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**DEVELOPMENT OF GROUT FORMULATIONS FOR 106-AN WASTE:
MIXTURE-EXPERIMENT RESULTS AND ANALYSIS**

VOL. 2. DATA PRESENTATION

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PREFACE

This two-volume report meets the requirements for Milestone 3.4, *Final Report on Mixture-Experiment Results and Analysis*, as described in Statement of Work RDS-SOW-H-92, rev. 1, in support of the Westinghouse Hanford Grout Disposal Program. The data for this work were recorded in Laboratory notebooks A-104019-G, A-104824-G, A-104919-G, A-105040-G, and A-105093-G.

Appendix A
SURROGATE 106-AN RECIPE

Appendix A SURROGATE 106-AN RECIPE

PROCEDURE FOR PREPARING A 10-L BATCH OF SURROGATE 106-AN

1. Warm approximately 6 L of water to about 40°C.
2. Add the following compounds in the listed order while stirring and maintaining the water at about 40°C:

<u>Compound*</u>	<u>Quantity, g</u>
Al(NO ₃) ₃ ·9H ₂ O	1580.
Na ₂ SO ₄	44.0
NaCl	87.7
NaF	3.40
Ca(NO ₃) ₂ ·4H ₂ O	4.72
Na ₂ B ₄ O ₇ ·10H ₂ O	1.91
Cu(NO ₃) ₂ ·3H ₂ O	0.10
Fe(NO ₃) ₃ ·9H ₂ O	0.81
NaOH (50 wt % aqueous solution)	1887.
NaNO ₃	23.0
NaNO ₂	523.
Na ₂ CO ₃	405.
HEDTA	52.9
Na ₄ EDTA	18.3
Glycolic Acid (70 wt % aqueous solution)	45.6
SiO ₂ (Ludox) (30 wt % aqueous solution)	0.40

3. Dissolve the following phosphate and citrate compounds in separate solutions and add to the mix from (2):

<u>Compound*</u>	<u>Quantity, g</u>
Na ₃ PO ₄ ·12H ₂ O	589.
Na ₃ C ₆ H ₅ O ₇ ·2H ₂ O (Citrate)	88.2

4. The solution should be clear with a slight yellow to yellow-green cast at this point. Add enough water to bring volume to 10 L at 40°C.

*Substitution of a different hydrated state, e.g., anhydrous for a listed hydrate, can be substituted for that listed as long as the appropriate mass correction is applied to give the necessary cationic or anionic concentration.

Appendix B
FINAL MODELS

Appendix B FINAL MODELS

Table B-1. Critical Flow Rate

TRANSFORMATION = $1/\text{SQRT}(\text{CFR})$

Analysis of Variance

Source	DF	Sum of squares	Mean square	F value	Prob > F
Model	9	0.22547	0.02505	1211.519	0.0001
Error	49	0.00101	0.00002		
C Total	58	0.22648			
Root MSE		0.00455	R-square	0.9955	
Dep Mean		0.18606	Adj R-sq	0.9947	
C.V.		2.44395			

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > T
INTERCEP	1	0.588578	0.01449314	40.611	0.0001
CE	1	-0.072128	0.00513922	-14.035	0.0001
FL	1	-0.039897	0.00286352	-13.933	0.0001
AC	1	-0.177619	0.00699489	-25.393	0.0001
SL	1	-0.042461	0.00292359	-14.523	0.0001
CEFL	1	0.006999	0.00094768	7.385	0.0001
CEAC	1	0.020723	0.00120399	17.212	0.0001
CESL	1	0.007063	0.00095165	7.422	0.0001
FLAC	1	0.006753	0.00120754	5.592	0.0001
ACSL	1	0.008592	0.00123023	6.984	0.0001

Table B-2. 10-Minute Gel Strength

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	6	3002.34179	500.39030	316.536	0.0001
Error	52	82.20329	1.58083		
C Total	58	3084.54508			
Root MSE		1.25731	R-square	0.9733	
Dep Mean		14.56949	Adj R-sq	0.9703	
C.V.		8.62976			

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > T
INTERCEP	1	-9.793749	1.43007570	-6.848	0.0001
CE	1	3.091258	0.20958853	14.749	0.0001
FL	1	2.088641	0.22692268	9.204	0.0001
AC	1	-1.499283	1.90988390	-0.785	0.4360
SL	1	2.408854	0.20778663	11.593	0.0001
FLAC	1	-0.721960	0.11820699	-6.108	0.0001
AC2	1	5.254386	0.74617817	7.042	0.0001

Table B-3. 28-Day Free Standing Liquid

TRANSFORMATION = LOG = Natural Log

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	10	191.01164	19.10116	118.575	0.0001
Error	48	7.73231	0.16109		
C Total	58	198.74395			
Root MSE		0.40136	R-square	0.9611	
Dep Mean		0.14643	Adj R-sq	0.9530	
C.V.		274.09546			

Parameter Estimates

Variable	DF	Parameter estimate	Standard error	T for H0: Parameter=0	Prob > T
INTERCEP	1	6.680767	0.90463392	7.385	0.0001
CE	1	1.315149	0.63577183	2.069	0.0440
FL	1	-0.605433	0.13266672	-4.564	0.0001
AC	1	-7.392599	0.90053218	-8.209	0.0001
SL	1	-0.652633	0.17706716	-3.686	0.0006
CEAC	1	0.371369	0.10488398	3.541	0.0009
FLAC	1	0.337797	0.10143197	3.330	0.0017
ACSL	1	0.390446	0.10312426	3.786	0.0004
CE2	1	-0.427936	0.12615098	-3.392	0.0014
AC2	1	0.840510	0.24966423	3.367	0.0015
SL2	1	0.026114	0.01532289	1.704	0.0948

Table B-4. Unconfined Compressive Strength

TRANSFORMATION = Square Root(UCS)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	9	3465.77802	385.08645	227.031	0.0001
Error	49	83.11308	1.69619		
C Total	58	3548.89110			
Root MSE		1.30238	R-square	0.9766	
Dep Mean		25.12279	Adj R-sq	0.9723	
C.V.		5.18405			

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > T
INTERCEP	1	10.920504	2.54504109	4.291	0.0001
CE	1	-1.294576	2.03708089	-0.636	0.5281
FL	1	4.718244	0.25409730	18.569	0.0001
AC	1	-13.479624	2.26915425	-5.940	0.0001
SL	1	1.504890	0.23063756	6.525	0.0001
CEAC	1	1.636114	0.33522615	4.881	0.0001
FLAC	1	-0.447417	0.11987898	-3.732	0.0005
FLSL	1	-0.416360	0.05855165	-7.111	0.0001
CE2	1	0.884694	0.40418411	2.189	0.0334
AC2	1	5.326284	0.81851046	6.507	0.0001

Table B-5. Leachability for $\text{NO}_3 + \text{NO}_2$

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	10	6.31636	0.63164	28.236	0.0001
Error	49	1.09614	0.02237		
C Total	59	7.41250			
Root MSE		0.14957	R-square	0.8521	
Dep Mean		5.87500	Adj R-sq	0.8219	
C.V.		2.54582			

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > T
INTERCEP	1	5.407310	0.31230756	17.314	0.0001
CE	1	-0.919400	0.23039800	-3.990	0.0002
FL	1	0.286915	0.03643789	7.874	0.0001
AC	1	-0.404062	0.24213285	-1.669	0.1015
SL	1	0.589833	0.10271360	5.742	0.0001
CESL	1	-0.026151	0.01107280	-2.362	0.0222
FLSL	1	-0.047552	0.01393906	-3.411	0.0013
ACSL	1	-0.079067	0.01460888	-5.412	0.0001
CE2	1	0.212715	0.04659805	4.565	0.0001
AC2	1	0.312049	0.09477321	3.293	0.0018
SL2	1	-0.046999	0.01164809	-3.967	0.0002

Table B-6. Rise in Heat at Hour 10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	9	1158.90720	128.76747	150.618	0.0001
Error	11	9.40423	0.85493		
C Total	20	1168.31143			
Root MSE		0.92462	R-square	0.9920	
Dep Mean		22.95714	Adj R-sq	0.9854	
C.V.		4.02761			

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > T
INTERCEP	1	-27.517681	2.99618817	-9.184	0.0001
CE	1	20.601878	2.47638046	8.319	0.0001
FL	1	1.880034	0.29268055	6.424	0.0001
AC	1	10.678895	1.10387686	9.674	0.0001
SL	1	3.683653	0.64248141	5.733	0.0001
CEAC	1	-2.111591	0.40898064	-5.163	0.0003
CESL	1	-0.591060	0.11899353	-4.967	0.0004
ACSL	1	-1.098459	0.15562832	-7.058	0.0001
CE2	1	-1.874541	0.47965701	-3.908	0.0024
SL2	1	-0.113794	0.05986617	-1.901	0.0838

Table B-7. Rise in Heat at Hour 24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	8	2045.29312	255.66164	341.452	0.0001
Error	12	8.98498	0.74875		
C Total	20	2054.27810			
Root MSE		0.86530	R-square	0.9956	
Dep Mean		32.10952	Adj R-sq	0.9927	
C.V.		2.69485			

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > T
INTERCEP	1	-20.510054	2.70121577	-7.593	0.0001
CE	1	21.967891	2.25124562	9.758	0.0001
FL	1	5.050273	0.48133960	10.492	0.0001
AC	1	7.794633	1.00621372	7.746	0.0001
SL	1	1.414842	0.33127936	4.271	0.0011
CEAC	1	-0.955031	0.37916603	-2.519	0.0270
ACSL	1	-0.961254	0.13786926	-6.972	0.0001
CE2	1	-2.824066	0.44026681	-6.414	0.0001
FL2	1	-0.234954	0.05712784	-4.113	0.0014

Table B-8. Rise in Heat at Hour 100

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	4	2993.65796	748.41449	122.426	0.0001
Error	16	97.81156	6.11322		
C Total	20	3091.46952			
Root MSE		2.47249	R-square	0.9684	
Dep Mean		43.09524	Adj R-sq	0.9605	
C.V.		5.73728			

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > T
INTERCEP	1	-8.172949	6.62694711	-1.233	0.2353
CE	1	23.995583	6.01492888	3.989	0.0011
FL	1	7.775333	0.86014917	9.040	0.0001
CE2	1	-3.018756	1.22267563	-2.469	0.0252
FL2	1	-0.643759	0.14571032	-4.418	0.0004

Appendix C
FORMULAS FOR PREDICTION AND
CONFIDENCE INTERVALS

Appendix C FORMULAS FOR PREDICTION AND CONFIDENCE INTERVALS

Formulas are presented for computing standard deviations and confidence intervals for predictions made using the fitted second-order polynomial models given in this report. A predicted value of a property for a specified formulation may be thought of either as a prediction of the mean property response or as a prediction of a single measured property value that might be seen at a given formulation. The standard deviation of the latter is greater than that of the former, because of the added variability of individual property observations.

Let cement, flyash, attapulgate clay, and slag represent pounds per gallon of the dry materials within the region defined in Table 1 of Section 1.2. Let the $n \times p$ matrix U consist of columns corresponding to the number of terms in the model, and rows corresponding to the number of observations. For example, for 10-minute gel strength, the columns of the 59×7 matrix U correspond to the intercept, cement, flyash, attapulgate clay, slag, flyash*attapulgate clay, attapulgate clay² terms in the final reduced model. Next, let the $1 \times p$ vector u' have columns corresponding to the columns in U for any formulation in the region defined by Table 1 of Section 1.2. Finally, let $\hat{\sigma}_y$ denote the root mean squared error from the fitted model (which is a combined measure of model lack-of-fit and uncertainty, in units of the transformed property).

The formulas for the standard deviations corresponding to predictions of transformed properties (denoted generally as y) from the fitted second-order polynomial models are given below:

Mean Prediction

$$SD[\text{mean } y(u)] = [u'(U'U)^{-1}u]^{0.5} * \hat{\sigma}_y$$

Individual Prediction

$$SD[\text{indiv. } y(u)] = [1 + u'(U'U)^{-1}u]^{0.5} * \hat{\sigma}_y$$

As noted above, the prediction standard deviations are in transformed property units. To get the prediction standard deviations in original units, it is necessary to apply variance propagation techniques. However, we are not directly interested in the prediction standard deviations, but rather some indication of how much the property value may differ from the predicted value. A way to do this is to compute a 95% confidence interval for the prediction in transformed property units, and then apply the inverse transformation to obtain a 95% confidence interval for the prediction in original property units.

The formulas for 95% confidence intervals corresponding to predictions of transformed properties (denoted generally as y) from the fitted second-order polynomial models are given below:

Mean Prediction

$$CI[\text{mean } y(u)] = \hat{y}(u) \pm t_{.95} * SD[\text{mean } y(u)]$$

Individual Prediction

$$CI[\text{indiv. } y(u)] = \hat{y}(u) \pm t_{.95} * SD[\text{indiv. } y(u)]$$

The $t_{.95}$ value is from a t-distribution and provides the required 95% confidence for the fitted models in this report. The table below gives the $t_{.95}$ value for each of the final reduced models in this report. The 95% confidence intervals (mean or individual) on a prediction in original property units are obtained by applying the inverse property transformation to the lower and upper end-points of the confidence interval.

Grout Property	# of Model Terms	Degrees of Freedom	$t_{.95}$
Critical Flow Rate Unconfined Compressive Strength	10	49	2.010
10-Minute Gel Strength	7	52	2.007
28-Day Free Standing Liquid	11	48	2.011
Leachability for $\text{NO}_2 + \text{NO}_2$	11	49	2.010
Adiabatic Calorimetry - 10 Hour	10	11	2.201

Grout Property	# of Model Terms	Degrees of Freedom	t _{.95}
Adiabatic Calorimetry - 24 Hour	9	12	2.179
Adiabatic Calorimetry - 100 Hour	5	16	2.120

* The degrees of freedom are obtained by subtracting the number of model terms from the number of observations.

Appendix D
EXPERIMENTAL DESIGN FOR THE
LARGER REGION

Appendix D EXPERIMENTAL DESIGN FOR THE LARGER REGION

Table D.1. 106-AN grout development experimental design for the larger region							
#	Random Run #	ORNL #	W ₁ W ₂ W ₃ W ₄ (lb/gal of liquid waste)				Description of Formulation ^a
			Cement	Fly Ash	Clay	Slag	
1	^b	FFLY-L	0.0	2.0	0.0	0.0	Slightly outside LR
2	^b	FFLY-H	0.0	15.0	0.0	0.0	Slightly outside LR
3	^b	T2/P62-H	2.0	13.0	0.0	0.0	LR edge point
4	^b	PORT2-H	15.0	0.0	0.0	0.0	LR vertex
5	^b	PORT2-L	2.0	0.0	0.0	0.0	LR vertex
6	^b	T2/S25-H	2.0	0.0	0.0	13.0	LR vertex
7	^b	T2/CL58-2	13.0	0.0	2.0	0.0	LR vertex
8	12	MX12	1.0	1.0	2.0	11.0	LR vertex
9	17	MX17	2.0	0.0	2.0	0.0	LR vertex
10	4	MX4	1.0	12.0	2.0	0.0	LR vertex
11	5	MX5	1.0	7.5	0.0	6.5	LR edge centroid
12	11	MX11	2.0	0.0	0.0	6.5	LR edge centroid
13	6	MX6	8.5	0.0	0.0	6.5	LR edge centroid
14	14	MX14	4.75	3.75	0.0	0.0	LR 2-d face centroid
15	8	MX8	7.5	6.5	1.0	0.0	LR 2-d face centroid
16	16	MX16	4.5	3.5	1.0	0.0	LR 3-d face centroid
17	18	MX18	1.5	0.0	0.5	6.0	SR vertex
18	10	MX10	1.5	0.0	2.0	6.0	SR vertex
19	13	MX13	1.5	6.0	2.0	0.0	SR vertex
20	1	MX1	1.5	0.0	1.25	6.0	SR edge centroid
21	2	MX2	1.5	6.0	1.25	0.0	SR edge centroid
22	19	MX19	3.5	0.0	1.25	4.0	SR edge centroid
23	15	MX15	2.75	2.625	2.0	2.625	SR 2-d face centroid
24	9	MX9	3.5	2.5	1.0	4.0	LR overall centroid
25	3	MX3	2.0	13.0	0.0	0.0	Replicate of #3
26	7	MX7	2.5	1.2	0.8	3.5	SR reference formulation
27	20	MX20	2.444	2.472	1.333	2.472	SR overall centroid

^a LR = larger region; SR = smaller region

^b Tested earlier in Phase I or Phase II

Appendix E
PREDICTED PROPERTIES AND COMPOSITIONS
OF THE 2000+ RANDOM GROUTS

Appendix E
PREDICTED PROPERTIES AND COMPOSITIONS
OF THE 2000+ RANDOM GROUTS

Grout composition column headings

Cement	=	Cement mix ratio, lb/gal
Fly Ash	=	Fly ash mix ratio, lb/gal
Att	=	Attapulgite clay mix ratio, lb/gal
Slag	=	Ground air-cooled blast furnace slag (GABFS) mix ratio, lb/gal

Predicted property column headings

CFR	=	Critical flow rate, GPM
DL	=	Drainable liquid (free-standing liquid), vol%
CS	=	28-d corrected unconfined compressive strength, psi
Li	=	Nitrate + Nitrite leachability index
10 hr	=	Adiabatic temperature rise at 10 hr
24 hr	=	Adiabatic temperature rise at 24 hr
100 hr	=	Adiabatic temperature rise at 100 hr

E-4

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
1.65	0.08	0.83	4.58	17	5.3	170	5.6	13.3	16.5	23.9
2.46	0.10	1.28	5.48	34	1.4	329	5.3	20.1	24.9	33.4
2.60	0.03	1.23	5.41	33	1.5	339	5.4	20.8	25.4	34.0
2.28	0.04	1.33	5.45	35	1.3	299	5.4	19.0	23.3	31.1
2.61	0.05	1.45	5.42	40	0.9	387	5.4	20.7	25.7	34.3
2.42	0.23	1.53	5.49	45	0.9	381	5.4	20.0	25.3	34.0
2.25	0.18	1.65	5.64	53	0.8	385	5.4	18.9	23.9	31.9
2.40	0.01	1.22	5.09	30	1.6	284	5.4	19.8	24.0	32.1
2.16	0.31	1.39	5.44	39	1.1	306	5.4	18.8	23.8	32.0
2.29	0.33	1.24	5.29	33	1.5	299	5.4	19.6	24.7	33.4
2.43	0.15	0.93	5.72	27	3.3	312	5.4	20.2	25.0	33.4
2.30	0.06	1.53	5.26	42	0.8	333	5.4	19.2	23.7	31.6
2.37	0.25	1.13	5.21	29	2.0	292	5.4	20.0	24.9	33.6
2.55	0.02	1.18	4.74	28	1.6	288	5.4	20.7	24.9	32.5
2.06	0.43	1.53	5.56	47	0.9	328	5.4	18.3	23.5	31.7
2.17	0.27	1.42	5.21	38	1.0	299	5.4	18.8	23.6	31.7
1.85	0.17	1.37	5.81	39	1.2	264	5.4	16.3	20.2	27.2
2.18	0.36	1.46	5.24	41	0.9	314	5.4	19.1	24.1	32.5
2.18	0.38	1.19	5.20	31	1.7	277	5.4	19.0	24.1	32.7
1.91	0.19	1.66	5.76	56	0.7	329	5.4	16.9	21.0	28.2
1.98	0.18	1.69	5.69	57	0.7	344	5.4	17.3	21.5	28.8
2.30	0.22	1.38	4.46	32	1.0	275	5.4	19.8	24.3	32.8
2.21	0.26	0.97	4.04	20	3.2	213	5.4	18.6	23.0	32.1
1.95	0.00	1.42	5.36	37	1.1	256	5.4	16.8	20.3	27.2
2.35	0.43	0.89	3.78	19	3.9	233	5.4	19.8	24.7	34.8
2.14	0.53	1.56	5.28	47	0.8	341	5.4	19.1	24.7	33.3
2.03	0.27	1.15	5.25	29	1.9	248	5.4	17.7	22.2	30.2
1.88	0.12	1.42	5.53	39	1.1	260	5.4	16.5	20.2	27.2
2.38	0.13	1.53	4.41	37	0.7	309	5.4	20.2	24.6	32.9
2.21	0.12	1.66	5.15	48	0.6	349	5.4	18.9	23.3	31.0
2.21	0.35	1.46	3.78	32	0.7	254	5.4	19.6	24.4	32.8
2.21	0.54	1.19	4.18	27	1.5	250	5.4	19.5	24.8	34.1
2.02	0.75	0.92	3.34	18	3.6	204	5.4	17.4	23.2	33.4
2.05	0.30	1.14	4.24	24	1.9	209	5.4	17.7	22.1	30.5
1.97	0.10	1.28	4.37	27	1.3	202	5.4	17.0	20.7	28.2
2.14	0.42	0.95	4.04	20	3.3	215	5.4	18.3	23.1	32.4
1.75	0.06	1.13	5.89	30	2.2	230	5.4	15.2	18.5	25.1
2.04	0.14	1.42	4.67	34	0.9	244	5.4	17.8	21.8	29.2
2.09	0.44	1.19	4.65	28	1.6	245	5.4	18.5	23.5	32.2
1.88	0.17	1.29	5.26	32	1.4	234	5.4	16.5	20.3	27.5
2.19	0.63	1.11	4.25	25	1.9	252	5.4	19.5	25.0	34.6
2.08	0.62	1.23	4.80	31	1.4	265	5.4	18.8	24.2	33.2
2.11	0.59	1.07	4.12	23	2.1	231	5.4	18.6	24.0	33.4
2.03	0.09	0.95	5.07	23	3.5	223	5.5	17.2	21.0	28.8
1.96	0.57	1.51	5.24	45	0.8	303	5.5	18.0	23.3	31.5
1.92	0.21	1.11	4.26	22	2.1	188	5.5	16.5	20.4	28.4
2.05	0.88	1.34	3.28	27	0.9	236	5.5	19.1	25.2	34.7
1.99	0.15	1.48	4.14	32	0.8	224	5.5	17.6	21.5	28.8
2.15	0.44	0.85	5.40	24	4.1	278	5.5	18.8	24.0	32.8
2.29	0.27	1.65	4.65	45	0.6	346	5.5	20.0	24.8	33.1
2.41	0.14	1.73	4.79	50	0.5	393	5.5	20.3	25.0	33.2
1.88	0.16	1.30	4.33	27	1.2	196	5.5	16.4	20.1	27.5
1.86	0.51	1.06	3.70	20	2.3	181	5.5	16.2	21.0	29.9
1.96	0.57	1.59	5.25	49	0.7	318	5.5	18.1	23.3	31.5

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
1.81	0.10	1.27	4.15	25	1.3	174	5.5	15.7	19.0	26.2
1.88	0.55	1.32	5.16	35	1.2	257	5.5	17.3	22.2	30.4
2.05	0.54	1.38	4.47	33	1.0	259	5.5	18.6	23.8	32.4
1.86	0.91	1.07	3.24	20	2.1	197	5.5	16.6	22.7	32.6
2.16	0.41	1.59	4.52	42	0.6	308	5.5	19.4	24.4	32.6
2.57	0.11	0.72	4.52	19	6.2	275	5.5	20.9	25.0	34.4
1.83	0.45	1.33	3.66	26	1.0	187	5.5	16.5	21.0	29.0
2.00	0.54	1.39	4.02	31	0.9	234	5.5	18.2	23.2	31.7
2.06	0.18	1.62	4.63	42	0.6	288	5.5	18.3	22.4	29.8
2.02	0.48	1.84	5.50	71	0.5	409	5.5	18.3	23.5	31.5
1.96	0.37	1.50	3.80	32	0.7	226	5.5	17.9	22.3	30.0
1.85	0.08	1.66	5.34	50	0.6	290	5.5	16.4	19.9	26.5
1.94	0.67	1.12	3.94	23	1.9	211	5.5	17.4	22.7	31.9
1.81	1.21	1.17	2.88	22	1.4	208	5.5	16.8	23.7	33.8
2.43	0.14	1.93	5.27	69	0.5	516	5.5	20.0	25.2	33.4
1.83	0.30	1.09	4.99	26	2.2	213	5.5	16.1	20.2	27.9
2.37	0.12	0.62	5.84	21	8.4	322	5.5	20.0	24.5	32.7
1.91	0.26	1.59	4.91	43	0.7	274	5.5	17.2	21.3	28.6
1.96	0.59	0.94	5.03	24	3.2	246	5.5	17.5	22.7	31.6
1.85	0.35	1.00	5.00	24	2.8	217	5.5	16.3	20.5	28.6
1.84	0.51	1.14	4.37	25	1.8	205	5.5	16.4	21.1	29.5
1.74	0.17	1.21	4.46	25	1.5	180	5.5	15.1	18.6	25.8
1.87	0.42	0.82	3.95	17	5.2	188	5.5	15.6	20.2	29.3
1.90	0.46	0.97	4.90	23	3.0	225	5.5	16.7	21.4	29.9
2.20	0.01	0.67	5.46	20	8.3	268	5.5	18.4	22.2	30.1
1.87	0.59	1.47	4.82	39	0.8	264	5.5	17.5	22.5	30.5
2.06	0.83	1.71	5.01	58	0.6	375	5.5	19.4	25.6	34.4
1.80	0.30	0.94	4.18	19	3.6	177	5.5	15.1	19.2	27.5
2.01	0.75	1.54	4.61	43	0.7	301	5.5	18.9	24.6	33.3
2.27	0.12	0.62	5.70	20	8.9	302	5.5	19.2	23.6	31.7
1.98	0.92	1.41	3.65	31	0.8	251	5.5	18.8	24.9	34.1
2.02	0.67	0.87	4.54	21	3.9	242	5.5	17.9	23.4	32.9
1.76	0.51	1.25	4.89	31	1.3	222	5.5	16.1	20.6	28.5
2.35	0.43	1.76	4.50	52	0.5	399	5.5	20.7	26.2	34.8
2.09	0.72	0.81	4.82	22	4.4	268	5.5	18.7	24.4	34.1
1.89	0.85	1.23	4.28	29	1.3	237	5.5	17.7	23.4	32.6
1.87	0.86	1.21	4.65	30	1.4	247	5.5	17.5	23.3	32.3
1.98	0.48	1.60	4.40	42	0.6	281	5.5	18.3	23.2	31.0
1.82	0.63	1.30	4.17	29	1.1	214	5.5	16.8	21.8	30.2
2.03	0.27	1.69	4.11	43	0.5	283	5.5	18.5	22.8	30.2
1.81	1.30	0.87	3.05	17	3.8	222	5.5	16.0	23.2	34.4
1.71	0.75	1.18	3.58	23	1.5	182	5.5	15.4	20.7	29.5
1.85	0.80	1.22	4.29	28	1.3	227	5.5	17.2	22.7	31.6
1.60	0.05	1.50	5.50	42	0.8	230	5.5	14.2	16.9	22.9
1.91	0.53	1.60	3.59	36	0.5	240	5.5	18.0	22.9	30.6
1.71	0.41	1.23	4.18	25	1.3	183	5.5	15.2	19.4	27.1
1.57	0.12	1.13	5.74	29	2.0	207	5.5	13.7	16.6	23.0
2.06	0.69	1.62	3.62	39	0.5	282	5.5	19.5	25.1	33.5
1.89	0.54	1.69	5.02	53	0.6	319	5.5	17.8	22.7	30.4
1.88	0.47	1.59	3.74	36	0.5	234	5.5	17.6	22.3	29.8
1.86	1.04	1.18	3.80	25	1.4	228	5.5	17.5	23.8	33.4
1.77	1.10	1.22	3.31	24	1.2	210	5.5	16.7	23.1	32.6
1.75	0.24	0.95	4.54	20	3.4	182	5.5	14.8	18.5	26.3
1.85	1.12	1.47	3.01	30	0.6	236	5.5	18.2	24.7	33.8
1.73	0.69	1.08	3.98	22	2.0	190	5.5	15.4	20.5	29.3

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Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
1.67	0.62	1.13	5.25	30	1.8	227	5.5	15.4	20.1	28.1
1.64	0.24	1.29	4.41	27	1.2	177	5.5	14.5	18.0	24.9
1.82	0.85	1.41	4.53	36	0.8	254	5.5	17.4	23.0	31.6
1.63	0.88	1.19	3.35	22	1.3	177	5.5	14.8	20.3	29.2
2.36	0.34	0.55	4.36	16	12.2	275	5.5	19.7	24.2	34.2
2.16	0.43	1.81	4.51	55	0.4	375	5.5	19.7	24.8	32.8
1.73	0.13	0.89	5.23	21	4.1	202	5.5	14.7	18.1	25.3
2.23	0.33	1.82	3.72	49	0.3	346	5.5	20.4	25.2	32.8
2.33	0.25	1.98	4.98	73	0.4	502	5.5	20.0	25.2	33.3
1.75	0.05	0.82	5.49	21	5.3	214	5.5	14.8	18.0	25.0
2.28	0.53	0.59	4.45	17	10.1	281	5.5	19.4	24.6	34.8
2.05	0.08	0.63	5.23	18	10.0	249	5.5	17.2	20.9	28.9
1.85	0.85	1.64	4.86	52	0.6	315	5.6	18.0	23.7	32.0
1.67	0.29	1.47	4.33	33	0.7	199	5.6	15.2	18.8	25.6
1.67	1.61	1.16	2.66	22	1.3	222	5.6	16.0	23.8	34.3
1.61	0.32	1.23	4.60	27	1.4	182	5.6	14.3	17.9	25.1
1.64	1.00	1.25	3.32	24	1.1	190	5.6	15.4	21.3	30.2
2.26	0.41	0.57	4.51	17	11.5	274	5.6	19.1	23.9	33.8
1.52	0.01	1.13	5.55	27	2.0	188	5.6	12.9	15.3	21.3
2.32	0.07	1.92	4.15	57	0.3	405	5.6	20.3	24.5	31.8
1.65	0.71	0.95	3.82	19	3.0	180	5.6	14.3	19.4	28.5
2.15	0.60	1.82	4.55	59	0.4	393	5.6	19.9	25.5	33.9
1.66	0.51	1.54	4.99	43	0.7	250	5.6	15.8	20.0	27.2
1.98	0.75	1.68	3.76	43	0.4	291	5.6	19.1	24.7	32.9
1.56	0.08	1.40	4.59	30	0.9	176	5.6	13.7	16.4	22.5
2.12	0.39	0.56	5.55	19	10.4	303	5.6	18.5	23.4	32.1
2.29	0.41	1.88	4.14	57	0.3	409	5.6	20.7	25.9	34.0
1.82	0.72	0.81	4.72	20	4.6	234	5.6	16.2	21.5	30.7
1.73	0.73	1.71	5.10	59	0.5	313	5.6	16.9	21.9	29.6
2.11	0.66	0.53	4.02	15	14.1	264	5.6	17.8	23.2	33.9
1.68	0.80	1.01	4.41	23	2.4	208	5.6	15.3	20.6	29.5
1.74	1.21	1.18	4.38	29	1.3	245	5.6	16.9	23.3	32.8
1.65	0.31	1.71	5.10	53	0.5	275	5.6	15.5	19.1	25.5
1.65	0.27	0.80	4.34	17	5.6	174	5.6	13.4	17.2	25.3
1.70	0.79	1.50	3.85	34	0.6	223	5.6	16.5	21.7	29.6
1.82	1.01	0.82	4.81	22	4.0	259	5.6	16.9	23.0	32.8
1.58	0.67	1.19	4.67	28	1.4	201	5.6	14.6	19.2	27.1
1.73	0.12	1.78	4.78	53	0.4	279	5.6	16.0	19.2	25.2
2.26	0.48	1.92	4.37	64	0.3	440	5.6	20.6	26.0	34.2
1.57	0.55	1.04	4.43	22	2.2	182	5.6	13.9	18.2	26.2
1.96	0.81	1.73	3.86	47	0.4	313	5.6	19.3	25.0	33.2
1.53	0.49	1.33	4.85	32	1.0	200	5.6	14.1	18.0	25.1
1.79	0.89	0.80	4.53	20	4.5	238	5.6	16.1	21.8	31.5
1.68	0.61	0.85	4.96	21	4.1	220	5.6	15.0	19.7	28.2
1.62	1.69	0.95	2.87	19	2.5	232	5.6	15.0	23.0	34.1
1.71	0.29	1.73	3.83	41	0.4	230	5.6	16.3	19.9	26.2
1.76	1.50	1.25	3.59	28	1.0	250	5.6	17.5	24.8	34.9
1.83	0.81	1.71	4.50	52	0.5	311	5.6	18.0	23.5	31.5
1.65	0.75	1.49	4.12	35	0.6	221	5.6	15.9	20.9	28.6
1.52	0.36	1.48	4.92	38	0.7	211	5.6	14.1	17.5	24.0
1.52	0.54	1.40	3.89	29	0.7	175	5.6	14.0	18.1	25.3
1.53	1.22	1.03	3.25	19	2.0	190	5.6	13.7	20.2	30.0
1.57	0.95	1.08	3.88	22	1.8	191	5.6	14.3	19.8	28.8
2.02	0.69	0.53	4.24	15	13.4	265	5.6	17.2	22.6	33.0
1.75	0.74	1.73	4.69	55	0.4	306	5.6	17.3	22.4	30.0

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
1.68	1.45	0.93	3.48	20	2.7	233	5.6	15.6	22.9	33.6
1.67	1.44	1.06	3.55	23	1.8	229	5.6	15.9	23.0	33.3
1.54	0.91	1.49	3.19	30	0.5	190	5.6	15.0	20.4	28.2
1.74	0.02	1.89	4.94	62	0.4	313	5.6	16.0	18.8	24.5
1.56	1.65	1.25	2.73	24	0.9	220	5.6	15.3	23.1	33.0
1.86	0.84	1.80	3.19	46	0.3	288	5.6	18.8	24.4	32.0
1.62	0.29	1.79	4.93	57	0.4	281	5.6	15.5	18.8	25.1
1.54	0.45	0.88	4.60	19	3.8	183	5.6	13.1	17.1	25.0
2.17	0.66	1.95	4.32	68	0.3	441	5.6	20.5	26.3	34.5
1.62	0.86	1.54	3.92	37	0.5	226	5.6	16.0	21.2	28.9
1.56	1.01	1.48	4.72	43	0.7	249	5.6	15.8	21.1	29.2
1.67	1.56	1.06	4.36	28	1.7	261	5.6	16.7	23.9	34.0
1.84	1.24	1.71	3.09	43	0.3	293	5.6	19.1	25.8	34.4
1.64	1.67	0.78	3.15	17	4.4	251	5.6	14.7	22.7	34.3
1.57	0.05	1.77	4.02	43	0.3	213	5.6	14.8	17.3	22.5
1.63	0.26	0.66	4.50	15	9.3	190	5.6	13.0	16.7	24.9
1.67	0.66	1.71	4.00	45	0.4	253	5.6	16.5	21.2	28.3
1.66	1.67	0.83	3.42	19	3.6	255	5.6	15.4	23.2	34.5
2.09	0.72	1.93	3.53	59	0.3	384	5.6	20.6	26.2	34.1
1.92	0.51	1.92	3.71	57	0.3	332	5.6	18.8	23.6	30.5
1.63	0.44	0.68	5.29	19	7.2	232	5.7	14.1	18.3	26.3
1.56	1.94	1.00	2.90	20	1.9	248	5.7	15.0	23.4	34.6
1.64	0.33	1.81	3.86	47	0.3	245	5.7	16.0	19.6	25.6
1.80	0.46	1.89	4.07	57	0.3	313	5.7	17.7	22.0	28.7
1.53	1.32	1.36	4.55	38	0.8	247	5.7	15.7	21.9	30.6
1.70	0.75	0.65	4.83	18	7.5	245	5.7	14.9	20.2	29.4
1.59	0.48	0.69	4.60	17	7.4	203	5.7	13.2	17.5	26.0
1.59	0.93	0.77	4.31	18	5.0	218	5.7	14.0	19.5	29.0
1.52	1.36	1.30	4.57	36	0.9	244	5.7	15.5	21.8	30.7
1.74	1.13	1.70	3.57	45	0.4	282	5.7	18.0	24.2	32.4
1.63	1.61	1.34	3.94	35	0.8	261	5.7	16.9	24.2	33.7
1.78	1.12	1.77	3.19	46	0.3	291	5.7	18.6	24.8	32.8
1.65	0.34	0.58	4.71	15	11.6	215	5.7	13.5	17.4	25.8
1.65	1.26	1.63	4.15	48	0.4	284	5.7	17.3	23.5	32.0
1.65	1.60	1.48	3.89	40	0.6	278	5.7	17.6	24.8	34.1
1.76	1.41	0.60	3.80	16	8.7	280	5.7	15.6	22.9	34.3
1.64	0.72	0.60	4.34	15	9.9	226	5.7	13.7	18.8	28.3
1.68	0.43	0.58	4.95	16	11.0	234	5.7	14.1	18.4	26.8
1.64	0.07	0.57	5.61	17	12.0	236	5.7	13.6	16.7	23.6
1.59	1.70	0.96	3.89	23	2.1	255	5.7	15.6	23.2	33.8
1.62	1.26	0.60	3.60	15	9.5	248	5.7	13.7	20.5	31.6
1.50	0.76	1.63	3.97	41	0.4	222	5.7	15.1	19.6	26.6
1.66	1.10	0.55	3.73	14	11.9	247	5.7	13.7	20.1	31.1
1.87	1.17	1.95	4.67	85	0.3	433	5.7	19.4	25.9	34.4
1.96	0.82	1.95	3.51	61	0.2	372	5.7	19.9	25.7	33.3
1.51	1.16	1.67	2.94	38	0.3	226	5.7	15.8	21.8	29.3
2.00	0.83	1.97	3.65	66	0.2	397	5.7	20.2	26.1	33.8
1.87	1.23	1.92	4.47	78	0.3	415	5.7	19.5	26.1	34.7
1.56	0.71	0.62	4.31	15	9.3	216	5.7	12.8	17.8	27.1
1.79	1.22	1.93	4.71	86	0.3	414	5.7	18.8	25.2	33.6
1.90	1.16	1.90	3.00	55	0.2	351	5.7	20.1	26.7	34.7
1.52	0.48	1.78	4.35	52	0.3	253	5.7	15.1	18.7	24.9
1.58	1.54	0.81	4.22	21	3.6	260	5.7	15.0	22.1	32.6
1.64	0.59	1.86	4.10	57	0.3	289	5.7	16.6	20.9	27.4
1.75	0.35	1.90	4.23	66	0.3	346	5.7	18.0	23.3	30.8

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Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
1.69	0.77	1.87	4.06	60	0.3	312	5.7	17.4	22.3	29.4
1.61	0.01	0.54	5.16	15	14.7	214	5.7	12.7	15.5	22.7
1.51	1.65	1.44	3.68	37	0.6	254	5.7	16.2	23.2	32.3
1.63	1.61	0.55	3.48	15	10.3	288	5.7	14.1	21.9	33.8
1.69	1.34	1.76	3.60	52	0.3	308	5.7	18.2	24.7	33.0
1.54	0.10	1.95	4.55	65	0.3	289	5.7	15.0	17.4	22.4
1.51	1.01	0.70	4.85	19	5.7	244	5.7	13.6	19.1	28.4
1.52	1.58	1.61	3.08	39	0.4	256	5.7	16.5	23.5	32.0
1.57	1.64	0.73	4.32	20	4.4	279	5.7	15.0	22.3	33.1
1.79	1.44	1.85	3.95	66	0.3	375	5.7	19.4	26.4	34.9
1.51	1.13	0.61	4.39	17	7.9	250	5.8	13.1	19.1	29.1
1.51	1.55	0.70	4.39	20	4.8	271	5.8	14.2	21.2	31.7
1.55	1.70	1.79	2.33	44	0.2	290	5.8	17.6	25.3	33.1
1.86	1.16	1.98	3.65	72	0.2	400	5.8	19.8	26.2	34.1
1.86	1.20	2.00	3.08	66	0.2	386	5.8	20.2	26.7	34.4
1.73	1.35	1.96	4.33	86	0.3	409	5.8	18.9	25.5	33.7
1.66	1.17	1.91	3.24	59	0.2	322	5.8	18.2	24.3	31.6
1.57	1.42	0.51	3.95	15	11.3	284	5.8	13.5	20.6	31.8
1.59	1.19	1.87	3.49	58	0.2	306	5.8	17.5	23.4	30.8
1.62	1.61	1.80	3.55	58	0.3	331	5.8	18.3	25.4	33.7
1.53	2.08	1.70	2.69	46	0.3	313	5.8	17.8	26.1	34.8
1.64	1.56	1.93	3.91	78	0.2	382	5.8	18.7	25.6	33.7
1.62	1.46	2.00	3.90	85	0.2	393	5.9	18.5	25.0	32.7
1.53	1.81	1.95	3.20	74	0.2	371	5.9	18.4	25.7	33.4
1.66	1.74	1.13	3.43	25	1.3	252	5.6	16.6	24.4	35.0
2.28	0.55	1.99	3.70	64	0.3	444	5.6	21.4	27.0	35.0
1.77	1.49	0.97	3.06	19	2.5	232	5.5	16.4	23.9	35.0
2.43	0.36	1.80	5.24	60	0.5	467	5.4	20.4	26.2	35.0
2.59	0.17	0.86	4.53	21	3.8	279	5.4	21.2	25.5	35.0
1.76	1.52	0.77	3.29	17	4.9	253	5.6	15.8	23.5	35.1
1.76	1.53	1.28	4.28	34	1.0	275	5.6	17.9	25.2	35.1
2.55	0.22	1.74	4.08	47	0.4	399	5.5	21.7	26.5	35.1
2.09	0.88	1.61	3.29	38	0.5	288	5.5	20.1	26.2	35.2
2.63	0.14	0.87	5.37	25	3.6	327	5.4	21.5	26.2	35.2
1.58	1.99	1.51	3.19	39	0.5	289	5.7	17.5	25.7	35.2
1.59	1.99	1.75	3.80	64	0.3	352	5.8	18.5	26.3	35.2
1.82	1.42	1.28	4.56	36	1.0	283	5.6	18.3	25.4	35.2
1.66	1.80	1.22	2.91	25	1.0	247	5.6	16.6	24.8	35.3
1.64	1.86	1.37	2.85	30	0.7	259	5.7	17.1	25.3	35.3
1.65	1.83	1.82	2.50	50	0.2	332	5.8	19.0	27.0	35.3
2.23	0.67	1.25	3.64	26	1.2	247	5.4	19.9	25.6	35.3
2.42	0.41	1.41	4.15	33	0.9	301	5.4	20.9	26.1	35.3
1.61	1.94	0.99	3.99	26	1.8	278	5.7	16.4	24.5	35.3
2.12	0.85	0.64	4.32	18	8.0	278	5.6	18.7	24.7	35.3
1.56	2.08	0.70	3.19	17	5.1	297	5.7	14.3	23.2	35.3
2.20	0.74	1.86	3.93	57	0.3	398	5.6	20.9	26.8	35.3
1.71	1.69	0.60	4.11	18	7.1	310	5.7	16.0	23.8	35.4
2.21	0.72	1.15	4.86	30	1.7	287	5.4	19.8	25.8	35.4
2.19	0.75	1.89	4.92	70	0.4	458	5.5	20.3	26.5	35.4
2.36	0.50	1.33	5.14	36	1.2	330	5.4	20.4	26.2	35.4
2.14	0.84	1.53	3.99	38	0.6	303	5.5	20.1	26.2	35.4
2.05	1.00	1.63	4.92	53	0.6	360	5.5	19.6	26.2	35.4
1.63	1.92	1.57	3.52	45	0.4	306	5.7	18.1	26.1	35.4
1.98	1.12	0.80	4.66	22	4.2	282	5.6	18.4	25.0	35.5
1.98	1.12	0.52	4.06	16	12.0	235	5.6	17.5	24.1	35.5

E-9

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
2.78	0.04	1.94	4.30	61	0.3	550	5.6	22.2	27.0	35.5
1.88	1.33	1.84	2.82	50	0.2	338	5.7	20.1	27.2	35.5
1.72	1.70	0.99	3.72	23	2.0	263	5.6	16.8	24.6	35.5
1.59	2.05	1.04	3.74	26	1.6	279	5.7	16.3	24.7	35.5
2.36	0.52	1.01	4.22	23	2.5	262	5.4	20.4	25.7	35.6
2.75	0.08	1.91	4.46	59	0.3	537	5.6	22.0	27.0	35.6
1.58	2.08	0.92	2.95	20	2.4	270	5.7	15.2	24.0	35.6
1.96	1.20	1.64	4.37	50	0.5	339	5.6	19.6	26.4	35.7
2.44	0.44	0.94	4.86	24	0.0	294	5.4	20.8	26.1	35.7
2.12	0.92	0.95	3.31	19	3.1	228	5.4	18.7	24.9	35.7
1.69	1.82	1.29	3.94	34	0.9	281	5.7	17.7	25.6	35.7
2.08	1.00	1.28	3.48	27	1.1	250	5.5	19.4	25.8	35.8
2.36	0.56	0.77	4.75	21	5.0	290	5.5	20.4	25.8	35.8
1.56	2.18	0.93	3.25	22	2.2	283	5.7	15.5	24.3	35.8
2.65	0.21	1.26	3.82	27	1.2	287	5.4	21.9	26.3	35.8
2.24	0.74	1.17	4.51	29	1.6	281	5.4	20.1	26.1	35.8
2.13	0.92	0.95	4.52	24	2.8	273	5.5	19.4	25.7	35.9
1.98	1.20	0.60	3.25	15	10.5	262	5.5	16.9	23.9	35.9
1.59	2.12	1.49	3.08	38	0.5	296	5.8	17.7	26.2	35.9
2.46	0.45	1.10	4.36	26	1.9	281	5.4	21.0	26.2	35.9
1.94	1.29	1.81	3.10	50	0.3	343	5.7	20.3	27.3	35.9
2.63	0.25	0.80	4.37	20	4.5	286	5.5	21.6	26.0	35.9
1.83	1.53	1.13	3.03	23	1.5	241	5.5	17.5	25.2	36.0
2.55	0.35	1.93	4.03	60	0.3	485	5.6	22.1	27.4	36.0
1.83	1.51	1.44	3.37	34	0.6	276	5.6	18.8	26.2	36.0
1.84	1.49	1.88	4.01	70	0.3	400	5.7	19.9	27.2	36.0
1.91	1.35	1.03	3.55	23	2.0	249	5.5	18.0	25.2	36.0
1.51	2.39	1.31	3.38	35	0.7	299	5.8	16.9	25.8	36.0
2.64	0.25	1.17	3.81	25	1.5	277	5.4	21.8	26.3	36.1
2.24	0.78	1.72	5.04	58	0.6	416	5.5	20.4	26.8	36.1
1.94	1.32	1.24	3.86	29	1.1	266	5.5	18.9	25.9	36.1
1.92	1.36	1.32	4.42	36	1.0	292	5.5	19.1	26.2	36.1
2.03	1.16	1.78	4.01	56	0.4	375	5.6	20.4	27.2	36.2
2.86	0.06	1.29	5.49	35	1.2	413	5.4	21.9	27.0	36.2
1.72	1.83	1.78	2.32	45	0.2	327	5.7	19.4	27.6	36.3
2.92	0.02	1.13	5.69	32	1.6	409	5.4	22.2	27.2	36.3
2.64	0.28	0.97	4.86	25	2.6	315	5.4	21.8	26.7	36.3
2.24	0.81	0.80	5.15	24	4.3	309	5.5	20.1	26.3	36.3
2.76	0.17	1.05	5.11	28	2.0	345	5.4	22.1	26.9	36.3
2.20	0.88	0.76	3.22	16	6.1	238	5.4	18.7	24.9	36.3
2.27	0.77	1.29	5.00	35	1.2	321	5.4	20.4	26.7	36.3
2.57	0.37	0.77	3.83	18	5.4	264	5.4	21.2	25.8	36.3
1.85	1.54	1.58	3.63	43	0.5	312	5.6	19.4	26.9	36.4
2.87	0.07	1.70	4.44	47	0.4	476	5.5	22.4	27.3	36.4
2.32	0.71	1.81	4.26	56	0.4	421	5.6	21.3	27.4	36.4
2.26	0.81	0.80	3.63	18	4.9	251	5.5	19.5	25.5	36.4
2.97	0.00	0.74	5.68	24	4.0	398	5.5	23.0	27.5	36.5
1.76	1.77	1.63	2.57	39	0.3	300	5.7	19.1	27.2	36.5
2.06	1.15	1.73	3.45	47	0.4	343	5.6	20.7	27.4	36.5
2.67	0.28	1.00	5.26	28	2.3	343	5.4	21.9	27.1	36.5
2.00	1.27	1.48	3.75	37	0.6	296	5.6	19.8	26.8	36.5
1.78	1.73	1.60	2.50	36	0.4	291	5.6	19.0	27.2	36.5
2.68	0.28	1.52	4.97	42	0.7	411	5.4	21.7	27.2	36.5
2.06	1.16	1.77	3.37	49	0.3	354	5.6	20.8	27.6	36.6
2.89	0.08	0.77	5.76	25	3.9	393	5.5	22.8	27.6	36.6

E-10

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
1.57	2.32	0.71	2.92	17	4.7	316	5.7	14.6	24.1	36.6
1.66	2.05	0.53	3.58	16	8.8	343	5.8	15.4	24.1	36.6
1.74	1.85	1.15	2.73	23	1.3	254	5.6	17.2	25.6	36.6
1.51	2.54	0.51	3.08	15	8.8	381	5.9	13.7	23.6	36.7
1.52	2.49	1.97	1.71	63	0.1	414	6.0	19.6	29.2	36.7
2.81	0.17	0.92	4.79	24	2.8	331	5.5	22.5	27.0	36.7
2.13	1.05	0.93	4.91	26	2.8	298	5.5	19.8	26.5	36.7
2.32	0.75	1.37	4.10	33	0.9	302	5.5	20.9	27.0	36.8
2.28	0.81	1.42	4.06	34	0.8	306	5.5	20.9	27.0	36.8
1.99	1.32	0.57	3.93	17	9.4	302	5.6	17.9	25.0	36.8
2.10	1.11	1.51	4.54	44	0.7	336	5.5	20.2	27.1	36.8
2.61	0.38	1.18	5.40	33	1.5	361	5.4	21.6	27.3	36.8
1.70	1.98	1.12	3.56	27	1.3	281	5.7	17.5	25.9	36.8
1.60	2.26	1.30	2.06	25	0.7	273	5.6	16.6	26.2	36.8
2.64	0.36	1.32	5.56	38	1.2	395	5.3	21.5	27.4	36.8
2.31	0.79	0.92	4.79	25	3.0	298	5.5	20.5	26.7	36.8
2.01	1.29	1.92	3.29	62	0.2	407	5.7	21.2	28.2	36.8
1.73	1.93	1.66	4.01	57	0.4	353	5.7	19.3	27.3	36.9
1.60	2.29	1.46	1.81	29	0.5	286	5.6	17.3	26.9	36.9
1.80	1.76	1.67	4.17	57	0.4	357	5.7	19.6	27.4	36.9
1.55	2.46	0.84	2.60	18	3.0	307	5.7	14.7	24.6	36.9
2.63	0.39	1.79	4.24	52	0.4	462	5.5	22.2	27.8	37.0
1.68	2.09	1.45	3.55	40	0.6	311	5.7	18.5	27.0	37.0
1.99	1.35	1.07	3.96	26	1.8	272	5.5	19.0	26.3	37.0
1.55	2.45	1.16	2.71	26	1.1	293	5.7	16.4	25.9	37.0
2.80	0.22	1.87	4.54	58	0.4	553	5.6	22.3	27.8	37.0
2.32	0.79	0.65	3.62	16	8.3	269	5.5	19.8	25.6	37.0
2.40	0.69	1.73	4.97	56	0.5	444	5.5	21.1	27.6	37.1
1.80	1.79	1.99	2.22	63	0.2	406	5.8	21.0	29.2	37.1
2.19	1.02	1.96	3.43	64	0.2	442	5.7	21.8	28.5	37.1
2.40	0.69	1.35	4.99	37	1.1	347	5.4	21.1	27.3	37.1
3.05	0.02	1.76	4.24	49	0.3	536	5.6	23.1	27.8	37.1
1.59	2.37	0.61	3.20	17	6.4	348	5.8	14.8	24.4	37.1
1.93	1.50	0.56	4.49	19	8.2	333	5.7	18.2	25.7	37.1
2.69	0.35	1.40	4.94	38	0.9	389	5.4	22.0	27.5	37.1
1.85	1.69	1.65	2.84	42	0.4	317	5.7	19.8	27.8	37.1
3.10	0.00	0.77	4.69	22	3.5	366	5.5	23.7	27.3	37.2
2.05	1.27	1.90	3.23	59	0.3	402	5.7	21.4	28.5	37.2
2.40	0.71	1.56	5.17	48	0.7	404	5.4	21.0	27.6	37.2
2.03	1.32	1.24	3.73	29	1.1	275	5.5	19.6	26.8	37.3
1.99	1.40	1.57	2.94	37	0.5	299	5.6	20.2	27.6	37.3
2.97	0.10	0.83	4.80	23	3.2	356	5.5	23.3	27.4	37.3
1.85	1.69	1.29	4.16	35	0.9	299	5.6	19.1	26.9	37.3
2.41	0.70	1.22	4.27	29	1.3	301	5.4	21.3	27.2	37.3
2.13	1.14	1.71	4.36	54	0.5	387	5.6	20.8	27.8	37.3
1.91	1.57	1.97	4.37	91	0.3	473	5.7	20.6	28.2	37.3
2.87	0.20	1.02	5.01	27	2.0	362	5.4	22.7	27.6	37.3
2.36	0.79	1.30	3.80	30	1.0	290	5.4	21.2	27.3	37.4
2.05	1.31	1.90	4.11	70	0.3	441	5.7	21.0	28.3	37.4
3.09	0.04	1.80	4.73	54	0.4	605	5.6	22.7	27.8	37.4
2.25	0.96	0.83	3.15	18	4.6	246	5.4	19.5	25.9	37.4
2.75	0.32	1.46	3.91	35	0.7	360	5.5	22.7	27.7	37.4
2.16	1.11	1.16	4.29	29	1.5	290	5.5	20.2	27.0	37.4
1.61	2.35	0.70	3.38	19	4.5	335	5.8	15.7	25.1	37.4
1.93	1.55	0.61	3.26	16	8.7	293	5.6	17.1	25.0	37.4

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
3.01	0.10	1.68	4.62	47	0.4	521	5.5	22.8	27.9	37.5
2.39	0.75	1.37	5.11	39	1.0	359	5.4	21.1	27.6	37.5
2.27	0.94	0.68	4.55	20	6.1	309	5.5	20.3	26.6	37.5
1.77	1.93	1.83	2.28	50	0.2	361	5.8	20.3	28.8	37.5
2.52	0.59	1.80	3.50	49	0.3	417	5.6	22.6	28.4	37.5
1.72	2.07	1.35	3.32	34	0.7	298	5.7	18.4	27.1	37.5
1.89	1.65	0.68	3.97	19	5.6	309	5.7	17.8	25.8	37.5
2.22	1.03	1.30	4.13	32	1.1	299	5.5	20.6	27.3	37.5
2.71	0.38	1.78	3.94	50	0.4	460	5.5	22.8	28.3	37.5
1.54	2.61	0.81	2.42	18	3.3	325	5.7	14.6	24.9	37.5
2.28	0.95	0.73	3.33	17	6.5	261	5.5	19.6	25.9	37.6
2.24	1.01	1.33	3.59	30	0.9	286	5.5	20.8	27.4	37.7
1.58	2.52	1.00	2.05	19	1.9	296	5.6	15.3	25.6	37.7
3.00	0.14	1.77	3.99	49	0.3	523	5.6	23.4	28.2	37.7
3.11	0.06	0.95	5.69	29	2.0	440	5.4	23.3	28.2	37.7
3.04	0.11	1.85	4.10	55	0.3	581	5.6	23.4	28.3	37.7
3.02	0.12	1.28	4.43	32	0.9	393	5.5	23.3	27.8	37.7
1.75	2.04	0.55	3.26	16	9.0	337	5.7	15.9	24.9	37.7
1.83	1.85	1.19	2.41	23	1.2	259	5.5	17.9	26.6	37.8
2.74	0.38	1.67	4.08	44	0.4	433	5.5	22.8	28.2	37.8
1.60	2.46	1.63	1.73	37	0.3	332	5.7	18.5	28.4	37.8
1.75	2.05	1.98	2.23	65	0.2	421	5.9	21.0	29.7	37.8
2.90	0.23	0.93	5.60	28	2.4	399	5.4	22.9	28.2	37.8
1.97	1.54	1.11	3.30	24	1.6	266	5.5	18.9	26.7	37.8
2.97	0.18	0.70	4.70	21	4.7	359	5.5	23.5	27.7	37.8
1.87	1.78	0.60	3.40	16	8.0	315	5.7	17.0	25.3	37.9
1.81	1.91	1.17	3.70	29	1.2	292	5.6	18.6	27.0	37.9
1.75	2.06	0.61	2.87	15	8.0	321	5.7	15.7	24.9	37.9
1.99	1.51	0.75	4.08	20	4.5	302	5.6	18.8	26.4	37.9
2.76	0.38	1.41	4.20	35	0.8	370	5.5	22.7	28.0	37.9
3.06	0.13	1.55	4.27	40	0.5	469	5.5	23.4	28.2	38.0
2.47	0.74	1.91	3.33	57	0.3	456	5.6	22.9	29.1	38.0
1.66	2.35	1.69	2.14	43	0.3	348	5.8	19.3	28.8	38.0
1.68	2.28	1.81	2.46	54	0.2	383	5.8	20.1	29.2	38.0
2.67	0.49	1.19	5.00	32	1.4	362	5.4	22.2	28.0	38.0
2.34	0.92	0.62	4.58	19	7.3	324	5.6	20.8	27.1	38.0
1.83	1.90	0.94	2.98	20	2.5	278	5.6	17.5	26.2	38.1
2.16	1.21	1.45	4.70	43	0.8	349	5.5	20.7	28.0	38.1
2.75	0.41	1.52	3.79	37	0.6	377	5.5	23.0	28.3	38.1
3.11	0.11	0.81	4.64	23	2.9	376	5.5	23.9	27.9	38.1
1.62	2.49	1.96	3.10	87	0.2	458	6.0	20.5	29.5	38.1
2.53	0.66	0.87	3.39	19	3.8	265	5.4	21.4	26.9	38.1
2.59	0.60	1.73	4.49	51	0.5	458	5.5	22.2	28.5	38.1
2.46	0.76	0.95	4.25	23	2.7	297	5.5	21.5	27.5	38.1
2.13	1.29	0.94	2.77	19	3.0	246	5.4	19.0	26.4	38.2
2.73	0.44	1.61	3.82	41	0.5	402	5.5	23.0	28.5	38.2
1.79	2.01	1.40	2.94	33	0.6	299	5.6	19.0	27.7	38.2
2.61	0.58	0.98	4.49	25	2.4	318	5.5	22.1	27.8	38.2
2.12	1.32	1.03	3.29	22	2.1	263	5.5	19.6	26.9	38.2
1.66	2.38	0.74	2.37	16	4.9	319	5.6	15.1	25.1	38.2
2.43	0.82	1.02	3.36	22	2.3	264	5.4	21.2	27.2	38.2
2.22	1.14	1.30	3.74	31	1.0	295	5.5	20.8	27.8	38.2
2.06	1.44	0.58	3.18	15	10.3	296	5.6	18.0	25.6	38.2
2.56	0.66	0.81	3.40	18	4.6	269	5.4	21.5	26.9	38.3
3.14	0.11	1.45	4.36	37	0.6	462	5.5	23.6	28.2	38.3

E-12

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
2.14	1.28	1.39	4.43	39	0.9	330	5.5	20.7	28.0	38.3
2.61	0.61	0.58	5.37	21	7.3	378	5.5	22.4	28.2	38.3
2.60	0.62	1.34	4.89	36	1.0	375	5.4	22.1	28.3	38.3
2.76	0.44	1.73	4.93	53	0.5	517	5.5	22.3	28.5	38.4
2.06	1.46	1.96	3.88	75	0.3	470	5.7	21.6	29.2	38.4
3.23	0.07	1.95	4.08	61	0.2	704	5.7	23.7	28.7	38.4
2.73	0.48	0.84	4.22	21	3.5	315	5.5	22.6	27.7	38.4
2.08	1.42	1.10	4.46	30	1.7	306	5.5	20.1	27.6	38.4
3.19	0.10	1.73	4.78	50	0.4	616	5.6	23.1	28.4	38.4
1.65	2.47	0.93	2.51	20	2.3	309	5.7	16.2	26.1	38.4
2.86	0.35	0.57	3.90	17	8.8	326	5.5	23.0	27.3	38.4
1.77	2.12	1.88	3.77	79	0.3	438	5.8	20.7	29.2	38.5
2.76	0.47	1.27	4.52	32	1.1	366	5.4	22.7	28.3	38.5
1.75	2.18	1.65	3.55	54	0.4	367	5.8	20.0	28.7	38.5
2.14	1.33	0.97	3.12	21	2.6	262	5.5	19.6	26.9	38.5
2.55	0.70	1.05	3.73	24	2.0	289	5.4	22.0	27.7	38.5
2.10	1.40	1.16	2.97	24	1.4	264	5.5	19.8	27.4	38.5
2.56	0.70	0.83	5.13	25	3.5	346	5.5	22.1	28.2	38.6
1.72	2.29	0.73	3.04	18	4.5	327	5.7	16.4	25.9	38.6
2.68	0.55	1.26	4.87	34	1.1	374	5.4	22.4	28.4	38.6
2.83	0.40	1.56	5.07	45	0.6	480	5.4	22.5	28.6	38.6
2.71	0.53	0.80	4.21	21	4.0	316	5.5	22.5	27.8	38.6
1.64	2.54	1.10	2.97	26	1.2	316	5.7	17.4	27.1	38.6
2.57	0.68	1.20	4.21	29	1.3	324	5.4	22.2	28.2	38.6
2.15	1.33	1.31	4.11	34	1.0	314	5.5	20.7	28.1	38.6
2.91	0.33	0.65	4.88	21	5.3	375	5.6	23.5	28.3	38.6
2.36	0.97	1.75	4.14	53	0.4	428	5.6	22.0	28.9	38.6
2.92	0.32	1.98	3.97	64	0.2	625	5.7	23.6	29.1	38.6
3.16	0.15	0.75	4.85	23	3.3	404	5.6	24.3	28.4	38.7
2.73	0.52	1.77	3.90	50	0.4	475	5.6	23.2	29.0	38.7
2.29	1.11	1.23	3.62	28	1.2	291	5.5	21.1	28.0	38.7
2.36	0.99	0.98	4.85	27	2.4	325	5.5	21.3	28.1	38.7
2.38	0.97	0.97	3.93	23	2.5	290	5.5	21.2	27.7	38.7
1.83	2.03	1.55	3.90	49	0.5	354	5.7	20.1	28.6	38.8
2.32	1.06	1.84	3.67	57	0.3	439	5.6	22.4	29.3	38.8
1.94	1.77	1.90	4.19	80	0.3	459	5.7	21.1	29.3	38.8
1.64	2.57	2.00	1.72	68	0.1	459	6.0	21.0	30.9	38.8
2.91	0.37	0.85	4.13	22	3.1	332	5.5	23.4	28.0	38.8
2.09	1.48	1.09	4.01	27	1.7	297	5.5	20.1	27.8	38.8
3.09	0.22	0.92	4.25	24	2.2	365	5.5	24.0	28.2	38.9
1.98	1.70	1.47	2.37	31	0.6	292	5.5	20.2	28.5	38.9
1.54	2.92	1.92	2.53	79	0.2	468	6.1	20.5	30.5	38.9
1.71	2.38	1.83	3.34	71	0.3	425	5.9	20.6	29.6	38.9
3.21	0.15	1.29	3.93	32	0.7	418	5.5	24.3	28.5	38.9
1.63	2.63	1.71	1.77	43	0.2	374	5.8	19.5	29.7	38.9
1.91	1.86	0.72	2.80	16	5.7	296	5.6	17.4	26.1	38.9
2.55	0.78	1.08	3.36	23	1.8	282	5.4	22.0	28.0	39.0
2.68	0.63	0.93	5.34	28	2.5	372	5.4	22.6	28.8	39.1
1.82	2.13	1.28	3.70	35	0.9	321	5.7	19.4	28.2	39.1
3.03	0.31	1.48	4.57	39	0.6	471	5.5	23.5	28.9	39.2
2.30	1.16	1.89	3.12	57	0.3	442	5.7	22.8	30.0	39.2
1.53	3.05	0.61	2.56	17	5.6	418	5.8	14.6	25.7	39.2
2.32	1.13	1.79	4.20	58	0.4	449	5.6	22.1	29.4	39.2
2.98	0.36	0.86	4.37	23	2.8	358	5.5	23.8	28.5	39.2
2.30	1.16	1.76	4.22	56	0.4	439	5.6	22.0	29.3	39.2

