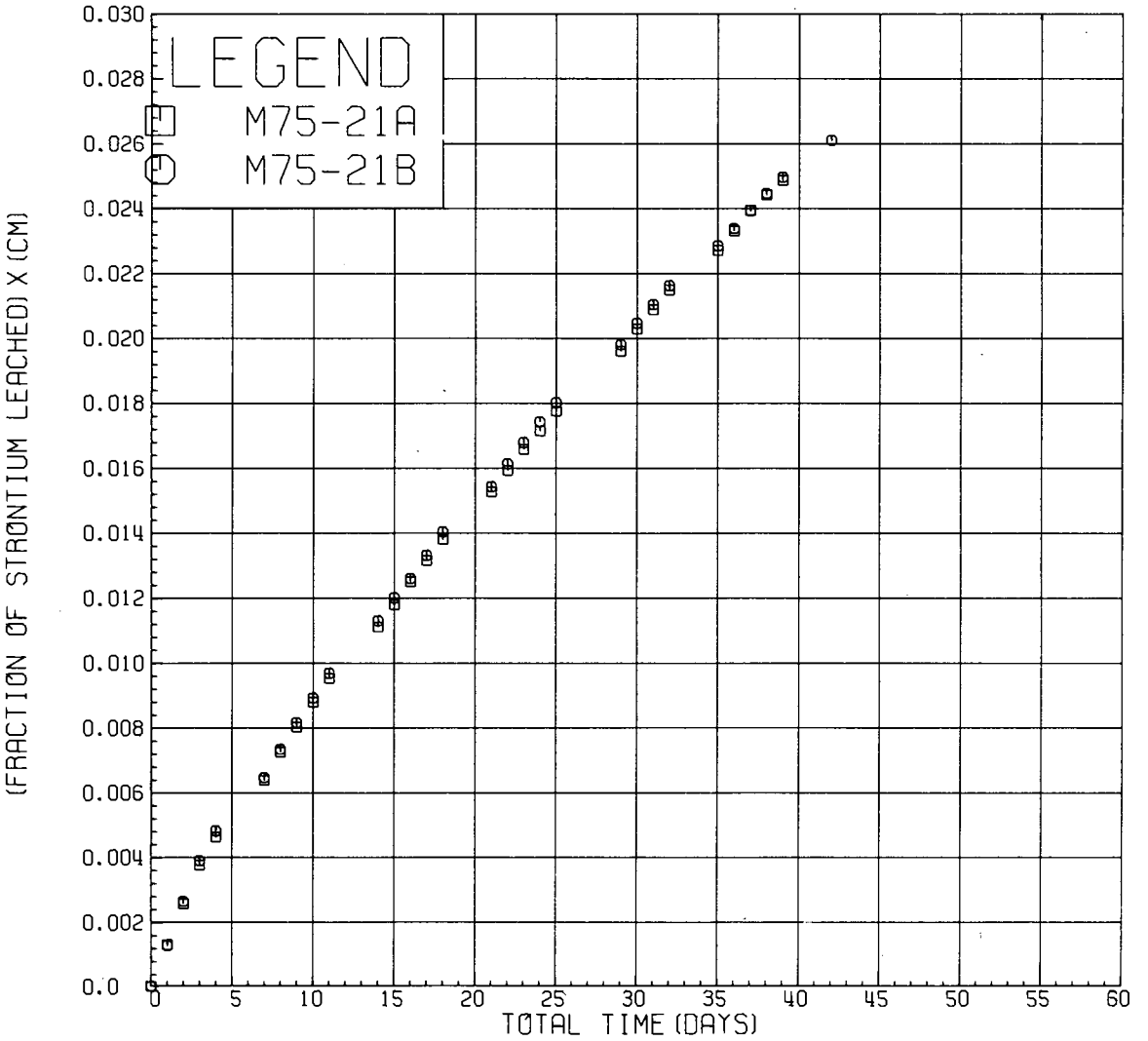

Fig. 6. Comparison of Strontium Leach Results from Specimens Made from the Same Grout. (The grout was made from a dry mix containing 7.7 wt % Conasauga shale and W-7 simulated waste solution. The specimens were cured 112 days prior to leaching with tap water. The data points are given in Tables A-65 and A-66 of Appendix A.)

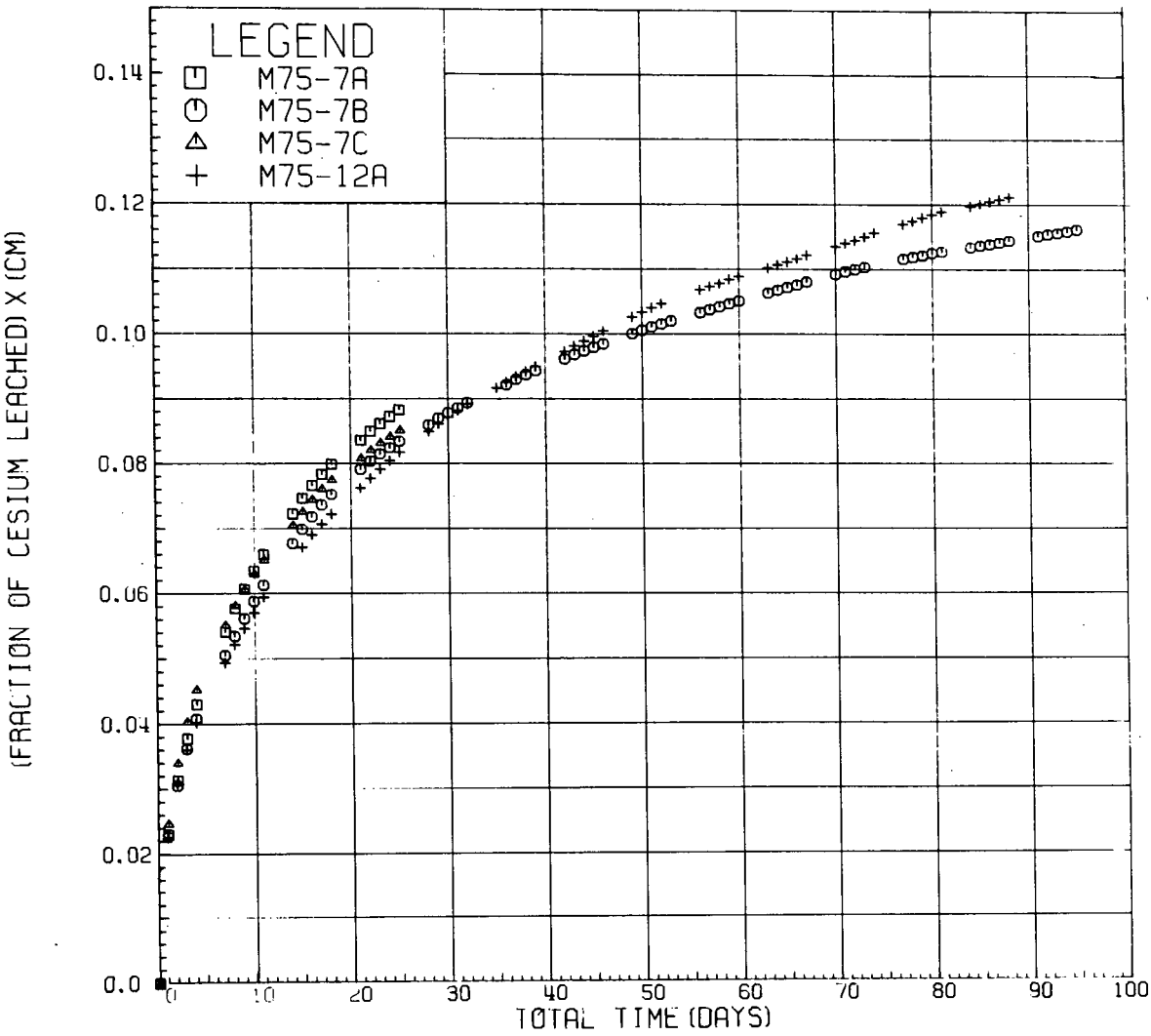

Fig. 7. Comparison of Cesium Leach Results from Specimens Made from the Same or Similar Grouts. (Both batches of grout (M75-7 and M75-12) were made from a dry mix containing 7.7 wt % Conasauga shale and W-7 simulated waste solution. The specimens were cured 28 days prior to leaching with tap water. The data points are given in Tables A-45, A-46, A-47, and A-54 of Appendix A.)

better retention properties, the pottery clay is commercially available and was used successfully in the last two injections at the Hydrofracture Facility.

To screen the new materials, grouts were prepared using the standard dry mix (Table 1) containing 7.7 wt % of the substitute material instead of Grundite. In addition, a control was made without Grundite or a substitute present. Two sets of grouts were made. The first had solids-to-liquid ratios of 5, 6 and 7 lb per gal of either water or W-7 simulated waste. They were mixed at 2000 rpm to simulate shear conditions in the tub at the injection site. The second set of grouts had a solids-to-liquid ratio of 6 lb per gal of W-7 simulated waste. These were mixed at 5000 rpm to simulate the shear conditions at the bottom of the injection well. The grouts in both sets which had about the same density, viscosity, and phase separation as grouts containing Grundite were then used in the following cesium retention screening studies. Grouts containing tracer concentrations of ^{137}Cs were mixed at 5000 rpm. Immediately after mixing, an aliquot of each grout was added to 10 volumes of tap water, agitated 1 hr, and the supernate analyzed for ^{137}Cs after settling 1 hr and 24 hr. There were essentially no differences in the results from the two settling times. Conasauga I shale and Amaco pottery clay retained the most cesium. The supernate over the Grundite contained more than 3 times as much cesium than the aqueous in the Conasauga I shale or Amaco pottery clay (Table 4). Two expanded vermiculites, Zonolite Expanded No. 3 and No. 4, had unsatisfactory physical properties and were not tested with cesium. Their densities were so low that it was nearly impossible to obtain a homogeneous dry mix.

Short-term leach tests were made with grout specimens incorporating the better sorbents. The specimens were cured under "wet" conditions for 10 days, then leached for 18 days with tap water. The cumulative fraction of cesium leached varied as follows: No grundite > Grundite > Richard's Brick Co. Shale Dust >>local Pumpkin Valley Conasauga Shale > Amaco Pottery Clay > local Rutledge Conasauga Shale.

Longer-term leach tests were made with specimens "wet" cured 28 days to compare Grundite with Rutledge Conasauga shale (Conshale). In tests using grouts containing 7.7 wt % of the sorbent in question, the fraction

Table 4. Loss of Cesium from Uncured Grouts Containing Various Cesium Sorbents into Tap Water

Sorbent	Cs in Supernate[a] (% of Total)
Control (No Sorbent)	16.6
Grundite	4.6[b]
Conasauga Shale I (<200 mesh sample of local Rutledge Shale)	1.5
Conasauga Shale II (<40>200 mesh sample of local Pumpkin Valley Shale)	5.6
Conasauga Shale II (<200 mesh sample of local Pumpkin Valley Shale	6.5
Shale Dust (-40 mesh from Richard's Brick Company)	6.4
Amaco Pottery Clay (Batch 1)	3.4
Amaco Pottery Clay (Batch 2)	1.2
Amaco Pottery Clay (Batch 2 with 2.4 wt % in dry mix rather than 7.7%)	4.0
Hydrite MP 1547 (kaolin from Georgia Kaolin Company)	11.0
Hydrite Flat 01555 (kaolin from Georgia Kaolin Company)	10.6

[a]Grout containing ^{137}Cs mixed for 1 hr with 10 volumes of tap water, allowed to settle, and supernate analyzed for ^{137}Cs.

[b]Average of two runs.

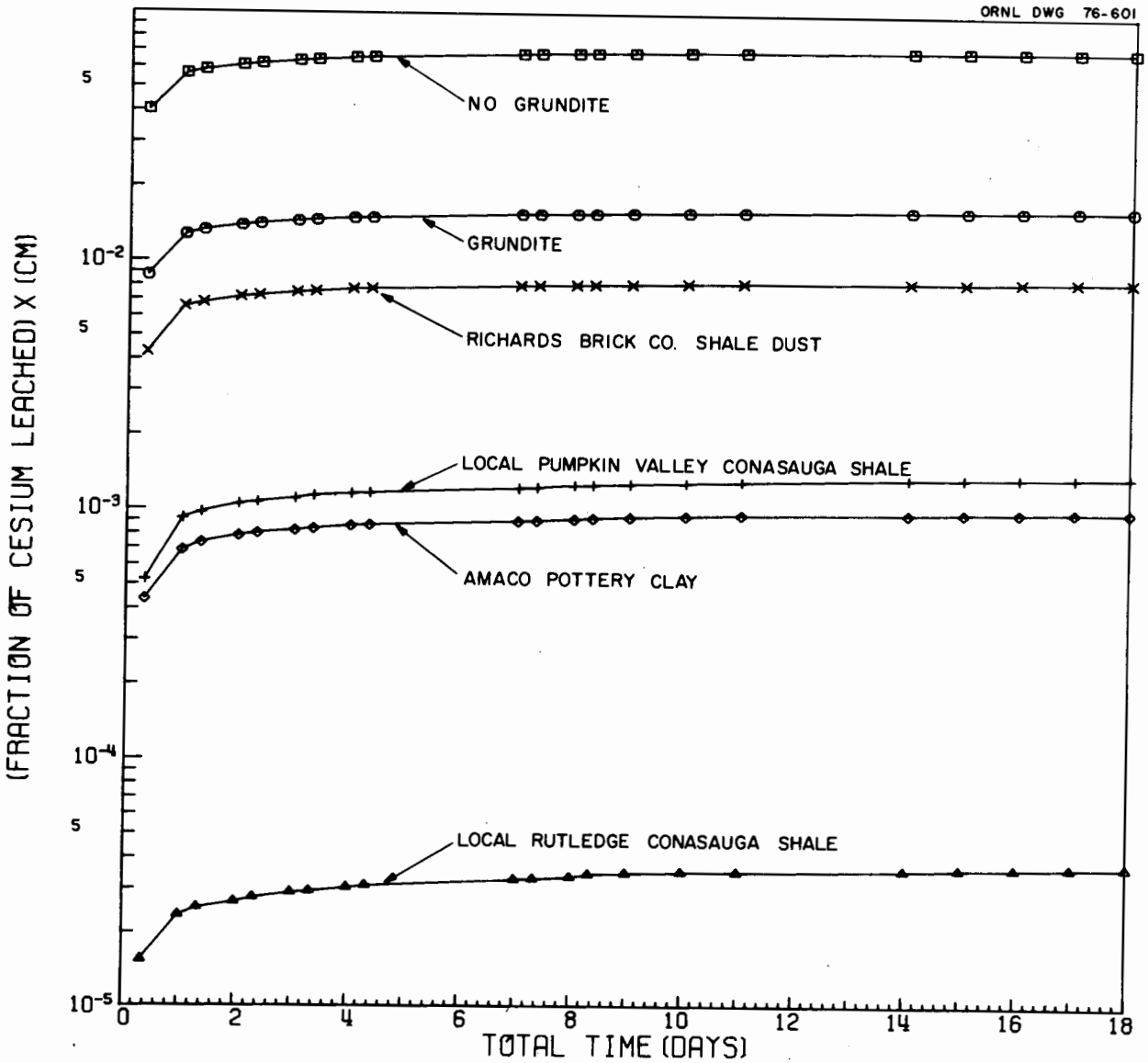

Fig. 8. Comparison of Cesium Leach Rates from Specimens Containing Different Cesium Sorbents. (The specimens were made from a dry mix containing 7.7 wt % sorbent as listed, and W-7 simulated waste solution. The specimens were cured 10 days prior to leaching with tap water. The data points are given in Table A-3 - A-8 of Appendix A.)

of cesium lost from Conshale specimen M75-7B after 70 days of leaching was about half that from the Grundite grout, M75-6 (Fig. 9). Doubling the amount of Conshale (M75-8A) decreased the cesium loss by about a factor of 2 after 95 days of leaching (Fig. 10). In Figs. 9 and 10 it should be noted that there is an increase in the leach rate of M75-7B at 105 days. This was caused by removing the specimen from the leachate, letting it air dry for 10 days, and then resuming leaching. The increased leach rate again confirms the effect of surface drying (see Sect. 4.8).

4.3 Effect of Leachate Renewal Frequency

Previous results indicated that, for a given leachate, the amount of a species removed from a specimen depends to some extent on the leachate replacement frequency.[1] To verify this effect, cesium specimens were leached by changing the tap water leachate either 1, 2, or 4 times a day. Although the evidence was slim (the differences noted are only slightly more than expected from experimental error), there was slightly more cesium leached from specimens when the leachate was changed more frequently than once a day. Studies were made with 60-day-"wet"-cured specimens made with three different cesium sorbents, Grundite, pottery clay, and Conasauga shale (Conshale). A control was run with a specimen containing no sorbent (no clay), and all specimens were leached for a total of 10 days. In the case of the control, the amount of cesium leached appeared to be independent of the leachate replacement. For the other three series there was slightly more leached in tests having more frequent leachate replacements than once a day (Figs. 11-14). Longer-term leach tests are needed to confirm the effect of leachate renewal frequency.

4.4 Effect of Curing Time

The cumulative fraction of cesium leached from simulated hydrofracture grout decreased with increased curing time. Specimens prepared from a dry mix containing 7.7 wt % Conasauga shale were "wet" cured 28, 56, and 112 days respectively. After 40 days of daily leachate changes, the amount of cesium lost to the leachate was 0.096, 0.072, and 0.058 fraction cm, respectively (Fig. 15). Similarly, specimens containing Grundite and "wet" cured either 28 or 56 days lost 0.184 and 0.128 fraction cm respectively (Fig. 16). Conasauga specimens that were "dry" cured showed comparatively little difference in the 28- and 56-day results, but at 112 days there was

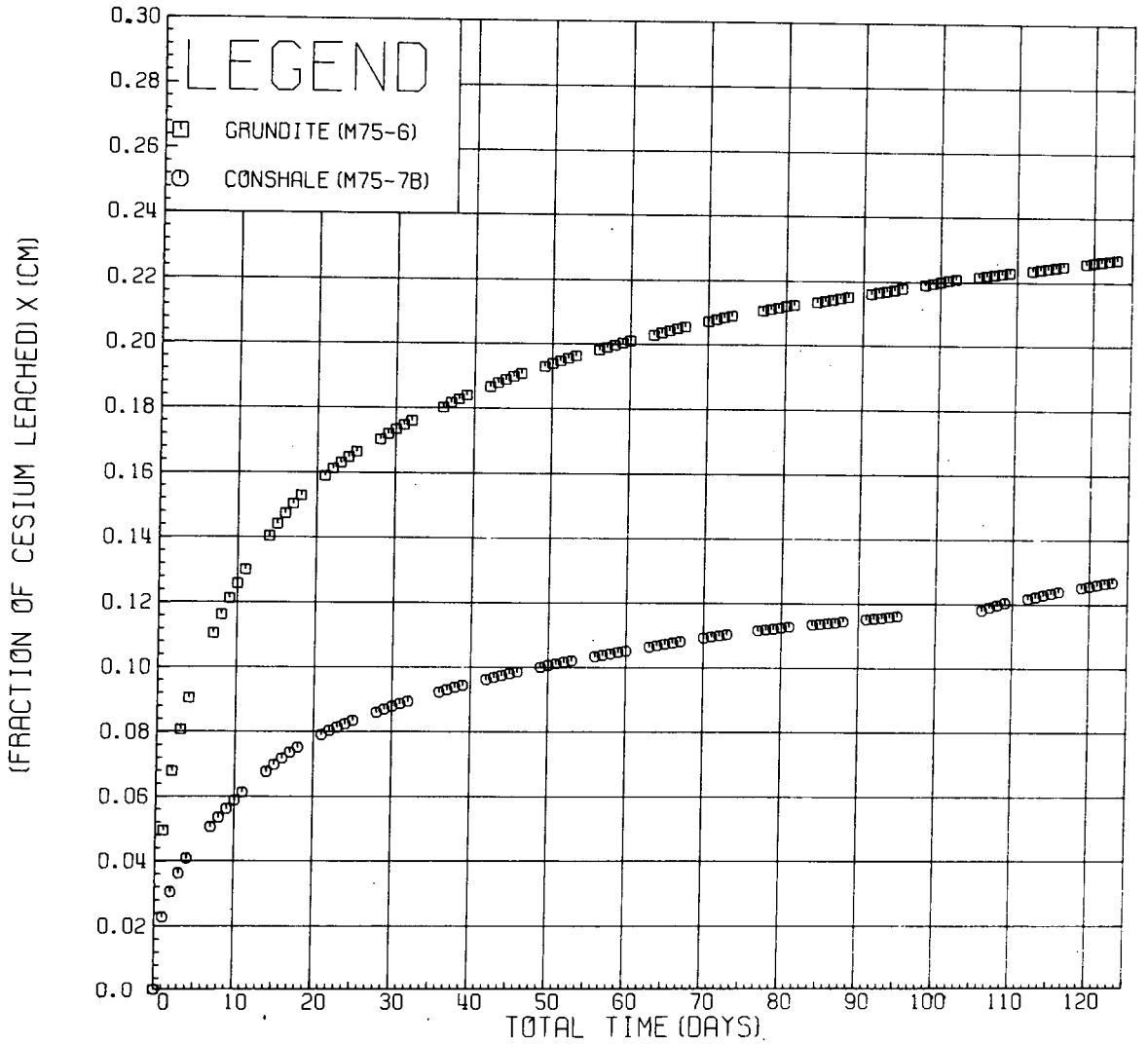

Fig. 9. Comparison of Cesium Leach Rates from a Specimen Containing Grundite with One Containing Rutledge Conasauga Shale. (The specimens were made with a dry mix containing 7.7 wt % of the clay in question and W-7 simulated waste and cured 28 days prior to leaching with tap water. The data points are given in Tables A-44 and A-46 of Appendix A.)

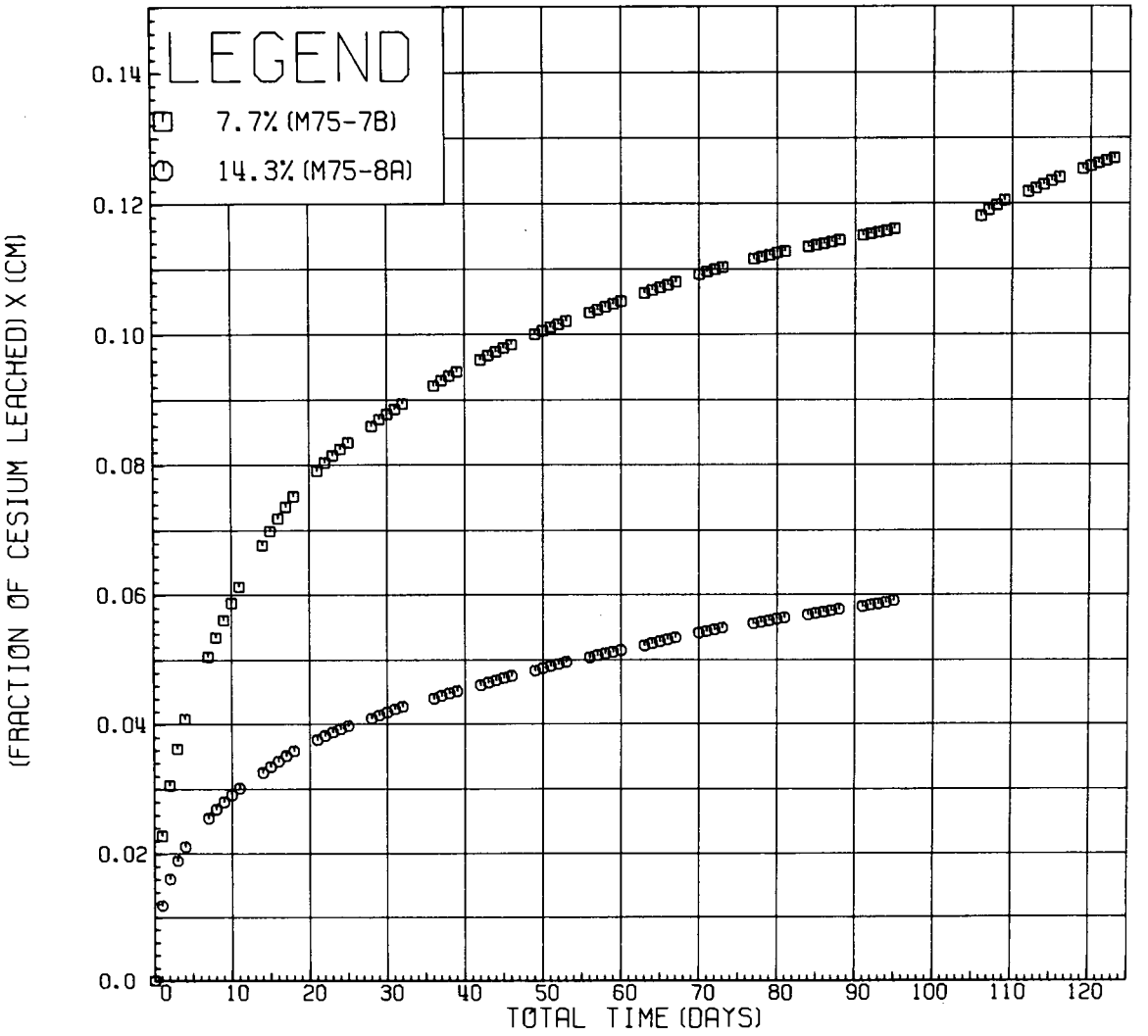

Fig. 10. Effect of Conasauga Shale Concentration on the Leachability of Cesium from Cementitious Grouts. (Specimens were prepared with W-7 simulated waste solution and cured 28 days prior to leaching with tap water. The data points are given in Tables A-46 and A-49 of Appendix A.)

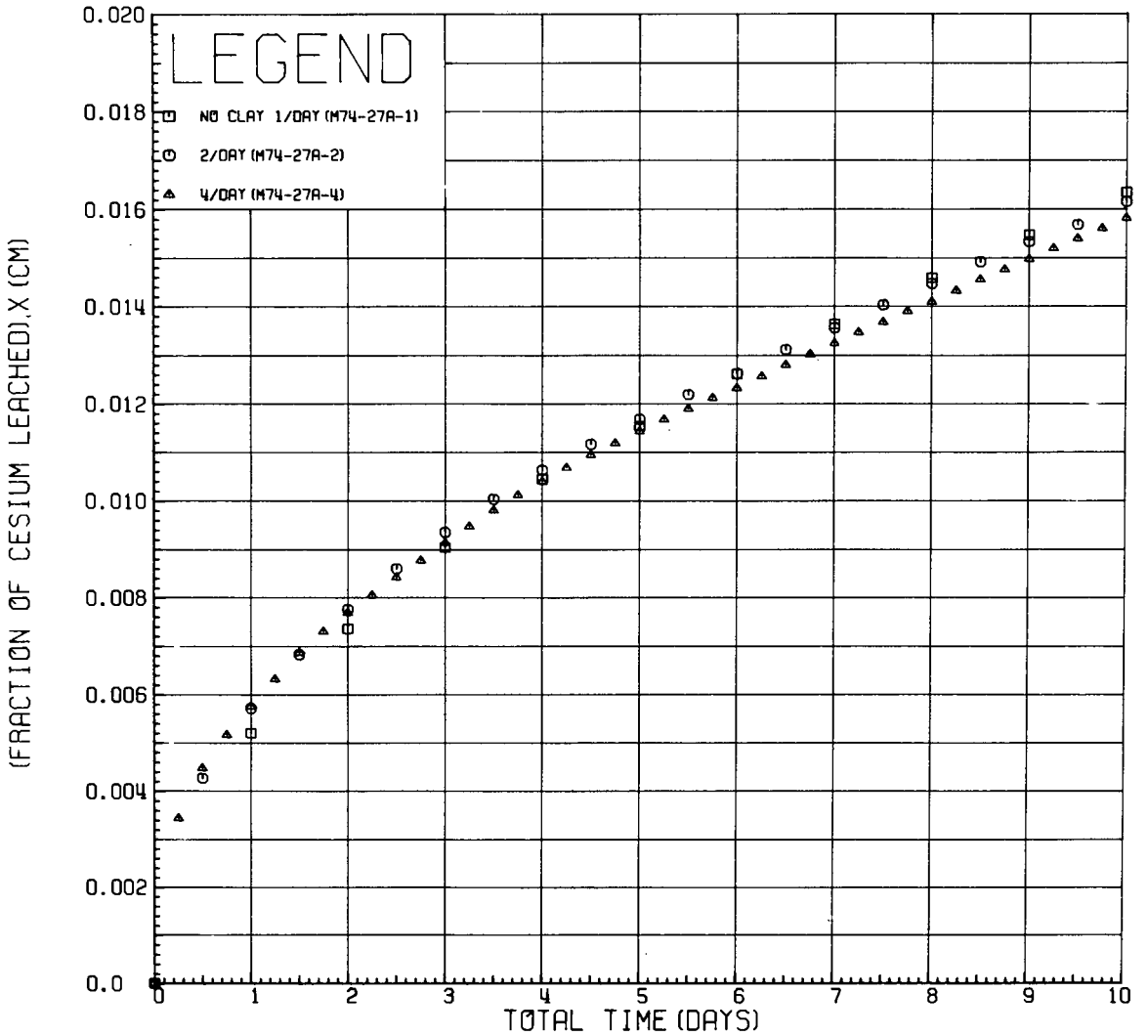

Fig. 11. Effect of Leachate Renewal Frequency on the Leachability of Cesium from Grouts Containing No Cesium Sorbent. (Specimens were made with W-7 simulated waste and cured 60 days prior to leaching with tap water. The data points are given in Tables A-9 - A-11 of Appendix A.)

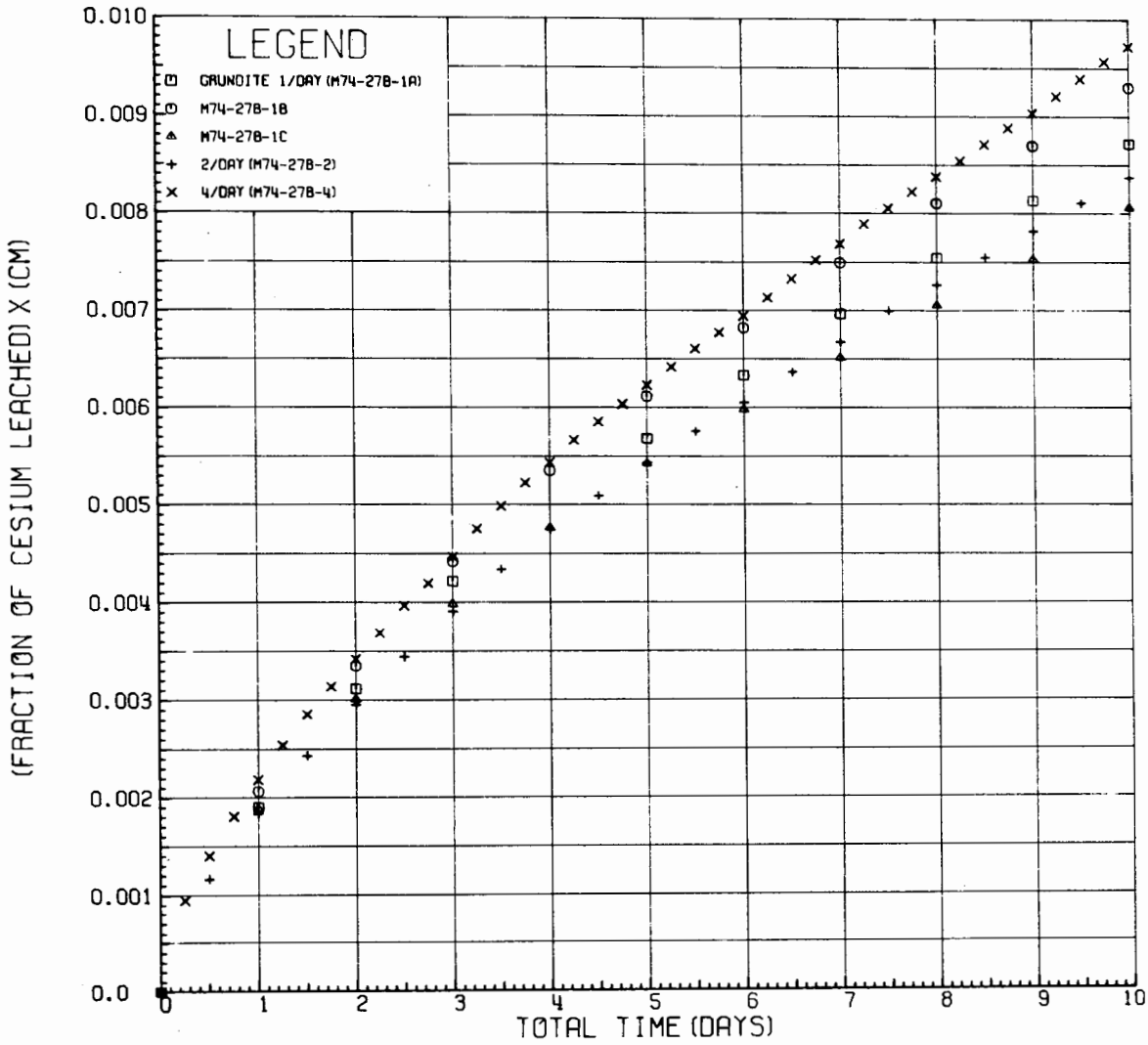

Fig. 12. Effect of Leachate Renewal Frequency on the Leachability of Cesium from Grouts Containing Grundite Clay. (Specimens were made with W-7 simulated waste and cured 60 days prior to leaching with tap water. The data points are given in Tables A-12 - A-16 of the Appendix.)