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
2.14	1.45	0.58	3.44	16	9.3	315	5.6	19.1	26.7	39.3
3.14	0.25	1.10	3.89	27	1.3	374	5.5	24.3	28.5	39.3
1.90	1.96	1.06	3.84	28	1.6	310	5.6	19.3	27.9	39.3
1.94	1.86	0.81	2.41	17	4.4	281	5.5	17.6	26.5	39.3
3.49	0.07	1.14	4.47	31	0.8	490	5.6	24.8	28.6	39.3
1.57	2.95	1.31	1.23	25	0.7	340	5.6	16.8	28.3	39.4
2.21	1.34	1.99	4.32	82	0.3	530	5.7	22.0	29.7	39.4
2.75	0.60	1.34	3.46	30	0.8	337	5.4	23.3	28.8	39.4
3.20	0.22	0.89	4.41	24	2.1	396	5.6	24.5	28.7	39.4
1.57	2.94	1.43	2.76	40	0.5	367	5.8	18.7	29.0	39.4
1.61	2.83	1.38	1.46	28	0.6	338	5.7	17.7	28.7	39.4
2.04	1.67	0.57	3.73	17	8.4	338	5.6	18.8	26.9	39.5
1.65	2.68	1.96	1.87	67	0.1	465	6.0	21.2	31.2	39.5
3.45	0.10	1.56	4.23	42	0.3	595	5.7	24.4	28.8	39.5
1.62	2.81	0.72	2.58	18	4.2	373	5.8	15.6	26.3	39.5
2.89	0.48	1.01	5.06	29	1.9	392	5.5	23.3	29.1	39.5
2.39	1.06	1.76	3.46	49	0.4	416	5.6	22.7	29.7	39.5
1.93	1.92	1.88	2.29	55	0.2	410	5.8	21.8	30.5	39.5
2.54	0.86	1.70	3.24	44	0.4	401	5.5	23.2	29.7	39.5
2.74	0.63	0.76	3.38	18	5.0	296	5.4	22.6	27.8	39.5
2.38	1.10	1.56	4.33	45	0.6	391	5.5	22.1	29.3	39.6
2.62	0.76	0.60	4.47	19	7.2	350	5.6	22.5	28.3	39.6
2.05	1.67	1.84	3.97	67	0.3	445	5.7	21.7	29.8	39.6
2.78	0.59	0.67	3.53	18	6.4	311	5.5	22.8	27.8	39.6
3.01	0.38	1.03	5.11	29	1.6	415	5.5	23.7	29.2	39.6
2.51	0.91	0.83	4.43	23	3.5	327	5.5	22.0	28.5	39.6
2.35	1.15	1.53	3.24	36	0.6	339	5.5	22.2	29.3	39.6
1.73	2.48	1.57	3.17	47	0.4	369	5.8	20.1	29.5	39.6
2.64	0.75	0.86	4.17	22	3.2	323	5.5	22.6	28.5	39.6
2.57	0.85	0.83	4.12	22	3.6	318	5.5	22.2	28.4	39.7
1.66	2.72	1.62	3.00	52	0.3	389	5.9	20.0	29.8	39.7
1.51	3.25	1.46	2.19	39	0.4	393	5.9	18.5	29.5	39.7
2.51	0.94	1.11	3.47	25	1.6	296	5.4	22.1	28.5	39.7
3.20	0.27	0.85	5.15	26	2.2	441	5.5	24.4	29.3	39.7
2.08	1.65	1.62	2.41	37	0.4	334	5.6	21.5	29.7	39.7
3.42	0.16	1.13	4.22	30	0.9	459	5.6	25.0	28.9	39.8
1.86	2.16	1.15	2.62	24	1.3	298	5.6	18.8	28.1	39.8
1.83	2.25	1.78	2.21	49	0.2	392	5.8	21.1	30.5	39.8
2.38	1.13	1.05	4.66	29	1.9	334	5.5	21.7	28.9	39.8
3.43	0.15	1.49	4.86	42	0.4	608	5.6	23.9	29.0	39.8
3.15	0.31	0.84	4.44	24	2.5	395	5.6	24.5	28.9	39.8
3.33	0.21	1.09	4.43	29	1.1	448	5.6	24.7	29.1	39.9
1.82	2.30	1.54	3.35	45	0.5	362	5.7	20.4	29.5	39.9
2.65	0.79	1.67	4.65	50	0.5	477	5.5	22.7	29.6	39.9
1.57	3.08	1.82	2.77	74	0.2	462	6.0	20.6	30.9	39.9
2.44	1.06	1.08	3.20	23	1.8	285	5.4	21.8	28.5	40.0
2.66	0.78	1.84	3.90	56	0.3	510	5.6	23.4	30.0	40.0
2.39	1.15	0.96	3.74	23	2.5	301	5.5	21.5	28.5	40.0
2.31	1.28	1.98	3.00	65	0.2	490	5.7	23.4	30.8	40.0
1.72	2.59	1.07	3.35	28	1.3	340	5.7	18.5	28.4	40.1
2.01	1.86	0.94	3.68	24	2.4	313	5.6	19.7	28.2	40.1
3.29	0.26	0.99	4.84	28	1.4	454	5.6	24.6	29.3	40.1
1.92	2.07	0.67	2.81	16	6.4	329	5.6	17.6	26.8	40.1
2.81	0.63	0.60	5.16	22	5.9	404	5.6	23.6	29.4	40.1
2.32	1.27	0.93	2.83	19	3.0	273	5.4	20.7	28.0	40.1

E-14

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
1.53	3.32	1.67	1.31	43	0.2	435	5.9	19.3	31.0	40.1
1.75	2.54	1.09	1.72	21	1.5	311	5.6	17.3	27.9	40.1
1.79	2.41	1.99	2.05	69	0.2	475	5.9	22.1	31.7	40.2
2.91	0.55	1.99	4.41	68	0.3	680	5.7	23.4	30.0	40.2
2.34	1.26	1.31	3.96	33	1.0	336	5.5	21.9	29.3	40.2
1.51	3.43	1.99	2.19	97	0.1	551	6.2	21.4	32.3	40.2
2.71	0.76	0.57	3.55	17	9.3	328	5.5	22.5	28.0	40.2
1.74	2.58	1.12	2.01	22	1.3	319	5.6	17.8	28.2	40.3
3.24	0.32	0.97	4.51	27	1.6	425	5.6	24.7	29.3	40.3
2.88	0.59	1.06	4.75	29	1.6	389	5.5	23.6	29.5	40.3
1.78	2.49	1.99	2.99	87	0.2	502	6.0	22.0	31.4	40.3
1.73	2.63	0.63	2.20	15	7.1	373	5.7	15.7	26.4	40.3
2.22	1.48	0.62	4.08	19	6.7	344	5.6	20.5	28.2	40.3
2.31	1.33	1.60	3.44	42	0.5	374	5.6	22.4	30.0	40.3
1.94	2.07	0.64	3.02	17	6.7	340	5.6	18.0	27.2	40.4
3.29	0.30	0.54	4.01	19	6.1	411	5.7	25.3	28.8	40.4
1.56	3.24	1.24	2.43	31	0.7	383	5.8	18.0	29.2	40.4
2.37	1.24	1.47	4.61	44	0.7	394	5.5	22.1	29.7	40.4
1.59	3.13	1.93	0.99	58	0.1	493	6.0	21.0	32.5	40.4
3.39	0.25	1.11	5.13	32	1.0	515	5.6	24.5	29.6	40.4
3.00	0.50	1.41	3.89	35	0.6	425	5.5	24.2	29.7	40.4
2.14	1.64	1.76	3.55	55	0.4	420	5.7	22.2	30.4	40.4
1.77	2.55	1.97	1.95	68	0.2	478	5.9	22.0	31.9	40.4
3.06	0.46	0.66	3.64	19	5.2	354	5.6	24.3	28.6	40.5
1.78	2.53	1.71	1.74	43	0.3	388	5.8	20.7	30.9	40.5
2.82	0.68	1.47	4.49	40	0.6	444	5.5	23.4	29.8	40.5
2.11	1.73	1.80	2.59	50	0.3	403	5.7	22.4	30.8	40.5
3.08	0.45	1.35	4.34	35	0.7	452	5.5	24.2	29.7	40.5
2.20	1.55	1.95	2.71	61	0.2	466	5.7	23.2	31.2	40.5
2.41	1.20	1.53	3.56	39	0.6	369	5.5	22.7	29.9	40.5
1.51	3.49	1.93	0.71	60	0.1	533	6.0	20.8	33.0	40.5
1.88	2.25	0.99	2.07	19	2.2	301	5.5	18.1	27.9	40.6
1.58	3.22	0.64	1.90	15	5.8	436	5.8	14.6	26.5	40.6
2.04	1.88	1.69	3.09	48	0.4	390	5.7	21.9	30.5	40.6
2.98	0.54	0.99	4.66	27	1.8	396	5.5	24.0	29.6	40.6
2.01	1.94	1.40	4.02	41	0.7	355	5.6	21.0	29.7	40.6
1.77	2.56	1.07	2.34	23	1.5	327	5.6	18.1	28.4	40.6
1.62	3.06	1.31	2.47	33	0.6	374	5.8	18.7	29.5	40.6
2.63	0.91	1.22	3.75	29	1.2	338	5.5	23.0	29.5	40.6
2.79	0.73	1.85	3.79	56	0.3	543	5.6	24.0	30.5	40.6
3.09	0.46	1.35	3.57	32	0.7	413	5.5	24.6	29.7	40.6
2.51	1.06	1.33	4.13	34	0.9	361	5.5	22.7	29.7	40.6
1.58	3.26	1.56	0.91	33	0.3	410	5.8	18.7	30.8	40.6
3.08	0.48	0.52	4.67	20	6.7	425	5.7	24.8	29.5	40.7
2.84	0.69	0.88	4.80	25	2.6	383	5.5	23.7	29.7	40.7
2.96	0.58	1.57	3.77	40	0.4	462	5.5	24.3	30.1	40.7
2.29	1.42	1.15	4.23	30	1.4	335	5.5	21.7	29.5	40.7
2.05	1.89	0.78	3.10	19	4.2	317	5.6	19.3	28.0	40.7
2.23	1.54	0.84	2.83	18	3.9	291	5.5	20.2	28.1	40.7
3.13	0.45	0.64	4.93	22	4.2	436	5.6	24.9	29.6	40.8
2.47	1.15	1.19	4.79	34	1.3	367	5.4	22.4	29.8	40.8
1.80	2.54	0.89	1.95	18	2.9	329	5.6	17.1	27.7	40.8
1.94	2.15	1.26	2.29	26	0.9	308	5.6	19.8	29.2	40.8
1.66	2.99	1.56	2.53	45	0.4	401	5.9	20.1	30.6	40.8
1.80	2.53	1.10	2.98	27	1.3	337	5.7	19.0	28.9	40.8

E-15

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
1.58	3.29	1.20	1.14	23	0.9	384	5.7	16.8	29.1	40.8
1.61	3.16	1.01	1.49	20	1.7	376	5.7	16.3	28.2	40.8
2.39	1.28	1.71	4.50	56	0.5	465	5.6	22.5	30.4	40.9
2.63	0.95	0.88	3.90	22	2.9	328	5.5	22.8	29.2	40.9
1.71	2.83	1.89	2.24	67	0.2	476	6.0	21.7	31.9	40.9
1.93	2.20	0.75	3.56	21	3.9	349	5.7	19.0	28.3	40.9
2.37	1.32	1.90	3.85	65	0.3	508	5.7	23.1	30.9	40.9
1.67	2.96	1.32	2.67	34	0.6	372	5.8	19.2	29.8	40.9
1.58	3.33	1.67	2.35	55	0.3	450	6.0	20.4	31.3	40.9
2.05	1.93	1.53	2.60	36	0.5	344	5.6	21.4	30.3	40.9
1.52	3.56	0.84	1.61	19	2.5	441	5.8	15.2	27.7	40.9
2.21	1.59	0.82	4.01	22	3.4	331	5.6	20.9	28.9	40.9
2.29	1.46	1.02	4.41	28	1.9	338	5.5	21.7	29.5	40.9
2.74	0.83	1.84	4.00	57	0.3	547	5.6	23.8	30.6	40.9
1.74	2.74	0.55	2.75	16	8.0	416	5.8	16.4	27.1	40.9
3.30	0.37	1.92	4.29	61	0.2	763	5.7	24.2	30.1	40.9
1.97	2.12	1.62	1.99	37	0.4	356	5.6	21.4	30.8	41.0
2.73	0.85	1.60	3.98	43	0.5	449	5.5	23.7	30.4	41.0
2.42	1.27	0.61	2.98	16	8.9	312	5.5	20.8	27.9	41.0
3.30	0.38	1.91	3.86	60	0.2	729	5.8	24.8	30.4	41.0
2.51	1.14	1.16	4.43	31	1.4	356	5.5	22.6	29.9	41.0
1.93	2.22	1.57	3.51	48	0.5	386	5.7	21.3	30.5	41.0
2.03	1.99	1.54	3.66	45	0.5	377	5.6	21.5	30.4	41.0
2.82	0.76	1.79	3.41	50	0.3	506	5.6	24.4	30.8	41.0
2.10	1.85	1.09	2.94	24	1.6	305	5.5	20.4	29.1	41.1
1.71	2.87	1.27	2.39	30	0.7	361	5.7	19.0	29.7	41.1
3.17	0.47	1.15	4.04	29	1.0	421	5.5	24.8	29.8	41.1
1.51	3.67	0.54	2.24	17	6.3	529	5.9	14.6	27.1	41.1
2.00	2.07	1.24	3.10	29	1.0	324	5.6	20.5	29.5	41.1
2.17	1.71	1.63	3.39	45	0.4	389	5.6	22.3	30.6	41.1
1.82	2.54	1.35	2.03	29	0.7	337	5.6	19.6	29.8	41.1
3.22	0.44	0.93	3.81	24	1.8	393	5.6	25.1	29.5	41.1
3.15	0.49	1.11	4.24	29	1.2	421	5.5	24.7	29.9	41.1
3.15	0.49	1.30	4.63	35	0.8	477	5.5	24.3	30.1	41.1
2.00	2.07	1.22	3.25	30	1.0	328	5.6	20.6	29.6	41.1
3.11	0.52	0.68	3.84	20	4.3	379	5.6	24.7	29.3	41.1
2.20	1.67	1.04	3.13	23	1.9	305	5.5	20.9	29.1	41.2
1.53	3.64	0.71	2.10	19	3.5	478	5.9	15.4	27.8	41.2
2.03	2.03	0.71	3.21	18	5.1	340	5.6	19.2	28.2	41.2
2.19	1.70	1.94	3.96	77	0.3	520	5.7	22.8	31.2	41.2
2.41	1.31	1.02	3.67	25	2.0	319	5.5	22.0	29.4	41.2
2.98	0.63	0.57	4.17	19	6.6	391	5.6	24.4	29.4	41.2
1.74	2.80	1.70	2.14	48	0.3	420	5.8	21.0	31.5	41.2
2.40	1.33	1.13	3.12	25	1.5	306	5.5	22.1	29.5	41.2
3.41	0.36	0.52	5.44	23	4.0	533	5.7	26.0	30.7	41.2
1.92	2.29	1.05	3.69	28	1.5	342	5.6	20.0	29.4	41.3
2.65	0.99	1.14	4.49	30	1.4	371	5.5	23.2	30.1	41.3
2.49	1.20	1.71	4.10	52	0.4	465	5.6	23.2	30.7	41.3
2.03	2.06	1.20	2.32	24	1.1	306	5.5	20.2	29.4	41.3
2.88	0.74	0.99	4.38	26	1.8	380	5.5	23.9	30.0	41.3
2.89	0.74	1.49	3.46	36	0.5	417	5.5	24.4	30.4	41.3
1.74	2.85	1.30	1.67	27	0.7	355	5.7	18.8	29.9	41.3
2.38	1.38	1.03	4.34	28	1.8	344	5.5	22.1	29.8	41.3
3.29	0.44	1.46	3.95	38	0.4	519	5.6	25.0	30.2	41.4
2.92	0.71	0.95	5.16	29	2.0	421	5.5	24.0	30.4	41.4

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Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
1.73	2.90	1.68	1.88	46	0.3	422	5.8	20.9	31.6	41.4
1.66	3.15	1.57	2.51	48	0.3	424	5.9	20.4	31.3	41.4
3.18	0.51	1.64	3.64	44	0.3	539	5.6	25.0	30.5	41.4
1.63	3.24	0.85	1.28	17	3.1	404	5.6	15.5	27.8	41.4
2.84	0.80	1.35	3.52	32	0.7	383	5.5	24.1	30.3	41.4
1.94	2.28	1.06	2.56	23	1.6	321	5.6	19.5	29.1	41.4
1.83	2.61	1.81	3.13	68	0.3	460	5.9	21.9	31.7	41.5
1.77	2.77	0.58	3.17	18	6.2	422	5.8	17.5	28.0	41.5
3.37	0.41	0.54	5.18	23	4.2	511	5.7	26.0	30.6	41.5
1.93	2.32	0.85	2.21	18	3.4	326	5.5	18.2	28.2	41.5
2.48	1.25	0.77	2.84	18	5.0	300	5.4	21.6	28.6	41.5
1.80	2.69	1.63	2.39	45	0.3	402	5.8	21.1	31.3	41.5
2.30	1.55	1.21	3.26	28	1.2	322	5.5	21.9	29.9	41.5
1.68	3.10	1.38	1.85	32	0.5	388	5.8	19.3	30.6	41.5
3.23	0.50	1.05	3.76	26	1.3	410	5.6	25.2	29.9	41.6
3.00	0.67	1.10	3.61	26	1.3	371	5.5	24.5	30.0	41.6
2.22	1.70	0.72	3.15	18	5.4	326	5.5	20.3	28.6	41.6
1.74	2.91	1.19	2.70	30	0.9	369	5.7	19.2	29.9	41.6
2.20	1.74	1.85	3.42	62	0.3	474	5.7	23.1	31.5	41.6
3.29	0.47	0.69	3.79	21	3.6	409	5.6	25.5	29.6	41.6
3.43	0.41	0.77	3.78	22	2.4	433	5.7	25.9	29.6	41.7
1.93	2.35	1.06	3.50	28	1.5	346	5.6	20.1	29.7	41.7
2.06	2.05	1.71	2.66	47	0.3	405	5.7	22.4	31.5	41.7
2.97	0.72	1.80	3.36	51	0.3	551	5.6	25.0	31.2	41.7
2.44	1.35	1.33	4.33	37	0.9	380	5.5	22.7	30.5	41.7
1.78	2.81	1.88	2.07	63	0.2	481	5.9	22.2	32.6	41.7
2.09	2.00	1.51	2.39	35	0.5	350	5.6	21.8	30.9	41.7
2.10	1.98	0.51	3.81	18	8.9	393	5.7	19.9	28.7	41.7
1.52	3.88	1.76	0.79	50	0.2	543	6.0	20.5	33.3	41.7
1.68	3.16	1.19	1.53	24	1.0	381	5.7	18.1	29.8	41.7
2.76	0.94	1.14	4.98	33	1.4	410	5.4	23.5	30.6	41.8
2.46	1.32	1.02	3.79	25	1.9	333	5.5	22.5	29.9	41.8
2.48	1.30	1.35	3.57	33	0.8	358	5.5	23.0	30.5	41.8
1.50	3.97	1.96	1.78	96	0.1	616	6.3	22.2	34.1	41.8
3.24	0.52	1.59	4.37	44	0.4	586	5.6	24.6	30.6	41.8
1.64	3.31	0.77	1.43	16	3.9	428	5.7	15.5	27.9	41.8
3.04	0.67	1.70	4.02	48	0.3	564	5.6	24.5	30.9	41.8
2.31	1.58	0.76	3.70	20	4.3	339	5.6	21.4	29.3	41.8
2.32	1.56	1.79	2.75	49	0.3	435	5.6	23.6	31.7	41.8
1.56	3.68	0.83	1.84	20	2.5	467	5.8	16.1	28.7	41.8
2.43	1.39	0.66	3.17	17	6.7	328	5.5	21.4	28.8	41.9
2.13	1.95	0.84	2.76	19	3.6	321	5.5	19.9	28.9	41.9
1.76	2.92	1.29	2.49	32	0.7	376	5.7	19.7	30.5	41.9
2.64	1.10	1.85	2.99	53	0.3	500	5.6	24.6	31.7	41.9
2.27	1.66	1.35	3.67	35	0.8	357	5.5	22.3	30.6	41.9
3.02	0.70	0.65	3.77	19	5.1	379	5.6	24.6	29.7	41.9
2.67	1.07	1.09	4.54	30	1.5	379	5.5	23.4	30.5	41.9
1.91	2.48	1.28	2.59	30	0.8	347	5.6	20.4	30.3	41.9
2.93	0.79	0.65	3.32	18	6.0	350	5.5	24.0	29.3	41.9
3.32	0.50	1.40	4.74	39	0.5	563	5.6	24.6	30.6	41.9
2.73	0.99	0.56	4.30	19	7.3	390	5.6	23.5	29.9	41.9
2.25	1.70	1.97	3.19	70	0.2	524	5.8	23.7	32.1	41.9
2.31	1.60	0.98	2.91	22	2.3	308	5.5	21.5	29.5	42.0
2.56	1.22	1.56	3.64	41	0.5	415	5.5	23.6	31.0	42.0
2.43	1.41	1.54	4.01	44	0.6	416	5.6	23.1	31.0	42.0

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
1.89	2.54	1.04	3.16	26	1.5	354	5.7	19.8	29.8	42.0
3.37	0.49	0.67	4.19	22	3.2	453	5.7	25.9	30.2	42.0
2.60	1.17	0.91	3.22	21	2.8	320	5.5	22.8	29.7	42.1
2.00	2.27	1.30	2.73	30	0.8	343	5.6	20.9	30.5	42.1
3.19	0.60	1.70	3.61	47	0.3	578	5.7	25.2	31.1	42.1
2.84	0.90	1.22	3.44	29	1.0	368	5.5	24.2	30.5	42.1
2.53	1.29	0.59	3.06	16	8.9	337	5.5	21.8	28.9	42.1
2.60	1.19	0.62	2.85	16	8.4	326	5.5	22.1	28.8	42.2
2.02	2.24	1.70	2.30	45	0.3	407	5.7	22.4	31.9	42.2
2.76	0.99	1.53	3.73	40	0.5	438	5.5	24.2	31.1	42.2
2.78	0.97	1.68	3.07	43	0.3	459	5.6	24.7	31.5	42.2
2.24	1.78	1.39	2.99	33	0.7	349	5.6	22.3	30.9	42.2
1.75	3.03	0.70	1.83	16	5.1	413	5.7	16.4	28.1	42.2
1.56	3.81	1.34	1.44	32	0.5	465	5.9	18.7	31.3	42.2
2.14	1.99	1.54	4.00	49	0.6	408	5.6	22.3	31.3	42.2
2.54	1.29	2.00	3.52	71	0.2	591	5.7	24.3	32.1	42.2
2.67	1.12	0.78	3.11	19	4.3	324	5.5	22.9	29.5	42.2
3.20	0.62	0.51	5.08	22	5.2	488	5.7	25.7	31.0	42.2
1.96	2.40	1.68	2.43	46	0.3	413	5.7	22.2	32.0	42.2
1.94	2.47	0.70	3.12	19	4.6	380	5.7	19.0	28.9	42.2
1.67	3.33	1.53	1.15	35	0.4	433	5.8	19.9	31.9	42.3
1.98	2.35	0.82	2.05	17	4.0	336	5.5	18.5	28.6	42.3
1.66	3.39	0.97	1.72	21	1.8	418	5.7	17.3	29.4	42.3
2.22	1.84	0.54	3.99	19	7.8	392	5.7	20.9	29.4	42.3
1.57	3.78	0.52	1.73	15	7.8	561	5.9	14.6	27.7	42.3
2.38	1.55	1.62	3.99	49	0.5	436	5.6	23.1	31.4	42.3
2.19	1.89	0.92	3.74	24	2.4	345	5.6	21.3	30.0	42.3
1.91	2.55	0.58	2.79	17	7.4	403	5.7	18.1	28.4	42.3
2.82	0.95	0.87	4.98	27	2.4	412	5.5	24.1	30.9	42.3
1.69	3.29	0.95	1.21	18	2.1	407	5.6	16.7	29.1	42.4
2.59	1.24	0.85	2.83	19	3.5	312	5.4	22.6	29.6	42.4
3.23	0.62	1.22	4.12	32	0.8	468	5.6	25.2	30.8	42.4
2.67	1.14	1.40	2.92	32	0.7	367	5.5	24.0	31.0	42.4
3.04	0.77	0.73	4.84	24	3.1	436	5.6	24.9	30.9	42.4
1.56	3.90	1.86	1.86	78	0.2	580	6.2	22.1	34.0	42.5
2.08	2.16	1.71	2.00	43	0.3	407	5.7	22.7	32.3	42.5
2.26	1.79	1.07	3.18	25	1.7	329	5.5	21.7	30.2	42.5
2.58	1.27	1.27	4.24	34	1.0	388	5.5	23.4	31.0	42.5
2.78	1.03	0.73	4.64	23	3.8	399	5.6	24.0	30.7	42.5
2.29	1.73	1.55	2.47	36	0.5	370	5.6	23.0	31.6	42.5
1.93	2.56	1.20	2.07	25	1.0	346	5.6	20.0	30.4	42.5
2.83	0.98	1.14	4.34	30	1.2	402	5.5	24.1	30.9	42.5
1.76	3.09	1.44	1.85	34	0.5	405	5.8	20.3	31.6	42.5
1.97	2.45	0.58	2.69	16	7.9	395	5.7	18.4	28.5	42.6
2.70	1.13	1.30	4.53	36	0.9	420	5.5	23.7	31.2	42.6
3.03	0.80	0.98	4.01	26	1.7	400	5.5	24.8	30.7	42.6
3.06	0.78	1.73	3.99	50	0.3	590	5.6	24.8	31.5	42.6
2.44	1.50	1.34	4.07	36	0.8	387	5.5	23.1	31.2	42.6
3.48	0.52	0.79	4.11	24	1.9	479	5.7	26.3	30.5	42.7
3.15	0.71	1.19	4.49	32	0.9	470	5.5	24.9	31.1	42.7
1.57	3.91	1.08	1.84	27	1.0	478	5.9	18.1	30.7	42.7
2.11	2.14	1.65	2.30	42	0.3	401	5.7	22.7	32.1	42.7
1.59	3.96	1.17	0.68	23	0.9	475	5.7	17.3	30.8	42.8
3.17	0.71	1.28	3.49	31	0.7	439	5.6	25.4	31.0	42.8
2.64	1.24	1.72	3.47	49	0.4	484	5.6	24.3	31.9	42.8

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
3.02	0.84	1.34	4.00	34	0.7	450	5.5	24.8	31.2	42.8
1.87	2.77	1.04	2.91	26	1.5	374	5.7	19.9	30.4	42.8
1.77	3.13	1.65	1.61	44	0.3	451	5.8	21.4	32.8	42.8
2.57	1.34	1.31	4.08	35	0.9	393	5.5	23.5	31.3	42.8
2.89	0.96	1.97	3.53	65	0.2	653	5.7	25.1	32.2	42.8
1.78	3.10	1.30	0.96	25	0.7	388	5.6	19.1	31.1	42.8
2.01	2.40	0.76	2.22	17	4.7	356	5.6	18.9	29.0	42.8
1.76	3.16	1.59	2.35	47	0.3	445	5.9	21.4	32.5	42.8
2.25	1.87	1.89	3.25	65	0.3	510	5.8	23.8	32.6	42.9
2.27	1.85	1.30	3.33	32	0.9	358	5.6	22.5	31.2	42.9
3.42	0.58	0.60	4.97	24	3.1	524	5.7	26.4	31.3	42.9
2.44	1.54	1.28	3.30	30	0.9	355	5.5	23.1	31.1	42.9
1.86	2.84	0.63	2.00	15	6.8	413	5.6	17.2	28.4	42.9
2.87	0.99	1.33	4.15	35	0.8	436	5.5	24.4	31.3	42.9
2.88	0.98	1.55	3.80	41	0.5	476	5.6	24.7	31.6	42.9
2.57	1.36	0.96	4.30	27	2.1	373	5.5	23.3	31.0	43.0
3.29	0.67	1.61	3.86	44	0.3	597	5.7	25.4	31.4	43.0
1.51	4.45	0.75	1.33	19	2.9	614	5.9	15.7	29.7	43.0
2.14	2.14	1.05	2.94	24	1.7	341	5.6	21.2	30.5	43.0
1.83	2.97	1.73	2.86	62	0.3	474	5.9	22.3	32.9	43.0
1.86	2.85	0.64	1.85	15	7.0	414	5.6	17.1	28.4	43.0
2.10	2.23	1.84	1.79	50	0.2	455	5.7	23.5	33.2	43.0
2.52	1.45	1.78	3.98	58	0.4	520	5.6	23.9	32.2	43.0
3.36	0.64	1.34	4.20	36	0.5	541	5.6	25.5	31.2	43.0
3.01	0.88	1.57	3.57	41	0.4	501	5.6	25.2	31.7	43.1
3.26	0.70	0.92	4.38	26	1.6	460	5.6	25.6	31.1	43.1
1.52	4.43	0.62	0.79	15	5.5	656	5.8	14.0	28.7	43.1
2.50	1.49	1.82	3.60	58	0.3	519	5.7	24.2	32.4	43.1
1.68	3.53	1.55	1.50	40	0.3	470	5.9	20.8	32.8	43.1
1.86	2.89	0.68	2.44	18	5.0	418	5.7	18.2	29.2	43.1
1.62	3.84	1.14	1.79	28	0.9	472	5.9	18.8	31.3	43.2
2.64	1.30	1.26	4.43	35	1.0	410	5.5	23.7	31.5	43.2
1.70	3.50	1.17	1.40	25	1.0	432	5.7	18.7	31.1	43.2
2.10	2.26	1.04	3.09	25	1.6	353	5.6	21.2	30.7	43.2
2.05	2.39	1.32	2.65	31	0.8	365	5.6	21.6	31.5	43.2
3.26	0.72	1.25	4.34	34	0.7	504	5.6	25.3	31.4	43.2
2.66	1.29	0.92	4.31	26	2.3	383	5.5	23.7	31.2	43.2
2.74	1.19	1.31	3.56	32	0.8	395	5.5	24.3	31.5	43.2
2.50	1.52	0.62	3.28	18	6.9	362	5.6	22.2	29.9	43.2
3.33	0.68	1.00	4.55	29	1.2	491	5.6	25.7	31.3	43.3
3.00	0.92	1.66	4.01	47	0.4	558	5.6	24.9	31.9	43.3
1.60	4.01	1.49	1.82	44	0.4	515	6.0	20.7	33.2	43.3
1.54	4.34	1.51	1.36	44	0.3	565	6.1	20.5	33.7	43.3
2.17	2.13	1.19	2.59	26	1.1	343	5.5	21.7	31.1	43.3
2.94	0.99	1.08	4.61	30	1.3	434	5.5	24.6	31.5	43.3
1.62	3.90	1.92	1.56	80	0.2	617	6.2	22.9	35.1	43.3
2.45	1.61	1.49	4.30	45	0.6	437	5.5	23.4	32.0	43.4
1.74	3.39	0.97	1.65	21	1.8	429	5.7	18.1	30.3	43.4
1.78	3.22	1.58	1.05	36	0.3	446	5.7	21.1	33.0	43.4
1.57	4.22	1.12	0.70	23	1.0	536	5.8	17.4	31.5	43.4
2.22	2.05	0.58	3.56	18	6.9	397	5.7	21.0	30.0	43.4
2.66	1.31	1.52	4.05	43	0.6	457	5.5	24.1	32.0	43.4
2.25	1.99	1.82	2.61	55	0.3	478	5.7	24.0	33.1	43.4
1.94	2.74	0.94	3.03	24	2.0	385	5.7	20.2	30.6	43.4
1.63	3.88	1.53	1.23	39	0.3	510	5.9	20.6	33.3	43.4

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Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
2.51	1.53	1.30	3.18	31	0.9	367	5.5	23.6	31.6	43.5
2.23	2.03	0.92	3.72	25	2.3	365	5.6	21.9	30.9	43.5
2.91	1.03	1.30	4.55	36	0.8	462	5.5	24.5	31.8	43.5
2.35	1.80	1.36	3.76	37	0.8	391	5.6	23.1	31.8	43.5
1.97	2.67	0.66	2.21	16	6.2	402	5.6	18.5	29.2	43.5
1.67	3.72	1.02	1.45	22	1.4	467	5.8	18.0	30.8	43.5
1.73	3.48	1.60	2.07	48	0.3	482	5.9	21.6	33.3	43.5
1.93	2.78	1.79	2.66	61	0.3	488	5.9	23.0	33.4	43.5
3.22	0.79	1.45	4.13	39	0.5	543	5.6	25.3	31.7	43.5
2.62	1.39	1.99	3.42	70	0.2	620	5.8	24.9	33.1	43.5
2.33	1.86	0.54	3.93	19	7.6	410	5.7	21.9	30.4	43.6
1.58	4.22	0.94	0.93	20	1.8	550	5.8	16.7	30.7	43.6
2.02	2.54	1.88	1.67	56	0.2	494	5.8	23.7	34.0	43.6
1.60	4.11	1.43	0.63	32	0.4	534	5.9	19.5	33.2	43.6
2.27	1.97	1.25	3.23	31	1.0	364	5.6	22.6	31.6	43.6
1.54	4.50	1.84	1.18	75	0.2	676	6.3	22.6	35.8	43.6
1.88	2.94	1.19	1.58	24	1.0	381	5.6	19.8	31.2	43.6
2.99	0.99	0.51	3.95	19	7.2	429	5.7	25.0	30.9	43.7
2.42	1.73	0.98	4.25	28	1.9	379	5.5	23.0	31.5	43.7
2.78	1.21	0.90	3.36	22	2.5	362	5.5	24.1	31.0	43.7
2.77	1.23	0.59	4.04	20	6.1	407	5.6	24.1	31.0	43.7
1.56	4.40	1.59	1.24	49	0.3	594	6.1	21.2	34.5	43.7
2.00	2.64	1.21	2.45	28	1.0	374	5.6	21.1	31.6	43.7
3.27	0.79	0.89	4.06	25	1.7	456	5.6	25.9	31.4	43.8
2.04	2.55	1.49	2.91	41	0.5	411	5.7	22.4	32.5	43.8
1.71	3.66	1.19	0.62	22	1.0	459	5.6	18.3	31.6	43.8
1.80	3.27	1.86	2.68	78	0.2	546	6.0	23.2	34.2	43.8
1.93	2.84	1.88	2.12	64	0.2	523	5.9	23.6	34.2	43.8
3.23	0.83	1.41	3.97	37	0.5	529	5.6	25.6	31.9	43.8
2.44	1.72	1.23	2.51	26	1.0	344	5.5	23.1	31.6	43.9
2.49	1.63	1.87	2.61	55	0.2	516	5.7	25.0	33.5	43.9
2.48	1.65	1.46	3.53	39	0.6	414	5.6	23.9	32.3	43.9
2.27	2.04	1.41	3.38	38	0.7	396	5.6	23.1	32.2	43.9
1.95	2.82	1.81	1.66	52	0.2	489	5.8	23.3	34.1	43.9
2.95	1.07	1.22	3.87	31	0.9	430	5.5	25.0	31.9	43.9
1.70	3.72	0.56	1.28	14	8.0	551	5.7	15.6	28.8	43.9
1.78	3.39	0.70	1.67	17	4.8	473	5.7	17.2	29.6	43.9
3.27	0.82	1.90	3.32	59	0.2	725	5.8	26.1	32.6	43.9
2.92	1.10	1.36	4.34	37	0.7	473	5.5	24.7	32.1	43.9
2.21	2.18	0.92	2.64	21	2.5	352	5.5	21.3	30.8	44.0
2.11	2.39	0.93	2.34	21	2.4	358	5.6	20.6	30.6	44.0
2.77	1.27	0.62	3.75	19	5.7	398	5.6	24.1	31.0	44.0
2.08	2.47	1.67	3.09	53	0.4	457	5.8	23.2	33.1	44.0
2.67	1.40	1.90	3.73	64	0.3	603	5.7	24.8	33.1	44.0
1.66	3.93	0.73	0.70	15	4.6	545	5.7	15.5	29.5	44.0
2.96	1.08	1.34	3.47	33	0.7	437	5.5	25.2	32.0	44.0
1.75	3.53	1.71	2.34	61	0.3	521	6.0	22.6	34.2	44.1
2.34	1.92	0.60	3.23	18	7.1	389	5.6	21.6	30.3	44.1
2.21	2.19	1.84	2.88	60	0.3	505	5.8	24.1	33.6	44.1
1.50	5.17	1.90	0.56	86	0.1	834	6.4	23.5	37.8	44.1
2.65	1.43	1.37	3.22	33	0.7	401	5.5	24.4	32.2	44.1
2.20	2.23	0.91	3.39	24	2.4	373	5.6	21.7	31.2	44.1
1.57	4.52	1.11	1.30	28	0.9	582	6.0	18.7	32.5	44.1
3.15	0.93	1.01	4.66	29	1.3	475	5.6	25.4	32.0	44.1
1.97	2.32	0.68	1.87	16	5.8	413	5.6	18.4	29.6	44.1

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
2.15	2.35	1.04	1.82	21	1.9	344	5.5	20.8	30.9	44.1
1.61	4.26	0.89	1.31	21	1.9	565	5.9	17.4	31.2	44.1
1.55	4.70	0.71	0.79	17	3.6	691	5.9	15.6	30.4	44.2
1.66	4.00	1.91	0.99	70	0.1	643	6.1	23.2	36.1	44.2
2.31	2.01	0.55	3.78	19	7.2	418	5.7	21.9	30.8	44.2
2.25	2.14	1.21	2.92	29	1.1	366	5.6	22.5	31.9	44.2
2.33	1.98	0.95	3.43	24	2.1	367	5.6	22.5	31.4	44.2
2.11	2.44	0.78	3.44	22	3.3	397	5.7	21.2	31.0	44.2
2.49	1.70	1.37	4.29	40	0.8	429	5.5	23.7	32.4	44.2
2.77	1.32	1.67	3.13	45	0.4	494	5.6	25.2	32.9	44.2
2.11	2.46	1.73	1.78	45	0.3	453	5.7	23.6	33.8	44.2
2.62	1.52	1.62	2.88	42	0.4	451	5.6	24.8	32.9	44.3
1.95	2.92	0.69	2.22	17	5.1	429	5.7	18.8	30.0	44.3
2.96	1.12	0.62	3.44	19	5.4	402	5.6	24.8	31.0	44.3
2.06	2.59	1.05	3.26	28	1.5	387	5.7	21.6	31.7	44.3
1.94	2.94	1.49	1.69	35	0.4	425	5.7	22.0	33.1	44.3
2.99	1.10	1.44	3.88	38	0.5	491	5.6	25.3	32.4	44.3
1.65	4.11	1.72	0.69	49	0.2	602	6.0	22.0	35.4	44.3
1.90	3.07	1.18	2.19	28	1.0	408	5.7	20.7	32.0	44.3
1.81	3.42	1.76	1.79	57	0.2	531	6.0	23.0	34.7	44.4
1.98	2.85	1.90	2.97	79	0.2	554	5.9	23.9	34.3	44.4
2.11	2.49	1.01	2.78	24	1.8	375	5.6	21.4	31.4	44.4
1.56	4.83	1.86	0.06	63	0.1	776	6.2	22.9	37.4	44.4
1.82	3.37	1.86	2.40	76	0.2	563	6.0	23.5	34.8	44.4
1.72	3.77	1.97	1.53	84	0.1	645	6.2	23.9	36.1	44.4
2.83	1.27	1.02	3.62	26	1.6	392	5.5	24.7	31.9	44.4
1.52	5.30	0.62	0.53	17	4.4	866	6.0	15.1	30.8	44.4
1.79	3.52	0.78	2.35	21	2.8	480	5.8	18.8	30.9	44.4
2.90	1.21	1.90	3.17	59	0.2	630	5.7	25.9	33.4	44.5
2.34	2.01	1.07	3.95	30	1.5	387	5.6	23.0	32.1	44.5
2.45	1.82	1.57	2.42	38	0.4	416	5.6	24.3	33.1	44.5
1.57	4.74	1.40	0.72	36	0.4	641	6.0	20.3	34.6	44.5
1.69	3.98	1.67	0.81	45	0.2	573	5.9	22.0	35.1	44.6
2.47	1.80	0.72	3.51	20	4.3	386	5.6	22.9	31.3	44.6
2.83	1.30	0.93	3.31	23	2.1	380	5.5	24.6	31.7	44.6
3.38	0.85	0.55	4.17	21	4.1	506	5.8	26.8	31.8	44.6
2.59	1.61	1.62	3.92	49	0.5	495	5.6	24.5	33.0	44.6
1.99	2.85	1.62	2.48	47	0.4	460	5.8	23.0	33.7	44.6
2.02	2.76	1.96	1.78	67	0.2	561	5.9	24.5	35.2	44.6
2.69	1.47	0.52	3.30	17	9.0	405	5.6	23.5	30.8	44.6
2.68	1.49	0.64	2.56	17	6.9	363	5.5	23.1	30.5	44.6
1.97	2.92	1.57	2.86	49	0.4	459	5.8	22.9	33.6	44.6
2.94	1.19	0.99	4.04	27	1.6	424	5.6	25.1	32.2	44.6
3.27	0.92	0.80	3.93	24	2.1	462	5.7	26.2	31.9	44.7
1.65	4.25	1.32	1.71	37	0.5	545	6.0	20.7	33.8	44.7
3.45	0.83	0.55	3.62	20	4.2	492	5.8	26.9	31.4	44.7
2.80	1.35	0.60	4.43	22	5.1	441	5.6	24.7	32.0	44.7
1.58	4.81	1.71	0.87	60	0.2	708	6.2	22.6	36.5	44.7
1.91	3.14	0.94	1.16	18	2.4	415	5.5	18.8	30.9	44.7
3.08	1.08	1.14	3.83	30	1.0	449	5.6	25.6	32.3	44.7
1.74	3.80	1.61	0.67	39	0.3	538	5.8	21.6	34.8	44.7
1.63	4.08	0.99	1.78	25	1.3	527	5.9	19.1	32.2	44.7
1.79	3.61	0.57	1.35	15	8.0	541	5.7	16.5	29.5	44.7
2.03	2.78	1.55	2.90	47	0.4	450	5.8	23.0	33.6	44.8
2.75	1.43	1.08	3.54	27	1.4	393	5.5	24.5	32.2	44.8

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
3.48	0.83	0.82	3.29	23	1.7	474	5.7	26.9	31.5	44.8
1.87	3.30	1.80	0.95	49	0.2	536	5.9	23.3	35.3	44.8
1.98	2.95	1.65	2.65	52	0.3	480	5.8	23.3	34.1	44.8
3.10	1.08	0.62	3.45	19	4.8	428	5.6	25.6	31.4	44.8
2.79	1.39	1.48	4.16	42	0.6	490	5.6	24.8	32.9	44.9
1.54	5.42	0.61	0.08	16	5.3	924	5.9	14.7	31.0	44.9
3.32	0.93	0.91	3.90	26	1.4	478	5.7	26.4	32.1	44.9
1.56	5.22	0.87	0.01	19	2.2	795	5.9	16.3	32.3	45.0
2.99	1.19	1.38	3.23	34	0.6	459	5.6	25.7	32.7	45.0
2.92	1.26	1.70	3.07	47	0.3	543	5.7	25.9	33.4	45.0
3.07	1.13	0.78	3.93	23	2.7	438	5.6	25.7	32.1	45.0
1.67	4.29	1.41	0.08	29	0.5	585	5.8	19.9	34.4	45.0
1.92	3.19	0.67	1.79	16	5.5	465	5.7	18.4	30.3	45.0
2.33	2.13	0.60	2.96	17	6.9	405	5.6	21.7	30.9	45.0
2.21	2.40	1.77	1.94	49	0.3	485	5.7	24.4	34.5	45.1
1.79	3.73	0.91	0.98	19	2.3	495	5.6	18.1	31.4	45.1
2.31	2.20	0.67	1.84	15	7.1	373	5.4	20.6	30.3	45.1
1.97	3.06	0.52	2.03	15	9.7	490	5.7	18.4	29.9	45.1
2.41	2.01	1.73	2.81	50	0.3	493	5.7	24.8	34.0	45.1
1.74	3.96	1.33	1.86	36	0.6	515	5.9	21.3	33.9	45.1
2.36	2.10	1.52	3.21	42	0.5	440	5.6	24.1	33.5	45.1
2.31	2.21	1.90	2.13	58	0.2	537	5.8	25.2	34.9	45.1
2.37	2.08	0.54	2.14	15	11.1	395	5.5	20.9	30.1	45.2
1.61	4.81	1.26	0.32	28	0.6	663	5.9	19.4	34.3	45.2
2.28	2.26	1.43	2.86	37	0.6	415	5.6	23.6	33.3	45.2
3.19	1.06	1.43	3.43	37	0.5	520	5.6	26.2	32.8	45.2
1.92	3.24	0.84	1.37	18	3.2	443	5.6	18.8	31.0	45.2
3.25	1.02	1.28	3.70	33	0.6	509	5.6	26.2	32.6	45.2
2.78	1.47	0.88	3.82	24	2.3	406	5.6	24.7	32.3	45.2
2.47	1.91	0.83	3.78	24	2.8	399	5.6	23.4	32.2	45.2
1.73	4.07	1.79	1.61	67	0.2	622	6.1	23.5	36.2	45.2
2.08	2.77	1.66	1.78	43	0.3	467	5.7	23.6	34.4	45.2
2.39	2.07	0.84	2.17	19	3.5	360	5.5	22.0	31.3	45.3
2.87	1.37	1.04	2.65	24	1.6	377	5.5	25.0	32.1	45.3
2.49	1.89	1.40	3.40	37	0.7	427	5.6	24.3	33.2	45.3
1.83	3.60	1.07	2.18	27	1.2	470	5.8	20.6	32.7	45.3
2.28	2.29	1.57	2.14	38	0.4	432	5.6	24.0	33.9	45.3
1.84	3.57	1.57	0.88	37	0.3	511	5.8	22.1	34.8	45.3
2.99	1.25	0.79	3.80	23	2.7	429	5.6	25.5	32.3	45.3
2.22	2.44	0.79	2.00	18	4.1	383	5.5	20.8	31.1	45.3
1.59	5.15	1.66	0.03	49	0.2	794	6.2	22.4	37.5	45.4
2.93	1.32	1.57	4.09	46	0.5	549	5.6	25.3	33.3	45.4
3.18	1.10	0.97	3.83	27	1.4	460	5.6	26.1	32.5	45.4
3.16	1.12	0.69	4.06	22	3.1	468	5.7	26.2	32.4	45.4
1.79	3.80	1.22	0.29	23	0.9	499	5.6	19.4	33.1	45.4
1.65	4.67	1.14	1.07	29	0.8	625	6.0	19.8	33.9	45.4
1.88	3.45	1.17	2.53	32	0.9	457	5.8	21.4	33.2	45.4
2.00	3.03	0.72	2.64	20	3.9	452	5.7	20.3	31.5	45.4
2.28	2.32	1.17	2.42	26	1.1	380	5.6	22.8	32.6	45.4
3.18	1.11	1.11	3.43	28	1.0	457	5.6	26.2	32.6	45.4
2.10	2.76	0.50	2.24	15	10.5	467	5.7	19.5	30.3	45.5
3.38	0.98	0.74	4.64	26	2.0	533	5.7	26.8	32.9	45.5
1.61	5.08	0.57	0.16	15	7.0	857	5.8	14.7	30.8	45.5
1.84	3.62	0.52	1.15	14	10.3	563	5.7	16.6	29.8	45.5
2.18	2.57	1.62	3.24	52	0.4	480	5.7	23.9	34.2	45.5

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
1.81	3.76	0.52	1.51	15	8.6	586	5.8	17.1	30.2	45.5
1.85	3.58	0.51	1.18	14	10.9	562	5.7	16.6	29.7	45.5
3.38	0.99	0.69	3.04	21	3.0	458	5.7	26.8	31.7	45.5
3.37	0.99	1.31	3.56	34	0.5	544	5.7	26.6	32.8	45.5
1.61	5.14	1.88	0.40	78	0.1	854	6.4	24.3	38.8	45.5
1.75	4.07	1.68	0.27	42	0.2	608	5.9	22.4	36.2	45.5
2.46	1.99	1.33	3.82	37	0.8	429	5.6	24.1	33.3	45.5
1.84	3.62	0.54	1.49	15	8.5	559	5.7	17.3	30.2	45.5
3.27	1.06	0.95	3.09	24	1.5	444	5.6	26.5	32.2	45.5
3.16	1.15	1.90	3.16	59	0.2	716	5.8	26.6	34.0	45.6
2.90	1.39	1.98	2.89	65	0.2	683	5.8	26.5	34.5	45.6
2.11	2.76	1.52	1.50	34	0.4	434	5.6	23.1	34.1	45.6
2.11	2.77	1.52	2.03	38	0.4	445	5.7	23.3	34.1	45.6
2.13	2.70	1.55	2.42	41	0.4	452	5.7	23.6	34.2	45.6
2.74	1.58	0.93	3.70	25	2.0	407	5.6	24.7	32.6	45.6
1.59	5.47	1.54	0.40	48	0.3	823	6.2	22.4	37.5	45.6
3.22	1.11	1.46	2.93	37	0.4	521	5.6	26.7	33.2	45.6
3.18	1.13	1.06	4.19	30	1.1	489	5.6	26.1	32.9	45.6
1.84	3.66	1.09	1.34	24	1.3	480	5.7	20.0	32.8	45.6
2.76	1.56	1.51	3.31	40	0.5	477	5.6	25.4	33.6	45.6
2.01	3.07	0.93	2.11	22	2.1	428	5.7	20.7	32.1	45.6
3.25	1.09	0.80	4.40	26	1.9	498	5.7	26.4	32.9	45.6
2.49	1.96	1.60	3.71	49	0.5	492	5.6	24.7	33.9	45.7
2.97	1.33	0.84	4.34	26	2.2	454	5.6	25.6	32.9	45.7
3.12	1.20	0.65	4.29	23	3.4	480	5.7	26.2	32.8	45.7
2.75	1.59	1.57	2.94	41	0.4	482	5.6	25.6	33.8	45.7
2.48	1.99	0.55	3.94	20	6.3	446	5.7	23.4	32.2	45.7
2.68	1.69	0.79	3.35	21	3.3	399	5.6	24.2	32.2	45.7
2.49	1.97	1.41	2.12	31	0.6	401	5.5	24.4	33.5	45.7
2.74	1.60	0.77	3.47	21	3.3	407	5.6	24.5	32.3	45.7
2.66	1.72	1.17	2.31	25	1.2	375	5.5	24.4	32.7	45.7
2.44	2.06	0.92	1.96	19	2.7	360	5.4	22.5	31.8	45.7
1.91	3.44	1.75	0.69	45	0.2	551	5.8	23.5	36.0	45.7
2.67	1.70	1.44	3.99	41	0.6	476	5.6	24.9	33.6	45.7
3.20	1.14	0.73	4.14	24	2.5	481	5.7	26.4	32.7	45.7
2.18	2.64	1.18	3.21	32	1.0	415	5.7	22.9	33.3	45.8
1.62	5.22	1.63	0.74	57	0.2	783	6.2	23.2	37.7	45.8
1.90	3.47	0.55	1.55	15	8.5	538	5.7	17.9	30.4	45.8
3.25	1.12	1.16	4.37	33	0.8	530	5.6	26.1	33.2	45.8
1.72	4.37	1.52	0.79	40	0.3	615	6.0	22.0	35.8	45.8
2.19	2.60	1.22	2.15	27	1.0	399	5.6	22.7	33.1	45.8
2.92	1.40	0.86	3.99	25	2.2	437	5.6	25.4	32.8	45.8
2.29	2.39	0.83	1.83	18	3.8	381	5.5	21.3	31.5	45.8
1.91	3.45	1.85	1.06	56	0.2	587	5.9	24.2	36.4	45.8
1.93	3.37	1.22	1.55	27	0.9	454	5.7	21.3	33.4	45.8
2.45	2.08	1.76	2.41	50	0.3	511	5.7	25.4	34.8	45.9
2.43	2.11	0.55	2.03	15	10.6	403	5.5	21.4	30.6	45.9
2.38	2.20	0.77	2.07	18	4.4	380	5.5	21.9	31.4	45.9
1.81	3.88	1.55	1.48	44	0.3	550	5.9	22.7	35.4	45.9
2.17	2.69	1.04	2.35	24	1.6	401	5.6	22.0	32.6	45.9
2.06	2.97	1.13	2.80	30	1.1	427	5.7	22.3	33.2	45.9
1.82	3.87	1.12	0.63	22	1.2	514	5.6	19.5	33.1	45.9
1.94	3.37	1.96	1.61	75	0.2	633	6.0	25.0	36.8	45.9
3.24	1.15	1.48	2.97	38	0.4	541	5.7	26.8	33.4	45.9
1.65	4.99	1.30	0.09	30	0.6	717	5.9	20.2	35.5	45.9

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
2.28	2.42	1.43	2.71	37	0.6	431	5.6	23.9	33.9	45.9
1.64	5.10	0.74	0.77	20	2.9	784	6.0	17.5	32.7	45.9
2.39	2.20	1.64	2.05	41	0.3	463	5.6	24.9	34.6	46.0
1.78	4.06	0.91	0.32	18	2.5	560	5.6	17.7	32.0	46.0
2.08	2.93	0.83	2.39	21	2.8	432	5.7	21.0	32.1	46.0
2.90	1.45	1.27	3.52	33	0.8	455	5.6	25.6	33.4	46.0
2.09	2.91	1.15	1.65	24	1.2	411	5.6	21.7	33.0	46.0
2.14	2.78	1.40	2.77	38	0.6	442	5.7	23.4	34.0	46.0
2.90	1.46	0.63	3.87	21	4.5	448	5.6	25.3	32.6	46.0
2.59	1.86	1.63	3.03	45	0.4	493	5.6	25.3	34.3	46.0
3.34	1.09	1.35	3.76	36	0.5	566	5.7	26.6	33.2	46.0
2.02	3.12	1.09	2.75	29	1.2	439	5.7	22.0	33.3	46.0
3.48	1.02	1.16	3.18	30	0.6	528	5.7	27.2	32.8	46.0
1.81	3.95	1.73	2.01	64	0.3	601	6.1	23.9	36.3	46.0
2.34	2.34	1.44	2.91	38	0.6	438	5.6	24.2	34.0	46.1
2.49	2.05	1.26	2.57	29	0.9	398	5.5	24.2	33.4	46.1
2.02	3.14	1.69	2.63	57	0.3	526	5.9	24.1	35.3	46.1
2.26	2.52	1.10	3.23	29	1.3	412	5.6	23.2	33.3	46.1
3.10	1.28	1.67	3.69	48	0.3	620	5.7	26.2	33.9	46.1
2.65	1.80	1.90	2.98	62	0.2	611	5.8	26.0	35.0	46.1
2.31	2.41	1.90	3.34	74	0.3	599	5.8	25.1	35.2	46.1
3.43	1.06	0.52	4.42	22	3.6	563	5.8	27.5	33.1	46.2
2.21	2.65	0.54	3.07	18	7.2	472	5.7	21.4	31.8	46.2
1.65	5.10	1.05	0.74	27	1.0	726	6.0	19.7	34.6	46.2
3.08	1.31	0.79	4.31	25	2.3	476	5.6	26.1	33.2	46.2
2.70	1.74	1.67	2.73	45	0.3	512	5.7	25.9	34.5	46.2
1.87	3.72	1.71	1.83	56	0.3	575	6.0	23.9	36.1	46.2
2.85	1.55	0.79	3.49	22	2.9	422	5.6	25.1	32.7	46.2
1.63	5.55	1.05	0.14	26	1.1	849	6.0	19.3	35.2	46.2
2.44	2.18	0.52	3.26	18	8.1	452	5.7	22.7	31.9	46.2
1.67	5.04	0.90	0.47	21	1.8	746	5.9	18.3	33.6	46.3
3.37	1.11	0.57	3.23	20	4.3	490	5.7	27.0	32.2	46.3
2.43	2.19	1.32	2.50	31	0.7	411	5.6	24.2	33.7	46.3
2.53	2.02	1.03	3.17	26	1.6	402	5.6	24.1	33.1	46.3
2.44	2.19	0.57	3.38	19	6.4	446	5.7	23.0	32.2	46.3
3.31	1.16	1.23	3.64	33	0.6	531	5.7	26.7	33.3	46.3
2.08	3.03	1.74	2.70	60	0.3	540	5.9	24.5	35.5	46.3
3.11	1.32	0.97	3.96	27	1.4	472	5.6	26.2	33.3	46.3
1.90	3.66	0.89	0.74	18	2.8	504	5.6	18.8	32.1	46.4
2.88	1.54	0.73	3.94	23	3.1	447	5.6	25.4	33.1	46.4
3.24	1.21	0.62	4.19	22	3.3	510	5.7	26.8	33.1	46.4
2.51	2.07	1.21	2.85	29	1.0	407	5.6	24.3	33.5	46.4
1.86	3.84	1.49	0.86	35	0.4	545	5.8	22.3	35.5	46.4
2.52	2.06	0.87	1.98	19	3.1	375	5.4	23.0	32.1	46.4
1.68	5.03	0.98	0.36	22	1.5	736	5.9	18.8	34.1	46.4
2.43	2.22	0.69	2.19	17	5.7	402	5.5	22.2	31.7	46.4
2.31	2.47	1.82	3.28	66	0.3	570	5.8	25.1	35.3	46.4
2.37	2.35	1.46	3.20	41	0.6	457	5.7	24.5	34.3	46.4
1.81	4.12	1.04	1.09	23	1.3	556	5.8	19.9	33.6	46.4
2.53	2.04	1.98	2.68	69	0.2	639	5.8	26.2	35.7	46.4
1.82	4.05	1.32	0.46	28	0.6	555	5.7	20.9	34.8	46.4
1.86	3.85	1.05	0.75	21	1.5	520	5.6	19.7	33.2	46.4
2.27	2.58	1.50	2.32	38	0.5	454	5.7	24.2	34.6	46.4
2.91	1.52	1.06	2.84	25	1.3	414	5.5	25.6	33.1	46.4
1.97	3.43	0.50	2.44	17	7.6	557	5.8	19.6	31.6	46.5

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
1.85	3.93	1.89	0.11	55	0.2	675	5.9	24.4	38.0	46.5
2.79	1.67	1.76	2.45	49	0.3	556	5.7	26.5	34.9	46.5
2.57	1.98	1.07	2.43	24	1.5	387	5.5	24.1	33.1	46.5
2.72	1.76	0.98	3.40	25	1.7	415	5.6	24.9	33.2	46.5
2.66	1.84	1.75	2.32	48	0.3	532	5.7	26.2	35.1	46.5
3.39	1.13	0.88	4.55	28	1.3	551	5.7	26.9	33.5	46.5
2.75	1.72	1.37	2.39	32	0.6	430	5.5	25.6	33.9	46.5
2.14	2.90	1.92	1.35	60	0.2	590	5.9	25.5	36.7	46.5
2.29	2.54	1.47	2.05	35	0.5	442	5.6	24.2	34.5	46.5
3.44	1.12	1.58	3.60	44	0.3	680	5.8	26.9	33.7	46.5
3.27	1.22	0.83	3.68	24	1.9	486	5.7	26.8	33.1	46.5
1.98	3.41	1.94	1.67	73	0.2	641	6.0	25.3	37.1	46.6
1.71	4.81	0.82	0.51	19	2.6	717	5.8	18.0	33.1	46.6
2.09	3.07	1.46	2.55	41	0.5	475	5.8	23.7	34.9	46.6
2.30	2.54	1.86	1.55	54	0.2	555	5.8	25.7	36.2	46.6
1.89	3.78	1.03	0.32	19	1.8	513	5.5	19.2	33.0	46.6
2.70	1.83	0.70	3.44	21	3.9	430	5.6	24.6	32.9	46.7
1.84	4.03	1.56	1.96	51	0.3	578	6.0	23.5	36.2	46.7
1.98	3.45	0.78	1.06	17	4.1	494	5.6	19.1	31.9	46.7
3.37	1.18	1.63	3.27	46	0.3	667	5.8	27.1	34.0	46.7
3.02	1.46	1.60	3.05	43	0.3	559	5.7	26.6	34.4	46.7
2.37	2.40	1.66	1.63	41	0.3	481	5.6	25.2	35.4	46.7
1.79	4.35	1.77	1.37	66	0.2	682	6.1	24.5	37.7	46.7
1.68	5.34	1.70	0.03	55	0.2	871	6.2	24.0	39.2	46.7
2.42	2.32	0.97	1.71	20	2.3	383	5.4	22.8	32.7	46.7
3.00	1.48	1.36	3.94	38	0.6	520	5.6	26.0	34.1	46.8
2.05	3.23	0.89	1.07	18	2.9	455	5.5	20.0	32.3	46.8
2.01	3.38	0.95	0.83	19	2.4	467	5.5	19.9	32.6	46.8
2.20	2.81	1.30	2.19	31	0.8	436	5.6	23.4	34.3	46.8
3.49	1.14	0.89	4.38	28	1.1	571	5.7	27.3	33.6	46.8
1.72	4.90	1.52	0.68	44	0.3	720	6.1	22.9	37.4	46.8
2.08	3.16	0.99	1.16	20	2.0	442	5.5	20.8	32.9	46.8
3.33	1.23	0.80	3.34	23	2.0	486	5.7	27.0	33.0	46.8
2.71	1.85	1.60	2.88	43	0.4	509	5.6	25.9	34.8	46.8
1.77	4.50	0.62	1.18	17	5.0	700	5.9	18.0	32.3	46.8
2.00	3.45	1.27	0.79	25	0.8	477	5.6	21.6	34.3	46.8
1.70	5.15	1.11	0.73	29	0.9	743	6.0	20.6	35.5	46.8
3.34	1.23	1.75	3.15	51	0.2	712	5.8	27.2	34.4	46.9
2.27	2.66	0.58	3.29	20	5.7	476	5.7	22.4	32.7	46.9
2.65	1.95	1.18	2.41	27	1.1	405	5.5	24.9	33.7	46.9
1.67	5.76	1.24	0.03	32	0.6	903	6.1	21.4	37.3	46.9
1.72	5.02	1.62	0.58	51	0.3	768	6.1	23.7	38.2	46.9
3.48	1.16	0.53	3.39	20	4.0	536	5.8	27.6	32.7	46.9
2.31	2.01	0.74	2.25	18	4.4	399	5.5	23.5	32.3	46.9
1.69	5.40	0.92	0.53	24	1.5	826	6.0	19.5	34.9	46.9
1.79	4.45	1.18	0.51	26	0.9	618	5.8	20.5	34.9	46.9
3.18	1.36	1.84	3.10	56	0.2	715	5.8	27.1	34.9	46.9
3.27	1.29	1.76	3.35	52	0.2	708	5.8	27.0	34.6	47.0
2.43	2.34	1.78	2.12	51	0.3	540	5.7	25.8	35.8	47.0
1.95	3.68	0.74	1.90	20	3.5	537	5.8	20.1	32.7	47.0
1.80	4.24	1.88	0.16	59	0.2	731	6.0	24.8	38.7	47.0
2.22	2.82	1.92	2.67	74	0.2	620	5.9	25.7	36.5	47.0
1.83	4.27	0.74	1.49	20	3.2	625	5.8	19.3	33.0	47.0
2.38	2.49	2.00	2.74	78	0.2	658	5.9	26.1	36.4	47.0
2.78	1.79	1.12	2.43	25	1.2	409	5.5	25.3	33.3	47.0

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
2.42	2.38	1.26	3.50	35	0.8	446	5.6	24.5	34.4	47.1
2.15	3.02	1.30	2.94	37	0.7	462	5.7	23.7	34.7	47.1
2.08	3.24	0.67	1.69	17	5.4	497	5.6	20.1	32.1	47.1
1.95	3.69	1.27	2.13	35	0.7	509	5.8	22.8	35.0	47.1
2.22	2.84	1.85	1.22	52	0.2	568	5.8	25.6	36.8	47.1
2.01	3.49	1.80	1.07	53	0.2	600	5.9	24.8	37.2	47.1
2.19	2.92	1.48	2.68	42	0.5	483	5.7	24.3	35.2	47.1
1.89	3.99	1.87	0.38	57	0.2	688	6.0	24.9	38.4	47.2
3.50	1.19	0.87	3.65	26	1.2	544	5.8	27.6	33.4	47.2
2.01	3.49	0.97	0.61	19	2.3	485	5.5	20.0	33.0	47.2
1.78	4.63	1.13	0.20	24	1.1	660	5.8	20.0	35.0	47.2
2.70	1.93	1.76	3.14	54	0.3	585	5.7	26.2	35.4	47.2
2.80	1.79	1.07	2.71	25	1.3	419	5.5	25.4	33.7	47.2
2.02	3.49	1.43	0.77	31	0.5	507	5.7	22.8	35.5	47.2
3.00	1.56	1.49	3.94	43	0.5	565	5.6	26.1	34.6	47.2
2.34	2.58	1.18	2.76	30	1.0	432	5.6	24.0	34.3	47.2
2.20	2.92	0.57	1.82	15	8.3	484	5.6	20.5	31.7	47.2
3.48	1.21	1.44	3.16	39	0.3	630	5.8	27.6	34.0	47.2
3.30	1.32	0.51	3.51	20	4.9	521	5.8	27.2	33.1	47.3
1.83	4.37	1.87	1.20	75	0.2	737	6.2	25.4	38.7	47.3
2.95	1.63	1.88	3.37	61	0.2	699	5.8	26.7	35.3	47.3
3.47	1.23	1.45	2.99	38	0.3	620	5.8	27.7	34.1	47.3
2.22	2.90	1.11	2.66	28	1.2	444	5.7	23.3	34.2	47.3
1.84	4.32	1.32	1.60	37	0.6	594	5.9	22.7	36.0	47.3
2.71	1.94	1.99	2.79	70	0.2	698	5.9	26.9	36.2	47.4
2.22	2.91	2.00	1.99	76	0.2	660	6.0	26.3	37.4	47.4
1.91	4.00	1.32	1.53	34	0.6	553	5.8	22.6	35.6	47.4
3.38	1.29	0.56	4.42	23	3.1	572	5.8	27.6	34.0	47.4
1.95	3.75	1.32	0.55	27	0.7	527	5.6	22.0	35.3	47.4
1.87	4.20	1.46	0.37	33	0.4	610	5.8	22.5	36.5	47.4
1.83	4.45	0.58	0.30	14	8.2	725	5.7	16.7	31.7	47.4
3.04	1.56	1.77	3.15	52	0.3	652	5.8	26.9	35.2	47.4
2.56	2.19	0.89	3.31	24	2.2	432	5.6	24.5	33.8	47.4
2.96	1.63	1.16	2.56	27	1.0	440	5.5	26.2	33.9	47.4
2.26	2.82	1.80	1.92	54	0.2	566	5.8	25.7	36.6	47.4
3.38	1.30	0.68	3.25	22	2.7	511	5.7	27.4	33.2	47.5
2.14	3.16	1.10	1.80	25	1.3	456	5.6	22.5	34.1	47.5
2.52	2.27	1.53	3.63	47	0.5	512	5.7	25.3	35.2	47.5
3.25	1.39	1.02	2.87	26	1.1	477	5.6	27.0	33.6	47.5
1.74	5.20	1.01	0.37	24	1.3	783	5.9	20.1	35.4	47.5
2.52	2.27	1.88	1.75	55	0.2	589	5.8	26.7	36.6	47.5
2.18	3.06	1.30	1.79	30	0.7	461	5.7	23.5	34.9	47.5
1.98	3.71	0.82	2.24	23	2.4	532	5.8	21.3	33.7	47.5
1.85	4.34	0.89	0.22	18	2.6	633	5.6	18.8	33.5	47.6
3.06	1.56	1.18	2.87	29	0.8	468	5.6	26.6	34.1	47.6
3.01	1.62	1.62	2.53	43	0.3	563	5.7	27.1	35.2	47.6
2.09	3.35	1.13	1.65	26	1.1	475	5.7	22.4	34.4	47.6
1.92	3.99	1.75	0.29	47	0.2	655	5.9	24.4	38.1	47.6
3.47	1.28	1.17	3.07	31	0.6	556	5.7	27.7	33.9	47.6
2.77	1.90	0.92	2.69	23	2.1	422	5.5	25.2	33.6	47.6
2.02	3.59	1.43	0.95	32	0.5	526	5.7	23.2	35.9	47.6
2.22	2.98	1.55	2.84	48	0.4	514	5.8	24.9	35.9	47.7
1.93	4.00	0.90	0.84	19	2.4	569	5.7	19.9	33.6	47.7
1.93	4.01	0.95	0.84	20	2.0	566	5.7	20.2	33.9	47.7
2.96	1.69	0.65	2.39	18	5.2	435	5.5	25.3	32.7	47.7

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
1.77	5.08	0.71	0.13	17	4.1	832	5.8	17.7	33.5	47.7
2.45	2.45	1.07	1.83	23	1.5	412	5.5	23.8	33.9	47.7
1.99	3.73	0.67	0.74	15	6.2	567	5.6	18.7	32.2	47.7
2.55	2.27	1.92	3.08	70	0.3	658	5.8	26.4	36.4	47.7
1.81	4.74	0.62	0.83	17	5.0	765	5.9	18.3	33.1	47.7
2.69	2.04	1.45	2.50	36	0.5	475	5.6	25.9	35.1	47.7
1.84	4.48	0.51	1.07	16	7.9	748	5.9	18.0	32.4	47.7
2.10	3.35	1.78	2.46	65	0.3	602	5.9	25.4	37.0	47.7
1.86	4.39	0.66	0.83	17	5.0	684	5.8	18.5	32.8	47.7
2.21	3.05	1.07	2.23	26	1.4	456	5.7	23.1	34.4	47.8
2.85	1.84	1.60	2.47	41	0.3	534	5.7	26.8	35.5	47.8
2.57	2.25	1.45	2.95	39	0.5	486	5.6	25.6	35.3	47.8
2.90	1.78	1.22	3.28	31	0.8	475	5.6	26.2	34.6	47.8
1.80	4.84	0.63	0.02	15	6.3	807	5.7	17.0	32.7	47.8
2.02	3.65	1.11	0.83	23	1.3	511	5.6	21.5	34.5	47.8
3.31	1.41	1.30	3.19	34	0.5	555	5.7	27.4	34.5	47.8
3.42	1.34	0.89	4.23	28	1.2	569	5.7	27.5	34.3	47.8
2.75	1.97	1.21	2.09	27	0.9	427	5.5	25.6	34.4	47.8
1.84	4.56	0.99	0.01	20	1.8	669	5.6	19.4	34.5	47.8
1.95	3.99	1.25	0.85	28	0.8	560	5.7	22.1	35.6	47.9
2.55	2.30	1.64	2.15	43	0.3	519	5.7	26.1	36.0	47.9
2.21	3.07	0.74	1.59	18	4.4	476	5.6	21.3	32.9	47.9
1.77	5.26	1.02	0.58	26	1.2	794	6.0	20.8	36.0	47.9
1.78	5.08	1.52	0.59	45	0.3	775	6.1	23.8	38.5	47.9
2.98	1.71	1.42	3.42	38	0.5	533	5.6	26.6	35.0	47.9
2.33	2.76	0.71	2.90	21	3.8	472	5.7	23.1	33.6	47.9
2.03	3.66	1.99	1.63	83	0.2	717	6.1	26.4	38.6	47.9
2.15	3.27	1.62	0.78	38	0.3	539	5.7	24.6	36.8	47.9
1.92	4.14	1.48	0.34	34	0.4	615	5.8	23.1	37.0	48.0
2.44	2.54	1.63	2.05	43	0.3	518	5.7	25.8	36.2	48.0
1.76	5.58	0.52	0.01	16	7.3	1045	5.9	17.1	33.5	48.0
2.77	1.99	1.28	2.22	29	0.7	447	5.5	26.0	34.8	48.0
2.61	2.22	0.98	2.41	23	1.8	424	5.5	24.7	34.0	48.0
2.51	2.43	0.63	2.59	18	5.7	462	5.6	23.4	33.2	48.1
2.90	1.83	0.80	2.92	21	2.8	448	5.6	25.7	33.3	48.1
3.02	1.69	0.89	3.04	24	1.9	460	5.6	26.4	34.0	48.1
2.62	2.24	0.63	1.94	16	6.9	439	5.5	23.4	32.6	48.1
2.38	2.69	0.93	2.79	24	2.0	449	5.6	23.8	34.2	48.1
1.93	4.16	0.88	1.59	23	2.0	595	5.8	21.1	34.5	48.1
2.52	2.41	1.74	1.74	47	0.3	551	5.7	26.5	36.6	48.1
1.94	4.14	0.66	1.69	19	4.2	635	5.8	20.2	33.5	48.1
2.89	1.86	0.84	3.44	24	2.2	462	5.6	25.9	34.2	48.1
2.29	2.92	1.56	2.10	42	0.4	516	5.7	25.2	36.3	48.1
2.92	1.81	1.23	3.00	31	0.8	477	5.6	26.4	34.8	48.1
2.62	2.23	1.21	2.73	30	0.9	451	5.6	25.4	34.9	48.2
3.14	1.59	0.81	4.23	26	1.9	520	5.7	26.9	34.6	48.2
3.13	1.61	0.93	3.82	27	1.4	504	5.7	26.8	34.5	48.2
2.98	1.75	1.58	2.99	43	0.4	578	5.7	27.0	35.5	48.2
1.78	5.48	1.90	0.06	80	0.2	1005	6.4	26.7	41.8	48.2
2.02	3.32	1.85	1.92	73	0.2	677	6.1	25.9	38.3	48.2
3.12	1.63	0.71	4.31	25	2.4	527	5.7	26.9	34.7	48.3
2.08	3.39	0.84	2.09	22	2.4	528	5.7	21.9	34.2	48.3
1.97	4.04	1.99	1.65	93	0.2	767	6.2	26.6	39.3	48.3
2.66	2.20	1.92	2.35	63	0.2	663	5.8	27.3	37.0	48.3
1.89	4.46	0.77	0.31	17	3.3	686	5.7	18.8	33.6	48.3

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
2.21	3.16	1.71	1.40	47	0.3	571	5.8	25.6	37.3	46.3
1.92	4.30	0.79	0.73	18	3.3	646	5.7	19.6	33.8	48.3
2.00	3.90	1.45	0.40	32	0.5	581	5.7	23.2	36.8	48.3
2.15	3.35	1.95	2.15	79	0.2	685	6.0	26.5	38.2	48.3
2.60	2.32	0.77	3.23	22	3.0	460	5.6	24.7	34.2	48.3
2.11	3.49	1.84	1.04	56	0.2	644	5.9	25.9	38.3	48.3
2.96	1.80	1.32	3.21	34	0.6	510	5.6	26.7	35.1	48.3
1.86	4.73	1.02	0.75	24	1.3	691	5.9	21.1	35.7	48.4
1.92	4.36	0.87	0.07	18	2.9	653	5.6	19.2	34.0	48.4
2.72	2.13	0.75	2.92	21	3.4	453	5.6	25.0	33.9	48.4
2.21	3.21	1.42	2.70	42	0.5	513	5.8	24.8	36.2	48.4
2.87	1.92	1.62	2.60	43	0.3	563	5.7	27.0	35.9	48.4
1.87	4.64	1.41	0.19	33	0.5	696	5.8	22.9	37.6	48.4
2.40	2.72	0.74	2.84	21	3.4	473	5.7	23.6	34.0	48.4
1.89	4.53	1.87	1.46	81	0.2	775	6.2	26.2	39.6	48.4
2.70	2.17	1.26	1.91	28	0.8	444	5.5	25.7	35.0	48.5
2.17	3.34	1.14	0.96	23	1.2	486	5.5	22.6	34.9	48.5
2.33	2.90	0.51	1.51	14	11.3	511	5.5	21.1	32.2	48.5
1.97	4.09	1.96	0.91	76	0.2	769	6.1	26.5	39.7	48.5
2.77	2.07	1.71	2.04	46	0.3	572	5.7	27.2	36.5	48.5
1.84	5.01	1.67	0.17	50	0.2	821	6.1	24.9	39.7	48.5
2.11	3.55	1.49	0.70	33	0.4	548	5.7	24.1	36.9	48.5
2.97	1.83	1.19	2.98	30	0.8	485	5.6	26.7	35.0	48.5
1.82	5.14	1.24	0.68	33	0.6	765	6.0	22.7	37.6	48.5
2.46	2.62	0.67	2.93	20	4.3	482	5.7	23.8	34.0	48.6
3.01	1.79	0.53	3.64	20	5.1	519	5.7	26.5	34.2	48.6
2.06	3.75	1.46	2.21	44	0.5	563	5.9	24.6	36.9	48.6
2.29	3.02	1.87	1.86	62	0.2	637	5.9	26.6	37.9	48.6
2.64	2.30	0.66	3.30	21	4.1	480	5.7	24.9	34.2	48.6
2.96	1.87	1.56	2.75	42	0.4	568	5.7	27.2	35.9	48.6
1.91	4.54	1.84	0.54	60	0.2	792	6.1	26.0	40.0	48.7
2.97	1.85	1.74	3.17	52	0.3	655	5.8	27.2	36.2	48.7
2.43	2.71	1.31	1.88	30	0.7	467	5.6	25.0	35.6	48.7
2.21	3.28	1.14	2.27	29	1.0	492	5.7	23.8	35.5	48.7
2.06	3.80	0.98	0.25	19	2.1	550	5.5	20.7	34.4	48.7
2.84	2.02	0.54	3.87	21	5.0	518	5.7	26.0	34.6	48.7
2.77	2.11	0.62	3.47	21	4.3	492	5.7	25.5	34.3	48.7
3.33	1.54	1.31	3.39	36	0.5	593	5.7	27.6	35.1	48.7
2.94	1.91	0.56	3.17	19	5.3	499	5.7	26.0	34.0	48.7
1.93	4.43	1.88	0.68	68	0.2	789	6.1	26.3	40.1	48.7
1.82	5.41	0.72	0.56	20	3.0	904	6.0	19.9	35.4	48.8
2.74	2.18	0.94	1.99	21	2.1	432	5.5	25.1	34.2	48.8
2.27	3.11	1.89	0.94	56	0.2	643	5.8	26.7	38.5	48.8
3.47	1.47	1.57	2.98	43	0.2	701	5.8	28.1	35.4	48.8
2.00	4.09	1.40	0.06	29	0.5	611	5.6	23.0	37.1	48.8
2.81	2.07	1.32	2.18	31	0.7	474	5.6	26.5	35.4	48.8
3.23	1.63	0.54	3.81	21	4.0	554	5.8	27.4	34.5	48.8
1.84	5.19	1.88	0.53	79	0.2	926	6.3	26.8	41.4	48.8
2.48	2.64	0.93	1.91	21	2.2	446	5.5	23.9	34.3	48.8
2.48	2.64	1.28	2.26	31	0.8	470	5.6	25.2	35.6	48.8
2.28	3.12	1.39	1.57	33	0.6	501	5.7	24.7	36.3	48.8
2.91	1.95	1.75	2.41	50	0.2	628	5.8	27.6	36.6	48.8
3.41	1.52	1.48	3.03	40	0.3	653	5.8	28.0	35.4	48.9
3.19	1.68	0.51	3.54	20	4.8	544	5.8	27.2	34.3	48.9
2.58	2.46	0.70	3.47	23	3.4	489	5.7	24.9	34.7	48.9

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
2.33	3.01	1.78	2.24	58	0.3	612	5.9	26.4	37.7	48.9
2.44	2.74	1.33	1.90	31	0.7	476	5.6	25.2	35.9	48.9
2.08	3.78	1.75	1.82	60	0.3	649	6.0	25.9	38.4	48.9
2.56	2.51	1.31	2.96	35	0.7	489	5.7	25.7	35.9	48.9
1.86	5.08	1.66	0.09	49	0.3	844	6.1	25.1	40.1	48.9
1.98	4.24	1.12	0.52	24	1.1	615	5.7	21.8	35.9	48.9
1.93	4.59	1.09	0.46	24	1.2	676	5.8	21.6	36.2	49.0
2.08	3.83	1.61	2.12	54	0.3	613	5.9	25.5	37.9	49.0
2.47	2.70	1.45	2.91	41	0.5	517	5.7	25.8	36.4	49.0
2.21	3.37	1.07	1.42	24	1.4	499	5.6	23.1	35.2	49.0
1.99	4.23	1.31	0.12	27	0.7	626	5.7	22.6	36.9	49.0
2.86	2.05	1.56	2.93	43	0.4	568	5.7	27.0	36.2	49.0
2.19	3.43	1.86	1.74	65	0.2	668	6.0	26.6	38.6	49.0
2.64	2.38	0.52	1.95	16	9.7	486	5.6	23.5	33.0	49.0
1.91	4.73	1.06	0.53	24	1.2	703	5.8	21.6	36.3	49.0
2.39	2.90	1.12	2.28	27	1.1	472	5.6	24.5	35.4	49.0
2.65	2.37	1.44	2.87	39	0.5	516	5.7	26.3	36.2	49.0
2.84	2.09	0.97	2.56	24	1.6	458	5.6	26.0	34.8	49.0
2.26	3.23	0.99	2.42	26	1.5	495	5.7	23.8	35.3	49.0
2.85	2.08	0.90	2.44	22	2.1	454	5.6	25.8	34.5	49.1
2.38	2.93	1.08	1.91	25	1.3	470	5.6	24.2	35.3	49.1
3.40	1.57	1.30	2.76	34	0.4	590	5.7	28.2	35.2	49.1
2.17	3.55	0.69	1.88	19	4.2	560	5.7	21.9	34.2	49.1
2.78	2.19	0.62	3.66	22	4.0	509	5.7	25.8	34.8	49.1
2.82	2.13	1.93	3.09	68	0.2	741	5.9	27.4	37.2	49.1
2.76	2.23	1.47	2.21	36	0.5	516	5.6	26.8	36.3	49.2
2.45	2.80	1.41	2.68	39	0.6	512	5.7	25.7	36.5	49.2
3.30	1.64	0.53	4.04	22	3.5	586	5.8	27.9	35.0	49.2
2.23	3.36	1.97	1.51	72	0.2	716	6.0	27.2	39.2	49.2
1.88	5.09	1.11	0.81	29	0.9	763	6.0	22.7	37.4	49.2
1.85	5.57	0.71	0.04	19	3.5	981	5.9	19.5	35.6	49.2
2.47	2.75	1.56	1.37	37	0.4	527	5.6	26.2	37.0	49.2
3.45	1.56	1.09	2.93	29	0.7	571	5.7	28.2	35.0	49.2
2.40	2.92	0.99	1.26	21	2.0	463	5.5	23.5	34.7	49.3
1.90	4.94	1.01	0.80	26	1.3	744	5.9	22.0	36.7	49.3
2.07	3.95	1.82	1.84	69	0.2	701	6.1	26.5	39.1	49.3
2.86	2.11	1.33	2.91	34	0.6	514	5.6	26.8	35.9	49.3
2.03	4.16	1.12	1.32	28	1.0	599	5.8	23.0	36.4	49.3
1.98	4.45	0.63	0.13	15	7.1	740	5.6	18.6	33.5	49.3
2.37	3.01	1.04	2.19	25	1.4	482	5.6	24.3	35.4	49.3
2.38	3.00	1.65	1.94	47	0.3	575	5.8	26.3	37.6	49.3
2.78	2.23	1.13	2.19	26	1.1	463	5.6	26.1	35.4	49.3
2.49	2.74	1.45	3.04	42	0.5	529	5.7	26.0	36.7	49.3
2.74	2.29	1.26	2.16	29	0.8	477	5.6	26.3	35.8	49.4
2.24	3.39	0.70	2.09	20	3.9	543	5.7	22.6	34.4	49.4
2.98	1.98	1.16	2.37	28	0.9	484	5.6	26.9	35.4	49.4
2.60	2.53	1.55	2.83	44	0.4	553	5.7	26.5	36.8	49.4
2.02	4.24	0.70	0.90	18	4.3	667	5.7	20.4	34.3	49.4
2.66	2.43	0.97	2.06	22	1.8	454	5.5	25.1	34.9	49.4
1.95	4.67	0.72	0.77	19	3.6	746	5.8	20.3	34.9	49.4
1.88	5.33	1.26	0.57	34	0.6	823	6.0	23.7	38.7	49.4
2.77	2.26	0.75	2.32	20	3.5	467	5.6	25.3	34.4	49.4
2.53	2.68	1.64	2.81	50	0.4	581	5.8	26.6	37.2	49.4
3.07	1.90	1.27	3.39	34	0.6	547	5.7	27.2	35.9	49.5
2.66	2.45	0.52	2.73	18	7.2	517	5.7	24.6	34.1	49.5

Cement	Fly Ash	Att	Slag	CFR	DL	DS	Li	10 hr	24 hr	100 hr
2.12	3.82	1.63	0.33	39	0.3	635	5.7	25.2	38.6	49.5
2.21	3.52	1.33	0.69	28	0.7	539	5.6	24.1	36.8	49.5
2.22	3.49	1.27	1.13	28	0.8	531	5.6	24.1	36.5	49.5
3.18	1.80	1.45	3.53	41	0.4	623	5.7	27.5	36.1	49.5
2.83	2.20	0.62	2.85	19	4.6	499	5.7	25.7	34.5	49.5
2.52	2.74	1.50	1.50	35	0.4	522	5.6	26.2	37.0	49.6
1.88	5.58	1.15	0.37	31	0.8	890	6.0	23.2	38.7	49.6
1.89	5.41	1.44	0.24	41	0.4	877	6.1	24.8	40.0	49.6
2.02	3.23	0.76	1.90	20	3.5	522	5.6	23.0	34.6	49.6
3.23	1.78	0.54	2.25	18	5.7	519	5.7	27.0	33.8	49.6
2.34	3.18	1.50	1.50	37	0.4	547	5.7	25.7	37.4	49.6
2.60	2.60	1.82	1.93	55	0.2	644	5.8	27.6	38.1	49.6
2.26	3.40	1.34	0.84	29	0.7	531	5.6	24.4	36.8	49.7
2.55	2.69	1.90	1.81	61	0.2	677	5.9	27.7	38.5	49.7
2.91	2.12	0.62	3.50	21	3.9	524	5.7	26.4	35.1	49.7
2.65	2.51	1.55	2.65	43	0.4	559	5.7	26.8	37.0	49.7
2.09	4.05	0.78	1.67	21	2.8	618	5.8	22.2	35.3	49.7
2.96	2.06	0.86	3.43	25	1.8	507	5.7	26.8	35.5	49.7
2.34	3.18	1.55	1.80	42	0.4	563	5.8	26.0	37.6	49.7
3.11	1.90	0.68	3.94	24	2.5	547	5.7	27.3	35.5	49.7
1.95	4.87	1.62	0.98	54	0.3	784	6.1	25.9	40.1	49.7
3.48	1.63	0.62	4.17	25	2.0	625	5.9	28.6	35.5	49.7
2.08	4.09	1.74	1.64	61	0.3	699	6.0	26.5	39.4	49.7
2.23	3.53	1.90	0.81	60	0.2	712	5.9	27.2	39.8	49.7
2.25	3.46	1.70	0.87	45	0.3	623	5.8	26.3	38.7	49.8
2.28	3.38	1.38	1.52	34	0.6	542	5.7	25.2	37.2	49.8
3.31	1.75	1.40	3.54	39	0.4	644	5.7	27.8	36.1	49.8
2.85	2.22	0.68	3.70	23	3.0	521	5.7	26.4	35.5	49.8
2.62	2.60	1.15	1.83	26	1.1	473	5.6	25.6	35.8	49.8
2.97	2.07	1.55	2.71	42	0.4	596	5.7	27.7	36.8	49.8
2.61	2.62	1.60	2.21	43	0.4	569	5.7	26.9	37.4	49.8
1.99	4.65	1.56	0.64	44	0.3	743	6.0	25.3	39.5	49.8
1.91	5.43	1.99	0.54	103	0.1	1058	6.5	28.6	43.2	49.9
1.99	4.67	1.73	0.63	56	0.2	799	6.1	26.4	40.5	49.9
2.96	2.10	1.19	2.96	31	0.8	517	5.6	27.1	36.0	49.9
2.12	3.96	0.63	1.33	17	5.2	643	5.7	21.3	34.5	49.9
1.96	4.86	0.67	0.91	19	3.9	801	5.9	20.8	35.4	49.9
1.98	4.78	1.10	0.61	26	1.1	724	5.8	22.8	37.4	49.9
2.86	2.24	1.20	2.82	31	0.8	507	5.6	26.8	36.1	49.9
3.45	1.68	1.48	3.18	41	0.3	636	5.8	28.3	36.1	49.9
3.21	1.86	1.80	3.12	56	0.2	779	5.9	28.1	37.0	50.0
2.26	3.49	0.92	2.47	26	1.8	538	5.7	24.1	36.0	50.0
3.10	1.96	1.27	3.44	35	0.6	567	5.7	27.5	36.3	50.0
2.18	3.80	1.11	0.86	24	1.2	568	5.6	23.3	36.4	50.0
1.92	5.50	0.52	0.41	17	6.2	1028	6.0	19.7	35.4	50.0
2.56	2.75	1.72	1.56	47	0.3	607	5.8	27.4	38.2	50.0
2.07	3.20	1.83	0.86	52	0.2	660	5.8	27.3	39.3	50.0
0.11	1.96	1.94	2.89	65	0.2	822	5.9	28.3	37.5	50.0
1.93	5.03	1.75	0.46	64	0.2	936	6.3	27.1	41.9	50.0
1.92	5.45	0.95	0.20	24	1.6	895	5.9	22.0	37.6	50.0
2.23	3.63	0.72	1.31	18	4.2	579	5.6	22.1	34.7	50.0
2.30	3.41	1.67	1.88	51	0.3	624	5.9	26.6	38.6	50.1
2.07	4.28	0.72	0.89	18	4.0	681	5.7	21.1	35.0	50.1
2.05	3.28	1.45	1.18	34	0.5	552	5.7	25.7	37.6	50.1
2.57	2.75	1.03	2.16	25	1.5	485	5.6	25.3	35.8	50.1

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Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
2.31	3.40	1.73	2.10	57	0.3	646	5.9	26.9	38.8	50.1
2.73	2.47	0.62	2.25	18	5.4	506	5.6	25.0	34.5	50.1
3.33	1.79	0.78	2.22	21	2.2	526	5.7	27.9	34.7	50.1
2.44	3.06	0.58	0.96	15	9.4	538	5.5	22.0	33.5	50.2
3.38	1.76	0.99	3.45	29	0.9	587	5.8	28.3	35.8	50.2
2.65	2.62	0.98	2.35	24	1.6	486	5.6	25.6	35.8	50.2
2.77	2.42	0.62	2.13	18	5.5	503	5.6	25.1	34.5	50.2
2.23	3.68	0.97	1.00	21	1.9	558	5.6	23.0	35.8	50.2
1.93	5.46	1.61	0.50	55	0.3	922	6.2	26.6	41.5	50.2
2.87	2.27	0.68	2.71	20	3.7	508	5.7	26.1	35.1	50.2
3.02	2.09	0.94	2.81	25	1.5	507	5.6	27.1	35.7	50.2
2.27	3.54	1.77	0.93	50	0.2	669	5.9	26.9	39.4	50.2
2.10	4.20	1.31	1.28	34	0.6	631	5.8	24.6	38.0	50.2
3.33	1.81	1.19	3.68	34	0.6	611	5.7	28.0	36.2	50.2
1.99	4.84	1.11	0.12	24	1.1	755	5.8	22.5	37.6	50.2
2.18	3.88	1.24	0.31	25	0.9	591	5.6	23.6	37.2	50.2
2.56	2.81	1.79	1.86	54	0.2	648	5.8	27.6	38.6	50.2
3.27	1.86	1.44	2.81	38	0.4	630	5.8	28.3	36.5	50.2
2.28	3.51	1.84	1.38	60	0.2	701	6.0	27.4	39.6	50.3
2.79	2.41	1.02	2.80	27	1.3	498	5.6	26.4	36.0	50.3
2.22	3.74	1.88	0.74	59	0.2	736	6.0	27.4	40.3	50.3
2.66	2.63	0.82	1.49	19	3.2	479	5.5	24.7	34.8	50.3
2.67	2.60	0.64	1.60	17	6.0	499	5.5	24.2	34.2	50.3
3.23	1.90	0.91	3.01	26	1.3	541	5.7	27.9	35.6	50.3
2.73	2.50	1.06	2.61	27	1.2	495	5.6	26.3	36.1	50.3
2.06	4.48	1.07	0.85	26	1.2	673	5.8	23.2	37.2	50.3
1.99	4.90	1.15	0.83	30	0.9	745	5.9	23.7	38.2	50.3
2.26	3.59	1.62	1.99	50	0.3	627	5.9	26.5	38.7	50.3
1.99	4.98	1.04	0.83	27	1.1	766	5.9	23.2	37.8	50.3
2.12	4.18	0.85	0.45	19	2.9	649	5.6	21.5	35.5	50.3
2.67	2.62	0.62	3.24	21	4.1	536	5.7	25.6	35.5	50.3
2.77	2.46	1.20	2.75	31	0.8	513	5.6	26.7	36.6	50.3
2.60	2.76	1.66	1.60	44	0.3	597	5.7	27.4	38.2	50.3
2.68	2.60	0.94	2.80	25	1.7	499	5.6	25.9	36.0	50.3
3.38	1.80	0.70	2.53	21	2.4	554	5.7	28.2	34.9	50.3
2.37	3.29	1.45	1.31	35	0.5	560	5.7	25.9	37.8	50.4
2.17	3.95	1.65	0.98	46	0.3	676	5.9	26.3	39.4	50.4
2.81	2.41	1.90	1.60	58	0.2	716	5.8	28.7	38.8	50.4
2.31	3.47	0.83	2.42	24	2.3	553	5.7	24.2	36.0	50.4
1.97	5.25	0.78	0.27	20	2.8	886	5.9	21.2	36.6	50.4
2.22	3.79	0.80	1.83	22	2.7	591	5.7	23.2	35.8	50.4
2.13	4.15	0.71	1.58	20	3.4	659	5.8	22.4	35.6	50.4
2.00	4.95	0.77	0.94	21	2.6	800	5.9	21.9	36.5	50.4
2.00	4.99	1.57	0.65	48	0.3	820	6.1	26.1	40.6	50.5
2.61	2.76	1.73	2.11	51	0.3	637	5.8	27.6	38.4	50.5
3.40	1.81	1.59	2.61	44	0.2	722	5.8	28.9	36.9	50.5
2.95	2.24	1.24	2.68	32	0.7	533	5.7	27.4	36.6	50.5
3.12	2.04	1.13	3.44	32	0.8	562	5.7	27.7	36.4	50.5
2.45	3.13	1.04	1.02	22	1.6	505	5.5	24.3	35.9	50.5
3.11	2.05	1.08	2.51	27	1.0	525	5.6	27.7	36.0	50.5
2.43	3.17	0.54	2.79	20	5.6	583	5.8	24.2	35.3	50.5
3.46	1.78	0.90	2.95	26	1.1	587	5.8	28.6	35.6	50.5
2.02	4.82	0.60	0.83	18	5.2	829	5.9	20.8	35.4	50.5
3.42	1.81	0.85	3.75	27	1.2	609	5.8	28.5	36.1	50.5
2.72	2.59	1.69	2.78	52	0.3	642	5.8	27.6	38.0	50.5

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
2.52	2.98	1.83	1.84	58	0.2	680	5.9	27.8	39.1	50.5
2.28	3.62	0.96	2.37	27	1.5	559	5.8	24.5	36.7	50.6
2.24	3.76	1.37	0.37	29	0.6	598	5.6	24.8	38.0	50.6
3.07	2.11	1.39	3.05	38	0.5	594	5.7	27.9	36.9	50.6
3.05	2.14	0.68	3.15	22	2.9	542	5.7	27.3	35.7	50.6
2.51	3.00	1.39	2.09	36	0.5	547	5.7	26.5	37.6	50.6
2.06	4.61	1.07	0.48	24	1.2	710	5.8	23.0	37.5	50.6
2.11	4.34	1.88	1.51	78	0.2	810	6.2	27.8	41.0	50.6
2.04	4.75	1.58	0.99	49	0.3	774	6.1	26.3	40.4	50.6
2.22	3.88	1.83	1.29	63	0.2	741	6.0	27.5	40.3	50.7
2.14	4.23	1.59	0.46	41	0.3	709	5.9	26.0	39.8	50.7
2.61	2.82	1.63	2.79	50	0.4	620	5.8	27.3	38.2	50.7
2.68	2.68	0.76	1.48	18	3.8	498	5.5	24.8	35.0	50.7
2.27	3.71	1.49	1.64	41	0.4	615	5.8	26.2	38.7	50.8
2.06	4.74	1.85	0.01	60	0.2	896	6.1	27.6	42.2	50.8
3.42	1.86	1.42	2.40	37	0.3	662	5.8	29.0	36.7	50.8
2.59	2.89	1.22	1.62	28	0.8	516	5.6	26.1	37.0	50.8
2.63	2.81	0.60	2.83	20	4.6	554	5.7	25.3	35.7	50.9
2.61	2.88	1.72	2.72	56	0.3	658	5.8	27.6	38.6	50.9
2.85	2.45	0.61	2.12	18	5.3	528	5.6	25.8	35.0	50.9
3.03	2.22	0.99	2.20	24	1.4	515	5.6	27.3	36.1	50.9
2.59	2.92	0.70	1.94	19	4.1	532	5.6	24.7	35.4	50.9
2.03	5.10	0.84	0.69	22	2.2	834	5.9	22.5	37.4	51.0
2.22	3.99	0.51	1.06	16	8.8	702	5.7	21.3	34.6	51.0
2.86	2.45	1.18	3.19	33	0.8	544	5.7	27.2	37.1	51.0
2.20	4.08	1.37	1.11	35	0.5	641	5.8	25.5	38.7	51.0
2.29	3.74	1.73	1.17	52	0.3	697	5.9	27.3	40.0	51.0
3.38	1.92	0.58	2.39	20	3.7	579	5.8	28.2	35.0	51.0
3.47	1.86	0.62	3.33	23	2.3	625	5.9	28.9	35.8	51.0
3.43	1.89	0.66	2.93	22	2.3	600	5.8	28.7	35.6	51.0
2.27	3.82	1.74	1.41	55	0.3	707	6.0	27.4	40.1	51.0
2.32	3.66	1.03	0.52	21	1.7	571	5.5	23.5	36.5	51.0
2.48	3.18	0.70	2.54	21	3.4	560	5.7	24.8	36.0	51.0
2.17	4.22	1.39	1.36	38	0.5	662	5.9	25.8	39.1	51.0
2.65	2.82	1.39	1.26	32	0.5	542	5.6	26.9	37.7	51.0
2.38	3.48	1.97	1.64	75	0.2	788	6.0	28.4	40.6	51.1
3.02	2.26	0.69	3.59	24	2.5	563	5.7	27.5	36.4	51.1
2.04	5.04	0.74	0.79	21	2.9	842	5.9	22.2	36.9	51.1
3.04	2.24	0.88	2.63	24	1.7	530	5.7	27.4	36.1	51.1
2.90	2.42	1.52	1.81	38	0.4	591	5.7	28.1	37.9	51.1
2.58	2.97	0.98	1.65	23	1.7	515	5.6	25.4	36.3	51.1
2.03	5.22	0.71	0.36	19	3.5	909	5.9	21.5	36.8	51.1
2.49	3.18	1.25	1.24	28	0.8	539	5.6	25.8	37.4	51.1
2.20	4.12	1.88	0.16	58	0.2	815	6.0	27.9	41.6	51.1
2.39	3.46	0.61	1.23	16	6.5	599	5.6	22.8	34.9	51.2
2.25	3.92	1.40	1.60	33	0.5	629	5.8	26.1	38.9	51.2
3.41	1.94	1.61	2.63	45	0.2	752	5.9	29.1	37.4	51.2
3.22	2.08	0.95	3.23	28	1.1	573	5.7	28.2	36.5	51.2
2.48	3.24	1.43	1.99	38	0.5	580	5.8	26.7	38.3	51.2
2.12	4.64	0.64	0.81	18	4.7	730	5.8	21.7	36.0	51.3
2.92	2.44	0.75	3.20	24	2.4	548	5.7	27.1	36.5	51.3
2.21	4.13	1.37	0.52	32	0.6	662	5.7	25.3	39.0	51.3
2.46	3.32	0.80	1.48	20	3.1	556	5.6	24.2	35.9	51.3
2.43	3.41	0.93	1.49	22	2.0	554	5.6	24.6	36.5	51.3
2.36	3.61	1.18	2.16	32	0.8	576	5.8	25.8	37.9	51.3

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
2.75	2.72	1.19	2.77	32	0.8	543	5.7	27.1	37.4	51.3
2.06	5.14	1.90	0.33	75	0.2	1001	6.3	28.7	43.4	51.4
2.22	4.14	0.52	0.91	16	8.6	735	5.7	21.4	35.0	51.4
3.21	2.13	0.78	3.80	26	1.6	594	5.8	28.2	36.8	51.4
2.17	4.40	0.63	0.46	16	6.0	756	5.7	21.2	35.5	51.4
3.48	1.94	1.37	2.18	36	0.3	671	5.8	29.4	37.0	51.4
2.21	4.20	1.21	0.45	27	0.9	660	5.7	24.5	38.3	51.4
2.04	5.48	0.65	0.47	19	3.8	993	6.0	21.9	37.3	51.5
2.82	2.63	1.79	2.68	58	0.3	723	5.9	28.4	38.9	51.5
3.05	2.59	1.69	0.68	28	0.3	784	6.1	19.2	34.0	42.8
2.47	3.35	1.30	0.68	28	0.7	565	5.6	25.8	38.0	51.5
2.74	2.76	0.76	1.34	18	3.7	521	5.5	25.2	35.5	51.5
2.47	3.34	1.70	0.88	45	0.3	668	5.8	27.8	39.9	51.5
2.73	2.79	1.52	1.34	37	0.4	590	5.7	27.8	38.5	51.5
2.20	4.32	1.13	1.53	30	0.9	661	5.8	25.1	38.5	51.5
2.76	2.75	1.55	2.78	46	0.4	629	5.8	27.8	38.5	51.6
2.73	2.81	1.46	2.52	40	0.5	596	5.7	27.6	38.3	51.6
3.27	2.12	1.83	2.48	57	0.2	836	5.9	29.4	38.5	51.6
3.08	2.31	1.11	2.68	29	0.9	563	5.7	28.0	37.1	51.6
2.37	3.69	0.95	0.78	21	2.0	591	5.6	24.0	36.7	51.6
2.87	2.59	1.32	2.67	35	0.6	575	5.7	27.8	37.8	51.6
3.10	2.30	0.73	3.14	23	2.2	571	5.7	27.8	36.6	51.6
2.52	3.28	1.70	1.11	46	0.3	669	5.8	28.0	39.8	51.7
2.25	4.15	1.52	1.35	44	0.4	695	5.9	26.9	40.0	51.7
2.50	3.32	1.05	1.21	24	1.4	552	5.6	25.3	37.1	51.7
3.29	2.12	1.18	3.22	33	0.6	625	5.8	28.6	37.2	51.7
3.15	2.25	0.65	3.08	22	2.8	584	5.8	28.0	36.4	51.7
3.23	2.17	0.72	3.03	23	2.1	585	5.8	28.3	36.4	51.7
2.34	3.79	1.71	0.78	47	0.3	715	5.9	27.6	40.5	51.7
2.45	3.46	0.97	1.42	23	1.7	567	5.6	25.0	37.0	51.7
2.65	3.00	0.74	2.42	22	2.9	557	5.7	25.8	36.5	51.7
2.06	5.44	1.99	0.00	89	0.1	1143	6.4	29.8	44.9	51.7
2.76	2.79	1.47	2.40	40	0.4	604	5.7	27.8	38.5	51.7
3.03	2.39	1.11	3.06	31	0.9	570	5.7	27.9	37.4	51.7
3.04	2.38	0.96	3.08	27	1.2	562	5.7	27.8	37.1	51.7
2.06	5.52	1.38	0.24	39	0.5	940	6.1	26.3	41.5	51.8
2.18	4.52	1.35	1.27	38	0.5	716	5.9	26.2	39.9	51.8
2.25	4.20	0.56	0.19	14	9.5	750	5.5	20.8	35.0	51.8
2.56	3.21	0.96	2.35	26	1.5	555	5.7	26.1	37.3	51.8
2.97	2.49	0.83	1.79	21	2.4	531	5.6	26.9	36.2	51.8
2.95	2.52	1.30	2.69	35	0.6	585	5.7	28.0	37.9	51.8
2.62	3.08	0.72	2.32	21	3.2	567	5.7	25.6	36.5	51.8
2.61	3.11	0.99	2.75	28	1.3	555	5.7	26.5	37.6	51.8
2.91	2.57	1.16	1.73	27	0.9	542	5.6	27.5	37.3	51.8
3.03	2.43	0.99	3.54	30	1.1	576	5.7	27.9	37.5	51.9
2.48	3.44	1.74	1.42	52	0.3	702	5.9	28.1	40.2	51.9
2.63	3.07	1.90	0.98	59	0.2	761	5.9	29.2	40.7	51.9
3.05	2.40	1.75	2.65	53	0.2	751	5.9	28.9	38.8	51.9
3.08	2.37	1.01	2.88	28	1.1	568	5.7	28.1	37.2	51.9
2.17	4.61	1.88	0.36	66	0.2	911	6.1	28.6	42.8	51.9
2.35	3.35	0.69	0.19	15	6.1	654	5.4	22.0	35.4	51.9
3.33	2.13	1.60	2.84	46	0.2	755	5.9	29.1	38.1	51.9
2.68	2.98	1.23	1.46	23	0.8	552	5.6	26.0	37.3	51.9
2.60	3.17	1.92	1.79	67	0.2	781	6.0	29.0	40.5	51.9
2.23	4.32	0.96	0.78	20	1.7	687	5.7	24.0	37.7	51.9

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
3.21	2.24	1.38	2.86	38	0.4	649	5.8	28.7	37.8	51.9
2.34	3.07	1.27	1.39	32	0.7	626	5.8	26.1	38.8	51.9
3.26	2.20	0.64	3.70	24	2.3	625	5.8	28.6	37.0	51.9
2.25	4.24	0.81	0.15	18	3.5	703	5.5	22.4	36.5	52.0
3.07	2.40	1.50	1.69	38	0.3	633	5.7	28.9	38.3	52.0
2.67	3.01	1.06	1.87	26	1.2	546	5.6	26.5	37.4	52.0
2.66	3.05	1.46	1.21	35	0.4	599	5.7	27.6	38.9	52.0
2.85	2.72	0.72	2.43	21	3.0	560	5.7	26.7	36.5	52.0
3.19	2.28	0.99	2.70	27	1.0	581	5.7	28.4	37.1	52.1
2.54	3.34	1.06	2.35	29	1.1	570	5.7	26.4	37.9	52.1
2.68	3.02	0.67	2.19	20	3.9	576	5.7	25.7	36.4	52.1
2.59	3.21	1.53	1.54	40	0.4	628	5.8	27.8	39.3	52.1
2.20	4.56	1.15	0.71	28	0.9	725	5.8	25.0	39.1	52.1
2.38	3.81	1.74	1.38	55	0.3	738	6.0	28.2	40.8	52.1
2.34	3.96	0.61	1.27	18	5.5	690	5.7	23.2	36.1	52.1
3.18	2.30	0.83	3.31	26	1.5	595	5.8	28.4	37.2	52.1
2.41	3.73	1.41	0.38	31	0.5	639	5.6	26.4	39.3	52.1
3.04	2.47	1.18	2.59	31	0.7	582	5.7	28.2	37.7	52.2
2.77	2.87	1.05	1.76	25	1.2	545	5.6	26.9	37.4	52.2
3.02	2.50	1.32	3.09	37	0.5	617	5.7	28.3	38.2	52.2
2.60	3.23	0.68	1.88	19	4.0	590	5.7	25.2	36.4	52.2
2.98	2.55	0.63	2.49	20	3.8	578	5.7	27.1	36.4	52.2
2.84	2.76	0.78	1.42	19	3.2	543	5.5	26.1	36.2	52.2
2.83	2.78	1.27	2.11	32	0.6	574	5.7	27.8	38.1	52.2
2.16	4.88	1.46	1.11	45	0.4	805	6.0	27.1	41.2	52.2
2.78	2.87	1.14	2.07	28	0.9	559	5.7	27.3	37.8	52.2
2.99	3.83	1.59	1.49	46	0.3	695	5.9	27.7	40.4	52.3
2.59	3.28	1.87	0.72	55	0.2	764	5.9	29.2	41.1	52.3
2.75	2.95	0.87	1.35	21	2.4	547	5.5	26.0	36.7	52.3
3.02	2.53	1.23	3.12	35	0.6	605	5.7	28.3	38.1	52.3
2.56	3.35	1.94	1.58	69	0.2	811	6.0	29.2	41.2	52.3
2.12	5.37	1.81	0.25	68	0.2	1044	6.3	29.2	44.1	52.3
2.33	4.10	1.45	0.88	37	0.4	697	5.8	26.9	40.2	52.4
2.73	2.92	0.69	2.50	21	3.1	581	5.7	26.6	36.9	52.4
2.62	3.24	0.69	2.55	22	3.2	600	5.8	26.0	37.1	52.4
2.15	5.16	1.12	0.31	31	0.9	841	6.0	25.6	40.2	52.4
3.34	2.23	0.53	2.39	19	4.1	630	5.8	28.5	36.1	52.4
2.78	2.94	0.80	1.36	19	3.0	557	5.6	26.0	36.5	52.5
2.20	4.80	1.83	0.04	60	0.2	947	6.1	28.8	43.4	52.5
3.26	2.30	1.07	2.34	31	0.8	629	5.8	28.8	37.8	52.5
2.25	2.67	1.82	2.28	56	0.2	785	5.9	29.3	39.8	52.5
3.46	2.16	0.98	2.11	26	0.9	626	5.8	29.4	36.9	52.5
2.23	4.39	1.00	1.39	27	1.3	698	5.8	25.3	38.7	52.5
2.46	3.68	1.62	1.42	47	0.3	700	5.9	28.1	40.5	52.5
2.87	2.73	0.77	1.77	20	2.9	563	5.6	26.7	36.6	52.5
2.68	3.14	1.77	1.15	31	0.2	728	5.8	29.1	40.6	52.5
2.85	2.33	1.58	2.06	40	0.3	666	5.8	28.7	39.4	52.6
2.41	3.36	0.71	1.49	20	3.5	659	5.7	24.5	37.1	52.6
2.71	3.11	1.68	2.00	50	0.3	699	5.9	28.7	40.0	52.6
2.94	2.71	1.87	1.60	58	0.2	797	5.9	29.8	40.3	52.6
2.34	4.15	1.12	0.44	25	1.1	677	5.6	25.1	38.7	52.6
3.02	2.60	0.64	3.25	20	2.8	609	5.8	27.9	37.4	52.6
2.42	3.04	1.33	1.89	37	0.6	645	5.8	27.1	39.6	52.6
2.09	3.97	0.37	0.50	15	3.1	717	5.6	22.5	35.3	52.6
2.28	4.02	1.40	0.60	37	0.4	703	5.8	27.2	40.4	52.7

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
2.67	3.19	1.52	1.78	41	0.4	648	5.8	28.2	39.7	52.7
2.60	3.36	0.70	1.45	19	4.0	608	5.6	25.1	36.6	52.7
2.83	2.90	1.28	1.89	32	0.6	592	5.7	28.0	38.6	52.7
2.80	2.96	1.43	1.88	37	0.4	625	5.7	28.3	39.2	52.7
2.66	3.25	1.48	2.34	43	0.4	645	5.8	28.1	39.6	52.7
2.26	4.55	0.66	1.27	20	3.7	787	5.8	23.8	37.6	52.7
2.88	2.84	1.13	2.27	29	0.9	581	5.7	27.9	38.2	52.8
2.62	3.35	0.99	1.04	22	1.6	583	5.6	25.9	37.7	52.8
2.23	4.79	1.51	0.83	44	0.4	825	6.0	27.6	41.8	52.8
2.81	2.96	0.86	2.76	25	1.7	584	5.7	27.3	37.8	52.8
2.24	4.75	1.33	0.26	32	0.6	799	5.8	26.3	40.7	52.8
3.40	2.27	0.63	1.74	20	3.2	619	5.7	28.7	36.1	52.8
3.12	2.53	1.07	2.10	27	0.9	592	5.7	28.6	37.8	52.9
2.58	3.47	1.50	1.84	42	0.4	661	5.8	28.1	40.0	52.9
2.16	5.47	1.89	0.18	77	0.2	1127	6.4	30.2	45.2	52.9
2.30	4.48	1.11	0.82	27	1.0	729	5.8	25.6	39.5	52.9
2.79	3.04	1.43	1.46	35	0.5	627	5.7	28.3	39.3	52.9
2.64	3.34	1.98	1.57	73	0.2	868	6.1	29.9	41.8	52.9
2.21	5.07	1.55	0.67	47	0.3	891	6.1	28.1	42.5	53.0
2.45	3.88	0.58	0.47	15	8.0	708	5.5	22.9	36.0	53.0
2.51	3.69	1.24	1.15	29	0.8	632	5.7	26.8	39.2	53.0
2.96	2.77	0.60	1.26	17	5.7	592	5.6	26.3	36.0	53.0
2.72	3.18	0.78	1.71	21	2.8	594	5.7	26.3	37.2	53.0
2.51	3.71	1.06	1.23	25	1.2	625	5.7	26.1	38.5	53.0
2.24	4.87	1.64	0.97	55	0.3	877	6.1	28.6	42.7	53.0
3.24	2.44	0.90	3.35	28	1.1	631	5.8	28.9	38.0	53.0
2.93	2.83	1.70	1.81	49	0.2	738	5.9	29.5	40.1	53.1
2.47	3.86	0.86	0.63	20	2.7	655	5.6	24.6	37.5	53.1
2.39	4.13	1.95	0.38	68	0.2	919	6.1	29.8	43.3	53.1
2.54	3.64	0.51	1.75	18	6.7	692	5.8	24.8	36.7	53.1
2.72	3.21	0.67	2.70	22	3.0	621	5.8	26.8	37.7	53.1
2.50	3.76	0.75	2.03	22	2.7	653	5.8	25.7	37.9	53.1
2.71	3.23	0.74	0.86	18	4.1	599	5.5	25.3	36.6	53.1
2.47	3.88	1.78	1.24	57	0.2	798	6.0	29.1	41.9	53.1
2.31	4.52	1.50	0.61	40	0.4	794	5.9	27.7	41.6	53.2
2.27	4.78	1.48	1.02	44	0.4	820	6.0	27.9	41.9	53.2
2.73	3.23	1.40	1.55	35	0.5	638	5.7	28.2	39.6	53.2
2.77	3.15	1.75	1.98	55	0.2	759	5.9	29.3	40.7	53.2
2.78	3.14	1.52	0.93	37	0.4	661	5.7	28.7	40.0	53.2
3.40	2.35	0.80	2.83	25	1.4	653	5.8	29.4	37.6	53.2
2.30	4.60	1.51	0.91	43	0.4	803	6.0	27.9	41.8	53.2
2.63	3.47	1.35	0.66	55	0.2	808	5.9	29.7	41.9	53.2
2.22	5.24	1.64	0.02	49	0.3	988	6.1	28.6	43.6	53.2
3.49	2.30	0.83	2.16	24	1.3	653	5.8	29.6	37.2	53.3
2.89	2.95	0.56	1.69	18	5.7	623	5.7	26.4	36.5	53.3
2.57	3.61	1.78	1.75	59	0.2	782	6.0	29.2	41.5	53.3
2.25	4.86	1.23	0.93	34	0.7	819	6.0	26.9	41.1	53.3
3.20	2.53	1.15	1.54	28	0.7	614	5.7	29.1	38.1	53.3
2.89	2.96	1.18	2.59	32	0.7	613	5.7	28.3	39.0	53.3
2.85	3.03	1.66	1.00	43	0.3	714	5.8	29.4	40.5	53.3
3.48	2.32	0.65	1.37	21	2.5	655	5.8	29.3	36.6	53.3
2.48	3.90	1.35	0.64	58	0.2	846	6.0	29.6	42.6	53.3
2.45	4.01	1.13	1.20	28	1.0	670	5.8	26.5	39.4	53.4
3.07	2.71	1.38	1.86	35	0.4	655	5.7	29.2	39.2	53.4
2.36	4.39	1.46	0.60	37	0.4	770	5.9	27.6	41.0	53.4

E-35

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
2.53	3.79	0.71	0.39	17	4.9	675	5.5	24.0	36.8	53.4
2.52	3.82	0.93	2.10	27	1.5	646	5.8	26.6	38.9	53.4
2.58	3.63	1.69	1.12	48	0.3	752	5.9	29.0	41.4	53.4
2.78	3.17	0.83	2.00	23	2.1	604	5.7	27.0	37.9	53.4
3.26	2.51	1.23	2.79	34	0.5	668	5.8	29.3	38.7	53.4
3.25	2.51	1.14	2.18	30	0.7	638	5.8	29.3	38.3	53.4
2.49	3.90	0.76	0.54	18	3.8	683	5.6	24.4	37.3	53.4
2.90	2.97	1.06	2.65	30	1.0	608	5.7	28.2	38.8	53.5
3.42	2.39	0.73	3.02	25	1.5	673	5.9	29.6	37.8	53.5
2.53	3.82	1.71	0.76	48	0.3	779	5.9	29.0	41.8	53.5
2.31	4.73	1.78	0.45	58	0.2	934	6.1	29.4	43.6	53.5
3.22	2.57	1.91	2.11	63	0.2	931	6.0	30.4	40.5	53.5
3.03	2.80	1.65	1.52	45	0.2	739	5.8	29.9	40.2	53.5
2.98	2.86	0.59	2.03	19	4.3	629	5.7	27.3	37.1	53.5
2.63	3.54	1.02	0.88	23	1.5	622	5.6	26.4	38.4	53.5
2.71	3.36	1.54	2.21	45	0.4	695	5.9	28.3	40.5	53.5
2.40	4.31	1.78	1.47	64	0.2	853	6.1	29.4	42.7	53.5
2.86	3.06	1.79	1.33	53	0.2	787	5.9	30.0	41.1	53.5
2.24	5.39	1.02	0.40	27	1.2	940	5.9	25.9	40.9	53.6
2.49	3.97	1.87	0.91	63	0.2	871	6.0	29.8	42.8	53.6
2.30	4.88	1.23	0.38	29	0.8	842	5.8	26.3	41.0	53.6
3.13	2.72	0.51	3.13	21	3.7	677	5.9	28.6	37.9	53.7
2.95	2.97	1.09	2.24	29	0.9	617	5.7	28.5	38.9	53.7
3.28	2.56	1.13	2.40	30	0.6	658	5.8	29.5	38.6	53.7
2.56	3.82	0.65	1.32	19	4.3	697	5.7	25.3	37.6	53.8
2.65	3.58	0.83	0.67	19	2.9	642	5.5	25.6	37.7	53.8
2.23	5.90	1.19	0.07	33	0.7	1084	6.1	27.4	42.9	53.8
2.98	4.50	0.86	0.14	20	2.6	784	5.6	24.4	38.6	53.8
2.90	3.07	1.17	1.47	28	0.8	619	5.7	28.3	39.0	53.8
2.34	4.73	0.62	0.28	17	5.6	882	5.7	23.3	37.7	53.8
2.35	4.73	1.13	0.54	28	0.9	803	5.8	26.4	40.6	53.9
3.37	2.52	1.28	2.65	35	0.4	717	5.9	29.9	39.0	53.9
2.95	3.01	0.60	2.26	20	3.8	650	5.8	27.6	37.7	53.9
2.41	4.43	0.78	1.43	23	2.3	762	5.8	25.7	39.0	53.9
3.14	2.75	0.88	2.30	27	1.2	643	5.8	29.0	38.7	54.0
2.41	4.46	1.76	0.28	53	0.2	907	6.0	29.6	43.5	54.0
2.89	3.14	1.07	0.89	24	1.2	614	5.6	27.8	38.6	54.0
3.40	2.52	1.43	1.70	37	0.3	749	5.8	30.4	39.3	54.0
2.37	4.73	1.74	0.13	53	0.2	948	6.0	29.6	43.9	54.1
3.08	2.86	1.35	2.13	36	0.4	680	5.8	29.4	39.7	54.1
2.51	4.08	0.30	1.68	25	1.6	699	5.8	26.6	39.3	54.1
3.28	2.64	0.79	1.67	22	1.9	640	5.7	29.0	37.6	54.1
2.52	4.06	1.99	0.03	68	0.1	976	6.0	30.8	44.2	54.1
2.92	3.11	0.66	1.69	19	3.6	642	5.7	27.2	37.6	54.1
2.39	4.60	1.82	0.89	65	0.2	943	6.2	30.1	43.9	54.1
2.86	3.21	1.20	1.68	30	0.7	639	5.7	28.5	39.5	54.1
2.85	3.24	1.66	2.24	51	0.3	766	5.9	29.6	41.1	54.1
2.31	5.18	0.76	0.07	20	3.1	960	5.8	24.3	39.3	54.1
2.57	3.93	1.13	1.72	30	0.9	679	5.8	27.5	40.0	54.1
2.47	4.28	1.59	0.76	44	0.3	812	5.9	28.9	42.4	54.2
2.57	3.32	1.46	1.59	42	0.4	720	5.9	28.7	41.3	54.2
2.71	3.56	0.92	0.82	21	2.0	647	5.6	26.6	38.5	54.2
2.53	4.06	0.85	0.98	21	2.3	711	5.7	25.9	38.8	54.2
2.42	4.53	1.18	1.41	33	0.8	760	5.9	27.5	41.0	54.2
2.43	4.26	1.63	0.32	47	0.3	854	5.9	29.3	43.0	54.2

Cement	Fly Ash	Att	Slag	CFR	DL	CS	L1	10 hr	24 hr	100 hr
2.56	3.98	0.99	1.28	25	1.4	688	5.7	26.8	39.5	54.2
2.89	3.18	0.56	1.71	18	5.1	669	5.7	27.0	37.4	54.2
3.17	2.78	0.71	2.51	23	2.2	657	5.8	28.9	38.2	54.2
2.56	3.98	0.75	1.44	21	2.8	711	5.8	26.1	38.6	54.2
2.90	3.18	1.59	1.13	41	0.3	734	5.8	29.8	41.0	54.2
2.35	4.94	1.38	0.80	39	0.5	865	6.0	28.3	42.5	54.2
2.45	4.41	1.01	0.68	24	1.4	757	5.7	26.3	39.9	54.3
2.39	4.72	0.60	1.06	19	4.3	874	5.9	24.8	38.7	54.3
2.67	3.69	1.35	2.00	38	0.5	691	5.8	28.6	40.7	54.3
3.47	2.53	0.62	3.36	25	1.8	730	6.0	30.1	38.5	54.3
2.53	4.12	0.87	1.17	23	2.0	718	5.7	26.2	39.1	54.3
2.79	3.41	0.99	2.20	27	1.2	643	5.8	28.1	39.4	54.3
2.36	4.94	1.45	0.85	42	0.4	880	6.0	28.7	42.8	54.3
2.81	3.38	1.56	1.09	41	0.3	733	5.8	29.5	41.2	54.3
2.34	5.13	1.74	0.45	59	0.2	1021	6.2	30.2	44.7	54.4
3.11	2.90	1.15	1.30	28	0.8	646	5.7	29.2	39.1	54.4
2.69	3.68	0.97	0.71	22	1.7	664	5.6	26.8	39.0	54.4
2.65	3.78	0.86	1.52	23	1.9	681	5.7	26.9	39.1	54.4
2.82	3.39	1.38	1.75	37	0.5	691	5.8	29.1	40.6	54.4
2.43	4.61	0.77	0.75	21	2.8	822	5.8	25.4	39.2	54.4
2.98	3.10	1.63	2.02	48	0.3	777	5.9	30.0	41.0	54.5
2.69	3.70	1.99	1.28	74	0.2	958	6.1	30.9	43.4	54.5
2.66	3.80	1.06	1.65	28	1.0	679	5.8	27.8	40.0	54.5
2.39	4.93	1.30	0.69	35	0.6	868	6.0	28.1	42.3	54.6
3.03	3.06	0.63	2.40	21	3.0	677	5.8	28.4	38.4	54.6
2.53	4.24	1.64	1.58	53	0.3	831	6.0	29.7	42.8	54.6
2.98	3.15	1.19	1.03	28	0.7	656	5.6	28.9	39.6	54.6
2.40	4.90	1.57	1.08	51	0.3	907	6.1	29.6	43.6	54.7
2.84	3.43	0.58	1.40	18	5.0	699	5.7	26.7	37.8	54.7
2.98	3.17	1.55	1.45	42	0.3	754	5.8	30.1	41.1	54.7
2.69	3.79	1.10	0.96	26	1.0	688	5.7	27.7	40.0	54.7
2.92	3.28	0.94	1.33	23	1.5	650	5.7	28.1	39.0	54.7
3.38	2.70	1.86	1.83	59	0.1	990	6.1	31.3	41.2	54.7
2.76	3.60	1.42	0.95	35	0.4	721	5.8	29.1	41.2	54.7
2.58	4.11	1.44	1.11	39	0.4	769	5.9	29.0	41.9	54.7
2.68	3.81	0.88	0.63	21	2.2	695	5.6	26.5	38.9	54.8
2.49	4.50	1.08	0.65	26	1.1	786	5.8	27.0	40.7	54.8
3.14	2.95	1.01	1.11	24	1.1	651	5.6	29.0	38.8	54.8
2.81	3.51	0.89	1.13	22	1.9	665	5.7	27.5	39.0	54.8
2.44	4.75	1.05	0.03	24	1.3	845	5.7	26.4	40.7	54.8
3.08	3.04	1.18	2.30	32	0.6	681	5.8	29.5	39.9	54.8
3.02	3.13	0.81	1.53	22	2.0	656	5.7	28.3	38.6	54.8
3.33	2.76	1.83	1.41	56	0.1	950	6.0	31.5	41.4	54.8
2.45	4.71	0.67	0.85	20	3.5	872	5.8	25.4	39.3	54.8
3.25	2.84	0.93	2.71	28	1.0	685	5.8	29.7	39.3	54.8
3.01	3.15	0.74	2.09	22	2.2	669	5.8	28.4	38.7	54.8
2.42	4.90	0.61	0.09	17	5.5	953	5.7	24.1	38.7	54.8
2.83	3.50	1.55	2.04	46	0.3	762	5.9	29.8	41.6	54.9
3.27	2.85	1.77	1.86	54	0.2	912	6.0	31.1	41.3	54.9
3.40	2.73	1.13	2.39	31	0.5	727	5.9	30.3	39.5	54.9
3.38	2.75	0.95	1.80	26	1.0	694	5.8	30.0	38.8	54.9
2.71	3.80	1.04	1.60	27	1.1	692	5.8	28.1	40.2	54.9
2.51	4.46	1.44	0.28	36	0.4	837	5.8	28.7	42.5	55.0
2.65	3.98	1.18	0.26	26	0.9	728	5.6	27.6	40.6	55.0
3.20	2.94	1.44	1.51	38	0.3	750	5.8	30.4	40.6	55.0