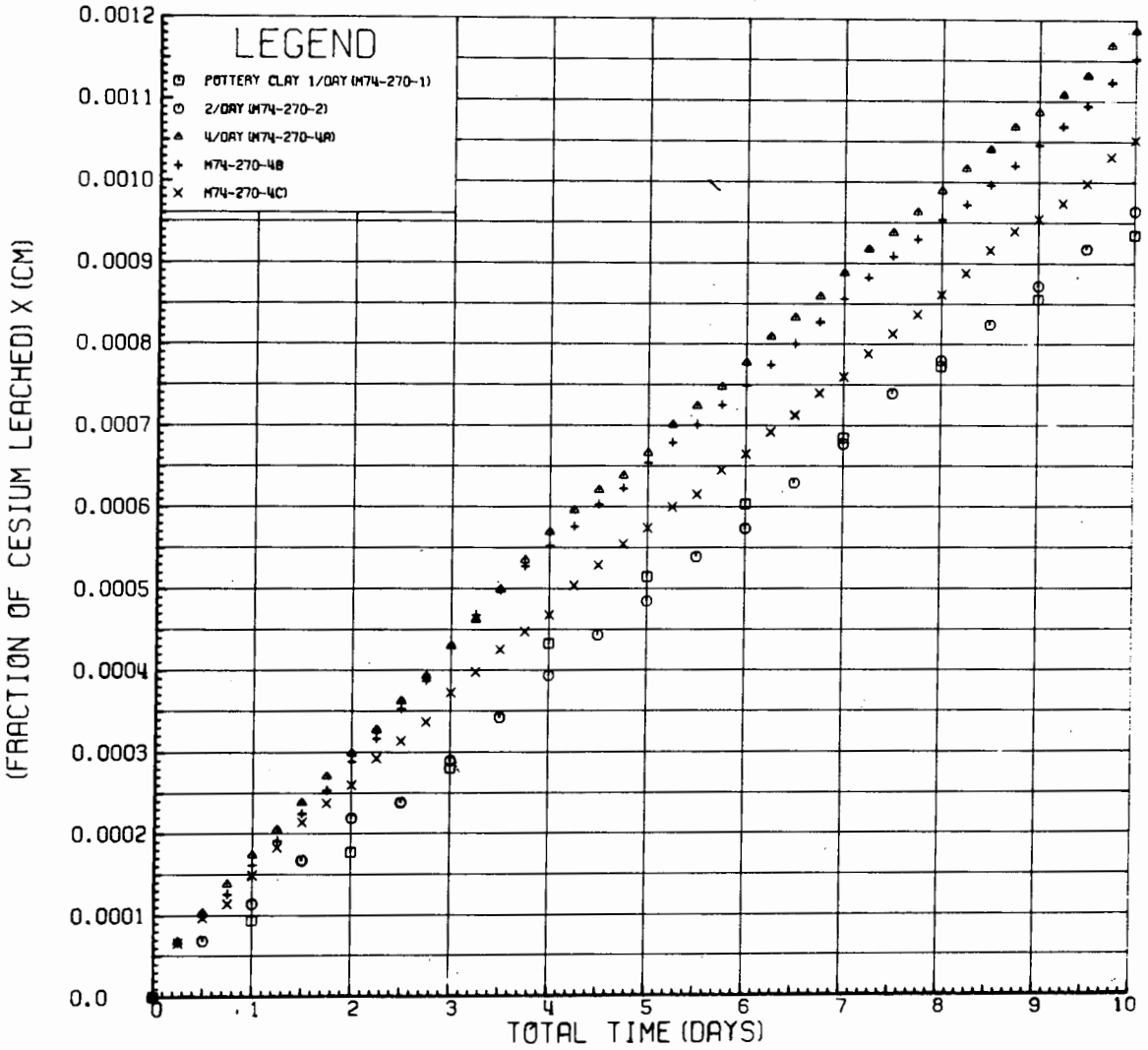

Fig. 13. Effect of Leachate Renewal Frequency on the Leachability of Cesium from Grouts Containing Amaco Pottery Clay. (Specimens were made with W-7 simulated waste and cured 60 days prior to leaching with tap water. The data points are given in Tables A-22 - A-26 of the Appendix.)

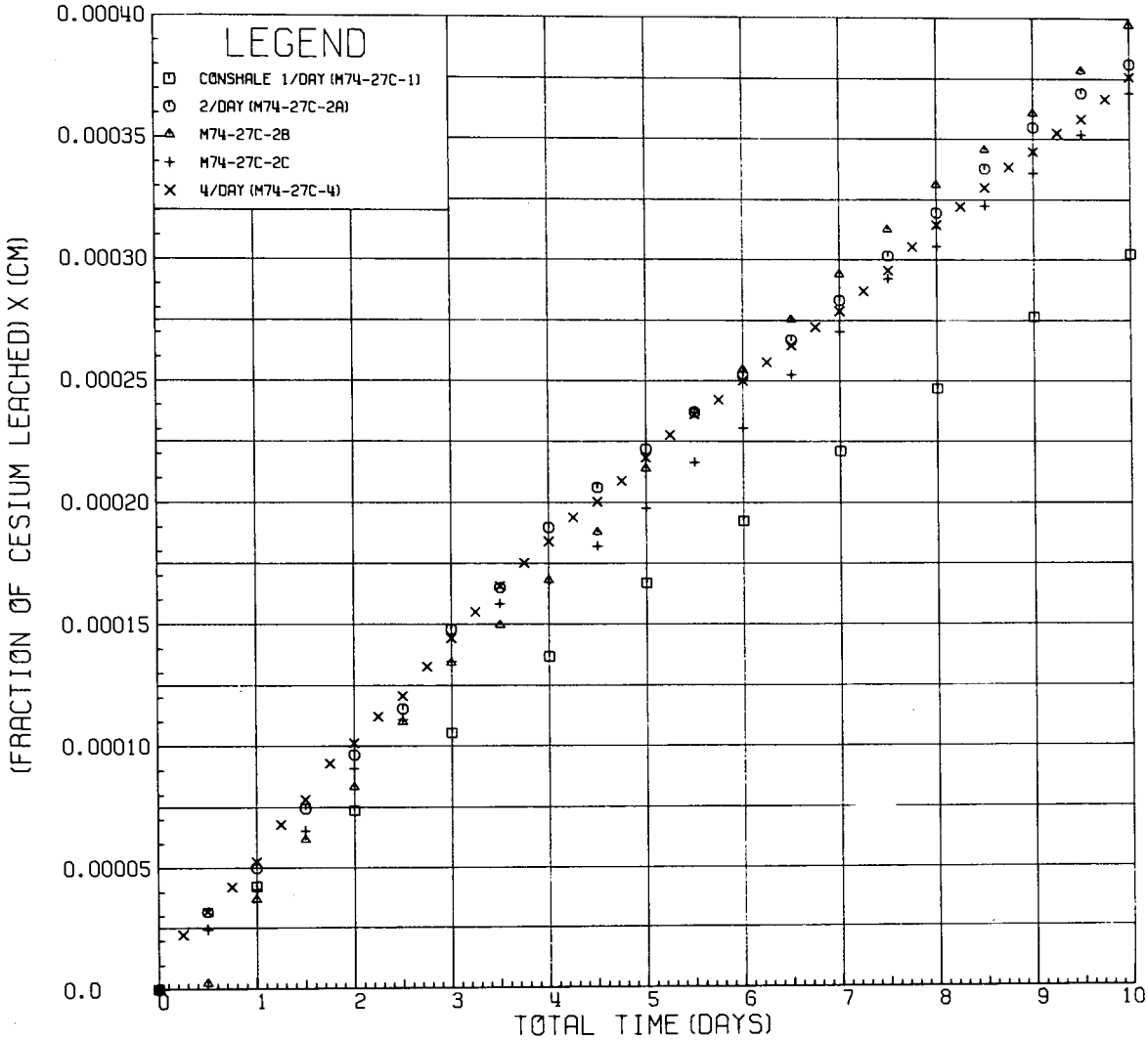

Fig. 14. Effect of Leachate Renewal Frequency on the Leachability of Cesium from Grouts Containing Conasauga Shale (Conshale). (Specimens were made with W-7 simulated waste and cured 60 days prior to leaching with tap water. The data points are given in Tables A-17 - A-21 of the Appendix.)

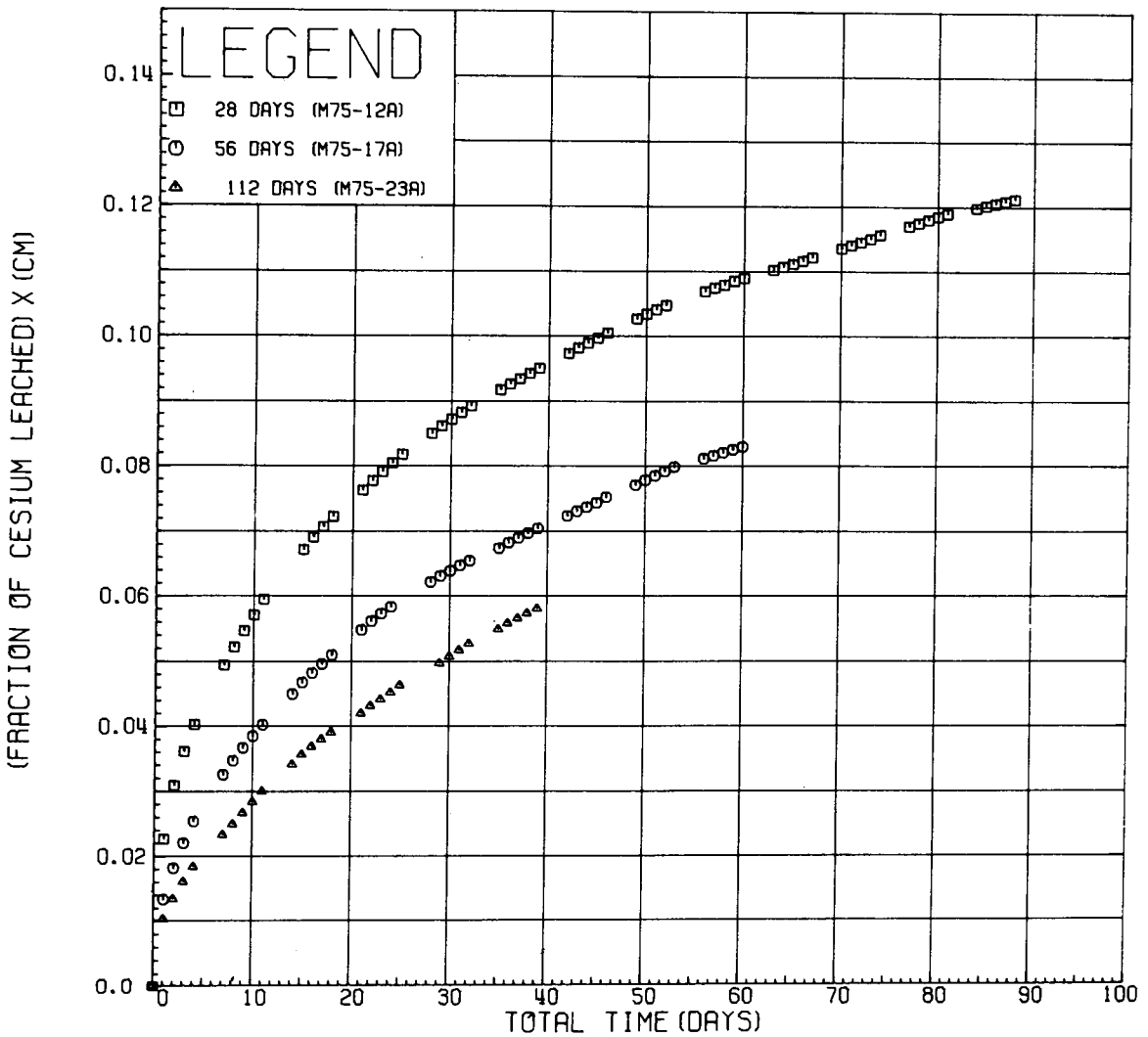

Fig. 15. Effect of "Wet" Curing Time on the Leachability of Cesium from Grouts Containing Conasauga Shale. (Specimens were prepared with a dry mix containing 7.7 wt % Conasauga shale and W-7 simulated waste. They were leached with tap water after curing the desired time. The data points are given in Tables A-54, A-61, and A-67 of the Appendix.)

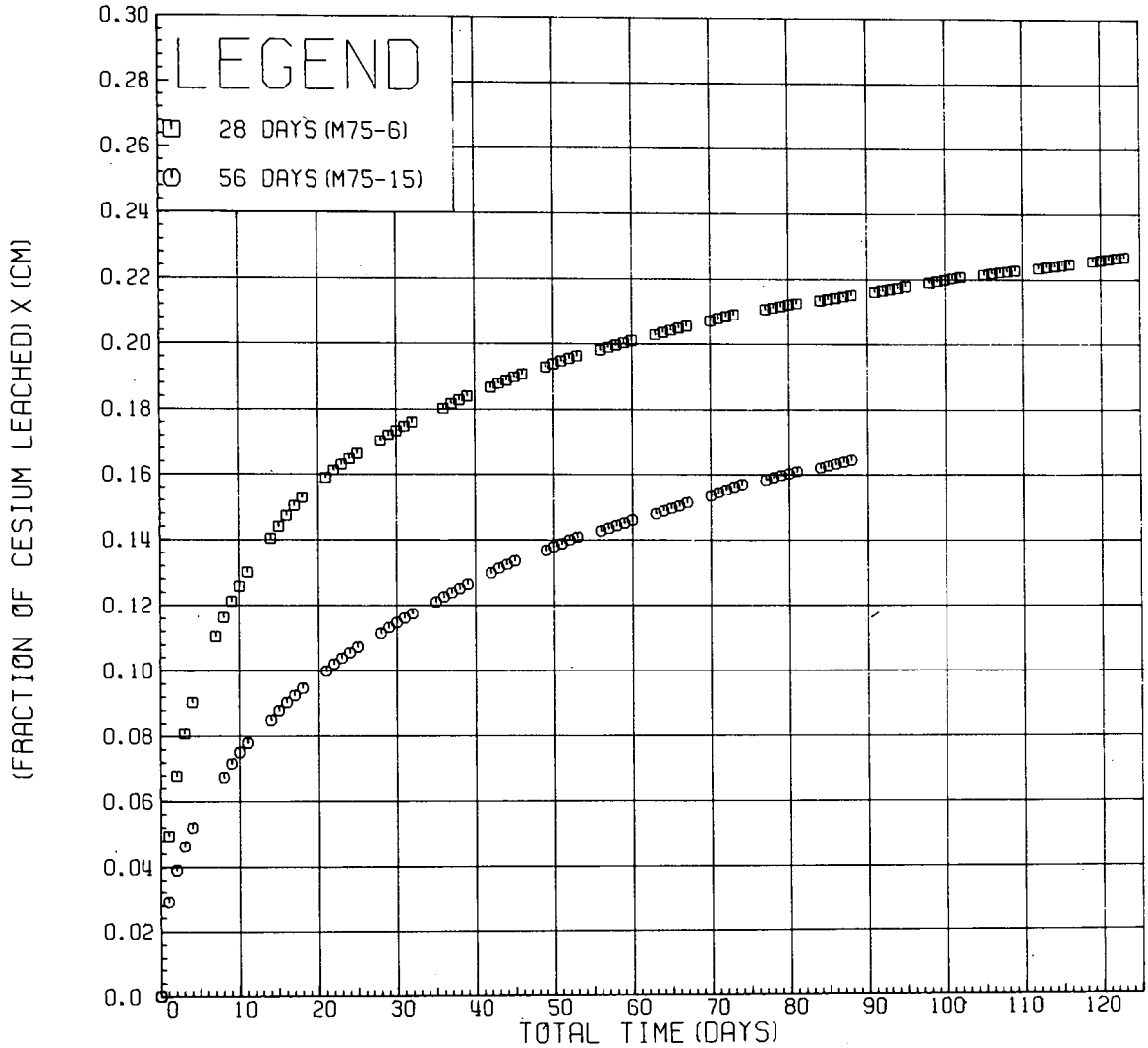

Fig. 16. Effect of "Wet" Curing Time on the Leachability of Cesium from Grouts Containing Grundite Clay. (Specimens were prepared with a dry mix containing 7.7 wt % Grundite clay and W-7 simulated waste. They were leached with tap water after curing the desired time. The data points are given in Tables A-44 and A-58 of the Appendix.)

much less lost to the leachate (Fig. 17). This again demonstrated the effect of surface drying on the amount of cesium leached from the surface. Results in the previous report[1] indicated that after 28 days there was little effect of curing. Those results may have been brought about by some unintentional surface drying. Greater care was taken in these later specimens to assure that proper curing had taken place as desired.

In the case of strontium, there was very little effect of curing time on the amount leached by tap water (Fig. 18). However, in the case of distilled water, the amount leached varied inversely with the curing time. These specimens were "wet" cured, and unfortunately leaching of the 112-day cured grout was stopped by mistake after 25 days (Fig. 19).

4.5 Effect of Drying During Curing

Normally specimens are cured the desired length of time in a humid atmosphere. To determine the effect of drying, several cesium specimens were prepared, and half were allowed to dry during curing while the others were maintained in the normal humid atmosphere. In every case, the "dry" specimens had a higher cumulative loss than specimens cured under humid, "wet" conditions (Figs. 20-22). The specimens were all prepared from the same grout and were cured 28 days (M75-12A and M75-12C), 56 days (M75-17A and M75-17B), and 112 days (M75-23A and M75-23B). The higher loss occurred from the dry cured specimens during the first 10 to 15 days of leaching. After this, cesium was removed from both types of specimens at approximately the same rate. The difference in the fraction leached from "dry" specimens versus "wet" specimens was dependent on the length of time the specimens were cured. The maximum difference occurred with 56-day curing and the least at 112 days.

4.6 Effect of Waste Concentration

Short-term leach tests indicated that increasing the overall waste concentration, i.e., by further evaporation of the waste, may have little effect on the leachability of cesium or strontium from simulated hydrofracture grout. Cesium tests were carried out with 28-day-cured grout specimens prepared from simulated waste solutions that were 1, 2, and 4 times the concentration of W-7 waste. The tests were run 10 days with the

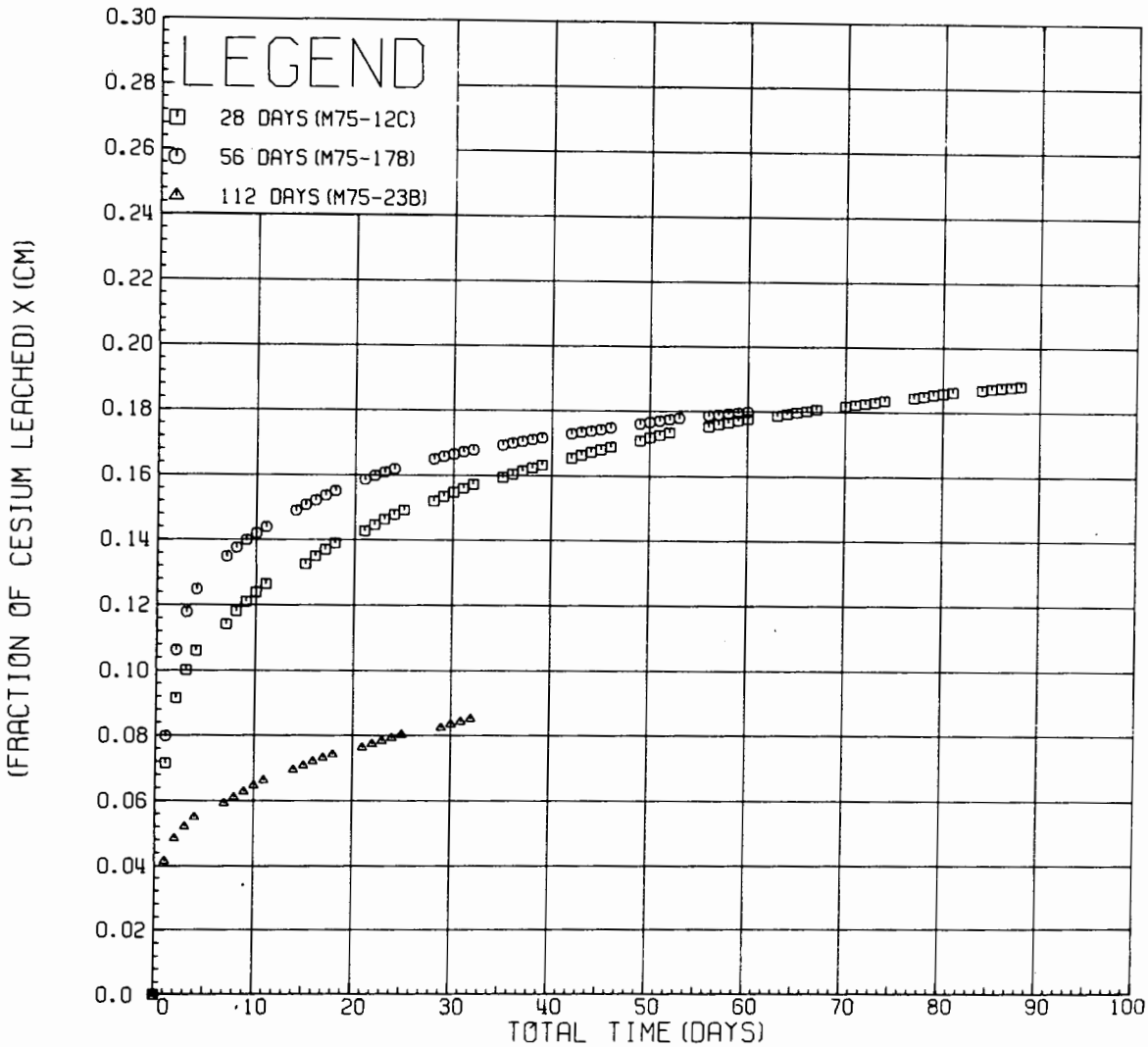

Fig. 17. Effect of "Dry" Curing Time on the Leachability of Cesium from Grouts Containing Conasauga Shale. (Specimens were prepared with a dry mix containing 7.7 wt % Conasauga shale and W-7 simulated waste. They were leached with tap water after curing the desired time. The data points are given in Tables A-56, A-62, and A-68 of the Appendix.)

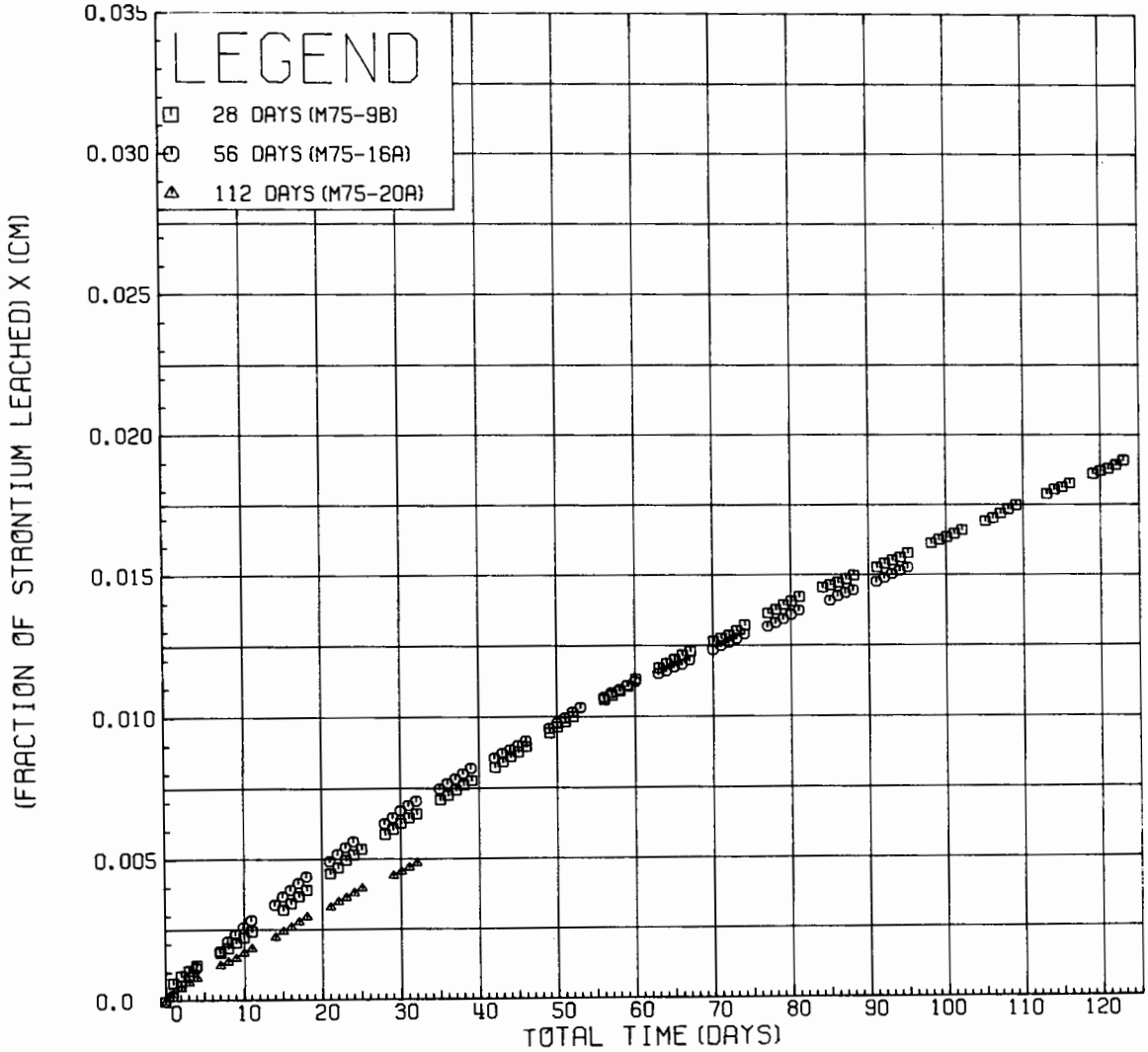

Fig. 18. Effect of "Wet" Curing Time on the Leachability of Strontium into Tap Water from Grouts Containing Conasauga Shale. (Specimens were prepared with a dry mix containing 7.7 wt % Conasauga shale and W-7 simulated waste. The data points are given in Tables A-51, A-59, and A-63 of the Appendix.)

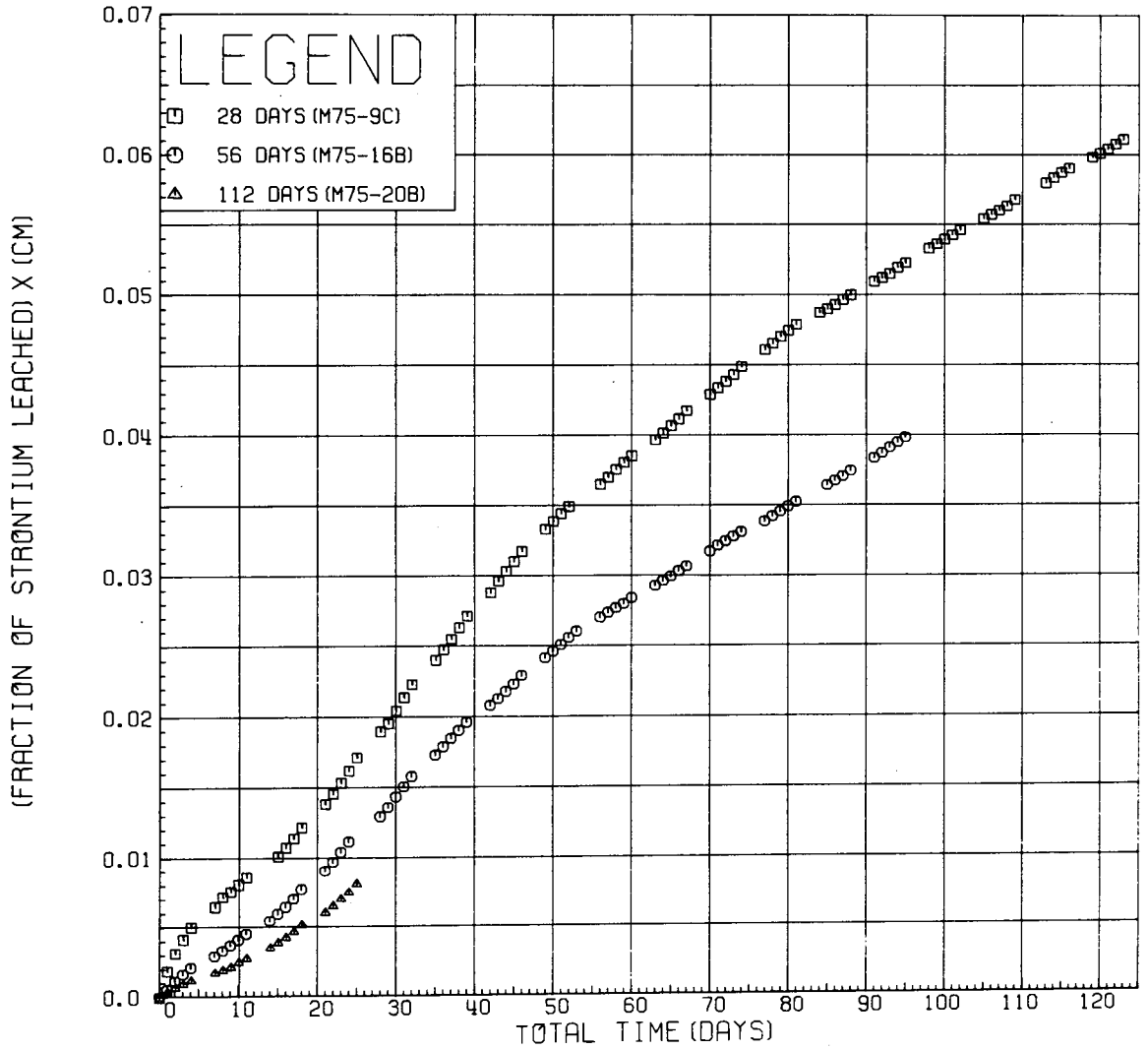

Fig. 19. Effect of "Wet" Curing Time on the Leachability of Strontium into Tap Water from Grouts Containing Conasauga Shale. (Specimens were prepared with a dry mix containing 7.7 wt % Conasauga shale and W-7 simulated waste. The data points are given in Tables A-52, A-60, and A-64 of the Appendix.)

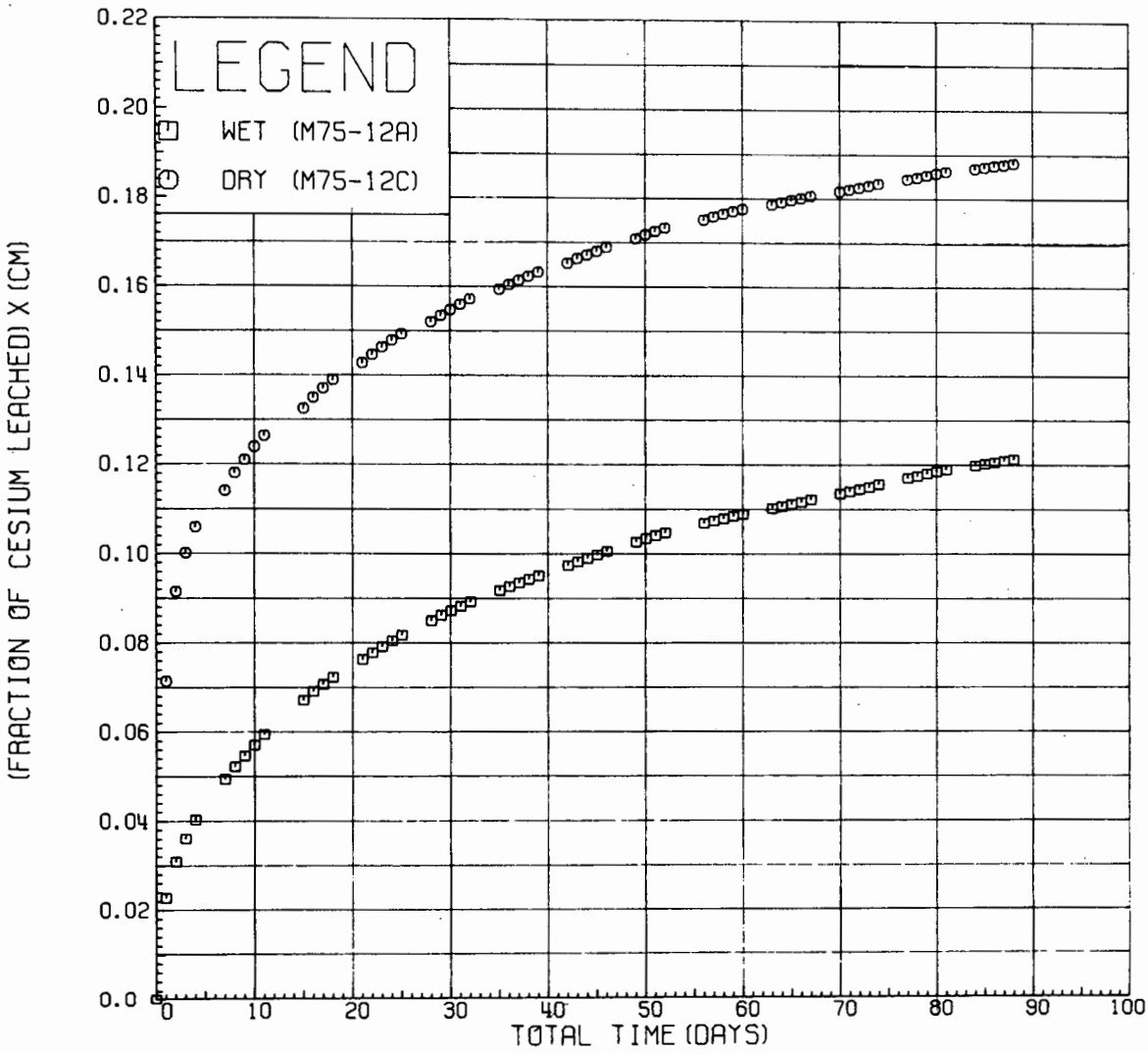

Fig. 20. Effect of Surface Drying on the Leachability of Cesium into Tap Water from 28-day-cured Grout. (The specimens were prepared with dry mixes containing 7.7 wt % Conasauga shale and W-7 simulated waste. The data points are given in Tables A-54 and A-56 of the Appendix.)

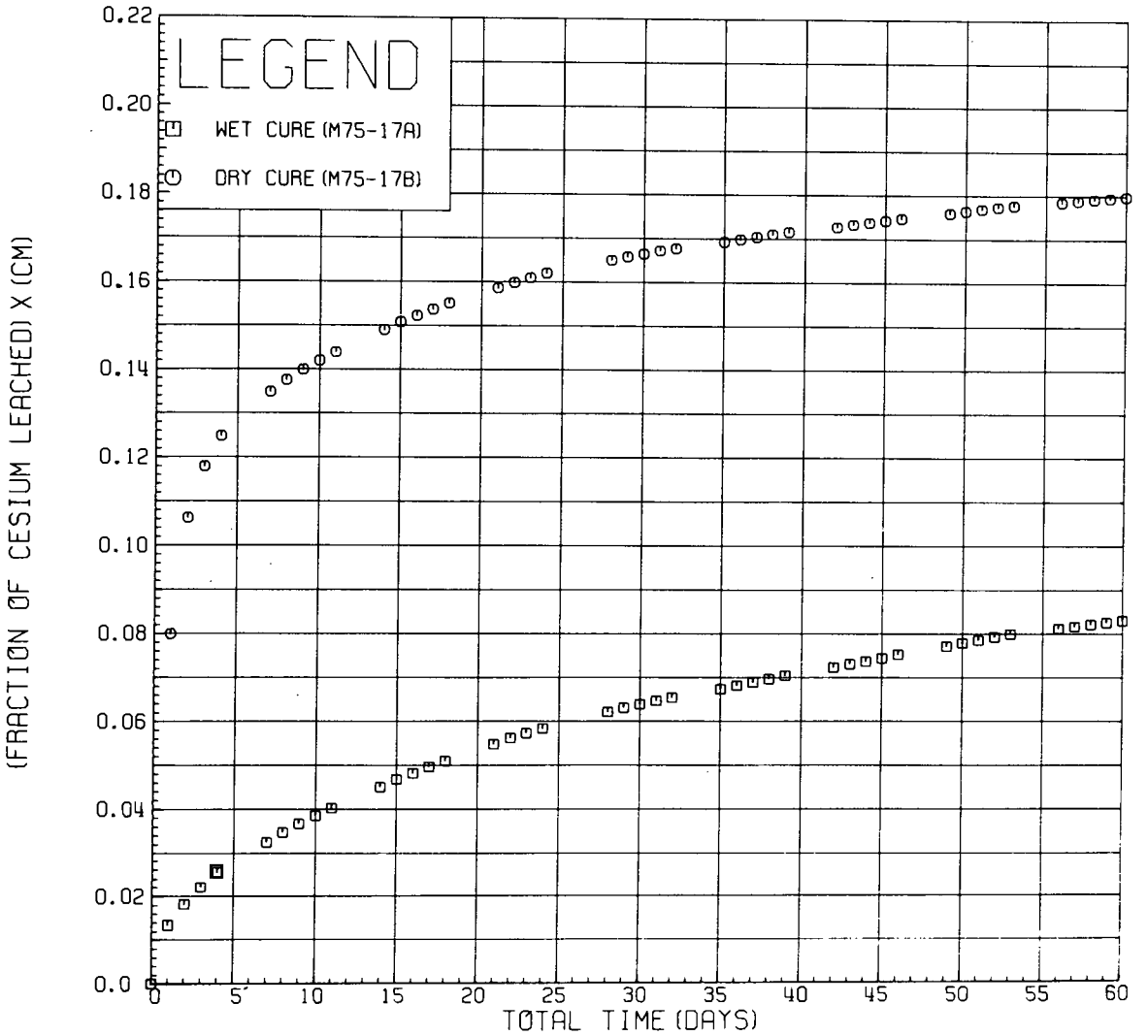

Fig. 21. Effect of Surface Drying on the Leachability of Cesium into Tap Water from 28-day-cured Grout. (The specimens were prepared with dry mixes containing 7.7 wt % Conasauga shale and W-7 simulated waste. The data points are given in Tables A-61 and A-62 of the Appendix.)

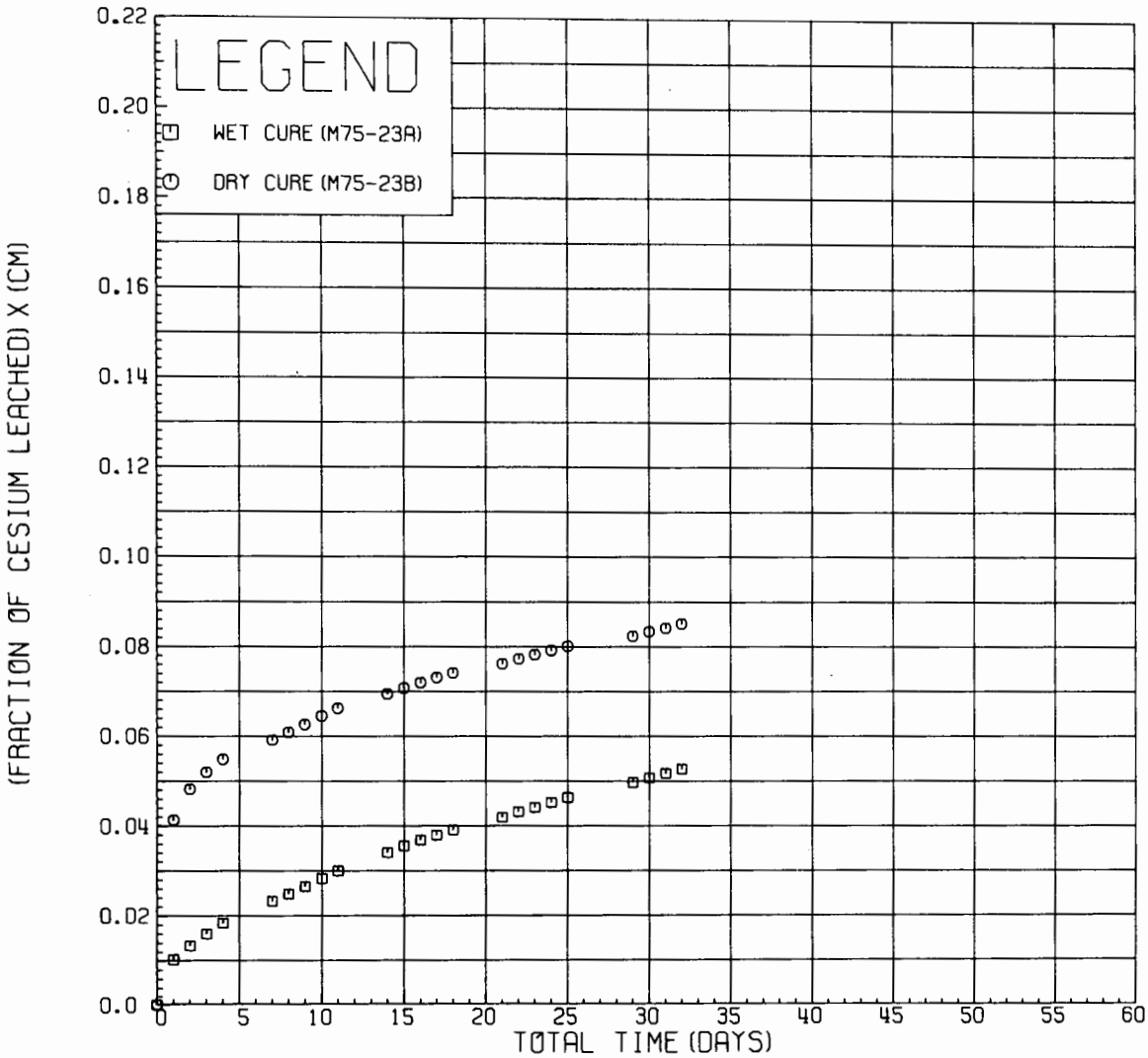

Fig. 22. Effect of Surface Drying on the Leachability of Cesium into Tap Water from 28-day-cured Grout. (The specimens were prepared with dry mixes containing 7.7 wt % Conasauga shale and W-7 simulated waste. The data points are given in Tables A-67 and A-68 of the Appendix.)

tap water leachate changed daily (Fig. 23). During this short time period, the differences observed in the results from these specimens were within the reproducibility of experiments using different grouts. Longer leach tests are needed to confirm these observations.

Sodium analyses were made on the leachates from the same cesium experiments. The 4X waste specimens showed a much faster leach rate in the first 2 or 3 days of leaching, followed by a slower rate than that observed with the more dilute waste samples. There is not enough evidence to warrant any discussions of possible mechanisms or causes of this phenomenon (Fig. 24).

Two tests were run with strontium, one prepared with the regular concentration of W-7 and the other at twice the concentration. These specimens were cured 28 days, then leached 60 days with tap water. The leachates were changed daily. Although less strontium was leached from the 1XW-7 specimen, it amounted to only about 10% at the end of 60 days, which is probably within experimental reproducibility (Fig. 25).

4.7 Effect of Cesium or Strontium Concentration

Nonradioactive cesium or strontium was added to many of the grouts to determine the effect on the leachability of the respective element. In the case of cesium, the total fraction of cesium leached from the specimens varied directly with the initial concentration of cesium in the grouts (Fig. 26). One specimen contained only tracer concentrations (M75-13), which amounted to 0.01 Ci/gal, and the other (M75-12A) had a cesium concentration of 0.5 mg/cm^3 of grout (equivalent to about 200 Ci/gal, or 100 times greater than the maximum of 2 curies per gallon that is currently planned to be used in actual injections at the hydrofracture site). Of course, the most probable explanation for the increased loss of cesium is that the clay (Conasauga shale) simply could not sorb this quantity of cesium.

Three tests were made with strontium: M75-10 containing only tracer amounts, M75-9B with a strontium concentration of 0.35 mg/cm^3 grout, and M75-3A with a strontium concentration of 0.5 mg/cm^3 grout. There was little, if any, difference in the results from the 0.5-mg and 0.35-mg specimens.

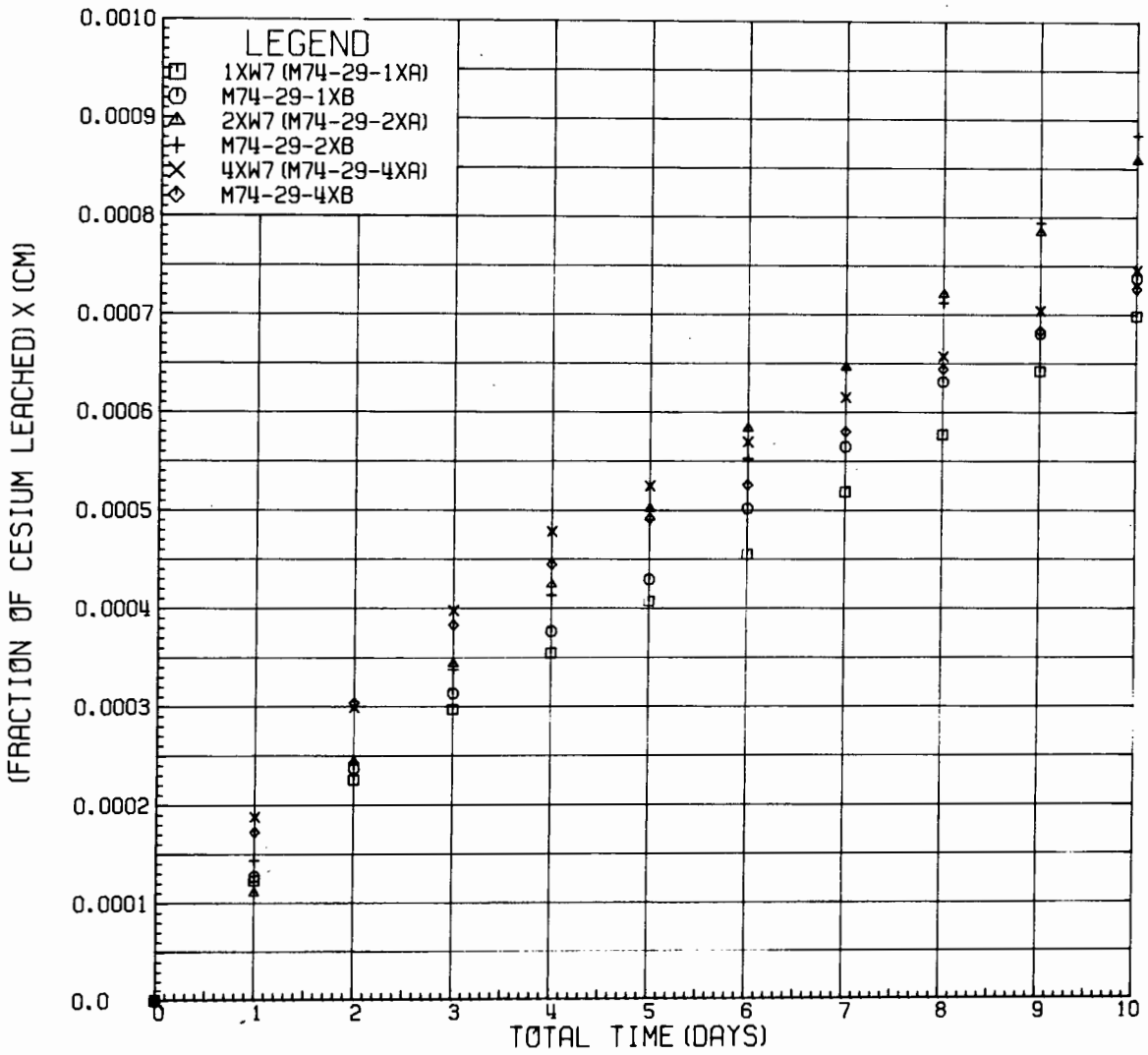

Fig. 23. Effect of Waste Concentration on the Leachability of Cesium from Grouts Containing Amaco Pottery Clay. (Specimens were prepared with dry mixes containing 7.7 wt % Amaco pottery clay and the desired concentration of W-7 simulated waste. They were cured 28 days prior to leaching with tap water. The data points are given in Tables A-27 - A-32 of the Appendix.)

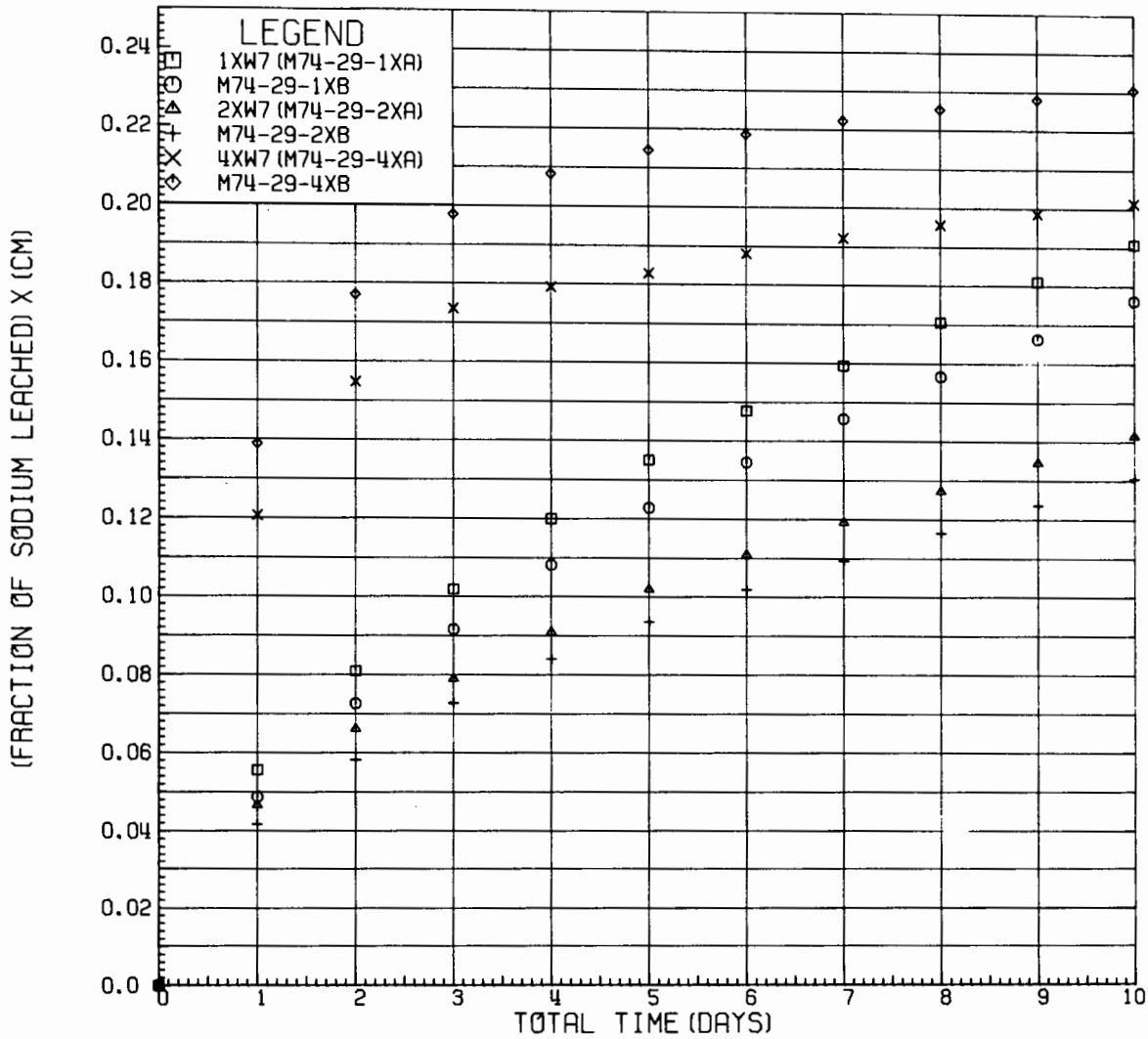

Fig. 24. Effect of Waste Concentration on the Leachability of Sodium from Grouts Containing Amaco Pottery Clay. (Specimens were prepared with dry mixes containing 7.7 wt % Amaco pottery clay and the desired concentration of W-7 simulated waste. They were cured 28 days prior to leaching with tap water. The data points are given in Tables A-33 - A-38 of the Appendix.)

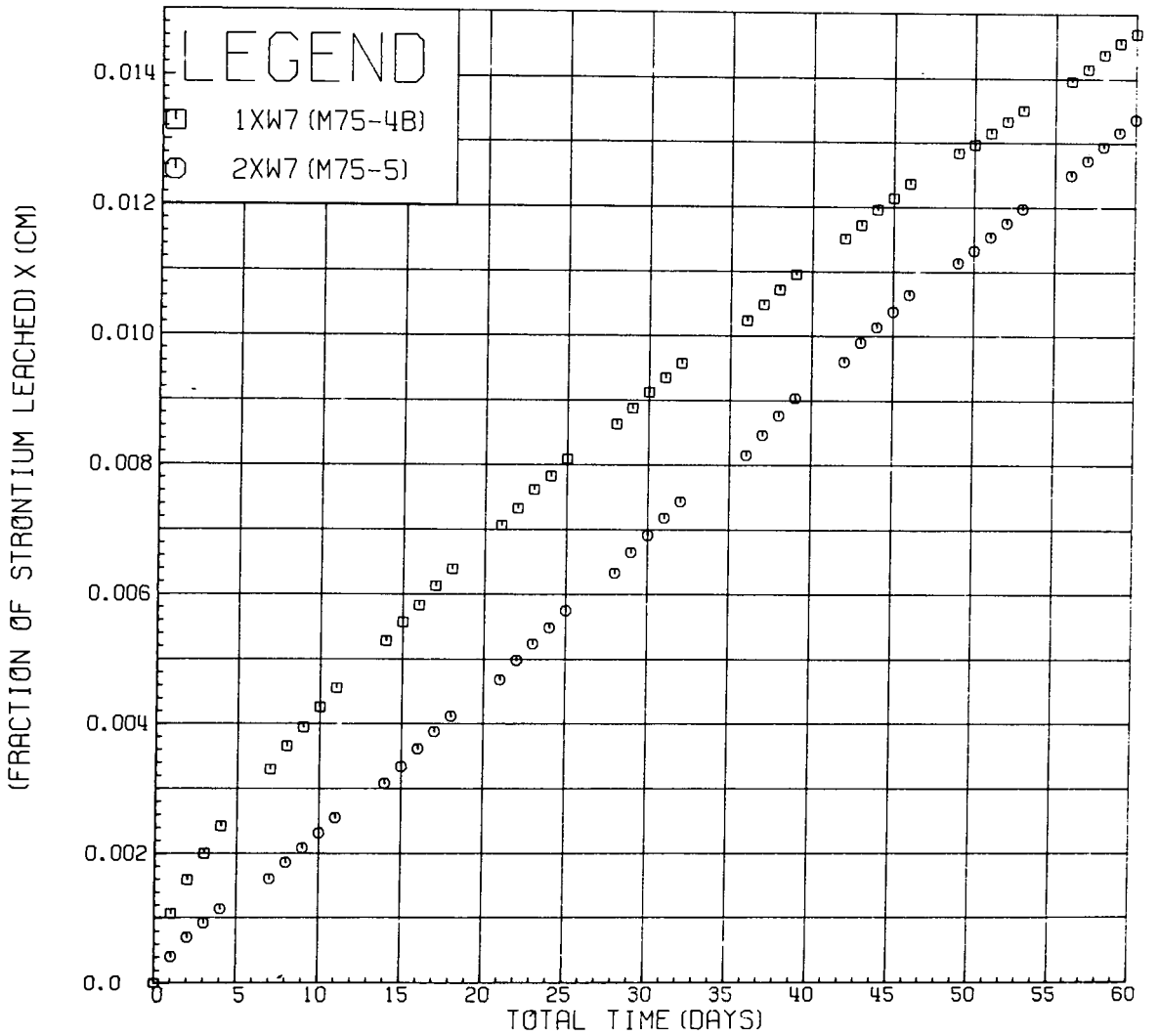

Fig. 25. Effect of Waste Concentration on the Leachability of Strontium from Grouts Containing Conasauga Shale. (Specimens were prepared with dry mixes containing 14.3 % Conasauga shale and the desired concentration of W-7 simulated waste. They were cured 28 days prior to leaching with tap water. The data points are given in Tables A-41 and A-43 of the Appendix.)

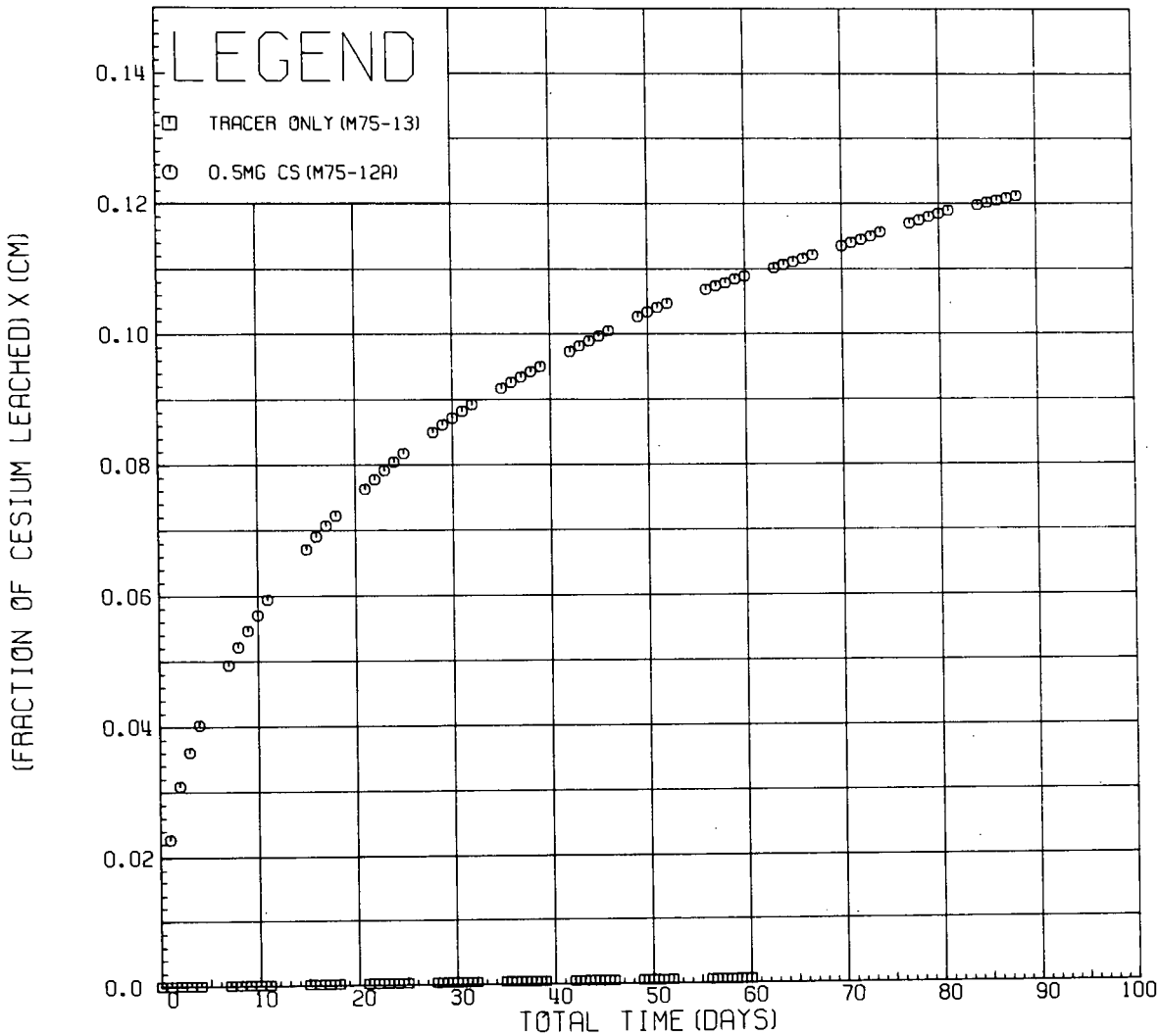

Fig. 26. Effect of Cesium Concentration on the Leachability of Cesium from Grouts Containing Conasauga Shale. (The specimens were prepared with dry mixes containing 7.7 wt % Conasauga shale and W-7 simulated waste solution with the desired concentration of cesium. They were cured 28 days prior to leaching with tap water. The data points are given in Tables A-57 and A-54 of the Appendix.)

However, the fraction leached was much higher from the grout containing only tracer concentrations of strontium, showing that the amount of radioactive strontium leached from a specimen can be reduced by the addition of stable strontium to the waste solution (Fig. 27).

4.8 Effect of Leachant Composition

The leachability of cesium and strontium from simulated hydrofracture grout is dependent on the composition of the leachate. Three different leachates were used in these tests: distilled water, tap water, and a solution designated grout water that consisted of the supernatant liquid obtained after mixing 1 volume of freshly prepared grout containing no cesium or strontium with 35 volumes of distilled water. In every case, there was a greater effect on strontium than cesium; however, with both isotopes the cumulative fraction leached was in the order: distilled water > tap water > grout water. After 60 days leaching there was over 3 times more strontium leached by distilled water than tap water (Fig. 28). In the case of cesium, about 30% more was leached by the distilled water (Fig. 29). Any daily fluctuations that may have been in the tap water produced no effect as shown by results of leach tests made using water from a stored volume of tap water compared with a test made with water drawn daily from the tap (Fig. 28).

The leach results obtained in tests using grout water followed a more complicated path than those obtained with tap or distilled water. With both strontium and cesium, the leach rate for about the first 10 days was higher for grout water than with tap water, but then the rate decreased sharply with the overall effect that, after about 20 days, the cumulative fraction leached was greater with tap water than with grout water. The effect was very marked in the strontium tests (Fig. 30), but only to a slight extent with cesium (Fig. 31). The increase in the leach rates shown after the 45th day (M75-4C and M75-7D) was due to the substitution of tap water for grout water. The increase observed with M75-7B of Fig. 31 was brought about by allowing the specimen to dry out for several days before resuming the leach process.

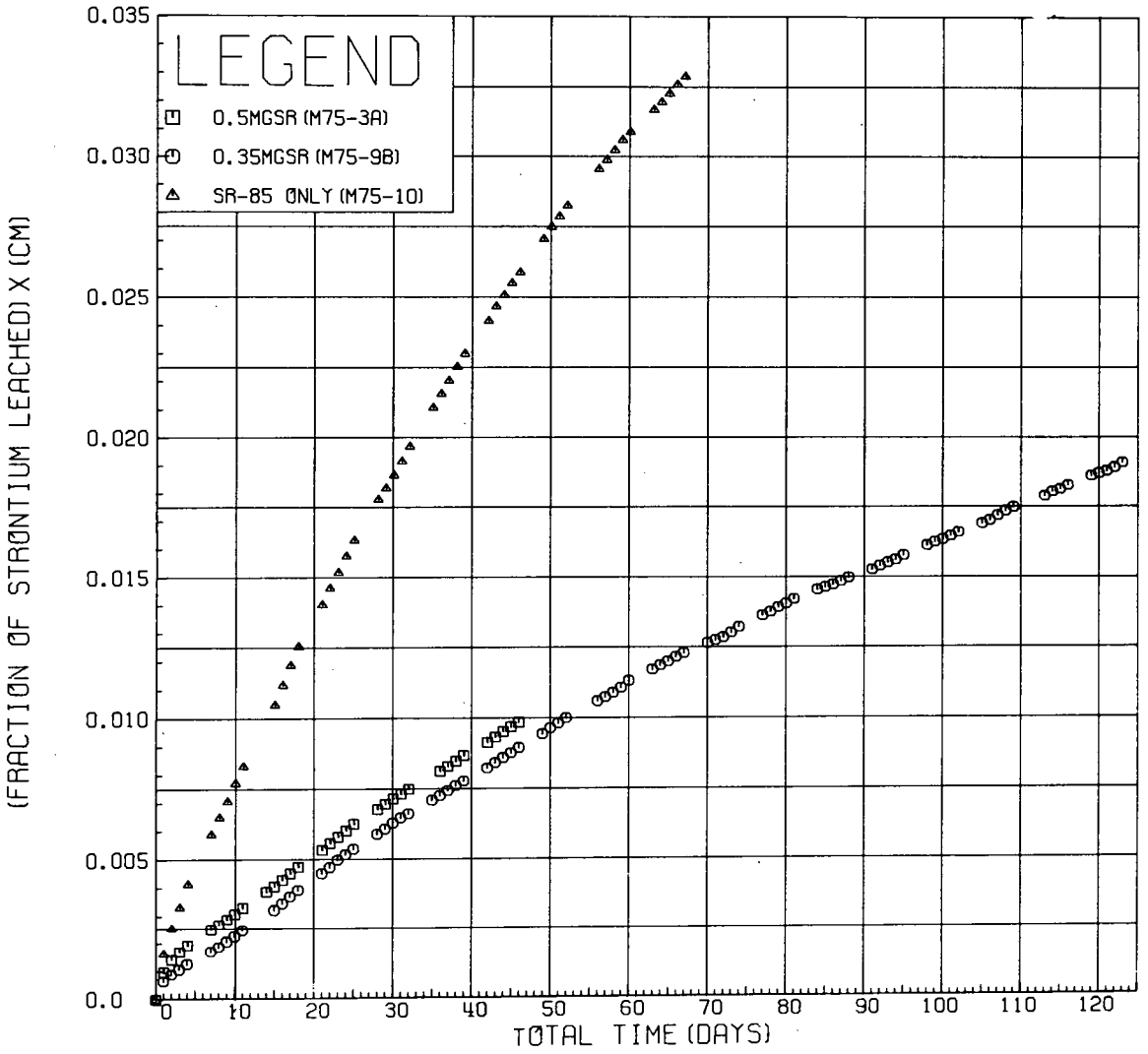

Fig. 27. Effect of Strontium Concentration on the Leachability of Strontium from Grouts Containing Conasauga Shale. (The specimens were prepared with dry mixes containing 7.7 wt % Conasauga shale and W-7 simulated waste solution with the desired concentration of strontium. They were cured 28 days prior to leaching with tap water. The data points are given in Tables A-39, A-51, and A-53 of the Appendix.)

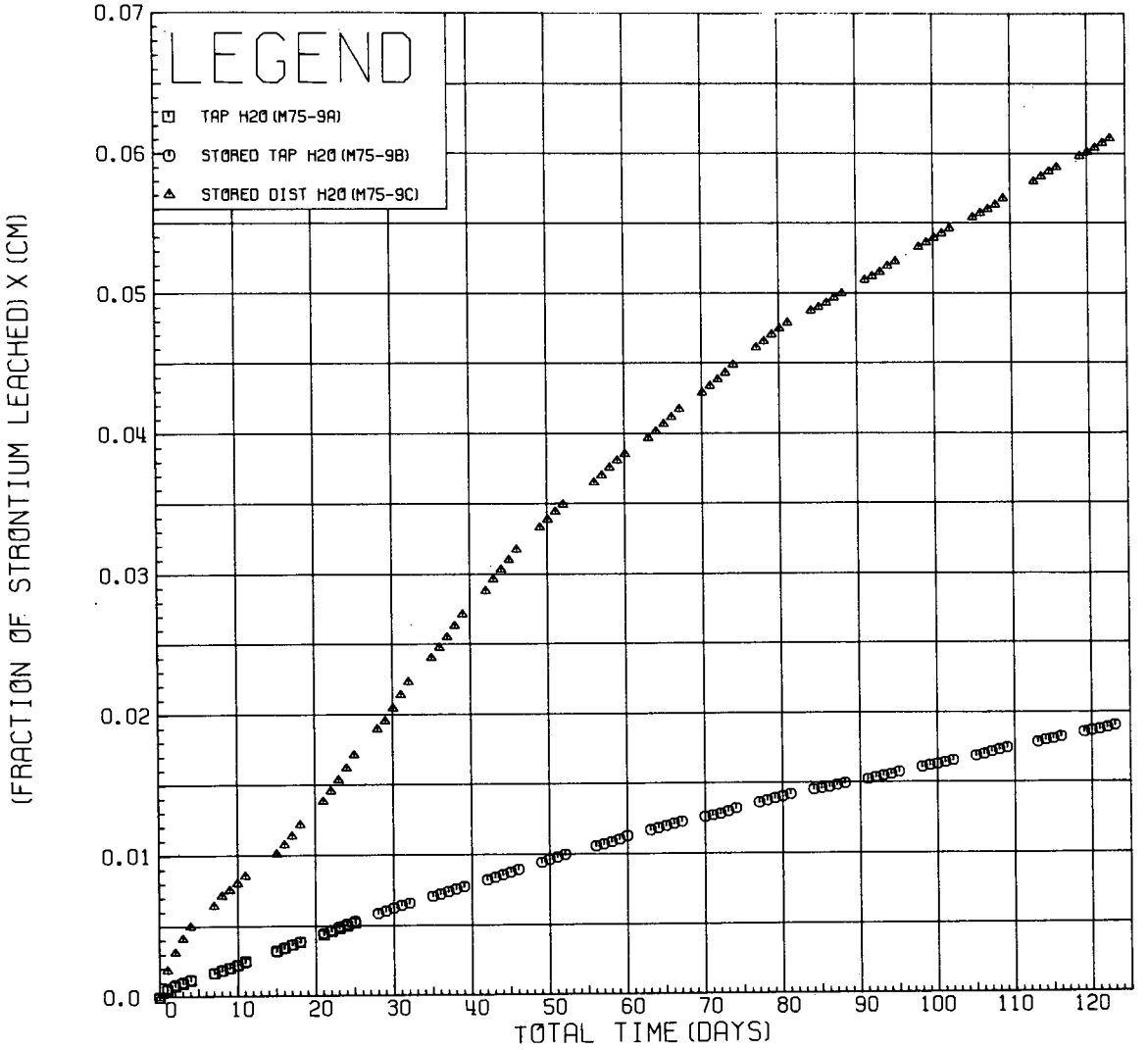

Fig. 28. Comparison of Strontium Leachability into Tap Water and Distilled Water from Cementitious Grouts Cured 28 Days. (The specimens were made with dry mixes containing 7.7 wt % Conasauga shale and W-7 simulated waste solution. The specimens were cured under humid conditions. Data points are given in Tables A-50, A-51, and A-52 of the Appendix.)