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
2.92	3.34	1.99	1.39	71	0.1	988	6.1	31.4	43.1	55.0
2.61	4.11	1.25	0.54	29	0.7	750	5.7	28.1	41.1	55.0
2.43	4.94	1.36	0.48	36	0.5	896	6.0	28.6	42.9	55.0
2.37	5.43	1.48	0.26	43	0.4	1031	6.1	29.6	44.4	55.0
2.83	3.54	1.59	0.70	41	0.3	781	5.8	30.0	42.0	55.0
2.51	4.53	1.30	0.77	34	0.6	814	5.9	28.4	42.1	55.0
3.45	2.72	1.87	1.96	60	0.1	1042	6.1	31.5	41.3	55.1
2.78	3.67	0.72	0.61	18	3.8	707	5.6	26.4	38.3	55.1
2.93	3.37	1.57	0.74	40	0.3	775	5.8	30.2	41.7	55.1
2.73	3.81	1.88	0.89	62	0.2	934	6.1	31.1	43.7	55.1
2.53	4.46	1.85	0.47	62	0.2	989	6.1	30.9	44.6	55.1
2.76	3.73	0.94	1.30	24	1.5	694	5.7	27.8	39.7	55.1
2.66	4.01	0.60	1.70	20	3.9	772	5.8	26.8	39.0	55.2
2.60	4.24	1.93	1.23	75	0.2	999	6.2	31.2	44.4	55.2
2.95	3.35	1.26	0.82	29	0.6	695	5.7	29.2	40.4	55.2
2.41	5.20	1.86	0.29	69	0.2	1130	6.3	31.5	46.0	55.2
2.50	4.63	1.02	1.05	27	1.1	812	5.9	27.5	41.1	55.2
2.39	5.48	0.66	0.31	20	3.5	1082	5.9	25.5	40.3	55.2
2.94	3.37	0.73	2.37	23	2.2	694	5.8	28.5	39.4	55.2
2.79	3.69	1.80	1.35	58	0.2	887	6.0	30.8	43.0	55.2
2.57	4.37	1.35	0.59	34	0.5	805	5.8	28.7	42.1	55.2
3.46	2.74	1.42	1.59	38	0.3	810	5.9	31.1	40.2	55.2
2.63	4.12	1.26	1.56	35	0.6	749	5.9	28.8	41.6	55.2
2.91	3.43	1.22	1.62	31	0.6	696	5.8	29.3	40.6	55.2
2.73	3.86	1.28	2.00	37	0.6	726	5.9	29.2	41.4	55.2
3.04	3.22	1.29	2.30	36	0.5	717	5.8	29.8	40.7	55.2
2.39	5.51	0.64	0.41	20	3.5	1091	6.0	25.7	40.5	55.3
3.13	3.10	1.49	1.09	38	0.3	766	5.8	30.6	41.1	55.3
3.26	2.94	1.09	1.78	29	0.7	702	5.8	30.0	39.7	55.3
3.46	2.76	0.72	2.62	25	1.4	743	5.9	30.4	39.0	55.3
3.10	3.15	0.68	2.31	23	2.3	703	5.8	29.0	39.1	55.3
2.86	3.58	0.71	1.94	22	2.6	711	5.8	28.0	39.3	55.3
3.17	3.06	1.53	1.91	43	0.3	800	5.9	30.6	41.2	55.3
3.47	2.78	1.13	1.80	30	0.5	751	5.9	30.7	39.6	55.4
2.89	3.55	1.38	1.04	34	0.5	740	5.8	29.7	41.4	55.4
2.78	3.82	1.65	0.68	45	0.3	842	5.9	30.5	42.9	55.5
3.45	2.82	1.25	1.63	33	0.4	773	5.9	30.9	40.0	55.5
2.43	5.41	0.92	0.52	26	1.4	1004	6.0	27.4	42.0	55.5
2.42	5.55	1.72	0.25	60	0.2	1161	6.3	31.5	46.3	55.6
2.53	4.76	1.70	0.09	50	0.2	998	6.0	30.6	44.8	55.6
2.69	4.10	0.58	1.80	21	3.7	798	5.9	27.2	39.5	55.6
3.44	2.85	1.35	1.29	58	0.1	1036	6.1	32.2	42.0	55.6
2.74	3.96	1.39	0.61	34	0.5	780	5.8	29.4	42.0	55.6
3.27	3.02	1.55	1.09	41	0.2	826	5.9	31.2	41.4	55.6
3.20	3.11	0.39	1.53	26	1.0	702	5.8	29.7	39.7	55.6
3.20	3.12	1.24	1.91	33	0.5	740	5.8	30.4	40.6	55.7
2.58	4.53	1.13	0.53	28	0.9	825	5.8	28.1	41.7	55.7
3.14	3.20	0.64	2.58	23	2.3	732	5.9	29.4	39.5	55.7
2.52	4.33	0.64	0.16	18	4.6	950	5.7	25.3	39.4	55.7
2.52	4.38	1.70	0.11	51	0.2	1025	6.1	30.8	45.1	55.7
2.87	3.69	0.96	0.39	22	1.6	716	5.6	27.9	39.7	55.7
2.59	4.52	1.36	0.37	48	0.3	943	6.0	30.6	44.3	55.7
2.76	3.35	0.54	0.67	17	6.7	808	5.7	26.0	38.3	55.7
2.97	3.49	1.31	1.35	65	0.2	985	6.1	31.7	43.5	55.8
2.30	3.08	1.12	2.12	31	0.7	715	5.8	29.8	40.7	55.8

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
2.86	3.74	1.31	0.64	31	0.5	755	5.7	29.5	41.6	55.8
2.98	3.49	1.16	1.82	31	0.7	722	5.8	29.7	40.9	55.8
2.97	3.51	0.55	2.12	21	3.7	759	5.9	28.5	39.3	55.8
3.00	3.47	1.35	1.53	36	0.4	756	5.8	30.2	41.5	55.9
3.16	3.24	0.79	2.48	25	1.5	726	5.9	29.8	40.0	55.9
2.98	3.53	0.94	1.98	27	1.2	717	5.8	29.3	40.5	56.0
3.39	2.98	1.47	1.63	40	0.3	847	5.9	31.4	41.2	56.0
3.47	2.93	1.00	2.58	30	0.6	774	5.9	30.9	40.1	56.0
3.30	3.08	0.63	0.92	19	3.5	739	5.7	29.0	38.2	56.0
2.60	4.61	1.55	0.89	46	0.3	914	6.0	30.4	44.0	56.0
3.09	3.37	0.79	1.21	21	2.1	720	5.7	28.9	39.4	56.0
2.94	3.62	1.77	1.25	55	0.2	922	6.0	31.4	43.4	56.0
3.38	3.01	0.91	2.40	28	0.9	751	5.9	30.6	40.0	56.0
3.26	3.14	1.90	1.64	63	0.1	1047	6.1	32.0	42.9	56.0
3.23	3.18	1.39	0.85	35	0.4	785	5.8	30.9	41.3	56.0
2.96	3.60	1.56	1.70	45	0.3	831	5.9	30.8	42.5	56.0
2.51	5.16	1.26	0.21	33	0.6	975	5.9	29.1	43.5	56.0
3.26	3.14	1.10	1.40	28	0.7	737	5.8	30.4	40.3	56.1
3.10	3.37	1.59	0.75	42	0.2	845	5.9	31.2	42.4	56.1
2.59	4.74	1.47	0.87	43	0.4	915	6.0	30.2	43.9	56.1
3.01	3.53	0.68	2.05	22	2.4	747	5.8	29.0	39.8	56.1
2.49	5.54	0.51	0.30	18	5.5	1184	6.0	25.8	40.5	56.2
2.58	4.85	0.62	0.39	19	4.4	967	5.8	26.1	40.0	56.2
2.77	4.11	1.38	0.61	35	0.5	820	5.8	29.8	42.6	56.2
2.99	3.58	1.23	0.93	30	0.6	751	5.8	29.9	41.3	56.2
2.83	3.93	1.85	1.05	62	0.2	987	6.1	31.7	44.3	56.2
3.43	3.01	1.16	1.65	31	0.5	784	5.9	31.1	40.4	56.2
3.07	3.45	1.92	1.49	66	0.2	1031	6.1	32.0	43.6	56.2
2.64	4.57	1.12	0.44	27	0.9	851	5.8	28.5	42.0	56.2
2.69	4.40	1.96	0.44	72	0.2	1105	6.2	32.3	45.8	56.2
2.71	4.33	1.62	0.06	43	0.3	931	5.9	30.7	44.2	56.2
2.49	5.76	1.29	0.03	36	0.5	1138	6.1	30.0	44.9	56.3
2.80	4.06	0.94	1.22	25	1.3	773	5.8	28.7	40.9	56.3
3.14	3.38	1.03	1.24	26	0.9	737	5.8	29.9	40.5	56.3
2.84	3.97	0.71	1.33	21	2.6	789	5.8	28.1	40.1	56.4
2.86	3.94	1.19	1.60	33	0.6	773	5.9	29.8	41.9	56.4
2.84	4.00	1.39	0.41	34	0.5	823	5.8	30.0	42.6	56.4
2.71	4.41	0.50	0.96	18	5.9	911	5.8	26.7	39.5	56.4
2.89	3.38	1.90	0.14	60	0.1	1033	6.0	32.3	45.0	56.5
2.84	4.01	0.58	1.90	21	3.3	819	5.9	28.3	40.2	56.5
2.81	4.09	1.05	0.18	24	1.2	794	5.6	28.4	41.1	56.5
2.67	4.57	0.51	0.67	17	6.1	947	5.8	26.3	39.5	56.5
2.86	3.99	0.73	1.96	24	2.0	787	5.9	28.8	40.7	56.5
2.96	3.78	0.54	0.76	17	5.8	816	5.7	27.5	38.8	56.6
3.11	3.51	1.04	2.24	30	0.8	756	5.9	30.3	41.3	56.6
2.75	4.36	1.17	0.76	30	0.8	833	5.8	29.3	42.3	56.6
2.63	4.84	1.11	0.76	30	0.8	904	5.9	29.1	42.8	56.6
2.86	4.04	1.85	0.56	59	0.2	1026	6.1	32.2	45.0	56.7
3.17	3.44	0.60	2.44	23	2.4	792	5.9	30.0	40.3	56.7
2.76	4.35	1.74	0.67	54	0.2	994	6.1	31.7	44.9	56.7
2.72	4.51	1.07	0.55	27	1.0	857	5.8	28.8	42.1	56.7
2.55	5.53	1.44	0.23	42	0.4	1113	6.1	31.0	45.6	56.7
3.07	3.62	1.13	0.67	27	0.8	771	5.7	30.0	41.2	56.7
2.78	4.30	1.43	0.78	38	0.4	877	5.9	30.5	43.5	56.7
2.79	4.27	0.74	0.19	19	3.3	854	5.6	27.2	40.0	56.7

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
2.96	3.83	1.19	1.19	31	0.7	786	5.8	30.1	41.9	56.7
3.49	3.11	0.99	1.66	28	0.7	804	5.9	31.3	40.4	56.8
2.91	3.95	0.74	0.69	20	2.8	805	5.7	28.1	40.0	56.8
2.76	4.39	0.82	0.23	22	1.7	852	5.7	28.0	41.2	56.8
2.67	4.79	1.53	0.89	46	0.3	972	6.1	31.1	44.8	56.8
3.13	3.55	1.02	1.50	27	0.9	767	5.8	30.2	41.1	56.8
2.66	4.88	1.42	0.73	40	0.4	965	6.0	30.7	44.5	56.9
2.84	4.19	0.95	1.05	25	1.3	815	5.8	29.1	41.5	56.9
2.94	3.95	0.96	1.73	28	1.1	786	5.9	29.8	41.6	56.9
3.39	3.25	0.99	0.95	26	0.9	789	5.8	30.8	40.4	56.9
2.92	3.99	1.36	0.21	33	0.5	847	5.8	30.4	42.8	56.9
3.15	3.56	0.50	2.27	21	3.4	830	6.0	29.8	40.2	57.0
3.45	3.20	1.09	1.15	29	0.6	813	5.9	31.3	40.8	57.0
2.68	4.85	1.38	0.39	37	0.4	964	6.0	30.4	44.3	57.0
2.77	4.44	1.57	0.20	42	0.3	959	5.9	31.2	44.5	57.0
3.38	3.27	1.19	2.10	34	0.4	826	6.0	31.4	41.5	57.0
2.62	5.22	1.32	0.07	35	0.5	1039	6.0	30.2	44.6	57.0
3.08	3.69	1.01	1.73	28	0.9	779	5.9	30.3	41.5	57.0
3.00	3.84	0.81	1.71	24	1.6	791	5.9	29.6	41.0	57.0
3.07	3.71	1.17	0.93	29	0.7	795	5.8	30.4	41.8	57.0
3.49	3.18	1.55	1.73	45	0.2	965	6.1	32.2	42.2	57.0
2.85	4.22	1.49	1.09	42	0.3	894	6.0	31.1	43.8	57.0
2.93	4.02	0.98	0.31	23	1.4	810	5.7	28.9	41.1	57.1
2.73	4.67	0.80	0.31	21	2.3	923	5.8	27.8	41.2	57.1
3.42	3.27	0.57	0.86	19	3.5	827	5.8	29.9	38.9	57.1
2.85	4.26	0.71	0.07	18	3.6	874	5.6	27.4	40.1	57.1
3.37	3.32	1.38	1.62	38	0.3	874	6.0	31.8	42.1	57.1
3.48	3.22	0.64	1.95	23	1.8	836	6.0	31.0	40.0	57.1
2.93	4.04	1.55	0.50	41	0.3	914	5.9	31.4	43.9	57.1
2.91	4.09	1.85	0.57	60	0.2	1062	6.1	32.6	45.3	57.1
3.08	3.74	1.44	0.36	36	0.3	866	5.8	31.3	43.0	57.1
2.82	4.37	0.61	1.57	22	3.0	890	5.9	28.6	41.0	57.2
2.70	4.90	1.77	0.14	57	0.2	1133	6.2	32.5	46.5	57.2
3.13	3.67	1.85	0.67	58	0.1	1059	6.1	32.8	44.6	57.2
3.06	3.80	1.59	1.42	47	0.3	921	6.0	31.8	43.6	57.2
3.28	3.45	1.36	0.92	35	0.4	857	5.9	31.6	42.2	57.2
2.80	4.49	0.86	0.02	21	2.1	896	5.7	28.0	41.2	57.2
2.68	5.02	1.45	0.84	43	0.4	1010	6.1	31.3	45.1	57.3
3.14	3.68	0.68	1.53	22	2.3	815	5.9	29.7	40.5	57.3
2.75	4.71	1.93	0.23	70	0.2	1198	6.3	33.2	47.0	57.3
3.46	3.29	1.10	1.34	30	0.5	838	5.9	31.6	41.2	57.3
3.03	3.88	0.82	2.01	26	1.4	807	5.9	30.1	41.5	57.3
2.62	5.51	1.25	0.38	36	0.5	1119	6.1	30.9	45.3	57.3
2.70	4.97	0.81	0.56	23	1.9	984	5.9	28.5	42.1	57.4
2.91	4.20	0.85	0.61	22	1.9	850	5.8	28.9	41.2	57.4
3.41	3.36	1.59	1.28	45	0.2	980	6.1	32.5	43.0	57.4
3.02	3.96	0.80	1.08	23	1.8	827	5.8	29.5	41.0	57.4
2.95	4.13	1.07	1.30	29	0.8	832	5.9	30.2	42.4	57.4
3.08	3.84	1.13	1.07	29	0.7	822	5.8	30.6	42.1	57.5
3.24	3.58	1.84	0.58	57	0.1	1082	6.1	33.1	44.5	57.5
3.39	3.41	1.86	0.65	59	0.1	1131	6.1	33.4	44.2	57.5
2.87	4.42	1.75	0.72	55	0.2	1058	6.1	32.5	45.6	57.6
3.16	3.76	0.70	0.25	19	3.2	841	5.6	29.0	39.9	57.6
3.11	3.84	2.00	0.76	72	0.1	1194	6.2	33.5	45.7	57.6
2.90	4.36	0.60	0.51	18	4.3	933	5.8	28.0	40.4	57.7

E-40

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
2.84	4.59	0.98	1.18	28	1.0	898	5.9	30.0	42.8	57.7
3.14	3.82	0.62	1.26	20	2.9	859	5.9	29.6	40.5	57.7
2.87	4.46	0.55	0.13	17	5.9	972	5.7	27.3	40.0	57.7
3.36	3.52	1.64	0.52	46	0.2	1013	6.0	32.9	43.7	57.7
2.69	5.48	0.85	0.31	25	1.6	1123	6.0	29.3	43.4	57.8
3.22	3.73	0.60	0.30	18	4.2	870	5.7	29.1	39.6	57.8
3.47	3.44	0.68	2.00	24	1.5	873	6.0	31.4	40.9	57.8
2.95	4.30	1.01	0.22	24	1.2	886	5.7	29.7	42.2	57.9
2.91	4.44	1.90	0.27	65	0.2	1183	6.2	33.5	46.7	57.9
3.01	4.15	1.75	1.05	56	0.2	1057	6.1	32.7	45.3	57.9
3.31	3.62	1.96	0.44	67	0.1	1220	6.2	34.0	45.4	57.9
2.81	4.84	1.71	0.17	52	0.2	1133	6.1	32.8	46.5	57.9
3.21	3.79	0.74	1.50	23	1.7	854	5.9	30.5	41.2	58.0
3.30	3.67	1.16	0.84	30	0.5	869	5.9	31.6	42.2	58.0
3.41	3.55	0.76	1.96	25	1.2	868	6.0	31.5	41.3	58.0
3.00	4.26	1.14	1.31	32	0.6	884	5.9	31.1	43.3	58.1
2.94	4.44	0.79	0.98	23	1.8	916	5.9	29.7	42.0	58.1
3.34	3.65	0.77	1.26	23	1.5	865	5.9	30.9	41.1	58.1
2.78	5.14	0.88	0.22	24	1.5	1055	5.9	29.4	43.1	58.1
2.79	5.08	0.57	0.71	20	3.6	1094	6.0	28.6	41.9	58.1
2.81	4.94	0.59	0.29	19	4.1	1072	5.9	28.1	41.4	58.1
3.02	4.24	1.82	0.90	60	0.2	1120	6.2	33.2	45.9	58.2
2.99	4.37	1.19	0.43	30	0.6	926	5.9	31.0	43.5	58.3
3.03	4.27	0.93	0.94	25	1.2	896	5.9	30.4	42.5	58.3
2.94	4.54	1.33	0.51	35	0.4	971	5.9	31.5	44.4	58.3
2.78	5.26	0.69	0.51	22	2.4	1113	6.0	29.1	42.8	58.3
3.03	4.28	1.24	0.12	30	0.6	933	5.8	31.1	43.6	58.3
2.94	4.56	1.23	0.63	32	0.6	954	5.9	31.2	44.1	58.3
2.96	4.49	0.55	1.16	20	3.6	986	5.9	29.3	41.5	58.3
3.03	4.30	1.14	0.92	30	0.6	909	5.9	31.1	43.4	58.3
3.35	3.73	1.69	0.41	49	0.2	1089	6.1	33.5	44.7	58.4
3.35	3.74	0.63	1.69	23	1.9	904	6.0	31.1	41.2	58.4
2.94	4.59	1.39	0.79	39	0.4	994	6.0	32.0	44.9	58.4
3.02	4.36	0.59	0.79	20	3.5	967	5.9	29.3	41.2	58.4
2.84	5.08	1.66	0.18	51	0.2	1185	6.2	33.2	47.1	58.5
3.05	4.36	1.47	0.05	38	0.3	1019	5.9	32.3	45.0	58.6
3.07	4.30	0.74	0.61	21	2.2	940	5.8	29.9	41.7	58.6
3.07	4.31	1.72	0.02	50	0.2	1122	6.1	33.4	46.1	58.6
2.78	5.83	0.81	0.09	24	1.6	1277	6.1	30.2	44.4	58.6
3.13	4.18	1.72	0.82	53	0.2	1107	6.2	33.4	45.7	58.6
3.46	3.69	1.34	0.91	36	0.3	980	6.0	32.8	43.3	58.6
3.38	3.79	1.19	1.54	34	0.4	929	6.0	32.3	43.1	58.6
2.83	5.26	0.71	0.56	23	2.2	1123	6.0	29.7	43.1	58.7
2.82	5.36	1.02	0.06	27	1.0	1132	6.0	30.7	44.6	58.7
2.90	4.93	1.31	0.85	37	0.4	1039	6.1	32.1	45.4	58.7
3.37	3.82	0.54	1.68	22	2.4	950	6.0	31.3	41.3	58.7
3.33	3.87	0.54	0.39	18	4.2	959	5.8	30.0	40.2	58.7
2.97	4.68	1.54	0.70	45	0.3	1074	6.1	32.8	45.9	58.7
3.44	3.76	1.03	0.49	27	0.7	927	5.9	32.0	42.1	58.8
3.08	4.36	1.06	1.11	30	0.7	932	6.0	31.4	43.5	58.8
3.39	3.81	1.41	0.87	38	0.3	999	6.0	32.9	43.8	58.8
3.12	4.27	0.69	1.35	23	2.0	945	6.0	30.6	42.2	58.8
3.18	4.16	1.63	0.09	45	0.2	1090	6.0	33.3	45.5	58.8
3.17	4.20	0.88	0.89	25	1.2	927	5.9	31.0	42.5	58.8
3.13	4.30	1.60	0.47	46	0.2	1083	6.1	33.2	45.6	58.9

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Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
3.20	4.16	1.77	0.00	53	0.2	1173	6.1	34.0	46.2	58.9
2.82	5.79	0.96	0.11	28	1.0	1256	6.1	31.2	45.3	58.9
2.94	4.92	1.87	0.01	64	0.2	1313	6.3	34.4	48.1	58.9
3.26	4.07	1.22	1.34	34	0.4	951	6.0	32.4	43.8	58.9
2.85	5.45	1.61	0.03	49	0.2	1284	6.2	33.8	47.9	59.0
3.44	3.83	0.72	0.74	22	1.7	949	5.9	31.4	41.3	59.0
3.18	4.26	1.31	0.74	35	0.4	989	6.0	32.4	44.4	59.0
3.12	4.39	0.72	0.62	22	2.1	982	5.9	30.3	42.1	59.0
3.49	3.80	0.53	1.69	22	2.2	992	6.1	31.9	41.5	59.1
3.17	4.30	0.75	0.80	23	1.8	966	5.9	30.7	42.3	59.1
3.28	4.10	0.98	0.56	26	0.9	946	5.9	31.6	42.7	59.1
3.26	4.13	0.97	1.35	28	0.8	938	6.0	31.9	43.1	59.1
3.38	3.95	1.61	1.06	47	0.2	1109	6.2	33.6	45.0	59.1
2.98	4.91	1.53	0.38	44	0.3	1147	6.1	33.3	46.6	59.2
3.33	4.06	0.82	0.91	24	1.2	956	5.9	31.6	42.3	59.2
3.09	4.56	0.59	0.51	20	3.4	1048	5.9	29.8	41.8	59.2
3.04	4.72	0.68	0.55	21	2.4	1049	5.9	30.1	42.5	59.2
2.99	4.94	0.62	0.81	22	2.6	1099	6.0	30.2	42.8	59.2
3.48	3.90	0.66	0.22	20	2.3	996	5.8	31.2	41.0	59.3
2.98	5.05	0.90	0.34	25	1.2	1094	6.0	31.0	44.0	59.4
3.27	4.23	0.53	1.03	20	3.1	1026	6.0	30.8	41.7	59.4
3.09	4.68	1.17	1.03	33	0.5	1022	6.0	32.4	44.9	59.4
3.47	3.97	1.56	0.30	43	0.2	1139	6.1	34.0	45.0	59.4
3.30	4.22	1.07	0.40	28	0.7	992	5.9	32.1	43.5	59.5
3.31	4.21	0.67	0.01	20	2.7	1017	5.8	30.5	41.5	59.5
3.03	4.92	1.20	0.54	33	0.5	1079	6.0	32.4	45.3	59.5
3.40	4.12	0.74	0.01	21	1.9	1017	5.8	31.2	41.7	59.6
3.17	4.57	0.69	1.27	24	1.7	1036	6.0	31.5	43.2	59.7
3.43	4.11	1.24	0.09	32	0.4	1052	5.9	33.1	44.0	59.7
3.43	4.12	1.92	0.23	65	0.1	1393	6.3	35.3	47.0	59.7
3.45	4.10	1.44	0.21	39	0.2	1117	6.0	33.9	44.9	59.7
3.46	4.09	0.67	1.26	23	1.5	1025	6.1	32.2	42.4	59.7
3.01	5.20	0.55	0.76	21	2.9	1206	6.1	30.6	43.3	59.7
3.48	4.07	0.81	0.37	23	1.2	1022	5.9	32.1	42.3	59.7
3.23	4.48	1.34	0.49	36	0.3	1078	6.0	33.2	45.3	59.8
3.22	4.52	0.79	0.16	22	1.7	1052	5.9	31.1	42.8	59.8
3.17	4.68	0.78	0.80	24	1.4	1061	6.0	31.5	43.5	59.8
3.49	4.12	0.63	0.22	20	2.3	1064	5.9	31.6	41.6	59.9
3.29	4.42	0.89	0.76	26	1.0	1033	6.0	32.1	43.5	59.9
3.44	4.19	0.67	0.80	22	1.7	1050	6.0	32.0	42.3	59.9
3.23	4.50	0.96	0.47	26	0.9	1058	6.0	32.1	44.0	60.0
3.14	4.39	0.80	0.36	24	1.5	1116	6.0	31.4	43.7	60.0
3.17	4.77	0.58	0.66	21	2.7	1133	6.0	31.0	42.9	60.0
3.14	4.91	1.24	0.26	33	0.5	1135	6.0	33.0	45.7	60.0
3.23	4.65	1.02	0.77	29	0.7	1065	6.0	32.6	44.5	60.1
3.02	5.62	0.81	0.27	25	1.3	1289	6.1	32.0	45.2	60.1
3.43	4.31	0.77	0.38	23	1.4	1071	5.9	32.1	42.7	60.2
3.45	4.30	1.07	1.05	31	0.5	1065	6.1	33.3	44.3	60.2
3.25	4.68	0.71	0.64	23	1.7	1106	6.0	31.8	43.4	60.2
3.38	4.47	1.64	0.01	47	0.2	1278	6.2	34.9	46.8	60.3
3.20	4.91	0.99	0.45	28	0.8	1132	6.0	32.6	44.9	60.4
3.41	4.45	0.79	0.06	23	1.4	1108	5.9	32.1	43.0	60.4
3.07	5.71	1.18	0.04	33	0.5	1337	6.2	33.7	47.2	60.4
3.28	4.74	1.32	0.17	35	0.3	1171	6.1	33.8	46.0	60.4
3.23	4.53	1.51	0.24	42	0.2	1223	6.2	34.5	46.4	60.4

E-42

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	10 hr	24 hr	100 hr
3.22	4.93	1.28	0.50	36	0.4	1178	6.1	33.8	46.3	60.5
3.36	4.65	0.87	0.76	26	0.9	1118	6.1	32.9	44.3	60.6
3.23	4.99	0.79	0.56	25	1.2	1176	6.1	32.4	44.4	60.6
3.13	5.52	0.95	0.12	28	0.8	1295	6.1	32.9	45.9	60.6
3.49	4.45	1.58	0.15	45	0.2	1293	6.2	35.1	46.6	60.6
3.36	4.69	1.07	0.80	31	0.5	1132	6.1	33.5	45.2	60.7
3.28	4.89	0.62	0.07	21	2.5	1220	6.0	31.5	43.2	60.7
3.26	4.98	0.76	0.43	24	1.4	1193	6.1	32.4	44.3	60.7
3.21	5.22	0.83	0.40	25	1.1	1232	6.1	32.6	45.0	60.8
3.36	4.76	1.23	0.49	34	0.4	1181	6.1	34.0	45.9	60.8
3.19	5.37	1.12	0.09	31	0.5	1280	6.1	33.7	46.5	60.8
3.33	5.01	0.70	0.45	23	1.5	1239	6.1	32.7	44.3	61.0
3.21	5.60	0.60	0.35	23	2.0	1403	6.2	32.5	44.9	61.1
3.36	4.97	0.73	0.44	24	1.3	1235	6.1	32.9	44.4	61.1
3.23	5.45	0.77	0.38	25	1.2	1323	6.2	33.1	45.4	61.1
3.49	4.71	0.84	0.14	25	1.0	1211	6.1	33.3	44.1	61.1
3.33	5.07	1.17	0.19	33	0.4	1260	6.1	34.2	46.4	61.1
3.45	4.80	1.10	0.07	30	0.5	1230	6.1	34.0	45.5	61.2
3.35	5.06	0.80	0.20	24	1.2	1256	6.1	33.0	44.7	61.2
3.40	4.97	0.66	0.53	23	1.5	1263	6.1	33.0	44.3	61.3
3.47	5.12	0.77	0.03	24	1.1	1341	6.1	33.6	44.9	61.7

Appendix F
PREDICTED PROPERTIES AND COMPOSITIONS
OF THE RANDOM GROUTS THAT MET THE CRITERIA

Appendix F
PREDICTED PROPERTIES AND COMPOSITIONS
OF THE RANDOM GROUTS THAT MET THE CRITERIA

CRITERIA USED TO SCREEN RANDOM GROUTS

Critical flow rate:	< 50 GPM
Drainable liquids (free-standing liquid):	< 3.0 vol%
Compressive strength:	> 500 psi
Leachability index:	> 6
Attapulgate mix ratio:	< 1.5 lb/gal

Cement wt%	Fly Ash wt%	Attapulgit wt%	Slag wt%	Mix Ratio, lb/gal	Critical Flow Rate, gpm	Drainable Liquids, vol%	Compressive Strength, psi	Leachability Index	$\Delta T-10$ hr °C	$\Delta T-24$ hr °C	$\Delta T-100$ hr °C	% of 100-hr @ 10 hr	100 hr - 10 hr
19	53	13	15	8.5	28	0.9	582	6.0	18.7	32.5	44.1	42.5	25.4
19	56	17	9	8.4	36	0.4	641	6.0	20.3	34.6	44.5	45.7	24.2
19	48	15	19	8.9	37	0.5	545	6.0	20.7	33.8	44.7	46.4	23.9
19	55	13	13	8.5	29	0.8	625	6.0	19.8	33.9	45.4	43.5	25.7
20	62	9	9	8.2	20	2.9	784	6.0	17.5	32.7	45.9	38.1	28.4
19	60	12	9	8.5	27	1.0	726	6.0	19.7	34.6	46.2	42.6	26.5
19	66	13	2	8.4	26	1.1	849	6.0	19.3	35.2	46.2	41.8	26.9
20	59	13	8	8.7	29	0.9	743	6.0	20.6	35.5	46.8	44.0	26.2
19	66	14	0	8.7	32	0.6	903	6.1	21.4	37.3	46.9	45.6	25.5
20	63	11	6	8.5	24	1.5	826	6.0	19.5	34.9	46.9	41.6	27.4
20	61	12	7	8.6	26	1.2	794	6.0	20.8	36.0	47.9	43.5	27.1
21	58	14	8	8.9	33	0.6	765	6.0	22.7	37.6	48.5	46.9	25.8
21	64	8	7	8.5	20	3.0	904	6.0	19.9	35.4	48.8	40.8	28.9
21	57	12	9	8.9	29	0.9	763	6.0	22.7	37.4	49.2	46.1	26.6
21	59	14	6	9.0	34	0.6	823	6.0	23.7	38.7	49.4	47.9	25.7
21	62	13	4	9.0	31	0.8	890	6.0	23.2	38.7	49.6	46.9	26.3
21	60	16	3	9.0	41	0.4	877	6.1	24.8	40.0	49.6	50.0	24.8
22	60	15	3	9.2	39	0.5	940	6.1	26.3	41.5	51.8	50.8	25.5
23	51	15	12	9.6	45	0.4	805	6.0	27.1	41.2	52.2	52.0	25.1
23	56	12	9	9.2	31	0.9	841	6.0	25.6	40.2	52.4	48.8	26.9
24	50	15	11	9.6	44	0.4	820	6.0	27.9	41.9	53.2	52.4	25.3
24	53	13	10	9.4	34	0.7	819	6.0	26.9	41.1	53.3	50.4	26.4
24	63	13	1	9.4	33	0.7	1084	6.1	27.4	42.9	53.8	51.0	26.4
25	52	15	8	9.5	39	0.5	865	6.0	28.3	42.5	54.2	52.1	26.0
35	25	6	34	10.0	25	1.8	730	6.0	30.1	38.5	54.3	55.5	24.1
25	51	15	9	9.6	42	0.4	880	6.0	28.7	42.8	54.3	52.8	25.6
26	53	14	7	9.3	35	0.6	868	6.0	28.1	42.3	54.6	51.5	26.5
26	54	16	5	9.2	36	0.5	896	6.0	28.6	42.9	55.0	52.0	26.4
25	57	15	3	9.5	43	0.4	1031	6.1	29.6	44.4	55.0	53.7	25.4
26	58	10	6	9.3	26	1.4	1004	6.0	27.4	42.0	55.5	49.3	28.2
27	49	15	9	9.7	43	0.4	915	6.0	30.2	43.9	56.1	53.9	25.9
26	60	13	0	9.6	36	0.5	1138	6.1	30.0	44.9	56.3	53.3	26.3
26	57	15	2	9.8	42	0.4	1113	6.1	31.0	45.6	56.7	54.7	25.7
27	50	15	8	9.7	40	0.4	965	6.0	30.7	44.5	56.9	54.0	26.2

Cement wt%	Fly Ash wt%	Attapulgitite wt%	Slag wt%	Mix Ratio, lb/gal	Critical Flow Rate, gpm	Drainable Liquids, vol%	Compressive Strength, psi	Leachability Index	$\Delta T-10$ hr °C	$\Delta T-24$ hr °C	$\Delta T-100$ hr °C	% of 100- hr @ 10 hr	100 hr - 10 hr
29	52	15	4	9.3	37	0.4	964	6.0	30.4	44.3	57.0	53.4	26.5
34	33	12	21	9.9	34	0.4	826	6.0	31.4	41.5	57.0	55.0	25.6
28	57	14	1	9.2	35	0.5	1039	6.0	30.2	44.6	57.0	53.1	26.8
30	44	15	11	9.6	42	0.3	894	6.0	31.1	43.8	57.0	54.5	25.9
35	34	14	17	9.7	38	0.3	874	6.0	31.8	42.1	57.1	55.6	25.4
37	35	7	21	9.3	23	1.8	836	6.0	31.0	40.0	57.1	54.3	26.1
27	50	15	8	10.0	43	0.4	1010	6.1	31.3	45.1	57.3	54.7	26.0
27	57	13	4	9.9	36	0.5	1119	6.1	30.9	45.3	57.3	53.8	26.5
29	59	9	3	9.3	25	1.6	1123	6.0	29.3	43.4	57.8	50.6	28.5
36	36	7	21	9.6	24	1.5	873	6.0	31.4	40.9	57.8	54.4	26.4
35	37	8	20	9.7	25	1.2	868	6.0	31.5	41.3	58.0	54.2	26.6
30	57	8	6	9.3	22	2.4	1113	6.0	29.1	42.8	58.3	50.0	29.2
36	40	7	18	9.4	23	1.9	904	6.0	31.1	41.2	58.4	53.3	27.2
30	47	14	8	9.7	39	0.4	994	6.0	32.0	44.9	58.4	54.8	26.4
29	61	8	1	9.5	24	1.6	1277	6.1	30.2	44.4	58.6	51.5	28.4
37	39	14	10	9.4	36	0.3	980	6.0	32.8	43.3	58.6	56.0	25.8
34	38	12	16	9.9	34	0.4	929	6.0	32.3	43.1	58.6	55.2	26.3
30	56	8	6	9.4	23	2.2	1123	6.0	29.7	43.1	58.7	50.6	29.0
30	58	11	1	9.3	27	1.0	1132	6.0	30.7	44.6	58.7	52.2	28.0
29	49	13	9	10.0	37	0.4	1039	6.1	32.1	45.4	58.7	54.6	26.6
36	41	6	18	9.4	22	2.4	950	6.0	31.3	41.3	58.7	53.3	27.4
32	45	11	12	9.6	30	0.7	932	6.0	31.4	43.5	58.8	53.5	27.3
36	40	15	9	9.5	38	0.3	999	6.0	32.9	43.8	58.8	56.1	25.8
33	45	7	14	9.4	23	2.0	945	6.0	30.6	42.2	58.8	52.1	28.2
29	60	10	1	9.7	28	1.0	1256	6.1	31.2	45.3	58.9	53.0	27.7
33	41	12	14	9.9	34	0.4	951	6.0	32.4	43.8	58.9	54.9	26.6
33	45	14	8	9.5	35	0.4	989	6.0	32.4	44.4	59.0	55.0	26.6
37	40	6	18	9.5	22	2.2	992	6.1	31.9	41.5	59.1	54.0	27.2
34	43	10	14	9.7	28	0.8	938	6.0	31.9	43.1	59.1	54.0	27.2
32	53	7	9	9.4	22	2.6	1099	6.0	30.2	42.8	59.2	51.0	29.0
32	54	10	4	9.3	25	1.2	1094	6.0	31.0	44.0	59.4	52.2	28.4
31	47	12	10	10.0	33	0.5	1022	6.0	32.4	44.9	59.4	54.5	27.1
31	51	12	6	9.7	33	0.5	1079	6.0	32.4	45.3	59.5	54.4	27.1
33	47	7	13	9.7	24	1.7	1036	6.0	31.5	43.2	59.7	52.8	28.2

Cement wt%	Fly Ash wt%	Attapulgate wt%	Slag wt%	Mix Ratio, lb/gal	Critical Flow Rate, gpm	Drainable Liquids, vol%	Compressive Strength, psi	Leachability Index	$\Delta T-10$ hr $^{\circ}C$	$\Delta T-24$ hr $^{\circ}C$	$\Delta T-100$ hr $^{\circ}C$	% of 100- hr @ 10 hr	100 hr - 10 hr
38	45	16	2	9.2	39	0.2	1117	6.0	33.9	44.9	59.7	56.7	25.9
37	43	7	13	9.5	23	1.5	1025	6.1	32.2	42.4	59.7	54.0	27.5
32	55	6	8	9.5	21	2.9	1206	6.1	30.6	43.3	59.7	51.2	29.1
34	47	14	5	9.5	36	0.3	1078	6.0	33.2	45.3	59.8	55.5	26.6
34	50	8	8	9.4	24	1.4	1061	6.0	31.5	43.5	59.8	52.7	28.3
35	47	9	8	9.4	26	1.0	1033	6.0	32.1	43.5	59.9	53.7	27.8
38	46	7	9	9.1	22	1.7	1050	6.0	32.0	42.3	59.9	53.4	27.9
35	50	10	5	9.3	26	0.9	1058	6.0	32.1	44.0	60.0	53.6	27.8
34	53	9	4	9.2	24	1.5	1116	6.0	31.4	43.7	60.0	52.4	28.6
35	52	6	7	9.2	21	2.7	1133	6.0	31.0	42.9	60.0	51.6	29.0
33	51	13	3	9.5	33	0.5	1135	6.0	33.0	45.7	60.0	55.0	27.0
33	48	11	8	9.7	29	0.7	1065	6.0	32.6	44.5	60.1	54.2	27.5
31	58	8	3	9.7	25	1.3	1289	6.1	32.0	45.2	60.1	53.1	28.2
35	44	11	11	9.9	31	0.5	1065	6.1	33.3	44.3	60.2	55.4	26.9
35	50	8	7	9.3	23	1.7	1106	6.0	31.8	43.4	60.2	52.7	28.5
34	51	10	5	9.5	28	0.8	1132	6.0	32.6	44.9	60.4	54.0	27.7
31	57	12	0	10.0	33	0.5	1337	6.2	33.7	47.2	60.4	55.8	26.7
34	50	14	2	9.5	35	0.3	1171	6.1	33.8	46.0	60.4	55.9	26.7
32	50	13	5	9.9	36	0.4	1178	6.1	33.8	46.3	60.5	55.9	26.7
35	48	9	8	9.6	26	0.9	1118	6.1	32.9	44.3	60.6	54.3	27.7
34	52	8	6	9.6	25	1.2	1176	6.1	32.4	44.4	60.6	53.5	28.2
32	57	10	1	9.7	28	0.8	1295	6.1	32.9	45.9	60.6	54.3	27.7
34	47	11	8	9.9	31	0.5	1132	6.1	33.5	45.2	60.7	55.3	27.1
37	55	7	1	8.9	21	2.5	1220	6.0	31.5	43.2	60.7	51.9	29.2
35	53	8	5	9.4	24	1.4	1193	6.1	32.4	44.3	60.7	53.3	28.4
33	54	9	4	9.6	25	1.1	1232	6.1	32.6	45.0	60.8	53.7	28.1
34	48	12	5	9.8	34	0.4	1181	6.1	34.0	45.9	60.8	56.0	26.8
33	55	11	1	9.8	31	0.5	1280	6.1	33.7	46.5	60.8	55.3	27.2
35	53	7	5	9.5	23	1.5	1239	6.1	32.7	44.3	61.0	53.5	28.4
33	57	6	4	9.8	23	2.0	1403	6.2	32.5	44.9	61.1	53.3	28.5
35	52	8	5	9.5	24	1.3	1235	6.1	32.9	44.4	61.1	53.8	28.2
33	55	8	4	9.8	25	1.2	1323	6.2	33.1	45.4	61.1	54.1	28.0
38	51	9	2	9.2	25	1.0	1211	6.1	33.3	44.1	61.1	54.4	27.9
34	52	12	2	9.8	33	0.4	1260	6.1	34.2	46.4	61.1	56.0	26.9

Cement wt%	Fly Ash wt%	Attapulgitte wt%	Slag wt%	Mix Ratio, lb/gal	Critical Flow Rate, gpm	Drainable Liquids, vol%	Compressive Strength, psi	Leachability Index	$\Delta T-10$ hr $^{\circ}C$	$\Delta T-24$ hr $^{\circ}C$	$\Delta T-100$ hr $^{\circ}C$	% of 100- hr @ 10 hr	100 hr - 10 hr
37	51	12	1	9.4	30	0.5	1230	6.1	34.0	45.5	61.2	55.6	27.1
36	54	8	2	9.4	24	1.2	1256	6.1	33.0	44.7	61.2	53.9	28.2
36	52	7	6	9.6	23	1.5	1263	6.1	33.0	44.3	61.3	53.9	28.3
37	55	8	0	9.4	24	1.1	1341	6.1	33.6	44.9	61.7	54.5	28.0

Appendix G
DATA FOR PHASE I

Appendix G
DATA FOR PHASE I

Hanford Phase I :

PORT2-L : Type II-LA Portland Cement 21b/gal

PORT2-H : Type II-LA Portland Cement 151b/gal

BFS-L : Ground Granulated Blast Furnace Slag 21b/gal

BFS-H : Ground Granulated Blast Furnace Slag 151b/gal

FFLY-L : Class F Fly Ash 21b/gal

FFLY-H : Class F Fly Ash 151b/gal

PORT5-L : Type V Portland Cement 21b/gal

PORT5-H : Type V Portland Cement 151b/gal

HCEM-L : Class H Cement 21b/gal

HCEM-H : Class H Cement 151b/gal

FANN VISCOMETER READINGS FOR PORT2-L

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1 RUN 2 RUN 3

ROTOR: 1 1 1

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)
 lbf/sq ft = dynes/sq cm * 0.002089

G-4

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	8.3	8.0	8.4
300	3.5	3.8	3.6
200	2.8	2.6	2.5
100	1.4	1.4	1.3
181	2.4	2.3	2.4
90	1.4	1.3	1.2
60	1.0	1.3	1.0
30	0.5	0.5	0.5
6	0.5	0.5	0.3
3	0.3	0.3	0.3
1.8	0.3	0.3	0.3
0.9	0.3	0.3	0.3

G-5

PHASE SEPARATION FOR PORT2-L

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 344.51 344.75 339.35
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 265 266 261
 (USING MEAS'D DENSITY AND MASS)

TIME	d	RUN 1			RUN 2			RUN 3			RUN 3		
		MEAS'D	MEAS'D	FREE ST.	MEAS'D	MEAS'D	FREE ST.	MEAS'D	MEAS'D	FREE ST.	MEAS'D	MEAS'D	FREE ST.
		TOTAL	LIQUID	LIQUID	TOTAL	LIQUID	LIQUID	TOTAL	LIQUID	LIQUID	TOTAL	LIQUID	LIQUID
		g	g	vol%	g	g	vol%	g	g	vol%	g	g	vol%
0.08333		344.35	202.84	63.31%	344.65	210.8	65.61%	339.32	201.24	63.61%			
1		344.13	203.24	63.51%	344.41	208.96	65.11%	338.16	201.4	64.03%			
2		344.04	203.23	63.53%	344.33	208.46	64.98%	339.06	201.23	63.69%			
7		343.77	201.57	63.10%	344.19	203.95	63.62%	338.88	196.35	62.20%			
13		343.01	199.46	62.68%	344.15	202.79	63.27%	338.85	194.98	61.78%			
21		342.53	196.95	62.04%	343.59	202.83	63.46%	338.29	195.16	62.01%			
28		342.13	195.21	61.63%	343.34	202.02	63.29%	338.22	195.21	62.05%			

THERMAL CYCLING FOR PORT2-L

CURE TIME, d: 28
CUBE LIFE AFTER TESTING, d: 10

	MASS			DIMENSIONS, in. (CRUSHED SIDE)			FORCE		UCS		CORR'D UCS	
	g	L	W	H	lb	in.	lb	in.	psi	in.	psi	in.
AFTER THERMAL CYCLING												
RUN 1	40.8	2	0.5	2	513				513		128	
RUN 2	48.2	2	0.5	2	619				619		155	
RUN 3	49.6	2	0.375	2	223				297		56	
							AVERAGE		476.44		112.92	
							STD. DEV.		133.84		41.85	

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

RUN 1	230	2	0.5	2	417				417		104	
RUN 2	231.4	2	0.625	2	782				626		196	
RUN 3	228.1	2	0.625	2	452				362		113	
							AVERAGE		468.07		137.58	
							STD. DEV.		113.67		41.11	

FANN VISCOMETER READINGS FOR PORT2-H

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1 RUN 2 RUN 3
 ROTOR: 1 1 1
 BOB: 1 1 1
 K2, /cc: 0.01323 0.01323 0.01323
 K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3 * RPM, SHEAR STRESS = K1 * K2 * (FANN VISCOMETER READING)
 lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	114.5	106.5	105.0
300	62.0	58.8	58.3
200	45.0	43.0	42.4
100	26.5	25.5	25.3
181	42.0	40.0	39.5
90	25.2	24.4	24.2
60	19.6	19.0	18.8
30	13.5	13.0	13.4
6	8.0	8.0	7.8
3	7.3	7.4	7.0
1.8	7.0	7.2	7.0
0.9	6.3	6.5	6.5

G-10

PHASE SEPARATION FOR PORT2-H

LIQUID DENSITY, g/mL:

1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 484.62 493.4 476.89
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 257 263 254
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	FREE ST. LIQUID
	g	g	g	vol%	g	g	g	vol%	g	g	g	g	vol%	vol%
0.08333	484.62	0	0	0.00%	493.4	0	476.79	0.00%	476.79	0	476.79	0	0.03%	0.03%
1	484.52	0	0	0.03%	493.3	0	476.89	0.03%	476.89	0	476.89	0	0.00%	0.00%
2	484.52	0	0	0.03%	493.3	0	476.89	0.03%	476.89	0	476.89	0	0.00%	0.00%
7	484.42	0	0	0.06%	493.3	0	476.79	0.03%	476.79	0	476.79	0	0.03%	0.03%
13	484.32	0	0	0.10%	493.2	0	476.69	0.06%	476.69	0	476.69	0	0.07%	0.07%
21	484.22	0	0	0.13%	493.1	0	476.59	0.09%	476.59	0	476.59	0	0.10%	0.10%
28	484.22	0	0	0.13%	493.1	0	476.59	0.09%	476.59	0	476.59	0	0.10%	0.10%

THERMAL CYCLING FOR PORT2-H

CURE TIME, d: 28
 CUBE LIFE AFTER TESTING, d: 10

	MASS			DIMENSIONS, in. (CRUSHED SIDE)			FORCE		UCS		CORR'D UCS	
	g	L	W	H			lbf		psi		psi	
AFTER THERMAL CYCLING												
RUN 1	230	2	2	2			16670		4168		4168	
RUN 2	231.4	2	2	2			15810		3953		3953	
RUN 3	228.1	2	2	2			16990		4248		4248	
							AVERAGE		4122.5		4122.5	
							STD. DEV.		124.57		124.57	
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING												
RUN 1	255.9	2	2	2			17070		4268		4268	
RUN 2	256.9	2	2	2			14740		3685		3685	
RUN 3	250.3	2	2	2			15710		3928		3928	
							AVERAGE		3960		3960	
							STD. DEV.		238.91		238.91	

FANN VISCOMETER READINGS FOR BFS-L

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

ROTOR: RUN 1 RUN 2 RUN 3
1 1 1 1
BOB: 1 1 1
K2, /cc: 0.01323 0.01323 0.01323
K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3*RPM, SHEAR STRESS = K1 *K2*(FANN VISCOMETER READING)
lb/ft² = dynes/cm² * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	7.6	7.4	7.3
300	3.4	3.4	3.4
200	2.4	2.8	2.4
100	1.4	1.6	1.5
181	2.3	2.5	2.3
90	1.4	1.5	1.5
60	1.0	1.4	1.3
30	0.7	0.7	0.8
6	0.5	0.5	0.6
3	0.5	0.5	0.5
1.8	0.5	0.5	0.5
0.9	0.5	0.5	0.5

PHASE SEPARATION FOR BFS-L

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 339.1 340.43 334.85
 APPROX. INIT. GR. VOL., mL: 250 250 250
 264 264 261
 CALC'D GROUT VOLUME, mL:
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1			RUN 2			RUN 2			RUN 3			RUN 3		
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID
	g	g	vol%	g	g	vol%	g	g	vol%	g	g	vol%	g	g	vol%
0.08333	338.71	192.99	60.54%	339.92	189.84	59.64%	333.35	186.6	59.63%						
1	338.43	206.17	64.75%	339.57	195.48	61.51%	333.21	193.29	61.80%						
2	338.17	211.18	66.40%	339.43	199.82	62.92%	333.13	197.28	63.09%						
7	338	210.38	66.21%	339.33	195.14	61.48%	333.05	191.92	61.42%						
14	337.75	203.32	64.07%	339.08	192.39	60.70%	332.7	189.92	60.89%						
21	337.36	201.8	63.72%	338.88	191.22	60.39%	332.45	188.13	60.40%						
28	337.07	200.28	63.33%	338.69	190.52	60.23%	332.19	186.59	60.00%						

CURE TIME, d: 28

	MASS g	DIMENSIONS, in. (CRUSHED SIDE)			FORCE lbf	CALC'D psi	UCS psi	CORR'D psi
		L	W	H				
RUN 1	76.4	2	0.75	2	476	317	119	
RUN 2	74.8	2	0.625	2	392	314	98	
RUN 3	73.9	2	0.75	2	391	261	98	
					AVERAGE	297.2	104.92	
					STD. DEV.	25.88	9.96	

THERMAL CYCLING FOR BFS-L

CURE TIME, d: 28
 CUBE LIFE AFTER TESTING, d: 10

	MASS			DIMENSIONS, in.			FORCE		UCS		CORR'D UCS	
	(CRUSHED SIDE)			(CRUSHED SIDE)			lb f		psi		psi	
	g	L	W	H								
AFTER THERMAL CYCLING												
RUN 1	47.8	2	0.75	2			1306		871		327	
RUN 2	46.2	2	0.625	2			1063		850		266	
RUN 3	45.2	2	0.625	2			994		795		249	
AVERAGE							838.76		280.25			
STD. DEV.							31.89		33.45			

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

RUN 1	74.7	2	0.625	2			545		436		136	
RUN 2	74.8	2	0.625	2			553		442		138	
RUN 3	79.8	2	0.75	2			379		253		95	
AVERAGE							377.02		123.08			
STD. DEV.							87.97		20.05			

FANN VISCOMETER READINGS FOR BFS-H

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

ROTOR: RUN 1 RUN 2 RUN 3

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = $K3 \cdot \text{RPM}$, SHEAR STRESS = $K1 \cdot K2 \cdot (\text{FANN VISCOMETER READING})$
 lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	0.0	0.0	
300	0.0	237.5	214.8
200	0.0	184.4	165.5
100	0.0	115.5	104.7
181	0.0	171.5	154.5
90	0.0	108.2	97.5
60	0.0	85.0	77.2
30	0.0	59.5	54.3
6	0.0	29.8	27.8
3	0.0	21.3	20.0
1.8	0.0	15.3	15.0
0.9	0.0	10.5	10.5

PHASE SEPARATION FOR BFS-H

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 453.1 481.51 485.68
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 249 266 270
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D	LIQUID	MEAS'D	FREE ST.	MEAS'D	TOTAL	MEAS'D	TOTAL	MEAS'D	FREE ST.	MEAS'D	TOTAL	MEAS'D	LIQUID	MEAS'D	FREE ST.
		g		vol%		g		g		vol%		g		g		vol%
0.08333	453.13	6.33		2.09%		481.39		5.88		1.86%		485.57		4.29		1.35%
1	452.79	11.89		4.06%		481.51		11.5		3.57%		485.58		9		2.79%
2	452.61	7.31		2.59%		481.43		5.12		1.62%		485.55		4.27		1.35%
7	452.4	2.59		1.09%		481.31		3.28		1.08%		485.48		2.29		0.76%
14	452.3	2.2		1.00%		481.27		1.66		0.59%		485.41		0.93		0.37%
21	452.2	1.4		0.76%		481.09		1.88		0.71%		485.18		0.2		0.21%
28	452.09	0.29		0.43%		480.92		0.71		0.40%		485.18		0		0.15%

THERMAL CYCLING FOR BFS-H

CURE TIME, d: 28
 CUBE LIFE AFTER TESTING, d: 10

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
		L	W	H			
	g				lbf	psi	psi
AFTER THERMAL CYCLING							
RUN 1	207.6	2	2	2	11390	2848	2848
RUN 2	220	2	2	2	22040	5510	5510
RUN 3	222	2	1.75	2	21180	6051	5295
					AVERAGE	4802.98	4550.83
					STD. DEV.	1400.29	1207.63

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

RUN 1	246.6	2	2	2	18610	4653	4653
RUN 2	233.6	2	1.75	2	17820	5091	4455
RUN 3	236.1	2	1.75	2	22440	6411	5610
					AVERAGE	5385.12	4905.83
					STD. DEV.	747.51	504.41

FANN VISCOMETER READINGS FOR FFLY-H

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1 RUN 2 RUN 3
 ROTOR: 1 1 1
 BOB: 1 1 1
 K2, /cc: 0.01323 0.01323 0.01323
 K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)
 lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	52.0	50.3	51.4
300	26.7	25.9	26.0
200	18.4	18.0	18.0
100	10.3	10.0	10.4
181	17.3	16.7	16.7
90	9.7	10.0	9.5
60	7.3	7.2	7.3
30	4.8	4.8	4.8
6	2.2	2.5	2.7
3	1.8	2.5	2.3
1.8	1.8	2.3	1.7
0.9	1.5	1.8	1.5

FANN VISCOMETER READINGS FOR FFLY-L

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1	RUN 2	RUN 3
1	1	1
1	1	1
0.01323	0.01323	0.01323
1.7023	1.7023	1.7023

ROTOR: 1 1 1

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = $K3 \cdot \text{RPM}$, SHEAR STRESS = $K1 \cdot K2 \cdot (\text{FANN VISCOMETER READING})$
 lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	7.6	7.6	8.0
300	3.5	3.8	4.0
200	2.3	2.5	2.5
100	1.4	1.4	1.5
181	2.0	2.3	2.3
90	1.3	1.5	1.5
60	1.0	1.3	1.5
30	0.7	1.0	1.0
6	0.5	0.5	0.8
3	0.5	0.5	0.8
1.8	0.5	0.5	0.8
0.9	0.7	0.7	0.8

PHASE SEPARATION FOR FFLY-L

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 APPROX. INIT. GR. VOL., mL: 328.4 333.7 338.3
 CALC'D GROUT VOLUME, mL: 250 250 250
 262 269 269
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1			RUN 2			RUN 3			RUN 3			RUN 3		
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID
0.08333	327.87	244.62	77.25%	333.18	249.58	76.96%	337.61	249.31	76.84%						
1	326.22	242.22	77.01%	332.85	247.14	76.31%	336.65	247.5	76.58%						
2	325.62	239.15	76.23%	332.9	247.38	76.37%	336.1	262.37	81.31%						
5	325.4	229.9	73.39%	332.7	237.34	73.34%	335.7	240.05	74.58%						
14	324.49	223.15	71.55%	331.72	223.96	69.53%	334.87	228.95	71.42%						
21	324.13	219.4	70.48%	331.4	220.73	68.63%	334.74	223.32	69.73%						
28	323.94	214.68	69.05%	331.27	214.43	66.73%	334.59	219.71	68.67%						

THERMAL CYCLING FOR FFLY-L

CURE TIME, d: 28
 CUBE LIFE AFTER TESTING, d: 11

	MASS		DIMENSIONS, in. (CRUSHED SIDE)			FORCE		UCS		CORR'D UCS	
	g	L	W	H	lbf	psi	psi	psi	psi		
AFTER THERMAL CYCLING											
RUN 1	34.3	2	0.375	2	952	1269	238				
RUN 2	37.1	2	0.375	2	2109	2812	527				
RUN 3	31.9					ERR	0				
					AVERAGE	2040.67	382.63				
					STD. DEV.	771.33	144.63				

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

RUN 1	49.9	2	0.4375	2	1248	1426	312	
RUN 2						ERR	0	
RUN 3						ERR	0	
					AVERAGE	1426.29	312	
					STD. DEV.	557.14	0	

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PHASE SEPARATION FOR FFLY-H

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 424.2 418.9 416.8
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 267 262 261
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	FREE ST. LIQUID
	g	g	g	vol%	g	vol%	g	vol%	g	vol%	g	vol%	g	vol%
0.08333	424.2	23.26	418.9	7.21%	22.48	7.10%	416.8	7.10%	28.54	9.04%	416.8	9.04%	28.54	9.04%
1	423.77	26.57	418.59	8.37%	26.59	8.49%	416.32	8.49%	33.02	10.61%	416.32	10.61%	33.02	10.61%
2	423.6	29.24	418.5	9.25%	28.6	9.16%	416.3	9.16%	36.06	11.57%	416.3	11.57%	36.06	11.57%
5	423.5	24.61	418.4	7.84%	25.61	8.24%	416.1	8.24%	29.8	9.66%	416.1	9.66%	29.8	9.66%
14	423.21	10.61	418.19	3.59%	12.69	4.23%	415.92	4.23%	15.22	5.10%	415.92	5.10%	15.22	5.10%
21	423.17	7.77	418.19	2.73%	10.14	3.43%	415.73	3.43%	12.63	4.34%	415.73	4.34%	12.63	4.34%
28	422.92	5.72	417.89	2.17%	8.19	2.90%	415.7	2.90%	11	3.83%	415.7	3.83%	11	3.83%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR FFLY-H
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28											
	MASS	DIMENSIONS, in.			FORCE	UCS		CORR'D			
		(CRUSHED SIDE)									
	g	L	W	H	lbf	psi	psi				
RUN 1	208.9	2	2	2	2160	540	540				540
RUN 2	202.1	2	2	2	2590	648	648				648
RUN 3	197.8	2	2	2	2743	686	686				686
AVERAGE						624.42	624.42				624.42
STD. DEV.						61.70	61.70				61.70

THERMAL CYCLING FOR				FFLY-H							
CURE TIME, d:				28							
CUBE LIFE AFTER TESTING, d:				10							
MASS		DIMENSIONS, in.		FORCE		UCS		CORR'D			
(CRUSHED SIDE)											
g	L	W	H	lbf		psi		psi		UCS	
AFTER THERMAL CYCLING											
RUN 1	153.5	2	1.875	2	3649	973		912		912	
RUN 2	152.1	2	1.875	2	3479	928		870		870	
RUN 3	151	2	1.875	2	3451	920		863		863	
				AVERAGE		940.36		881.58			
				STD. DEV.		23.33		21.87			
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING											
RUN 1	214.6	2	2	2	2472	618		618		618	
RUN 2	209.2	2	2	2	2854	714		714		714	
RUN 3	210.2	2	2	2	2331	583		583		583	
				AVERAGE		638.08		638.08			
				STD. DEV.		55.24		55.24

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FANN VISCOMETER READINGS FOR PORT5-L

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

ROTOR: RUN 1 RUN 2 RUN 3

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3 * RPM, SHEAR STRESS = K1 * K2 * (FANN VISCOMETER READING)
 lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	8.5	8.8	8.5
300	4.0	4.0	4.2
200	2.8	3.0	3.0
100	1.5	1.5	2.0
181	2.5	2.5	2.5
90	1.4	1.4	2.0
60	1.0	1.4	1.5
30	0.5	1.2	1.3
6	0.5	0.5	0.7
3	0.5	0.5	0.5
1.8	0.5	0.5	0.5
0.9	0.5	0.5	0.5

PHASE SEPARATION FOR PORT5-L

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 338.09 323.32 333.06
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 261 248 256
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	vol%	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	vol%	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	vol%	MEAS'D TOTAL	MEAS'D LIQUID
0.08333	337.89	205.94	65.39%		323.25	196.49	65.44%		333.05	197.3	63.60%		333.05	197.3
1	337.76	204.76	65.06%		322.94	196.74	65.63%		333.13	195.93	63.13%		333.13	195.93
2	337.66	205.14	65.21%		322.81	196.78	65.69%		333.03	187.9	60.57%		333.03	187.9
7	337.59	201.43	64.06%		322.8	191.94	64.08%		333.06	185.47	59.78%		333.06	185.47
14	337.03	200.23	63.85%		322.44	189.16	63.27%		332.86	185.51	59.86%		332.86	185.51
21	336.64	197.41	63.08%		322.23	188.9	63.26%		332.72	185.56	59.92%		332.72	185.56
28	336.52	197.21	63.06%		322.11	187.75	62.91%		332.63	184.87	59.72%		332.63	184.87

THERMAL CYCLING FOR PORT5-L

CURE TIME, d: 28
 CUBE LIFE AFTER TESTING, d: 10

	MASS			DIMENSIONS, in. (CRUSHED SIDE)			FORCE		UCS		CORR'D UCS	
	g	L	W	H			lbf		psi		psi	
AFTER THERMAL CYCLING												
RUN 1		2	1.5	2			1073		358		268	
RUN 2		2	1.375	2			1135		413		284	
RUN 3		2	1.5625	2			991		317		248	
							AVERAGE		362.50		266.58	
							STD. DEV.		39.18		14.74	

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

RUN 1	61.2	2	1.5	2			424		141		106	
RUN 2	60	2	1.5	2			365		122		91	
RUN 3	66.8	2	1.5625	2			695		222		174	
							AVERAGE		161.8		123.67	
							STD. DEV.		43.60		35.92	

FANN VISCOMETER READINGS FOR PORT5-H

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)

lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	129.5	129.5	124.3
300	72.0	72.0	69.4
200	51.8	52.3	49.5
100	30.4	31.0	29.4
181	48.2	49.5	47.2
90	28.8	30.2	28.5
60	21.8	23.0	21.7
30	14.6	15.4	15.0
6	8.0	8.3	8.4
3	7.0	8.0	7.4
1.8	6.8	7.0	7.0
0.9	6.3	6.5	6.5

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PHASE SEPARATION FOR PORT5-H