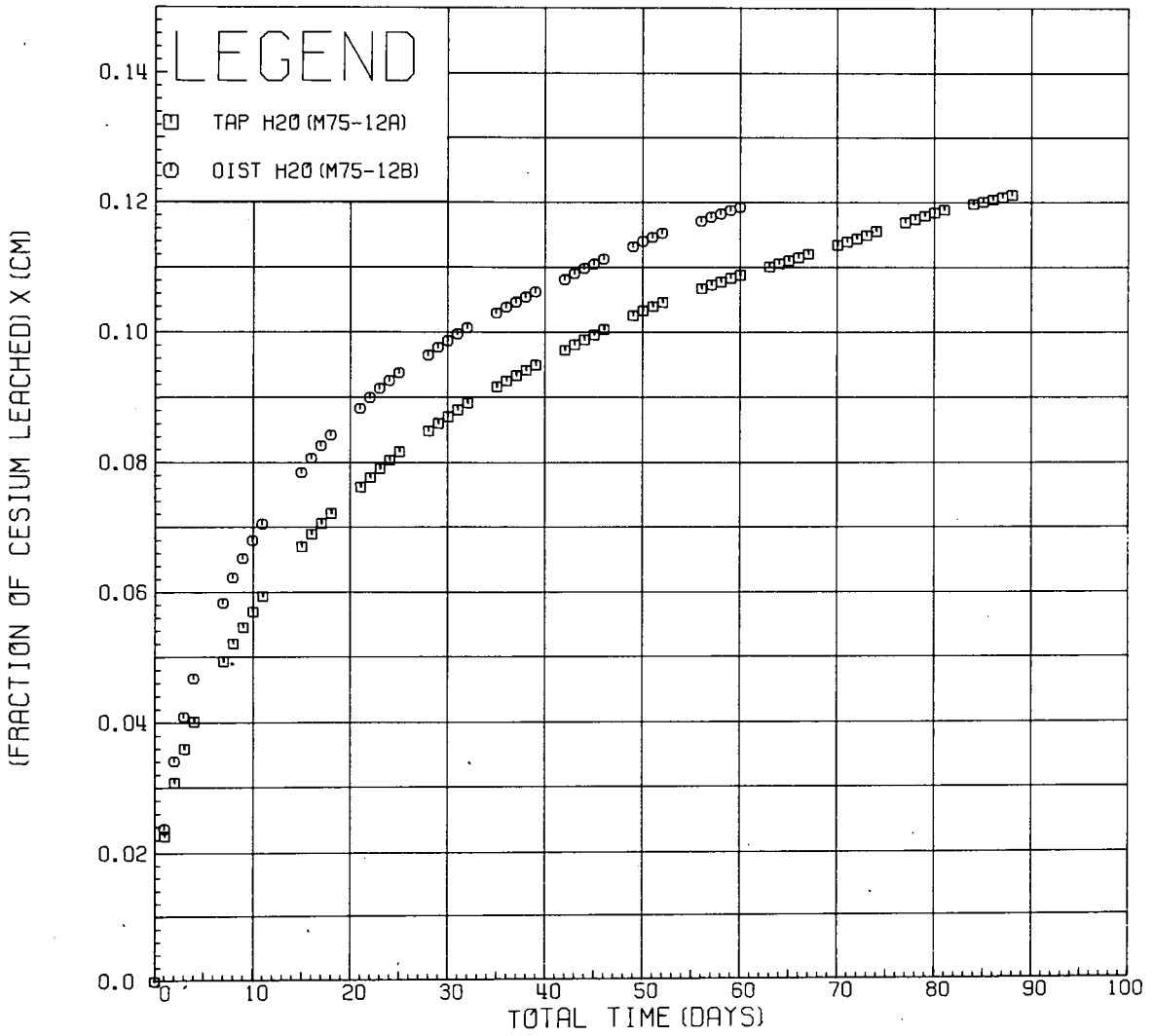

Fig. 29. Comparison of Cesium Leachability into Tap Water and Distilled Water from Cementitious Grouts Cured 28 Days. (The specimens were made with dry mixes containing 7.7 wt % Conasauga shale and W-7 simulated waste solution. The specimens were cured under humid conditions. Data points are given in Tables A-54 and A-55 of the Appendix.)

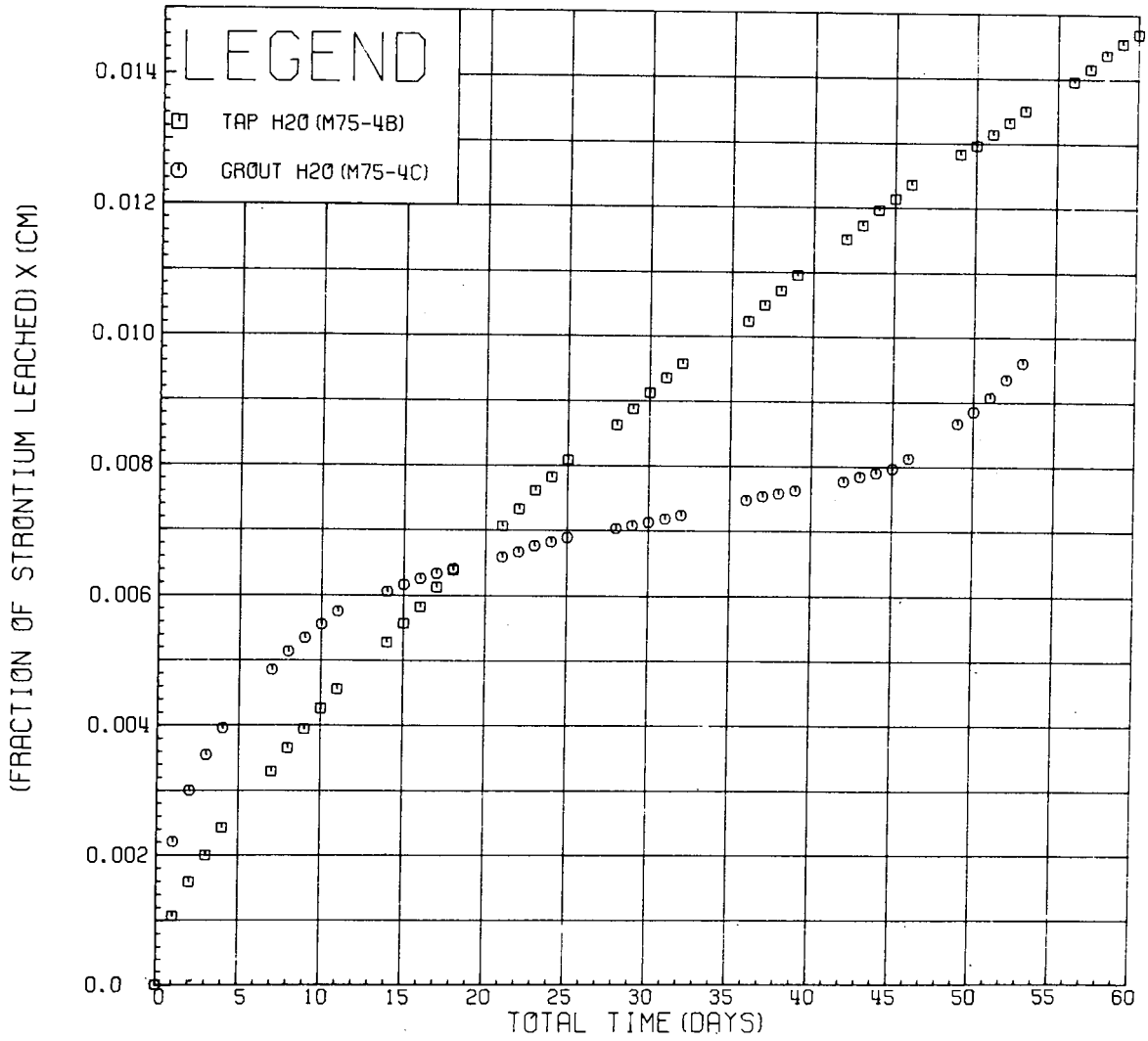

Fig. 30. Comparison of Strontium Leachability into Tap Water and Grout Water from Cementitious Grouts Cured 28 Days. (The specimens were made with dry mixes containing 14.3 % Conasauga shale and W-7 simulated waste solution. The specimens were cured under humid conditions. Data points are given in Tables A-41 and A-42 of the Appendix.)

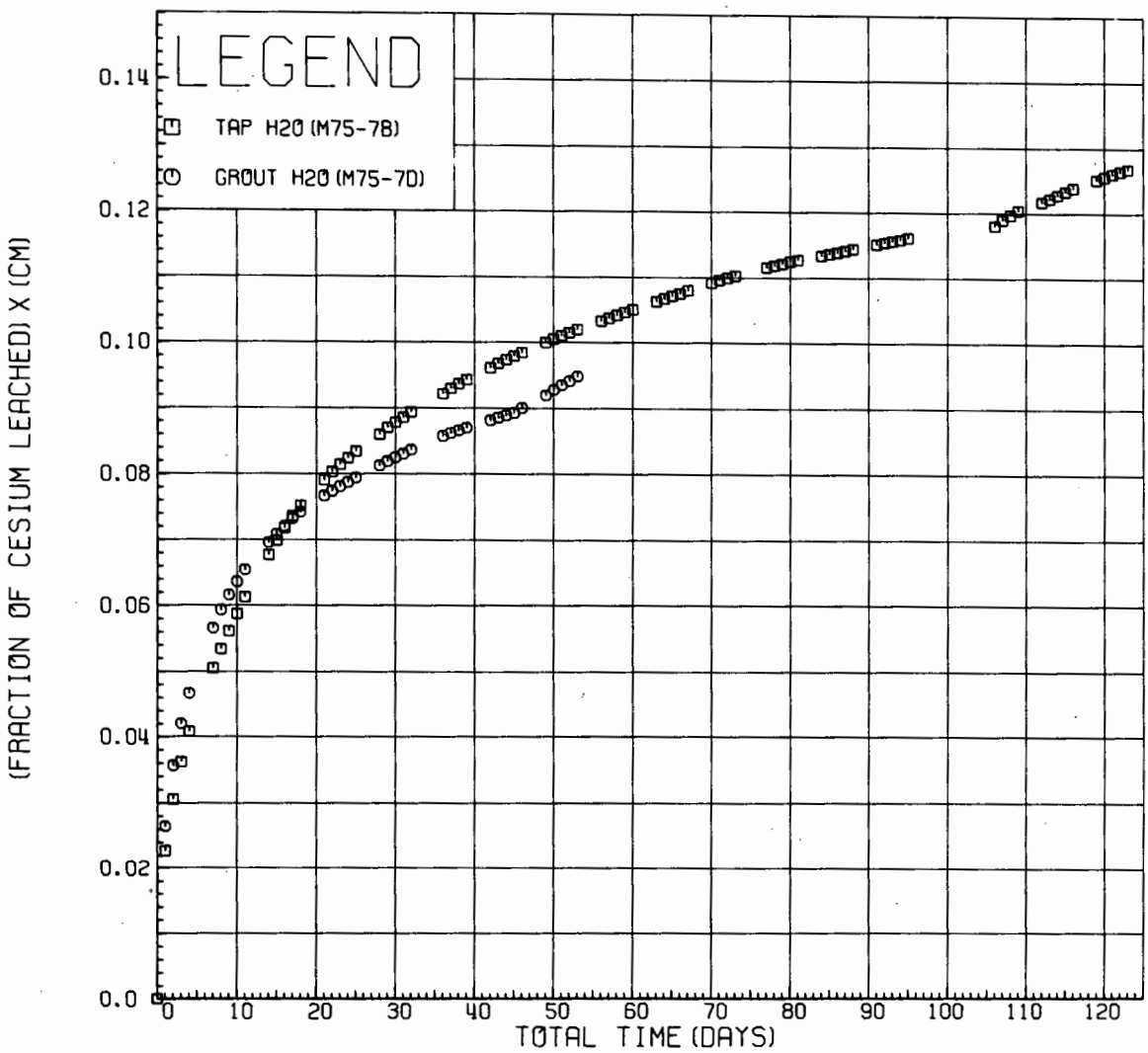

Fig. 31. Comparison of Cesium Leachability into Tap Water and Grout Water from Cementitious Grouts Cured 28 Days. (The specimens were made with dry mixes containing 7.7 wt % Conasauga shale and W-7 simulated waste solution. The specimens were cured under humid conditions. Data points are given in Tables A-46 and A-48 of the Appendix.)

5. LEACHABILITY OF ACTUAL HYDROFRACTURE GROUT

A leach test was run with actual hydrofracture grout and the data used in previously described theoretical expressions.[1] Modified effective diffusivities were calculated for ^{137}Cs and ^{90}Sr using Equation (1) and the few data points obtained in the leach study. The D_e's were 8.3×10^{-11} cm^2/sec and 5.8×10^{-10} cm^2/sec for cesium and strontium respectively. This study was made in a modified Soxhlet extractor, which was constructed so that tests could be run with continuously changing leachant. The sample of hydrofracture grout was a fragment of a core recovered from the ORNL injection site in a core drilling program of the late 1960's. The 2.3-g specimen had a surface area of about 10 cm^2 and a volume-to-surface ratio of 0.16. It was contacted with distilled water at the rate of 40 ml/min for six weeks and the leachate sampled each week. Although there were few data points and they were somewhat erratic, the calculated D_e's gave predicted values within $\pm$ 3% of the actual strontium values and within $\pm$ 20% of the actual cesium values (Tables 5 and 6).

Comparisons of the diffusivities obtained from laboratory studies with simulated grout and those obtained with data from the core fragment were most encouraging. The 550-day cesium laboratory leach test (Sect. 3.2) indicated a diffusivity of 1.1×10^{-9}, or about 10 times greater than the D_e obtained with data from the core fragment. In the case of strontium, estimates of effective diffusivities from short-term tap water tests produced values in the 10^{-11} range[1] or about 20 times less than obtained with the actual samples. Considering the very limited number of data points, the difference in manner and time of curing, and the difference between tap and distilled water leach rates, the core results lend much credibility to those obtained from laboratory grouts.

6. CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE STUDIES

1. The ORNL leach test method proved to be an acceptable method for screening and parametric studies, giving reproducible leach data in a short period of time.
2. The cumulative fraction of cesium and strontium leached from hydrofracture grout depended on the time and manner of curing. The amount

Table 5. Comparison of the Cumulative Fraction of Strontium Leached from a Hydrofracture Grout Fragment to That Predicted by a D_e of 5.8×10^{-10} cm2/sec

Time (days)	Cumulative Fraction Leached (cm) Data	Calculated	Difference[a] (%)
14.0	3.08×10^{-2}	2.99×10^{-2}	-3
21.0	3.61×10^{-2}	3.66×10^{-2}	1
28.0	4.19×10^{-2}	4.23×10^{-2}	1
35.0	4.79×10^{-2}	4.73×10^{-2}	-1
42.0	5.12×10^{-2}	5.18×10^{-2}	1

[a]% difference = $\left(\frac{\text{calculated} - \text{data}}{\text{data}}\right) \times 100.$

Table 6. Comparison of the Cumulative Fraction of Cesium Leached from a Hydrofracture Grout Fragment to That Predicted by a D_e of 8.3×10^{-11} cm2/sec

Time (days)	Cumulative Fraction Leached (cm) Data	Calculated	Difference[a] (%)
14.0	9.41×10^{-3}	1.13×10^{-2}	20
21.0	1.24×10^{-2}	1.38×10^{-2}	11
28.0	1.41×10^{-2}	1.59×10^{-2}	13
35.0	1.84×10^{-2}	1.78×10^{-2}	- 3.3
42.0	2.26×10^{-2}	1.96×10^{-2}	-13

[a]% difference = $\left(\frac{\text{calculated} - \text{data}}{\text{data}}\right) \times 100.$

decreased with increased curing time and increased if the specimen dried during curing.

3. The amount of cesium and strontium leached depended on the composition of the leachant and was in the order: distilled water > tap water > grout water.
4. Short-term leach tests indicated that increasing the overall waste concentration had little effect on the leachability of strontium or cesium. However, the addition of stable strontium decreased the amount of radioactive strontium leached from the specimen, while additional stable cesium increased the loss of cesium.
5. The amount of cesium leached from a specimen depended on the amount and type of clay incorporated in the grout and varied as follows: No clay > Grundite > Richard's Brick dust > local Pumpkin Valley Conasauga Shale > Amaco Pottery Clay > local Rutledge Conasauga Shale.
6. A short-term continuous leach test using a fragment of actual hydrofracture grout confirmed the credibility of the laboratory tests using simulated grout.
7. Long-term (550 days) leach tests using the IAEA test method confirmed the reliability of the extrapolations of the shorter-term (140 days) data.
8. There was further evidence that the cumulative fraction of an isotope leached from a specimen was dependent on the frequency of leachant renewal.

Future work on the leachability of cementitious mixtures will follow the recommendations discussed in the previous report.[1] The emphasis will be on the formulation and treatment of grouts to produce the properties required for the encapsulation of specific waste materials. The ORNL test method will be used to determine the effect any change in the grout composition or treatment has on the leachability of the resulting material. The better grouts will then be subjected to long-term studies in which the leachant is replaced continuously to confirm the reliability of the matrix for the fixation of radioactive waste.

7. ACKNOWLEDGEMENTS

Sincere appreciation is expressed to H. W. Godbee, A. H. Kibbey, and H. O. Weeren for their suggestions and helpful discussions during the course of this project.

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APPENDIX: COMPILATION OF DATA ON LEACHING OF CEMENTITIOUS GROUTS

The data for all the grout specimens discussed in this report are listed according to the specimen's experiment number. A general description of each specimen and leach conditions is given in Table 3. The general composition of the dry mix and waste solution used to prepare the specimens may be found in Tables 1 and 2 respectively. In every case, the incremental fraction leached was determined by comparing, at the leach time in question, the amount of activity in the leachate with an equivalent sample of the original waste feed solution and tracer used to prepare the specimen. To obtain the experimental value of the incremental fraction leached, multiply the number in that column by the reciprocal of the power of 10 appearing in the column heading. For example, the first value in the "Incremental Fraction Leached" column of Table A-1 would be read as 17.870×10^{-4}.

Table A-1. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M73-93C

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.276 mCi
Mass: 137 g (as prepared)
Volume: 98 cm^3
Exposed Surface Area: 19.6 cm^2

Curing Time 28 days

Leachant 150 ml tap water; 2 changes/day for 56 days, then daily (initial pH = 7.75 - 8.48)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
0.25	0.25	11.01	17.870	0.1787
0.75	1.00	11.29	11.590	0.2946
0.25	1.25	10.28	3.300	0.3276
0.75	2.00	10.73	5.080	0.3784
0.25	2.25	9.85	2.190	0.4003
0.75	3.00	10.55	3.570	0.4360
0.25	3.25	9.58	1.520	0.4512
0.75	4.00	10.26	3.120	0.4824
0.25	4.25	9.21	1.330	0.4957
2.75	7.00	11.15	7.360	0.5693
0.25	7.25	9.70	1.450	0.5838
0.75	8.00	10.02	2.490	0.6087
0.25	8.25	9.48	1.160	0.6203
0.75	9.00	10.05	2.340	0.6437
0.25	9.25	9.38	1.130	0.6550
0.75	10.00	9.92	2.100	0.6760
0.25	10.25	9.29	1.030	0.6863
0.75	11.00	9.81	2.210	0.7084
0.25	11.25	9.10	1.090	0.7193
2.75	14.00	10.76	5.510	0.7744
0.25	14.25	9.44	1.290	0.7873
0.75	15.00	9.71	2.150	0.8088
0.25	15.25	9.18	1.030	0.8191
0.75	16.00	9.61	1.840	0.8375
0.25	16.25	9.25	1.520	0.8527
0.75	17.00	9.51	2.370	0.8764
0.25	17.25	8.84	0.817	0.8846
0.75	18.00	9.48	1.903	0.9036
0.25	18.25	8.82	1.093	0.9145
2.75	21.00	10.36	5.625	0.9708
0.25	21.25	9.22	1.208	0.9829
0.75	22.00	9.47	1.910	1.0020
1.0	23.00	9.74	2.247	1.0244
0.25	23.25	9.15	1.066	1.0351
0.75	24.00	9.48	1.788	1.0530
0.25	24.25	8.70	0.900	1.0620
0.75	25.00	9.18	2.211	1.0841
0.25	25.25	8.62	1.070	1.0948
2.75	28.00	10.03	4.658	1.1414
0.25	28.25	8.96	1.050	1.1519
0.75	29.00	9.37	2.293	1.1748
1.0	30.00	9.38	2.676	1.2016
0.25	30.25	8.54	0.947	1.2110
0.75	31.00	9.07	2.293	1.2340
0.25	31.25	8.67	1.196	1.2459
0.75	32.00	8.92	2.084	1.2668
0.25	32.25	8.54	0.934	1.2761
2.75	35.00	9.81	4.053	1.3166
0.25	35.25	8.82	0.872	1.3254
0.75	36.00	9.29	2.328	1.3486
0.25	36.25	8.37	0.922	1.3578
0.75	37.00	9.91	1.958	1.3774
0.25	37.25	8.36	0.930	1.3867
0.75	38.00	8.77	1.962	1.4063
0.25	38.25	8.32	0.803	1.4144
0.75	39.00	8.75	1.701	1.4314
0.25	39.25	8.56	0.860	1.4400
3.75	43.00	9.94	3.972	1.4796

Table A-1 (Continued)

Leaching Time (days) Incremental t_n	Leaching Time (days) Cumulative Σt_n	Final pH of Leachate	Fraction Leached Incremental $(a_n/A_o) \times 10^4$	Fraction Leached Cumulative $(\Sigma a_n/A_o) \times 10^2$	Leaching Time (days) Incremental t_n	Leaching Time (days) Cumulative Σt_n	Final pH of Leachate	Fraction Leached Incremental $(a_n/A_o) \times 10^4$	Fraction Leached Cumulative $(\Sigma a_n/A_o) \times 10^2$
0.25	43.25	8.99	0.800	1.4877	1.0	92.0	8.71	1.516	2.2017
0.75	44.00	9.35	2.396	1.5117	1.0	93.0	8.63	1.492	2.2167
0.25	44.25	8.65	1.068	1.5223	1.0	94.0	8.62	1.400	2.2306
0.75	45.00	8.85	1.832	1.5407	4.0	98.0	9.23	2.294	2.2536
0.25	45.25	8.51	0.703	1.5480	1.0	99.0	8.92	1.757	2.2712
0.75	46.00	8.89	1.665	1.5643	1.0	100.0	8.66	1.478	2.2860
0.25	46.25	8.58	0.775	1.5721	1.0	101.0	8.45	1.407	2.3000
2.75	49.00	9.60	2.936	1.6014	1.0	102.0	8.59	1.240	2.3124
0.25	49.25	8.86	0.715	1.6086	3.0	105.0	9.05	2.219	2.3346
0.75	50.00	9.13	2.102	1.6296	1.0	106.0	8.75	1.342	2.3480
0.25	50.25	8.60	0.758	1.6372	1.0	107.0	8.63	1.303	2.3611
0.75	51.00	8.87	1.466	1.6519	1.0	108.0	8.54	1.143	2.3725
0.25	51.25	8.51	0.728	1.6591	1.0	109.0	8.54	1.249	2.3850
1.75	53.00	9.28	2.364	1.6828	3.0	112.0	9.06	1.915	2.4041
0.25	53.25	8.65	0.844	1.6912	1.0	113.0	8.58	1.492	2.4190
2.75	56.00	9.54	2.984	1.7211	1.0	114.0	8.57	1.216	2.4312
1.0	57.0	9.20	1.220	1.7333	1.0	115.0	8.43	1.116	2.4424
1.0	58.0	9.25	2.076	1.7540	1.0	116.0	8.61	1.296	2.4553
1.0	59.0	9.00	2.064	1.7747	3.0	119.0	8.98	1.921	2.4745
4.0	63.0	9.80	3.481	1.8095	1.0	120.0	8.70	1.303	2.4876
1.0	64.0	9.27	1.220	1.8217	1.0	121.0	8.58	1.375	2.5013
1.0	65.0	9.26	2.483	1.8465	1.0	122.0	8.48	1.009	2.5114
1.0	66.0	8.90	2.126	1.8678	1.0	123.0	8.48	1.033	2.5217
1.0	67.0	8.91	1.943	1.8872	3.0	126.0	8.78	1.601	2.5378
4.0	71.0	9.73	3.250	1.9197	1.0	127.0	8.58	1.115	2.5489
1.0	72.0	9.42	2.204	1.9417	1.0	128.0	8.52	1.063	2.5595
1.0	73.0	9.09	1.988	1.9616	1.0	129.0	8.40	1.099	2.5705
1.0	74.0	8.94	1.868	1.9803	1.0	130.0	8.44	0.882	2.5793
3.0	77.0	9.52	2.968	2.0100	3.0	133.0	8.64	1.637	2.5957
1.0	78.0	8.99	1.824	2.0282	1.0	134.0	8.20	1.144	2.6071
1.0	79.0	8.89	1.876	2.0470	1.0	135.0	8.38	1.207	2.6192
1.0	80.0	8.95	1.618	2.0632	1.0	136.0	8.43	1.017	2.6294
1.0	81.0	8.88	1.575	2.0789	1.0	137.0	8.45	1.021	2.6396
3.0	84.0	9.40	2.519	2.1041	4.0	141.0	8.87	1.838	2.6580
1.0	85.0	9.14	1.836	2.1224	1.0	142.0	8.75	1.253	2.6705
1.0	86.0	8.85	1.667	2.1391	1.0	143.0	8.46	1.164	2.6821
1.0	87.0	8.79	1.550	2.1546	1.0	144.0	8.40	0.995	2.6921
1.0	88.0	8.74	1.458	2.1692	3.0	147.0	8.64	1.654	2.7086
3.0	91.0	9.04	1.737	2.1866	1.0	148.0	8.54	1.169	2.7203

Table A-1 (Continued)

Leaching Time (days)		Final pH of Leachate	Fraction Leached		Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^2$	Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	149.0	8.41	1.107	2.7314	1.0	205.0	8.34	0.922	3.1502
1.0	150.0	8.36	1.076	2.7422	1.0	206.0	8.40	0.825	3.1585
1.0	151.0	8.35	0.964	2.7518	1.0	207.0	8.34	0.692	3.1654
3.0	154.0	8.58	1.647	2.7683	3.0	210.0	8.58	1.171	3.1771
1.0	155.0	8.34	1.077	2.7790	1.0	211.0	8.42	0.908	3.1862
1.0	156.0	8.31	1.042	2.7894	1.0	212.0	8.34	0.729	3.1935
1.0	157.0	8.41	1.139	2.8008	1.0	213.0	8.37	0.813	3.2016
1.0	158.0	8.21	0.903	2.8099	1.0	214.0	8.33	0.958	3.2112
3.0	161.0	8.63	1.585	2.8257	3.0	217.0	8.45	1.288	3.2241
1.0	162.0	8.42	1.062	2.8363	1.0	218.0	8.36	0.939	3.2335
1.0	163.0	8.32	1.093	2.8473	1.0	219.0	8.33	0.954	3.2430
1.0	164.0	8.43	0.896	2.8562	1.0	220.0	8.42	0.997	3.2530
1.0	165.0	8.37	0.810	2.8643	1.0	221.0	8.36	0.886	3.2618
3.0	168.0	8.56	1.651	2.8808	3.0	224.0	8.43	1.476	3.2766
1.0	169.0	8.37	0.985	2.8907	1.0	225.0	8.40	0.933	3.2859
1.0	170.0	8.34	0.973	2.9004	1.0	226.0	8.41	0.892	3.2949
1.0	171.0	8.46	0.962	2.9100	1.0	227.0	8.42	0.806	3.3029
1.0	172.0	8.33	0.969	2.9236	1.0	228.0	8.33	0.745	3.3104
3.0	175.0	8.67	1.360	2.9326	3.0	231.0	8.52	1.208	3.3224
1.0	176.0	8.31	0.895	2.9415	1.0	232.0	8.38	0.888	3.3313
1.0	177.0	8.25	0.891	2.9504	1.0	233.0	8.34	0.750	3.3388
2.0	179.0	8.32	1.279	2.9632	1.0	234.0	8.35	0.725	3.3461
3.0	182.0	8.55	1.565	2.9789	1.0	235.0	8.16	0.829	3.3544
1.0	183.0	8.22	1.071	2.9896	4.0	239.0	8.42	1.461	3.3690
1.0	184.0	8.19	0.921	2.9988	1.0	240.0	8.52	0.955	3.3785
1.0	185.0	8.30	0.948	3.0083	1.0	241.0	8.23	0.780	3.3863
1.0	186.0	8.22	0.983	3.0181	1.0	242.0	8.27	0.890	3.3952
3.0	189.0	8.58	1.856	3.0367	3.0	245.0	8.32	1.281	3.4080
1.0	190.0	8.41	0.923	3.0459	1.0	246.0	8.17	0.868	3.4167
1.0	191.0	8.26	0.906	3.0550	1.0	247.0	7.96	0.911	3.4258
1.0	192.0	8.42	0.863	3.0636	1.0	248.0	8.10	0.921	3.4350
1.0	193.0	8.21	0.792	3.0715	1.0	249.0	8.12	0.910	3.4441
3.0	196.0	8.50	1.221	3.0837	3.0	252.0	8.34	1.715	3.4613
1.0	197.0	8.57	0.896	3.0930	1.0	253.0	8.23	0.941	3.4707
1.0	198.0	8.37	0.874	3.1014	1.0	254.0	8.31	1.021	3.4809
1.0	199.0	8.24	0.815	3.1096	1.0	255.0	8.23	0.928	3.4902
1.0	200.0	8.26	0.795	3.1175	1.0	256.0	8.20	0.906	3.4992
3.0	203.0	8.47	1.382	3.1314	3.0	259.0	8.42	1.248	3.5117
1.0	204.0	8.32	0.967	3.1410	1.0	260.0	8.27	0.802	3.5197

Table A-1 (Continued)

Leaching Time (days) Incremental t_n	Leaching Time (days) Cumulative Σt_n	Final pH of Leachate	Fraction Leached Incremental $(a_n/A_o) \times 10^4$	Fraction Leached Cumulative $(\Sigma a_n/A_o) \times 10^2$	Leaching Time (days) Incremental t_n	Leaching Time (days) Cumulative Σt_n	Final pH of Leachate	Fraction Leached Incremental $(a_n/A_o) \times 10^4$	Fraction Leached Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	261.0	8.29	0.754	3.5273	1.0	316.0	8.31	0.7973	3.8919
1.0	262.0	8.12	0.918	3.5364	1.0	317.0	8.20	0.7508	3.8993
1.0	263.0	8.17	0.826	3.5447	1.0	318.0	8.10	0.7652	3.9070
3.0	266.0	8.25	1.3389	3.5581	1.0	319.0	8.39	0.7601	3.9146
1.0	267.0	8.21	1.0556	3.5687	3.0	322.0	8.55	1.1716	3.9263
1.0	268.0	8.25	1.0179	3.5788	1.0	323.0	8.30	0.7863	3.9342
1.0	269.0	8.30	0.8008	3.5868	1.0	324.0	8.15	0.8209	3.9424
1.0	270.0	8.40	0.8035	3.5949	5.0	329.0	8.44	1.6214	3.9586
3.0	273.0	8.46	1.4227	3.6091	1.0	330.0	8.26	0.9892	3.9685
1.0	274.0	8.47	0.8845	3.6180	1.0	331.0	8.10	0.8898	3.9774
1.0	275.0	8.14	0.8517	3.6265	1.0	332.0	8.23	0.8362	3.9858
1.0	276.0	8.16	0.8116	3.6346	1.0	333.0	8.19	0.8263	3.9403
1.0	277.0	8.10	0.7853	3.6424	3.0	336.0	8.29	1.2806	4.0068
3.0	280.0	8.23	1.1894	3.6543	1.0	337.0	8.16	0.9411	4.0162
1.0	281.0	8.11	0.8076	3.6624	1.0	338.0	8.14	0.8935	4.0252
1.0	282.0	8.16	0.7615	3.6700	1.0	339.0	8.10	0.7356	4.0325
1.0	283.0	8.16	0.7615	3.6776	1.0	340.0	8.06	0.7983	4.0405
1.0	284.0	8.17	0.7363	3.6850	3.0	343.0	8.55	1.1679	4.0522
3.0	287.0	8.34	1.3367	3.6984	1.0	344.0	8.22	0.7108	4.0593
1.0	288.0	8.38	0.9134	3.7075	1.0	345.0	8.47	0.7791	4.0671
1.0	289.0	8.21	0.7709	3.7152	1.0	346.0	8.07	0.6595	4.0737
1.0	290.0	8.27	0.8918	3.7241	1.0	347.0	8.00	0.7001	4.0807
1.0	291.0	8.24	0.7882	3.7320	13.0	360.0	8.76	2.3425	4.0830
3.0	294.0	8.29	1.0687	3.7427	1.0	361.0	8.42	0.7001	4.0900
1.0	295.0	8.28	0.9164	3.7519	3.0	364.0	8.73	1.5360	4.1054
1.0	296.0	8.23	0.8107	3.7600	1.0	365.0	8.17	0.8873	4.1143
1.0	297.0	8.20	0.8995	3.7690	1.0	366.0	8.57	0.7896	4.1222
1.0	298.0	8.21	0.6893	3.7759	1.0	367.0	8.20	0.8325	4.1305
3.0	301.0	8.44	1.5694	3.7916	1.0	368.0	8.13	0.8188	4.1387
1.0	302.0	8.35	0.9332	3.8009	3.0	371.0	8.45	1.4054	4.1527
1.0	303.0	8.29	0.8417	3.8093	1.0	372.0	8.24	0.9020	4.1618
1.0	304.0	8.28	0.8460	3.8178	1.0	373.0	8.21	0.7539	4.1693
1.0	305.0	8.24	0.6289	3.8241	1.0	374.0	8.16	0.8078	4.1774
3.0	308.0	8.46	1.2426	3.8365	4.0	378.0	8.53	1.4712	4.1921
1.0	309.0	8.28	1.2405	3.8489	1.0	379.0	8.27	0.8061	4.2001
1.0	310.0	8.39	0.7881	3.8568	1.0	380.0	8.35	0.7430	4.2076
1.0	311.0	8.28	0.7669	3.8644	1.0	381.0	8.14	0.7011	4.2146
1.0	312.0	8.42	0.8068	3.8725	1.0	382.0	8.15	0.7125	4.2217
3.0	315.0	8.39	1.1379	3.8839	3.0	385.0	8.55	1.2463	4.2342

Table A-1 (Continued)

Leaching Time (days) Incremental t_n	Leaching Time (days) Cumulative Σt_n	Final pH of Leachate	Fraction Leached Incremental $(a_n/A_o) \times 10^4$	Fraction Leached Cumulative $(\Sigma a_n/A_o) \times 10^2$	Leaching Time (days) Incremental t_n	Leaching Time (days) Cumulative Σt_n	Final pH of Leachate	Fraction Leached Incremental $(a_n/A_o) \times 10^4$	Fraction Leached Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	386.0	8.16	0.7207	4.2414	1.0	442.0	8.26	0.9262	4.5635
1.0	387.0	8.09	0.7745	4.2491	1.0	443.0	8.20	0.7472	4.5709
1.0	388.0	8.12	0.8377	4.2575	1.0	444.0	8.38	0.6837	4.5778
1.0	389.0	8.08	0.6070	4.2636	4.0	448.0	8.53	1.4940	4.5927
3.0	392.0	8.46	1.2292	4.2759	1.0	449.0	8.39	0.7396	4.6001
1.0	393.0	8.07	0.8212	4.2841	1.0	450.0	8.30	0.6680	4.6068
1.0	394.0	8.27	0.6765	4.2908	1.0	451.0	8.34	0.7440	4.6142
1.0	395.0	8.29	0.7143	4.2980	1.0	452.0	8.21	0.6215	4.6204
1.0	396.0	8.25	0.6681	4.3047	3.0	455.0	7.83	1.0828	4.6313
3.0	399.0	8.44	1.1735	4.3164	1.0	456.0	7.66	0.5935	4.6372
1.0	400.0	8.21	0.7227	4.3236	1.0	457.0	7.74	0.6792	4.6440
1.0	401.0	8.22	0.6715	4.3303	1.0	458.0	7.79	0.7167	4.6512
1.0	402.0	8.24	0.6715	4.3371	1.0	459.0	7.91	0.7100	4.6583
1.0	403.0	8.31	0.7020	4.3441	3.0	462.0	7.97	1.2785	4.6710
4.0	407.0	8.45	1.3206	4.3573	1.0	463.0	8.06	0.6959	4.6780
1.0	408.0	8.26	0.7837	4.3651	1.0	464.0	8.12	0.6099	4.6841
1.0	409.0	8.35	0.6989	4.3721	1.0	465.0	8.04	0.6782	4.6909
1.0	410.0	8.27	0.9584	4.3817	1.0	466.0	8.03	0.9102	4.7000
3.0	413.0	8.47	1.7635	4.3993	3.0	469.0	8.11	1.3440	4.7134
1.0	414.0	8.17	0.7480	4.4068	1.0	470.0	8.09	0.8031	4.7215
1.0	415.0	8.28	0.7921	4.4147	1.0	471.0	8.24	0.8625	4.7301
1.0	416.0	8.22	0.6735	4.4215	1.0	472.0	8.36	0.7187	4.7373
1.0	417.0	8.20	0.7388	4.4289	1.0	473.0	8.30	0.6384	4.7437
3.0	420.0	8.48	1.1130	4.4400	3.0	476.0	8.22	1.0448	4.7541
1.0	421.0	8.27	0.6353	4.4463	1.0	477.0	7.67	0.6536	4.7606
1.0	422.0	8.28	0.6508	4.4528	1.0	478.0	8.04	0.5844	4.7665
1.0	423.0	8.29	0.6491	4.4593	1.0	479.0	8.04	0.4940	4.7714
1.0	424.0	8.40	0.7312	4.4666	1.0	480.0	8.03	0.5635	4.7771
3.0	427.0	8.23	1.1178	4.4778	3.0	483.0	8.20	0.8349	4.7854
1.0	428.0	8.29	0.6555	4.4844	1.0	484.0	7.98	0.5701	4.7911
1.0	429.0	8.40	0.6120	4.4905	1.0	485.0	8.03	0.5429	4.7965
1.0	430.0	8.23	0.5811	4.4963	1.0	486.0	8.06	0.6412	4.8030
1.0	431.0	8.26	0.5824	4.5021	1.0	487.0	8.16	0.6246	4.8092
3.0	434.0	8.34	1.1165	4.5133	3.0	490.0	7.98	1.0394	4.8196
1.0	435.0	8.23	0.8050	4.5214	1.0	491.0	7.97	0.5744	4.8253
1.0	436.0	8.03	0.3995	4.5253	1.0	492.0	7.98	0.6608	4.8319
1.0	437.0	8.04	0.6979	4.5323	1.0	493.0	8.03	0.5397	4.8373
1.0	438.0	8.10	0.7311	4.5396	1.0	494.0	8.05	0.5481	4.8428
3.0	441.0	8.45	1.4563	4.5542	3.0	497.0	8.14	0.9758	4.8526

Table A-1 (Continued)

Leaching Time (days)		Final pH of Leachate	Fraction Leached		Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^2$	Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	498.0	8.07	0.5742	4.8583	1.0	526.0	8.06	0.5834	4.9862
1.0	499.0	8.13	0.6058	4.8644	1.0	527.0	8.01	0.6285	4.9925
1.0	500.0	8.16	0.5001	4.8694	1.0	528.0	8.08	0.5738	4.9982
1.0	501.0	8.19	0.6211	4.8756	1.0	529.0	8.03	0.5203	5.0034
4.0	505.0	8.19	1.1052	4.8866	3.0	532.0	8.16	0.9629	5.0130
1.0	506.0	8.12	0.6308	4.8930	1.0	533.0	8.09	0.6239	5.0193
1.0	507.0	7.97	0.6300	4.8992	1.0	534.0	8.07	0.5667	5.0249
1.0	508.0	8.08	0.6364	4.9056	1.0	535.0	8.02	0.5709	5.0306
3.0	511.0	8.17	1.0419	4.9160	1.0	536.0	8.12	0.5338	5.0360
1.0	512.0	8.12	0.6313	4.9224	3.0	539.0	8.14	0.9066	5.0450
1.0	513.0	8.11	0.5134	4.9275	1.0	540.0	8.07	0.5605	5.0506
1.0	514.0	8.04	0.5677	4.9332	1.0	541.0	8.13	0.5325	5.0560
1.0	515.0	8.11	0.5762	4.9389	1.0	542.0	8.14	0.5571	5.0616
3.0	518.0	8.18	0.9253	4.9482	4.0	546.0	8.26	0.8880	5.0704
1.0	519.0	8.09	0.6060	4.9542	1.0	547.0	8.11	0.6200	5.0766
1.0	520.0	8.11	0.5836	4.9601	1.0	548.0	8.08	0.6172	5.0828
1.0	521.0	8.10	0.5477	4.9656	1.0	549.0	8.12	0.5447	5.0882
1.0	522.0	8.07	0.5565	4.9711	1.0	550.0	8.20	0.5509	5.0938
3.0	525.0	8.16	0.9229	4.9803					

Table A-2. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-12

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.10 mCi
Mass: 137 g (as prepared)
Volume: 98 cm^3
Exposed Surface Area: 19.6 cm^2

Curing Time 365 days

Leachant 150 ml tap water, 1 change/day (initial pH = 7.59 - 8.48)

Leaching Time (days)		Final pH of Leachate	Fraction Leached		Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^5$	Cumulative $(\Sigma a_n/A_o) \times 10^2$	Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^5$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	1.0	9.91	249.4	0.2494	1.0	43.0	9.28	6.900	0.6630
1.0	2.0	10.02	85.78	0.3352	1.0	44.0	9.24	11.18	0.6742
1.0	3.0	10.15	39.62	0.3748	1.0	45.0	9.07	8.510	0.6827
3.0	6.0	10.57	38.12	0.4129	3.0	48.0	9.27	12.24	0.6950
1.0	7.0	10.21	14.79	0.4277	1.0	49.0	8.53	6.090	0.7011
1.0	8.0	10.14	14.38	0.4421	1.0	50.0	8.88	9.030	0.7101
1.0	9.0	10.04	10.96	0.4531	1.0	51.0	8.77	8.790	0.7189
1.0	10.0	9.95	9.830	0.4629	1.0	52.0	8.84	10.85	0.7297
3.0	13.0	10.26	19.45	0.4823	3.0	55.0	8.75	16.28	0.7460
1.0	14.0	9.87	10.71	0.4930	1.0	56.0	8.58	7.140	0.7532
1.0	15.0	9.94	8.720	0.5018	1.0	57.0	8.69	6.930	0.7601
1.0	16.0	9.77	8.470	0.5102	1.0	58.0	8.69	9.840	0.7699
1.0	17.0	9.71	8.060	0.5183	1.0	59.0	8.67	7.500	0.7774
3.0	20.0	10.04	14.00	0.5323	3.0	62.0	8.46	13.91	0.7913
1.0	21.0	9.72	7.720	0.5400	1.0	63.0	8.29	9.260	0.8006
1.0	22.0	9.68	6.490	0.5465	1.0	64.0	8.57	9.420	0.8100
1.0	23.0	9.63	6.650	0.5532	1.0	65.0	8.54	8.940	0.8190
1.0	24.0	9.53	7.390	0.5606	1.0	66.0	8.49	9.390	0.8283
3.0	27.0	9.84	13.40	0.5740	3.0	69.0	8.24	12.97	0.8413
1.0	28.0	9.58	5.760	0.5797	1.0	70.0	8.10	10.250	0.8516
1.0	29.0	9.54	5.760	0.5855	1.0	71.0	8.22	8.460	0.8600
2.0	31.0	9.73	9.860	0.5953	1.0	72.0	8.29	9.910	0.8699
3.0	34.0	9.73	14.97	0.6103	1.0	73.0	8.31	10.28	0.8802
1.0	35.0	9.33	6.850	0.6172	3.0	76.0	8.19	15.58	0.8958
1.0	36.0	9.34	7.430	0.6246	1.0	77.0	8.17	9.920	0.9057
1.0	37.0	9.33	7.020	0.6316	1.0	78.0	8.25	12.20	0.9179
1.0	38.0	9.34	7.840	0.6394	1.0	79.0	8.27	8.980	0.9269
3.0	41.0	9.48	10.55	0.6500	1.0	80.0	8.24	10.25	0.9371
1.0	42.0	9.20	6.150	0.6561	3.0	83.0	8.12	15.78	0.9529

Table A-2 (Continued)

Leaching Time (days) Incremental t_n	Leaching Time (days) Cumulative Σt_n	Final pH of Leachate	Fraction Leached Incremental $(a_n/A_o) \times 10^5$	Fraction Leached Cumulative $(\Sigma a_n/A_o) \times 10^2$	Leaching Time (days) Incremental t_n	Leaching Time (days) Cumulative Σt_n	Final pH of Leachate	Fraction Leached Incremental $(a_n/A_o) \times 10^5$	Fraction Leached Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	84.0	8.15	11.56	0.9645	1.0	140.0	8.08	8.973	1.4056
1.0	85.0	8.16	11.16	0.9756	1.0	141.0	7.83	9.586	1.4152
1.0	86.0	8.17	12.08	0.9877	1.0	142.0	8.10	10.72	1.4259
1.0	87.0	8.12	8.720	0.9964	1.0	143.0	7.81	11.33	1.4373
4.0	91.0	8.12	16.76	1.0132	3.0	146.0	7.76	13.68	1.4510
1.0	92.0	8.07	8.890	1.0220	1.0	147.0	8.01	9.461	1.4604
1.0	93.0	7.99	8.040	1.0301	1.0	148.0	7.88	8.512	1.4689
1.0	94.0	8.08	8.460	1.0386	1.0	149.0	7.93	8.408	1.4773
3.0	97.0	7.84	13.86	1.0524	1.0	150.0	7.84	7.667	1.4850
1.0	98.0	7.71	10.32	1.0628	3.0	153.0	7.86	13.64	1.4986
1.0	99.0	7.72	8.040	1.0708	1.0	154.0	8.10	8.417	1.5071
1.0	100.0	7.84	9.740	1.0806	1.0	155.0	7.90	8.861	1.5159
1.0	101.0	7.84	10.76	1.0913	1.0	156.0	7.92	8.664	1.5246
3.0	104.0	7.82	16.73	1.1080	1.0	157.0	8.00	7.512	1.5321
1.0	105.0	7.82	10.01	1.1180	3.0	160.0	8.04	13.01	1.5451
1.0	106.0	7.92	13.14	1.1312	1.0	161.0	7.96	9.870	1.555
1.0	107.0	7.95	13.14	1.1443	1.0	162.0	8.06	9.444	1.5644
1.0	108.0	8.00	11.30	1.1556	1.0	163.0	8.03	8.516	1.5730
3.0	111.0	7.95	16.54	1.1722	1.0	164.0	8.13	10.17	1.5831
1.0	112.0	7.91	7.790	1.1800	3.0	167.0	8.07	12.61	1.5957
1.0	113.0	7.91	10.08	1.1900	1.0	168.0	8.05	7.725	1.6035
1.0	114.0	7.77	12.37	1.2024	1.0	169.0	8.04	7.826	1.6113
1.0	115.0	7.91	12.28	1.2147	1.0	170.0	8.08	8.342	1.6196
3.0	118.0	7.81	17.17	1.2319	1.0	171.0	8.20	8.739	1.6284
1.0	119.0	7.92	14.45	1.2463	3.0	174.0	8.25	12.32	1.6407
1.0	120.0	7.91	9.318	1.2556	1.0	175.0	8.24	8.973	1.6497
1.0	121.0	7.93	9.957	1.2656	1.0	176.0	8.14	9.432	1.6591
1.0	122.0	8.60	9.132	1.2747	5.0	181.0	8.08	17.99	1.6771
3.0	125.0	8.05	16.49	1.2912	1.0	182.0	8.04	8.534	1.6856
1.0	126.0	8.08	10.23	1.3014	1.0	183.0	7.98	10.01	1.6956
1.0	127.0	7.91	10.69	1.3121	1.0	184.0	8.03	9.839	1.7055
1.0	128.0	7.89	9.415	1.3216	1.0	185.0	8.05	9.882	1.7154
1.0	129.0	7.92	7.546	1.3291	3.0	188.0	8.11	13.35	1.7287
3.0	132.0	7.83	14.88	1.3440	1.0	189.0	8.02	9.121	1.7378
1.0	133.0	7.88	11.74	1.3557	1.0	190.0	8.03	9.714	1.7476
1.0	134.0	7.91	8.694	1.3644	1.0	191.0	7.98	7.988	1.7555
1.0	135.0	7.84	8.270	1.3727	1.0	192.0	8.08	7.787	1.7633
1.0	136.0	7.86	9.373	1.3821	3.0	195.0	8.17	12.76	1.7761
3.0	139.0	7.83	14.57	1.3966	1.0	196.0	8.06	7.653	1.7837

Table A-2 (Continued)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^5$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	197.0	8.32	9.298	1.7930
1.0	198.0	7.99	8.345	1.8014
1.0	199.0	7.98	7.237	1.8086
13.0	212.0	8.02	26.26	1.8349
1.0	213.0	8.10	6.917	1.8418
3.0	216.0	8.35	13.19	1.8550
1.0	217.0	8.11	8.718	1.8637
1.0	218.0	8.39	9.021	1.8727
1.0	219.0	8.01	7.073	1.8798
1.0	220.0	7.89	7.454	1.8873
3.0	223.0	8.09	15.34	1.9026
1.0	224.0	8.05	9.957	1.9126
1.0	225.0	8.09	7.713	1.9203
1.0	226.0	8.06	7.310	1.9276
4.0	230.0	8.14	16.40	1.9440
1.0	231.0	8.10	8.231	1.9522
1.0	232.0	8.24	7.976	1.9602
1.0	233.0	8.07	7.336	1.9676
1.0	234.0	8.13	7.336	1.9749
3.0	237.0	8.18	14.61	1.9895
1.0	238.0	8.03	9.669	1.9992
1.0	239.0	8.11	10.46	2.0096
1.0	240.0	8.08	10.65	2.0203
1.0	241.0	8.05	7.646	2.0279
3.0	244.0	8.17	12.61	2.0406
1.0	245.0	7.95	7.626	2.0482
1.0	246.0	8.06	8.180	2.0564
1.0	247.0	8.18	7.952	2.0643
1.0	248.0	8.07	7.710	2.0720
3.0	251.0	8.28	13.36	2.0854
1.0	252.0	8.09	8.508	2.0939
1.0	253.0	8.08	9.241	2.1031
1.0	254.0	8.11	8.273	2.1114
1.0	255.0	8.15	8.358	2.1198
4.0	259.0	8.21	17.54	2.1373
1.0	260.0	8.15	9.272	2.1466
1.0	261.0	8.15	9.069	2.1556
1.0	262.0	8.16	10.84	2.1665
3.0	265.0	8.26	20.49	2.1870
1.0	266.0	8.17	8.097	2.1951
1.0	267.0	8.14	7.527	2.2026
1.0	268.0	8.17	6.627	2.2092
1.0	269.0	8.10	6.903	2.2161
3.0	272.0	8.38	13.04	2.2292
1.0	273.0	8.16	7.958	2.2372
1.0	274.0	8.20	7.510	2.2447
1.0	275.0	8.20	7.334	2.2520
1.0	276.0	8.25	8.662	2.2607
3.0	279.0	8.30	11.58	2.2722
1.0	280.0	8.18	5.543	2.2778
1.0	281.0	8.21	5.697	2.2835
1.0	282.0	8.15	5.271	2.2888
1.0	283.0	8.13	7.071	2.2958
3.0	286.0	8.21	11.26	2.3071
1.0	287.0	8.16	9.296	2.3164
1.0	288.0	8.03	7.304	2.3237
1.0	289.0	7.89	8.393	2.3321
1.0	290.0	7.89	17.30	2.3494
3.0	293.0	8.03	9.974	2.3594
1.0	294.0	7.90	12.20	2.3716
1.0	295.0	7.81	8.918	2.3805
1.0	296.0	8.06	7.516	2.3880
4.0	300.0	8.18	16.71	2.4047
1.0	301.0	8.14	7.181	2.4119
1.0	302.0	8.13	9.783	2.4217
1.0	303.0	8.22	10.12	2.4318
1.0	304.0	8.08	6.987	2.4388
3.0	307.0	7.83	13.26	2.4520
1.0	308.0	7.78	8.125	2.4602
1.0	309.0	7.91	8.009	2.4682
1.0	310.0	7.91	8.785	2.4770
1.0	311.0	7.85	9.816	2.4868
3.0	314.0	7.89	14.54	2.5013
1.0	315.0	7.96	7.528	2.5088
1.0	316.0	8.03	9.022	2.5179
1.0	317.0	8.00	9.022	2.5269
1.0	318.0	8.07	12.38	2.5393
3.0	321.0	8.05	16.54	2.5558
1.0	322.0	8.08	10.18	2.5660
1.0	323.0	8.08	10.28	2.5763

Table A-2 (Continued)

Leaching Time (days)		Final pH of Leachate	Fraction Leached		Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^5$	Cumulative $(\Sigma a_n/A_o) \times 10^2$	Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^5$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	324.0	8.13	9.878	2.5862	1.0	346.0	8.05	7.340	2.7189
1.0	325.0	8.02	7.964	2.5941	3.0	349.0	8.12	10.13	2.7291
3.0	328.0	8.05	13.67	2.6078	1.0	350.0	8.05	7.280	2.7364
1.0	329.0	7.94	9.168	2.6170	1.0	351.0	8.17	7.892	2.7442
1.0	330.0	8.08	7.680	2.6246	1.0	352.0	8.13	7.445	2.7517
1.0	331.0	8.06	5.173	2.6298	1.0	353.0	8.10	6.468	2.7582
1.0	332.0	8.03	8.123	2.6380	4.0	357.0	8.19	12.99	2.7712
3.0	335.0	8.13	10.44	2.6484	1.0	358.0	8.15	7.874	2.7790
1.0	336.0	8.04	6.558	2.6550	1.0	359.0	8.05	7.814	2.7868
1.0	337.0	8.04	5.999	2.6610	1.0	360.0	8.19	7.788	2.7946
1.0	338.0	8.12	8.686	2.6696	3.0	363.0	8.27	17.73	2.8124
1.0	339.0	8.16	7.715	2.6774	1.0	364.0	8.16	8.345	2.8207
3.0	342.0	8.05	12.11	2.6895	1.0	365.0	8.07	6.007	2.8267
1.0	343.0	8.10	6.180	2.6956	1.0	366.0	8.11	7.356	2.8341
1.0	344.0	8.06	8.052	2.7037	1.0	367.0	8.20	7.511	2.8416
1.0	345.0	8.08	7.894	2.7116					

Table A-3. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-22A

Specimen · Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 10 days

Leachant 150 ml of tap water; 2 changes/day for 10 days, then daily (initial pH = 7.97 - 8.29)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
0.33	0.33	11.73	139.18	1.3918
0.67	1.00	11.53	55.50	1.9468
0.33	1.33	9.75	7.005	2.0168
0.67	2.00	10.22	9.342	2.1103
0.33	2.33	9.27	3.096	2.1413
0.67	3.00	9.77	6.110	2.2024
0.33	3.33	8.92	2.356	2.2260
0.67	4.00	9.37	4.391	2.2699
0.33	4.33	8.79	1.571	2.2856
2.67	7.00	9.53	8.118	2.3668
0.33	7.33	8.43	1.030	2.3771
0.67	8.00	8.94	1.271	2.3898
0.33	8.33	8.58	0.552	2.3953
0.67	9.00	8.89	1.082	2.4061
1.0	10.0	8.94	1.408	2.4202
1.0	11.0	8.92	1.386	2.4340
3.0	14.0	9.17	3.445	2.4685
1.0	15.0	8.81	1.003	2.4785
1.0	16.0	8.70	0.692	2.4854
1.0	17.0	8.70	0.562	2.4911
1.0	18.0	8.61	0.627	2.4973

Table A-4. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-22B

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 10 days

Leachant 150 ml of tap water; 2 changes/day for 10 days, then daily (initial pH = 7.97 - 8.29)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
0.33	0.33	11.76	30.088	3.0088
0.67	1.00	11.53	13.912	4.4000
0.33	1.33	9.75	1.795	4.5795
0.67	2.00	10.15	2.253	4.8048
0.33	2.33	9.18	0.678	4.8726
0.67	3.00	9.62	1.343	5.0069
0.33	3.33	8.82	0.508	5.0577
0.67	4.00	8.72	0.950	5.1527
0.33	4.33	9.21	0.298	5.1825
2.67	7.00	9.36	1.861	5.3686
0.33	7.33	8.42	0.154	5.3840
0.67	8.00	8.95	0.310	5.4150
0.33	8.33	8.59	0.104	5.4254
0.67	9.00	8.90	0.325	5.4579
1.0	10.0	8.94	0.409	5.4988
1.0	11.0	8.94	0.348	5.5336
3.0	14.0	9.11	0.993	5.6329
1.0	15.0	8.78	0.243	5.6572
1.0	16.0	8.78	0.255	5.6827
1.0	17.0	8.73	0.159	5.6986
1.0	18.0	8.69	0.176	5.7162

Table A-5. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-22C

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 10 days

Leachant 150 ml of tap water; 2 changes/day for 10 days, then daily (initial pH = 7.97 - 8.29)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^5$	Cumulative $(\Sigma a_n/A_o) \times 10^3$
0.33	0.33	11.76	53.547	0.5354
0.67	1.00	11.35	27.384	0.8093
0.33	1.33	9.67	6.034	0.8696
0.67	2.00	10.11	5.00	0.9196
0.33	2.33	9.15	3.663	0.9562
0.67	3.00	9.63	4.360	0.9998
0.33	3.33	8.84	1.228	1.0121
0.67	4.00	8.79	3.663	1.0487
0.33	4.33	9.32	1.941	1.0682
2.67	7.00	9.66	6.176	1.1299
0.33	7.33	8.49	0.904	1.1390
0.67	8.00	8.98	1.807	1.1570
0.33	8.33	8.60	3.072	1.1877
0.67	9.00	8.92	0.904	1.1968
1.0	10.0	8.96	1.180	1.2086
4.0	14.0	9.14	2.224	1.2308
1.0	15.0	8.82	1.552	1.2463
1.0	16.0	a	0.429	a
1.0	17.0	a	2.012	a
1.0	18.0	9.07	2.690	1.2732

[a]Removed aliquot of leachate, counted it, and returned it to the specimen without measuring the pH.

Table A-6. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-22E

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 10 days

Leachant 150 ml of tap water; 2 changes/day for 10 days, then daily (initial pH = 7.97 - 8.29)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^3$
0.33	0.33	11.72	18.018	1.8018
0.67	1.00	11.50	13.667	3.1685
0.33	1.33	9.70	1.807	3.3492
0.67	2.00	10.03	2.754	3.6246
0.33	2.33	9.06	0.684	3.6930
0.67	3.00	9.50	1.281	3.8211
0.33	3.33	8.73	1.035	3.9246
0.67	4.00	9.20	0.789	4.0035
0.33	4.33	8.67	0.335	4.0370
2.67	7.00	9.38	1.959	4.2329
0.33	7.33	8.46	0.304	4.2633
0.67	8.00	8.91	0.946	4.3579
0.33	8.33	8.60	0.054	4.3633
0.67	9.00	8.88	0.482	4.4115
1.0	10.0	8.94	0.489	4.4604
1.0	11.0	8.91	0.559	4.5163
3.0	14.0	9.10	1.554	4.6717
1.0	15.0	8.80	0.295	4.7012
1.0	16.0	a	0.325	a
1.0	17.0	8.97	0.510	4.7522
1.0	18.0	8.72	0.473	4.7995

[a]Removed aliquot of leachate, counted it, and returned it to the specimen without measuring the pH.

Table A-7. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-22F

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 10 days

Leachant 150 ml of tap water; 2 changes/day for 10 days, then daily (initial pH = 7.97 - 8.29)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
0.33	0.33	11.73	147.77	1.4777
0.67	1.00	11.50	79.035	2.2680
0.33	1.33	9.72	8.158	2.3496
0.67	2.00	10.16	13.596	2.4856
0.33	2.33	9.17	3.316	2.5187
0.67	3.00	9.61	7.632	2.5950
0.33	3.33	8.79	2.382	2.6189
0.67	4.00	9.24	6.018	2.6790
0.33	4.33	8.69	1.367	2.6927
2.67	7.00	9.38	9.107	2.7838
0.33	7.33	8.44	0.855	2.7923
0.67	8.00	8.91	1.657	2.8089
0.33	8.33	8.56	0.621	2.8151
0.67	9.00	8.87	1.402	2.8291
1.0	10.0	8.93	2.322	2.8523
1.0	11.0	8.89	1.858	2.8709
3.0	14.0	9.08	4.081	2.9117
1.0	15.0	8.30	0.297	2.9147
1.0	16.0	a	2.102	a
1.0	17.0	9.07	3.704	2.9517
1.0	18.0	8.76	0.786	2.9596

[a]Removed aliquot of leachate, counted it, and returned it to the specimen without measuring the pH.

Table A-8. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-22G

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 10 days

Leachant 150 ml of tap water; 2 changes/day for 10 days, then daily (initial pH = 7.97 - 8.29)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^3$
0.33	0.33	11.72	15.034	1.5034
0.67	1.00	11.57	8.598	2.3632
0.33	1.33	9.72	1.750	2.5382
0.67	2.00	9.94	1.683	2.7065
0.33	2.33	8.97	0.624	2.7689
0.67	3.00	9.43	0.792	2.8481
0.33	3.33	8.69	0.419	2.8900
0.67	4.00	9.15	0.821	2.9721
0.33	4.33	8.64	0.285	3.0006
2.67	7.00	9.39	1.123	3.1129
0.33	7.33	8.50	0.203	3.1332
0.67	8.00	8.87	0.424	3.1756
0.33	8.33	8.52	0.288	3.2044
0.67	9.00	8.83	0.356	3.2400
1.0	10.0	8.87	0.373	3.2773
1.0	11.0	8.84	0.399	3.3172
3.0	14.0	9.03	0.412	3.3584
1.0	15.0	8.75	0.310	3.3894
1.0	16.0	a	0.244	3.4138
1.0	17.0	8.95	0.323	3.4461
1.0	18.0	8.65	b	3.4461

[a]Did not measure pH.

[b]Activity was too low to measure.

Table A-9. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-27A-1

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 60 days

Leachant 200 ml tap water; 1 change/day (initial pH = 8.00 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	1.0	10.23	18.005	1.8005
1.0	2.0	9.62	7.4582	2.5463
1.0	3.0	9.37	5.8316	3.1295
1.0	4.0	9.37	4.8531	3.6148
1.0	5.0	9.20	3.7825	3.9930
1.0	6.0	9.14	3.7281	4.3658
1.0	7.0	9.14	3.5374	4.7196
1.0	8.0	9.08	3.2994	5.0495
1.0	9.0	9.06	3.0519	5.3547
1.0	10.0	9.01	3.0181	5.6565

Table A-10. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-27A-2

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)

Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 60 days

Leachant 200 ml tap water; 2 changes/day (initial pH = 8.00 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
0.5	0.5	10.01	14.774	1.4774
0.5	1.0	9.40	5.0016	1.9776
0.5	1.5	9.20	3.8562	2.3632
0.5	2.0	9.12	3.2331	2.6865
0.5	2.5	8.99	2.9174	2.9782
0.5	3.0	8.97	2.5990	3.2381
0.5	3.5	8.92	2.3764	3.4758
0.5	4.0	8.86	2.0383	3.6796
0.5	4.5	8.84	1.8541	3.8650
0.5	5.0	8.89	1.7865	4.0437
0.5	5.5	8.82	1.7637	4.2200
0.5	6.0	8.83	1.5149	4.3715
0.5	6.5	8.81	1.6964	4.5412
0.5	7.0	8.79	1.5412	4.6953
0.5	7.5	8.70	1.6068	4.8560
0.5	8.0	8.71	1.5276	5.0087
0.5	8.5	8.63	1.5370	5.1624
0.5	9.0	8.76	1.4263	5.3050
0.5	9.5	8.72	1.5209	5.4571
0.5	10.0	8.69	1.3179	5.5889

Table A-11. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-27A-4

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 60 days

Leachant 200 ml tap water; 4 changes/day (initial pH = 8.00 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
0.25	0.25	9.87	118.84	1.1884
0.25	0.50	9.21	35.814	1.5465
0.25	0.75	9.06	23.892	1.7855
0.25	1.00	8.97	20.393	1.9894
0.25	1.25	8.90	19.680	2.1862
0.25	1.50	8.72	18.707	2.3733
0.25	1.75	8.73	15.100	2.5243
0.25	2.00	8.79	13.444	2.6587
0.25	2.25	8.67	12.346	2.7822
0.25	2.50	8.61	12.971	2.9119
0.25	2.75	8.66	12.234	3.0342
0.25	3.00	8.65	12.615	3.1604
0.25	3.25	8.58	11.739	3.2778
0.25	3.50	8.61	11.402	3.3918
0.25	3.75	8.59	10.706	3.4988
0.25	4.00	8.63	9.5353	3.5942
0.25	4.25	8.54	9.8628	3.6928
0.25	4.50	8.54	8.9662	3.7825
0.25	4.75	8.62	8.5771	3.8682
0.25	5.00	8.60	8.5094	3.9533
0.25	5.25	8.52	8.5433	4.0388
0.25	5.50	8.51	7.6297	4.1151
0.25	5.75	8.58	7.7820	4.1929
0.25	6.00	8.60	7.0038	4.2629
0.25	6.25	8.50	8.5094	4.3480
0.25	6.50	8.48	8.0984	4.4290
0.25	6.75	8.42	7.5270	4.5043
0.25	7.00	8.53	7.8327	4.5826
0.25	7.25	8.37	7.5622	4.6582
0.25	7.50	8.33	7.2590	4.7308
0.25	7.75	8.29	7.7643	4.8085
0.25	8.00	8.46	6.8716	4.8772
0.25	8.25	8.39	7.7143	4.9543
0.25	8.50	8.43	7.9512	5.0338
0.25	8.75	8.46	7.0715	5.1045
0.25	9.00	8.47	7.5113	5.1797
0.25	9.25	8.41	7.6974	5.2566
0.25	9.50	8.49	7.0376	5.3270
0.25	9.75	8.50	6.9869	5.3969
0.25	10.00	8.41	7.5113	5.4720

Table A-12. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-27B-1a

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 60 days

Leachant 200 ml tap water; 1 change/day (initial pH = 8.00 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	1.0	10.36	6.5805	0.6580
1.0	2.0	9.69	4.1956	1.0776
1.0	3.0	9.40	3.8214	1.4598
2.0	5.0	9.62	5.1644	1.9662
1.0	6.0	9.15	2.2393	2.1901
1.0	7.0	9.12	2.2084	2.4110
1.0	8.0	9.04	1.9932	2.6103
1.0	9.0	9.04	2.0343	2.8137
1.0	10.0	9.01	2.0461	3.0183

Table A-13. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-27B-1b

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 60 days

Leachant 200 ml tap water; 1 change/day (initial pH = 8.00 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	1.0	10.39	7.1402	0.7140
1.0	2.0	9.73	4.4328	1.1573
1.0	3.0	9.49	3.7261	1.5299
1.0	4.0	9.31	3.2187	1.8518
1.0	5.0	9.22	2.6370	2.1155
1.0	6.0	9.20	2.4478	2.3603
1.0	7.0	9.19	2.3279	2.5930
1.0	8.0	9.08	2.1133	2.8044
1.0	9.0	9.08	2.0597	3.0104
1.0	10.0	9.05	2.0837	3.2187

Table A-14. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-27B-1c

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 60 days

Leachant 200 ml tap water; 1 change/day (initial pH = 8.00 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	1.0	10.34	6.5279	0.6528
1.0	2.0	9.66	3.8613	1.0389
1.0	3.0	9.40	3.3904	1.3780
1.0	4.0	9.30	2.6891	1.6469
1.0	5.0	9.23	2.2972	1.8766
1.0	6.0	9.13	1.9197	2.0686
1.0	7.0	9.18	1.8411	2.2527
1.0	8.0	9.08	1.8766	2.4403
1.0	9.0	9.07	1.6522	2.6056
1.0	10.0	9.03	1.8241	2.7880

Table A-15. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-27B-2

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 60 days

Leachant 200 ml tap water; 2 changes/day (initial pH = 8.00 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
0.5	0.5	9.95	4.0325	0.4032
0.5	1.0	9.38	2.3232	0.6356
0.5	1.5	9.21	2.0567	0.8412
0.5	2.0	9.13	1.8064	1.0219
0.5	2.5	9.04	1.6991	1.1918
0.5	3.0	9.01	1.6038	1.3522
0.5	3.5	8.98	1.4877	1.5009
0.5	4.0	8.92	1.4143	1.6424
0.5	4.5	8.86	1.1904	1.7614
0.5	5.0	8.88	1.1955	1.8810
0.5	5.5	8.84	1.1101	1.9920
0.5	6.0	8.77	1.0406	2.0960
0.5	6.5	8.81	1.0787	2.2039
0.5	7.0	8.77	1.0657	2.3105
0.5	7.5	8.74	1.1192	2.4224
0.5	8.0	8.68	0.9332	2.5157
0.5	8.5	8.66	0.9751	2.6132
0.5	9.0	8.74	0.9307	2.7063
0.5	9.5	8.73	0.9957	2.8059
0.5	10.0	8.74	0.9137	2.8972

Table A-16. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-27B-4

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 60 days

Leachant 200 ml tap water; 4 changes/day (initial pH = 8.00 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
0.25	0.25	9.82	32.776	0.3278
0.25	0.50	9.23	15.690	0.4847
0.25	0.75	9.10	13.968	0.6243
0.25	1.00	8.99	13.107	0.7554
0.25	1.25	8.95	12.262	0.8780
0.25	1.50	8.78	10.851	0.9865
0.25	1.75	8.79	9.8469	1.0850
0.25	2.00	8.85	9.7316	1.1823
0.25	2.25	8.74	9.3365	1.2756
0.25	2.50	8.67	9.6244	1.3719
0.25	2.75	8.70	8.1112	1.4530
0.25	3.00	8.73	9.2477	1.5455
0.25	3.25	8.66	9.8056	1.6436
0.25	3.50	8.66	8.1319	1.7249
0.25	3.75	8.66	8.2767	1.8077
0.25	4.00	8.67	7.2144	1.8798
0.25	4.25	8.59	7.8906	1.9587
0.25	4.50	8.63	6.6609	2.0253
0.25	4.75	8.66	6.2169	2.0875
0.25	5.00	8.67	6.7634	2.1551
0.25	5.25	8.56	6.4901	2.2200
0.25	5.50	8.59	6.6268	2.2863
0.25	5.75	8.61	5.6361	2.3427
0.25	6.00	8.63	6.0119	2.4028
0.25	6.25	8.56	6.6780	2.4696
0.25	6.50	8.52	6.6315	2.5359
0.25	6.75	8.51	6.6647	2.6025
0.25	7.00	8.56	5.7386	2.6599
0.25	7.25	8.44	7.0499	2.7304
0.25	7.50	8.39	5.5790	2.7862
0.25	7.75	8.36	5.9003	2.8452
0.25	8.00	8.51	5.3254	2.8984
0.25	8.25	8.44	5.6605	2.9551
0.25	8.50	8.44	6.0410	3.0155
0.25	8.75	8.44	5.7715	3.0732
0.25	9.00	8.49	5.3751	3.1269
0.25	9.25	8.44	5.9436	3.1864
0.25	9.50	8.47	6.1998	3.2484
0.25	9.75	8.48	6.0802	3.3092
0.25	10.00	8.47	5.4995	3.3642