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 474.03 466.14 481.22
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 252 248 255
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID g	MEAS'D TOTAL	LIQUID vol%	MEAS'D TOTAL	LIQUID g	MEAS'D TOTAL	LIQUID vol%	MEAS'D TOTAL	LIQUID g	MEAS'D TOTAL	LIQUID vol%	MEAS'D TOTAL	LIQUID g	MEAS'D TOTAL	LIQUID vol%
0.08333	474.03	2.22	0.73%	466.14	2.4	0.80%	481.22	0.65	0.21%							
1	473.4	1.87	0.82%	466.58	0.94	0.17%	481.13	0.21	0.10%							
2	472.83	0	0.39%	465.94	0	0.07%	481.02	0	0.06%							
7	472.53	0.43	0.63%	465.84	0	0.10%	481.02	0	0.06%							
14	472.53	0	0.49%	465.84	0	0.10%	480.92	0	0.10%							
21	472.43	0	0.53%	465.74	0	0.13%	480.92	0	0.10%							
28	472.43	0	0.53%	465.74	0	0.13%	480.82	0	0.13%							

THERMAL CYCLING FOR PORT5-H

CURE TIME, d: 28
 CUBE LIFE AFTER TESTING, d: 10

MASS	DIMENSIONS, in.			FORCE	UCS	CORR'D UCS
	(CRUSHED SIDE)					
g	L	W	H	lbf	psi	psi

AFTER THERMAL CYCLING

RUN 1	2	2	2	17180	4295	4295
RUN 2	2	2	2	17650	4413	4413
RUN 3	2	2	2	18320	4580	4580
AVERAGE				4429.17	4429.17	4429.17
STD. DEV.				116.95	116.95	116.95

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

RUN 1	256.1	2	2	16520	4130	4130
RUN 2	257.5	2	2	15940	3985	3985
RUN 3	255.6	2	2	17020	4255	4255
AVERAGE				4123.33	4123.33	4123.33
STD. DEV.				110.33	110.33	110.33

FANN VISCOMETER READINGS FOR HCEM-L

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386
 RUN 1 RUN 2 RUN 3
 ROTOR: 1 1 1
 BOB: 1 1 1
 K2, /cc: 0.01323 0.01323 0.01323
 K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)
 lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	8.5	8.5	8.3
300	3.5	3.8	3.5
200	2.3	2.7	2.5
100	1.3	1.7	1.4
181	2.0	2.5	2.3
90	1.3	1.5	1.3
60	1.0	1.4	1.3
30	0.8	1.0	1.0
6	0.8	0.8	0.8
3	0.5	0.8	0.5
1.8	0.5	0.5	0.5
0.9	0.3	0.5	0.5

PHASE SEPARATION FOR

HCEM-L

LIQUID DENSITY, g/mL:

1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 347.49 347.38 355.69
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 254 254 260
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID
	g	g	g	vol%	g	g	g	vol%	g	g	g	vol%	g	g	g	vol%
0.08333	347.39	234.3	347.17	76.29%	238.41	77.56%	355.59	83.78%	347.12	75.20%	238.46	77.60%	355.41	82.96%	261.08	82.96%
1	346.97	225.75	346.78	73.65%	234.35	76.36%	355.32	82.71%	346.37	72.65%	233.63	76.22%	354.91	82.57%	259.36	82.64%
7	346.66	226.2	346.49	73.90%	233.7	76.28%	354.66	82.50%	346.12	72.23%	233.87	76.42%	354.46	82.50%	258.68	82.50%
14	346.61	222.33	346.37	72.65%	233.7	76.28%	354.66	82.50%	346.12	72.23%	233.87	76.42%	354.46	82.50%	258.68	82.50%
21	346.32	220.75	346.12	72.23%	233.87	76.42%	354.46	82.50%	346.12	72.23%	233.87	76.42%	354.46	82.50%	258.68	82.50%
28	346.32	220.75	346.12	72.23%	233.87	76.42%	354.46	82.50%	346.12	72.23%	233.87	76.42%	354.46	82.50%	258.68	82.50%

THERMAL CYCLING FOR				HCEM-L			
CURE TIME, d:				28			
CUBE LIFE AFTER TESTING, d:				11			
	MASS	DIMENSIONS, in.			FORCE	UCS	CORR'D UCS
		(CRUSHED SIDE)					
	g	L	W	H	lbf	psi	psi
AFTER THERMAL CYCLING							
RUN 1	32.2	2	0.375	2	357	476	89
RUN 2	24.3	2	0.3125	2	217	347	54
RUN 3	32.9	0	0	0	0	ERR	0
					AVERAGE	411.60	71.75
					STD. DEV.	64.40	17.50
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING							
RUN 1	52.3	2	0.4375	2	308	352	77
RUN 2	52.6	2	0.4375	2	534	610	134
RUN 3	39.1	2	0.375	2	132	176	33
					AVERAGE	379.43	81.17
					STD. DEV.	178.35	41.13

FANN VISCOMETER READINGS FOR HCEM-H

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

ROTOR: RUN 1 RUN 2 RUN 3

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = $K3 \cdot \text{RPM}$, SHEAR STRESS = $K1 \cdot K2 \cdot (\text{FANN VISCOMETER READING})$
 lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	61.5	64.9	63.5
300	32.3	33.0	31.0
200	22.5	23.3	22.4
100	13.0	13.3	12.8
181	21.8	21.7	21.5
90	12.6	12.5	12.5
60	9.4	9.0	9.5
30	6.3	6.0	6.4
6	3.3	3.4	3.4
3	3.0	2.8	3.0
1.8	2.8	2.8	2.7
0.9	2.5	2.5	2.7

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PHASE SEPARATION FOR HCEM-H

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 513.08 515.21 509.96
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 262 263 261
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID
	g	g	g	vol%	g	vol%	g	vol%	g	vol%	g	vol%	g	vol%
0.08333	513.08	54.56	514.97	17.19%	43.26	13.65%	509.9	13.57%	42.74	13.57%	509.9	13.57%	42.74	13.57%
1	512.97	50.79	514.98	16.03%	41.37	13.06%	509.9	12.05%	37.94	12.05%	509.9	12.05%	37.94	12.05%
7	512.79	48.41	514.84	15.34%	38.83	12.30%	509.79	11.45%	35.93	11.45%	509.79	11.45%	35.93	11.45%
14	512.68	46.4	514.71	14.74%	37.7	11.99%	509.64	11.16%	34.88	11.16%	509.64	11.16%	34.88	11.16%
21	512.6	46.02	514.52	14.65%	37.21	11.90%	509.58	11.07%	34.52	11.07%	509.58	11.07%	34.52	11.07%
28	512.64	44.06	514.43	14.02%	36.22	11.61%	509.39	10.91%	33.83	10.91%	509.39	10.91%	33.83	10.91%

THERMAL CYCLING FOR				HCEM-H			
CURE TIME, d:				28			
CUBE LIFE AFTER TESTING, d:				11			
	MASS	DIMENSIONS, in.		FORCE	UCS	CORR'D UCS	
		(CRUSHED SIDE)					
	g	L	W	H	lbf	psi	
AFTER THERMAL CYCLING							
RUN 1	215	2	1.875	2	13120	3499	
RUN 2	218.6	2	1.875	2	11700	3120	
RUN 3	215.7	2	1.875	2	11090	2957	
					AVERAGE	3192	
					STD. DEV.	226.79	
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING							
RUN 1	238.4	2	1.8125	2	11690	3225	
RUN 2	243.5	2	1.875	2	11740	3131	
RUN 3	241.9	2	1.875	2	10340	2757	
					AVERAGE	3037.609	
					STD. DEV.	201.8786	

Appendix H
DATA FOR PHASE II

Appendix H
DATA FOR PHASE II

Hanford Phase II :

T2/P62-H : Class F Fly Ash (131b/gal), Type II-LA Portland
Cement (21b/gal)

T2/CL58 : Attapulgate Clay (1.731b/gal), Type II-LA Portland
Cement (0.271b/gal)

T2/CL58-2 : Attapulgate Clay (21b/gal), Type II-LA Portland
Cement (131b/gal)

T2/S24-H : Standard Slag GABSF (131b/gal), Type II-LA Portland
Cement (21b/gal)

T2/S25-H : Takahashi GABFS (131b/gal), Type II-LA Portland
Cement (21b/gal)

T2/P65-H : Ground Limestone (131b/gal), Type II-LA Portland
Cement (21b/gal)

T2/AD44 : Sodium Silicate (131b/gal), Type II-La Portland
Cement (21b/gal)

T2/C94 : Slaked Lime (4.471b/gal), Type II-LA Portland
Cement (0.531b/gal)

T2/SIKA-L : Sika Liquid Admixtures (15%wt), Type II-LA Portland
Cement (21b/gal)

T2/SIKA-H : Sika Liquid Admixtures (15%wt), Type II-LA Portland
Cement (151b/gal)

T2/MSTR-L : Masterbuilders Liquid Admixtures (15%wt), Type II-LA
Portland Cement (21b/gal)

T2/MSTR-H : Masterbuilders Liquid Admixtures (15%wt), Type II-LA
Portland Cement (151b/gal)

FANN VISCOMETER READINGS FOR T2/P62-H

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1	RUN 2	RUN 3
1	1	1
1	1	1
0.01323	0.01323	0.01323
1.7023	1.7023	1.7023

ROTOR:

BOB:

K2, /cc:

K3, /s/RPM:

SHEAR RATE = K3 * RPM, SHEAR STRESS = K1 * K2 * (FANN VISCOMETER READING)

lb/ft² = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	63.6	63.8	63.5
300	32.7	33.0	32.7
200	22.5	22.9	23.0
100	12.4	12.8	13.5
181	20.5	21.2	21.0
90	11.4	11.7	12.3
60	8.3	8.7	8.8
30	5.3	5.8	5.8
6	2.3	2.9	2.8
3	2.0	2.4	2.4
1.8	1.8	2.4	2.4
0.9	1.5	2.4	1.8

H-5

PHASE SEPARATION FOR T2/P62-H

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 434.38 448.73 427.79
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 257 265 253
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	FREE ST. LIQUID
	g	g	g	vol%	g	g	g	vol%	g	g	g	g	g	vol%
0.08333	434.32	10.94	448.73	3.54%	448.73	17.9	427.89	5.59%	427.89	17.64	427.89	17.64	5.74%	5.74%
1	434.19	5.61	448.54	1.87%	448.54	12.51	427.11	3.97%	427.11	12.72	427.11	12.72	4.38%	4.38%
2	434.18	2.2	448.46	0.77%	448.46	8.53	427.07	2.75%	427.07	9.48	427.07	9.48	3.34%	3.34%
7	434.08	0	448.46	0.10%	448.46	2.23	426.93	0.78%	426.93	1.24	426.93	1.24	0.69%	0.69%
14	433.98	0	448.3	0.13%	448.3	0.77	426.89	0.37%	426.89	0.3	426.89	0.3	0.39%	0.39%
21	433.88	0	448.23	0.16%	448.23	0	426.79	0.16%	426.79	0	426.79	0	0.33%	0.33%
28	433.88	0	448.13	0.16%	448.13	0	426.69	0.19%	426.69	0	426.69	0	0.36%	0.36%

FANN VISCOMETER READINGS FOR T2/CL58

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1	RUN 2	RUN 3
1	1	1
1	1	1
0.01323	0.01323	0.01323
1.7023	1.7023	1.7023

ROTOR:

BOB:

K2, /cc:

K3, /s/RPM:

SHEAR RATE = K3 * RPM, SHEAR STRESS = K1 * K2 * (FANN VISCOMETER READING)

lb/sq ft = dynes/sq cm *

0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	37.0	34.4	36.0
300	22.4	21.0	21.6
200	17.3	16.0	16.7
100	11.3	10.5	10.9
181	16.5	15.0	15.7
90	11.0	10.0	10.4
60	8.8	8.2	8.7
30	6.8	6.3	6.5
6	4.7	4.3	4.5
3	4.5	3.8	4.3
1.8	4.0	3.5	4.0
0.9	3.8	3.3	3.5

H-10

PHASE SEPARATION FOR

T2/CL58

LIQUID DENSITY, g/mL:

1.21

INITIAL MASS, g:

RUN 1 RUN 2 RUN 3
345.3 323.51 361

APPROX. INIT. GR. VOL., mL:

250 250 250

CALC'D GROUT VOLUME, mL:

261 243 273

(USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1			RUN 1			RUN 2			RUN 2			RUN 3			RUN 3		
	MEAS'D TOTAL	LIQUID	g	MEAS'D TOTAL	LIQUID	vol%	MEAS'D TOTAL	LIQUID	g	MEAS'D TOTAL	LIQUID	vol%	MEAS'D TOTAL	LIQUID	g	MEAS'D TOTAL	LIQUID	vol%
0.08333	345.2	9.1	2.91%	323.44	7.97	2.74%	360.99	7.19	2.18%									
1	345.17	47.18	14.95%	323.31	46.38	15.86%	360.85	51.43	15.59%									
2	344.78	68.12	21.69%	323.13	66.47	22.76%	360.76	76.81	23.29%									
7	344.29	81.35	26.03%	322.87	78.99	27.11%	360.68	89.13	27.04%									
14	343.89	86.39	27.75%	322.7	83.87	28.83%	360.39	93.69	28.51%									
21	343.6	88.12	28.39%	322.4	84.81	29.25%	360.2	94.17	28.71%									
28	343.15	87.65	28.38%	322.31	86.7	29.92%	359.91	96.31	29.45%									

CURE TIME, d: 28

	MASS g	DIMENSIONS, in. (CRUSHED SIDE)			FORCE lbf	UCS CALC'D psi	CORR'D psi
		L	W	H			
RUN 1	129	2	1.375	2	17	6	4
RUN 2	124.7	2	1.375	2	9	3	2
RUN 3	127.6	2	1.25	2	6	2	2
AVERAGE					3.95	2.67	
STD. DEV.					1.62	1.16	

FANN VISCOMETER READINGS FOR T2/CL58-2

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

SHEAR RATE = $K3 \cdot \text{RPM}$, SHEAR STRESS = $K1 \cdot K2 \cdot (\text{FANN VISCOMETER READING})$
 lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600			
300			
200	208.0	209.3	206.8
100	119.2	120.3	117.3
181	193.0	194.8	190.5
90	110.5	110.5	108.2
60	80.8	81.5	80.3
30	48.8	49.8	48.5
6	20.0	20.3	19.8
3	14.4	14.4	14.3
1.8	11.2	11.4	10.8
0.9	8.5	8.5	8.2

H-15

PHASE SEPARATION FOR T2/CL58-2

LIQUID DENSITY, g/mL:

1.21

RUN 1 RUN 2 RUN 3

INITIAL MASS, g:

478 481.4 473.51

APPROX. INIT. GR. VOL., mL:

250 250 250

CALC'D GROUT VOLUME, mL:

254 255 250

(USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1			RUN 2			RUN 3			RUN 3			RUN 3		
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID
	g	g	vol%	g	g	vol%	g	g	vol%	g	g	vol%	g	g	vol%
0.083333	478	0	0.00%	481.4	0	0.00%	473.51	0	0.00%	473.51	0	0.00%	473.51	0	0.00%
1	478	0	0.00%	481.4	0	0.00%	473.41	0	0.00%	473.41	0	0.03%	473.41	0	0.03%
2	478	0	0.00%	481.4	0	0.00%	473.41	0	0.00%	473.41	0	0.03%	473.41	0	0.03%
7	478	0	0.00%	481.4	0	0.00%	473.41	0	0.00%	473.41	0	0.03%	473.41	0	0.03%
14	477.9	0	0.03%	481.3	0	0.03%	473.41	0	0.03%	473.41	0	0.03%	473.41	0	0.03%
21	477.8	0	0.07%	481.3	0	0.07%	473.31	0	0.03%	473.31	0	0.07%	473.31	0	0.07%
28	477.8	0	0.07%	481.2	0	0.06%	473.21	0	0.06%	473.21	0	0.10%	473.21	0	0.10%

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)				FORCE lbf	UCS CALC'D psi	CORR'D psi
		g	L	W	H			
RUN 1	251.6	2	2	2	9850	2463	2463	
RUN 2	246.7	2	2	2	11720	2930	2930	
RUN 3	247.6	2	2	2	11170	2793	2793	
AVERAGE						2728.33	2728.33	
STD. DEV.						196.18	196.18	

THERMAL CYCLING FOR T2/CL58-2

CURE TIME, d: 28
 CUBE LIFE AFTER TESTING, d: 10

	MASS		DIMENSIONS, in. (CRUSHED SIDE)			FORCE		UCS		CORR'D UCS	
	g	L	W	H	lbf	psi	psi	psi			
AFTER THERMAL CYCLING											
RUN 1	220.9	2	2	2	2	12300	3075	3075	3075	3075	3075
RUN 2	219.4	2	2	2	2	12310	3078	3078	3078	3078	3078
RUN 3	217.8	2	2	2	2	12480	3120	3120	3120	3120	3120
					AVERAGE	3090.83	3090.83	3090.83	3090.83	3090.83	3090.83
					STD. DEV.	20.65	20.65	20.65	20.65	20.65	20.65

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

RUN 1	251.3	2	2	2	2	2	10940		2735		2735	
RUN 2	248.5	2	2	2	2	2	10530		2633		2633	
RUN 3	247.2	2	2	2	2	2	10720		2680		2680	
							AVERAGE		2682.5		2682.5	
							STD. DEV.		41.88		41.88	

FANN VISCOMETER READINGS FOR T2/S24-H

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1 RUN 2 RUN 3

ROTOR: 1 1 1

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)

lb/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	88.3	84.2	86.0
300	47.0	45.2	46.4
200	33.9	33.3	33.4
100	19.5	19.4	19.6
181	31.4	31.3	31.3
90	18.9	18.3	18.4
60	14.5	13.8	14.3
30	9.8	9.5	9.6
6	5.5	5.7	5.5
3	5.4	5.3	4.8
1.8	5.2	5.0	5.0
0.9	4.5	4.5	4.5

H-20

PHASE SEPARATION FOR T2/S24-H

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 479.21 483.33 451.15
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 252 253 236
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID
	g	g	g	vol%	g	g	g	vol%	g	g	g	vol%	g	g	g	vol%
0.083333	479.01	11.7	3.90%	483.33	8.9	2.91%	451.1	9.45	3.32%							
1	478.96	9.05	3.05%	483.12	5.29	1.80%	451.06	5.71	2.03%							
2	478.87	8.26	2.82%	483.09	4.66	1.60%	451.05	4.8	1.71%							
7	478.78	8.97	3.08%	483.06	5.03	1.73%	451.06	5.81	2.06%							
14	478.69	8.78	3.05%	482.96	4.73	1.67%	450.91	5.46	1.99%							
21	478.57	8.36	2.95%	482.85	4.32	1.57%	450.88	5.03	1.85%							
28	478.24	7.83	2.88%	482.79	3.96	1.47%	450.76	4.61	1.75%							

CURE TIME, d: 28

	MASS g	DIMENSIONS, in. (CRUSHED SIDE)			FORCE lbf	UCS CALC'D psi	CORR'D psi
		L	W	H			
RUN 1	236.8	2	2	2	982	246	246
RUN 2	236	2	2	2	889	222	222
RUN 3	241.3	2	2	2	1026	257	257
AVERAGE					241.42	241.42	241.42
STD. DEV.					14.28	14.28	14.28

THERMAL CYCLING FOR T2/S24-H

CURE TIME, d: 28
 CUBE LIFE AFTER TESTING, d: 13

	MASS	DIMENSIONS, in.			FORCE	UCS	CORR'D UCS
		(CRUSHED SIDE)					
	g	L	W	H	lbf	psi	psi
AFTER THERMAL CYCLING							
RUN 1	175.8	2	2	2	1844	461	461
RUN 2	175.2	2	2	2	1815	454	454
RUN 3	184.2	2	2	2	1270	318	318
					AVERAGE	410.75	410.75
					STD. DEV.	66.00	66.00

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

RUN 1	239.6	2	2	2	1005	251	251
RUN 2	240.3	2	2	2	1008	252	252
RUN 3	245.8	2	2	2	1034	259	259
					AVERAGE	253.92	253.92
					STD. DEV.	3.26	3.26

FANN VISCOMETER READINGS FOR T2/S25-H

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1 RUN 2 RUN 3

ROTOR: 1 1 1

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = $K3 \cdot \text{RPM}$, SHEAR STRESS = $K1 \cdot K2 \cdot (\text{FANN VISCOMETER READING})$
 lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	118.8	113.0	112.3
300	65.4	62.3	62.6
200	47.0	44.6	45.0
100	27.6	26.3	26.0
181	46.8	45.5	43.4
90	27.4	26.5	25.4
60	20.8	20.0	19.4
30	14.3	13.7	13.0
6	8.0	7.8	7.5
3	7.3	7.0	6.7
1.8	6.8	6.7	6.4
0.9	6.0	5.6	5.9

H-25

PHASE SEPARATION FOR T2/S25-H

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 483.34 476.07 485.3
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 255 251 256
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	FREE ST. LIQUID
	g	g	g	vol%	g	g	g	vol%	g	g	g	g	vol%	vol%
0.083333	483.28	4.64	4.64	1.52%	475.95	5.58	485.31	1.88%	485.31	4.61	485.31	4.61	1.48%	1.48%
1	483.22	2.88	2.88	0.97%	475.91	2.34	485.28	0.82%	485.28	2.28	485.28	2.28	0.74%	0.74%
2	483.15	1.81	1.81	0.65%	475.9	2.43	485.18	0.86%	485.18	1.28	485.18	1.28	0.45%	0.45%
7	482.98	1.94	1.94	0.74%	475.81	1.94	485.21	0.72%	485.21	0.31	485.21	0.31	0.13%	0.13%
14	483.06	1.62	1.62	0.62%	475.59	1.32	484.95	0.59%	484.95	0.95	484.95	0.95	0.42%	0.42%
21	482.94	1.4	1.4	0.58%	475.51	1.04	484.78	0.53%	484.78	0.38	484.78	0.38	0.29%	0.29%
28	483.11	0.47	0.47	0.23%	475.38	0.61	484.08	0.43%	484.08	0.08	484.08	0.08	0.42%	0.42%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR T2/S25-H
 ASSUME 2-in. CUBES INITIALLY

CURE TIME, d:		28									
	MASS	DIMENSIONS, in.			FORCE	UCS		CORR'D			
		(CRUSHED SIDE)				CALC'D	psi				
	g	L	W	H	lbf	psi	psi				
RUN 1	236.5	2	2	2	1467	367	367				
RUN 2	237.2	2	2	2	1485	371	371				
RUN 3	234.7	2	2	2	1417	354	354				
AVERAGE						364.08	364.08				
STD. DEV.						7.19	7.19				

THERMAL CYCLING FOR						T2/S25-H	
CURE TIME, d:						28	
CUBE LIFE AFTER TESTING, d:						12	
	MASS	DIMENSIONS, in.			FORCE	UCS	CORR'D UCS
		(CRUSHED SIDE)					
	g	L	W	H	lbf	psi	psi
AFTER THERMAL CYCLING							
RUN 1	183.2	2	2	2	1546	387	387
RUN 2	181.2	2	2	2	1701	425	425
RUN 3	179.5	2	2	2	1506	377	377
AVERAGE					396.08	396.08	396.08
STD. DEV.					21.02	21.02	21.02
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING							
RUN 1	242.2	2	2	2	1571	393	393
RUN 2	237.4	2	2	2	1553	388	388
RUN 3						ERR	0
AVERAGE					390.5	390.5	390.5
STD. DEV.					2.25	2.25	2.25

FANN VISCOMETER READINGS FOR T2/P65-H

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1	RUN 2	RUN 3
1	1	1
1	1	1

ROTOR: K2, /cc: 0.01323 0.01323 0.01323

BOB: K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)

lb/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	96.5	97.7	99.5
300	50.7	51.5	53.5
200	35.3	36.0	36.6
100	19.6	20.0	20.0
181	32.4	32.7	33.5
90	18.5	18.8	18.5
60	13.5	13.8	13.6
30	8.6	8.6	8.3
6	3.9	4.4	4.0
3	3.4	3.4	3.5
1.8	3.2	3.4	3.0
0.9	3.0	3.0	2.5

H-30

PHASE SEPARATION FOR T2/P65-H

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 469.49 485.32 476.3
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 253 261 256
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1			RUN 2			RUN 3			RUN 3		
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID
	g	g	vol%	g	g	vol%	g	g	vol%	g	g	vol%
0.083333	469.45	20.36	6.66%	485.32	23.98	7.60%	476.3	38.5	12.43%	476.3	38.5	12.43%
1	469.38	16.99	5.58%	485.02	21.5	6.91%	476.01	16.51	5.42%	476.01	16.51	5.42%
2	469.43	15.64	5.13%	485.06	20.94	6.72%	475.95	15.95	5.26%	475.95	15.95	5.26%
7	469.15	17.16	5.71%	484.85	20.33	6.59%	475.85	16.05	5.33%	475.85	16.05	5.33%
14	469.08	16.69	5.58%	484.78	19.56	6.37%	475.73	15.53	5.20%	475.73	15.53	5.20%
21	468.89	16.4	5.55%	484.62	19.28	6.33%	475.6	14.45	4.89%	475.6	14.45	4.89%
28	466.49	15.89	6.17%	484.52	19.15	6.32%	475.5	14.52	4.95%	475.5	14.52	4.95%

CURE TIME, d: 28

	MASS g	DIMENSIONS, in. (CRUSHED SIDE)			FORCE lbf	CALC'D psi	UCS psi	CORR'D psi
		L	W	H				
RUN 1	225.7	2	1.9375	2	380	98	95	
RUN 2	223.1	2	1.9375	2	377	97	94	
RUN 3	225.5	2	1.9375	2	391	101	98	
AVERAGE						98.75	95.67	
STD. DEV.						1.55	1.50	

THERMAL CYCLING FOR T2/P65-H

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 11

	MASS			DIMENSIONS, in. (CRUSHED SIDE)			FORCE		UCS		CORR'D UCS	
	g	L	W	H	lb	in.	lb	in.	psi	in.	psi	in.
AFTER THERMAL CYCLING												
RUN 1	166.9	2	1.9375	2	1307				337		327	
RUN 2	168.3	2	1.9375	2	1321				341		330	
RUN 3	168.6	2	1.9375	2	1265				326		316	
							AVERAGE		334.88		324.42	
							STD. DEV.		6.14		5.95	

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

RUN 1	228.1	2	1.9375	2	336				87		84	
RUN 2	229.2	2	1.9375	2	358				92		90	
RUN 3	229.3	2	1.9375	2	373				96		93	
							AVERAGE		91.78		88.92	
							STD. DEV.		3.92		3.80	

FANN VISCOMETER READINGS FOR T2/AD44

386

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386
 RUN 1 RUN 2 RUN 3
 ROTOR: 1 1 1
 BOB: 1 1 1
 K2, /cc: 0.01323 0.01323 0.01323
 K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3 * RPM, SHEAR STRESS = K1 * K2 * (FANN VISCOMETER READING)
 lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600			
300	193.3	192.5	199.5
200	133.6	130.5	134.0
100	67.6	66.3	67.5
181	119.5	117.5	118.5
90	60.3	58.8	60.0
60	41.4	41.0	41.0
30	22.7	22.3	22.5
6	7.3	7.0	7.2
3	4.8	4.8	4.8
1.8	3.8	3.5	3.5
0.9	2.5	2.5	2.5

H-35

PHASE SEPARATION FOR T2/AD44

LIQUID DENSITY, g/mL: 1.21

RUN 1 RUN 2 RUN 3

INITIAL MASS, g: 378.8 372.4 384.4

APPROX. INIT. GR. VOL., mL: 250 250 250

CALC'D GROUT VOLUME, mL: 253 249 257

(USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1			RUN 2			RUN 3		
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID
	g	g	vol%	g	g	vol%	g	g	vol%
0.083333	378.8	0	0.00%	372.4	0	0.00%	384.4	0	0.00%
1	378.7	0	0.03%	372.4	0	0.00%	384.4	0	0.00%
2	378.7	0	0.03%	372.4	0	0.00%	384.4	0	0.00%
7	378.7	0	0.03%	372.4	0	0.00%	384.3	0	0.03%
14	378.6	0	0.07%	372.3	0	0.03%	384.3	0	0.03%
21	378.5	0	0.10%	372.2	0	0.07%	384.2	0	0.06%
28	378.5	0	0.10%	372.2	0	0.07%	384.1	0	0.10%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR T2/AD44
 ASSUME 2-in. CUBES INITIALLY

CURE TIME, d:		28									
RUN	1 2 3	MASS		DIMENSIONS, in.		FORCE	UCS				
		(CRUSHED SIDE)					CALC'D	psi	CORR'D	psi	
		g	L	W	H	lbf					
RUN 1			2			2	ERR		0		
RUN 2			2			2	ERR		0		
RUN 3			2			2	ERR		0		
							AVERAGE	ERR	0		
							STD. DEV.	ERR	0		

THERMAL CYCLING FOR		T2/AD44											
CURE TIME, d:		28											
CUBE LIFE AFTER TESTING, d:													
	MASS	DIMENSIONS, in.			FORCE	UCS	CORR'D UCS						
	(CRUSHED SIDE)	L	W	H									
	g				lbf	psi	psi						
AFTER THERMAL CYCLING													
RUN 1						ERR	0						
RUN 2						ERR	0						
RUN 3						ERR	0						
					AVERAGE	ERR	0						
					STD. DEV.	ERR	0						
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING													
RUN 1						ERR	0						
RUN 2						ERR	0						
RUN 3						ERR	0						
					AVERAGE	ERR	0						
					STD. DEV.	ERR	0						

FANN VISCOMETER READINGS FOR T2/C94

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386
RUN 1 RUN 2 RUN 3
ROTOR: 1 1 1
BOB: 1 1 1
K2, /cc: 0.01323 0.01323 0.01323
K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)
lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600			
300	202.0	188.0	182.6
200	156.0	142.8	139.4
100	91.5	84.8	83.0
181	142.0	132.8	130.0
90	84.0	78.3	76.8
60	62.3	57.5	57.0
30	38.0	35.5	35.0
6	15.0	14.8	14.6
3	10.5	10.0	10.3
1.8	7.8	7.5	7.9
0.9	6.4	5.8	5.7

H-40

PHASE SEPARATION FOR T2/C94

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 378.26 370 381.59
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 266 262 271
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID
	g	g	g	vol%	g	vol%	g	vol%	g	vol%	g	vol%	g	vol%	g	vol%
0.083333	378.21	6.45	2.02%	369.92	6.92	2.21%	381.6	6.31	1.92%							
1	378.07	10.21	3.23%	369.92	9.92	3.16%	381.6	11.01	3.36%							
2	377.93	12.47	3.98%	369.76	11.46	3.70%	381.39	13.2	4.09%							
7	377.84	11.48	3.70%	369.67	10.97	3.57%	381.28	12.69	3.97%							
14	377.76	9.81	3.20%	369.6	8.81	2.91%	381.19	9.8	3.12%							
21	377.35	8.69	2.98%	368.6	7.1	2.68%	381.11	8.52	2.75%							
28	376.94	7.78	2.83%	369.06	6.56	2.37%	381.03	9.34	3.02%							

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR T2/C94
 ASSUME 2-in. CUBES INITIALLY

CURE TIME, d:		28									
MASS		DIMENSIONS, in.		FORCE		UCS		CORR'D			
(CRUSHED SIDE)											
g	L	W	H	lbf	psi	psi	psi	psi	psi	psi	psi
RUN 1	2	2	2		ERR	ERR	ERR	ERR	ERR	ERR	ERR
RUN 2	2	2	2		ERR	ERR	ERR	ERR	ERR	ERR	ERR
RUN 3	2	2	2		ERR	ERR	ERR	ERR	ERR	ERR	ERR
				AVERAGE	ERR	ERR	ERR	ERR	ERR	ERR	ERR
				STD. DEV.	ERR	ERR	ERR	ERR	ERR	ERR	ERR

THERMAL CYCLING FOR T2/C94

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d:

	MASS g	DIMENSIONS, in. (CRUSHED SIDE)			FORCE lbf	UCS psi	CORR'D UCS psi
		L	W	H			
AFTER THERMAL CYCLING							
RUN 1						ERR	0
RUN 2						ERR	0
RUN 3						ERR	0
					AVERAGE	ERR	0
					STD. DEV.	ERR	0
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING							
RUN 1						ERR	0
RUN 2						ERR	0
RUN 3						ERR	0
					AVERAGE	ERR	0
					STD. DEV.	ERR	0

FANN VISCOMETER READINGS FOR T2/SIKA-L

386

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg:
 RUN 1 RUN 2 RUN 3
 ROTOR: 1 1 1
 BOB: 1 1 1
 K2, /cc: 0.01323 0.01323 0.01323
 K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3 * RPM, SHEAR STRESS = K1 * K2 * (FANN VISCOMETER READING)
 lb/ft² = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	9.3	9.8	9.5
300	4.5	4.5	4.5
200	3.0	3.4	3.3
100	1.8	2.0	2.2
181	2.8	2.9	2.8
90	1.8	1.7	1.8
60	1.5	1.6	1.5
30	1.3	1.4	1.3
6	1.0	1.2	1.3
3	1.3	1.0	1.3
1.8	1.3	1.0	1.0
0.9	1.0	0.8	1.3

H-45

PHASE SEPARATION FOR T2/SIKA-L

LIQUID DENSITY, g/mL:

1.21

RUN 1 RUN 2 RUN 3

INITIAL MASS, g:

282.6 336.7 340.3

APPROX. INIT. GR. VOL., mL:

176.1 250 250

CALC'D GROUT VOLUME, mL:

210 249 251

(USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	FREE ST. LIQUID
	g	g	g	vol%	g	g	g	vol%	g	g	g	vol%	g	vol%
0.083333	282.22	179.15	70.72%	336.27	205.35	68.22%	339.89	201.75	66.66%					
1	281.31	204.77	81.17%	335	228.34	76.26%	339.47	236.63	78.30%					
2	280.6	196.43	78.16%	334.8	227.05	75.90%	339.4	234.7	77.69%					
7	279.73	186.07	74.42%	333.66	226.7	76.16%	338.78	210.43	69.89%					
14	278.9	179.73	72.25%	333.31	178.78	60.39%	338.51	194.75	64.81%					
21	278.19	178.64	72.10%	332.93	181.69	61.48%	338.38	194.01	64.61%					
28	277.38	175.99	71.38%	332.57	179.91	61.01%	338.33	192.52	64.13%					

THERMAL CYCLING FOR T2/SIKA-L

CURE TIME, d: 28
 CUBE LIFE AFTER TESTING, d: 10

	MASS		DIMENSIONS, in.		FORCE	UCS		CORR'D UCS
	(CRUSHED SIDE)		H	lb		psi		
	g	L					W	
AFTER THERMAL CYCLING								
RUN 1	39.8	2	0.625	2	735	588	184	
RUN 2	39.3	2	0.625	2	548	438	137	
RUN 3	42.4	2	0.625	2	435	348	109	
					AVERAGE	458.13	143.17	
					STD. DEV.	98.97	30.93	

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

RUN 1	59.6	2	0.625	2	320	256	80			
RUN 2	63.6	2	0.625	2	369	295	92			
RUN 3	61.6	2	0.625	2	297	238	74			
AVERAGE							262.93			
STD. DEV.							24.02			

FANN VISCOMETER READINGS FOR T2/SIKA-H

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = $K3 \cdot \text{RPM}$, SHEAR STRESS = $K1 \cdot K2 \cdot (\text{FANN VISCOMETER READING})$
 lb/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	100.5	90.4	88.8
300	49.8	43.7	44.8
200	31.8	30.6	30.0
100	16.5	16.0	16.0
181	28.3	27.3	28.0
90	14.3	14.8	14.3
60	9.8	10.4	9.8
30	5.5	5.7	5.5
6	1.8	1.8	1.8
3	1.3	1.5	1.3
1.8	1.3	1.3	1.3
0.9	1.0	1.0	1.0

H-50

PHASE SEPARATION FOR T2/SIKA-H

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 455.1 447.8 433.3
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 278 241 233
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	FREE ST. LIQUID
	g	g	g	vol%	g	g	g	vol%	g	g	g	g	g	vol%
0.083333	455	16.81	16.81	5.02%	447.8	16.1	433.3	5.53%	433.3	16.41	433.3	16.41	5.82%	5.82%
1	452.9	18.43	18.43	6.13%	446.8	24.13	431.7	8.63%	431.7	17.84	431.7	17.84	6.90%	6.90%
2	450.33	14.99	14.99	5.87%	445.6	22.79	431.1	8.58%	431.1	13.75	431.1	13.75	5.66%	5.66%
7	448.13	1.03	1.03	2.38%	445	8.7	430.8	3.95%	430.8	0	430.8	0	0.89%	0.89%
14	448	0	0	2.11%	443.59	10.99	430.7	5.22%	430.7	0	430.7	0	0.92%	0.92%
28	447.64	8.54	8.54	4.75%	441.7	10.4	430.6	5.67%	430.6	0	430.6	0	0.96%	0.96%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR T2/SIKA-H
 ASSUME 2-in. CUBES INITIALLY

CURE TIME, d:		28									
	MASS	DIMENSIONS, in.			FORCE	UCS					
		(CRUSHED SIDE)				CALC'D		CORR'D			
	g	L	W	H	lbf	psi	psi	psi	psi	psi	psi
RUN 1	229.7	2	2	2	5070	1268	1268	1268	1268	1268	1268
RUN 2	235.8	2	2	2	5658	1415	1415	1415	1415	1415	1415
RUN 3	245.5	2	2	2	5222	1306	1306	1306	1306	1306	1306
AVERAGE						1329.17	1329.17	1329.17	1329.17	1329.17	1329.17
STD. DEV.						62.30	62.30	62.30	62.30	62.30	62.30

 THERMAL CYCLING FOR T2/SIKA-H

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 13

	MASS			DIMENSIONS, in. (CRUSHED SIDE)			FORCE		UCS		CORR'D UCS	
	g	L	W	H			lbf		psi		psi	
AFTER THERMAL CYCLING												
RUN 1	203.9	2	2	2			5330		1333		1333	
RUN 2	209.7	2	2	2			7960		1990		1990	
RUN 3	209	2	2	2			5820		1455		1455	
							AVERAGE		1592.5		1592.5	
							STD. DEV.		285.49		285.49	

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

RUN 1	240.4	2	2	2			5190		1298		1298	
RUN 2	244.6	2	2	2			5820		1455		1455	
RUN 3	246.3	2	2	2			5760		1440		1440	
							AVERAGE		1397.5		1397.5	
							STD. DEV.		70.98		70.98	

FANN VISCOMETER READINGS FOR T2/MSTR-L

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

ROTOR: RUN 1 RUN 2 RUN 3

BOB: RUN 1 RUN 2 RUN 3

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3 * RPM, SHEAR STRESS = K1 * K2 * (FANN VISCOMETER READING)
lb/ft² = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	8.5	9.0	9.4
300	3.8	4.3	4.0
200	3.0	3.0	3.0
100	1.9	1.6	1.5
181	2.3	2.3	2.5
90	1.7	1.5	1.5
60	1.5	1.4	1.4
30	1.0	1.2	1.2
6	1.0	1.0	0.8
3	0.8	0.8	0.8
1.8	0.8	0.8	0.6
0.9	0.8	0.5	0.6

H-55

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR T2/MSTR-L
 ASSUME 2-in. CUBES INITIALLY

CURE TIME, d:		28									
MASS	g	DIMENSIONS, in. (CRUSHED SIDE)			FORCE lbf	UCS		CORR'D psi			
		L	W	H		CALC'D psi					
RUN 1	63.5	2	0.5625	2	381	339		95			
RUN 2	64.1	2	0.5625	2	327	291		82			
RUN 3	63.6	2	0.5625	2	239	212		60			
AVERAGE						280.59		78.92			
STD. DEV.						52.02		14.63			

THERMAL CYCLING FOR T2/MSTR-L

CURE TIME, d: 28
 CUBE LIFE AFTER TESTING, d: 10

	MASS			DIMENSIONS, in.			FORCE		UCS		CORR'D UCS	
	(CRUSHED SIDE)											
	g	L	W	H			lbf		psi		psi	
AFTER THERMAL CYCLING												
RUN 1	40.3	2	0.625	2			516		413		129	
RUN 2	41.1	2	0.625	2			305		244		76	
RUN 3	41.1	2	0.625	2			362		290		91	
							AVERAGE		315.47		98.58	
							STD. DEV.		71.30		22.28	

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

RUN 1	58.5	2	0.5625	2			205		182		51	
RUN 2	65.2	2	0.625	2			404		323		101	
RUN 3	62.8	2	0.625	2			271		217		68	
							AVERAGE		240.74		73.33	
							STD. DEV.		59.99		20.69	

FANN VISCOMETER READINGS FOR T2/MSTR-H

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1 RUN 2 RUN 3

ROTOR: 1 1 1

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = $K3 \cdot \text{RPM}$, SHEAR STRESS = $K1 \cdot K2 \cdot (\text{FANN VISCOMETER READING})$
 lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	76.8	75.3	76.0
300	36.0	36.3	36.0
200	25.5	25.4	25.0
100	13.4	13.6	12.8
181	22.8	22.8	22.2
90	11.5	12.5	11.7
60	8.3	8.4	7.8
30	4.5	4.8	4.5
6	1.5	1.8	1.5
3	1.3	1.4	1.3
1.8	1.0	1.3	1.0
0.9	0.8	1.3	1.0

H-60

PHASE SEPARATION FOR T2/MSTR-H

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 APPROX. INIT. GR. VOL., mL: 286.9 321.2 334.2
 CALC'D GROUT VOLUME, mL: 250 250 250
 152 171 176
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1			RUN 2			RUN 3		
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID
	g	g	vol%	g	g	vol%	g	g	vol%
0.083333	286.91	0	-0.01%	321.2	0	0.00%	334.2	0	0.00%
1	286.8	0	0.05%	321.2	0	0.00%	334.2	0	0.00%
2	286.8	0	0.05%	321	0	0.10%	334.1	0	0.05%
7	286.48	23.62	13.04%	320.68	92.4	44.86%	334.1	0	0.05%
21	284.77	6.51	4.68%	316.78	2.36	3.27%	334	0	0.09%
28	284.64	7.3	5.18%	316.55	0	2.24%	333.9	0	0.14%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR T2/MSTR-H
 ASSUME 2-in. CUBES INITIALLY

CURE TIME, d:		28									
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE		UCS		CORR'D		
		g	L	W	H	lbf	psi	psi	psi		
RUN 1	232.7	2	1.875	2	4769	1272	1192				
RUN 2	232	2	1.875	2	4130	1101	1033				
RUN 3	231.7	2	1.875	2	7190	1917	1798				
					AVERAGE	1430.13	1340.75				
					STD. DEV.	351.46	329.49				

Appendix I
DATA FOR PHASE III

Appendix I

DATA FOR PHASE III

The experimental design for the larger region was MX-1 through MX-20. Runs MX-1 through MX-11 had been run when the design for the smaller region was adopted as the official design. This design added runs MX-21 through MX-35 to runs MX-1, MX-7, MX-15, and MX-20 from the design for the larger region. These runs (i.e., MX-1, MX-7, MX-15, and MX-20 through MX-35) composed the mixture experiment for 106-AN in this report and were the runs used to generate the surface response models. No data were taken during this work for runs MX-12, MX-13, MX-14, MX-16, MX-17, MX-18, and MX-19. Data were taken, and are presented in this appendix, for runs MX-2, MX-3, MX-4, MX-6, MX-8, MX-9, MX-10, and MX-11; however, these data are not presented or discussed in the text and were not used in generating the surface response models.

FANN VISCOMETER READINGS FOR MX1

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1 RUN 2 RUN 3

ROTOR: 1 1 1

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)

lb/ft² = dynes/cm² * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	59.4	60.0	58.5
300	32.0	32.7	31.7
200	23.4	23.6	23.3
100	13.6	13.9	13.5
181	21.3	22.6	22.0
90	12.9	13.2	13.2
60	9.7	10.0	9.9
30	6.7	7.0	6.8
6	3.9	4.2	4.3
3	3.4	3.8	3.5
1.8	3.3	3.8	3.5
0.9	3.3	3.5	3.5

PHASE SEPARATION FOR MX1

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 423.5 419.9 428.8
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 252 250 256
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	FREE ST. LIQUID
	g	g	g	vol%	g	g	g	vol%	g	g	g	g	g	vol%
0.08	423.37	9.07	3.02%	11.51	3.84%	428.68	9.38	3.07%						
1	422.17	7	2.73%	9.11	3.08%	428.7	7.61	2.49%						
2	423.17	6.67	2.30%	8.95	3.04%	428.6	7.1	2.36%						
7	423.15	6.75	2.33%	8.22	2.84%	428.51	5.91	2.01%						
14	423.02	6.82	2.40%	9.36	3.24%	428.46	6.26	2.13%						
21	422.85	6.55	2.36%	8.43	2.98%	428.27	5.37	1.91%						
28	422.8	6.2	2.26%	7.11	2.61%	428.25	5.65	2.01%						

THERMAL CYCLING FOR										MX1	
CURE TIME, d:										28	
CUBE LIFE AFTER TESTING, d:										12	
	MASS	DIMENSIONS, in.			FORCE	UCS	CORR'D				
		(CRUSHED SIDE)									
	g	L	W	H	lbf	psi	psi				
AFTER THERMAL CYCLING											
RUN 1		2	1.94		2	1820	470	455			
RUN 2		2	2		2	1977	494	494			
RUN 3		2	2		2	2150	538	538			
					AVERAGE	500.48		495.58			
					STD. DEV.	28.04		33.69			
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING											
RUN 1		2	1.94		2	1098	283	275			
RUN 2		2	2		2	986	247	247			
RUN 3		2	2		2	985	246	246			
					AVERAGE	258.7		255.75			
					STD. DEV.	17.43		13.26			

FANN VISCOMETER READINGS FOR MX3

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1 RUN 2 RUN 3

ROTOR: 1 1 1

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = $K3 \cdot \text{RPM}$, SHEAR STRESS = $K1 \cdot K2 \cdot (\text{FANN VISCOMETER READING})$
 lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	64.4	63.4	68.8
300	32.7	31.8	34.1
200	23.0	22.4	24.4
100	12.5	12.4	13.4
181	21.3	20.7	22.5
90	11.8	11.8	12.5
60	8.4	8.9	9.4
30	5.4	5.8	5.8
6	2.4	2.6	2.4
3	2.2	2.4	2.4
1.8	2.0	2.3	2.0
0.9	2.0	1.9	1.7

PHASE SEPARATION FOR MX3

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 410.4 433.6 417.4
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 244 258 248
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	vol%	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	vol%	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	vol%	MEAS'D TOTAL	MEAS'D LIQUID
0.08	410.21	11.21	3.87%		433.5	12.1	3.91%		417.36	15.36	5.13%		417.36	15.36
1	410.1	6.02	2.14%		433.4	6.91	2.28%		417.2	10.68	3.63%		417.2	10.68
2	410	0	0.14%		433.19	1.89	0.74%		417.09	6.89	2.40%		417.09	6.89
7	410	0	0.14%		432.9	0	0.22%		416.9	0	0.17%		416.9	0
14	409.9	0	0.17%		432.8	0	0.26%		416.8	0	0.20%		416.8	0
21	409.8	0	0.20%		432.7	0	0.29%		416.7	0	0.23%		416.7	0
28	409.8	0	0.20%		432.6	0	0.32%		416.7	0	0.23%		416.7	0

CURE TIME, d: 28

	MASS		DIMENSIONS, in. (CRUSHED SIDE)				FORCE lbf	UCS		CORR'D psi
	g	L	W	H	CALC'D psi					
RUN 1	205.5	2	1.875	2	7950	2120	1988			
RUN 2	208.2	2	1.9375	2	8470	2186	2118			
RUN 3	214.1	2	2	2	8380	2095	2095			
AVERAGE						2133.60	2066.67			
STD. DEV.						38.30	56.73			

THERMAL CYCLING FOR MX3

CURE TIME, d: 28
 CUBE LIFE AFTER TESTING, d: 10

	MASS			DIMENSIONS, in. (CRUSHED SIDE)			FORCE		UCS		CORR'D UCS	
	g	L	W	H			lbf		psi		psi	
AFTER THERMAL CYCLING												
RUN 1	180.4	2	1.94	2			8620		2225		2155	
RUN 2	184.2	2	1.94	2			7870		2031		1968	
RUN 3	185.7	2	1.94	2			8770		2263		2193	
							AVERAGE		2172.90		2105.00	
							STD. DEV.		101.60		98.43	

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

RUN 1	212.5	2	1.94	2			8050		2077		2013	
RUN 2	216.1	2	1.94	2			6370		1644		1593	
RUN 3	215	2	1.94	2			7240		1868		1810	
							AVERAGE		1863.23		1805.00	
							STD. DEV.		177.03		171.50	

FANN VISCOMETER READINGS FOR MX5

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

ROTOR: RUN 1 RUN 2 RUN 3

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = $K3 \cdot \text{RPM}$, SHEAR STRESS = $K1 \cdot K2 \cdot (\text{FANN VISCOMETER READING})$

lb/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	81.9	80.8	83.3
300	43.3	42.3	44.6
200	31.3	30.4	31.5
100	17.4	17.4	17.7
181	29.5	28.7	29.5
90	17.0	16.2	16.5
60	12.8	12.3	12.7
30	8.3	7.9	8.2
6	4.3	4.3	3.8
3	3.8	3.7	3.4
1.8	3.4	3.4	3.4
0.9	3.4	3.4	3.4

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PHASE SEPARATION FOR MX5

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 453.3 453.9 440.5
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 255 256 248
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1			RUN 2			RUN 2			RUN 3			RUN 3		
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID
	g	g	vol%	g	g	vol%	g	g	vol%	g	g	vol%	g	g	vol%
0.08	453.3	11.1	3.60%	453.86	13.66	4.43%	440.44	10.34	3.46%	440.44	10.34	3.46%	440.44	10.34	3.46%
1	453.2	8.19	2.69%	453.7	11.16	3.67%	440.3	8.57	2.92%	440.3	8.57	2.92%	440.3	8.57	2.92%
2	453.07	4.57	1.55%	453.56	8.76	2.94%	440.24	4.14	1.46%	440.24	4.14	1.46%	440.24	4.14	1.46%
7	453.05	3.85	1.33%	453.25	5.65	2.04%	440.11	2.31	0.90%	440.11	2.31	0.90%	440.11	2.31	0.90%
14	452.94	2.54	0.94%	453.06	4.29	1.66%	440.03	1.23	0.57%	440.03	1.23	0.57%	440.03	1.23	0.57%
21	452.7	1.3	0.62%	453.01	3.41	1.39%	439.84	0.24	0.30%	439.84	0.24	0.30%	439.84	0.24	0.30%
28	452.7	0	0.19%	453	2.8	1.20%	439.8	0	0.23%	439.8	0	0.23%	439.8	0	0.23%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX5
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D psi	CORR'D psi
		L	W	H			
	g						
RUN 1	219.7	2	1.875	2	6840	1824	1710
RUN 2	219.2	2	1.9375	2	6000	1548	1500
RUN 3	223	2	1.9375	2	6090	1572	1523
					AVERAGE	1648	1577.5
					STD. DEV.	124.81	94.14

THERMAL CYCLING FOR										MX5	
CURE TIME, d:										28	
CUBE LIFE AFTER TESTING, d:										10	
MASS		DIMENSIONS, in.			FORCE		UCS		CORR'D UCS		
(CRUSHED SIDE)		H			lb f		psi		psi		
g		W									
L											
AFTER THERMAL CYCLING											
RUN 1	179.4	2	2	2	6740	1685	1685				
RUN 2	180.3	2	1.94	2	7650	1974	1913				
RUN 3	183.1	2	2	2	6030	1508	1508				
					AVERAGE	1722.23	1701.67				
					STD. DEV.	192.34	165.76				
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING											
RUN 1	225.5	2	2	2	7170	1793	1793				
RUN 2	226.4	2	2	2	7250	1813	1813				
RUN 3	222.9	2	2	2	6820	1705	1705				
					AVERAGE	1770	1770				
					STD. DEV.	46.68	46.68				

FANN VISCOMETER READINGS FOR MX2

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1 RUN 2 RUN 3

ROTOR: 1 1 1

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = $K3 \cdot \text{RPM}$, SHEAR STRESS = $K1 \cdot K2 \cdot (\text{FANN VISCOMETER READING})$
 lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	58.2	58.5	57.9
300	30.6	30.9	30.8
200	22.2	22.2	22.4
100	12.8	13.0	13.0
181	20.5	20.9	20.7
90	12.0	12.5	12.7
60	8.9	9.2	9.4
30	6.0	6.3	6.4
6	3.2	3.5	3.5
3	2.4	3.0	3.0
1.8	2.4	2.9	3.0
0.9	2.4	2.7	3.0

PHASE SEPARATION FOR MX2

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 395.1 388 382.6
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 252 247 244
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	g	MEAS'D LIQUID	g	FREE ST. LIQUID	vol%	MEAS'D TOTAL	g	MEAS'D LIQUID	g	FREE ST. LIQUID	vol%	MEAS'D TOTAL	g	MEAS'D LIQUID	g
0.08	395	9.8	3.25%	387.86	8.36	2.85%	382.53	5.83	2.00%							
1	395	3.87	1.30%	387.9	2.94	1.02%	382.5	0.29	0.13%							
2	394.93	1.03	0.39%	387.81	0.61	0.27%	382.5	0	0.03%							
7	394.8	0	0.10%	387.7	0	0.10%	382.4	0	0.07%							
14	394.8	0	0.10%	387.6	0	0.13%	382.3	0	0.10%							
21	394.7	0	0.13%	387.6	0	0.13%	382.3	0	0.10%							
28	394.6	0	0.16%	387.5	0	0.17%	382.2	0	0.14%							

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX2
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS		DIMENSIONS, in. (CRUSHED SIDE)			FORCE lbf	UCS CALC'D psi	CORR'D psi
	g	L	W	H				
RUN 1	195.5	2	1.9375	2	1750	452	438	
RUN 2	188.9	2	1.9375	2	1580	408	395	
RUN 3	185.8	2	2	2	1530	383	383	
AVERAGE						413.95	405	
STD. DEV.						28.55	23.54	

THERMAL CYCLING FOR MX2									
CURE TIME, d: 28									
CUBE LIFE AFTER TESTING, d: 12									
	MASS		DIMENSIONS, in.			FORCE		UCS	CORR'D UCS
	g	L	W	H		lbf		psi	psi
AFTER THERMAL CYCLING									
RUN 1	2		2		2	1465		366	366
RUN 2	2		2		2	1547		387	387
RUN 3	2		1.94		2	1573		406	393
						AVERAGE		386.31	382.08
						STD. DEV.		16.20	11.51
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING									
RUN 1	2		1.94		2	1659		428	415
RUN 2	2		2		2	1580		395	395
RUN 3	2		1.94		2	1112		287	278
						AVERAGE		370.03	362.58
						STD. DEV.		60.27	60.35

FANN VISCOMETER READINGS FOR MX6

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386
 RUN 1 RUN 2 RUN 3
 ROTOR: 1 1 1
 BOB: 1 1 1
 K2, /cc: 0.01323 0.01323 0.01323
 K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3 * RPM, SHEAR STRESS = K1 * K2 * (FANN VISCOMETER READING)
 lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	114.4	115.8	117.8
300	61.8	61.4	63.2
200	45.0	44.5	45.5
100	26.5	25.8	26.4
181	44.9	44.4	44.7
90	26.5	26.2	26.5
60	20.0	19.5	20.3
30	13.4	13.5	13.5
6	8.2	7.6	8.0
3	6.9	6.9	7.4
1.8	6.4	6.6	7.0
0.9	6.0	6.0	6.4

PHASE SEPARATION FOR MX6

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 488.4 487.1 482.4
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 254 254 251
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1			RUN 2			RUN 3		
	MEAS'D TOTAL	LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	LIQUID	FREE ST. LIQUID
	g	g	vol%	g	g	vol%	g	g	vol%
0.08	488.32	0.62	0.23%	487.04	3.04	1.01%	482.1	1.4	0.56%
1	488.3	0	0.03%	486.8	0	0.10%	482.3	0	0.03%
2	488.3	0	0.03%	486.8	0	0.10%	482.3	0	0.03%
7	488.2	0	0.06%	486.8	0	0.10%	482.3	0	0.03%
14	488.2	0	0.06%	486.7	0	0.13%	482.2	0	0.07%
21	488.1	0	0.10%	486.7	0	0.13%	482.2	0	0.07%
28	488.1	0	0.10%	486.6	0	0.16%	482.1	0	0.10%

THERMAL CYCLING FOR MX6

CURE TIME, d: 28
 CUBE LIFE AFTER TESTING, d: 13

CUBE LIFE AFTER TESTING, d:										CORR'D
MASS		DIMENSIONS, in.			FORCE		UCS		UCS	
(CRUSHED SIDE)										
g	L	W	H	lbf	psi	psi	psi	psi		
AFTER THERMAL CYCLING										
RUN 1	211.8	2	2	2	6880	1720	1720	1720	1720	
RUN 2	213.2	2	2	2	6990	1748	1748	1748	1748	
RUN 3	214.5	2	2	2	7320	1830	1830	1830	1830	
				AVERAGE	1765.83	1765.83	1765.83	1765.83	1765.83	
				STD. DEV.	46.74	46.74	46.74	46.74	46.74	
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING										
RUN 1	251.1	2	2	2	8510	2128	2128	2128	2128	
RUN 2	249.2	2	2	2	8550	2138	2138	2138	2138	
RUN 3	250.9	2	2	2	10100	2525	2525	2525	2525	
				AVERAGE	2263.33	2263.33	2263.33	2263.33	2263.33	
				STD. DEV.	185.07	185.07	185.07	185.07	185.07	

FANN VISCOMETER READINGS FOR MX7/PRF

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)

lb/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	31.0	30.5	31.6
300	15.7	15.5	15.7
200	11.4	11.4	11.4
100	6.9	7.0	6.7
181	10.7	10.9	11.0
90	6.4	6.7	6.6
60	5.3	5.3	5.3
30	3.5	3.7	3.5
6	2.3	2.4	2.3
3	2.0	2.2	2.0
1.8	1.8	2.0	1.8
0.9	1.8	1.9	1.8

I-30

PHASE SEPARATION FOR MX7/PRF

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 APPROX. INIT. GR. VOL., mL: 397.4 386.1 414.1
 CALC'D GROUT VOLUME, mL: 250 250 250
 243 236 253
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1			RUN 2			RUN 3		
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID
	g	g	vol%	g	g	vol%	g	g	vol%
0.08	397.27	29.87	10.21%	385.94	20.54	7.24%	414.02	28.32	9.27%
1	396.88	26.78	9.29%	385.63	17.63	6.33%	413.95	24.45	8.03%
2	396.47	24.77	8.75%	385.5	15.1	5.49%	413.76	22.46	7.45%
7	396.04	23.91	8.60%	385.43	13.43	4.93%	413.65	21.55	7.18%
14	395.87	23.37	8.47%	385.37	12.47	4.62%	413.51	21.01	7.05%
21	395.78	22.68	8.27%	385.35	10.65	3.99%	413.4	22.1	7.45%
28	395.34	22.14	8.23%	385.19	10.49	3.99%	413.26	21.06	7.15%

CURE TIME, d: 28

	MASS		DIMENSIONS, in. (CRUSHED SIDE)			FORCE lbf	UCS		CORR'D psi
	g		L	W	H		CALC'D psi		
RUN 1	196.2		2	1.5	2	777	259		194
RUN 2	191.6		2	1.88	2	1138	303		285
RUN 3	195.6		2	1.88	2	1305	348		326
AVERAGE							303.49		268.33
STD. DEV.							36.33		55.09

THERMAL CYCLING FOR			MX7/PRF					
CURE TIME, d:			28					
CUBE LIFE AFTER TESTING, d:			27					
	MASS	DIMENSIONS, in.			FORCE	UCS	CORR'D UCS	
		(CRUSHED SIDE)						
	g	L	W	H	lbf	psi	psi	
AFTER THERMAL CYCLING								
RUN 1	124.9	2	1.88	2	2973	793	743	
RUN 2	120.2	2	1.88	2	3376	900	844	
RUN 3	126.8	2	1.88	2	3427	914	857	
					AVERAGE	868.98	814.67	
					STD. DEV.	54.15	50.77	
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING								
RUN 1	193.2	2	1.88	2	805	215	201	
RUN 2	198	2	1.88	2	1079	288	270	
RUN 3	201.4	2	1.88	2	1018	271	255	
					AVERAGE	257.96	241.83	
					STD. DEV.	31.32	29.36	

FANN VISCOMETER READINGS FOR MX8

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)

lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600			
300	185.5	187.5	186.0
200	144.4	140.7	140.5
100	87.5	84.0	84.8
181	134.5	124.5	129.8
90	79.5	73.0	77.5
60	59.5	55.4	58.8
30	39.4	37.3	39.5
6	23.2	23.5	24.7
3	16.8	17.3	16.9
1.8	13.3	13.4	13.4
0.9	9.0	9.5	9.8

PHASE SEPARATION FOR MX8

LIQUID DENSITY, g/mL:

1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 465.8 452.7 456.5
 APPROX. INIT. GR. VOL., mL: 250 250 250
 260
 CALC'D GROUT VOLUME, mL: 266 257 260

(USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	vol%	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	vol%	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	vol%	MEAS'D TOTAL	MEAS'D LIQUID
0.08	465.7	0	0.03%		452.6	0	0.03%		456.5	0	0.00%		456.5	0
1	465.7	0	0.03%		452.6	0	0.03%		456.5	0	0.00%		456.5	0
2	465.7	0	0.03%		452.6	0	0.03%		456.5	0	0.00%		456.5	0
7	465.6	0	0.06%		452.6	0	0.03%		456.4	0	0.03%		456.4	0
14	465.6	0	0.06%		452.5	0	0.06%		456.4	0	0.03%		456.4	0
21	465.5	0	0.09%		452.5	0	0.06%		456.3	0	0.06%		456.3	0
28	465.5	0	0.09%		452.4	0	0.10%		456.3	0	0.06%		456.3	0

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX8
 ASSUME 2-in. CUBES INITIALLY

CURE TIME, d:		28									
	MASS	DIMENSIONS, in.			FORCE	UCS					
		(CRUSHED SIDE)				CALC'D	psi	CORR'D	psi		
	g	L	W	H	lbf						
RUN 1	233.4	2	2	2	14370	3593		3593			
RUN 2	236.7	2	2	2	9450	2363		2363			
RUN 3	231.2	2	2	2	14870	3718		3718			
AVERAGE						3224.17		3224.17			
STD. DEV.						611.42		611.42			

THERMAL CYCLING FOR MX8

CURE TIME, d: 28
 CUBE LIFE AFTER TESTING, d: 13

	MASS			DIMENSIONS, in.			FORCE		UCS		CORR'D UCS	
	(CRUSHED SIDE)											
	g	L	W	H			lbf		psi		psi	
AFTER THERMAL CYCLING												
RUN 1	203		2	2		2	15830		3958		3958	
RUN 2	203.9		2	2		2	15310		3828		3828	
RUN 3	202.5		2	2		2	15590		3898		3898	
							AVERAGE		3894.17		3894.17	
							STD. DEV.		53.12		53.12	

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

COMPARATOR NOT SUBMITTED TO THERMAL STABILITY TEST											
RUN 1	237.9	2	2	2	2	13880		3470		3470	
RUN 2	238.4	2	2	2	2	12480		3120		3120	
RUN 3	239.2	2	2	2	2	14230		3558		3558	
							AVERAGE	3382.50		3382.50	
							STD. DEV.	189.02		189.02	

FANN VISCOMETER READINGS FOR MX9

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1 RUN 2 RUN 3

ROTOR: 1 1 1

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = $K3 \cdot \text{RPM}$, SHEAR STRESS = $K1 \cdot K2 \cdot (\text{FANN VISCOMETER READING})$
 lb/ft² = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	79.4	79.5	80.3
300	42.5	42.8	42.0
200	31.0	31.2	30.5
100	17.7	17.7	17.7
181	29.7	29.4	29.3
90	17.3	17.3	17.3
60	12.7	13.2	12.8
30	8.5	8.8	8.4
6	4.5	4.8	4.8
3	4.3	4.4	4.3
1.8	3.7	4.3	4.0
0.9	3.5	3.9	3.8

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UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX9
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)				FORCE lbf	UCS		CORR'D psi
		g	L	W	H		CALC'D psi		
RUN 1	214.3	2	2	2	2	3480	870	870	
RUN 2	214.8	2	2	2	2	3580	895	895	
RUN 3	211.8	2	2	2	2	3320	830	830	
AVERAGE						865.00	865.00	865.00	
STD. DEV.						26.77	26.77	26.77	

THERMAL CYCLING FOR										MX9	

CURE TIME, d:		28									
CUBE LIFE AFTER TESTING, d:		11									
MASS		DIMENSIONS, in.				FORCE		UCS		CORR'D UCS	
		(CRUSHED SIDE)									
g		L	W	H	lbf	psi	psi				

AFTER THERMAL CYCLING											
RUN 1	158.5	2	1.94	2	5870	1515	1468				
RUN 2	157.2	2	1.94	2	5607	1447	1402				
RUN 3	156	2	1.94	2	5370	1386	1343				
					AVERAGE	1449.20	1403.92				
					STD. DEV.	52.70	51.05				
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING											
RUN 1	221	2	1.94	2	3151	813	788				
RUN 2	222	2	1.94	2	3126	807	782				
RUN 3	220.5	2	1.94	2	3203	827	801				
					AVERAGE	815.48	790.00				
					STD. DEV.	8.28	8.02				

FANN VISCOMETER READINGS FOR MX10

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1 RUN 2 RUN 3
 ROTOR: 1 1 1
 BOB: 1 1 1
 K2, /cc: 0.01323 0.01323 0.01323
 K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = $K3 \cdot \text{RPM}$, SHEAR STRESS = $K1 \cdot K2 \cdot (\text{FANN VISCOMETER READING})$
 lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	226.4	218.5	237.5
300	159.4	154.3	149.5
200	118.5	109.8	111.4
100	64.5	57.8	62.0
181	99.4	90.2	95.4
90	55.3	51.5	53.5
60	40.8	38.5	39.3
30	27.7	25.7	26.7
6	18.5	16.3	19.5
3	15.5	13.3	14.5
1.8	11.0	10.4	10.7
0.9	9.3	8.0	7.8

PHASE SEPARATION FOR MX10

LIQUID DENSITY, g/mL:

1.21

RUN 1 RUN 2 RUN 3

INITIAL MASS, g: 439.5 434.7 441.2

APPROX. INIT. GR. VOL., mL: 250 250 250

CALC'D GROUT VOLUME, mL: 264 261 264

(USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	LIQUID
	g	g	g	vol%	g	vol%	g	vol%	g	vol%	g	vol%	g	vol%
0.08333	439.47	2.37	0.75%	434.61	2.01	0.67%	441.18	2.28	0.72%					
1	439.45	0.15	0.06%	434.66	0.76	0.25%	441.1	0	0.03%					
2	439.5	0	0.00%	434.59	0.59	0.22%	441.1	0	0.03%					
7	439.32	0.52	0.22%	434.5	0.7	0.29%	441.1	0	0.03%					
14	439.29	0.77	0.31%	434.4	1	0.41%	441	0	0.06%					
21	439.25	1.05	0.41%	434.29	0.89	0.41%	440.91	0.11	0.13%					
28	439.15	0.85	0.38%	434.1	1	0.51%	440.94	0.44	0.22%					

CURE TIME, d: 28

	MASS g	DIMENSIONS, in. (CRUSHED SIDE)			FORCE lbf	UCS CALC'D psi	CORR'D psi
		L	W	H			
RUN 1	203.8	2	2	2	1310	328	328
RUN 2	204.8	2	2	2	1260	315	315
RUN 3	205.1	2	2	2	1310	328	328
AVERAGE					323.33	323.33	323.33
STD. DEV.					5.89	5.89	5.89

FANN VISCOMETER READINGS FOR MX11

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1 RUN 2 RUN 3

ROTOR: 1 1 1

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)

lb/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	22.4	22.4	22.5
300	12.2	11.4	11.4
200	9.4	9.2	8.8
100	5.7	5.5	5.4
181	8.5	8.4	8.2
90	5.3	5.4	5.2
60	3.8	4.2	4.2
30	2.8	3.0	3.0
6	1.7	1.5	2.0
3	1.5	1.4	1.7
1.8	1.5	1.4	1.5
0.9	1.3	1.3	1.4

PHASE SEPARATION FOR MX11

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 422.6 433 425.2
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 251 257 251
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1			RUN 2			RUN 2			RUN 3			RUN 3		
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID
0.08333	422.55	55.15	18.21%	432.87	48.17	15.56%	425.12	54.12	17.83%	425.12	54.12	17.83%	425.12	54.12	17.83%
1	422.46	53.76	17.78%	432.78	45.88	14.85%	425.1	51.2	16.88%	425.1	51.2	16.88%	425.1	51.2	16.88%
2	422.37	52.17	17.28%	432.67	44.17	14.34%	424.95	50.55	16.71%	424.95	50.55	16.71%	424.95	50.55	16.71%
7	422.26	49.46	16.43%	432.64	42.44	13.79%	424.92	47.72	15.79%	424.92	47.72	15.79%	424.92	47.72	15.79%
14	422.14	48.84	16.26%	432.36	40.76	13.34%	424.74	46.54	15.46%	424.74	46.54	15.46%	424.74	46.54	15.46%
21	421.9	47.3	15.83%	432.17	39.17	12.89%	424.66	46.36	15.43%	424.66	46.36	15.43%	424.66	46.36	15.43%
28	421.35	43.35	14.71%	431.72	36.22	12.08%	424.32	45.62	15.30%	424.32	45.62	15.30%	424.32	45.62	15.30%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX11
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS g	DIMENSIONS, in.			FORCE lbf	UCS CALC'D psi	CORR'D psi
		(CRUSHED SIDE) L	W	H			
RUN 1	193.5	2	1.8125	2	718	198	180
RUN 2	192.9	2	1.8125	2	641	177	160
RUN 3	189.5	2	1.8125	2	654	180	164
AVERAGE					185.10	167.75	
STD. DEV.					9.28	8.41	

THERMAL CYCLING FOR MX11

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 10

	MASS		DIMENSIONS, in. (CRUSHED SIDE)			FORCE		UCS		CORR'D UCS
	g	L	W	H	lbf	psi	psi			
AFTER THERMAL CYCLING										
RUN 1	134	2	1.8125	2	1036		286		259	
RUN 2	136.6	2	1.8125	2	1257		347		314	
RUN 3	135.4	2	1.8125	2	983		271		246	
					AVERAGE		301.24		273	
					STD. DEV.		32.73		29.67	
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING										
RUN 1	198.4	2	1.8125	2	630		174		158	
RUN 2	200.5	2	1.875	2	601		160		150	
RUN 3	198.8	2	1.875	2	475		127		119	
					AVERAGE		153.58		142.17	
					STD. DEV.		19.81		16.82	

FANN VISCOMETER READINGS FOR MX15

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

ROTOR: RUN 1 RUN 2 RUN 3

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)
lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	141.4	136.7	139.3
300	79.6	79.5	77.5
200	58.6	59.3	64.5
100	34.7	35.8	38.0
181	59.5	60.7	60.6
90	34.3	35.8	35.6
60	25.3	26.4	26.3
30	16.3	17.2	16.8
6	8.8	9.5	9.7
3	7.6	8.2	8.3
1.8	6.8	7.2	6.7
0.9	5.3	5.4	5.3

PHASE SEPARATION FOR MX15

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 428.4 432.2 432
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 262 262 262
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	FREE ST. LIQUID
	g	vol%	g	vol%	g	vol%	g	vol%	g	vol%	g	vol%	g	vol%	g	vol%
0.08333	428.31	5.01	1.62%	432.11	4.91	1.58%	431.97	4.97	1.58%	431.97	4.97	1.58%	431.97	4.97	1.58%	4.97
1	428.2	0	0.06%	432	0	0.06%	431.9	0	0.06%	431.9	0	0.06%	431.9	0	0.06%	0.03%
2	428.2	0	0.06%	432	0	0.06%	431.9	0	0.06%	431.9	0	0.06%	431.9	0	0.06%	0.03%
7	428.1	0	0.10%	431.8	0	0.13%	432.7	0	0.13%	432.7	0	0.13%	432.7	0	0.13%	-0.22%
15	428	0	0.13%	431.7	0	0.16%	431.7	0	0.16%	431.7	0	0.16%	431.7	0	0.16%	0.09%
21	427.9	0	0.16%	431.6	0	0.19%	431.7	0	0.19%	431.7	0	0.19%	431.7	0	0.19%	0.09%
28	427.8	0	0.19%	431.5	0	0.22%	431.6	0	0.22%	431.6	0	0.22%	431.6	0	0.22%	0.13%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX15
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)				FORCE lbf	UCS CALC'D psi	CORR'D psi
		g	L	W	H			
RUN 1	194	2	2	2	3506	877	877	
RUN 2	197.7	2	2	2	3291	823	823	
RUN 3	199.6	2	2	2	3382	846	846	
AVERAGE						848.25	848.25	
STD. DEV.						22.03	22.03	

THERMAL CYCLING FOR MX15

CURE TIME, d: 28
 CUBE LIFE AFTER TESTING, d: 10

CUBE LIFE AFTER TESTING, α:										CORR'D
	MASS	DIMENSIONS, in.				FORCE	UCS		CORR'D	
		(CRUSHED SIDE)					UCS			
	g	L	W	H	lbf	psi	psi			
AFTER THERMAL CYCLING										
RUN 1	146.7	2	2	2	4808	1202	1202	1202	1202	
RUN 2	146.3	2	2	2	4884	1221	1221	1221	1221	
RUN 3	145.8	2	2	2	4778	1195	1195	1195	1195	
					AVERAGE	1205.83	1205.83	1205.83	1205.83	
					STD. DEV.	11.15	11.15	11.15	11.15	
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING										
RUN 1	206.4	2	2	2	3564	891	891	891	891	
RUN 2	208.4	2	2	2	3087	772	772	772	772	
RUN 3	205	2	2	2	3157	789	789	789	789	
					AVERAGE	817.33	817.33	817.33	817.33	
					STD. DEV.	52.58	52.58	52.58	52.58	

FANN VISCOMETER READINGS FOR MX20

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

ROTOR: RUN 1 RUN 2 RUN 3

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = $K3 \cdot \text{RPM}$, SHEAR STRESS = $K1 \cdot K2 \cdot (\text{FANN VISCOMETER READING})$
 lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	58.2	60.5	61.4
300	30.9	32.3	32.3
200	22.5	23.3	23.3
100	12.7	13.3	13.3
181	21.9	21.7	21.6
90	12.5	12.4	12.5
60	9.4	9.3	9.3
30	6.2	5.7	6.0
6	2.9	3.0	2.8
3	2.5	2.5	2.5
1.8	2.5	2.3	2.3
0.9	2.4	2.3	2.0

PHASE SEPARATION FOR

MX20

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 408.7 414.2 411.6
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 253 256 255
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	FREE ST. LIQUID
	g	g	g	vol%	g	g	g	vol%	g	g	g	vol%	g	g	g	vol%
0.08333	408.71	9.91	3.24%		414.12	10.62	3.45%		411.55	9.85	3.21%		411.55	9.85	3.21%	
1	408.65	3.15	1.05%		414.05	5.75	1.90%		411.59	4.79	1.56%		411.59	4.79	1.56%	
2	408.52	0.72	0.29%		414	4.2	1.42%		411.49	3.19	1.07%		411.49	3.19	1.07%	
7	407.41	1.51	0.92%		413.88	3.38	1.19%		411.47	1.17	0.42%		411.47	1.17	0.42%	
14	408.4	1.5	0.59%		413.75	3.25	1.19%		411.31	0.31	0.19%		411.31	0.31	0.19%	
21	408.33	0.43	0.26%		413.69	3.09	1.16%		412.16	1.36	0.26%		412.16	1.36	0.26%	
28	408.24	1.24	0.56%		413.52	3.02	1.19%		411.08	0.48	0.32%		411.08	0.48	0.32%	

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX20
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d:		28									
	MASS	DIMENSIONS, in.			FORCE	UCS		CORR'D			
		(CRUSHED SIDE)				lbf	CALC'D	psi	psi		
		L	W	H							
	g										
RUN 1	189	2	1.875	2	1870	499	468				
RUN 2	188.7	2	1.875	2	1563	417	391				
RUN 3	183.9	2	1.875	2	1827	487	457				
AVERAGE						467.56	438.33				
STD. DEV.						36.19	33.93				

THERMAL CYCLING FOR MX20

CURE TIME, d: 28
 CUBE LIFE AFTER TESTING, d: 11

	MASS			DIMENSIONS, in. (CRUSHED SIDE)			FORCE		UCS		CORR'D UCS	
	g	L	W	H			lbf		psi		psi	
AFTER THERMAL CYCLING												
RUN 1	133.9	2	1.875	2			3886		1036		972	
RUN 2	134.1	2	1.875	2			3212		857		803	
RUN 3	135.4	2	1.875	2			3326		887		832	
							AVERAGE		926.58		868.67	
							STD. DEV.		78.55		73.64	

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

RUN 1	197.9	2	2	2			1704		426		426	
RUN 2	196.1	2	1.875	2			1534		409		384	
RUN 3	190	2	1.875	2			1760		469		440	
							AVERAGE		434.8		416.5	
							STD. DEV.		25.38		24.02	

FANN VISCOMETER READINGS FOR MX21

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TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg:
 RUN 1 RUN 2 RUN 3
 ROTOR: 1 1 1
 BOB: 1 1 1
 K2, /cc: 0.01323 0.01323 0.01323
 K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3 * RPM, SHEAR STRESS = K1 * K2 * (FANN VISCOMETER READING)
 lb/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	45.3	44.3	44.7
300	22.7	22.3	22.4
200	16.0	15.4	16.0
100	9.0	8.5	8.5
181	15.3	14.5	14.7
90	8.3	8.5	8.2
60	6.3	6.0	6.2
30	3.5	3.8	3.8
6	1.8	1.7	1.8
3	1.4	1.5	1.4
1.8	1.4	1.4	1.4
0.9	1.3	1.3	1.4

PHASE SEPARATION FOR

MX21

LIQUID DENSITY, g/mL:

1.21

RUN 1 RUN 2 RUN 3

INITIAL MASS, g: 409.5 410.3 416.5

APPROX. INIT. GR. VOL., mL: 250 250 250

CALC'D GROUT VOLUME, mL: 253 254 258

(USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1			RUN 2			RUN 3			RUN 3			RUN 3		
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID
	g	g	vol%	g	g	vol%	g	g	vol%	g	g	vol%	g	g	vol%
0.08333	409.49	21.69	7.08%	410.28	23.58	7.69%	416.4	23.6	7.59%	416.4	23.6	7.59%	416.4	23.6	7.59%
1	409.33	12.33	4.08%	410.24	15.34	5.02%	416.38	15.08	4.87%	416.38	15.08	4.87%	416.38	15.08	4.87%
2	409.17	6.37	2.18%	410.05	10.35	3.45%	416.3	10.6	3.46%	416.3	10.6	3.46%	416.3	10.6	3.46%
7	409.01	2.81	1.08%	409.98	7.18	2.44%	416.2	7.2	2.40%	416.2	7.2	2.40%	416.2	7.2	2.40%
14	408.85	2.25	0.95%	409.8	7	2.44%	416	5.4	1.89%	416	5.4	1.89%	416	5.4	1.89%
21	408.8	0	0.23%	409.67	6.17	2.21%	415.34	5.44	2.11%	415.34	5.44	2.11%	415.34	5.44	2.11%
28	408.7	0	0.26%	409.55	4.55	1.73%	415.28	3.08	1.38%	415.28	3.08	1.38%	415.28	3.08	1.38%

THERMAL CYCLING FOR										MX21	

CURE TIME, d: 28											
CUBE LIFE AFTER TESTING, d: 11											
MASS		DIMENSIONS, in.			FORCE		UCS		CORR'D		
(CRUSHED SIDE)									UCS		
g		L	W	H	lbf	psi	psi	psi			

AFTER THERMAL CYCLING											
RUN 1	160.3	2	1.875	2	8740	2331	2185			2185	
RUN 2	156.3	2	1.875	2	8340	2224	2085			2085	
RUN 3	154.3	2	1.875	2	7610	2029	1903			1903	
					AVERAGE		2194.67		2057.5		
					STD. DEV.		124.76		116.96		
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING											
RUN 1	207.2	2	1.875	2	7940	2117	1985			1985	
RUN 2	200	2	1.875	2	8140	2171	2035			2035	
RUN 3	198.9	2	1.875	2	7140	1904	1785			1785	
					AVERAGE		2064		1935		
					STD. DEV.		115.21		108.01		

FANN VISCOMETER READINGS FOR MX22

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1 RUN 2 RUN 3

ROTOR: 1 1 1

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = $K3 \cdot \text{RPM}$, SHEAR STRESS = $K1 \cdot K2 \cdot (\text{FANN VISCOMETER READING})$
 lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	26.0	25.5	26.0
300	13.3	12.8	13.0
200	9.7	9.3	9.5
100	5.9	5.7	5.6
181	9.1	9.2	9.3
90	5.5	5.7	5.4
60	4.3	4.5	4.3
30	3.0	3.2	2.8
6	2.0	1.7	1.7
3	1.5	1.7	1.5
1.8	1.5	1.5	1.5
0.9	1.5	1.5	1.4

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PHASE SEPARATION FOR

MX22

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 APPROX. INIT. GR. VOL., mL: 427.4 426.1 422.8
 CALC'D GROUT VOLUME, mL: 250 250 250
 258 257 255
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	FREE ST. LIQUID
	g	g	g	vol%	g	g	g	g	g	vol%	g	g	g	g	vol%	vol%
0.08333	427.36	32.76	10.51%	426.04	35.44	11.41%	422.72	44.62	14.49%							
1	427.3	29	9.32%	425.94	33.64	10.86%	422.68	41.98	13.64%							
2	427.25	27.65	8.91%	425.87	31.07	10.06%	422.61	38.81	12.64%							
7	427.17	25.47	8.23%	425.8	29.7	9.64%	422.48	38.08	12.44%							
14	427.01	24.11	7.85%	425.39	29.99	9.86%	422.24	38.34	12.61%							
21	426.64	23.94	7.91%	425.56	30.66	10.03%	422.04	38.24	12.64%							
28	426.51	23.21	7.72%	425.36	29.36	9.67%	421.87	34.97	11.63%							

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX22
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d:		28									
	MASS	DIMENSIONS, in.			FORCE	UCS		CORR'D			
		(CRUSHED SIDE)				lbf	CALC'D psi	psi	CORR'D psi		
	g	L	W	H							
RUN 1	197.7	2	1.875	2	1360	363	340				
RUN 2	195.4	2	1.875	2	1430	381	358				
RUN 3	195.7	2	1.875	2	1219	325	305				
AVERAGE						356.36	334.08				
STD. DEV.						23.40	21.94				

THERMAL CYCLING FOR												MX22			

CURE TIME, d: 28															
CUBE LIFE AFTER TESTING, d: 10															
		MASS		DIMENSIONS, in.				FORCE		UCS		CORR'D			
				(CRUSHED SIDE)								UCS			
		g		L		W		H		lbf		psi			
												psi			
AFTER THERMAL CYCLING															
RUN 1		133.5	2	1.8125	2	1611	444	403							
RUN 2		136.6	2	1.8125	2	1198	330	300							
RUN 3		133.9	2	1.8125	2	1464	404	366							
AVERAGE														392.92	356.08
STD. DEV.														47.15	42.73
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING															
RUN 1		200	2	1.8125	2	1246	344	312							
RUN 2		198.3	2	1.8125	2	1101	304	275							
RUN 3		199.8	2	1.8125	2	1263	348	316							
AVERAGE														331.95	300.83
STD. DEV.														20.05	18.17

FANN VISCOMETER READINGS FOR MX23

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1 RUN 2 RUN 3

ROTOR: 1 1 1

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3 * RPM, SHEAR STRESS = K1 * K2 * (FANN VISCOMETER READING)

lb/sq ft = dynes/sq cm * 0.002089

RPM READING

	RUN 1	RUN 2	RUN 3
600	59.3	58.5	
300	47.2	46.5	
200	263.0	32.8	33.5
100	152.5	22.7	21.8
181	243.0	29.4	29.0
90	178.5	20.7	19.7
60	79.5	17.8	17.0
30	32.5	13.7	13.0
6	15.5	10.5	10.3
3	11.3	6.8	6.7
1.8	7.8	4.5	4.5
0.9	6.3	3.2	3.2

PHASE SEPARATION FOR MX23

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 APPROX. INIT. GR. VOL., mL: 392 380.2 383.8
 CALC'D GROUT VOLUME, mL: 250 250 250
 253 246 248

(USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1			RUN 2			RUN 3			RUN 3		
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID
	g	g	vol%	g	g	vol%	g	g	vol%	g	g	vol%
0.08	391.8	0	0.07%	380.1	0	0.03%	383.8	0	0.00%			
1	391.8	0	0.07%	380.1	0	0.03%	383.7	0	0.03%			
7	391.8	0	0.07%	380.1	0	0.03%	383.7	0	0.03%			
14	391.6	0	0.13%	379.9	0	0.10%	383.6	0	0.07%			
22	391.6	0	0.13%	379.8	0	0.13%	383.5	0	0.10%			
28	391.6	0	0.13%	379.8	0	0.13%	383.5	0	0.10%			

CURE TIME, d:

	MASS g	DIMENSIONS, in. (CRUSHED SIDE)			FORCE lbf	UCS CALC'D psi	CORR'D psi
		L	W	H			
RUN 1	189.3	2	2	2	4260	1065	1065
RUN 2	187.8	2	2	2	4318	1080	1080
RUN 3	190.5	2	2	2	4257	1064	1064
AVERAGE					1069.58	1069.58	1069.58
STD. DEV.					7.02	7.02	7.02

THERMAL CYCLING FOR MX23

CURE TIME, d: 28
 CUBE LIFE AFTER TESTING, d: 10

	MASS			DIMENSIONS, in.			FORCE		UCS		CORR'D	
	(CRUSHED SIDE)											
	g	L	W	H			lbf		psi		psi	

AFTER THERMAL CYCLING

RUN 1	140.1	2	2	2	2	4240	1060	1060	1060
RUN 2	140	2	2	2	2	4165	1041	1041	1041
RUN 3	135.7	2	2	2	2	4421	1105	1105	1105
AVERAGE							1068.83	1068.83	1068.83
STD. DEV.							26.86	26.86	26.86

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

RUN 1	195.6	2	2	2	2	3984	996	996	996
RUN 2	194.7	2	2	2	2	3863	966	966	966
RUN 3	185.8	2	2	2	2	4238	1060	1060	1060
AVERAGE							1007.08	1007.08	1007.08
STD. DEV.							39.07	39.07	39.07

FANN VISCOMETER READINGS FOR MX24

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1 RUN 2 RUN 3

ROTOR: 1 1 1

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = $K3 \cdot \text{RPM}$, SHEAR STRESS = $K1 \cdot K2 \cdot (\text{FANN VISCOMETER READING})$

lb/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	55.7	75.5	74.1
300	28.9	40.0	40.3
200	20.5	28.7	28.6
100	11.7	16.5	16.3
181	19.1	28.4	26.8
90	10.7	15.7	15.4
60	8.0	11.8	11.2
30	5.3	8.0	7.7
6	2.6	4.3	4.0
3	2.3	3.5	3.5
1.8	2.3	3.8	3.5
0.9	2.0	3.3	3.4

PHASE SEPARATION FOR MX24

LIQUID DENSITY, g/mL:

1.21

INITIAL MASS, g:

	RUN 1	RUN 2	RUN 3
	417.5	412	418.8

APPROX. INIT. GR. VOL., mL:

	RUN 1	RUN 2	RUN 3
	250	250	250

CALC'D GROUT VOLUME, mL:

	RUN 1	RUN 2	RUN 3
	254	249	251

(USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	vol%	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	vol%	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	vol%	MEAS'D TOTAL	MEAS'D LIQUID
0.08333	417.35	9.55	3.16%		411.93	6.73	2.26%		418.65	6.95	2.33%		418.65	6.95
1	417.37	3.47	1.17%		411.88	1.98	0.70%		418.77	0.37	0.13%		418.77	0.37
2	417.32	2.92	1.01%		411.85	0.25	0.13%		418.65	0.45	0.20%		418.65	0.45
7	417.23	2.63	0.94%		411.81	0.21	0.13%		418.59	0.79	0.33%		418.59	0.79
14	417.01	2.11	0.85%		411.55	0.45	0.30%		418.51	0.91	0.39%		418.51	0.91
21	416.9	3.2	1.24%		411.49	0.99	0.50%		418.35	0.95	0.46%		418.35	0.95
28	416.81	3.61	1.40%		411.44	1.04	0.53%		418.3	1.1	0.53%		418.3	1.1

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX24
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS		DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D
	g	L	W	H	lbf	psi	psi	
RUN 1	191	2	1.9375	2	1989	513	497	
RUN 2	198.8	2	1.9375	2	2679	691	670	
RUN 3	198.1	2	1.875	2	2718	725	680	
AVERAGE						643.15	615.5	
STD. DEV.						92.83	83.71	

THERMAL CYCLING FOR MX24

CURE TIME, d: 28
CUBE LIFE AFTER TESTING, d: 11

	MASS			DIMENSIONS, in.			FORCE		UCS		CORR'D UCS	
	(CRUSHED SIDE)											
	g	L	W	H			lbf		psi		psi	
AFTER THERMAL CYCLING												
RUN 1	138.3	2	1.9375	2			3991		1030		998	
RUN 2	146.2	2	1.9375	2			4598		1187		1150	
RUN 3	143.4	2	1.9375	2			4632		1195		1158	
							AVERAGE		1137.29		1101.75	
							STD. DEV.		76.00		73.62	

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

RUN 1	201.7	2	1.9375	2			1909		493		477	
RUN 2	208.2	2	1.9375	2			2744		708		686	
RUN 3	201.8	2	1.9375	2			2399		619		600	
							AVERAGE		606.62		587.67	
							STD. DEV.		88.41		85.65	

FANN VISCOMETER READINGS FOR MX25

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)
lb/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	27.2	27.3	27.4
300	13.4	13.4	13.7
200	10.0	10.0	10.2
100	6.3	6.0	6.1
181	9.4	9.2	9.8
90	5.8	5.7	5.8
60	4.3	4.4	4.5
30	3.0	3.0	3.2
6	2.2	1.7	1.8
3	1.5	1.5	1.5
1.8	1.8	1.5	1.5
0.9	1.5	1.4	1.5

PHASE SEPARATION FOR MX25

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 416.8 416.6 422.6
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 257 257 261
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1			RUN 2			RUN 3		
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID
	g	g	vol%	g	g	vol%	g	g	vol%
0.08333	416.53	25.33	8.23%	416.54	27.24	8.78%	422.51	35.61	11.31%
1	416.56	17.76	5.78%	416.47	22.47	7.27%	422.53	31.93	10.13%
2	416.35	14.15	4.69%	416.44	20.74	6.72%	422.39	28.79	9.18%
7	416.24	11.84	3.98%	416.23	19.03	6.24%	422.27	27.27	8.74%
14	416.04	9.04	3.15%	415.65	18.05	6.11%	422.03	24.23	7.85%
21	415.85	7.35	2.67%	415.57	16.67	5.69%	421.95	23.05	7.51%
28	415.83	8.53	3.05%	415.38	14.88	5.18%	421.83	22.03	7.22%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX25
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS	DIMENSIONS, in.			FORCE	UCS		CORR'D
		(CRUSHED SIDE)				CALC'D	psi	
	g	L	W	H	lbf	psi	psi	
RUN 1	196.4	2	1.75	2	2522	721	631	
RUN 2	184.2	2	1.75	2	2280	651	570	
RUN 3	187.5	2	1.75	2	2352	672	588	
AVERAGE						681.33	596.17	
STD. DEV.						28.99	25.37	

THERMAL CYCLING FOR MX25

CURE TIME, d: 28
 CUBE LIFE AFTER TESTING, d: 10

	MASS g	DIMENSIONS, in. (CRUSHED SIDE)			FORCE lbf	UCS psi	CORR'D UCS psi
		L	W	H			

AFTER THERMAL CYCLING

RUN 1	138.9	2	1.8125	2	2992	825	748
RUN 2	130.2	2	1.75	2	2428	694	607
RUN 3	134	2	1.75	2	3009	860	752
AVERAGE					792.94	702.42	
STD. DEV.					71.55	67.49	

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

RUN 1	200.5	2	1.8125	2	2465	680	616
RUN 2	181.2	2	1.625	2	1941	597	485
RUN 3	196.4	2	1.6875	2	2435	721	609
AVERAGE					666.24	570.08	
STD. DEV.					51.65	60.06	

FANN VISCOMETER READINGS FOR MX26

386

TORSION SPRING ASSEMBLY:		F1 K1, dyne-cm/deg:		
		RUN 1	RUN 2	RUN 3
ROTOR:		1	1	1
BOB:		1	1	1
K2, /cc:		0.01323	0.01323	0.01323
K3, /s/RPM:		1.7023	1.7023	1.7023

SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)
lb/ft² = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	26.7	26.5	26.4
300	13.2	13.2	13.2
200	9.6	9.5	9.5
100	5.6	5.5	5.5
181	9.2	8.8	8.9
90	5.3	5.4	5.2
60	4.2	3.8	4.0
30	2.8	2.5	2.7
6	1.5	1.6	1.5
3	1.4	1.3	1.3
1.8	1.0	1.3	1.3
0.9	1.2	1.3	1.2

PHASE SEPARATION FOR

MX26

LIQUID DENSITY, g/mL:

1.21

RUN 1 RUN 2 RUN 3

INITIAL MASS, g:

412.6 413.6 406.5

APPROX. INIT. GR. VOL., mL:

250 250 250

CALC'D GROUT VOLUME, mL:

258 259 254

(USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1			RUN 2			RUN 3		
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID
	g	g	vol%	g	g	vol%	g	g	vol%
0.08333	412.52	31.42	10.07%	413.6	38.9	12.43%	406.45	33.85	11.03%
1	412.46	26.96	8.67%	413.47	34.67	11.12%	406.39	27.59	9.01%
2	412.38	22.58	7.29%	413.36	30.96	9.97%	406.28	24.18	7.94%
7	412.2	20.3	6.62%	413.36	30.96	9.97%	406.13	20.63	6.83%
14	411.95	19.35	6.40%	413.03	29.13	9.49%	405.76	19.96	6.73%
21	411.86	18.76	6.24%	412.87	28.17	9.23%	405.68	19.08	6.47%
28	411.68	18.78	6.30%	412.83	28.13	9.23%	405.53	19.63	6.70%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX26
 ASSUME 2-in. CUBES INITIALLY

CURE TIME, d:		28									
	MASS	DIMENSIONS, in.			FORCE	UCS					
		(CRUSHED SIDE)				CALC'D	psi	CORR'D	psi		
	g	L	W	H	lbf						
RUN 1	191.1	2	1.875	2	1935	516	484				
RUN 2	187.8	2	1.8125	2	1565	432	391				
RUN 3	180.7	2	1.8125	2	1590	439	398				
AVERAGE						462.11	424.17				
STD. DEV.						38.21	42.21				

THERMAL CYCLING FOR MX26

CURE TIME, d: 28
 CUBE LIFE AFTER TESTING, d: 10

	MASS		DIMENSIONS, in.		FORCE	UCS		CORR'D UCS
	(CRUSHED SIDE)		L	W	H	lbf	psi	psi
	g							
AFTER THERMAL CYCLING								
RUN 1	123.1	2	1.75		2	1571	449	393
RUN 2	127.8	2	1.6875		2	1607	476	402
RUN 3	120.4	2	1.6875		2	1510	447	378
						AVERAGE	457.47	390.67
						STD. DEV.	13.22	10.01

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

RUN 1	178.5	2	1.6875		2	1830	542	458
RUN 2	179.5	2	1.6875		2	1623	481	406
RUN 3	182	2	1.75		2	1629	465	407
						AVERAGE	496.18	423.5
						STD. DEV.	33.16	24.05

FANN VISCOMETER READINGS FOR MX27

386

TORSION SPRING ASSEMBLY:		F1 K1, dyne-cm/deg:		
		RUN 1	RUN 2	RUN 3
ROTOR:		1	1	1
BOB:		1	1	1
K2, /cc:		0.01323	0.01323	0.01323
K3, /s/RPM:		1.7023	1.7023	1.7023

SHEAR RATE = K3 * RPM, SHEAR STRESS = K1 * K2 * (FANN VISCOMETER READING)
lb/ft² = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	41.0	41.5	41.8
300	20.3	21.4	21.6
200	15.6	15.7	15.8
100	9.3	9.4	9.8
181	15.2	14.9	15.3
90	8.8	8.9	9.2
60	6.7	6.7	7.0
30	4.8	4.8	5.2
6	2.7	2.8	2.9
3	2.5	2.4	2.6
1.8	2.5	2.5	2.6
0.9	2.4	2.4	2.5

PHASE SEPARATION FOR MX27

LIQUID DENSITY, g/mL: 1.21

RUN 1 RUN 2 RUN 3

INITIAL MASS, g: 448.4 440.5 445.6

APPROX. INIT. GR. VOL., mL: 250 250 250

CALC'D GROUT VOLUME, mL: 257 253 256

(USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	FREE ST. LIQUID
	g	g	g	vol%	g	g	g	vol%	g	g	g	g	g	vol%
0.08333	448.34	19.24	440.35	6.20%	440.35	19.35	445.51	6.38%	445.51	19.81	444.88	13.58	12.77	4.40%
1	448.25	16.15	440.49	5.24%	440.49	17.69	445.5	5.79%	445.5	16.2	444.77	12.77	12.19	4.24%
2	448.06	15.26	440.32	5.01%	440.32	16.62	445.38	5.49%	445.38	15.18	444.88	13.58	12.77	4.40%
8	447.77	13.57	440.15	4.56%	440.15	15.05	445.23	5.04%	445.23	14.13	444.88	13.58	12.77	4.40%
14	447.83	13.83	440.04	4.63%	440.04	14.24	444.88	4.81%	444.88	13.58	444.77	12.77	12.19	4.24%
21	447.76	13.86	439.86	4.66%	439.86	11.86	444.77	4.09%	444.77	12.77	444.69	12.19	11.86	4.24%
28	447.69	12.69	439.82	4.31%	439.82	9.82	444.69	3.43%	444.69	12.19	444.69	12.19	11.86	4.24%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX27
 ASSUME 2-in. CUBES INITIALLY

CURE TIME, d:		28									
	MASS g	DIMENSIONS, in. (CRUSHED SIDE)			FORCE lbf	UCS					
		L	W	H		CALC'D psi	CORR'D psi				
RUN 1	209.8	2	1.875	2	2336	623	584				
RUN 2	209.9	2	1.875	2	2165	577	541				
RUN 3	206.3	2	1.9375	2	2182	563	546				
AVERAGE						587.79	556.92				
STD. DEV.						25.52	19.23				

THERMAL CYCLING FOR MX27

CURE TIME, d: 28
 CUBE LIFE AFTER TESTING, d: 10

	MASS		DIMENSIONS, in. (CRUSHED SIDE)			FORCE		UCS		CORR'D UCS	
	g	L	W	H		lbf		psi		psi	
AFTER THERMAL CYCLING											
RUN 1	160.3	2	1.9375	2	2038		526		510		
RUN 2	161.6	2	1.9375	2	1626		420		407		
RUN 3	164.5	2	1.9375	2	2113		545		528		
						AVERAGE	496.95		481.42		
						STD. DEV.	55.25		53.52		

COMPARATOR NOT SUBJECTED TO THERMAL CYCLING

RUN 1	213.9	2	1.9375	2	2345		605		586		
RUN 2	216	2	1.9375	2	2676		691		669		
RUN 3	213.8	2	1.9375	2	2494		644		624		
						AVERAGE	646.45		626.25		
						STD. DEV.	34.93		33.84		

FANN VISCOMETER READINGS FOR MX28

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1 RUN 2 RUN 3

ROTOR: 1 1 1

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)

lb/ft² = dynes/cm² * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	34.0	34.5	33.3
300	16.5	16.4	16.2
200	11.8	11.8	11.5
100	6.5	6.6	6.7
181	10.9	10.8	11.0
90	6.3	6.2	6.0
60	4.4	4.4	4.2
30	2.6	2.5	2.6
6	1.3	1.3	1.3
3	1.2	1.3	1.2
1.8	1.2	1.0	1.0
0.9	0.8	0.8	0.8

PHASE SEPARATION FOR MX28

LIQUID DENSITY, g/mL:

1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	403.5	396.6	409.4
APPROX. INIT. GR. VOL., mL:	250	250	250
CALC'D GROUT VOLUME, mL:	255	251	259

(USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	FREE ST. LIQUID
	g	g	g	vol%	g	g	g	vol%	g	g	g	g	g	vol%
0.08	403.27	40.97	13.34%	43.28	396.48	35.99	14.30%	409.27	47.87	15.32%	40.66	13.02%	35.34	11.36%
1	403.15	35.45	11.59%	30.04	396.39	22.04	9.98%	409.14	26.76	8.68%	25.35	8.36%	24.04	8.01%
2	403.07	28.87	9.49%	22.37	396.34	19.05	7.64%	408.96	24.04	8.62%	24.04	8.01%	24.04	8.01%
7	402.96	21.36	7.09%	17.18	395.94	17.18	6.59%	408.58	24.04	8.62%	24.04	8.01%	24.04	8.01%
14	402.78	21.28	7.12%	17.18	395.77	17.18	6.59%	408.58	24.04	8.62%	24.04	8.01%	24.04	8.01%
21	402.67	18.07	6.12%	17.18	395.65	17.18	6.59%	408.58	24.04	8.62%	24.04	8.01%	24.04	8.01%
28	402.51	14.71	5.08%	17.18	395.48	17.18	6.59%	408.58	24.04	8.62%	24.04	8.01%	24.04	8.01%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX28
 ASSUME 2-in. CUBES INITIALLY

CURE TIME, d:		28									
	MASS	DIMENSIONS, in.			FORCE	UCS		CORR'D	psi	CORR'D	psi
		(CRUSHED SIDE)				CALC'D					
	g	L	W	H	lbf	psi					
RUN 1	182.5	2	1.88	2	5304	1414			1326		
RUN 2	181.6	2	1.88	2	5627	1501			1407		
RUN 3	180.9	2	1.88	2	4905	1308			1226		
AVERAGE						1407.64			1319.67		
STD. DEV.						78.75			73.82		

THERMAL CYCLING FOR												MX28	

CURE TIME, d:												28	
CUBE LIFE AFTER TESTING, d:												11	
MASS		DIMENSIONS, in.			FORCE		UCS		CORR'D				
		(CRUSHED SIDE)							UCS				
g		L	W	H	lbf	psi	psi			-----			
AFTER THERMAL CYCLING													
RUN 1	143	2	1.88	2	4920	1312			1230				
RUN 2	143.1	2	1.88	2	4548	1213			1137				
RUN 3	143.2	2	1.88	2	4691	1251			1173				
					AVERAGE	1258.58			1179.92				
					STD. DEV.	40.86			38.30				
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING													
RUN 1	189.2	2	1.88	2	4816	1284			1204				
RUN 2	188.7	2	1.88	2	4757	1269			1189				
RUN 3	187.3	2	1.88	2	4789	1277			1197				
					AVERAGE	1276.62			1196.83				
					STD. DEV.	6.43			6.03				

FANN VISCOMETER READINGS FOR MX29

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1

BOB:	1	1	1
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K2, /cc:	0.01323	0.01323	0.01323
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K3, /s/RPM:	1.7023	1.7023	1.7023
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SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)
 lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	101.0	103.7	102.8
300	61.0	62.0	60.3
200	50.5	51.0	50.6
100	30.7	31.0	30.8
181	47.5	49.5	49.3
90	29.3	31.0	30.0
60	21.9	23.5	22.3
30	15.0	15.4	15.0
6	9.5	9.7	9.4
3	8.6	9.3	8.6
1.8	7.0	7.0	7.0
0.9	4.9	4.7	5.0

PHASE SEPARATION FOR MX29

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 396.1 408.6 403.5
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 255 262 260
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	vol%	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	vol%	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	vol%	MEAS'D TOTAL	MEAS'D LIQUID
0.08	396.13	3.93	1.27%		408.45	4.45	1.45%		403.43	3.83	1.24%		403.43	3.83
2	396.1	0	0.00%		408.4	0	0.06%		403.4	0	0.03%		403.4	0
7	395.9	0	0.06%		408.3	0	0.09%		403.18	0.28	0.19%		403.18	0.28
14	395.9	0	0.06%		408.3	0	0.09%		403.1	0	0.13%		403.1	0
21	395.8	0	0.10%		408.2	0	0.13%		402.9	0	0.19%		402.9	0
28	395.8	0	0.10%		408.1	0	0.16%		402.8	0	0.22%		402.8	0

CURE TIME, d: 28

	MASS g	DIMENSIONS, in. (CRUSHED SIDE)			FORCE lbf	UCS CALC'D psi	CORR'D psi
		L	W	H			
RUN 1	186.1	2	2	2	1689	422	422
RUN 2	188.5	2	2	2	1725	431	431
RUN 3	183.4	2	2	2	1643	411	411
AVERAGE					421.42	421.42	421.42
STD. DEV.					8.39	8.39	8.39

THERMAL CYCLING FOR		MX29									
CURE TIME, d:		28									
CUBE LIFE AFTER TESTING, d:		12									
	MASS	DIMENSIONS, in.			FORCE	UCS	CORR'D UCS				
	(CRUSHED SIDE)	L	W	H	lbf	psi	psi				
AFTER THERMAL CYCLING											
RUN 1	121.5	2	2	2	2193	548	548				
RUN 2	119.6	2	2	2	2116	529	529				
RUN 3	121.8	2	2	2	1795	449	449				
					AVERAGE	508.67	508.67				
					STD. DEV.	43.09	43.09				
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING											
RUN 1	193.3	2	2	2	1636	409	409				
RUN 2	196	2	2	2	1809	452	452				
RUN 3	191.5	2	2	2	1584	396	396				
					AVERAGE	419.08	419.08				
					STD. DEV.	24.05	24.05

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FANN VISCOMETER READINGS FOR MX30

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1	RUN 2	RUN 3
1	1	1
1	1	1
0.01323	0.01323	0.01323
1.7023	1.7023	1.7023

ROTOR: 1 1 1

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = $K3 \cdot \text{RPM}$, SHEAR STRESS = $K1 \cdot K2 \cdot (\text{FANN VISCOMETER READING})$
 lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	18.2	18.2	18.0
300	7.8	8.2	8.2
200	5.7	5.8	6.0
100	3.3	3.2	3.3
181	5.5	5.4	5.3
90	3.0	3.0	2.9
60	2.2	2.3	2.4
30	1.5	1.6	1.5
6	0.9	0.8	0.6
3	0.6	0.6	0.5
1.8	0.6	0.5	0.4
0.9	0.6	0.5	0.4

PHASE SEPARATION FOR MX30

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 379.5 373.9 380
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 256 251 256
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	vol%	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	vol%	MEAS'D TOTAL	MEAS'D LIQUID
0.08	379.42	71.27	23.04%	373.58	72.46	23.95%	379.74	79.03	25.63%							
1	379.02	68.6	22.30%	373.31	69.93	23.20%	379.21	76.45	24.97%							
2	378.9	61.38	20.01%	373.13	64.68	21.54%	379.02	69.45	22.76%							
7	378.73	58.52	19.14%	373.02	57.33	19.15%	378.6	63.1	20.85%							
14	378.48	55.2	18.15%	372.73	55.55	18.66%	378.17	60.82	20.25%							
21	378.27	53.73	17.74%	372.53	53.77	18.14%	377.95	59.72	19.97%							
28	377.99	53.16	17.65%	372.22	53.19	18.05%	376.81	58.6	19.97%							

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX30
 ASSUME 2-in. CUBES INITIALLY

CURE TIME, d:		28									
	MASS	DIMENSIONS, in.			FORCE	UCS	CORR'D	UCS	CORR'D		
		(CRUSHED SIDE)									
	g	L	W	H	lbf	psi	psi	psi	psi		
RUN 1	145.4	2	1.38	2	2932	1066	733				
RUN 2	144.7	2	1.44	2	2627	914	657				
RUN 3	150.6	2	1.44	2	2410	838	603				
AVERAGE						939.39	664.08				
STD. DEV.						94.80	53.53				

THERMAL CYCLING FOR										MX30	
CURE TIME, d:										28	
CUBE LIFE AFTER TESTING, d:										10	
	MASS	DIMENSIONS, in.				FORCE	UCS	CORR'D	UCS		
		(CRUSHED SIDE)									
	g	L	W	H	lbf	psi	psi				
AFTER THERMAL CYCLING											
RUN 1	102.9	2	1.5	2	2115	705		529			
RUN 2	106.3	2	1.5	2	1865	622		466			
RUN 3	106.8	2	1.56	2	1605	514		401			
					AVERAGE	613.42		465.42			
					STD. DEV.	78.36		52.05			
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING											
RUN 1	149	2	1.5	2	2760	920		690			
RUN 2	152.6	2	1.5	2	2292	764		573			
RUN 3	159.8	2	1.56	2	1740	557		435			
					AVERAGE	746.93		566.00			
					STD. DEV.	148.77		104.22			

FANN VISCOMETER READINGS FOR MX31

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

SHEAR RATE = K3 * RPM, SHEAR STRESS = K1 * K2 * (FANN VISCOMETER READING)

lb/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	48.2	48.4	48.5
300	25.0	25.2	24.8
200	17.8	17.9	18.0
100	10.2	10.0	9.8
181	16.5	16.8	16.5
90	9.2	9.4	9.3
60	6.7	6.7	6.6
30	4.5	4.2	4.3
6	2.4	2.1	2.0
3	1.8	1.6	1.5
1.8	1.5	1.4	1.5
0.9	1.5	1.4	1.5

PHASE SEPARATION FOR MX31

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 396.1 398.3 389
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 258 259 253
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1		RUN 1		RUN 2		RUN 2		RUN 2		RUN 3		RUN 3		RUN 3	
	MEAS'D TOTAL	LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	FREE ST. LIQUID
	g	g	g	vol%	g	g	g	vol%	g	g	g	g	g	g	vol%	vol%
0.08	396.09	13.19	4.23%	13.64	398.24	13.64	398.94	4.37%	388.78	13.74	388.94	13.74	388.94	13.74	4.50%	4.50%
1	395.87	8.07	2.66%	6	398.2	6	388.78	1.94%	388.78	9.28	388.78	9.28	388.78	9.28	3.10%	3.10%
2	395.82	3.82	1.31%	3.21	398.01	3.21	388.75	1.12%	388.75	4.55	388.75	4.55	388.75	4.55	1.57%	1.57%
7	395.62	1.52	0.64%	1.6	397.8	1.6	388.55	0.67%	388.55	2.65	388.55	2.65	388.55	2.65	1.01%	1.01%
14	395.49	0.69	0.42%	0.68	397.68	0.68	388.43	0.41%	388.43	1.83	388.43	1.83	388.43	1.83	0.78%	0.78%
21	395.31	0.51	0.42%	0.41	397.61	0.41	388.38	0.35%	388.38	1.78	388.38	1.78	388.38	1.78	0.78%	0.78%
28	395.2	0	0.29%	0.2	397.5	0.2	387.9	0.32%	387.9	0.2	387.9	0.2	387.9	0.2	0.42%	0.42%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX31
 ASSUME 2-in. CUBES INITIALLY

CURE TIME, d:		28									
	MASS g	DIMENSIONS, in.			FORCE lbf	UCS CALC'D		CORR'D			
		(CRUSHED SIDE)	L	W	H	psi	psi	psi	psi		
RUN 1	182.4	2	1.88	2	2516	671	629				
RUN 2	179.6	2	1.88	2	2549	680	637				
RUN 3	186.8	2	1.88	2	2543	678	636				
AVERAGE						676.27	634.00				
STD. DEV.						3.83	3.59				

THERMAL CYCLING FOR										MX31	
CURE TIME, d:										28	
CUBE LIFE AFTER TESTING, d:										10	
	MASS	DIMENSIONS, in.			FORCE	UCS	CORR'D UCS				
		(CRUSHED SIDE)									
	g	L	W	H	lbf	psi	psi				
AFTER THERMAL CYCLING											
RUN 1	125.8	2	1.94	2	1796	463	449				
RUN 2	125.6	2	1.94	2	1796	463	449				
RUN 3	126.2	2	1.94	2	1754	453	439				
					AVERAGE	459.87	445.50				
					STD. DEV.	5.11	4.95				
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING											
RUN 1	187.5	2	1.94	2	2417	624	604				
RUN 2	190.2	2	1.94	2	2544	657	636				
RUN 3	190.1	2	1.94	2	2324	600	581				
					AVERAGE	626.67	607.08				
					STD. DEV.	23.27	22.54				

FANN VISCOMETER READINGS FOR MX32

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1 RUN 2 RUN 3

ROTOR: 1 1 1

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3 * RPM, SHEAR STRESS = K1 * K2 * (FANN VISCOMETER READING)

lb/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	143.0	148.2	147.0
300	79.7	80.5	82.6
200	71.5	67.4	70.4
100	41.0	39.5	37.7
181	68.5	67.2	63.8
90	37.0	36.7	35.3
60	27.5	27.3	26.0
30	17.3	17.4	16.5
6	9.0	9.5	8.8
3	7.7	8.3	7.7
1.8	6.4	6.8	6.5
0.9	4.5	5.4	4.8

PHASE SEPARATION FOR MX32

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 416.6 402.6 410.8
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 258 249 255
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1			RUN 2			RUN 3		
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID
	g	g	vol%	g	g	vol%	g	g	vol%
0.08	416.6	3.8	1.22%	402.49	2.49	0.86%	410.73	3.53	1.17%
1	416.5	0	0.03%	402.5	0	0.03%	410.7	0	0.03%
2	416.5	0	0.03%	402.5	0	0.03%	410.7	0	0.03%
8	416.4	0	0.06%	402.4	0	0.07%	410.6	0	0.06%
14	416.4	0	0.06%	402.4	0	0.07%	410.6	0	0.06%
21	416.3	0	0.10%	402.2	0	0.13%	410.6	0	0.06%
28	416.2	0	0.13%	402.1	0	0.17%	410.6	0	0.06%

THERMAL CYCLING FOR								MX32	
CURE TIME, d:		28							
CUBE LIFE AFTER TESTING, d:		13							
	MASS	DIMENSIONS, in.			FORCE	UCS	CORR'D UCS		
		(CRUSHED SIDE)							
	g	L	W	H	lbf	psi	psi		
AFTER THERMAL CYCLING									
RUN 1	144.6	2	2	2	8400	2100	2100		
RUN 2	146.8	2	2	2	6970	1743	1743		
RUN 3	146.1	2	2	2	8030	2008	2008		
					AVERAGE	1950.00	1950.00		
					STD. DEV.	151.51	151.51		
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING									
RUN 1	200	2	2	2	7210	1803	1803		
RUN 2	203	2	2	2	7670	1918	1918		
RUN 3	204.1	2	2	2	6650	1663	1663		
					AVERAGE	1794.17	1794.17		
					STD. DEV.	104.27	104.27		

FANN VISCOMETER READINGS FOR MX33

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386
RUN 1 RUN 2 RUN 3
ROTOR: 1 1 1
BOB: 1 1 1
K2, /cc: 0.01323 0.01323 0.01323
K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3 * RPM, SHEAR STRESS = K1 * K2 * (FANN VISCOMETER READING)
lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	120.8	117.8	118.2
300	65.6	68.7	68.5
200	55.6	54.3	53.5
100	32.5	32.4	31.8
181	53.8	51.8	51.2
90	30.7	30.5	29.8
60	22.7	23.0	21.4
30	14.0	15.0	13.7
6	7.9	9.5	9.0
3	7.0	7.3	7.8
1.8	6.4	6.0	6.8
0.9	4.4	4.0	5.2

PHASE SEPARATION FOR MX33

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	393.6	406.1	411.4
APPROX. INIT. GR. VOL., mL:	250	250	250
CALC'D GROUT VOLUME, mL:	253	260	264

(USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1			RUN 2			RUN 3		
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID
	g	g	vol%	g	g	vol%	g	g	vol%
0.08333	393.53	1.93	0.65%	406.04	2.34	0.76%	411.35	2.45	0.78%
1	393.5	0	0.03%	406	0	0.03%	411.3	0	0.03%
2	393.5	0	0.03%	406	0	0.03%	411.3	0	0.03%
7	393.4	0	0.07%	406	0	0.03%	411.2	0	0.06%
14	393.3	0	0.10%	405.9	0	0.06%	411.2	0	0.06%
21	393.3	0	0.10%	405.8	0	0.10%	411.1	0	0.09%
28	393.2	0	0.13%	405.7	0	0.13%	411	0	0.13%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX333
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d:

	MASS g	DIMENSIONS, in. (CRUSHED SIDE)			FORCE lbf	UCS CALC'D psi	CORR'D psi
		L	W	H			
RUN 1	187.9	2	2	2	3855	964	964
RUN 2	196.1	2	2	2	3647	912	912
RUN 3	198.8	2	2	2	4069	1017	1017
AVERAGE						964.25	964.25
STD. DEV.						43.07	43.07

THERMAL CYCLING FOR								MX33	
CURE TIME, d:								28	
CUBE LIFE AFTER TESTING, d:								12	
	MASS	DIMENSIONS, in.			FORCE	UCS	CORR'D UCS		
		(CRUSHED SIDE)							
	g	L	W	H	lbf	psi	psi		
AFTER THERMAL CYCLING									
RUN 1	132.4	2	2	2	3350	838	838		
RUN 2	133.8	2	2	2	3534	884	884		
RUN 3	131.1	2	2	2	3628	907	907		
					AVERAGE	876	876		
					STD. DEV.	28.86	28.86		
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING									
RUN 1	199.4	2	2	2	3713	928	928		
RUN 2	198.1	2	2	2	4033	1008	1008		
RUN 3	193.3	2	2	2	4004	1001	1001		
					AVERAGE	979.17	979.17		
					STD. DEV.	36.12	36.12		

FANN VISCOMETER READINGS FOR MX34

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

ROTOR: RUN 1 RUN 2 RUN 3

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)
lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	18.3	18.4	18.8
300	8.6	8.8	8.7
200	6.3	6.5	6.5
100	3.5	3.8	3.6
181	5.8	6.0	6.0
90	3.4	3.4	3.4
60	2.5	2.6	2.4
30	1.6	1.7	1.6
6	0.6	0.8	1.0
3	0.6	0.6	0.6
1.8	0.3	0.4	0.5
0.9	0.3	0.4	0.5

PHASE SEPARATION FOR MX34

LIQUID DENSITY, g/mL: 1.21

INITIAL MASS, g: RUN 1 RUN 2 RUN 3
 414.2 419.5 409.5
 APPROX. INIT. GR. VOL., mL: 250 250 250
 CALC'D GROUT VOLUME, mL: 262 266 259
 (USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1			RUN 2			RUN 3		
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID
	g	g	vol%	g	g	vol%	g	g	vol%
0.08333	414.43	75.33	23.66%	419.2	71.94	22.47%	405.24	67.44	21.57%
1	413.65	74.85	23.75%	418.88	71.68	22.49%	409.07	66.67	21.38%
2	413.56	71.26	22.65%	418.75	69.35	21.80%	408.92	64.12	20.61%
7	413.23	69.63	22.24%	418.62	67.82	21.37%	408.78	62.38	20.10%
14	413.03	67.73	21.70%	418.6	67.1	21.15%	408.66	61.46	19.85%
21	412.86	66.36	21.32%	418.37	64.57	20.43%	408.52	59.62	19.31%
28	412.59	64.79	20.91%	418.17	62.47	19.84%	408.32	58.32	18.96%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX34
 ASSUME 2-in. CUBES INITIALLY

CURE TIME, d:		28									
	MASS	DIMENSIONS, in.				FORCE	UCS		CORR'D		
		(CRUSHED SIDE)					CALC'D				
	g	L	W	H	lbf	psi	psi	psi			
RUN 1	160.8	2	1.625	2	602	185		151			
RUN 2	165.7	2	1.625	2	631	194		158			
RUN 3	159.8	2	1.625	2	553	170		138			
AVERAGE						183.18		148.83			
STD. DEV.						9.90		8.05			

THERMAL CYCLING FOR											MX34			
CURE TIME, d:													28	
CUBE LIFE AFTER TESTING, d:													12	
	MASS	DIMENSIONS, in.			FORCE	UCS	CORR'D							
		(CRUSHED SIDE)												
	g	L	W	H	lbf	psi								
AFTER THERMAL CYCLING														
RUN 1	103.6	2	1.6875	2	429	127					107			
RUN 2	106.9	2	1.625	2	1259	387					315			
RUN 3	101.1	2	1.5	2	1012	337					253			
					AVERAGE	283.94					225			
					STD. DEV.	112.76					86.99			
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING														
RUN 1	167.1	2	1.625	2	378	116					95			
RUN 2	172.8	2	1.625	2	537	165					134			
RUN 3	161.6	2	1.625	2	492	151					123			
					AVERAGE	144.31					117.25			
					STD. DEV.	20.59					16.73			

FANN VISCOMETER READINGS FOR MX35

TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

RUN 1 RUN 2 RUN 3

ROTOR: 1 1 1

BOB: 1 1 1

K2, /cc: 0.01323 0.01323 0.01323

K3, /s/RPM: 1.7023 1.7023 1.7023

SHEAR RATE = $K3 \cdot \text{RPM}$, SHEAR STRESS = $K1 \cdot K2 \cdot (\text{FANN VISCOMETER READING})$

lb/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	128.5	135.5	133.5
300	78.3	78.5	77.8
200	58.3	60.6	58.3
100	35.5	37.0	35.5
181	57.7	58.7	57.1
90	34.4	35.4	34.0
60	26.0	26.5	25.7
30	17.4	18.2	17.2
6	10.5	10.9	10.5
3	9.7	10.0	10.0
1.8	8.0	7.5	7.5
0.9	5.9	5.5	5.5

PHASE SEPARATION FOR MX35

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	427.8	436.7	440.5
APPROX. INIT. GR. VOL., mL:	250	250	250
CALC'D GROUT VOLUME, mL:	254	260	262

(USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1			RUN 2			RUN 3		
	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID	MEAS'D TOTAL	MEAS'D LIQUID	FREE ST. LIQUID
	g	g	vol%	g	g	vol%	g	g	vol%
0.08333	427.63	3.23	1.11%	436.49	2.19	0.76%	440.43	3.53	1.14%
1	427.61	0.21	0.13%	436.6	0	0.03%	440.4	0	0.03%
2	427.6	0	0.07%	436.6	0	0.03%	440.4	0	0.03%
7	427.6	0	0.07%	436.5	0	0.06%	440.4	0	0.03%
14	427.5	0	0.10%	436.5	0	0.06%	440.3	0	0.06%
21	427.4	0	0.13%	436.4	0	0.10%	440.2	0	0.09%
28	427.4	0	0.13%	436.3	0	0.13%	440.1	0	0.13%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX35
 ASSUME 2-in. CUBES INITIALLY

CURE TIME, d:		28									
	MASS g	DIMENSIONS, in. (CRUSHED SIDE)			FORCE lbf	UCS CALC'D		UCS CORR'D			
		L	W	H		psi	psi	psi	psi		
RUN 1	210.2	2	2	2	2738	685	685	685	685		
RUN 2	209.6	2	1.375	2	2546	926	926	637	637		
RUN 3	203	2	1.5	2	2459	820	820	615	615		
AVERAGE						809.99	809.99	645.25	645.25		
STD. DEV.						98.75	98.75	29.14	29.14		

THERMAL CYCLING FOR										MX35	
CURE TIME, d:										28	
CUBE LIFE AFTER TESTING, d:										11	
	MASS	DIMENSIONS, in.			FORCE	UCS	CORR'D UCS				
		(CRUSHED SIDE)									
	g	L	W	H	lbf	psi	psi				
AFTER THERMAL CYCLING											
RUN 1	149.6	2	2	2	2660	665	665				
RUN 2	112.8	2	1.5	2	2144	715	536				
RUN 3	152.9	2	2	2	2616	654	654				
					AVERAGE	677.89	618.33				
					STD. DEV.	26.39	58.39				
COMPARATOR NOT SUBJECTED TO THERMAL CYCLING											
RUN 1	214.5	2	2	2	2474	619	619				
RUN 2	171.6	2	1.5	2	1484	495	371				
RUN 3	146.9	2	1.4375	2	2084	725	521				
					AVERAGE	612.68	503.5				
					STD. DEV.	94.07	101.80				

Appendix J
ADIABATIC CALORIMETRY DATA

Appendix J
ADIABATIC CALORIMETRY DATA

Data from "ORNL.01"

Data from "ORNL.02"

Data from "ORNL.03"

Data from "ORNL.04"

Data from "ORNL.05"

Data from "ORNL.06"

Data from "ORNL.07"

Data from "ORNL.08"

Data from "ORNL.09"

Data from "ORNL.10"

J-8

Data from "ORNL.11"

Data from "ORNL.12"

Data from "ORNL.13"

Data from "ORNL.14"

Data from "ORNL.15"

Data from "ORNL.16"

Data from "ORNL.17 Corr"

Data from "ORNL.18"

Data from "ORNL.19"

Data from "ORNL.20"

Data from "ORNL.21"

Appendix K
LEACH DATA FOR PHASE I

Appendix K
LEACH DATA FOR PHASE I

ANSI/ANS-16.1-1986 Leaching Data				Phase I: Binder Selection for 106-AN			
Run No.:	BFS-HIGH			Surrogate 106-AN Concentrations, mg/mL			
Mix Ratio	15	lb/gal	Chloride	Nitrite	Nitrate	Sulfate	
			5.32	34.87	79.99	2.98	
Sample Cylinder Dimensions			After Curing 28 d				
	Initially			Batch 1	Batch 2	Batch 3	
	Vol, cc	2.50	Dia., cm	2.55	2.55	2.55	
	22.83	4.65	Length,cm	4.67	4.55	4.57	
	Grout Density, lb/gal			15.18	15.08	15.00	
mL of 106-AN in Sample Cylinder				13.75	13.66	13.59	
Leach Vol + Boric Acid Vol Added, mL				481.1	471.4	473	
Leachate Concentrations			Mass in Leachate				
		mg/L			mg		Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
BFS-HIGH Chloride	Initially:			73.13	72.64	72.26	
0	0.9	0.96	1.92	0.43	0.45	0.91	0
1	14.51	13.68	16.13	6.98	6.45	7.63	0.083333
2	12.23	11.36	13.08	5.88	5.36	6.19	0.291666
3	20.52	19.27	28.69	9.87	9.08	13.57	1
4	16.67	15.64	16.64	8.02	7.37	7.87	2
5	11.55	10.87	10.79	5.56	5.12	5.10	3
6	8.1	7.9	4.39	3.90	3.72	2.08	4
7	6.28	6.23	5.74	3.02	2.94	2.72	5
BFS-HIGH Nitrite	Initially:			479.51	476.35	473.82	
0	1.72	1.86	4.63	0.83	0.88	2.19	0
1	45.6	45.54	55.47	21.94	21.47	26.24	0.083333
2	39.85	36.46	42.86	19.17	17.19	20.27	0.291666
3	71.94	66.12	86.26	34.61	31.17	40.80	1
4	59.71	52.39	55.61	28.73	24.70	26.30	2
5	41.62	35.41	38.83	20.02	16.69	18.37	3
6	26.92	26.12	25.97	12.95	12.31	12.28	4
7	20.53	19.75	19.19	9.88	9.31	9.08	5
BFS-HIGH Nitrate	Initially:			1099.85	1092.61	1086.81	
0	10.84	11.47	25.41	5.22	5.41	12.02	0
1	195.88	197.23	239.15	94.24	92.97	113.12	0.083333
2	177.98	165.08	192.46	85.63	77.82	91.03	0.291666
3	313.54	293	331.04	150.84	138.12	156.58	1
4	251.34	239.54	252.41	120.92	112.92	119.39	2
5	170.31	164.29	170.28	81.94	77.45	80.54	3
6	129.86	124.86	126.6	62.48	58.86	59.88	4
7	101.92	100.04	97.22	49.03	47.16	45.99	5