Table A-17. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-27C-1

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 60 days

Leachant 200 ml tap water; 1 change/day (initial pH = 8.00 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^4$
1.0	1.0	10.20	1.4632	1.4632
1.0	2.0	9.62	1.0844	2.5476
1.0	3.0	9.36	1.0991	3.6467
1.0	4.0	9.33	1.0882	4.7349
1.0	5.0	9.21	1.0386	5.7735
1.0	6.0	9.16	0.7867	6.5602
1.0	7.0	9.14	0.8862	7.4464
1.0	8.0	9.07	0.8967	8.3437
1.0	9.0	9.05	1.0233	9.3664
1.0	10.0	9.03	0.8977	10.2641

Table A-18. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-27C-2a

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 60 days

Leachant 200 ml tap water; 2 changes/day (initial pH = 8.00 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^5$	Cumulative $(\Sigma a_n/A_o) \times 10^4$
0.5	0.5	10.08	11.015	1.1015
0.5	1.0	9.26	6.2474	1.7262
0.5	1.5	9.26	8.4720	2.5734
0.5	2.0	9.17	7.6248	3.3359
0.5	2.5	9.05	6.5311	3.9890
0.5	3.0	9.04	11.310	5.1200
0.5	3.5	9.01	5.8629	5.7063
0.5	4.0	8.94	8.6084	6.5672
0.5	4.5	8.88	5.6329	7.1304
0.5	5.0	8.92	5.4569	7.6761
0.5	5.5	8.87	5.2143	8.1976
0.5	6.0	8.84	5.2857	8.7261
0.5	6.5	8.85	5.1008	9.2362
0.5	7.0	8.85	5.6329	9.7995
0.5	7.5	8.76	6.3571	10.4352
0.5	8.0	8.72	6.2078	11.0560
0.5	8.5	8.74	6.3345	11.6892
0.5	9.0	8.77	5.8571	12.2749
0.5	9.5	8.73	4.9288	12.7678
0.5	10.0	8.77	4.2143	13.1892

Table A-19. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-27C-2b

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 60 days

Leachant 200 ml tap water; 2 changes/day (initial pH = 8.00 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^5$	Cumulative $(\Sigma a_n/A_o) \times 10^4$
0.5	0.5	8.34	0.8220	0.0822
0.5	1.0	10.20	12.002	1.2824
0.5	1.5	9.31	8.4720	2.1296
0.5	2.0	9.15	7.4554	2.8751
0.5	2.5	9.05	9.2389	3.7990
0.5	3.0	9.07	8.4425	4.6433
0.5	3.5	8.98	5.3456	5.1778
0.5	4.0	9.00	6.3345	5.8113
0.5	4.5	8.92	6.8650	6.4978
0.5	5.0	8.94	8.9774	7.3955
0.5	5.5	8.89	8.2143	8.2170
0.5	6.0	8.86	5.9286	8.8098
0.5	6.5	8.87	7.1412	9.5239
0.5	7.0	8.90	6.4286	10.1670
0.5	7.5	8.68	6.5000	10.8168
0.5	8.0	8.72	6.3802	11.4550
0.5	8.5	8.80	5.0351	11.9580
0.5	9.0	8.78	5.1975	12.4780
0.5	9.5	8.77	6.1610	13.0940
0.5	10.0	8.83	6.5714	13.7513

Table A-20. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-27C-2c

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 60 days

Leachant 200 ml tap water; 2 changes/day (initial pH = 8.00 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^5$	Cumulative $(\Sigma a_n/A_o) \times 10^4$
0.5	0.5	10.08	8.5491	0.8549
0.5	1.0	9.45	5.7542	1.4303
0.5	1.5	9.28	8.3026	2.2606
0.5	2.0	9.14	8.8109	3.1417
0.5	2.5	9.05	7.0090	3.8426
0.5	3.0	9.04	8.2834	4.6709
0.5	3.5	9.00	8.1046	5.4814
0.5	4.0	8.97	3.1685	5.7982
0.5	4.5	8.88	5.0351	6.3017
0.5	5.0	8.92	5.4569	6.8474
0.5	5.5	8.89	6.4367	7.4911
0.5	6.0	8.86	4.8571	7.9768
0.5	6.5	8.83	7.6513	8.7419
0.5	7.0	8.82	6.1610	9.3580
0.5	7.5	8.74	7.5000	10.1080
0.5	8.0	8.76	4.6558	10.5736
0.5	8.5	8.79	5.8472	11.1583
0.5	9.0	8.78	4.7102	11.6293
0.5	9.5	8.77	5.4569	12.1750
0.5	10.0	8.80	5.9849	12.7735

Table A-21. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-27C-4

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 60 days

Leachant 200 ml tap water; 4 changes/day (initial pH = 8.00 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^5$	Cumulative $(\Sigma a_n/A_o) \times 10^4$
0.25	0.25	9.94	7.7683	0.7768
0.25	0.50	9.23	3.2857	1.1054
0.25	0.75	9.06	3.5000	1.4554
0.25	1.00	8.97	3.5714	1.8125
0.25	1.25	8.90	5.3571	2.3482
0.25	1.50	8.73	3.5000	2.6982
0.25	1.75	8.74	5.1046	3.2087
0.25	2.00	8.79	2.9286	3.5016
0.25	2.25	8.71	3.7857	3.8801
0.25	2.50	8.69	2.9286	4.1730
0.25	2.75	8.69	4.2143	4.5944
0.25	3.00	8.74	4.0000	4.9944
0.25	3.25	8.67	3.7143	5.3659
0.25	3.50	8.68	3.6429	5.7302
0.25	3.75	8.65	3.2857	6.0587
0.25	4.00	8.64	3.0714	6.3659
0.25	4.25	8.52	3.4286	6.7087
0.25	4.50	8.64	2.2143	6.9302
0.25	4.75	8.70	2.9286	7.2230
0.25	5.00	8.62	3.2857	7.5516
0.25	5.25	8.55	3.2143	7.8730
0.25	5.50	8.57	2.9286	8.1659
0.25	5.75	8.68	2.1429	8.3802
0.25	6.00	8.65	2.7143	8.6516
0.25	6.25	8.59	2.6429	8.9159
0.25	6.50	8.55	2.4286	9.1587
0.25	6.75	8.56	2.5714	9.4159
0.25	7.00	8.61	2.2857	9.6444
0.25	7.25	8.50	2.8571	9.9302
0.25	7.50	8.45	2.9286	10.223
0.25	7.75	8.40	3.4286	10.566
0.25	8.00	8.52	3.1429	10.880
0.25	8.25	8.49	2.6429	11.144
0.25	8.50	8.49	2.7143	11.416
0.25	8.75	8.48	2.9286	11.709
0.25	9.00	8.52	2.2143	11.930
0.25	9.25	8.46	2.6429	12.194
0.25	9.50	8.50	2.0000	12.394
0.25	9.75	8.56	2.8571	12.680
0.25	10.00	8.49	3.2143	13.002

Table A-22. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-27D-1

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 60 days

Leachant 200 ml tap water; 1 change/day (initial pH = 8.00 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^3$
1.0	1.0	9.98	3.2331	0.3233
1.0	2.0	9.61	2.8857	0.6119
1.0	3.0	9.34	3.5713	0.9690
1.0	4.0	9.32	5.2702	1.4960
1.0	5.0	9.20	2.8365	1.7797
1.0	6.0	9.14	3.0744	2.0871
1.0	7.0	9.15	2.8197	2.3691
1.0	8.0	9.08	3.0274	2.6718
1.0	9.0	9.04	2.8701	2.9588
1.0	10.0	9.06	2.7526	3.2341

Table A-23. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-27D-2

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 60 days

Leachant 200 ml tap water; 2 changes/day (initial pH = 8.00 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^3$
0.5	0.5	9.98	2.3668	0.2367
0.5	1.0	9.39	1.5624	0.3929
0.5	1.5	9.22	1.8320	0.5761
0.5	2.0	9.11	1.7995	0.7561
0.5	2.5	9.00	0.6658	0.8226
0.5	3.0	9.02	1.7705	0.9997
0.5	3.5	8.95	1.8164	1.1813
0.5	4.0	8.94	1.7772	1.3591
0.5	4.5	8.89	1.7288	1.5319
0.5	5.0	8.89	1.4434	1.6763
0.5	5.5	8.86	1.8684	1.8631
0.5	6.0	8.82	1.1890	1.9820
0.5	6.5	8.84	1.9360	2.1756
0.5	7.0	8.83	1.6616	2.3418
0.5	7.5	8.74	2.1437	2.5562
0.5	8.0	8.70	1.4073	2.6969
0.5	8.5	8.72	1.5454	2.8514
0.5	9.0	8.75	1.6535	3.0168
0.5	9.5	8.72	1.5777	3.1745
0.5	10.0	8.74	1.6113	3.3357

Table A-24. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-27D-4a

Specimen Solid-to-waste-ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 60 days

Leachant 200 ml tap water; 4 changes/day (initial pH = 8.00 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^3$
0.25	0.25	9.84	2.3408	0.2341
0.25	0.50	9.20	1.2066	0.3547
0.25	0.75	9.04	1.2221	0.4770
0.25	1.00	8.97	1.2221	0.5992
0.25	1.25	8.90	1.0829	0.7074
0.25	1.50	8.73	1.1511	0.8226
0.25	1.75	8.75	1.1186	0.9344
0.25	2.00	8.81	0.9727	1.0317
0.25	2.25	8.72	0.9889	1.1306
0.25	2.50	8.64	1.1955	1.2501
0.25	2.75	8.67	1.0593	1.3561
0.25	3.00	8.71	1.2928	1.4853
0.25	3.25	8.62	1.1128	1.5966
0.25	3.50	8.51	1.2928	1.7259
0.25	3.75	8.62	1.2363	1.8495
0.25	4.00	8.61	1.1745	1.9670
0.25	4.25	8.55	0.9231	2.0593
0.25	4.50	8.55	0.8560	2.1449
0.25	4.75	8.63	0.6210	2.2070
0.25	5.00	8.61	0.9735	2.3043
0.25	5.25	8.50	1.1917	2.4235
0.25	5.50	8.55	0.7888	2.5024
0.25	5.75	8.64	0.8224	2.5846
0.25	6.00	8.60	1.0238	2.6870
0.25	6.25	8.57	1.1077	2.7978
0.25	6.50	8.50	0.8320	2.8810
0.25	6.75	8.55	0.8960	2.9706
0.25	7.00	8.53	1.0070	3.0713
0.25	7.25	8.45	1.0146	3.1727
0.25	7.50	8.43	0.7037	3.2431
0.25	7.75	8.45	0.8837	3.3315
0.25	8.00	8.50	0.9000	3.4215
0.25	8.25	8.47	0.9427	3.5158
0.25	8.50	8.48	0.8345	3.5992
0.25	8.75	8.44	0.9582	3.6950
0.25	9.00	8.48	0.6336	3.7584
0.25	9.25	8.42	0.7385	3.8322
0.25	9.50	8.48	0.8224	3.9145
0.25	9.75	8.56	1.2756	4.0420
0.25	10.00	8.46	0.6378	4.1058

Table A-25. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-27D-4b

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 60 days

Leachant 200 ml tap water; 4 changes/day (initial pH = 8.00 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^5$	Cumulative $(\Sigma a_n/A_o) \times 10^3$
0.25	0.25	9.92	23.100	0.2310
0.25	0.50	9.14	11.293	0.3439
0.25	0.75	9.07	9.1270	0.4352
0.25	1.00	8.98	12.376	0.5590
0.25	1.25	8.86	10.210	0.6611
0.25	1.50	8.77	11.511	0.7762
0.25	1.75	8.75	9.8893	0.8751
0.25	2.00	8.83	12.483	0.9999
0.25	2.25	8.72	9.5651	1.0955
0.25	2.50	8.65	12.409	1.2196
0.25	2.75	8.69	11.804	1.3377
0.25	3.00	8.76	14.728	1.4850
0.25	3.25	8.61	13.419	1.6191
0.25	3.50	8.65	10.146	1.7206
0.25	3.75	8.64	10.354	1.8241
0.25	4.00	8.65	8.6543	1.9107
0.25	4.25	8.55	8.0563	1.9912
0.25	4.50	8.56	9.3991	2.0852
0.25	4.75	8.62	6.8815	2.1541
0.25	5.00	8.64	10.910	2.2632
0.25	5.25	8.54	8.5599	2.3488
0.25	5.50	8.54	7.5528	2.4243
0.25	5.75	8.65	8.5599	2.5099
0.25	6.00	8.62	8.0563	2.5904
0.25	6.25	8.57	8.7277	2.6777
0.25	6.50	8.63	9.1198	2.7689
0.25	6.75	8.50	9.4398	2.8633
0.25	7.00	8.56	9.9026	2.9623
0.25	7.25	8.45	9.0003	3.0523
0.25	7.50	8.42	9.1639	3.1440
0.25	7.75	8.41	7.2002	3.2160
0.25	8.00	8.49	8.3457	3.2994
0.25	8.25	8.48	6.4907	3.3644
0.25	8.50	8.44	8.3452	3.4478
0.25	8.75	8.45	8.3452	3.5313
0.25	9.00	8.46	8.8089	3.6193
0.25	9.25	8.45	7.8885	3.6982
0.25	9.50	8.46	8.8955	3.7872
0.25	9.75	8.58	10.070	3.8879
0.25	10.00	8.44	9.9026	3.9869

Table A-26. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-27D-4c

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.025 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 60 days

Leachant 200 ml tap water; 4 changes/day (initial pH = 8.00 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^5$	Cumulative $(\Sigma a_n/A_o) \times 10^3$
0.25	0.25	9.66	22.792	0.2279
0.25	0.50	9.19	10.674	0.3347
0.25	0.75	9.01	5.8784	0.3934
0.25	1.00	8.98	12.066	0.5141
0.25	1.25	8.87	11.757	0.6317
0.25	1.50	8.73	10.700	0.7387
0.25	1.75	8.75	8.2681	0.8214
0.25	2.00	8.79	7.6196	0.8976
0.25	2.25	8.69	11.348	1.0110
0.25	2.50	8.55	7.4151	1.0852
0.25	2.75	8.64	7.8690	1.1639
0.25	3.00	8.69	12.273	1.2866
0.25	3.25	8.53	8.8366	1.3750
0.25	3.50	8.59	9.4912	1.4699
0.25	3.75	8.61	7.7271	1.5472
0.25	4.00	8.64	7.1089	1.6182
0.25	4.25	8.54	12.420	1.7424
0.25	4.50	8.58	8.7277	1.8297
0.25	4.75	8.61	8.7277	1.9170
0.25	5.00	8.64	6.7136	1.9841
0.25	5.25	8.39	8.8955	2.0731
0.25	5.50	8.52	5.3709	2.1268
0.25	5.75	8.62	10.406	2.2309
0.25	6.00	8.58	6.8815	2.2997
0.25	6.25	8.53	9.3991	2.3937
0.25	6.50	8.53	7.0398	2.4641
0.25	6.75	8.50	9.4398	2.5585
0.25	7.00	8.56	6.8815	2.6273
0.25	7.25	8.44	9.8185	2.7255
0.25	7.50	8.44	8.5093	2.8105
0.25	7.75	8.41	8.3457	2.8940
0.25	8.00	8.45	8.5093	2.9791
0.25	8.25	8.44	9.2725	3.0718
0.25	8.50	8.49	9.7361	3.1692
0.25	8.75	8.42	8.1907	3.2511
0.25	9.00	8.48	5.0999	3.3021
0.25	9.25	8.43	6.7136	3.3692
0.25	9.50	8.48	8.3920	3.4531
0.25	9.75	8.51	11.413	3.5673
0.25	10.00	8.48	7.0493	3.6378

Table A-27. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-29-1XA

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.020 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.95 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^3$
1.0	1.0	11.10	4.2463	0.4246
1.0	2.0	10.12	3.5504	0.7797
1.0	3.0	9.62	2.4719	1.0269
1.0	4.0	9.77	2.0022	1.2271
1.0	5.0	9.62	1.8109	1.4082
1.0	6.0	9.53	1.6543	1.5736
1.0	7.0	9.50	2.2110	1.7947
1.0	8.0	9.24	2.0022	1.9949
1.0	9.0	9.19	2.2632	2.2212
1.0	10.0	9.18	1.9500	2.4162

Table A-28. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-29-1XB

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.020 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.95 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^3$
1.0	1.0	10.90	4.3854	0.4385
1.0	2.0	10.05	3.8114	0.8197
1.0	3.0	9.63	2.6459	1.0843
1.0	4.0	9.71	2.1762	1.3019
1.0	5.0	9.60	1.8283	1.4847
1.0	6.0	9.51	2.5067	1.7354
1.0	7.0	9.47	2.1762	1.9530
1.0	8.0	9.24	2.2980	2.1828
1.0	9.0	9.18	1.7239	2.3552
1.0	10.0	9.08	1.9500	2.5502

Table A-29. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-29-2XA

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 2XW-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.020 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.95 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^3$
1.0	1.0	11.14	3.8066	0.3807
1.0	2.0	10.19	4.6195	0.8426
1.0	3.0	9.83	3.4607	1.1887
1.0	4.0	9.81	2.7689	1.4656
1.0	5.0	9.68	2.6825	1.7338
1.0	6.0	9.65	2.8381	2.0176
1.0	7.0	9.61	2.1636	2.2340
1.0	8.0	9.35	2.5960	2.4936
1.0	9.0	9.29	2.1982	2.7134
1.0	10.0	9.22	2.5441	2.9678

Table A-30. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-29-2XB

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 2XW-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.020 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.95 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^3$
1.0	1.0	11.00	4.9654	0.4965
1.0	2.0	10.10	3.4434	0.8409
1.0	3.0	9.73	3.2878	1.1697
1.0	4.0	9.72	2.5960	1.4293
1.0	5.0	9.67	2.6652	1.6958
1.0	6.0	9.61	2.1636	1.9121
1.0	7.0	9.58	3.1840	2.2305
1.0	8.0	9.31	2.3366	2.4642
1.0	9.0	9.25	2.8381	2.7480
1.0	10.0	9.18	3.1148	3.0595

Table A-31. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-29-4XA

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 4XW-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.020 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.95 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^3$
1.0	1.0	11.73	6.5023	0.6502
1.0	2.0	11.20	3.8437	1.0346
1.0	3.0	10.50	3.4149	1.3761
1.0	4.0	10.24	2.7803	1.6541
1.0	5.0	10.04	1.6140	1.8155
1.0	6.0	9.94	1.5454	1.9701
1.0	7.0	9.85	1.5797	2.1280
1.0	8.0	9.52	1.4596	2.2739
1.0	9.0	9.43	1.6140	2.4354
1.0	10.0	9.32	1.4425	2.5796

Table A-32. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M74-29-4XB

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 4XW-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.020 mCi
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.95 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^3$
1.0	1.0	11.80	5.9534	0.5953
1.0	2.0	11.31	4.5470	1.0500
1.0	3.0	10.58	2.7460	1.3246
1.0	4.0	10.30	2.1286	1.5375
1.0	5.0	10.02	1.6311	1.7006
1.0	6.0	9.90	1.1852	1.8191
1.0	7.0	9.82	1.8713	2.0063
1.0	8.0	9.49	2.2143	2.2277
1.0	9.0	9.40	1.3567	2.3634
1.0	10.0	9.29	1.4939	2.5128

Table A-33. Experimental Results for the Leaching of Sodium from Cementitious Grout No. M74-29-1XA

Specimen Solid-to-waste ratio: 6 lb dry mix/gal W-7 waste (719 g/liter)
Sodium added: stable = 120 mg
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.95 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental (a_n/A_o)	Cumulative $(\Sigma a_n/A_o)$
1.0	1.0	11.10	0.1922	0.1922
1.0	2.0	10.12	0.0877	0.2799
1.0	3.0	9.62	0.0725	0.3524
1.0	4.0	9.77	0.0624	0.4148
1.0	5.0	9.62	0.0523	0.4671
1.0	6.0	9.53	0.0438	0.5109
1.0	7.0	9.50	0.0405	0.5514
1.0	8.0	9.24	0.0388	0.5902
1.0	9.0	9.19	0.0363	0.6265
1.0	10.0	9.18	0.0334	0.6599

Table A-34. Experimental Results for the Leaching of Sodium from Cementitious Grout No. M74-29-1XB

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Sodium added: stable = 120 mg
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.95 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental (a_n/A_o)	Cumulative $(\Sigma a_n/A_o)$
1.0	1.0	10.90	0.1686	0.1686
1.0	2.0	10.05	0.0826	0.2512
1.0	3.0	9.63	0.0658	0.3170
1.0	4.0	9.71	0.0573	0.3743
1.0	5.0	9.60	0.0506	0.4249
1.0	6.0	9.51	0.0405	0.4654
1.0	7.0	9.47	0.0388	0.5042
1.0	8.0	9.24	0.0379	0.5421
1.0	9.0	9.18	0.0332	0.5753
1.0	10.0	9.08	0.0342	0.6095

Table A-35. Experimental Results for the Leaching of Sodium from Cementitious Grout No. M74-29-2XA

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 2XW-7 waste (719 g/liter)
Sodium added: stable = 237 mg
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.95 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental (a_n/A_o)	Cumulative $(\Sigma a_n/A_o)$
1.0	1.0	11.14	0.1610	0.1610
1.0	2.0	10.19	0.0674	0.2284
1.0	3.0	9.83	0.0447	0.2731
1.0	4.0	9.81	0.0413	0.3144
1.0	5.0	9.68	0.0379	0.3523
1.0	6.0	9.65	0.0312	0.3835
1.0	7.0	9.61	0.0287	0.4122
1.0	8.0	9.35	0.0278	0.4400
1.0	9.0	9.29	0.0253	0.4653
1.0	10.0	9.22	0.0240	0.4893

Table A-36. Experimental Results for the Leaching of Sodium from Cementitious Grout No. M74-29-2XB

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 2XW-7 waste (719 g/liter)
Sodium added: stable = 237 mg
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.95 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental (a_n/A_o)	Cumulative $(\Sigma a_n/A_o)$
1.0	1.0	11.00	0.1442	0.1442
1.0	2.0	10.10	0.0573	0.2015
1.0	3.0	9.73	0.0506	0.2521
1.0	4.0	9.72	0.0388	0.2909
1.0	5.0	9.67	0.0329	0.3238
1.0	6.0	9.61	0.0287	0.3525
1.0	7.0	9.58	0.0261	0.3786
1.0	8.0	9.31	0.0249	0.4035
1.0	9.0	9.25	0.0243	0.4278
1.0	10.0	9.18	0.0238	0.4516

Table A-37. Experimental Results for the Leaching of Sodium from Cementitious Grout No. M74-29-4XA

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 4XW-7 waste (719 g/liter)
Sodium added: stable = 474 mg
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.95 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental (a_n/A_o)	Cumulative $(\Sigma a_n/A_o)$
1.0	1.0	11.73	0.4173	0.4173
1.0	2.0	11.20	0.1180	0.5353
1.0	3.0	10.50	0.0653	0.6006
1.0	4.0	10.24	0.0194	0.6200
1.0	5.0	10.04	0.0126	0.6326
1.0	6.0	9.94	0.0181	0.6507
1.0	7.0	9.85	0.0143	0.6650
1.0	8.0	9.52	0.0121	0.6771
1.0	9.0	9.43	0.0101	0.6872
1.0	10.0	9.32	0.0096	0.6968

Table A-38. Experimental Results for the Leaching of Sodium from Cementitious Grout No. M74-29-4XB

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 4XW-7 waste (719 g/liter)
Sodium added: stable = 474 mg
Mass: 5.7 g (as prepared)
Volume: 4.1 cm^3
Exposed Surface Area: 14.2 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.95 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental (a_n/A_o)	Cumulative $(\Sigma a_n/A_o)$
1.0	1.0	11.80	0.4805	0.4805
1.0	2.0	11.31	0.1319	0.6124
1.0	3.0	10.58	0.0717	0.6841
1.0	4.0	10.30	0.0363	0.7204
1.0	5.0	10.02	0.0215	0.7419
1.0	6.0	9.90	0.0148	0.7567
1.0	7.0	9.82	0.0126	0.7693
1.0	8.0	9.49	0.0105	0.7798
1.0	9.0	9.40	0.0091	0.7889
1.0	10.0	9.29	0.0089	0.7978

Table A-39. Experimental Results for the Leaching of Strontium from Cementitious Grout No. M75-3A

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Strontium added: stable = 2.5 mg
^{85}Sr at time t_o = 0.015 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.76 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	1.0	11.42	32.627	0.3263
1.0	2.0	10.56	14.335	0.4696
1.0	3.0	10.19	9.6305	0.5659
1.0	4.0	9.98	7.7928	0.6439
3.0	7.0	10.58	18.161	0.8255
1.0	8.0	9.71	6.4932	0.8904
1.0	9.0	9.57	6.6824	0.9572
1.0	10.0	9.51	6.2524	1.0197
1.0	11.0	9.48	7.2793	1.0925
3.0	14.0	10.00	18.792	1.2804
1.0	15.0	9.34	6.2768	1.3432
1.0	16.0	9.25	7.6002	1.4192
1.0	17.0	9.26	7.4111	1.4933
1.0	18.0	9.25	7.5056	1.5684
3.0	21.0	9.78	19.520	1.7636
1.0	22.0	9.17	7.8408	1.8420
1.0	23.0	9.15	7.6477	1.9185
1.0	24.0	9.09	7.2223	1.9907
1.0	25.0	9.12	7.6774	2.0675
3.0	28.0	9.57	16.975	2.2373
1.0	29.0	9.05	6.3606	2.3009
1.0	30.0	9.03	6.3356	2.3643
1.0	31.0	9.00	5.4563	2.4189
1.0	32.0	8.98	5.8514	2.4774
4.0	36.0	9.47	20.952	2.6869
1.0	37.0	8.98	5.7824	2.7447
1.0	38.0	8.91	6.0001	2.8047
1.0	39.0	8.86	6.6208	2.8709
3.0	42.0	9.36	14.987	3.0208
1.0	43.0	8.92	6.4640	3.0854
1.0	44.0	8.84	6.3533	3.1489
1.0	45.0	8.86	5.3324	3.2022
1.0	46.0	8.84	5.2196	3.2544

Table A-40. Experimental Results for the Leaching of Strontium from Cementitious Grout No. M75-3B

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Strontium added: stable = 2.5 mg
^{85}Sr at time t_o = 0.015 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.86 - 7.96)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	1.0	11.44	3.1619	0.3162
1.0	2.0	10.63	1.6637	0.4826
1.0	3.0	10.23	1.1524	0.5978
1.0	4.0	10.05	1.2141	0.7192
3.0	7.0	10.64	2.7191	0.9911
1.0	8.0	9.74	1.1026	1.1014
1.0	9.0	9.59	1.0234	1.2037
1.0	10.0	9.52	1.0209	1.3058
1.0	11.0	9.51	1.0733	1.4131
3.0	14.0	9.98	2.6097	1.6741
1.0	15.0	9.34	1.0058	1.7747
1.0	16.0	9.28	0.9774	1.8724
1.0	17.0	9.27	1.0625	1.9787
1.0	18.0	9.22	0.9302	2.0717
3.0	21.0	9.78	2.2983	2.3015
1.0	22.0	9.21	0.8583	2.3873
1.0	23.0	9.15	0.8340	2.4707
1.0	24.0	9.13	0.7974	2.5505
1.0	25.0	9.13	0.7549	2.6260

Table A-41. Experimental Results for the Leaching of Strontium from Cementitious Grout No. M75-4B

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Strontium added: stable = 2.5 mg
^{85}Sr at time t_o = 0.015 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.76 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	1.0	11.38	35.203	0.3520
1.0	2.0	10.53	17.094	0.5230
1.0	3.0	10.17	13.584	0.6588
1.0	4.0	9.96	13.987	0.7987
3.0	7.0	10.59	28.618	1.0849
1.0	8.0	9.70	11.889	1.2038
1.0	9.0	9.58	9.7536	1.3013
1.0	10.0	9.53	10.369	1.4050
1.0	11.0	9.47	9.7383	1.5024
3.0	14.0	9.98	23.864	1.7410
1.0	15.0	9.32	9.5930	1.8369
1.0	16.0	9.25	8.5625	1.9225
1.0	17.0	9.22	9.7803	2.0204
1.0	18.0	9.21	8.7498	2.1078
3.0	21.0	9.77	22.296	2.3308
1.0	22.0	9.24	8.6337	2.4171
1.0	23.0	9.16	9.5441	2.5125
1.0	24.0	9.13	6.8957	2.5815
1.0	25.0	9.15	8.6907	2.6684
3.0	28.0	9.59	17.867	2.8471
1.0	29.0	9.08	8.1378	2.9285
1.0	30.0	9.05	8.1733	3.0102
1.0	31.0	9.00	7.4667	3.0849
1.0	32.0	9.01	7.3734	3.1586
4.0	36.0	9.48	21.965	3.3782
1.0	37.0	8.96	8.1423	3.4596
1.0	38.0	8.86	7.4548	3.5341
1.0	39.0	8.89	7.9275	3.6134
3.0	42.0	9.36	18.437	3.7978
1.0	43.0	8.90	6.9851	3.8677
1.0	44.0	8.85	7.9266	3.9470
1.0	45.0	8.90	5.8073	4.0051
1.0	46.0	8.83	7.4379	4.0795
3.0	49.0	9.34	15.508	4.2346
1.0	50.0	8.77	4.2721	4.2773
1.0	51.0	8.82	5.8732	4.3360
1.0	52.0	8.80	6.0275	4.3963
1.0	53.0	8.83	5.8492	4.4548
3.0	56.0	9.25	15.155	4.6064
1.0	57.0	8.69	6.3252	4.6697
1.0	58.0	8.75	7.2865	4.7426
1.0	59.0	8.74	5.8668	4.8013
1.0	60.0	8.72	4.8282	4.8496

Table A-42. Experimental Results for the Leaching of Strontium from Cementitious Grout No. M75-4C

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Strontium added: stable = 2.5 mg
^{85}Sr at time t_o = 0.015 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 28 days

Leachant 200 ml grout water; 1 change/day (initial pH = 11.94)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	1.0	11.96	72.751	0.7275
1.0	2.0	11.90	26.254	0.9900
1.0	3.0	11.87	18.176	1.1718
1.0	4.0	11.88	13.408	1.3059
3.0	7.0	11.89	29.610	1.6020
1.0	8.0	11.86	9.2412	1.6944
1.0	9.0	11.81	6.8924	1.7633
1.0	10.0	11.84	6.8754	1.8321
1.0	11.0	11.83	6.5856	1.8980
3.0	14.0	12.09	10.176	1.9998
1.0	15.0	12.13	3.5037	2.0348
1.0	16.0	12.08	3.0353	2.0651
1.0	17.0	12.10	2.6605	2.0917
1.0	18.0	12.10	2.3795	2.1155
3.0	21.0	12.11	6.0767	2.1763
1.0	22.0	11.95	2.4477	2.2009
1.0	23.0	11.94	3.0408	2.2312
1.0	24.0	11.94	2.0206	2.2514
1.0	25.0	12.03	2.2168	2.2736
3.0	28.0	11.94	4.6922	2.3205
1.0	29.0	11.94	1.5505	2.3359
1.0	30.0	11.95	1.7144	2.3530
1.0	31.0	11.94	1.6502	2.3695
1.0	32.0	11.94	2.0068	2.3896
4.0	36.0	11.88	7.7571	2.4671
1.0	37.0	11.92	2.0715	2.4878
1.0	38.0	11.94	1.2998	2.5008
1.0	39.0	11.95	1.4824	2.5156
3.0	42.0	11.94	4.7188	2.5628
1.0	43.0	11.95	2.6714	2.5895
1.0	44.0	11.93	1.7955	2.6075
1.0	45.0	11.92	2.2336	2.6298
Changed to tap water leachant.				
1.0	46.0	9.98	5.2490	2.6823
3.0	49.0	10.00	17.931	2.8616
1.0	50.0	9.30	5.8756	2.9204
1.0	51.0	9.27	7.3327	2.9937
1.0	52.0	9.21	8.9938	3.0836
1.0	53.0	9.14	8.5170	3.1688

Table A-43. Experimental Results for the Leaching of Strontium from Cementitious Grout No. M75-5

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 2XW-7 waste (719 g/liter)
Strontium added: stable = 2.5 mg
^{85}Sr at time t_o = 0.015 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.76 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	1.0	11.34	13.460	0.1346
1.0	2.0	10.60	9.5775	0.2304
1.0	3.0	10.28	7.3989	0.3044
1.0	4.0	10.01	7.1647	0.3760
3.0	7.0	10.70	15.381	0.5298
1.0	8.0	9.94	8.2866	0.6127
1.0	9.0	9.79	7.4407	0.6871
1.0	10.0	9.77	7.6306	0.7634
1.0	11.0	9.71	7.7098	0.8405
3.0	14.0	10.25	17.612	1.0166
1.0	15.0	9.72	8.4393	1.1010
1.0	16.0	9.53	9.1001	1.1920
1.0	17.0	9.53	8.7225	1.2792
1.0	18.0	9.54	7.9673	1.3589
3.0	21.0	9.91	18.647	1.5454
1.0	22.0	9.37	9.8349	1.6437
1.0	23.0	9.32	8.3481	1.7272
1.0	24.0	9.31	8.1203	1.8084
1.0	25.0	9.35	8.5758	1.8942
3.0	28.0	9.72	19.134	2.0855
1.0	29.0	9.33	10.632	2.1918
1.0	30.0	9.21	8.9451	2.2813
1.0	31.0	9.24	8.7316	2.3686
1.0	32.0	9.19	8.4363	2.4530
4.0	36.0	9.75	23.785	2.6908
1.0	37.0	9.27	10.142	2.7922
1.0	38.0	9.18	10.002	2.8922
1.0	39.0	9.15	8.9244	2.9814
3.0	42.0	9.52	18.784	3.1692
1.0	43.0	9.20	9.6959	3.2662
1.0	44.0	9.17	7.9621	3.3458
1.0	45.0	9.12	7.8850	3.4246
1.0	46.0	9.01	8.6735	3.5113
3.0	49.0	9.41	16.351	3.6748
1.0	50.0	8.97	6.1846	3.7366
1.0	51.0	8.95	7.1270	3.8079
1.0	52.0	8.92	7.2108	3.8800
1.0	53.0	8.89	7.2262	3.9523
3.0	56.0	9.31	17.151	4.1238
1.0	57.0	8.85	7.3775	4.1976
1.0	58.0	8.84	7.1758	4.2694
1.0	59.0	8.76	7.5051	4.3445
1.0	60.0	8.83	6.6056	4.4106

Table A-44. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M75-6

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Cesium added: stable = 2.5 mg
^{137}Cs at time t_o = 0.010 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.52 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached		Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$	Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	1.0	11.46	162.87	1.6287	1.0	43.0	9.03	4.2092	6.1974
1.0	2.0	10.69	60.777	2.2365	1.0	44.0	8.98	3.3631	6.2310
1.0	3.0	10.28	42.433	2.6608	1.0	45.0	8.96	3.0321	6.2613
1.0	4.0	10.07	32.183	2.9826	1.0	46.0	8.87	3.0876	6.2922
3.0	7.0	10.66	65.958	3.6422	3.0	49.0	9.36	7.0187	6.3624
1.0	8.0	9.81	19.145	3.8337	1.0	50.0	8.86	3.2439	6.3948
1.0	9.0	9.65	16.490	3.9986	1.0	51.0	8.84	2.7820	6.4226
1.0	10.0	9.57	15.025	4.1489	1.0	52.0	8.84	2.6900	6.4495
1.0	11.0	9.56	13.999	4.2889	1.0	53.0	8.78	2.6130	6.4756
3.0	14.0	10.04	33.925	4.6281	3.0	56.0	9.27	6.1592	6.5372
1.0	15.0	9.47	12.285	4.7509	1.0	57.0	8.73	2.7287	6.5645
1.0	16.0	9.33	10.774	4.8586	1.0	58.0	8.76	2.3145	6.5876
1.0	17.0	9.30	9.7074	4.9567	1.0	59.0	8.70	2.3635	6.6112
1.0	18.0	9.31	8.4961	5.0417	1.0	60.0	8.68	2.2916	6.6341
3.0	21.0	9.75	20.192	5.2436	3.0	63.0	9.17	5.7581	6.6918
1.0	22.0	9.25	7.6564	5.3202	1.0	64.0	8.75	2.5185	6.7170
1.0	23.0	9.21	5.8687	5.3789	1.0	65.0	8.64	2.2333	6.7393
1.0	24.0	9.17	5.5357	5.4343	1.0	66.0	8.71	2.2901	6.7622
1.0	25.0	9.21	5.5134	5.4894	1.0	67.0	8.60	2.0972	6.7832
3.0	28.0	8.58	12.689	5.6163	3.0	70.0	9.19	5.3544	6.8367
1.0	29.0	9.13	5.6244	5.6725	1.0	71.0	8.73	2.2094	6.8588
1.0	30.0	9.06	4.7336	5.7198	1.0	72.0	8.68	1.9471	6.8783
1.0	31.0	9.09	4.6009	5.7658	1.0	73.0	8.62	1.8369	6.8967
1.0	32.0	9.05	4.2340	5.8081	4.0	77.0	9.16	5.3486	6.9502
4.0	36.0	9.53	13.548	5.9436	1.0	78.0	8.58	1.7932	6.9681
1.0	37.0	9.07	4.8101	5.9917	1.0	79.0	8.70	1.3873	6.9819
1.0	38.0	8.98	3.9042	6.0307	1.0	80.0	8.69	1.7842	6.9997
1.0	39.0	8.99	3.7261	6.0680	1.0	81.0	8.60	1.2115	7.0119
3.0	42.0	9.38	8.7307	6.1553	3.0	84.0	8.92	3.1018	7.0429

Table A-44 (Continued)

Leaching Time (days)		Final pH of Leachate	Fraction Leached		Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$	Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	85.0	8.55	1.3390	7.0563	1.0	115.0	8.44	1.0862	7.4064
1.0	86.0	8.56	1.3725	7.0700	1.0	116.0	8.42	1.1644	7.4180
1.0	87.0	8.59	1.3112	7.0831	3.0	119.0	8.82	2.6737	7.4448
1.0	88.0	8.57	1.6596	7.0997	1.0	120.0	8.50	1.2228	7.4570
3.0	91.0	8.96	3.2053	7.1318	1.0	121.0	8.50	1.0964	7.4680
1.0	92.0	8.60	1.3294	7.1451	1.0	122.0	8.51	0.9666	7.4777
1.0	93.0	8.53	1.3413	7.1585	1.0	123.0	8.46	0.9075	7.4867
1.0	94.0	8.49	1.2799	7.1713	3.0	126.0	8.79	2.4430	7.5111
1.0	95.0	8.63	1.7288	7.1886	1.0	127.0	8.96	0.9974	7.5211
3.0	98.0	8.99	3.6352	7.2250	1.0	128.0	8.51	1.0115	7.5312
1.0	99.0	8.58	1.6239	7.2412	1.0	129.0	8.06	0.8736	7.5400
1.0	100.0	8.64	1.4770	7.2560	1.0	130.0	8.39	1.2060	7.5521
1.0	101.0	8.60	1.4898	7.2709	4.0	134.0	8.90	2.8316	7.5804
1.0	102.0	8.54	1.3517	7.2844	1.0	135.0	8.45	1.2611	7.5930
3.0	105.0	8.80	2.4460	7.3089	1.0	136.0	8.44	1.0493	7.6035
1.0	106.0	8.42	1.1708	7.3206	1.0	137.0	8.47	1.0087	7.6136
1.0	107.0	8.45	1.0562	7.3312	3.0	140.0	8.82	2.2437	7.6360
1.0	108.0	8.41	1.0106	7.3413	1.0	141.0	8.45	1.0799	7.6468
1.0	109.0	8.41	0.9954	7.3513	1.0	142.0	8.43	0.9883	7.6567
3.0	112.0	8.76	2.2568	7.3739	1.0	143.0	8.40	1.0443	7.6671
1.0	113.0	8.43	1.1421	7.3853	1.0	144.0	8.47	0.9616	7.6767
1.0	114.0	8.34	1.0215	7.3955					

Table A-45. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M75-7A

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Cesium added: stable = 2.5 mg
^{137}Cs at time t_o = 0.010 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.86 - 7.96)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^2$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	1.0	11.38	7.5986	0.7599
1.0	2.0	10.58	2.7391	1.0338
1.0	3.0	10.22	2.1161	1.2454
1.0	4.0	10.10	1.7329	1.4187
3.0	7.0	10.59	3.6409	1.7828
1.0	8.0	9.75	1.1887	1.9016
1.0	9.0	9.64	0.9980	2.0014
1.0	10.0	9.53	0.9024	2.0917
1.0	11.0	9.55	0.8348	2.1752
3.0	14.0	9.96	2.0885	2.3840
1.0	15.0	9.42	0.7712	2.4611
1.0	16.0	9.34	0.6555	2.5267
1.0	17.0	9.32	0.5718	2.5839
1.0	18.0	9.28	0.5146	2.6353
3.0	21.0	9.75	1.2265	2.7579
1.0	22.0	9.20	0.4555	2.8034
1.0	23.0	9.21	0.3783	2.8412
1.0	24.0	9.19	0.3572	2.8769
1.0	25.0	9.20	0.3564	2.9125

Table A-46. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M75-7B

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Cesium added: stable = 2.5 mg
^{137}Cs at time t_o = 0.010 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.52 - 8.24)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	1.0	11.38	75.063	0.7506
1.0	2.0	10.54	25.705	1.0077
1.0	3.0	10.18	18.609	1.1938
1.0	4.0	10.02	15.309	1.3469
3.0	7.0	10.60	31.937	1.6663
1.0	8.0	9.73	9.6195	1.7625
1.0	9.0	9.59	8.9449	1.8519
1.0	10.0	9.54	8.5589	1.9375
1.0	11.0	9.51	8.4010	2.0215
3.0	14.0	10.02	21.115	2.2326
1.0	15.0	9.40	7.2458	2.3051
1.0	16.0	9.32	6.3369	2.3685
1.0	17.0	9.31	6.0032	2.4285
1.0	18.0	9.30	5.2937	2.4814
3.0	21.0	9.79	12.746	2.6089
1.0	22.0	9.22	4.2278	2.6512
1.0	23.0	9.23	3.5170	2.6864
1.0	24.0	9.18	3.2592	2.7190
1.0	25.0	9.21	3.3810	2.7528
3.0	28.0	9.64	8.2228	2.8350
1.0	29.0	9.12	3.4462	2.8695
1.0	30.0	9.04	2.7223	2.8967
1.0	31.0	9.07	2.5723	2.9224
1.0	32.0	9.04	2.6605	2.9490
4.0	36.0	9.54	9.1893	3.0409
1.0	37.0	9.02	2.6917	3.0678
1.0	38.0	9.01	2.3419	3.0912
1.0	39.0	8.98	2.0988	3.1122
3.0	42.0	9.42	5.9460	3.1717
1.0	43.0	8.99	2.2387	3.1941
1.0	44.0	8.94	1.8817	3.2129
1.0	45.0	8.95	1.8701	3.2316
1.0	46.0	8.86	1.7716	3.2493
3.0	49.0	9.35	5.0716	3.3000
1.0	50.0	8.85	1.8175	3.3182
1.0	51.0	8.82	1.7025	3.3352
1.0	52.0	8.84	1.5069	3.3503
1.0	53.0	8.83	1.5963	3.3663
3.0	56.0	9.31	4.2580	3.4089
1.0	57.0	8.77	1.4633	3.4235
1.0	58.0	8.78	1.4810	3.4383
1.0	59.0	8.79	1.4047	3.4523
1.0	60.0	8.76	1.3677	3.4660
3.0	63.0	9.22	4.1492	3.5075
1.0	64.0	8.77	1.4729	3.5222
1.0	65.0	8.64	1.3944	3.5361

Table A-47. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M75-7C

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Cesium added: stable = 2.5 mg
^{137}Cs at time t_o = 0.010 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.86 - 7.96)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	1.0	11.40	81.505	0.8150
1.0	2.0	10.55	30.689	1.1219
1.0	3.0	10.18	20.876	1.3307
1.0	4.0	10.01	16.129	1.4920
3.0	7.0	10.62	32.625	1.8182
1.0	8.0	9.75	9.8312	1.9165
1.0	9.0	9.60	8.0412	1.9969
1.0	10.0	9.56	7.8307	2.0752
1.0	11.0	9.43	7.1902	2.1471
3.0	14.0	10.02	17.816	2.3253
1.0	15.0	9.39	6.7690	2.3930
1.0	16.0	9.30	6.1557	2.4546
1.0	17.0	9.32	5.4227	2.5088
1.0	18.0	9.29	4.7316	2.5561
3.0	21.0	9.80	10.886	2.6650
1.0	22.0	9.22	4.1525	2.7065
1.0	23.0	9.22	3.7285	2.7438
1.0	24.0	9.16	3.1811	2.7756
1.0	25.0	9.19	3.2160	2.8078

Table A-48. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M75-7D

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Cesium added: stable = 2.5 mg
^{137}Cs at time t_o = 0.010 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 28 days

Leachant 200 ml grout water; 1 change/day (initial pH = 11.94)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	1.0	11.95	87.252	0.8725
1.0	2.0	11.89	30.388	1.1764
1.0	3.0	11.87	21.005	1.3864
1.0	4.0	11.90	15.450	1.5409
3.0	7.0	11.89	32.634	1.8672
1.0	8.0	11.84	9.0373	1.9576
1.0	9.0	11.83	7.4095	2.0317
1.0	10.0	11.87	6.6988	2.0987
1.0	11.0	11.84	6.1285	2.1600
3.0	14.0	12.10	13.559	2.2956
1.0	15.0	12.12	4.2581	2.3382
1.0	16.0	12.10	4.0992	2.3792
1.0	17.0	12.11	3.6996	2.4162
1.0	18.0	12.10	3.3218	2.4494
3.0	21.0	12.14	8.1231	2.5306
1.0	22.0	11.97	2.4421	2.5550
1.0	23.0	11.94	2.2823	2.5778
1.0	24.0	11.92	2.1552	2.5994
1.0	25.0	12.05	2.1339	2.6207
3.0	28.0	11.92	6.1504	2.6822
1.0	29.0	11.94	2.0956	2.7032
1.0	30.0	11.94	1.9293	2.7225
1.0	31.0	11.96	1.8695	2.7412
1.0	32.0	11.93	1.9524	2.7607
4.0	36.0	11.88	6.8430	2.8291
1.0	37.0	11.93	1.5024	2.8441
1.0	38.0	11.92	1.3774	2.8579
1.0	39.0	11.92	1.3595	2.8715
3.0	42.0	11.93	3.7993	2.9095
1.0	43.0	11.95	1.3900	2.9234
1.0	44.0	11.93	1.1175	2.9346
1.0	45.0	11.95	1.2551	2.9472
Changed to water leachant.				
1.0	46.0	9.91	2.3929	2.9711
3.0	49.0	10.09	6.5292	3.0364
1.0	50.0	9.39	2.7413	3.0638
1.0	51.0	9.33	2.3723	3.0875
1.0	52.0	9.24	2.1450	3.1089
1.0	53.0	9.18	2.3012	3.1319

Table A-49. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M75-8A

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Cesium added: stable = 2.5 mg
^{137}Cs at time t_o = 0.010 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.63 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	1.0	11.41	38.562	0.3856
1.0	2.0	10.58	14.421	0.5298
1.0	3.0	10.27	9.2782	0.6226
1.0	4.0	10.02	7.2358	0.6950
3.0	7.0	10.65	14.546	0.8404
1.0	8.0	9.87	4.5846	0.8863
1.0	9.0	9.66	3.7337	0.9236
1.0	10.0	9.67	3.5879	0.9595
1.0	11.0	9.70	3.4598	0.9941
3.0	14.0	10.10	7.8931	1.0730
1.0	15.0	9.54	3.0041	1.1031
1.0	16.0	9.50	2.7410	1.1305
1.0	17.0	9.48	2.7747	1.1582
1.0	18.0	9.42	2.4629	1.1828
3.0	21.0	9.83	5.6709	1.2396
1.0	22.0	9.30	2.1748	1.2613
1.0	23.0	9.27	1.7948	1.2792
1.0	24.0	9.26	1.6166	1.2954
1.0	25.0	9.15	1.6673	1.3121
3.0	28.0	9.66	3.8639	1.3507
1.0	29.0	9.28	1.6120	1.3668
1.0	30.0	9.13	1.4575	1.3814
1.0	31.0	9.09	1.5991	1.3974
1.0	32.0	9.13	1.3091	1.4105
4.0	36.0	9.63	4.0709	1.4512
1.0	37.0	9.10	1.5321	1.4665
1.0	38.0	9.19	1.2768	1.4793
1.0	39.0	9.12	1.0879	1.4902
3.0	42.0	9.50	2.9085	1.5193
1.0	43.0	9.04	1.3987	1.5333
1.0	44.0	9.04	1.1370	1.5447
1.0	45.0	9.04	1.1664	1.5564
1.0	46.0	8.94	1.0463	1.5669
3.0	49.0	9.40	2.6494	1.5934

Table A-49 (Continued)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	50.0	8.88	1.2535	1.6059
1.0	51.0	8.88	1.1572	1.6175
1.0	52.0	8.88	1.0496	1.6280
1.0	53.0	8.84	0.9969	1.6380
3.0	56.0	9.32	2.3182	1.6612
1.0	57.0	8.80	1.0347	1.6715
1.0	58.0	8.79	0.9335	1.6808
1.0	59.0	8.80	0.8681	1.6895
1.0	60.0	8.78	0.8857	1.6984
3.0	63.0	9.21	2.3448	1.7218
1.0	64.0	8.79	1.0376	1.7322
1.0	65.0	8.57	1.0840	1.7430
1.0	66.0	8.73	0.9622	1.7526
1.0	67.0	8.64	0.9175	1.7618
3.0	70.0	9.13	2.3679	1.7855
1.0	71.0	8.70	0.9525	1.7950
1.0	72.0	8.72	0.8183	1.8032
1.0	73.0	8.69	0.8394	1.8116
4.0	77.0	9.18	2.2509	1.8341
1.0	78.0	8.72	0.8108	1.8422
1.0	79.0	8.69	0.7241	1.8494
1.0	80.0	8.75	0.8217	1.8576
1.0	81.0	8.63	0.6823	1.8644
3.0	84.0	8.99	1.4689	1.8791
1.0	85.0	8.59	0.6717	1.8858
1.0	86.0	8.63	0.6479	1.8923
1.0	87.0	8.64	0.7030	1.8993
1.0	88.0	8.64	0.7474	1.9068
3.0	91.0	9.00	1.3778	1.9206
1.0	92.0	8.67	0.7519	1.9281
1.0	93.0	8.56	0.5836	1.9339
1.0	94.0	8.55	0.7605	1.9415
1.0	95.0	8.64	0.8925	1.9505

Table A-50. Experimental Results for the Leaching of Strontium from Cementitious Grout No. M75-9A

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Strontium added: stable = 1.8 mg
^{85}Sr at time t_o = 0.010 mg
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.76 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	1.0	11.33	17.669	0.1767
1.0	2.0	10.55	8.6217	0.2629
1.0	3.0	10.23	6.7978	0.3309
1.0	4.0	10.06	7.3973	0.4049
3.0	7.0	10.50	16.190	0.5668
1.0	8.0	9.73	6.8132	0.6349
1.0	9.0	9.62	5.5390	0.6903
1.0	10.0	9.55	6.5705	0.7560
1.0	11.0	9.51	8.4857	0.8408
4.0	15.0	9.98	24.455	1.0854
1.0	16.0	9.35	6.8901	1.1543
1.0	17.0	9.35	6.7497	1.2218
1.0	18.0	9.25	6.2867	1.2847
3.0	21.0	9.68	17.186	1.4566
1.0	22.0	9.20	7.7251	1.5339
1.0	23.0	9.16	6.3797	1.5977
1.0	24.0	9.17	6.6948	1.6646
1.0	25.0	9.09	6.6067	1.7307

Table A-51. Experimental Results for the Leaching of Strontium from Cementitious Grout No. M75-9B

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Strontium added: stable = 1.8 mg
^{85}Sr at time t_o = 0.010 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 28 days

Leachant 200 ml stored tap water; 1 change/day (initial pH = 8.14)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	1.0	11.30	21.311	0.2131
1.0	2.0	10.53	8.4559	0.2977
1.0	3.0	10.22	5.9051	0.3567
1.0	4.0	10.08	6.0709	0.4174
3.0	7.0	10.47	15.274	0.5702
1.0	8.0	9.75	5.2440	0.6226
1.0	9.0	9.65	6.4891	0.6875
1.0	10.0	9.60	5.9460	0.7470
1.0	11.0	9.54	6.9341	0.8163
4.0	15.0	10.01	25.196	1.0683
1.0	16.0	9.41	7.4093	1.1424
1.0	17.0	9.41	8.1951	1.2243
1.0	18.0	9.33	7.4093	1.2984
3.0	21.0	9.73	19.544	1.4938
1.0	22.0	9.31	6.8137	1.5620
1.0	23.0	9.27	8.6510	1.6485
1.0	24.0	9.27	6.4012	1.7125
1.0	25.0	9.22	6.4012	1.7765
3.0	28.0	9.62	17.366	1.9502
1.0	29.0	9.18	5.9734	2.0099
1.0	30.0	9.16	6.8420	2.0783
1.0	31.0	9.12	6.2129	2.1404
1.0	32.0	9.09	4.6536	2.1870
3.0	35.0	9.52	16.121	2.3482
1.0	36.0	9.09	5.2686	2.4009
1.0	37.0	9.07	6.0581	2.4615
1.0	38.0	9.08	5.5574	2.5170
1.0	39.0	9.10	5.2880	2.5699
3.0	42.0	9.46	15.383	2.7237
1.0	43.0	9.08	6.2254	2.7860
1.0	44.0	8.78	6.1377	2.8474
1.0	45.0	9.03	5.5847	2.9032
1.0	46.0	8.87	5.9048	2.9623
3.0	49.0	9.27	16.061	3.1229
1.0	50.0	9.02	6.8805	3.1917
1.0	51.0	9.00	5.4619	3.2463
1.0	52.0	9.00	5.9602	3.3059
4.0	56.0	9.34	19.594	3.5019
1.0	57.0	8.99	4.6700	3.5486
1.0	58.0	8.98	5.0869	3.5994
1.0	59.0	9.02	5.8005	3.6574
1.0	60.0	9.00	8.1821	3.7392
3.0	63.0	9.16	13.069	3.8699
1.0	64.0	8.98	4.9621	3.9196

Table A-51 (Continued)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	65.0	8.91	4.5856	3.9655
1.0	66.0	8.99	5.1350	4.0168
1.0	67.0	8.96	4.7332	4.0641
3.0	70.0	9.18	11.404	4.1782
1.0	71.0	9.00	3.4234	4.2124
1.0	72.0	8.97	3.5391	4.2478
1.0	73.0	8.95	5.4944	4.3027
1.0	74.0	9.03	6.7475	4.3702
3.0	77.0	9.20	13.567	4.5059
1.0	78.0	8.96	4.3335	4.5492
1.0	79.0	8.99	5.3917	4.6031
1.0	80.0	9.01	4.2579	4.6457
1.0	81.0	8.99	5.2005	4.6977
3.0	84.0	9.01	11.007	4.8078
1.0	85.0	8.91	2.7998	4.8358
1.0	86.0	8.92	3.0185	4.8660
1.0	87.0	8.90	4.0302	4.9063
1.0	88.0	8.88	4.3015	4.9493
3.0	91.0	9.02	9.1769	5.0410
1.0	92.0	8.84	4.7706	5.0887
1.0	93.0	8.84	3.7322	5.1261
1.0	94.0	8.87	3.2610	5.1587
1.0	95.0	8.93	5.0131	5.2088
3.0	98.0	9.06	11.607	5.3249
1.0	99.0	8.91	4.1207	5.3661
1.0	100.0	8.89	3.0765	5.3969
1.0	101.0	8.89	3.9682	5.4365
1.0	102.0	8.87	4.4122	5.4807
3.0	105.0	9.01	10.377	5.5844
1.0	106.0	8.89	3.9216	5.6236
1.0	107.0	8.90	5.7965	5.6816
1.0	108.0	8.93	4.9167	5.7308
1.0	109.0	8.92	4.7454	5.7782
4.0	113.0	9.09	12.943	5.9077
1.0	114.0	8.88	5.1529	5.9592
1.0	115.0	8.88	3.1184	5.9904
1.0	116.0	8.89	4.3949	6.0343
3.0	119.0	8.99	11.277	6.1471
1.0	120.0	8.91	3.0917	6.1780
1.0	121.0	8.90	2.8471	6.2065
1.0	122.0	8.98	4.3271	6.2497
1.0	123.0	8.91	5.3709	6.3035

Table A-52. Experimental Results for the Leaching of Strontium from Cementitious Grout No. M75-9C

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Strontium added: stable = 1.8 mg
^{85}Sr at time t_o = 0.010 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 28 days

Leachant 200 ml distilled water; 1 change/day (initial pH = 7.89 - 6.32)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	1.0	11.71	6.2695	0.0627
1.0	2.0	11.39	4.1744	0.1044
1.0	3.0	11.24	3.3326	0.1378
1.0	4.0	11.23	2.8224	0.1660
3.0	7.0	11.29	4.7836	0.2138
1.0	8.0	10.92	2.3382	0.2372
1.0	9.0	10.83	1.3643	0.2508
1.0	10.0	10.78	1.5720	0.2666
1.0	11.0	10.73	1.6861	0.2834
4.0	15.0	10.91	5.0735	0.3342
1.0	16.0	10.57	2.1021	0.3552
1.0	17.0	10.61	2.1667	0.3769
1.0	18.0	10.49	2.5694	0.4026
3.0	21.0	10.73	5.4307	0.4569
1.0	22.0	10.52	2.4275	0.4811
1.0	23.0	10.48	2.5765	0.5069
1.0	24.0	10.49	2.7895	0.5348
1.0	25.0	10.46	3.1022	0.5658
3.0	28.0	10.61	6.0997	0.6268
1.0	29.0	10.36	1.8197	0.6450
1.0	30.0	10.36	2.9916	0.6749
1.0	31.0	10.33	3.1332	0.7062
1.0	32.0	10.15	2.9916	0.7362
3.0	35.0	10.52	5.6757	0.7929
1.0	36.0	10.34	2.4215	0.8172
1.0	37.0	10.26	2.4750	0.8419
1.0	38.0	10.29	2.7119	0.8690
1.0	39.0	10.34	2.7166	0.8962
3.0	42.0	10.47	5.4865	0.9511
1.0	43.0	10.18	2.7269	0.9783
1.0	44.0	10.17	2.3236	1.0016
1.0	45.0	10.12	2.2392	1.0240
1.0	46.0	9.88	2.4473	1.0485
3.0	49.0	10.27	5.1038	1.0995
1.0	50.0	10.00	1.8806	1.1183
1.0	51.0	10.15	1.8060	1.1364
1.0	52.0	10.16	1.6984	1.1533
4.0	56.0	10.21	5.2226	1.2055
1.0	57.0	10.10	1.6676	1.2222
1.0	58.0	9.87	1.8084	1.2403
1.0	59.0	9.80	1.6912	1.2572

Table A-52 (Continued)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	60.0	10.03	1.5160	1.2724
3.0	63.0	10.08	3.7547	1.3099
1.0	64.0	9.87	1.5440	1.3253
1.0	65.0	9.87	1.7589	1.3429
1.0	66.0	9.87	1.5785	1.3587
1.0	67.0	9.83	1.9134	1.3779
3.0	70.0	10.08	3.8005	1.4159
1.0	71.0	10.01	1.5961	1.4318
1.0	72.0	10.03	1.5105	1.4469
1.0	73.0	9.87	1.5302	1.4622
1.0	74.0	9.92	1.8989	1.4812
3.0	77.0	10.06	4.0918	1.5221
1.0	78.0	9.82	1.4260	1.5364
1.0	79.0	9.79	1.6351	1.5527
1.0	80.0	9.76	1.3832	1.5666
1.0	81.0	9.81	1.3975	1.5806
3.0	84.0	9.72	2.8222	1.6088
1.0	85.0	9.74	0.8815	1.6176
1.0	86.0	9.64	1.0045	1.6276
1.0	87.0	9.89	1.2096	1.6397
1.0	88.0	9.63	1.0375	1.6501
3.0	91.0	9.58	3.1743	1.6818
1.0	92.0	9.51	0.8866	1.6907
1.0	93.0	9.72	0.9789	1.7005
1.0	94.0	9.51	1.4282	1.7148
1.0	95.0	9.45	1.0806	1.7256
3.0	98.0	9.58	3.4065	1.7597
1.0	99.0	9.46	1.0359	1.7700
1.0	100.0	9.57	1.1102	1.7811
1.0	101.0	9.55	1.0329	1.7914
1.0	102.0	9.48	1.1484	1.8029
3.0	105.0	9.59	2.6981	1.8299
1.0	106.0	9.53	0.9390	1.8393
1.0	107.0	9.43	1.0171	1.8495
1.0	108.0	9.68	0.9885	1.8594
1.0	109.0	9.85	1.5367	1.8748
4.0	113.0	9.57	3.9948	1.9147
1.0	114.0	9.31	1.2000	1.9267
1.0	115.0	9.67	1.1872	1.9386
1.0	116.0	9.43	0.9866	1.9485
3.0	119.0	9.43	2.6531	1.9750
1.0	120.0	9.85	0.9528	1.9846
1.0	121.0	9.60	1.0364	1.9950
1.0	122.0	9.82	1.1240	2.0062
1.0	123.0	9.37	1.0968	2.0172

Table A-53. Experimental Results for the Leaching of Strontium from Cementitious Grout No. M75-10

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Strontium added: stable = 0
^{85}Sr at time t_o = 0.010 mCi
Mass: 517 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day, (initial pH = 7.52 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	1.0	11.38	5.4097	0.5410
1.0	2.0	10.60	2.9578	0.8368
1.0	3.0	10.28	2.6142	1.0982
1.0	4.0	10.10	2.6928	1.3675
3.0	7.0	10.57	5.7826	1.9458
1.0	8.0	9.71	2.0119	2.1470
1.0	9.0	9.67	1.9074	2.3377
1.0	10.0	9.60	2.1380	2.5515
1.0	11.0	9.55	1.9681	2.7483
4.0	15.0	10.07	7.1540	3.4637
1.0	16.0	9.37	2.2906	3.6928
1.0	17.0	9.36	2.2792	3.9207
1.0	18.0	9.30	2.2360	4.1443
3.0	21.0	9.77	4.9129	4.6356
1.0	22.0	9.22	1.9402	4.8296
1.0	23.0	9.21	1.8410	5.0137
1.0	24.0	9.19	1.9067	5.2044
1.0	25.0	9.14	1.8286	5.3873
3.0	28.0	9.62	4.8349	5.8708
1.0	29.0	9.05	1.3286	6.0037
1.0	30.0	9.03	1.5289	6.1566
1.0	31.0	9.00	1.6417	6.3208
1.0	32.0	8.98	1.7978	6.5006
3.0	35.0	9.54	4.5996	6.9606
1.0	36.0	8.95	1.5879	7.1194
1.0	37.0	8.92	1.5250	7.2719
1.0	38.0	8.91	1.6349	7.4354
1.0	39.0	8.90	1.5335	7.5888
3.0	42.0	9.43	3.8281	7.9716
1.0	43.0	8.90	1.7220	8.1438
1.0	44.0	8.82	1.3602	8.2798
1.0	45.0	8.88	1.3740	8.4172
1.0	46.0	8.71	1.2491	8.5421
3.0	49.0	9.31	3.9263	8.9347
1.0	50.0	8.79	1.4104	9.0757
1.0	51.0	8.80	1.2140	9.1971
1.0	52.0	8.79	1.3022	9.3273
4.0	56.0	9.31	4.2977	9.7571
1.0	57.0	8.64	1.1029	9.8674
1.0	58.0	8.70	1.1546	9.9829
1.0	59.0	8.74	1.1980	10.1030
1.0	60.0	8.67	0.9729	10.2000
3.0	63.0	9.05	2.6068	10.4610
1.0	64.0	8.64	0.8967	10.5510
1.0	65.0	8.63	1.0335	10.6540
1.0	66.0	8.68	1.0567	10.7600
1.0	67.0	8.69	0.9346	10.8530

Table A-54. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M75-12A

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Cesium added: stable = 2.5 mg
^{137}Cs at time t_o = 0.015 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.52 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	1.0	11.36	74.753	0.7475
1.0	2.0	10.47	26.949	1.0170
1.0	3.0	10.19	17.212	1.1891
1.0	4.0	10.04	13.882	1.3279
3.0	7.0	10.49	30.088	1.6288
1.0	8.0	9.73	9.1228	1.7200
1.0	9.0	9.65	8.1596	1.8016
1.0	10.0	9.61	7.9637	1.8812
1.0	11.0	9.56	7.9445	1.9606
4.0	15.0	10.08	25.294	2.2135
1.0	16.0	9.37	6.4162	2.2777
1.0	17.0	9.34	5.3824	2.3315
1.0	18.0	9.29	5.1476	2.3830
3.0	21.0	9.76	13.318	2.5162
1.0	22.0	9.23	4.8711	2.5649
1.0	23.0	9.19	4.5660	2.6106
1.0	24.0	9.17	4.2629	2.6532
1.0	25.0	9.14	4.2971	2.6962
3.0	28.0	9.66	10.674	2.8029
1.0	29.0	9.07	3.8758	2.8417
1.0	30.0	9.06	3.3670	2.8754
1.0	31.0	9.03	3.4491	2.9099
1.0	32.0	9.01	3.2503	2.9424
3.0	35.0	9.52	8.2731	3.0251
1.0	36.0	9.00	2.9269	3.0544
1.0	37.0	8.89	2.7563	3.0820
1.0	38.0	8.96	2.6843	3.1088
1.0	39.0	8.95	2.5884	3.1347
3.0	42.0	9.43	7.5904	3.2106
1.0	43.0	8.92	2.7846	3.2384
1.0	44.0	8.85	2.5625	3.2640
1.0	45.0	8.88	2.4799	3.2888

Table A-54 (Continued)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	46.0	8.80	2.6809	3.3156
3.0	49.0	9.32	7.0091	3.3857
1.0	50.0	8.86	2.5540	3.4112
1.0	51.0	8.85	2.2078	3.4333
1.0	52.0	8.84	2.0778	3.4541
4.0	56.0	9.34	7.0908	3.5250
1.0	57.0	8.76	1.7923	3.5429
1.0	58.0	8.74	1.5829	3.5587
1.0	59.0	8.68	1.8876	3.5776
1.0	60.0	8.63	1.5299	3.5929
3.0	63.0	9.06	4.2289	3.6352
1.0	64.0	8.71	1.5757	3.6509
1.0	65.0	8.71	1.5120	3.6660
1.0	66.0	8.61	1.5197	3.6812
1.0	67.0	8.63	1.9209	3.7004
3.0	70.0	9.12	4.4521	3.7449
1.0	71.0	8.79	1.6935	3.7618
1.0	72.0	8.69	1.5942	3.7777
1.0	73.0	8.64	1.6442	3.7942
1.0	74.0	8.75	2.1243	3.8154
3.0	77.0	9.15	4.4773	3.8602
1.0	78.0	8.71	1.5995	3.8762
1.0	79.0	8.72	1.6738	3.8929
1.0	80.0	8.71	1.6189	3.9091
1.0	81.0	8.69	1.5154	3.9242
3.0	84.0	8.91	2.8966	3.9532
1.0	85.0	8.56	1.2130	3.9653
1.0	86.0	8.57	1.1746	3.9770
1.0	87.0	8.54	1.0414	3.9874
1.0	88.0	8.55	1.1052	3.9985

Table A-55. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M75-12B

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Cesium added: stable = 2.5 mg
^{137}Cs at time t_o = 0.015 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 28 days

Leachant 200 ml stored distilled water; 1 change/day (initial pH = 7.89 - 6.32)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	1.0	11.71	78.531	0.7853
1.0	2.0	11.40	34.247	1.1278
1.0	3.0	11.26	22.309	1.3509
1.0	4.0	11.21	19.288	1.5438
3.0	7.0	11.32	38.234	1.9261
1.0	8.0	10.87	12.954	2.0556
1.0	9.0	10.88	10.092	2.1565
1.0	10.0	10.81	8.8786	2.2453
1.0	11.0	10.80	8.3348	2.3286
4.0	15.0	10.89	26.247	2.5911
1.0	16.0	10.61	7.3057	2.6642
1.0	17.0	10.55	6.3571	2.7278
1.0	18.0	10.50	5.4692	2.7825
3.0	21.0	10.66	13.318	2.9157
1.0	22.0	10.48	5.4575	2.9703
1.0	23.0	10.45	4.5812	3.0161
1.0	24.0	10.45	3.9467	3.0556
1.0	25.0	10.41	3.9556	3.0952
3.0	28.0	10.62	8.8635	3.1838
1.0	29.0	10.33	3.9934	3.2237
1.0	30.0	10.36	3.4156	3.2579
1.0	31.0	10.32	3.4133	3.2920
1.0	32.0	10.21	3.2197	3.3242
3.0	35.0	10.43	7.5300	3.3995
1.0	36.0	10.36	2.9955	3.4295
1.0	37.0	10.22	2.6511	3.4560
1.0	38.0	10.27	2.6012	3.4820
1.0	39.0	10.29	2.5021	3.5070
3.0	42.0	10.49	6.3138	3.5701
1.0	43.0	10.21	3.1090	3.6012
1.0	44.0	10.20	2.5592	3.6268
1.0	45.0	10.20	2.3096	3.6499
1.0	46.0	9.88	2.4963	3.6749
3.0	49.0	10.05	6.2071	3.7370
1.0	50.0	9.92	2.7868	3.7649
1.0	51.0	10.13	1.9827	3.7847
1.0	52.0	10.14	2.0575	3.8053
4.0	56.0	10.08	6.1109	3.8664
1.0	57.0	10.10	2.0270	3.8867
1.0	58.0	9.84	1.6427	3.9031
1.0	59.0	9.81	1.9421	3.9225
1.0	60.0	10.03	1.4534	3.9371

Table A-56. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M75-12C

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Cesium added: stable = 2.5 mg
^{137}Cs at time t_o = 0.015 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.52 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	1.0	11.53	235.68	2.3568
1.0	2.0	11.06	66.169	3.0185
1.0	3.0	10.39	28.421	3.3027
1.0	4.0	10.04	19.368	3.4964
3.0	7.0	10.08	26.826	3.7647
1.0	8.0	9.41	13.064	3.8953
1.0	9.0	9.29	9.6912	3.9922
1.0	10.0	9.23	9.5184	4.0874
1.0	11.0	9.15	8.2708	4.1701
4.0	15.0	10.64	20.090	4.3710
1.0	16.0	9.12	8.1255	4.4523
1.0	17.0	9.09	6.8482	4.5208
1.0	18.0	9.06	6.2511	4.5833
3.0	21.0	9.45	12.521	4.7085
1.0	22.0	9.02	6.1800	4.7703
1.0	23.0	9.02	5.6439	4.8267
1.0	24.0	9.02	4.9943	4.8766
1.0	25.0	8.94	4.7829	4.9244
3.0	28.0	9.42	9.0890	5.0153
1.0	29.0	8.92	4.7156	5.0625
1.0	30.0	8.91	4.2171	5.1047
1.0	31.0	8.90	4.1010	5.1457
1.0	32.0	8.90	4.0476	5.1862
3.0	35.0	9.27	7.1506	5.2577
1.0	36.0	8.89	3.5213	5.2929
1.0	37.0	8.78	3.2969	5.3259
1.0	38.0	8.83	3.1221	5.3571
1.0	39.0	8.82	2.9943	5.3871
3.0	42.0	9.27	6.7526	5.4546
1.0	43.0	8.82	3.3750	5.4884
1.0	44.0	8.79	2.8661	5.5171

Table A-56 (Continued)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	45.0	8.75	2.6444	5.5435
1.0	46.0	8.66	2.8706	5.5722
3.0	49.0	9.07	6.4922	5.6371
1.0	50.0	8.74	3.0023	5.6671
1.0	51.0	8.74	2.6877	5.6940
1.0	52.0	8.76	2.5025	5.7190
4.0	56.0	9.12	6.1294	5.7803
1.0	57.0	8.70	2.2995	5.8033
1.0	58.0	8.66	1.8774	5.8221
1.0	59.0	8.70	2.0718	5.8428
1.0	60.0	8.65	1.6363	5.8592
3.0	63.0	8.93	3.4819	5.8940
1.0	64.0	8.61	1.7548	5.9115
1.0	65.0	8.51	1.5956	5.9275
1.0	66.0	8.54	1.5878	5.9434
1.0	67.0	8.58	1.7902	5.9613
3.0	70.0	8.95	3.2608	5.9939
1.0	71.0	8.67	1.4887	6.0088
1.0	72.0	8.57	1.4318	6.0231
1.0	73.0	8.54	1.4601	6.0377
1.0	74.0	8.64	1.5877	6.0536
3.0	77.0	8.94	3.1697	6.0853
1.0	78.0	8.59	1.4345	6.0996
1.0	79.0	8.59	1.5912	6.1156
1.0	80.0	8.60	1.3737	6.1293
1.0	81.0	8.56	1.4506	6.1438
3.0	84.0	8.74	2.2198	6.1660
1.0	85.0	8.34	1.0940	6.1769
1.0	86.0	8.42	1.0159	6.1871
1.0	87.0	8.43	0.8275	6.1954
1.0	88.0	8.42	1.0075	6.2055

Table A-57. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M75-13

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Cesium added: stable = 0
^{137}Cs at time t_o = 0.010 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 28 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.52 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^5$	Cumulative $(\Sigma a_n/A_o) \times 10^3$
1.0	1.0	11.45	10.123	0.1012
1.0	2.0	10.54	9.8391	0.1996
1.0	3.0	10.21	4.4465	0.2441
1.0	4.0	10.09	5.3428	0.2975
3.0	7.0	10.47	13.156	0.4291
1.0	8.0	9.75	4.2906	0.4720
1.0	9.0	9.61	3.3712	0.5057
1.0	10.0	9.62	4.1169	0.5469
1.0	11.0	9.52	4.0863	0.5877
4.0	15.0	10.00	14.506	0.7328
1.0	16.0	9.31	3.5586	0.7684
1.0	17.0	9.28	3.4859	0.8032
1.0	18.0	9.24	5.7684	0.8609
3.0	21.0	9.68	9.4307	0.9552
1.0	22.0	9.21	5.4883	1.0101
1.0	23.0	9.15	4.4197	1.0543
1.0	24.0	9.16	4.1810	1.0961
1.0	25.0	9.11	5.8520	1.1546
3.0	28.0	9.55	9.0768	1.2454
1.0	29.0	9.08	4.6157	1.2916
1.0	30.0	8.97	3.2351	1.3240
1.0	31.0	9.01	2.5598	1.3496
1.0	32.0	8.99	3.1113	1.3807
3.0	35.0	9.49	7.6066	1.4568
1.0	36.0	8.99	3.2799	1.4896
1.0	37.0	8.95	2.7975	1.5176
1.0	38.0	8.96	2.6903	1.5445
1.0	39.0	8.92	2.9583	1.5741
3.0	42.0	9.43	7.7479	1.6516
1.0	43.0	8.93	3.5680	1.6873
1.0	44.0	8.88	2.9249	1.7165
1.0	45.0	8.93	3.3398	1.7499
1.0	46.0	8.76	3.3676	1.7836
3.0	49.0	9.25	10.845	1.8920
1.0	50.0	8.86	4.4343	1.9363
1.0	51.0	8.83	3.5976	1.9723
1.0	52.0	8.80	2.8323	2.0006
4.0	56.0	9.25	9.7251	2.0979
1.0	57.0	8.72	2.8102	2.1260
1.0	58.0	8.68	2.1685	2.1477
1.0	59.0	8.74	3.1753	2.1795
1.0	60.0	8.71	3.0662	2.2101

Table A-58. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M75-15

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Cesium added: stable = 2.5 mg
^{137}Cs at time t_o = 0.010 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 56 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.52 - 8.28)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	1.0	10.90	95.815	0.9582
1.0	2.0	10.19	32.943	1.2876
1.0	3.0	9.97	23.155	1.5191
1.0	4.0	9.82	19.398	1.7131
4.0	8.0	10.35	51.285	2.2260
1.0	9.0	9.53	13.478	2.3607
1.0	10.0	9.47	11.359	2.4743
1.0	11.0	9.43	9.5317	2.5696
3.0	14.0	9.92	23.614	2.8058
1.0	15.0	9.35	9.2161	2.8980
1.0	16.0	9.32	8.1628	2.9796
1.0	17.0	9.30	7.3548	3.0531
1.0	18.0	9.25	7.1626	3.1247
3.0	21.0	9.78	17.026	3.2950
1.0	22.0	9.24	7.2571	3.3676
1.0	23.0	9.19	5.8960	3.4265
1.0	24.0	9.20	5.7310	3.4838
1.0	25.0	9.15	5.7590	3.5414
3.0	28.0	9.67	13.327	3.6747
1.0	29.0	9.14	5.6919	3.7316
1.0	30.0	9.08	5.1243	3.7829
1.0	31.0	9.09	4.6805	3.8297
1.0	32.0	9.06	4.4851	3.8745
3.0	35.0	9.57	11.513	3.9897
1.0	36.0	9.07	5.2093	4.0418
1.0	37.0	9.02	4.3708	4.0855
1.0	38.0	9.04	4.1526	4.1270
1.0	39.0	8.93	4.3102	4.1701
3.0	42.0	9.46	11.194	4.2820
1.0	43.0	9.02	4.8916	4.3309
1.0	44.0	8.96	3.8071	4.3690

Table A-58 (Continued)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	45.0	8.95	3.7869	4.4069
4.0	49.0	9.44	10.591	4.5128
1.0	50.0	8.92	3.7612	4.5504
1.0	51.0	8.82	3.0059	4.5805
1.0	52.0	8.86	3.3921	4.6144
1.0	53.0	8.81	2.5402	4.6398
3.0	56.0	9.16	6.2373	4.7022
1.0	57.0	8.78	2.7308	4.7295
1.0	58.0	8.79	2.6557	4.7560
1.0	59.0	8.79	2.6945	4.7830
1.0	60.0	8.77	3.1106	4.8141
3.0	63.0	9.16	6.2164	4.8762
1.0	64.0	8.83	2.8636	4.9049
1.0	65.0	8.71	2.4645	4.9295
1.0	66.0	8.70	2.4957	4.9545
1.0	67.0	8.77	3.5273	4.9898
3.0	70.0	9.20	6.8844	5.0586
1.0	71.0	8.75	3.3165	5.0918
1.0	72.0	8.74	2.7811	5.1196
1.0	73.0	8.74	2.7845	5.1474
1.0	74.0	8.72	2.5770	5.1732
3.0	77.0	8.95	4.6387	5.2196
1.0	78.0	8.62	2.2375	5.2419
1.0	79.0	8.59	2.1355	5.2633
1.0	80.0	8.57	1.8643	5.2820
1.0	81.0	8.45	2.2065	5.3040
3.0	84.0	8.94	3.9617	5.3436
1.0	85.0	8.58	1.9105	5.3627
1.0	86.0	8.54	2.0014	5.3827
1.0	87.0	8.57	1.9987	5.4027
1.0	88.0	8.59	2.0628	5.4234

Table A-59. Experimental Results for the Leaching of Strontium from Cementitious Grout No. M75-16A

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Strontium added: stable = 1.8 mg
^{85}Sr at time t_o = 0.010 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 56 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.52 - 8.06)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	1.0	10.75	7.1589	0.0716
1.0	2.0	10.09	11.608	0.1877
1.0	3.0	9.93	9.8777	0.2864
1.0	4.0	9.78	10.354	0.3900
3.0	7.0	10.32	19.695	0.5869
1.0	8.0	9.60	11.052	0.6975
1.0	9.0	9.48	8.1275	0.7787
1.0	10.0	9.48	8.4279	0.8630
1.0	11.0	9.06	8.5270	0.9483
3.0	14.0	9.97	17.743	1.1257
1.0	15.0	9.37	9.6449	1.2221
1.0	16.0	9.38	7.8913	1.3010
1.0	17.0	9.38	7.8079	1.3791
1.0	18.0	9.25	7.7545	1.4566
3.0	21.0	9.78	17.693	1.6335
1.0	22.0	9.24	8.4569	1.7181
1.0	23.0	9.21	7.9536	1.7976
1.0	24.0	9.15	6.8572	1.8662
4.0	28.0	9.67	20.703	2.0732
1.0	29.0	9.11	7.0049	2.1432
1.0	30.0	8.99	7.9413	2.2226
1.0	31.0	8.98	6.0553	2.2832
1.0	32.0	8.96	5.3411	2.3366
3.0	35.0	9.34	13.864	2.4752
1.0	36.0	8.93	6.2027	2.5372
1.0	37.0	8.90	5.3609	2.5909
1.0	38.0	8.91	6.1174	2.6520
1.0	39.0	8.90	6.1844	2.7138
3.0	42.0	9.31	12.028	2.8341
1.0	43.0	8.94	5.0889	2.8850
1.0	44.0	8.84	4.2330	2.9273

Table A-59 (Continued)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	45.0	8.82	4.8919	2.9762
1.0	46.0	8.92	5.2534	3.0288
3.0	49.0	9.36	14.097	3.1697
1.0	50.0	8.84	6.2735	3.2324
1.0	51.0	8.85	6.0971	3.2934
1.0	52.0	8.83	6.3994	3.3574
1.0	53.0	8.82	5.5876	3.4133
3.0	56.0	9.06	11.704	3.5303
1.0	57.0	8.68	4.9325	3.5796
1.0	58.0	8.69	3.7568	3.6172
1.0	59.0	8.65	4.9871	3.6671
1.0	60.0	8.64	4.5244	3.7123
3.0	63.0	9.02	9.1769	3.8041
1.0	64.0	8.65	3.3285	3.8374
1.0	65.0	8.58	4.5975	3.8834
1.0	66.0	8.53	3.0632	3.9140
1.0	67.0	8.63	4.6740	3.9608
3.0	70.0	9.10	12.001	4.0808
1.0	71.0	8.10	4.5147	4.1259
1.0	72.0	8.72	4.0871	4.1668
1.0	73.0	8.69	4.5627	4.2124
1.0	74.0	8.67	5.3346	4.2657
3.0	77.0	9.04	8.8398	4.3541
1.0	78.0	8.64	3.9841	4.3939
1.0	79.0	8.60	4.6091	4.4400
1.0	80.0	8.53	4.9167	4.4892
1.0	81.0	8.49	4.9167	4.5384
4.0	85.0	9.16	11.651	4.6549
1.0	86.0	8.60	5.5022	4.7099
1.0	87.0	8.61	3.4102	4.7440
1.0	88.0	8.61	3.1913	4.7759
3.0	91.0	9.03	9.9747	4.8756
1.0	92.0	8.58	4.5800	4.9214
1.0	93.0	8.58	4.5997	4.9674
1.0	94.0	8.65	3.6260	5.0037
1.0	95.0	8.64	3.8374	5.0421

Table A-60. Experimental Results for the Leaching of Strontium from Cementitious Grout No. M75-16B

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Strontium added: stable = 1.8 mg
^{85}Sr at time t_o = 0.010 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 56 days

Leachant 200 ml distilled water; 1 change/day (initial pH = 6.32 - 7.89)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	1.0	11.43	1.8906	0.1891
1.0	2.0	11.10	2.0007	0.3891
1.0	3.0	10.98	1.6798	0.5571
1.0	4.0	10.82	1.4842	0.7055
3.0	7.0	11.09	2.6808	0.9736
1.0	8.0	10.71	1.3080	1.1044
1.0	9.0	10.65	1.3017	1.2346
1.0	10.0	10.64	1.2967	1.3643
1.0	11.0	10.62	1.3729	1.5016
3.0	14.0	10.84	3.1179	1.8134
1.0	15.0	10.44	1.6782	1.9812
1.0	16.0	10.45	1.5783	2.1390
1.0	17.0	10.44	1.8604	2.3250
1.0	18.0	10.21	2.3548	2.5605
3.0	21.0	10.53	4.2767	2.9882
1.0	22.0	10.28	2.1625	3.2044
1.0	23.0	10.31	2.3602	3.4404
1.0	24.0	10.36	2.4299	3.6834
4.0	28.0	10.42	5.8958	4.2730
1.0	29.0	10.32	2.1443	4.4874
1.0	30.0	10.11	2.4711	4.7345
1.0	31.0	10.10	2.4660	4.9811
1.0	32.0	10.16	2.3342	5.2145
3.0	35.0	10.36	4.9661	5.7111
1.0	36.0	10.11	1.9981	5.9109
1.0	37.0	10.06	1.9428	6.1052
1.0	38.0	10.06	1.8352	6.2887
1.0	39.0	10.02	1.9290	6.4816
3.0	42.0	10.32	3.8976	6.8714
1.0	43.0	10.24	1.6030	7.0317
1.0	44.0	10.18	1.6539	7.1971

Table A-60 (Continued)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	45.0	9.99	1.7302	7.3701
1.0	46.0	10.08	2.0315	7.5733
3.0	49.0	10.22	4.0678	7.9800
1.0	50.0	9.82	1.5470	8.1347
1.0	51.0	9.94	1.5595	8.2906
1.0	52.0	9.94	1.6603	8.4567
1.0	53.0	9.94	1.4930	8.6060
3.0	56.0	9.78	3.2429	8.9303
1.0	57.0	9.76	1.0674	9.0370
1.0	58.0	9.87	1.1276	9.1498
1.0	59.0	10.00	0.9772	9.2475
1.0	60.0	9.85	1.3857	9.3861
3.0	63.0	9.92	2.8623	9.6723
1.0	64.0	9.82	1.1116	9.7835
1.0	65.0	9.92	1.0251	9.8860
1.0	66.0	9.68	1.3067	10.0170
1.0	67.0	9.64	1.0806	10.1250
3.0	70.0	9.81	3.4722	10.4720
1.0	71.0	9.72	1.3905	10.6110
1.0	72.0	9.69	1.0418	10.7150
1.0	73.0	9.57	1.1013	10.8250
1.0	74.0	9.73	1.0670	10.9320
3.0	77.0	9.78	2.5228	11.1840
1.0	78.0	9.67	1.1734	11.3010
1.0	79.0	9.44	1.1171	11.4130
1.0	80.0	9.84	1.2009	11.5330
1.0	81.0	9.86	1.0913	11.6420
4.0	85.0	9.86	3.9599	12.0380
1.0	86.0	9.62	1.0742	12.1460
1.0	87.0	9.82	1.0705	12.2530
1.0	88.0	9.58	1.2164	12.3740
3.0	91.0	9.71	3.0363	12.6780
1.0	92.0	9.97	1.1649	12.7940
1.0	93.0	9.89	1.3168	12.9260
1.0	94.0	9.95	1.2000	13.0460
1.0	95.0	9.45	1.1811	13.1640

Table A-61. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M75-17A

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Cesium added: stable = 2.5 mg
^{137}Cs at time t_o = 0.015 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 56 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.52 - 8.06)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	1.0	10.73	44.082	0.4408
1.0	2.0	10.12	15.809	0.5989
1.0	3.0	9.95	12.778	0.7267
1.0	4.0	9.80	11.070	0.8374
3.0	7.0	10.27	23.381	1.0712
1.0	8.0	9.59	7.2857	1.1441
1.0	9.0	9.52	6.5643	1.2097
1.0	10.0	9.50	5.9419	1.2691
1.0	11.0	9.47	5.7169	1.3263
3.0	14.0	9.86	15.659	1.4829
1.0	15.0	9.32	5.8085	1.5410
1.0	16.0	9.36	4.8220	1.5892
1.0	17.0	9.36	4.5625	1.6348
1.0	18.0	9.22	4.5204	1.6800
3.0	21.0	9.63	12.590	1.8059
1.0	22.0	9.24	4.4838	1.8507
1.0	23.0	9.12	3.7878	1.8886
1.0	24.0	9.21	3.5057	1.9237
4.0	28.0	9.64	12.527	2.0490
1.0	29.0	9.13	3.1086	2.0801
1.0	30.0	9.00	2.6718	2.1068
1.0	31.0	9.00	2.8717	2.1355
1.0	32.0	9.03	2.2513	2.1580
3.0	35.0	9.43	6.3717	2.2217
1.0	36.0	8.96	2.8046	2.2498
1.0	37.0	8.92	2.3384	2.2732
1.0	38.0	8.94	2.4779	2.2980
1.0	39.0	8.91	2.5412	2.3234
3.0	42.0	9.32	6.2356	2.3858
1.0	43.0	8.95	2.4978	2.4108
1.0	44.0	8.85	2.1309	2.4321
1.0	45.0	8.83	2.1487	2.4536
1.0	46.0	8.97	2.9557	2.4832
3.0	49.0	9.32	6.1769	2.5450
1.0	50.0	8.83	2.4065	2.5690
1.0	51.0	8.85	2.1977	2.5910
1.0	52.0	8.82	2.2736	2.6137
1.0	53.0	8.80	2.1788	2.6355
3.0	56.0	9.03	4.1197	2.6767
1.0	57.0	8.70	1.5149	2.6918
1.0	58.0	8.68	1.6460	2.7083
1.0	59.0	8.68	1.4065	2.7224
1.0	60.0	8.67	1.4927	2.7373

Table A-62. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M75-17B

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Cesium added: stable = 2.5 mg
^{137}Cs at time t_o = 0.015 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 56 days (dry)

Leachant 200 ml tap water; 1 change/day (initial pH = 7.52 - 8.06)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	1.0	11.64	263.49	2.6349
1.0	2.0	11.13	87.026	3.5052
1.0	3.0	10.52	38.423	3.8894
1.0	4.0	10.10	23.059	4.1200
3.0	7.0	10.30	32.975	4.4498
1.0	8.0	9.51	8.9358	4.5392
1.0	9.0	9.41	7.6083	4.6153
1.0	10.0	9.35	6.7510	4.6828
1.0	11.0	9.32	6.4404	4.7472
3.0	14.0	9.54	16.871	4.9159
1.0	15.0	9.09	5.9734	4.9756
1.0	16.0	9.06	4.7310	5.0229
1.0	17.0	9.05	4.7752	5.0707
1.0	18.0	8.97	4.5395	5.1161
3.0	21.0	9.39	11.641	5.2325
1.0	22.0	9.01	4.2522	5.2750
1.0	23.0	8.96	3.5305	5.3103
1.0	24.0	8.93	3.4792	5.3451
4.0	28.0	9.41	9.8862	5.4440
1.0	29.0	8.96	2.5768	5.4698
1.0	30.0	8.87	2.2596	5.4924
1.0	31.0	8.87	2.4973	5.5174
1.0	32.0	8.89	1.9209	5.5366
3.0	35.0	9.26	4.9116	5.5857
1.0	36.0	8.79	1.9461	5.6052
1.0	37.0	8.84	1.8258	5.6235
1.0	38.0	8.84	1.9184	5.6427
1.0	39.0	8.83	1.8589	5.6613
3.0	42.0	9.22	4.0766	5.7021
1.0	43.0	8.87	1.6921	5.7190
1.0	44.0	8.78	1.4364	5.7334
1.0	45.0	8.74	1.4910	5.7483
1.0	46.0	8.87	1.8198	5.7665
3.0	49.0	9.26	4.0861	5.8074
1.0	50.0	8.78	1.5736	5.8231
1.0	51.0	8.81	1.4947	5.8380
1.0	52.0	8.74	1.5989	5.8540
1.0	53.0	8.75	1.2982	5.8670
3.0	56.0	8.99	2.5461	5.8925
1.0	57.0	8.65	1.0658	5.9032
1.0	58.0	8.67	1.0108	5.9133
1.0	59.0	8.64	0.8818	5.9221
1.0	60.0	8.65	1.0682	5.9328

Table A-63. Experimental Results for the Leaching of Strontium from Cementitious Grout No. M75-20A

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Strontium added: stable = 1.8 mg
^{85}Sr at time t_o = 0.005 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 112 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.59 - 7.92)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^4$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	1.0	10.54	8.7603	0.0876
1.0	2.0	9.80	6.4909	0.1525
1.0	3.0	9.67	6.6276	0.2188
1.0	4.0	9.57	5.3601	0.2724
3.0	7.0	10.08	14.470	0.4171
1.0	8.0	9.38	4.3091	0.4602
1.0	9.0	9.27	3.8188	0.4984
1.0	10.0	9.22	6.5673	0.5640
1.0	11.0	9.24	5.2391	0.6164
3.0	14.0	9.74	12.822	0.7446
1.0	15.0	9.14	7.0101	0.8148
1.0	16.0	9.19	4.8899	0.8634
1.0	17.0	9.14	6.1678	0.9250
1.0	18.0	9.11	5.9496	0.9845
3.0	21.0	9.58	11.238	1.0969
1.0	22.0	9.02	6.3590	1.1605
1.0	23.0	8.98	4.5466	1.2060
1.0	24.0	9.07	5.6019	1.2620
1.0	25.0	9.04	5.4992	1.3170
4.0	29.0	9.67	14.795	1.4649
1.0	30.0	8.91	4.5590	1.5105
1.0	31.0	8.97	4.9420	1.5599
1.0	32.0	8.91	4.9420	1.6093
3.0	35.0	9.41	12.281	1.7321
1.0	36.0	8.96	3.5754	1.7679
1.0	37.0	8.95	3.6260	1.8042
1.0	38.0	8.99	4.3271	1.8475
1.0	39.0	8.90	5.7542	1.9050
3.0	42.0	9.26	10.470	2.0097
1.0	43.0	9.00	5.4694	2.0644
1.0	44.0	8.80	3.8852	2.1033
1.0	45.0	8.87	3.5084	2.1384
1.0	46.0	8.92	5.1473	2.1899
3.0	49.0	9.40	10.089	2.2908
1.0	50.0	8.89	4.7526	2.3383
1.0	51.0	8.82	4.1004	2.3793
1.0	52.0	8.86	5.9942	2.4392
1.0	53.0	8.79	2.2425	2.4616
3.0	56.0	9.31	10.747	2.5691
1.0	57.0	8.91	4.5767	2.6149
1.0	58.0	8.79	4.7139	2.6620
1.0	59.0	8.88	4.1140	2.7031
1.0	60.0	8.78	4.2074	2.7452

Table A-64. Experimental Results for the Leaching of Strontium from Cementitious Grout No. M75-20B

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Strontium added: stable = 1.8 mg
^{85}Sr at time t_o = 0.005 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 112 days

Leachant 200 ml distilled water; 1 change/day (initial pH = 7.59 - 7.91)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	1.0	11.39	1.2916	0.1292
1.0	2.0	11.01	0.9635	0.2255
1.0	3.0	10.94	0.8542	0.3109
1.0	4.0	10.81	0.8843	0.3994
3.0	7.0	11.22	1.7758	0.5769
1.0	8.0	10.76	0.6501	0.6419
1.0	9.0	10.60	0.7078	0.7127
1.0	10.0	10.59	1.0721	0.8199
1.0	11.0	10.47	0.9874	0.9187
3.0	14.0	10.79	2.5135	1.1700
1.0	15.0	10.39	1.2329	1.2933
1.0	16.0	10.34	1.2410	1.4174
1.0	17.0	10.36	1.3242	1.5498
1.0	18.0	10.35	1.6527	1.7151
3.0	21.0	10.57	2.9133	2.0064
1.0	22.0	10.34	1.4921	2.1556
1.0	23.0	10.30	1.6577	2.3214
1.0	24.0	10.37	1.6292	2.4843
1.0	25.0	10.34	1.9718	2.6815

Table A-65. Experimental Results for the Leaching of Strontium from Cementitious Grout No. M75-21A

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 (719 g/liter)
Strontium added: stable = 0
^{85}Sr at time t_o = 0.005 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 112 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.59 - 7.91)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	1.0	10.69	4.3248	0.4325
1.0	2.0	9.94	4.1661	0.8491
1.0	3.0	9.78	3.9218	1.2413
1.0	4.0	9.67	2.8416	1.5255
3.0	7.0	10.11	5.8062	2.1061
1.0	8.0	9.42	2.8660	2.3927
1.0	9.0	9.38	2.5500	2.6477
1.0	10.0	9.32	2.5233	2.9000
1.0	11.0	9.29	2.4659	3.1466
3.0	14.0	9.73	5.1998	3.6666
1.0	15.0	9.24	2.2452	3.8911
1.0	16.0	9.20	2.3120	4.1223
1.0	17.0	9.13	2.1746	4.3398
1.0	18.0	9.12	2.1197	4.5518
3.0	21.0	9.51	4.8466	5.0365
1.0	22.0	9.08	2.1782	5.2543
1.0	23.0	9.04	2.1520	5.4695
1.0	24.0	9.07	1.8565	5.6551
1.0	25.0	9.09	2.0431	5.8594
4.0	29.0	9.56	6.0722	6.4666
1.0	30.0	8.99	2.2806	6.6947
1.0	31.0	8.98	1.9609	6.8908
1.0	32.0	8.91	1.9943	7.0902
3.0	35.0	9.36	4.0345	7.4936
1.0	36.0	8.99	1.9753	7.6911
1.0	37.0	8.96	2.0681	7.8979
1.0	38.0	9.01	1.5914	8.0570
1.0	39.0	8.92	1.4733	8.2043

Table A-66. Experimental Results for the Leaching of Strontium from Cementitious Grout No. M75-21B

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Strontium added: stable = 0
^{85}Sr at time t_o = 0.005 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 112 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.58 - 7.91)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^2$
1.0	1.0	10.65	4.2687	0.4269
1.0	2.0	9.91	4.4763	0.8745
1.0	3.0	9.77	4.1221	1.2867
1.0	4.0	9.64	3.0410	1.5908
3.0	7.0	10.12	5.4591	2.1367
1.0	8.0	9.46	2.8891	2.4256
1.0	9.0	9.35	2.7045	2.6961
1.0	10.0	9.35	2.5042	2.9465
1.0	11.0	9.35	2.5195	3.1984
3.0	14.0	9.82	5.3145	3.7299
1.0	15.0	9.28	2.3015	3.9601
1.0	16.0	9.24	1.9490	4.1550
1.0	17.0	9.20	2.3858	4.3936
1.0	18.0	9.16	2.3761	4.6312
3.0	21.0	9.63	4.6141	5.0926
1.0	22.0	9.11	2.3048	5.3231
1.0	23.0	9.05	2.1563	5.5387
1.0	24.0	9.13	2.1156	5.7503
1.0	25.0	9.13	1.9333	5.9436
4.0	29.0	9.66	5.9153	6.5351
1.0	30.0	9.07	2.1948	6.7546
1.0	31.0	9.02	1.9181	6.9464
1.0	32.0	8.96	1.9062	7.1370
3.0	35.0	9.34	4.0172	7.5387
1.0	36.0	9.06	1.7723	7.7160
1.0	37.0	8.99	1.8074	7.8967
1.0	38.0	9.03	1.7528	8.0720
1.0	39.0	8.96	1.6641	8.2380
3.0	42.0	9.26	3.7572	8.6141
1.0	43.0	9.08	2.2046	8.8346
1.0	44.0	8.98	1.9147	9.0261
1.0	45.0	8.99	1.7509	9.2012
1.0	46.0	9.01	1.7162	9.3728
3.0	49.0	9.46	3.6642	9.7392
1.0	50.0	9.00	1.7721	9.9164
1.0	51.0	8.88	1.6981	10.0860
1.0	52.0	8.94	1.6981	10.2560
1.0	53.0	8.87	1.5701	10.4130
3.0	56.0	9.29	4.3066	10.8440
1.0	57.0	8.96	1.7229	11.0160
1.0	58.0	8.85	1.7427	11.1900
1.0	59.0	8.89	1.6251	11.3530
1.0	60.0	8.86	1.3751	11.4910

Table A-67. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M75-23A

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Cesium added: stable = 2.5 mg
^{137}Cs at time t_o = 0.015 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 112 days

Leachant 200 ml tap water; 1 change/day (initial pH = 7.58 - 7.91)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	1.0	10.63	33.857	0.3386
1.0	2.0	9.85	10.158	0.4402
1.0	3.0	9.73	8.7053	0.5272
1.0	4.0	9.62	7.8479	0.6057
3.0	7.0	10.09	16.123	0.7669
1.0	8.0	9.39	5.3522	0.8204
1.0	9.0	9.20	5.6740	0.8772
1.0	10.0	9.25	5.6152	0.9333
1.0	11.0	9.21	5.3618	0.9869
3.0	14.0	9.74	13.738	1.1243
1.0	15.0	9.12	4.8740	1.1730
1.0	16.0	9.16	4.1000	1.2140
1.0	17.0	9.09	3.7096	1.2511
1.0	18.0	9.11	3.5195	1.2863
3.0	21.0	9.56	9.5790	1.3821
1.0	22.0	9.07	4.0525	1.4226
1.0	23.0	9.01	3.3040	1.4556
1.0	24.0	9.06	3.4578	1.4902
1.0	25.0	9.03	3.6880	1.5271
4.0	29.0	9.65	10.973	1.6368
1.0	30.0	8.90	3.5324	1.6721
1.0	31.0	8.96	3.2694	1.7048
1.0	32.0	8.91	3.1673	1.7365
3.0	35.0	9.37	7.1191	1.8077
1.0	36.0	8.95	2.9884	1.8376
1.0	37.0	8.77	2.6137	1.8637
1.0	38.0	8.77	2.6042	1.8898
1.0	39.0	8.78	2.4029	1.9138
3.0	42.0	9.29	5.2742	1.9665
1.0	43.0	9.03	3.1887	1.9984
1.0	44.0	8.89	2.8638	2.0270
1.0	45.0	8.89	2.6146	2.0532
1.0	46.0	8.95	2.6787	2.0800
3.0	49.0	9.44	6.0173	2.1402
1.0	50.0	8.77	2.4817	2.1650
1.0	51.0	8.83	2.4099	2.1891
1.0	52.0	8.85	2.2592	2.2117
1.0	53.0	8.85	2.1515	2.2332
3.0	56.0	9.39	5.3249	2.2864
1.0	57.0	8.89	2.2137	2.3085
1.0	58.0	8.78	2.1299	2.3298
1.0	59.0	8.91	2.0897	2.3507
1.0	60.0	8.86	1.8640	2.3693

Table A-68. Experimental Results for the Leaching of Cesium from Cementitious Grout No. M75-23B

Specimen Solid-to-waste ratio: 6 lb dry mix/gal 1XW-7 waste (719 g/liter)
Cesium added: stable = 2.5 mg
^{137}Cs at time t_o = 0.015 mCi
Mass: 5.7 g (as prepared)
Volume: 5.03 cm^3
Exposed Surface Area: 16.6 cm^2

Curing Time 112 days (dry)

Leachant 200 ml tap water; 1 change/day (initial pH = 7.58 - 7.91)

Leaching Time (days)		Final pH of Leachate	Fraction Leached	
Incremental t_n	Cumulative Σt_n		Incremental $(a_n/A_o) \times 10^3$	Cumulative $(\Sigma a_n/A_o) \times 10^1$
1.0	1.0	11.10	136.31	1.3631
1.0	2.0	10.58	22.749	1.5906
1.0	3.0	10.15	12.396	1.7146
1.0	4.0	9.81	9.6259	1.8109
3.0	7.0	10.01	14.037	1.9513
1.0	8.0	9.32	5.8310	2.0096
1.0	9.0	9.11	5.8679	2.0683
1.0	10.0	9.06	6.1688	2.1300
1.0	11.0	9.01	5.3346	2.1833
3.0	14.0	9.40	10.668	2.2900
1.0	15.0	8.87	4.4485	2.3345
1.0	16.0	8.88	4.0199	2.3747
1.0	17.0	8.81	3.7190	2.4119
1.0	18.0	8.76	3.3784	2.4457
3.0	21.0	9.14	6.8657	2.5144
1.0	22.0	8.73	3.6304	2.5507
1.0	23.0	8.68	3.1269	2.5820
1.0	24.0	8.69	2.9485	2.6115
1.0	25.0	8.66	3.0962	2.6425
4.0	29.0	9.11	7.2885	2.7153
1.0	30.0	8.58	3.4729	2.7500
1.0	31.0	8.64	2.7989	2.7780
1.0	32.0	8.59	2.9786	2.8078
3.0	35.0	8.91	5.2870	2.8607
1.0	36.0	8.58	2.5535	2.8862
1.0	37.0	8.51	2.3617	2.9099
1.0	38.0	8.53	2.2605	2.9325
1.0	39.0	8.53	2.3162	2.9556
3.0	42.0	8.83	3.8038	2.9936
1.0	43.0	8.58	2.5517	3.0192
1.0	44.0	8.51	2.7398	3.0466
1.0	45.0	8.54	2.4412	3.0710
1.0	46.0	8.34	2.6638	3.0976
3.0	49.0	8.85	4.5888	3.1435
1.0	50.0	8.41	2.3553	3.1671
1.0	51.0	8.46	2.2764	3.1899
1.0	52.0	8.41	2.1452	3.2114
1.0	53.0	8.44	2.0432	3.2318
3.0	56.0	8.82	4.1414	3.2732
1.0	57.0	8.49	1.9201	3.2924
1.0	58.0	8.45	2.0586	3.3130
1.0	59.0	8.52	2.1934	3.3349
1.0	60.0	8.51	1.8240	3.3531

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