K-4

BFS-HIGH Sulfate		Initially:		40.95	40.68	40.46	
0	5.1	3.88	6.73	2.45	1.83	3.18	0
1	55	50.4	60.6	26.46	23.76	28.66	0.083333
2	45.24	41.87	54.95	21.76	19.74	25.99	0.291666
3	83.41	75.92	86.61	40.13	35.79	40.97	1
4	71.85	66.65	73.87	34.57	31.42	34.94	2
5	52.13	48.98	51.36	25.08	23.09	24.29	3
6	44.96	42.27	43.04	21.63	19.93	20.36	4
7	42.62	50.04	42.32	20.50	23.59	20.02	5

Cumulative Amount Leached, mg Observed				(Adding Rinse to Interval 1) Calculated (NEWBOX) (No Washoff or Washout)			Time d
mg				mg			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	

BFS-HIGH Chloride

				0.00	0.00	0.00	0
1	7.41	6.90	8.54	7.11	6.49	8.17	0.083333
2	13.30	12.26	14.72	13.02	11.91	14.81	0.291666
3	23.17	21.34	28.29	22.89	20.99	25.87	1
4	31.19	28.71	36.17	31.01	28.55	34.76	2
5	36.75	33.84	41.27	36.64	33.85	40.75	3
6	40.64	37.56	43.35	41.03	38.06	45.45	4
7	43.66	40.50	46.06	44.68	41.48	49.14	5

Added in 106-AN				Newbox Estimate		
Ao =	73.13	72.64	72.26	73.13	72.64	72.26

Per cent of 106-AN ion leachable:	100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:	2.75E-07	2.28E-07	3.70E-07
Std. Deviation, sq cm/s:	8.77E-09	8.92E-09	3.95E-08
Leachability Index:	6.560	6.641	6.432
Upper 95% Confidence Int.:	0.014	0.017	0.048
Lower 95% Confidence Int.:	0.013	0.016	0.043

BFS-HIGH Nitrite

				0.00	0.00	0.00	0
1	22.77	22.34	28.43	22.01	19.86	24.16	0.083333
2	41.94	39.53	48.70	40.76	36.82	44.73	0.291666
3	76.55	70.70	89.50	73.84	66.69	80.55	1
4	105.27	95.40	115.80	102.14	92.89	111.82	2
5	125.30	112.09	134.17	123.23	111.94	134.56	3
6	138.25	124.40	146.45	140.50	127.66	153.04	4
7	148.13	133.71	155.53	155.36	141.48	168.68	5

K-5

Added in 106-AN				Newbox Estimate			
Ao =	479.51	476.35	473.82	479.51	476.35	473.82	
Per cent of 106-AN ion leachable:				100%	100%	100%	
Eff. Diffusion Coefficient, sq cm/s:				5.94E-08	4.83E-08	7.29E-08	
Std. Deviation, sq cm/s:				3.35E-09	3.96E-09	9.12E-09	
Leachability Index:				7.227	7.316	7.137	
Upper 95% Confidence Int.:				0.024	0.036	0.056	
Lower 95% Confidence Int.:				0.023	0.033	0.050	
BFS-HIGH Nitrate							
				0.00	0.00	0.00	0
1	99.45	98.38	125.14	103.28	96.26	113.03	0.083333
2	185.08	176.20	216.17	189.17	175.91	206.49	0.291666
3	335.92	314.32	372.75	333.25	312.49	362.99	1
4	450.84	427.24	492.14	452.04	423.93	490.15	2
5	538.78	504.69	572.68	534.53	503.69	577.10	3
6	601.25	563.54	632.57	600.52	565.97	644.48	4
7	650.29	610.70	678.55	653.31	617.32	699.91	5

Added in 106-AN				Newbox Estimate			
Ao =	1099.85	1092.61	1086.81	1099.85	1092.61	1086.81	
Per cent of 106-AN ion leachable:				100%	100%	100%	
Eff. Diffusion Coefficient, sq cm/s:				2.56E-07	2.22E-07	3.16E-07	
Std. Deviation, sq cm/s:				5.53E-09	3.39E-09	1.88E-08	
Leachability Index:				6.591	6.653	6.500	
Upper 95% Confidence Int.:				0.009	0.006	0.026	
Lower 95% Confidence Int.:				0.009	0.006	0.024	
BFS-HIGH Sulfate							
				0.00	0.00	0.00	0
1	28.91	25.59	31.85	27.27	24.98	30.82	0.083333
2	50.68	45.33	57.84	50.53	46.22	56.27	0.291666
3	90.81	81.11	98.80	91.43	82.84	99.63	1
4	125.37	112.53	133.75	126.05	114.67	135.05	2
5	150.45	135.62	158.04	152.02	137.34	159.87	3
6	172.08	155.55	178.40	173.12	156.09	179.40	4
7	192.59	179.14	198.41	190.97	171.78	195.29	5

Added in 106-AN				Newbox Estimate		
Ao =	40.95	40.68	40.46	541	436	331

Per cent of 106-AN ion leachable:	1321%	1072%	818%
Eff. Diffusion Coefficient, sq cm/s:	7.20E-08	9.21E-08	2.49E-07
Std. Deviation, sq cm/s:	1.82E-09	4.04E-09	7.36E-09
Leachability Index:	7.143	7.036	6.603
Upper 95% Confidence Int.:	0.011	0.019	0.013
Lower 95% Confidence Int.:	0.011	0.018	0.012

BFS-HIGH Nitrate + Nitrite

				0.00	0.00	0.00	0
1	122.22	120.73	153.56	123.98	114.85	135.93	0.083333
2	227.02	215.73	264.87	227.43	211.81	249.70	0.291666
3	412.47	385.02	462.25	405.90	378.12	441.66	1
4	562.12	522.64	607.95	552.78	516.19	599.28	2
5	664.08	616.78	706.86	658.59	616.60	711.65	3
6	739.50	687.95	779.02	743.88	696.62	800.60	4
7	798.41	744.42	834.08	813.37	762.51	873.95	5

	Added in 106-AN			Newbox Estimate		
Ao =	1579.36	1568.96	1560.63	1579.36	1568.96	1560.63

Per cent of 106-AN ion leachable:	100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:	1.77E-07	1.52E-07	2.17E-07
Std. Deviation, sq cm/s:	4.53E-09	5.40E-09	1.76E-08
Leachability Index:	6.751	6.818	6.663
Upper 95% Confidence Int.:	0.011	0.015	0.036
Lower 95% Confidence Int.:	0.011	0.015	0.033

K-7

BFS-HIGH : Nitrate

BFS-HIGH : Nitrite

BFS-HIGH : Nitrate + Nitrite

K-8

BFS-HIGH : Chloride

BFS-HIGH : Sulfate

ANSI/ANS-16.1-1986 Leaching Data

Phase I: Binder Selection for 106-AN

Run No.: BFS-LOW

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio 2 lb/gal

Chloride

Nitrite

Nitrate

Sulfate

5.32

34.87

79.99

2.98

Sample Cylinder Dimensions

After Curing 28 d

Initially

Batch 1

Batch 2

Batch 3

Vol, cc

2.50

Dia., cm

2.51

2.51

2.51

22.83

4.65

Length, cm

1.88

1.77

1.56

Grout Density, lb/gal

10.70

10.75

10.70

mL of 106-AN in Sample Cylinder

20.19

20.29

20.19

Leach Vol + Boric Acid Vol Added, mL

249.7

241

223.5

Leachate Concentrations

Mass In Leachate

mg/L

mg

Time

Interval

Batch 1

Batch 2

Batch 3

Batch 1

Batch 2

Batch 3

d

BFS-LOW

Chloride

Initially:

107.38

107.89

107.38

0

64.48

154.46

160.32

16.10

37.22

35.83

0

1

26.06

26.33

27.58

6.51

6.35

6.16

0.083333

2

17

16.64

17.47

4.24

4.01

3.90

0.291666

3

16.2

16.83

14.11

4.05

4.06

3.15

1

4

4.63

3.92

1.53

1.16

0.94

0.34

2

5

0.28

0.35

0

0.07

0.08

0.00

3

6

0

0

0

0.00

0.00

0.00

4

7

0.05

0.05

0

0.01

0.01

0.00

5

BFS-LOW

Nitrite

Initially:

704.16

707.45

704.16

0

1109.17

1395

1403.5

276.96

336.20

313.68

0

1

214.31

224.21

236.9

53.51

54.03

52.95

0.083333

2

132.94

125.21

132

33.20

30.18

29.50

0.291666

3

126.95

125.37

107.09

31.70

30.21

23.93

1

4

28.02

31.45

12.69

7.00

7.58

2.84

2

5

2.79

4.11

1.14

0.70

0.99

0.25

3

6

0

0

0

0.00

0.00

0.00

4

7

0

0

0

0.00

0.00

0.00

5

BFS-LOW

Nitrate

Initially:

1615.12

1622.67

1615.12

0

1670.6

2136

2113

417.15

514.78

472.26

0

1

428.28

406.11

436.28

106.94

97.87

97.51

0.083333

2

269.7

258.31

271.5

67.34

62.25

60.68

0.291666

3

274

272.32

234.3

68.42

65.63

52.37

1

4

70.73

83.36

39.45

17.66

20.09

8.82

2

5

10.71

14.13

5.97

2.67

3.41

1.33

3

6

3.9

4.75

3.32

0.97

1.14

0.74

4

7

2.63

2.6

2.4

0.66

0.63

0.54

5

K-10

BFS-LOW Sulfate		Initially:			60.13	60.41	60.13	
0	210.49	276	211.2	52.56	66.52	47.20	0	
1	44.97	43.72	49.04	11.23	10.54	10.96	0.083333	
2	32.87	32.53	40.85	8.21	7.84	9.13	0.291666	
3	45.24	57.26	48.35	11.30	13.80	10.81	1	
4	26.09	26.68	22.74	6.51	6.43	5.08	2	
5	11.69	11.81	8.14	2.92	2.85	1.82	3	
6	4.8	5.69	3.49	1.20	1.37	0.78	4	
7	3.24	3.14	2.08	0.81	0.76	0.46	5	

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)			
Observed				Calculated (NEWBOX)			
				(No Washoff or Washout)			
		mg				mg	
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
BFS-LOW Chloride							
				0.00	0.00	0.00	0
1	22.61	43.57	42.00	21.02	42.72	41.59	0.083333
2	26.85	47.58	45.90	29.54	52.05	49.10	0.291666
3	30.90	51.64	49.05	32.11	52.68	49.40	1
4	32.05	52.58	49.40	32.14	52.68	49.40	2
5	32.12	52.67	49.40	32.14	52.68	49.40	3
6	32.12	52.67	49.40	32.14	52.68	49.40	4
7	32.14	52.68	49.40	32.14	52.68	49.40	5

		Added in 106-AN		Newbox Estimate	
Ao =	107.38	107.89	107.38	32.14	52.68
					49.4

Per cent of 106-AN ion leachable:	30%	49%	46%
Eff. Diffusion Coefficient, sq cm/s:	1.19E-05	2.26E-05	2.31E-05
Std. Deviation, sq cm/s:	3.49E-06	7.08E-06	5.64E-06
Leachability Index:	4.926	4.647	4.635
Upper 95% Confidence Int.:	0.147	0.158	0.117
Lower 95% Confidence Int.:	0.109	0.116	0.092

BFS-LOW Nitrite							
				0.00	0.00	0.00	0
1	330.47	390.23	366.63	322.80	385.10	364.80	0.083333
2	363.67	420.41	396.13	397.36	455.79	421.51	0.291666
3	395.37	450.62	420.07	403.00	459.00	423.20	1
4	402.36	458.20	422.90	403.00	459.00	423.20	2
5	403.06	459.19	423.16	403.00	459.00	423.20	3
6	403.06	459.19	423.16	403.00	459.00	423.20	4
7	403.06	459.19	423.16	403.00	459.00	423.20	5

K-11

Added in 106-AN				Newbox Estimate		
Ao =	704.16	707.45	704.16	403	459	423.2
Per cent of 106-AN ion leachable:				57%	65%	60%
Eff. Diffusion Coefficient, sq cm/s:				2.28E-05	2.58E-05	2.55E-05
Std. Deviation, sq cm/s:				6.88E-06	7.80E-06	6.10E-06
Leachability Index:				4.643	4.589	4.594
Upper 95% Confidence Int.:				0.151	0.151	0.115
Lower 95% Confidence Int.:				0.112	0.112	0.091

BFS-LOW Nitrate

				0.00	0.00	0.00	0
1	524.09	612.65	569.76	497.86	592.12	559.36	0.083333
2	591.43	674.90	630.44	656.77	749.91	684.98	0.291666
3	659.85	740.53	682.81	681.93	765.99	694.00	1
4	677.51	760.62	691.63	682.00	766.00	694.00	2
5	680.19	764.03	692.96	682.00	766.00	694.00	3
6	681.16	765.17	693.70	682.00	766.00	694.00	4
7	681.82	765.80	694.24	682.00	766.00	694.00	5

Added in 106-AN				Newbox Estimate		
Ao =	1615.12	1622.67	1615.12	682	766	694
Per cent of 106-AN ion leachable:				42%	47%	43%
Eff. Diffusion Coefficient, sq cm/s:				1.66E-05	1.90E-05	1.95E-05
Std. Deviation, sq cm/s:				5.61E-06	6.72E-06	5.60E-06
Leachability Index:				4.780	4.721	4.710
Upper 95% Confidence Int.:				0.173	0.183	0.142
Lower 95% Confidence Int.:				0.123	0.128	0.107

BFS-LOW Sulfate

				0.00	0.00	0.00	0
1	63.79	77.05	58.16	55.21	67.10	51.52	0.083333
2	72.00	84.89	67.29	81.54	97.35	75.60	0.291666
3	83.29	98.69	78.10	94.23	109.78	86.04	1
4	89.81	105.12	83.18	94.70	110.00	86.30	2
5	92.73	107.97	85.00	94.70	110.00	86.30	3
6	93.92	109.34	85.78	94.70	110.00	86.30	4
7	94.73	110.10	86.25	94.70	110.00	86.30	5

Added in 106-AN				Newbox Estimate		
Ao =	60.13	60.41	60.13	94.7	110	86.3

K-12

Per cent of 106-AN ion leachable:	157%	182%	144%
Eff. Diffusion Coefficient, sq cm/s:	8.59E-06	9.25E-06	7.78E-06
Std. Deviation, sq cm/s:	4.23E-06	4.60E-06	3.27E-06
Leachability Index:	5.066	5.034	5.109
Upper 95% Confidence Int.:	0.283	0.287	0.229
Lower 95% Confidence Int.:	0.170	0.171	0.149

BFS-LOW Nitrate + Nitrite

				0.00	0.00	0.00	0
1	854.56	1002.88	936.39	822.43	977.55	924.09	0.083333
2	955.10	1095.31	1026.58	1056.79	1207.85	1108.46	0.291666
3	1055.22	1191.15	1102.88	1084.98	1225.00	1117.40	1
4	1079.88	1218.82	1114.53	1085.00	1225.00	1117.40	2
5	1083.25	1223.21	1116.12	1085.00	1225.00	1117.40	3
6	1084.22	1224.36	1116.86	1085.00	1225.00	1117.40	4
7	1084.88	1224.99	1117.40	1085.00	1225.00	1117.40	5

	Added in 106-AN			Newbox Estimate		
Ao =	2319.28	2330.11	2319.28	1085	1225	1117.4

Per cent of 106-AN ion leachable:	47%	53%	48%
Eff. Diffusion Coefficient, sq cm/s:	1.88E-05	2.13E-05	2.15E-05
Std. Deviation, sq cm/s:	6.21E-06	7.19E-06	5.75E-06
Leachability Index:	4.727	4.672	4.667
Upper 95% Confidence Int.:	0.169	0.173	0.131
Lower 95% Confidence Int.:	0.121	0.123	0.100

BFS-LOW : Nitrate

BFS-LOW : Nitrite

BFS-LOW : Nitrate + Nitrite

BFS-LOW : Chloride

BFS-LOW : Sulfate

ANSI/ANS-16.1-1986 Leaching Data

Phase I: Binder Selection for 106-AN

Run No.: FFLY-HIGH

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio 15 lb/gal

Chloride

Nitrite

Nitrate

Sulfate

5.32

34.87

79.99

2.98

Sample Cylinder Dimensions

After Curing 28 d

Initially

Batch 1

Batch 2

Batch 3

Vol, cc 2.50

Dia., cm

2.55

2.55

2.55

22.83

4.65

Length, cm

4.22

4.11

4.01

Grout Density, lb/gal

13.25

13.33

13.30

mL of 106-AN in Sample Cylinder

12.00

12.07

12.05

Leach Vol + Boric Acid Vol Added, mL

444.6

435.8

427.8

Leachate Concentrations

Mass in Leachate

mg/L

mg

Time

Interval

Batch 1

Batch 2

Batch 3

Batch 1

Batch 2

Batch 3

d

FFLY-HIG Chloride

Initially:

63.83

64.21

64.07

0

2.63

2.63

2.1

1.17

1.15

0.90

0

1

33.21

34.65

32.84

14.77

15.10

14.05

0.083333

2

21.84

23.66

23.22

9.71

10.31

9.93

0.291666

3

25.04

25.85

26.04

11.13

11.27

11.14

1

4

12.67

11.78

12.41

5.63

5.13

5.31

2

5

3.39

2.5

2.94

1.51

1.09

1.26

3

6

0.87

0.96

0.82

0.39

0.42

0.35

4

7

0.9

1.07

0.25

0.40

0.47

0.11

5

FFLY-HIG Nitrite

Initially:

418.55

421.07

420.12

0

12.66

14.84

11.19

5.63

6.47

4.79

0

1

263.49

273.77

260.08

117.15

119.31

111.26

0.083333

2

162.1

179.44

177.75

72.07

78.20

76.04

0.291666

3

197.26

207.45

210.42

87.70

90.41

90.02

1

4

105.26

94.11

101.95

46.80

41.01

43.61

2

5

26.59

19.29

23.67

11.82

8.41

10.13

3

6

4.65

2.78

4.23

2.07

1.21

1.81

4

7

4.28

0.67

0.79

1.90

0.29

0.34

5

FFLY-HIG Nitrate

Initially:

960.01

965.81

963.64

0

19.84

31.8

24.25

8.82

13.86

10.37

0

1

477.66

501.34

475.58

212.37

218.48

203.45

0.083333

2

304.03

329.64

320.55

135.17

143.66

137.13

0.291666

3

369.27

386.24

384.21

164.18

168.32

164.37

1

4

197.49

186.91

200.62

87.80

81.46

85.83

2

5

54.44

45.4

53.19

24.20

19.79

22.75

3

6

9.53

7.35

9.62

4.24

3.20

4.12

4

7

1.84

1.16

2.27

0.82

0.51

0.97

5

FFLY-HIG Sulfate		Initially:		35.74	35.96	35.88	
0	2.35	4.11	3	1.04	1.79	1.28	0
1	52.07	12.29	53.67	23.15	5.36	22.96	0.083333
2	36.2	40.19	37.69	16.09	17.51	16.12	0.291666
3	49.3	54.2	52.71	21.92	23.62	22.55	1
4	39.31	39.72	40.93	17.48	17.31	17.51	2
5	23.46	21	23.08	10.43	9.15	9.87	3
6	10.84	9.24	10.9	4.82	4.03	4.66	4
7	4.8	4.04	5.1	2.13	1.76	2.18	5

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)			
Observed				Calculated (NEWBOX)			
				(No Washoff or Washout)			
				mg			Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
FFLY-HIG Chloride							
				0.00	0.00	0.00	0
1	15.93	16.25	14.95	15.20	15.81	14.71	0.083333
2	25.64	26.56	24.88	25.59	26.42	24.71	0.291666
3	36.78	37.82	36.02	37.92	38.76	36.68	1
4	42.41	42.96	41.33	42.70	43.16	41.36	2
5	43.92	44.05	42.59	43.85	44.13	42.51	3
6	44.30	44.46	42.94	44.11	44.36	42.81	4
7	44.70	44.93	43.05	44.16	44.39	42.86	5

Added in 106-AN				Newbox Estimate		
Ao =	63.83	64.21	64.07	44.2	44.4	42.9

Per cent of 106-AN ion leachable:	69%	69%	67%
Eff. Diffusion Coefficient, sq cm/s:	3.94E-06	4.20E-06	3.81E-06
Std. Deviation, sq cm/s:	3.21E-07	2.62E-07	1.52E-07
Leachability Index:	5.404	5.376	5.419
Upper 95% Confidence Int.:	0.036	0.027	0.017
Lower 95% Confidence Int.:	0.033	0.026	0.017

FFLY-HIG Nitrite							
				0.00	0.00	0.00	0
1	122.78	125.78	116.05	116.28	122.48	113.91	0.083333
2	194.85	203.98	192.09	195.85	204.58	191.65	0.291666
3	282.55	294.38	282.11	291.89	300.50	285.95	1
4	329.35	335.40	325.72	329.97	335.00	324.48	2
5	341.17	343.80	335.85	339.57	342.93	334.28	3
6	343.24	345.01	337.66	341.97	344.66	336.99	4
7	345.14	345.31	338.00	342.66	344.90	337.66	5

K-17

Ao =	Added in 106-AN			Newbox Estimate		
	418.55	421.07	420.12	343	345	338
Per cent of 106-AN ion leachable:				82%	82%	80%
Eff. Diffusion Coefficient, sq cm/s:				3.80E-06	4.16E-06	3.66E-06
Std. Deviation, sq cm/s:				3.29E-07	2.11E-07	1.27E-07
Leachability Index:				5.420	5.381	5.436
Upper 95% Confidence Int.:				0.038	0.022	0.015
Lower 95% Confidence Int.:				0.035	0.021	0.014

FFLY-HIG Nitrate

				0.00	0.00	0.00	0
1	221.19	232.34	213.83	211.48	224.21	207.57	0.083333
2	356.36	376.00	350.96	357.36	376.49	350.98	0.291666
3	520.54	544.32	515.32	535.72	557.28	526.47	1
4	608.34	625.78	601.15	609.61	626.62	600.69	2
5	632.55	645.56	623.90	629.36	642.82	620.82	3
6	636.78	648.77	628.02	635.09	646.70	626.48	4
7	637.60	649.27	628.99	636.36	647.68	628.37	5

Ao =	Added in 106-AN			Newbox Estimate		
	960.01	935.81	963.64	637	648	629
Per cent of 106-AN ion leachable:				66%	67%	65%
Eff. Diffusion Coefficient, sq cm/s:				3.63E-06	3.95E-06	3.50E-06
Std. Deviation, sq cm/s:				2.60E-07	2.37E-07	1.76E-07
Leachability Index:				5.440	5.404	5.456
Upper 95% Confidence Int.:				0.031	0.026	0.022
Lower 95% Confidence Int.:				0.029	0.025	0.021

FFLY-HIG Sulfate

				0.00	0.00	0.00	0
1	24.20	7.15	24.24	22.62	14.69	22.83	0.083333
2	40.29	24.66	40.37	39.69	26.35	40.10	0.291666
3	62.21	48.28	62.92	64.74	44.84	65.15	1
4	79.69	65.59	80.43	81.00	58.68	81.31	2
5	90.12	74.74	90.30	89.59	67.59	89.79	3
6	94.94	78.77	94.96	94.33	73.94	94.54	4
7	97.07	80.53	97.14	97.16	78.68	97.26	5

Ao =	Added in 106-AN			Newbox Estimate		
	35.74	35.96	35.88	101	94.8	101

Per cent of 106-AN ion leachable:	283%	264%	282%
Eff. Diffusion Coefficient, sq cm/s:	1.52E-06	6.83E-07	1.52E-06
Std. Deviation, sq cm/s:	1.15E-07	2.90E-07	9.89E-08
Leachability Index:	5.819	6.166	5.819
Upper 95% Confidence Int.:	0.033	0.231	0.028
Lower 95% Confidence Int.:	0.031	0.150	0.027

FFLY-HIG Nitrate + Nitrite

				0.00	0.00	0.00	0
1	343.96	358.12	329.88	328.30	346.56	322.01	0.083333
2	551.21	579.98	543.05	553.70	581.90	542.49	0.291666
3	803.09	838.71	797.43	827.12	857.95	812.28	1
4	937.69	961.17	926.87	939.82	961.22	925.42	2
5	973.71	989.37	959.75	969.22	986.05	955.40	3
6	980.02	993.78	965.68	977.06	991.01	964.10	4
7	982.74	994.58	966.99	979.02	992.60	966.03	5

	Added in 106-AN			Newbox Estimate		
Ao =	1378.56	1386.88	1383.76	980	993	967

Per cent of 106-AN ion leachable:	71%	72%	70%
Eff. Diffusion Coefficient, sq cm/s:	3.69E-06	4.02E-06	3.56E-06
Std. Deviation, sq cm/s:	2.83E-07	2.29E-07	1.59E-07
Leachability Index:	5.433	5.396	5.449
Upper 95% Confidence Int.:	0.034	0.025	0.019
Lower 95% Confidence Int.:	0.031	0.023	0.019

K-19

FFLY-HIGH : Nitrate

FFLY-HIGH : Nitrite

FFLY-HIGH : Nitrate + Nitrite

K-20

FFLY-HIGH : Chloride

FFLY-HIGH : Sulfate

ANSI/ANS-16.1-1986 Leaching Data

Phase I: Binder Selection for 106-AN

Run No.: FFLY-LOW

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio	2 lb/gal	Chloride	Nitrite	Nitrate	Sulfate
		5.32	34.87	79.99	2.98

Sample Cylinder Dimensions

After Curing 28 d

	Initially		Batch 1	Batch 2	Batch 3	
Vol, cc	2.55	Dia., cm	2.55	2.55	2.55	
	23.75	4.65	Length, cm	0.97	0.99	1.05
Grout Density, lb/gal			10.43	10.35	10.48	
mL of 106-AN in Sample Cylinder			20.48	20.32	20.58	
Leach Vol + Boric Acid Vol Added, mL			181.7	183.4	188.2	

Leachate Concentrations

Mass in Leachate

	Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
FFLY-LO	Chloride	Initially:			108.90	108.07	109.43	
	0	230.6	182.73	50.14	41.90	33.51	9.44	0
	1	18.79	19.34	23.42	3.41	3.55	4.41	0.083333
	2	4.24	4.52	6.23	0.77	0.83	1.17	0.291666
	3	8.26	7.51	10.43	1.50	1.38	1.96	1
	4	7.39	5.97	8.98	1.34	1.09	1.69	2
	5	4.85	3.45	4.88	0.88	0.63	0.92	3
	6	2.31	1.4	2.21	0.42	0.26	0.42	4
	7	1.67	1.13	1.2	0.30	0.21	0.23	5
FFLY-LO	Nitrite	Initially:			714.12	708.64	717.54	
	0	1788.26	2121.1	1852.77	324.93	389.01	348.69	0
	1	152.62	157.79	189.74	27.73	28.94	35.71	0.083333
	2	29.7	31.06	45.17	5.40	5.70	8.50	0.291666
	3	60.92	54.02	77.94	11.07	9.91	14.67	1
	4	57.72	44.93	70.14	10.49	8.24	13.20	2
	5	35.38	24.76	39.1	6.43	4.54	7.36	3
	6	19.12	12.53	17.54	3.47	2.30	3.30	4
	7	10.46	5.59	8.32	1.90	1.03	1.57	5
FFLY-LO	Nitrate	Initially:			1637.97	1625.40	1645.82	
	0	3790.03	2984.63	1380	688.65	547.38	259.72	0
	1	266.49	298.87	332.48	48.42	54.81	62.57	0.083333
	2	58.82	62.52	81.56	10.69	11.47	15.35	0.291666
	3	105.44	105.58	134.2	19.16	19.36	25.26	1
	4	102.56	92.58	122.3	18.64	16.98	23.02	2
	5	69.26	54.4	71.78	12.58	9.98	13.51	3
	6	40.41	29.27	38.52	7.34	5.37	7.25	4
	7	24.57	14.52	21.19	4.46	2.66	3.99	5

K-22

FFLY-LO	Sulfate	Initially:		60.98	60.51	61.27	
0	119.37	112.53	98.46	21.69	20.64	18.53	0
1	12.95	18.81	20.77	2.35	3.45	3.91	0.083333
2	3.27	5.29	6.06	0.59	0.97	1.14	0.291666
3	4.18	6.94	5.02	0.76	1.27	0.94	1
4	4.75	7.33	6.27	0.86	1.34	1.18	2
5	3.16	4.83	4.38	0.57	0.89	0.82	3
6	1.16	3.33	2.46	0.21	0.61	0.46	4
7	1.45	2	1.71	0.26	0.37	0.32	5

Cumulative Amount Leached, mg Observed			(Adding Rinse to Interval 1) Calculated (NEWBOX) (No Washoff or Washout)				Time d
Interval	Batch 1	Batch 2 mg	Batch 3	Batch 1	Batch 2 mg	Batch 3	
FFLY-LO	Chloride						
				0.00	0.00	0.00	0
1	45.31	37.06	13.84	45.10	36.94	11.49	0.083333
2	46.08	37.89	15.02	50.45	41.42	17.37	0.291666
3	47.59	39.27	16.98	50.50	41.50	20.12	1
4	48.93	40.36	18.67	50.50	41.50	20.20	2
5	49.81	40.99	19.59	50.50	41.50	20.20	3
6	50.23	41.25	20.00	50.50	41.50	20.20	4
7	50.53	41.46	20.23	50.50	41.50	20.20	5

	Added in 106-AN			Newbox Estimate		
Ao =	108.90	108.07	109.43	50.5	41.5	20.2
Per cent of 106-AN ion leachable:				46%	38%	18%
Eff. Diffusion Coefficient, sq cm/s:				1.68E-05	1.70E-05	4.51E-06
Std. Deviation, sq cm/s:				7.86E-06	7.53E-06	2.76E-06
Leachability Index:				4.776	4.771	5.346
Upper 95% Confidence Int.:				0.264	0.245	0.393
Lower 95% Confidence Int.:				0.163	0.156	0.203

FFLY-LO Nitrite							
				0.00	0.00	0.00	0
1	352.66	417.95	384.40	351.90	417.60	381.47	0.083333
2	358.05	423.64	392.90	390.61	449.82	432.13	0.291666
3	369.12	433.55	407.57	391.00	450.00	433.00	1
4	379.61	441.79	420.77	391.00	450.00	433.00	2
5	386.04	446.33	428.13	391.00	450.00	433.00	3
6	389.51	448.63	431.43	391.00	450.00	433.00	4
7	391.41	449.66	433.00	391.00	450.00	433.00	5

K-23

Added in 106-AN				Newbox Estimate			
Ao =	714.12	708.64	717.54	391	450	433	
Per cent of 106-AN ion leachable:				55%	64%	60%	
Eff. Diffusion Coefficient, sq cm/s:				1.74E-05	2.12E-05	1.76E-05	
Std. Deviation, sq cm/s:				8.11E-06	7.89E-06	8.09E-06	
Leachability Index:				4.761	4.674	4.754	
Upper 95% Confidence Int.:				0.263	0.195	0.257	
Lower 95% Confidence Int.:				0.163	0.134	0.160	
FFLY-LO Nitrate							
				0.00	0.00	0.00	0
1	737.07	602.19	322.29	734.67	599.86	299.21	0.083333
2	747.76	613.66	337.64	809.19	667.33	397.03	0.291666
3	766.92	633.02	362.89	810.00	668.00	410.98	1
4	785.55	650.00	385.91	810.00	668.00	411.00	2
5	798.14	659.98	399.42	810.00	668.00	411.00	3
6	805.48	665.35	406.67	810.00	668.00	411.00	4
7	809.94	668.01	410.66	810.00	668.00	411.00	5

Added in 106-AN				Newbox Estimate			
Ao =	1637.97	1625.40	1645.82	810	668	411	
Per cent of 106-AN ion leachable:				49%	41%	25%	
Eff. Diffusion Coefficient, sq cm/s:				1.81E-05	1.77E-05	8.93E-06	
Std. Deviation, sq cm/s:				8.26E-06	7.79E-06	5.56E-06	
Leachability Index:				4.741	4.752	5.049	
Upper 95% Confidence Int.:				0.254	0.242	0.404	
Lower 95% Confidence Int.:				0.159	0.155	0.206	
FFLY-LO Sulfate							
				0.00	0.00	0.00	0
1	24.04	24.09	22.44	23.81	23.22	21.70	0.083333
2	24.64	25.06	23.58	27.22	29.06	26.95	0.291666
3	25.40	26.33	24.52	27.30	29.50	27.30	1
4	26.26	27.68	25.70	27.30	29.50	27.30	2
5	26.83	28.56	26.53	27.30	29.50	27.30	3
6	27.04	29.17	26.99	27.30	29.50	27.30	4
7	27.31	29.54	27.31	27.30	29.50	27.30	5

Added in 106-AN				Newbox Estimate		
Ao =	60.98	60.51	61.27	27.3	29.5	27.3

K-24

Per cent of 106-AN ion leachable:	45%	49%	45%
Eff. Diffusion Coefficient, sq cm/s:	1.51E-05	1.05E-05	1.18E-05
Std. Deviation, sq cm/s:	7.52E-06	6.47E-06	6.84E-06
Leachability Index:	4.822	4.978	4.927
Upper 95% Confidence Int.:	0.289	0.395	0.359
Lower 95% Confidence Int.:	0.172	0.203	0.194

FFLY-LO Nitrate + Nitrite

				0.00	0.00	0.00	0
1	1089.73	1020.14	706.69	1086.91	1017.38	688.61	0.083333
2	1105.81	1037.30	730.54	1199.80	1116.88	838.53	0.291666
3	1136.04	1066.58	770.46	1201.00	1118.00	847.00	1
4	1165.16	1091.79	806.68	1201.00	1118.00	847.00	2
5	1184.18	1106.31	827.55	1201.00	1118.00	847.00	3
6	1194.99	1113.98	838.10	1201.00	1118.00	847.00	4
7	1201.36	1117.67	843.65	1201.00	1118.00	847.00	5

	Added in 106-AN			Newbox Estimate		
Ao =	2352.09	2334.04	2363.36	1201	1118	847

Per cent of 106-AN ion leachable:	51%	48%	36%
Eff. Diffusion Coefficient, sq cm/s:	1.79E-05	1.90E-05	1.28E-05
Std. Deviation, sq cm/s:	8.21E-06	7.92E-06	7.32E-06
Leachability Index:	4.748	4.722	4.894
Upper 95% Confidence Int.:	0.257	0.226	0.353
Lower 95% Confidence Int.:	0.160	0.148	0.192

K-25

FFLY-LOW : Nitrate

FFLY-LOW : Nitrite

FFLY-LOW : Nitrate + Nitrite

FFLY-LOW : Chloride

FFLY-LOW : Sulfate

ANSI/ANS-16.1-1986 Leaching Data

Phase I: Binder Selection for 106-AN

Run No.: HCEM-HIGH

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio 15 lb/gal

Chloride

Nitrite

Nitrate

Sulfate

5.32

34.87

79.99

2.98

Sample Cylinder Dimensions

After Curing 28 d

Initially

Batch 1

Batch 2

Batch 3

Vol, cc

2.50

Dia., cm

2.55

2.55

2.55

22.83

4.65

Length, cm

4.34

4.22

4.23

Grout Density, lb/gal

16.29

16.30

16.30

mL of 106-AN in Sample Cylinder

14.76

14.77

14.77

Leach Vol + Boric Acid Vol Added, mL

453.9

444.9

445.3

Leachate Concentrations

Mass in Leachate

mg/L

mg

Time

Interval

Batch 1

Batch 2

Batch 3

Batch 1

Batch 2

Batch 3

d

HCEM-HI

Chloride

Initially:

78.47

78.52

78.52

0

0.44

66.13

4.92

0.20

29.42

2.19

0

1

4.22

5.15

61.15

1.92

2.29

27.23

0.083333

2

3.48

3.86

4.2

1.58

1.72

1.87

0.291666

3

6.44

6.81

7.43

2.92

3.03

3.31

1

4

5.7

5.95

6.5

2.59

2.65

2.89

2

5

4.38

5.55

5

1.99

2.47

2.23

3

6

3.43

3.6

3.98

1.56

1.60

1.77

4

7

2.86

1

3.43

1.30

0.44

1.53

5

HCEM-HI

Nitrite

Initially:

514.57

514.89

514.89

0

2.66

373.18

31.99

1.21

166.03

14.25

0

1

28.38

33.94

342.28

12.88

15.10

152.42

0.083333

2

23.32

25.01

26.66

10.58

11.13

11.87

0.291666

3

43.16

44.34

49.44

19.59

19.73

22.02

1

4

39.07

39.72

43.44

17.73

17.67

19.34

2

5

29.28

29.4

32.41

13.29

13.08

14.43

3

6

23.69

23.78

25.58

10.75

10.58

11.39

4

7

19.81

3

21.51

8.99

1.33

9.58

5

HCEM-HI

Nitrate

Initially:

1180.27

1181.00

1181.00

0

6.97

765.16

69.33

3.16

340.42

30.87

0

1

64.2

74.76

710.04

29.14

33.26

316.18

0.083333

2

49.1

54.36

55.64

22.29

24.18

24.78

0.291666

3

90.89

94.39

104.91

41.25

41.99

46.72

1

4

82.97

84.11

91.56

37.66

37.42

40.77

2

5

63.7

66.55

70.16

28.91

29.61

31.24

3

6

51.55

51.11

55.59

23.40

22.74

24.75

4

7

42.95

44.02

46.44

19.50

19.58

20.68

5

HCEM-HI	Sulfate	Initially:		43.94	43.97	43.97	
0	3.46	251.39	15.35	1.57	111.84	6.84	0
1	13.63	16.57	236.49	6.19	7.37	105.31	0.083333
2	7.08	7.6	8.29	3.21	3.38	3.69	0.291666
3	15.62	15.67	17.85	7.09	6.97	7.95	1
4	13.24	13.38	18.93	6.01	5.95	8.43	2
5	10.22	10.33	11.11	4.64	4.60	4.95	3
6	7.43	7.27	8.65	3.37	3.23	3.85	4
7	5.83	5.82	7.17	2.65	2.59	3.19	5

Cumulative Amount Leached, mg Observed				(Adding Rinse to Interval 1) Calculated (NEWBOX) (No Washoff or Washout)			Time d
Interval	Batch 1	Batch 2 mg	Batch 3	Batch 1	Batch 2 mg	Batch 3	
HCEM-HI Chloride				0.00	0.00	0.00	0
1	2.12	31.71	29.42	2.00	9.19	8.72	0.083333
2	3.69	33.43	31.29	3.70	16.72	15.94	0.291666
3	6.62	36.46	34.60	6.61	29.13	27.80	1
4	9.21	39.11	37.49	9.20	39.02	37.30	2
5	11.19	41.58	39.72	11.19	45.70	43.81	3
6	12.75	43.18	41.49	12.76	50.80	48.84	4
7	14.05	43.62	43.02	14.03	54.81	52.84	5

		Added in 106-AN			Newbox Estimate		
Ao =	78.47	78.52	78.52	42.4	78.52	78.52	

Per cent of 106-AN ion leachable:	54%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:	6.07E-08	3.89E-07	3.49E-07
Std. Deviation, sq cm/s:	1.41E-09	2.93E-07	2.51E-07
Leachability Index:	7.217	6.410	6.457
Upper 95% Confidence Int.:	0.010	0.574	0.520
Lower 95% Confidence Int.:	0.010	0.239	0.230

HCEM-HI Nitrite							
				0.00	0.00	0.00	0
1	14.09	181.13	166.66	13.31	51.97	49.74	0.083333
2	24.67	192.25	178.53	24.70	94.68	91.14	0.291666
3	44.26	211.98	200.55	44.82	166.21	160.13	1
4	62.00	229.65	219.89	62.35	224.35	216.77	2
5	75.29	242.73	234.33	75.15	264.49	255.90	3
6	86.04	253.31	245.72	85.94	295.88	286.79	4
7	95.03	254.65	255.29	95.03	321.61	312.02	5

Added in 106-AN				Newbox Estimate			
Ao =	514.57	514.89	514.89	337	514.57	514.89	
Per cent of 106-AN ion leachable:				65%	100%	100%	
Eff. Diffusion Coefficient, sq cm/s:				4.25E-08	2.82E-07	2.60E-07	
Std. Deviation, sq cm/s:				9.41E-10	2.05E-07	1.76E-07	
Leachability Index:				7.372	6.549	6.584	
Upper 95% Confidence Int.:				0.009	0.530	0.467	
Lower 95% Confidence Int.:				0.009	0.232	0.220	
HCEM-HI Nitrate							
				0.00	0.00	0.00	0
1	32.30	373.68	347.05	28.96	106.17	101.80	0.083333
2	54.59	397.87	371.83	53.73	194.87	186.60	0.291666
3	95.85	439.86	418.55	97.70	343.67	330.68	1
4	133.51	477.28	459.32	135.54	466.50	449.96	2
5	162.42	506.89	490.56	163.06	552.71	533.81	3
6	185.82	529.63	515.31	186.45	621.21	599.95	4
7	205.31	549.21	535.99	205.71	676.71	655.46	5

Added in 106-AN				Newbox Estimate			
Ao =	1180.27	1181.00	1181.00	688	1181	1181	
Per cent of 106-AN ion leachable:				58%	100%	100%	
Eff. Diffusion Coefficient, sq cm/s:				4.82E-08	2.24E-07	2.06E-07	
Std. Deviation, sq cm/s:				2.03E-09	1.56E-07	1.37E-07	
Leachability Index:				7.317	6.650	6.686	
Upper 95% Confidence Int.:				0.018	0.492	0.452	
Lower 95% Confidence Int.:				0.017	0.225	0.217	

HCEM-HI Sulfate							
				0.00	0.00	0.00	0
1	7.76	119.22	112.14	6.01	113.73	100.77	0.083333
2	10.97	122.60	115.84	10.87	143.37	137.61	0.291666
3	18.06	129.57	123.78	18.79	145.99	144.97	1
4	24.07	135.52	132.21	24.93	146.00	145.00	2
5	28.71	140.12	137.16	29.03	146.00	145.00	3
6	32.08	143.35	141.01	32.08	146.00	145.00	4
7	34.73	145.94	144.21	34.49	146.00	145.00	5

Added in 106-AN				Newbox Estimate			
Ao =	43.94	43.97	43.97	45.5	146	145	
Per cent of 106-AN ion leachable:				104%	332%	330%	
Eff. Diffusion Coefficient, sq cm/s:				5.05E-07	3.31E-05	2.31E-05	
Std. Deviation, sq cm/s:				6.62E-08	2.24E-05	1.71E-05	
Leachability Index:				6.297	4.480	4.636	

Upper 95% Confidence Int.:	0.059	0.466	0.547
Lower 95% Confidence Int.:	0.052	0.220	0.235

HCEM-HI Nitrate + Nitrite

				0.00	0.00	0.00	0
1	46.39	554.81	513.72	42.32	157.72	151.44	0.083333
2	79.26	590.12	550.36	78.49	288.30	276.43	0.291666
3	140.11	651.84	619.10	142.70	508.77	490.11	1
4	195.50	706.93	679.21	197.21	690.23	666.48	2
5	237.71	749.62	724.89	237.84	817.42	788.59	3
6	271.86	782.94	761.03	271.53	915.78	886.95	4
7	300.35	803.86	791.29	300.27	997.18	966.66	5

	Added in 106-AN			Newbox Estimate		
Ao =	1694.85	1695.89	1695.89	991	1695.89	1695.89

Per cent of 106-AN ion leachable:	58%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:	4.97E-08	2.41E-07	2.21E-07
Std. Deviation, sq cm/s:	1.75E-09	1.70E-07	1.48E-07
Leachability Index:	7.304	6.619	6.655
Upper 95% Confidence Int.:	0.015	0.503	0.456
Lower 95% Confidence Int.:	0.015	0.227	0.218

K-31

HCEM-HIGH : Nitrate

HCEM-HIGH : Nitrite

HCEM-HIGH : Nitrate + Nitrite

HCEM-HIGH : Chloride

HCEM-HIGH : Sulfate

ANSI/ANS-16.1-1986 Leaching Data

Phase I: Binder Selection for 106-AN

Run No.: HCEM-LO

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio 2 lb/gal

Chloride

Nitrite

Nitrate

Sulfate

5.32

34.87

79.99

2.98

Sample Cylinder Dimensions

After Curing 28 d

Initially

Batch 1

Batch 2

Batch 3

Vol, cc

2.50

Dia., cm

2.55

2.55

2.55

22.83

4.65

Length, cm

0.99

1.03

0.89

Grout Density, lb/gal

11.40

11.38

11.38

mL of 106-AN in Sample Cylinder

21.51

21.48

21.48

Leach Vol + Boric Acid Vol Added, mL

183.6

186.6

174.9

Leachate Concentrations

Mass in Leachate

mg/L

mg

Time

Interval

Batch 1

Batch 2

Batch 3

Batch 1

Batch 2

Batch 3

d

HCEM-LO Chloride

Initially:

114.41

114.21

114.21

0

350.41

373.94

448.67

64.34

69.78

78.47

0

1

27.68

36.12

30.36

5.08

6.74

5.31

0.083333

2

19.83

20.78

17.77

3.64

3.88

3.11

0.291666

3

8.29

10.98

0.95

1.52

2.05

0.17

1

4

0.5

0.35

0.5

0.09

0.07

0.09

2

5

0.5

0.5

0.5

0.09

0.09

0.09

3

6

0.5

0.5

0.5

0.09

0.09

0.09

4

7

0.5

0.5

0.5

0.09

0.09

0.09

5

HCEM-LO Nitrite

Initially:

750.22

748.91

748.91

0

2834.66

2456.06

2480.09

520.44

458.30

433.77

0

1

165.85

179.68

166.23

30.45

33.53

29.07

0.083333

2

79.62

80.87

56.66

14.62

15.09

9.91

0.291666

3

31.12

40.41

6.27

5.71

7.54

1.10

1

4

0.74

2.38

1.5

0.14

0.44

0.26

2

5

1.5

0.32

1.5

0.28

0.06

0.26

3

6

1.5

1.5

1.5

0.28

0.28

0.26

4

7

1.5

1.5

1.5

0.28

0.28

0.26

5

HCEM-LO Nitrate

Initially:

1720.78

1717.76

1717.76

0

5967.15

5379.43

5197.43

1095.57

1003.80

909.03

0

1

364.14

375.21

346.41

66.86

70.01

60.59

0.083333

2

165.54

168.04

109.25

30.39

31.36

19.11

0.291666

3

67.97

82.22

17.64

12.48

15.34

3.09

1

4

7.32

7.92

1.97

1.34

1.48

0.34

2

5

2.02

2.66

2.5

0.37

0.50

0.44

3

6

2.5

2.5

2.5

0.46

0.47

0.44

4

7

2.5

2.5

2.5

0.46

0.47

0.44

5

K-34

HCEM-LO Sulfate	Initially:		64.06	63.95	63.95	
0	489.94	491.97	406.37	89.95	91.80	71.07
1	22.93	25.46	23.44	4.21	4.75	4.10
2	13.41	13.56	13.27	2.46	2.53	2.32
3	8.71	9.8	5.94	1.60	1.83	1.04
4	2.27	1.3	0.6	0.42	0.24	0.10
5	1	1	0.21	0.18	0.19	0.04
6	1	1	1	0.18	0.19	0.17
7	1	1	1	0.18	0.19	0.17

Cumulative Amount Leached, mg			(Adding Rinse to Interval 1)				
Observed			Calculated (NEWBOX)				
			(No Washoff or Washout)				
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time

HCEM-LO Chloride							
				0.00	0.00	0.00	0
1	69.42	76.52	83.78	69.43	76.45	83.80	0.083333
2	73.06	80.39	86.89	74.48	81.95	87.20	0.291666
3	74.58	82.44	87.06	74.50	82.20	87.20	1
4	74.67	82.51	87.14	74.50	82.20	87.20	2
5	74.76	82.60	87.23	74.50	82.20	87.20	3
6	74.86	82.70	87.32	74.50	82.20	87.20	4
7	74.95	82.79	87.41	74.50	82.20	87.20	5

Added in 106-AN			Newbox Estimate		
Ao =	114.41	114.21	114.21	74.5	82.2

Per cent of 106-AN ion leachable:	65%	72%	76%
Eff. Diffusion Coefficient, sq cm/s:	2.17E-05	2.27E-05	2.33E-05
Std. Deviation, sq cm/s:	2.68E-06	3.25E-06	9.21E-07
Leachability Index:	4.663	4.643	4.632
Upper 95% Confidence Int.:	0.055	0.065	0.017
Lower 95% Confidence Int.:	0.049	0.056	0.016

HCEM-LO Nitrite							
				0.00	0.00	0.00	0
1	550.89	491.83	462.84	551.02	510.00	472.00	0.083333
2	565.51	506.92	472.75	570.98	510.00	472.00	0.291666
3	571.23	514.46	473.85	571.00	510.00	472.00	1
4	571.36	514.90	474.11	571.00	510.00	472.00	2
5	571.64	514.96	474.37	571.00	510.00	472.00	3
6	571.91	515.24	474.63	571.00	510.00	472.00	4
7	572.19	515.52	474.90	571.00	510.00	472.00	5

Ao =	Added in 106-AN			Newbox Estimate		
	750.22	748.91	748.91	571	510	472
Per cent of 106-AN ion leachable:				76%	68%	63%
Eff. Diffusion Coefficient, sq cm/s:				2.86E-05	1.46E-04	2.38E-04
Std. Deviation, sq cm/s:				2.56E-06	5.02E-01	2.37E+05
Leachability Index:				4.544	3.836	3.623
Upper 95% Confidence Int.:				0.040	ERR	ERR
Lower 95% Confidence Int.:				0.036	3.525	8.985

HCEM-LO Nitrate

				0.00	0.00	0.00	0
1	1162.42	1073.82	969.62	1162.83	1113.00	1116.83	0.083333
2	1192.82	1105.17	988.73	1204.96	1113.00	1203.95	0.291666
3	1205.30	1120.51	991.81	1205.00	1113.00	1210.00	1
4	1206.64	1121.99	992.16	1205.00	1113.00	1210.00	2
5	1207.01	1122.49	992.59	1205.00	1113.00	1210.00	3
6	1207.47	1122.96	993.03	1205.00	1113.00	1210.00	4
7	1207.93	1123.42	993.47	1205.00	1113.00	1210.00	5

Ao =	Added in 106-AN			Newbox Estimate		
	1720.78	1717.76	1717.76	1205	1113	1210
Per cent of 106-AN ion leachable:				70%	65%	70%
Eff. Diffusion Coefficient, sq cm/s:				2.85E-05	2.08E-04	9.49E-06
Std. Deviation, sq cm/s:				2.75E-06	1.46E+02	1.52E-05
Leachability Index:				4.546	3.682	5.023
Upper 95% Confidence Int.:				0.043	ERR	ERR
Lower 95% Confidence Int.:				0.039	5.834	0.408

HCEM-LO Sulfate

				0.00	0.00	0.00	0
1	94.16	96.55	75.17	94.17	96.56	75.12	0.083333
2	96.63	99.08	77.49	98.39	100.99	78.50	0.291666
3	98.22	100.91	78.53	98.40	101.00	78.50	1
4	98.64	101.15	78.64	98.40	101.00	78.50	2
5	98.82	101.34	78.68	98.40	101.00	78.50	3
6	99.01	101.53	78.85	98.40	101.00	78.50	4
7	99.19	101.71	79.03	98.40	101.00	78.50	5

Ao =	Added in 106-AN			Newbox Estimate		
	64.06	63.95	63.95	98.4	101	78.5

Per cent of 106-AN ion leachable:	154%	158%	123%
Eff. Diffusion Coefficient, sq cm/s:	2.63E-05	2.78E-05	2.25E-05
Std. Deviation, sq cm/s:	4.36E-06	4.58E-06	2.70E-06
Leachability Index:	4.580	4.556	4.648
Upper 95% Confidence Int.:	0.076	0.076	0.054
Lower 95% Confidence Int.:	0.065	0.065	0.048

HCEM-LO Nitrate + Nitrite

				0.00	0.00	0.00	0
1	1713.32	1565.64	1432.46	1712.88	1623.00	1432.28	0.083333
2	1758.33	1612.09	1461.48	1774.95	1623.00	1465.99	0.291666
3	1776.52	1634.97	1465.66	1775.00	1623.00	1466.00	1
4	1778.00	1636.90	1466.27	1775.00	1623.00	1466.00	2
5	1778.65	1637.45	1466.97	1775.00	1623.00	1466.00	3
6	1779.38	1638.20	1467.66	1775.00	1623.00	1466.00	4
7	1780.12	1638.95	1468.36	1775.00	1623.00	1466.00	5

	Added in 106-AN			Newbox Estimate		
Ao =	2471.00	2466.67	2466.67	1775	1623	1466

Per cent of 106-AN ion leachable:	72%	66%	59%
Eff. Diffusion Coefficient, sq cm/s:	2.85E-05	3.18E-04	2.79E-05
Std. Deviation, sq cm/s:	2.69E-06	3.73E+06	1.24E-06
Leachability Index:	4.545	3.498	4.554
Upper 95% Confidence Int.:	0.042	ERR	0.019
Lower 95% Confidence Int.:	0.038	10.057	0.018

HCEM-HIGH : Nitrate

HCEM-HIGH : Nitrite

HCEM-LOW : Nitrate + Nitrite

HCEM-LOW : Chloride

HCEM-LOW : Sulfate

ANSI/ANS-16.1-1986 Leaching Data

Phase I: Binder Selection for 106-AN

Run No.: PORT2-HI

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio 15 lb/gal

Chloride

Nitrite

Nitrate

Sulfate

5.32

34.87

79.99

2.98

Sample Cylinder Dimensions

After Curing 28 d

Initially

Batch 1

Batch 2

Batch 3

Vol, cc

2.50

Dia., cm

2.51

2.51

2.51

22.83

4.65

Length, cm

4.43

4.58

4.53

Grout Density, lb/gal

15.70

15.65

15.65

mL of 106-AN in Sample Cylinder

14.22

14.18

14.18

Leach Vol + Boric Acid Vol Added, mL

452.9

464.7

460.7

Leachate Concentrations

Mass in Leachate

mg/L

mg

Time

Interval

Batch 1

Batch 2

Batch 3

Batch 1

Batch 2

Batch 3

d

PORT2-HI Chloride

Initially:

75.63

75.39

75.39

0

0.2

0.27

14.98

0.09

0.13

6.90

0

1

2.17

2.28

2.47

0.98

1.06

1.14

0.083333

2

2.13

2.81

2.59

0.96

1.31

1.19

0.291666

3

8.53

9.57

10.16

3.86

4.45

4.68

1

4

8.51

8.07

9.51

3.85

3.75

4.38

2

5

6.03

5.96

6.45

2.73

2.77

2.97

3

6

4.98

4.67

5.24

2.26

2.17

2.41

4

7

3.05

2.62

7.44

1.38

1.22

3.43

5

PORT2-HI Nitrite

Initially:

495.94

494.36

494.36

0

3.24

4.7

172.94

1.47

2.18

79.67

0

1

17.79

21

23.02

8.06

9.76

10.61

0.083333

2

18.51

24.09

23.99

8.38

11.19

11.05

0.291666

3

58.42

63.1

67.86

26.46

29.32

31.26

1

4

57.63

59.56

65.19

26.10

27.68

30.03

2

5

45.71

42.57

46.72

20.70

19.78

21.52

3

6

34.28

30.89

36.58

15.53

14.35

16.85

4

7

28.18

25.02

29.78

12.76

11.63

13.72

5

PORT2-HI Nitrate

Initially:

1137.53

1133.90

1133.90

0

4.15

6.02

326.98

1.88

2.80

150.64

0

1

43.75

51.25

55.08

19.81

23.82

25.38

0.083333

2

43.43

55.6

53.77

19.67

25.84

24.77

0.291666

3

120.09

129.49

133.92

54.39

60.17

61.70

1

4

121.48

120.49

130.89

55.02

55.99

60.30

2

5

94.18

89.8

100.71

42.65

41.73

46.40

3

6

77.55

71.4

75.26

35.12

33.18

34.67

4

7

66.55

60.03

67.1

30.14

27.90

30.91

5

PORT2-HI Sulfate Initially:				42.35	42.22	42.22	
0	1.73	1.97	60.13	0.78	0.92	27.70	0
1	5.52	6.72	7.52	2.50	3.12	3.46	0.083333
2	3.92	5.38	5	1.78	2.50	2.30	0.291666
3	12.42	13.98	14.11	5.63	6.50	6.50	1
4	12.62	12.68	13.27	5.72	5.89	6.11	2
5	9.09	8.84	10.03	4.12	4.11	4.62	3
6	7.14	6.55	7.37	3.23	3.04	3.40	4
7	6	5.51	6.41	2.72	2.56	2.95	5

Cumulative Amount Leached, mg Observed				(Adding Rinse to Interval 1) Calculated (NEWBOX) (No Washoff or Washout)			Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d

PORT2-HI Chloride							
				0.00	0.00	0.00	0
1	1.07	1.18	8.04	1.92	2.12	4.03	0.083333
2	2.04	2.49	9.23	3.58	3.94	7.46	0.291666
3	5.90	6.94	13.91	6.56	7.19	13.49	1
4	9.76	10.69	18.29	9.15	10.03	18.62	2
5	12.49	13.46	21.27	11.12	12.21	22.39	3
6	14.74	15.63	23.68	12.78	13.95	25.41	4
7	16.12	16.85	27.11	14.22	15.53	28.05	5

Added in 106-AN				Newbox Estimate		
Ao =	75.63	75.39	75.39	75.63	75.39	75.39
Per cent of 106-AN ion leachable:				100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:				1.72E-08	2.13E-08	7.82E-08
Std. Deviation, sq cm/s:				6.15E-09	6.45E-09	2.07E-08
Leachability Index:				7.764	7.672	7.107
Upper 95% Confidence Int.:				0.185	0.151	0.129
Lower 95% Confidence Int.:				0.129	0.112	0.100

PORT2-HI Nitrite							
				0.00	0.00	0.00	0
1	9.52	11.94	90.28	14.58	16.46	36.43	0.083333
2	17.91	23.14	101.33	27.13	30.60	67.23	0.291666
3	44.37	52.46	132.59	49.54	55.86	119.64	1
4	70.47	80.14	162.63	69.43	77.61	163.63	2
5	91.17	99.92	184.15	83.81	93.93	195.27	3
6	106.69	114.27	201.00	96.21	107.77	220.48	4
7	119.46	125.90	214.72	106.63	119.14	241.74	5

Ao =	Added in 106-AN			Newbox Estimate		
	495.94	494.36	494.36	495.94	494.36	494.36
Per cent of 106-AN ion leachable:				100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:				2.31E-08	3.00E-08	1.50E-07
Std. Deviation, sq cm/s:				6.24E-09	5.41E-09	6.28E-08
Leachability Index:				7.637	7.523	6.824
Upper 95% Confidence Int.:				0.133	0.084	0.227
Lower 95% Confidence Int.:				0.101	0.070	0.148

PORT2-HI Nitrate

				0.00	0.00	0.00	0
1	21.69	26.61	176.02	31.51	35.15	71.55	0.083333
2	41.36	52.45	200.79	58.70	65.43	131.53	0.291666
3	95.75	112.62	262.48	107.27	119.06	236.99	1
4	150.77	168.62	322.78	150.15	166.68	325.43	2
5	193.42	210.35	369.18	182.00	201.83	390.06	3
6	228.55	243.53	403.85	208.17	231.32	442.22	4
7	258.69	271.42	434.77	230.92	256.26	486.44	5

Ao =	Added in 106-AN			Newbox Estimate		
	1137.53	1133.90	1133.90	1137.53	1133.9	1133.9
Per cent of 106-AN ion leachable:				100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:				2.05E-08	2.60E-08	1.09E-07
Std. Deviation, sq cm/s:				4.84E-09	3.92E-09	4.40E-08
Leachability Index:				7.689	7.585	6.962
Upper 95% Confidence Int.:				0.114	0.069	0.216
Lower 95% Confidence Int.:				0.090	0.059	0.144

PORT2-HI Sulfate

				0.00	0.00	0.00	0
1	3.28	4.04	31.17	3.71	4.35	18.10	0.083333
2	5.06	6.54	33.47	6.82	7.94	30.86	0.291666
3	10.68	13.03	39.97	12.07	13.97	47.15	1
4	16.40	18.93	46.08	16.39	18.83	54.64	2
5	20.52	23.04	50.70	19.44	22.21	56.96	3
6	23.75	26.08	54.10	21.85	24.83	57.65	4
7	26.47	28.64	57.05	23.84	26.94	57.88	5

Ao =	Added in 106-AN			Newbox Estimate		
	42.35	42.22	42.22	42.35	42.22	58

Per cent of 106-AN ion leachable:	100%	100%	137%
Eff. Diffusion Coefficient, sq cm/s:	2.12E-07	3.01E-07	3.17E-06
Std. Deviation, sq cm/s:	4.62E-08	4.26E-08	2.27E-06
Leachability Index:	6.673	6.522	5.499
Upper 95% Confidence Int.:	0.103	0.064	0.519
Lower 95% Confidence Int.:	0.083	0.056	0.230

PORT2-HI Nitrate + Nitrite

				0.00	0.00	0.00	0
1	31.22	38.56	266.29	46.06	51.62	107.79	0.083333
2	59.27	75.59	302.12	85.92	96.07	198.65	0.291666
3	140.12	165.08	395.08	156.81	175.85	356.59	1
4	221.24	248.75	485.41	218.88	244.24	488.48	2
5	284.59	310.27	553.33	266.26	296.34	586.17	3
6	335.24	357.80	604.86	303.83	338.68	662.70	4
7	378.14	397.32	649.49	338.13	376.13	727.83	5

	Added in 106-AN			Newbox Estimate		
Ao =	1633.46	1628.26	1628.26	1633.47	1628.26	1628.26

Per cent of 106-AN ion leachable:	100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:	2.12E-08	2.72E-08	1.21E-07
Std. Deviation, sq cm/s:	5.25E-09	4.34E-09	4.93E-08
Leachability Index:	7.673	7.566	6.918
Upper 95% Confidence Int.:	0.119	0.073	0.219
Lower 95% Confidence Int.:	0.093	0.063	0.145

K-43

PORT2-HIGH : Nitrate

PORT2-HIGH : Nitrite

PORT2-HIGH : Nitrate + Nitrite

K-44

PORT2-HIGH : Chloride

PORT2-HIGH : Sulfate

ANSI/ANS-16.1-1986 Leaching Data

Phase I: Binder Selection for 106-AN

Run No.: PORT2-LOW

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio 2 lb/gal

Chloride

Nitrite

Nitrate

Sulfate

5.32

34.87

79.99

2.98

Sample Cylinder Dimensions

After Curing 28 d

Initially

Batch 1

Batch 2

Batch 3

Vol, cc

2.51

Dia., cm

2.51

2.51

2.51

23.01

4.65

Length, cm

1.00

1.59

1.50

Grout Density, lb/gal

10.83

10.81

10.81

mL of 106-AN in Sample Cylinder

20.60

20.56

20.56

Leach Vol + Boric Acid Vol Added, mL

180

226.5

219.4

Leachate Concentrations

Mass in Leachate

mg/L

mg

Time

Interval

Batch 1

Batch 2

Batch 3

Batch 1

Batch 2

Batch 3

d

PORT2-L

Chloride

Initially:

109.56

109.36

109.36

0

376.62

262.37

266.08

67.79

59.43

58.38

0

1

19.97

19.97

20.05

3.59

4.52

4.40

0.083333

2

10.2

10.16

10.07

1.84

2.30

2.21

0.291666

3

6.84

31.67

29.12

1.23

7.17

6.39

1

4

0.67

15.56

14.61

0.12

3.52

3.21

2

5

0

3

3

0.00

0.68

0.66

3

6

0

1.64

0

0.00

0.37

0.00

4

7

0

0.38

0

0.00

0.09

0.00

5

PORT2-L

Nitrite

Initially:

718.42

717.10

717.10

0

2709

1870.52

2124.6

487.62

423.67

466.14

0

1

159.58

145.04

154.3

28.72

32.85

33.85

0.083333

2

72.76

75.8

72.8

13.10

17.17

15.97

0.291666

3

52.49

97.19

94.68

9.45

22.01

20.77

1

4

4.47

47.04

37.46

0.80

10.65

8.22

2

5

0

10

10

0.00

2.27

2.19

3

6

0

8.22

0

0.00

1.86

0.00

4

7

0

2.26

0

0.00

0.51

0.00

5

PORT2-L

Nitrate

Initially:

1647.85

1644.80

1644.80

0

5848.5

3934.4

4591.76

1052.73

891.14

1007.43

0

1

321.59

293.99

316.74

57.89

66.59

69.49

0.083333

2

167.72

158.89

155.14

30.19

35.99

34.04

0.291666

3

77.74

168.51

164.13

13.99

38.17

36.01

1

4

16.82

88.26

43.44

3.03

19.99

9.53

2

5

1.41

38.99

17.77

0.25

8.83

3.90

3

6

0.5

7.9

5.58

0.09

1.79

1.22

4

7

0

8.01

1.76

0.00

1.81

0.39

5

K-46

PORT2-L Sulfate	Initially:		61.35	61.24	61.24	
0	477.4	348.2	362	85.93	78.87	79.42
1	20.99	21.02	23.73	3.78	4.76	5.21
2	11.93	12.98	12.7	2.15	2.94	2.79
3	11.37	14.08	13.89	2.05	3.19	3.05
4	2.09	6.24	5.59	0.38	1.41	1.23
5	0.43	2.57	2.26	0.08	0.58	0.50
6	0.41	1.44	1.15	0.07	0.33	0.25
7	0	0	0	0.00	0.00	0.00

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)			
Observed				Calculated (NEWBOX)			
				(No Washoff or Washout)			
mg				mg			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
PORT2-L Chloride							
				0.00	0.00	0.00	0
1	71.39	63.95	62.78	71.39	61.23	60.99	0.083333
2	73.22	66.25	64.99	74.60	76.69	74.37	0.291666
3	74.45	73.42	71.38	74.60	78.10	75.20	1
4	74.57	76.95	74.58	74.60	78.10	75.20	2
5	74.57	77.63	75.24	74.60	78.10	75.20	3
6	74.57	78.00	75.24	74.60	78.10	75.20	4
7	74.57	78.09	75.24	74.60	78.10	75.20	5

Added in 106-AN				Newbox Estimate		
Ao =	109.56	109.36	109.36	74.6	78.1	75.2

Per cent of 106-AN ion leachable:	68%	71%	69%
Eff. Diffusion Coefficient, sq cm/s:	2.65E-05	1.81E-05	1.92E-05
Std. Deviation, sq cm/s:	3.58E-06	9.37E-06	9.36E-06
Leachability Index:	4.576	4.743	4.716
Upper 95% Confidence Int.:	0.061	0.304	0.278
Lower 95% Confidence Int.:	0.054	0.177	0.168

PORT2-L Nitrite				0.00	0.00	0.00	0
1	516.34	456.52	499.99	515.70	454.79	498.86	0.083333
2	529.44	473.69	515.96	539.96	509.98	546.45	0.291666
3	538.89	495.71	536.74	540.00	511.00	547.00	1
4	539.69	506.36	544.95	540.00	511.00	547.00	2
5	539.69	508.63	547.15	540.00	511.00	547.00	3
6	539.69	510.49	547.15	540.00	511.00	547.00	4
7	539.69	511.00	547.15	540.00	511.00	547.00	5

Added in 106-AN				Newbox Estimate		
Ao =	718.42	717.10	717.10	540	511	547
Per cent of 106-AN ion leachable:				75%	71%	76%
Eff. Diffusion Coefficient, sq cm/s:				2.62E-05	3.02E-05	3.22E-05
Std. Deviation, sq cm/s:				3.75E-06	1.02E-05	9.24E-06
Leachability Index:				4.582	4.520	4.492
Upper 95% Confidence Int.:				0.065	0.174	0.142
Lower 95% Confidence Int.:				0.057	0.124	0.107

PORT2-L Nitrate

				0.00	0.00	0.00	0
1	1110.62	957.73	1076.92	1110.52	955.47	1076.01	0.083333
2	1140.81	993.72	1110.96	1157.94	1062.94	1161.54	0.291666
3	1154.80	1031.89	1146.97	1158.00	1064.00	1162.00	1
4	1157.83	1051.88	1156.50	1158.00	1064.00	1162.00	2
5	1158.08	1060.71	1160.40	1158.00	1064.00	1162.00	3
6	1158.17	1062.50	1161.63	1158.00	1064.00	1162.00	4
7	1158.17	1064.31	1162.01	1158.00	1064.00	1162.00	5

Added in 106-AN				Newbox Estimate		
Ao =	1647.85	1644.80	1644.80	1158	1064	1162
Per cent of 106-AN ion leachable:				70%	65%	71%
Eff. Diffusion Coefficient, sq cm/s:				2.71E-05	3.14E-05	3.51E-05
Std. Deviation, sq cm/s:				3.00E-06	1.02E-05	8.48E-06
Leachability Index:				4.567	4.503	4.455
Upper 95% Confidence Int.:				0.049	0.165	0.116
Lower 95% Confidence Int.:				0.044	0.119	0.092

PORT2-L Sulfate

				0.00	0.00	0.00	0
1	89.71	83.63	84.63	89.68	83.44	84.45	0.083333
2	91.86	86.57	87.42	94.39	92.01	92.31	0.291666
3	93.90	89.76	90.46	94.40	92.10	92.40	1
4	94.28	91.17	91.69	94.40	92.10	92.40	2
5	94.36	91.75	92.19	94.40	92.10	92.40	3
6	94.43	92.08	92.44	94.40	92.10	92.40	4
7	94.43	92.08	92.44	94.40	92.10	92.40	5

Added in 106-AN				Newbox Estimate		
Ao =	61.35	61.24	61.24	94.4	92.1	92.4

Per cent of 106-AN ion leachable:	154%	150%	151%
Eff. Diffusion Coefficient, sq cm/s:	2.50E-05	3.29E-05	3.25E-05
Std. Deviation, sq cm/s:	4.41E-06	9.97E-06	9.21E-06
Leachability Index:	4.602	4.483	4.488
Upper 95% Confidence Int.:	0.082	0.152	0.140
Lower 95% Confidence Int.:	0.069	0.112	0.106

PORT2-L Nitrate + Nitrite

				0.00	0.00	0.00	0
1	1626.96	1414.25	1576.92	1626.68	1409.63	1575.70	0.083333
2	1670.25	1467.41	1626.93	1697.83	1571.85	1707.29	0.291666
3	1693.69	1527.59	1683.71	1698.00	1575.00	1709.00	1
4	1697.52	1558.24	1701.46	1698.00	1575.00	1709.00	2
5	1697.77	1569.33	1707.55	1698.00	1575.00	1709.00	3
6	1697.86	1572.99	1708.77	1698.00	1575.00	1709.00	4
7	1697.86	1575.31	1709.16	1698.00	1575.00	1709.00	5

	Added in 106-AN			Newbox Estimate		
Ao =	2366.27	2361.90	2361.90	1698	1575	1709

Per cent of 106-AN ion leachable:	72%	67%	72%
Eff. Diffusion Coefficient, sq cm/s:	2.68E-05	3.09E-05	3.41E-05
Std. Deviation, sq cm/s:	3.25E-06	1.02E-05	8.76E-06
Leachability Index:	4.572	4.511	4.467
Upper 95% Confidence Int.:	0.054	0.169	0.125
Lower 95% Confidence Int.:	0.048	0.121	0.097

PORT2-LOW : Nitrate

PORT2-LOW : Nitrite

PORT2-LOW : Nitrate + Nitrite

K-50

PORT2-LOW : Chloride

PORT2-LOW : Sulfate

K-51

ANSI/ANS-16.1-1986 Leaching Data Phase I: Binder Selection for 106-AN

Run No.: TYPE5-HIGH Surrogate 106-AN Concentrations, mg/mL

Mix Ratio	15 lb/gal	Chloride	Nitrite	Nitrate	Sulfate
		5.32	34.87	79.99	2.98

Sample Cylinder Dimensions

After Curing 28 d

Initially			Batch 1	Batch 2	Batch 3
Vol, cc	2.50	Dia., cm	2.55	2.55	2.55
22.83	4.65	Length, cm	4.56	4.56	4.55
Grout Density, lb/gal			15.70	15.68	15.70
mL of 106-AN in Sample Cylinder			14.22	14.20	14.22
Leach Vol + Boric Acid Vol Added, mL			472.1	472.1	471.3

Leachate Concentrations

Mass in Leachate

Interval	mg/L			mg			Time
	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
TYPE5-HI Chloride	Initially:			75.63	75.53	75.63	
0	21.31	13.16	23.48	10.06	6.21	11.07	0
1	2.63	3.09	2.78	1.24	1.46	1.31	0.083333
2	2.22	2.89	2.73	1.05	1.36	1.29	0.291666
3	7.78	9.02	9.05	3.67	4.26	4.27	1
4	8.47	8.47	8.95	4.00	4.00	4.22	2
5	5.99	6.44	6.3	2.83	3.04	2.97	3
6	4.96	5.53	5.64	2.34	2.61	2.66	4
7	3.13	3.39	3.4	1.48	1.60	1.60	5
TYPE5-HI Nitrite	Initially:			495.94	495.31	495.94	
0	180.05	153.02	288.04	85.00	72.24	135.75	0
1	21.38	28.02	24.39	10.09	13.23	11.50	0.083333
2	18.07	23.58	23.21	8.53	11.13	10.94	0.291666
3	54.31	66.89	62.31	25.64	31.58	29.37	1
4	58.21	62.03	64.71	27.48	29.28	30.50	2
5	43.13	46.06	45.52	20.36	21.74	21.45	3
6	33.52	38.47	38.03	15.82	18.16	17.92	4
7	27.97	30.47	30.07	13.20	14.38	14.17	5
TYPE5-HI Nitrate	Initially:			1137.53	1136.08	1137.53	
0	360.38	258.77	565.74	170.14	122.17	266.63	0
1	55.13	66.1	56.46	26.03	31.21	26.61	0.083333
2	42.8	53.49	49.54	20.21	25.25	23.35	0.291666
3	113.57	130.15	122.84	53.62	61.44	57.89	1
4	116.33	130.02	125.64	54.92	61.38	59.21	2
5	90.18	99.23	97.05	42.57	46.85	45.74	3
6	74.82	81.62	80.14	35.32	38.53	37.77	4
7	64.66	70.21	67.81	30.53	33.15	31.96	5

K-52

TYPE5-HI Sulfate	Initially:		42.35	42.30	42.35	
0	84.45	60.23	135.39	39.87	28.43	63.81
1	9.53	11.11	9.36	4.50	5.25	4.41
2	4.52	6.08	5.25	2.13	2.87	2.47
3	11.56	13.62	12.29	5.46	6.43	5.79
4	11.49	13.01	11.79	5.42	6.14	5.56
5	8.16	9.03	8.4	3.85	4.26	3.96
6	6.39	7.28	7.01	3.02	3.44	3.30
7	5.59	5.48	5.43	2.64	2.59	2.56

Cumulative Amount Leached, mg			(Adding Rinse to Interval 1)				
Observed			Calculated (NEWBOX)				
			(No Washoff or Washout)				
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d

TYPE5-HI Chloride							
				0.00	0.00	0.00	0
1	11.30	7.67	12.38	4.38	3.79	4.90	0.083333
2	12.35	9.04	13.66	8.09	7.02	9.00	0.291666
3	16.02	13.29	17.93	14.52	12.69	16.18	1
4	20.02	17.29	22.15	20.04	17.52	22.24	2
5	22.85	20.33	25.12	24.05	21.15	26.62	3
6	25.19	22.94	27.77	27.38	24.02	30.18	4
7	26.67	24.54	29.38	30.10	26.51	33.20	5

Added in 106-AN			Newbox Estimate		
Ao =	75.63	75.53	75.63	75.53	75.63

Per cent of 106-AN ion leachable:	100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:	9.43E-08	7.07E-08	1.18E-07
Std. Deviation, sq cm/s:	3.89E-08	1.96E-08	4.89E-08
Leachability Index:	7.025	7.150	6.927
Upper 95% Confidence Int.:	0.222	0.136	0.223
Lower 95% Confidence Int.:	0.146	0.104	0.147

TYPE5-HI Nitrite							
				0.00	0.00	0.00	0
1	95.10	85.47	147.25	35.01	35.41	51.08	0.083333
2	103.63	96.60	158.19	64.47	65.38	93.24	0.291666
3	129.27	128.18	187.55	115.06	116.40	163.66	1
4	156.75	157.46	218.05	157.71	159.49	220.69	2
5	177.11	179.21	239.51	188.46	190.20	260.37	3
6	192.93	197.37	257.43	213.25	215.46	291.12	4
7	206.14	211.76	271.60	234.08	236.26	315.91	5

K-53

Added in 106-AN				Newbox Estimate		
Ao =	495.94	495.31	495.94	495.94	495.31	495.94
Per cent of 106-AN ion leachable:			100%	100%	100%	
Eff. Diffusion Coefficient, sq cm/s:			1.41E-07	1.45E-07	3.07E-07	
Std. Deviation, sq cm/s:			6.54E-08	5.79E-08	1.73E-07	
Leachability Index:			6.850	6.839	6.513	
Upper 95% Confidence Int.:			0.259	0.214	0.345	
Lower 95% Confidence Int.:			0.161	0.143	0.190	

TYPE5-HI Nitrate

				0.00	0.00	0.00	0
1	196.16	153.37	293.24	72.01	67.03	99.19	0.083333
2	216.37	178.62	316.59	133.09	123.83	182.00	0.291666
3	269.98	240.07	374.49	238.88	222.67	321.92	1
4	324.90	301.45	433.70	327.61	306.74	437.95	2
5	367.48	348.30	479.44	392.45	368.09	519.85	3
6	402.80	386.83	517.21	444.77	416.94	583.55	4
7	433.33	419.98	549.17	489.14	458.98	637.02	5

Added in 106-AN				Newbox Estimate		
Ao =	1137.53	1136.08	1137.53	1137.53	1136.08	1137.53
Per cent of 106-AN ion leachable:			100%	100%	100%	
Eff. Diffusion Coefficient, sq cm/s:			1.13E-07	9.80E-08	2.17E-07	
Std. Deviation, sq cm/s:			5.18E-08	3.48E-08	1.20E-07	
Leachability Index:			6.946	7.009	6.663	
Upper 95% Confidence Int.:			0.255	0.184	0.333	
Lower 95% Confidence Int.:			0.160	0.129	0.186	

TYPE5-HI Sulfate

				0.00	0.00	0.00	0
1	44.37	33.68	68.22	33.90	21.30	58.60	0.083333
2	46.50	36.55	70.70	52.93	35.70	84.00	0.291666
3	51.96	42.98	76.49	65.86	52.44	91.91	1
4	57.38	49.12	82.04	66.97	58.38	92.00	2
5	61.24	53.39	86.00	67.00	59.64	92.00	3
6	64.25	56.82	89.31	67.00	59.94	92.00	4
7	66.89	59.41	91.87	67.00	59.98	92.00	5

Added in 106-AN				Newbox Estimate		
Ao =	42.35	42.30	42.35	67	60	92

K-54

Per cent of 106-AN ion leachable:	158%	142%	217%
Eff. Diffusion Coefficient, sq cm/s:	1.01E-05	4.36E-06	1.84E-05
Std. Deviation, sq cm/s:	8.18E-06	3.23E-06	1.41E-05
Leachability Index:	4.995	5.361	4.734
Upper 95% Confidence Int.:	0.670	0.553	0.590
Lower 95% Confidence Int.:	0.252	0.236	0.241

TYPE5-HI Nitrate + Nitrite

				0.00	0.00	0.00	0
1	291.26	238.84	440.49	106.99	102.29	150.12	0.083333
2	319.99	275.22	474.78	197.65	189.24	274.42	0.291666
3	399.25	368.25	562.04	354.46	339.33	485.14	1
4	481.65	458.91	651.75	485.14	466.58	658.29	2
5	544.59	527.51	718.94	581.52	557.94	779.17	3
6	595.73	584.20	774.64	658.29	632.98	875.54	4
7	639.46	631.73	820.77	723.63	696.60	953.95	5

	Added in 106-AN			Newbox Estimate		
Ao =	1633.46	1631.38	1633.46	1633.47	1631.39	1633.47

Per cent of 106-AN ion leachable:	100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:	1.21E-07	1.11E-07	2.42E-07
Std. Deviation, sq cm/s:	5.64E-08	4.11E-08	1.34E-07
Leachability Index:	6.916	6.955	6.616
Upper 95% Confidence Int.:	0.261	0.194	0.337
Lower 95% Confidence Int.:	0.162	0.134	0.187

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TYPE5-HIGH : Nitrate

TYPE5-HIGH : Nitrite

TYPE5-HIGH : Nitrate + Nitrite

TYPE5-HIGH : Chloride

TYPE5-HIGH : Sulfate

ANSI/ANS-16.1-1986 Leaching Data

Phase I: Binder Selection for 106-AN

Run No.: TYPE5-LOW

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio	2 lb/gal	Chloride	Nitrite	Nitrate	Sulfate
		5.32	34.87	79.99	2.98

Sample Cylinder Dimensions

After Curing 28 d

	Initially		Batch 1	Batch 2	Batch 3
Vol, cc	2.55	Dia., cm	2.55	2.55	2.55
23.75	4.65	Length, cm	1.66	1.45	1.81
Grout Density, lb/gal			10.81	10.85	10.82
mL of 106-AN in Sample Cylinder			21.22	21.30	21.24
Leach Vol + Boric Acid Vol Added, mL			237.6	220.8	249.6

Leachate Concentrations

Mass in Leachate

Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
TYPE5-LO Chloride		Initially:		112.87	113.29	112.98	
0	165.44	182.75	130.57	39.31	40.35	32.59	0
1	23.71	23	21.93	5.63	5.08	5.47	0.083333
2	12.95	31.96	26.15	3.08	7.06	6.53	0.291666
3	31.58	35.62	36.02	7.50	7.86	8.99	1
4	9.06	19	19.89	2.15	4.20	4.96	2
5	0.67	15	15	0.16	3.31	3.74	3
6	0	0.55	6.5	0.00	0.12	1.62	4
7	0	0.19	0	0.00	0.04	0.00	5
TYPE5-LO Nitrite		Initially:		740.14	742.87	740.82	
0	1684.07	1686.88	1293.65	400.14	372.46	322.90	0
1	221.19	208.05	194.86	52.55	45.94	48.64	0.083333
2	111.08	146.34	118.59	26.39	32.31	29.60	0.291666
3	138.63	148.29	140.85	32.94	32.74	35.16	1
4	32.56	76.35	67.82	7.74	16.86	16.93	2
5	3.17	12	22.22	0.75	2.65	5.55	3
6	0.43	3.72	15	0.10	0.82	3.74	4
7	0	0.18	5	0.00	0.04	1.25	5
TYPE5-LO Nitrate		Initially:		1697.64	1703.93	1699.21	
0	2602.83	2569.38	1836.65	618.43	567.32	458.43	0
1	427.05	397.07	369.5	101.47	87.67	92.23	0.083333
2	217.51	210.95	199.69	51.68	46.58	49.84	0.291666
3	213.31	215.87	204.87	50.68	47.66	51.14	1
4	65.16	103.1	111.38	15.48	22.76	27.80	2
5	12.97	50	53.45	3.08	11.04	13.34	3
6	3.46	12.15	25.92	0.82	2.68	6.47	4
7	1.6	5.31	13.72	0.38	1.17	3.42	5

K-58

TYPE5-LO Sulfate				Initially:			
0	99.84	31.2	42	23.72	6.89	10.48	0
1	30.06	27.52	29.64	7.14	6.08	7.40	0.083333
2	16.94	15.79	16.31	4.02	3.49	4.07	0.291666
3	17.29	17.15	16.98	4.11	3.79	4.24	1
4	6.54	7.48	7.82	1.55	1.65	1.95	2
5	1.89	5	5.67	0.45	1.10	1.42	3
6	0	1.46	1.71	0.00	0.32	0.43	4
7	0.64	0.71	1.3	0.15	0.16	0.32	5

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)			
Observed				Calculated (NEWBOX)			
				(No Washoff or Washout)			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d

TYPE5-LO Chloride

				0.00	0.00	0.00	0
1	44.94	45.43	38.06	41.62	39.85	31.25	0.083333
2	48.02	52.49	44.59	55.43	59.02	48.82	0.291666
3	55.52	60.35	53.58	57.79	67.73	62.24	1
4	57.68	64.55	58.55	57.80	68.00	63.84	2
5	57.83	67.86	62.29	57.80	68.00	63.89	3
6	57.83	67.98	63.91	57.80	68.00	63.90	4
7	57.83	68.02	63.91	57.80	68.00	63.90	5

Added in 106-AN				Newbox Estimate		
Ao =	112.87	113.29	112.98	57.8	68	63.9
Per cent of 106-AN ion leachable:				51%	60%	57%
Eff. Diffusion Coefficient, sq cm/s:				1.45E-05	6.99E-06	5.39E-06
Std. Deviation, sq cm/s:				6.59E-06	3.16E-06	2.71E-06
Leachability Index:				4.840	5.155	5.268
Upper 95% Confidence Int.:				0.254	0.251	0.292
Lower 95% Confidence Int.:				0.159	0.158	0.173

TYPE5-LO Nitrite

				0.00	0.00	0.00	0
1	452.69	418.40	371.53	449.10	409.25	355.89	0.083333
2	479.08	450.71	401.13	518.92	498.46	453.33	0.291666
3	512.02	483.45	436.29	521.00	504.00	464.00	1
4	519.76	500.31	453.22	521.00	504.00	464.00	2
5	520.51	502.96	458.76	521.00	504.00	464.00	3
6	520.61	503.78	462.51	521.00	504.00	464.00	4
7	520.61	503.82	463.75	521.00	504.00	464.00	5

Added in 106-AN				Newbox Estimate		
Ao =	740.14	742.87	740.82	521	504	464
Per cent of 106-AN ion leachable:				70%	68%	63%
Eff. Diffusion Coefficient, sq cm/s:				2.76E-05	1.89E-05	1.93E-05
Std. Deviation, sq cm/s:				8.68E-06	6.92E-07	8.59E-06
Leachability Index:				4.558	4.723	4.715
Upper 95% Confidence Int.:				0.158	0.016	0.246
Lower 95% Confidence Int.:				0.116	0.015	0.156

TYPE5-LO Nitrate

				0.00	0.00	0.00	0
1	719.90	654.99	550.66	712.33	641.41	521.63	0.083333
2	771.58	701.57	600.50	836.95	779.13	680.50	0.291666
3	822.26	749.23	651.63	842.00	787.00	702.98	1
4	837.74	772.00	679.43	842.00	787.00	703.00	2
5	840.83	783.04	692.77	842.00	787.00	703.00	3
6	841.65	785.72	699.24	842.00	787.00	703.00	4
7	842.03	786.89	702.67	842.00	787.00	703.00	5

Added in 106-AN				Newbox Estimate		
Ao =	1697.64	1703.93	1699.21	842	787	703
Per cent of 106-AN ion leachable:				50%	46%	41%
Eff. Diffusion Coefficient, sq cm/s:				2.55E-05	1.91E-05	1.72E-05
Std. Deviation, sq cm/s:				7.87E-06	7.53E-06	7.91E-06
Leachability Index:				4.594	4.718	4.765
Upper 95% Confidence Int.:				0.155	0.209	0.257
Lower 95% Confidence Int.:				0.114	0.141	0.161

TYPE5-LO Sulfate

				0.00	0.00	0.00	0
1	30.86	12.97	17.88	28.92	11.14	15.45	0.083333
2	34.89	16.45	21.95	39.10	17.60	23.85	0.291666
3	39.00	20.24	26.19	41.20	22.77	29.72	1
4	40.55	21.89	28.14	41.20	23.45	30.27	2
5	41.00	22.99	29.56	41.20	23.50	30.30	3
6	41.00	23.32	29.98	41.20	23.50	30.30	4
7	41.15	23.47	30.31	41.20	23.50	30.30	5

Added in 106-AN				Newbox Estimate		
Ao =	63.20	63.44	63.26	41.2	23.5	30.3

K-60

Per cent of 106-AN ion leachable:	65%	37%	48%
Eff. Diffusion Coefficient, sq cm/s:	1.33E-05	4.06E-06	5.97E-06
Std. Deviation, sq cm/s:	5.02E-06	1.56E-06	2.53E-06
Leachability Index:	4.875	5.391	5.224
Upper 95% Confidence Int.:	0.198	0.203	0.231
Lower 95% Confidence Int.:	0.135	0.138	0.150

TYPE5-LO Nitrate + Nitrite

				0.00	0.00	0.00	0
1	1172.59	1073.39	922.19	1161.28	1050.87	876.83	0.083333
2	1250.66	1152.28	1001.63	1356.19	1276.80	1133.35	0.291666
3	1334.28	1232.69	1087.92	1363.00	1291.00	1165.98	1
4	1357.50	1272.31	1132.65	1363.00	1291.00	1166.00	2
5	1361.34	1286.00	1151.54	1363.00	1291.00	1166.00	3
6	1362.26	1289.51	1161.75	1363.00	1291.00	1166.00	4
7	1362.64	1290.72	1166.42	1363.00	1291.00	1166.00	5

	Added in 106-AN			Newbox Estimate		
Ao =	2437.78	2446.80	2440.04	1363	1291	1166

Per cent of 106-AN ion leachable:	56%	53%	48%
Eff. Diffusion Coefficient, sq cm/s:	2.63E-05	1.90E-05	1.80E-05
Std. Deviation, sq cm/s:	8.23E-06	7.30E-06	8.09E-06
Leachability Index:	4.581	4.720	4.745
Upper 95% Confidence Int.:	0.158	0.203	0.250
Lower 95% Confidence Int.:	0.115	0.138	0.157

TYPE 5 - LOW : Nitrate

TYPE 5 - LOW : Nitrite

TYPE 5 - LOW : Nitrate + Nitrite

TYPE 5 - LOW : Chloride

TYPE 5 - LOW : Sulfate

Appendix L
LEACH DATA FOR PHASE II

Appendix L
LEACH DATA FOR PHASE II

ANSI/ANS-16.1-1986 Leaching Data				Phase III: Mixt. Exp't for 106-AN			
Run No.:	III-01			Surrogate 106-AN Concentrations, mg/mL			
Mix Ratio	8.75	lb/gal	Chloride	Nitrite	Nitrate	Sulfate	
			5.32	34.87	79.99	2.98	
Sample Cylinder Dimensions			After Curing 28 d				
	Initially			Batch 1	Batch 2	Batch 3	
	Vol, cc	2.50	Dia., cm	2.51	2.51	2.51	
	22.83	4.65	Length,cm	4.47	4.45	4.42	
	Grout Density, lb/gal			14.01	14.00	13.98	
mL of 106-AN in Sample Cylinder				16.92	16.91	16.88	
Leach Vol + Boric Acid Vol Added, mL				455.9	454.4	452	
Leachate Concentrations			Mass in Leachate				
	mg/L			mg			Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
III-01	Chloride	Initially:		89.99	89.92	89.79	
0	0.5	0.95	0.5	0.23	0.43	0.23	0
1	25	26.45	23.48	11.40	12.02	10.61	0.083333
2	1	23.34	20.66	0.46	10.61	9.34	0.291666
3	22.64	24.52	23.22	10.32	11.14	10.50	1
4	11.96	9.28	8.85	5.45	4.22	4.00	2
5	1.35	0.71	1.75	0.62	0.32	0.79	3
6	0.5	0.5	0.5	0.23	0.23	0.23	4
7	0.5	0.5	0.5	0.23	0.23	0.23	5
III-01	Nitrite	Initially:		590.07	589.65	588.81	
0	6.6	5.12	3	3.01	2.33	1.36	0
1	294.68	337.4	290.93	134.34	153.31	131.50	0.083333
2	200.36	257.7	246.13	91.34	117.10	111.25	0.291666
3	276.81	284.79	274.06	126.20	129.41	123.88	1
4	111.01	100.03	94.78	50.61	45.45	42.84	2
5	15.68	13.06	19.7	7.15	5.93	8.90	3
6	1.62	1.53	2.55	0.74	0.70	1.15	4
7	1.5	1.5	1.5	0.68	0.68	0.68	5
III-01	Nitrate	Initially:		1353.44	1352.47	1350.54	
0	12.74	16.48	13.98	5.81	7.49	6.32	0
1	561.21	612.65	559.55	255.86	278.39	252.92	0.083333
2	478.08	502.21	478.63	217.96	228.20	216.34	0.291666
3	560.38	547.7	559.79	255.48	248.87	253.03	1
4	235.96	208.7	233.84	107.57	94.83	105.70	2
5	43.6	38.96	45.69	19.88	17.70	20.65	3
6	10.26	7.09	9.2	4.68	3.22	4.16	4
7	2.51	2.05	2.03	1.14	0.93	0.92	5

III-01	Sulfate	Initially:		50.39	50.35	50.28	
0	1	1.6	2	0.46	0.73	0.90	0
1	57.26	41.98	54.22	26.10	19.08	24.51	0.083333
2	37.2	58.35	45.12	16.96	26.51	20.39	0.291666
3	67.57	72	76.71	30.81	32.72	34.67	1
4	48.22	44.65	52.27	21.98	20.29	23.63	2
5	24	23.68	12.8	10.94	10.76	5.79	3
6	14.63	12.22	15.14	6.67	5.55	6.84	4
7	7.15	6.51	7.9	3.26	2.96	3.57	5

Cumulative Amount Leached, mg Observed				(Adding Rinse to Interval 1) Calculated (NEWBOX) (No Washoff or Washout)			Time d
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	
III-01	Chloride			0.00	0.00	0.00	0
1	11.63	12.45	10.84	8.38	13.31	11.79	0.083333
2	12.08	23.06	20.18	14.42	22.48	20.00	0.291666
3	22.40	34.20	30.67	22.56	33.57	30.26	1
4	27.86	38.41	34.67	26.88	38.00	34.71	2
5	28.47	38.74	35.46	28.50	39.11	35.99	3
6	28.70	38.96	35.69	29.16	39.38	36.35	4
7	28.93	39.19	35.92	29.42	39.46	36.46	5

Added in 106-AN				Newbox Estimate		
Ao =	89.99	89.92	89.79	29.6	39.5	36.5
Per cent of 106-AN ion leachable:				33%	44%	41%
Eff. Diffusion Coefficient, sq cm/s:				2.54E-06	3.75E-06	3.39E-06
Std. Deviation, sq cm/s:				9.75E-07	3.45E-07	2.80E-07
Leachability Index:				5.595	5.426	5.470
Upper 95% Confidence Int.:				0.203	0.041	0.036
Lower 95% Confidence Int.:				0.138	0.037	0.034

III-01	Nitrite			0.00	0.00	0.00	0
1	137.35	155.64	132.86	137.52	160.86	141.86	0.083333
2	228.70	272.74	244.11	233.24	269.63	239.84	0.291666
3	354.90	402.15	367.98	350.70	397.13	359.54	1
4	405.50	447.60	410.82	399.61	443.75	408.53	2
5	412.65	453.54	419.73	412.98	453.80	421.31	3
6	413.39	454.23	420.88	416.75	456.54	424.72	4
7	414.08	454.91	421.56	417.58	456.86	425.57	5

Added in 106-AN				Newbox Estimate			
Ao =	590.07	589.65	588.81	418	457	426	
Per cent of 106-AN ion leachable:				71%	78%	72%	
Eff. Diffusion Coefficient, sq cm/s:				3.56E-06	4.11E-06	3.63E-06	
Std. Deviation, sq cm/s:				1.76E-07	1.99E-07	3.29E-07	
Leachability Index:				5.449	5.386	5.440	
Upper 95% Confidence Int.:				0.021	0.021	0.040	
Lower 95% Confidence Int.:				0.020	0.020	0.037	
III-01	Nitrate						
				0.00	0.00	0.00	0
1	261.65	285.88	259.24	278.57	296.82	276.34	0.083333
2	479.62	514.08	475.58	473.92	500.23	469.26	0.291666
3	735.10	762.96	728.60	720.07	745.54	713.45	1
4	842.67	857.79	834.30	829.57	841.57	822.07	2
5	862.55	875.49	854.95	861.98	865.14	855.10	3
6	867.23	878.71	859.11	871.62	871.25	864.66	4
7	868.37	879.65	860.02	874.25	872.13	867.26	5

Added in 106-AN				Newbox Estimate			
Ao =	1353.44	1352.47	1350.54	876	873	869	
Per cent of 106-AN ion leachable:				65%	65%	64%	
Eff. Diffusion Coefficient, sq cm/s:				3.29E-06	3.82E-06	3.26E-06	
Std. Deviation, sq cm/s:				2.84E-07	3.11E-07	2.85E-07	
Leachability Index:				5.483	5.418	5.487	
Upper 95% Confidence Int.:				0.038	0.036	0.039	
Lower 95% Confidence Int.:				0.035	0.033	0.035	
III-01	Sulfate						
				0.00	0.00	0.00	0
1	26.56	19.80	25.41	26.72	24.84	27.85	0.083333
2	43.52	46.32	45.81	47.09	44.30	49.01	0.291666
3	74.33	79.03	80.48	77.23	74.38	80.14	1
4	96.31	99.32	104.10	96.87	95.91	100.55	2
5	107.25	110.08	109.89	107.48	109.02	111.26	3
6	113.92	115.64	116.73	113.46	117.71	117.43	4
7	117.18	118.59	120.30	117.00	123.79	120.96	5

Added in 106-AN				Newbox Estimate		
Ao =	50.39	50.35	50.28	122	138	126

L-6

Per cent of 106-AN ion leachable:	242%	274%	251%
Eff. Diffusion Coefficient, sq cm/s:	1.46E-06	9.51E-07	1.47E-06
Std. Deviation, sq cm/s:	9.30E-08	1.57E-07	1.21E-07
Leachability Index:	5.836	6.022	5.833
Upper 95% Confidence Int.:	0.028	0.076	0.036
Lower 95% Confidence Int.:	0.026	0.065	0.033

III-01 Nitrate + Nitrite

				0.00	0.00	0.00	0
1	399.02	441.52	392.09	416.35	457.52	417.96	0.083333
2	708.32	786.82	719.68	707.66	770.07	707.82	0.291666
3	1089.99	1165.10	1096.58	1069.87	1142.47	1071.43	1
4	1248.18	1305.39	1245.12	1225.84	1284.78	1230.59	2
5	1275.20	1329.03	1274.68	1270.95	1319.36	1275.88	3
6	1280.62	1332.95	1279.99	1283.84	1327.34	1288.82	4
7	1282.45	1334.56	1281.58	1287.71	1329.34	1292.71	5

	Added in 106-AN			Newbox Estimate		
Ao =	1943.51	1942.12	1939.35	1289	1330	1294

Per cent of 106-AN ion leachable:	66%	68%	67%
Eff. Diffusion Coefficient, sq cm/s:	3.41E-06	3.92E-06	3.38E-06
Std. Deviation, sq cm/s:	2.42E-07	2.82E-07	2.97E-07
Leachability Index:	5.467	5.407	5.471
Upper 95% Confidence Int.:	0.031	0.031	0.039
Lower 95% Confidence Int.:	0.029	0.029	0.036

L-7

Run III-01 : Nitrate

Run III-01 : Nitrite

Run III-01 : Nitrate + Nitrite

Run III-01 : Chloride

Run III-01 : Sulfate

ANSI/ANS-16.1-1986 Leaching Data				Phase III: Mixt. Exp't for 106-AN			
Run No.:	III-07		Surrogate 106-AN Concentrations, mg/mL				
Mix Ratio	8 lb/gal	Chloride	Nitrite	Nitrate	Sulfate		
		5.32	34.87	79.99	2.98		
Sample Cylinder Dimensions			After Curing 28 d				
	Initially		Batch 1	Batch 2	Batch 3		
Vol, cc	2.50	Dia., cm	2.51	2.51	2.51		
22.83	4.65	Length,cm	4.23	4.24	4.41		
Grout Density, lb/gal			13.63	13.62	13.63		
mL of 106-AN in Sample Cylinder			17.15	17.14	17.15		
Leach Vol + Boric Acid Vol Added, mL			437	437.8	451.2		
Leachate Concentrations			Mass in Leachate			Time d	
	mg/L		mg				
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	
III-07	Chloride	Initially:		91.19	91.13	91.19	
0	1.71	0.5	1.84	0.75	0.22	0.83	0
1	19.66	23.08	20	8.59	10.10	9.02	0.083333
2	22.87	22	20.6	9.99	9.63	9.29	0.291666
3	20	23.42	17.47	8.74	10.25	7.88	1
4	12.06	10	9.09	5.27	4.38	4.10	2
5	1	1.06	0.94	0.44	0.46	0.42	3
6	1	0.5	0.5	0.44	0.22	0.23	4
7	0.5	0.5	0.5	0.22	0.22	0.23	5
III-07	Nitrite	Initially:		597.98	597.55	597.98	
0	15.29	8.98	17.74	6.68	3.93	8.00	0
1	204.9	278.67	166.21	89.54	122.00	74.99	0.083333
2	291.06	245.6	240.5	127.19	107.52	108.51	0.291666
3	197.68	236.49	231.25	86.39	103.54	104.34	1
4	114.9	97.28	105.02	50.21	42.59	47.39	2
5	10.91	11.47	10.02	4.77	5.02	4.52	3
6	3.04	2.67	2.41	1.33	1.17	1.09	4
7	1.5	1.5	1.5	0.66	0.66	0.68	5
III-07	Nitrate	Initially:		1371.59	1370.59	1371.59	
0	40.22	16.81	34.42	17.58	7.36	15.53	0
1	374.61	567.13	324.4	163.70	248.29	146.37	0.083333
2	519.2	562.14	447.46	226.89	246.10	201.89	0.291666
3	482.25	495.5	426.43	210.74	216.93	192.41	1
4	238.69	254	217.52	104.31	111.20	98.15	2
5	34.46	35.52	30.85	15.06	15.55	13.92	3
6	13.51	12.4	9.63	5.90	5.43	4.35	4
7	4.16	3.72	3.52	1.82	1.63	1.59	5

III-07	Sulfate	Initially:		51.06	51.03	51.06	
0	7.88	2.27	7.24	3.44	0.99	3.27	0
1	44.03	76.78	45.87	19.24	33.61	20.70	0.083333
2	56.42	44.6	56.89	24.66	19.53	25.67	0.291666
3	59.96	71.58	61.34	26.20	31.34	27.68	1
4	49.1	44.97	51.19	21.46	19.69	23.10	2
5	22.35	22.93	23.37	9.77	10.04	10.54	3
6	16.26	16.86	13.55	7.11	7.38	6.11	4
7	7.86	8.47	6.94	3.44	3.71	3.13	5

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)			
Observed				Calculated (NEWBOX)			
				(No Washoff or Washout)			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
III-07	Chloride						
				0.00	0.00	0.00	0
1	9.34	10.32	9.85	10.61	11.38	9.04	0.083333
2	19.33	19.95	19.15	18.11	19.31	18.07	0.291666
3	28.07	30.21	27.03	27.82	29.37	27.09	1
4	33.34	34.59	31.13	32.49	33.93	30.78	2
5	33.78	35.05	31.56	34.06	35.29	31.75	3
6	34.22	35.27	31.78	34.62	35.72	32.00	4
7	34.44	35.49	32.01	34.80	35.83	32.07	5

Added in 106-AN				Newbox Estimate		
Ao =	91.19	91.13	91.19	34.9	35.9	32.1

Per cent of 106-AN ion leachable:	38%	39%	35%
Eff. Diffusion Coefficient, sq cm/s:	2.90E-06	3.19E-06	3.63E-06
Std. Deviation, sq cm/s:	4.72E-07	4.21E-07	4.68E-07
Leachability Index:	5.538	5.496	5.440
Upper 95% Confidence Int.:	0.075	0.060	0.058
Lower 95% Confidence Int.:	0.064	0.052	0.051

III-07	Nitrite			0.00	0.00	0.00	0
1	96.22	125.93	83.00	117.06	134.20	104.11	0.083333
2	223.42	233.46	191.51	198.97	225.62	178.42	0.291666
3	309.80	336.99	295.85	303.69	334.15	277.87	1
4	360.01	379.58	343.24	351.93	375.77	328.84	2
5	364.78	384.60	347.76	366.89	385.89	347.51	3
6	366.11	385.77	348.85	371.76	388.22	354.69	4
7	366.77	386.43	349.52	373.25	388.81	357.21	5

Added in 106-AN				Newbox Estimate			
Ao =	597.98	597.55	597.98	374	389	359	
Per cent of 106-AN ion leachable:				63%	65%	60%	
Eff. Diffusion Coefficient, sq cm/s:				3.09E-06	3.87E-06	2.65E-06	
Std. Deviation, sq cm/s:				8.19E-07	3.67E-07	7.24E-07	
Leachability Index:				5.510	5.412	5.577	
Upper 95% Confidence Int.:				0.129	0.042	0.134	
Lower 95% Confidence Int.:				0.100	0.038	0.102	
III-07	Nitrate						
				0.00	0.00	0.00	0
1	181.28	255.65	161.90	220.51	280.57	197.22	0.083333
2	408.17	501.75	363.79	378.45	475.33	339.77	0.291666
3	618.91	718.68	556.20	589.04	715.57	530.07	1
4	723.22	829.88	654.34	697.38	818.53	630.41	2
5	738.28	845.44	668.26	737.82	846.85	667.78	3
6	744.18	850.86	672.61	753.08	854.57	682.31	4
7	746.00	852.49	674.20	759.19	857.14	688.54	5

Added in 106-AN				Newbox Estimate			
Ao =	1371.59	1370.59	1371.59	763	858	692	
Per cent of 106-AN ion leachable:				56%	63%	50%	
Eff. Diffusion Coefficient, sq cm/s:				2.59E-06	3.43E-06	2.57E-06	
Std. Deviation, sq cm/s:				6.27E-07	4.52E-07	6.01E-07	
Leachability Index:				5.587	5.465	5.590	
Upper 95% Confidence Int.:				0.116	0.060	0.112	
Lower 95% Confidence Int.:				0.092	0.052	0.089	
III-07	Sulfate						
				0.00	0.00	0.00	0
1	22.68	34.61	23.96	25.92	31.24	27.71	0.083333
2	47.34	54.13	49.63	45.60	54.48	48.64	0.291666
3	73.54	85.47	77.31	74.76	87.63	79.26	1
4	95.00	105.16	100.41	94.08	107.70	98.62	2
5	104.77	115.20	110.95	104.64	117.22	108.66	3
6	111.87	122.58	117.06	110.76	122.05	114.10	4
7	115.32	126.29	120.20	114.48	124.46	117.13	5

Added in 106-AN				Newbox Estimate		
Ao =	51.06	51.03	51.06	120	127	121

Per cent of 106-AN ion leachable:	235%	249%	237%
Eff. Diffusion Coefficient, sq cm/s:	1.37E-06	1.82E-06	1.59E-06
Std. Deviation, sq cm/s:	1.23E-07	1.88E-07	1.62E-07
Leachability Index:	5.863	5.740	5.799
Upper 95% Confidence Int.:	0.040	0.046	0.045
Lower 95% Confidence Int.:	0.036	0.042	0.041

III-07 Nitrate + Nitrite

				0.00	0.00	0.00	0
1	277.50	381.58	244.90	337.09	415.25	301.35	0.083333
2	631.59	735.21	555.31	577.72	700.81	517.65	0.291666
3	928.72	1055.68	852.05	892.11	1049.97	807.45	1
4	1083.24	1209.47	997.58	1048.74	1194.63	958.65	2
5	1103.06	1230.04	1016.02	1104.36	1233.28	1014.30	3
6	1110.29	1236.64	1021.45	1123.65	1243.26	1036.35	4
7	1112.77	1238.92	1023.72	1130.46	1245.75	1044.75	5

	Added in 106-AN			Newbox Estimate		
Ao =	1969.58	1968.13	1969.58	1135	1247	1050

Per cent of 106-AN ion leachable:	58%	63%	53%
Eff. Diffusion Coefficient, sq cm/s:	2.76E-06	3.56E-06	2.60E-06
Std. Deviation, sq cm/s:	6.79E-07	4.28E-07	6.44E-07
Leachability Index:	5.559	5.449	5.585
Upper 95% Confidence Int.:	0.119	0.054	0.120
Lower 95% Confidence Int.:	0.093	0.048	0.094

Run III-07 : Nitrate

Run III-07 : Nitrite

Run III-07 : Nitrate + Nitrite

Run III-07 : Chloride

Run III-07 : Sulfate

ANSI/ANS-16.1-1986 Leaching Data				Phase III: Mixt. Exp't for 106-AN			
Run No.:	III-10			Surrogate 106-AN Concentrations, mg/mL			
Mix Ratio	9.5	lb/gal	Chloride	Nitrite	Nitrate	Sulfate	
			5.32	34.87	79.99	2.98	
Sample Cylinder Dimensions			After Curing 28 d				
	Initially			Batch 1	Batch 2	Batch 3	
	Vol, cc	2.51	Dia., cm	2.50	2.50	2.51	
	23.01	4.65	Length,cm	4.43	4.57	4.54	
	Grout Density, lb/gal			13.88	13.90	13.92	
mL of 106-AN in Sample Cylinder				16.25	16.27	16.30	
Leach Vol + Boric Acid Vol Added, mL				450.7	461.7	459.3	
Leachate Concentrations			Mass in Leachate				Time d
	mg/L			mg			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	
III-10	Chloride	Initially:		86.41	86.53	86.66	
0	1	0.79	0.91	0.45	0.36	0.42	0
1	27.5	28.01	26.28	12.39	12.93	12.07	0.083333
2	23.16	23.06	19.82	10.44	10.65	9.10	0.208333
3	27.9	31	25.82	12.57	14.31	11.86	1
4	13.67	20.82	16.1	6.16	9.61	7.39	2
5	3.06	1	1	1.38	0.46	0.46	3
6	1	0.5	0.5	0.45	0.23	0.23	4
7	0.5	0.5	0.5	0.23	0.23	0.23	5
III-10	Nitrite	Initially:		566.62	567.43	568.25	
0	3	4.63	5.1	1.35	2.14	2.34	0
1	326.25	354.5	343.7	147.04	163.67	157.86	0.083333
2	200.14	222.28	207.59	90.20	102.63	95.35	0.208333
3	468.33	487.5	469.48	211.08	225.08	215.63	1
4	163.64	173.36	153.02	73.75	80.04	70.28	2
5	32.85	27.56	27.38	14.81	12.72	12.58	3
6	4.17	4.13	4.38	1.88	1.91	2.01	4
7	1.5	0.67	1.5	0.68	0.31	0.69	5
III-10	Nitrate	Initially:		1299.64	1301.52	1303.39	
0	12.55	10.04	12.32	5.66	4.64	5.66	0
1	586.7	631.44	624.97	264.43	291.54	287.05	0.083333
2	362.01	389.9	348.84	163.16	180.02	160.22	0.208333
3	847.5	884.63	839.32	381.97	408.43	385.50	1
4	320.71	334.82	317.29	144.54	154.59	145.73	2
5	72.1	75.41	70.64	32.50	34.82	32.44	3
6	16.87	18.03	17.19	7.60	8.32	7.90	4
7	2.5	3.78	4.51	1.13	1.75	2.07	5

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III-10	Sulfate	Initially:		48.39	48.46	48.53	
0	2	2	2	0.90	0.92	0.92	0
1	57.59	67.78	69.02	25.96	31.29	31.70	0.083333
2	32.11	32.37	43.44	14.47	14.95	19.95	0.208333
3	118.65	112.2	113.7	53.48	51.80	52.22	1
4	61.38	64.53	65	27.66	29.79	29.85	2
5	37.54	2	36.71	16.92	0.92	16.86	3
6	19.47	23.59	15.39	8.78	10.89	7.07	4
7	11.4	11.84	11.83	5.14	5.47	5.43	5

Cumulative Amount Leached, mg Observed				(Adding Rinse to Interval 1) Calculated (NEWBOX) (No Washoff or Washout)			Time d
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	
III-10	Chloride						
				0.00	0.00	0.00	0
1	12.84	13.30	12.49	13.44	14.11	12.72	0.083333
2	23.28	23.94	21.59	23.01	24.35	21.75	0.208333
3	35.86	38.26	33.45	35.42	38.10	33.58	1
4	42.02	47.87	40.85	41.43	45.48	39.39	2
5	43.40	48.33	41.30	43.43	48.29	41.34	3
6	43.85	48.56	41.53	44.14	49.45	42.02	4
7	44.07	48.79	41.76	44.37	49.90	42.27	5

Added in 106-AN				Newbox Estimate		
Ao =	86.41	86.53	86.66	44.5	50.2	42.4

Per cent of 106-AN ion leachable:	51%	58%	49%
Eff. Diffusion Coefficient, sq cm/s:	2.91E-06	2.51E-06	2.90E-06
Std. Deviation, sq cm/s:	1.85E-07	2.83E-07	2.16E-07
Leachability Index:	5.536	5.600	5.538
Upper 95% Confidence Int.:	0.028	0.050	0.033
Lower 95% Confidence Int.:	0.026	0.045	0.030

III-10	Nitrite			0.00	0.00	0.00	0
1	148.39	165.81	160.20	152.59	169.63	162.16	0.083333
2	238.60	268.44	255.55	263.67	293.06	279.05	0.208333
3	449.67	493.52	471.18	415.70	459.65	436.63	1
4	523.42	573.56	541.46	500.41	549.02	520.28	2
5	538.23	586.28	554.04	535.19	584.29	552.37	3
6	540.11	588.19	556.05	549.78	598.27	564.41	4
7	540.79	588.50	556.74	555.95	603.74	569.56	5

Added in 106-AN				Newbox Estimate			
Ao =	566.62	567.43	568.25	561	608	573	
Per cent of 106-AN ion leachable:				99%	107%	101%	
Eff. Diffusion Coefficient, sq cm/s:				2.30E-06	2.47E-06	2.55E-06	
Std. Deviation, sq cm/s:				4.39E-07	4.40E-07	4.56E-07	
Leachability Index:				5.638	5.607	5.593	
Upper 95% Confidence Int.:				0.089	0.083	0.083	
Lower 95% Confidence Int.:				0.074	0.069	0.070	
III-10	Nitrate						
				0.00	0.00	0.00	0
1	270.08	296.17	292.71	275.04	301.01	287.47	0.083333
2	433.24	476.19	452.93	475.64	521.45	498.07	0.208333
3	815.21	884.62	838.43	753.79	823.58	784.49	1
4	959.75	1039.21	984.16	911.99	993.67	942.44	2
5	992.25	1074.03	1016.61	979.20	1064.17	1006.67	3
6	999.85	1082.35	1024.50	1009.18	1095.50	1032.99	4
7	1000.98	1084.09	1026.57	1022.63	1108.93	1044.58	5

Added in 106-AN				Newbox Estimate			
Ao =	1299.64	1301.52	1303.39	1034	1119	1053	
Per cent of 106-AN ion leachable:				80%	86%	81%	
Eff. Diffusion Coefficient, sq cm/s:				2.18E-06	2.27E-06	2.37E-06	
Std. Deviation, sq cm/s:				4.09E-07	3.97E-07	4.11E-07	
Leachability Index:				5.662	5.644	5.625	
Upper 95% Confidence Int.:				0.087	0.081	0.080	
Lower 95% Confidence Int.:				0.073	0.068	0.068	
III-10	Sulfate						
				0.00	0.00	0.00	0
1	26.86	32.22	32.62	28.76	31.77	35.16	0.083333
2	41.33	47.16	52.57	51.97	56.45	62.42	0.208333
3	94.80	98.97	104.79	89.89	94.47	104.53	1
4	122.47	128.76	134.65	119.07	121.17	134.23	2
5	139.39	129.68	151.51	138.24	137.06	151.90	3
6	148.16	140.57	158.58	152.72	147.37	163.37	4
7	153.30	146.04	164.01	163.80	154.30	171.27	5

Added in 106-AN				Newbox Estimate		
Ao =	48.39	48.46	48.53	213	169	188

Per cent of 106-AN ion leachable:	440%	349%	387%
Eff. Diffusion Coefficient, sq cm/s:	5.29E-07	1.05E-06	1.04E-06
Std. Deviation, sq cm/s:	7.98E-08	1.77E-07	1.11E-07
Leachability Index:	6.277	5.979	5.983
Upper 95% Confidence Int.:	0.069	0.078	0.048
Lower 95% Confidence Int.:	0.059	0.066	0.043

III-10	Nitrate + Nitrite			0.00	0.00	0.00	0
1	418.47	461.98	452.91	426.13	471.20	450.13	0.083333
2	671.84	744.63	708.48	738.95	812.95	776.75	0.208333
3	1264.88	1378.14	1309.61	1169.87	1282.42	1220.38	1
4	1483.18	1612.76	1525.62	1412.46	1543.04	1462.50	2
5	1530.48	1660.31	1570.65	1514.60	1648.33	1558.38	3
6	1539.96	1670.54	1580.55	1560.89	1693.21	1597.38	4
7	1541.76	1672.59	1583.31	1580.04	1712.19	1613.63	5

	Added in 106-AN			Newbox Estimate		
Ao =	1866.26	1868.95	1871.64	1596	1726	1625

Per cent of 106-AN ion leachable:	86%	92%	87%
Eff. Diffusion Coefficient, sq cm/s:	2.22E-06	2.34E-06	2.43E-06
Std. Deviation, sq cm/s:	4.20E-07	4.12E-07	4.29E-07
Leachability Index:	5.654	5.631	5.614
Upper 95% Confidence Int.:	0.088	0.081	0.082
Lower 95% Confidence Int.:	0.073	0.069	0.069

Run III-10 : Nitrate

Run III-10 : Nitrite

Run III-10 : Nitrate + Nitrite

Run III-10 : Chloride

Run III-10 : Sulfate

ANSI/ANS-16.1-1986 Leaching Data

Phase III: Mixt. Exp't for 106-AN

Run No.: III-15

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio	10 lb/gal	Chloride	Nitrite	Nitrate	Sulfate
		5.32	34.87	79.99	2.98

Sample Cylinder Dimensions

After Curing 28 d

	Initially	Batch 1	Batch 2	Batch 3
Vol, cc	2.50	2.50	2.50	2.50
22.83	4.65	4.46	4.48	4.53
Length, cm				
Grout Density, lb/gal		13.74	13.73	13.72
mL of 106-AN in Sample Cylinder		15.56	15.55	15.54
Leach Vol + Boric Acid Vol Added, mL		453.1	454.6	458.6

Leachate Concentrations

Mass in Leachate

	mg/L			mg			Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
III-15	Chloride	Initially:		82.74	82.68	82.62	
0	0.5	1	0.5	0.23	0.45	0.23	0
1	31.28	32.53	31.74	14.17	14.79	14.56	0.083333
2	30.86	35.96	31.09	13.98	16.35	14.26	0.208333
3	35.59	37.33	37.32	16.13	16.97	17.11	1
4	20.95	17.5	13.89	9.49	7.96	6.37	2
5	9.14	3.62	5.7	4.14	1.65	2.61	3
6	1	1	1	0.45	0.45	0.46	4
7	0.5	0.5	0.5	0.23	0.23	0.23	5
III-15	Nitrite	Initially:		542.53	542.13	541.74	
0	3	3	7.57	1.36	1.36	3.47	0
1	282.93	312.01	287.91	128.20	141.84	132.04	0.083333
2	291.88	293.29	276.28	132.25	133.33	126.70	0.208333
3	413.83	384.16	407.07	187.51	174.64	186.68	1
4	199.76	197.79	193.71	90.51	89.92	88.84	2
5	58.81	50.66	59.56	26.65	23.03	27.31	3
6	9.33	11.71	12.91	4.23	5.32	5.92	4
7	3.42	3.02	5.08	1.55	1.37	2.33	5
III-15	Nitrate	Initially:		1244.40	1243.49	1242.58	
0	10.01	13.7	11.88	4.54	6.23	5.45	0
1	424.16	438.62	411.48	192.19	199.40	188.70	0.083333
2	437.63	421.94	415.21	198.29	191.81	190.42	0.208333
3	622.73	622.37	608.67	282.16	282.93	279.14	1
4	338.38	335.38	338.9	153.32	152.46	155.42	2
5	111.92	97.12	107.25	50.71	44.15	49.18	3
6	42.28	31.58	33.43	19.16	14.36	15.33	4
7	13.43	11.62	12.82	6.09	5.28	5.88	5

III-15	Sulfate	Initially:		46.33	46.30	46.26	
0	2	2	1	0.91	0.91	0.46	0
1	49.41	44.86	47.83	22.39	20.39	21.93	0.083333
2	40.86	61.32	51.62	18.51	27.88	23.67	0.208333
3	86.25	103.21	95.19	39.08	46.92	43.65	1
4	75.79	61.1	78.96	34.34	27.78	36.21	2
5	45.73	42.38	46.11	20.72	19.27	21.15	3
6	27.89	32.46	32.93	12.64	14.76	15.10	4
7	18.31	17.75	19.57	8.30	8.07	8.97	5

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)			
Observed				Calculated (NEWBOX)			
				(No Washoff or Washout)			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
III-15	Chloride						
				0.00	0.00	0.00	0
1	14.40	15.24	14.79	15.88	17.55	16.53	0.083333
2	28.38	31.59	29.04	27.57	30.17	28.40	0.208333
3	44.51	48.56	46.16	43.81	46.82	44.13	1
4	54.00	56.52	52.53	53.15	55.29	52.20	2
5	58.14	58.16	55.14	57.21	58.30	55.10	3
6	58.59	58.62	55.60	59.02	59.44	56.18	4
7	58.82	58.84	55.83	59.87	59.86	56.57	5

Added in 106-AN				Newbox Estimate		
Ao =	82.74	82.68	82.62	60.6	60.1	56.8

Per cent of 106-AN ion leachable:	73%	73%	69%
Eff. Diffusion Coefficient, sq cm/s:	2.13E-06	2.71E-06	2.69E-06
Std. Deviation, sq cm/s:	2.26E-07	4.67E-07	3.65E-07
Leachability Index:	5.672	5.567	5.570
Upper 95% Confidence Int.:	0.047	0.080	0.061
Lower 95% Confidence Int.:	0.043	0.067	0.054

III-15	Nitrite			0.00	0.00	0.00	0
1	129.55	143.20	135.51	151.80	159.35	153.43	0.083333
2	261.81	276.53	262.21	264.00	275.18	266.86	0.208333
3	449.31	451.17	448.89	422.40	434.53	425.66	1
4	539.82	541.09	537.73	516.60	523.32	518.79	2
5	566.47	564.12	565.04	559.80	560.36	559.99	3
6	570.70	569.44	570.96	580.20	576.24	579.69	4
7	572.25	570.81	573.29	590.40	582.71	588.64	5

Added in 106-AN				Newbox Estimate			
Ao =	542.53	542.13	541.74	600	588	597	
Per cent of 106-AN ion leachable:				111%	108%	110%	
Eff. Diffusion Coefficient, sq cm/s:				1.96E-06	2.29E-06	2.05E-06	
Std. Deviation, sq cm/s:				3.51E-07	2.96E-07	3.07E-07	
Leachability Index:				5.708	5.640	5.688	
Upper 95% Confidence Int.:				0.083	0.058	0.068	
Lower 95% Confidence Int.:				0.070	0.051	0.059	
III-15	Nitrate						
				0.00	0.00	0.00	0
1	196.72	205.62	194.15	225.62	229.57	221.37	0.083333
2	395.01	397.44	384.57	395.78	400.10	387.39	0.208333
3	677.17	680.37	663.70	640.52	644.66	627.52	1
4	830.49	832.83	819.12	793.48	793.64	777.60	2
5	881.20	876.98	868.31	869.96	863.91	852.64	3
6	900.36	891.34	883.64	910.11	899.52	892.04	4
7	906.44	896.62	889.52	931.14	918.26	913.61	5

Added in 106-AN				Newbox Estimate			
Ao =	1244.40	1243.49	1242.58	956	937	938	
Per cent of 106-AN ion leachable:				77%	75%	75%	
Eff. Diffusion Coefficient, sq cm/s:				1.70E-06	1.83E-06	1.70E-06	
Std. Deviation, sq cm/s:				2.71E-07	2.73E-07	2.74E-07	
Leachability Index:				5.770	5.738	5.770	
Upper 95% Confidence Int.:				0.073	0.068	0.074	
Lower 95% Confidence Int.:				0.063	0.059	0.063	
III-15	Sulfate						
				0.00	0.00	0.00	0
1	23.29	21.30	22.39	25.57	26.91	28.33	0.083333
2	41.81	49.18	46.07	46.95	49.29	51.77	0.208333
3	80.89	96.10	89.72	83.92	87.42	91.76	1
4	115.23	123.87	125.93	114.55	118.73	124.31	2
5	135.95	143.14	147.08	136.20	141.05	147.25	3
6	148.59	157.90	162.18	153.85	158.41	165.54	4
7	156.88	165.97	171.15	168.50	172.98	180.42	5

Added in 106-AN				Newbox Estimate		
Ao =	46.33	46.30	46.26	333	310	310

Per cent of 106-AN ion leachable:	719%	670%	670%
Eff. Diffusion Coefficient, sq cm/s:	1.52E-07	2.07E-07	2.32E-07
Std. Deviation, sq cm/s:	1.17E-08	2.46E-08	1.84E-08
Leachability Index:	6.818	6.684	6.635
Upper 95% Confidence Int.:	0.034	0.053	0.035
Lower 95% Confidence Int.:	0.031	0.047	0.032

III-15	Nitrate + Nitrite			0.00	0.00	0.00	0
1	326.28	348.83	329.66	377.87	388.37	376.32	0.083333
2	656.82	673.97	646.78	659.32	676.21	657.41	0.208333
3	1126.48	1131.54	1112.60	1062.07	1079.81	1056.77	1
4	1370.31	1373.92	1356.85	1310.87	1317.40	1300.99	2
5	1447.67	1441.10	1433.35	1429.05	1422.48	1417.73	3
6	1471.06	1460.78	1454.60	1489.69	1475.79	1476.10	4
7	1478.69	1467.44	1462.81	1520.79	1500.16	1505.28	5

	Added in 106-AN			Newbox Estimate		
Ao =	1786.93	1785.63	1784.32	1555	1523	1536

Per cent of 106-AN ion leachable:	87%	85%	86%
Eff. Diffusion Coefficient, sq cm/s:	1.80E-06	2.01E-06	1.85E-06
Std. Deviation, sq cm/s:	3.00E-07	2.81E-07	2.79E-07
Leachability Index:	5.745	5.697	5.733
Upper 95% Confidence Int.:	0.077	0.063	0.069
Lower 95% Confidence Int.:	0.065	0.055	0.059

Run III-15 : Nitrate

Run III-15 : Nitrite

Run III-15 : Nitrate + Nitrite

Run III-15 : Chloride

Run III-15 : Sulfate

ANSI/ANS-16.1-1986 Leaching Data

Phase III: Mixt. Exp't for 106-AN

Run No.: III-20

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio	8.721 lb/gal	Chloride	Nitrite	Nitrate	Sulfate
		5.32	34.87	79.99	2.98

Sample Cylinder Dimensions

After Curing 28 d

	Initially		Batch 1	Batch 2	Batch 3
Vol, cc	2.50	Dia., cm	2.47	2.48	2.47
	22.83	Length, cm	4.34	4.21	4.36
Grout Density, lb/gal			13.48	13.46	13.47
mL of 106-AN in Sample Cylinder			16.31	16.28	16.29
Leach Vol + Boric Acid Vol Added, mL			437	429	438.6

Leachate Concentrations

Mass in Leachate

Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
III-20	Chloride	Initially:		86.72	86.59	86.65	
0	1	0.5	0.5	0.44	0.21	0.22	0
1	19.09	19.04	15.56	8.34	8.17	6.82	0.083333
2	37.57	41.72	42.25	16.42	17.90	18.53	0.291666
3	36.75	37.43	34.85	16.06	16.06	15.29	1
4	20.67	18.24	19.19	9.03	7.82	8.42	2
5	3.92	2.71	3.73	1.71	1.16	1.64	3
6	1	0.5	0.5	0.44	0.21	0.22	4
7	0.5	0.5	0.5	0.22	0.21	0.22	5
III-20	Nitrite	Initially:		568.63	567.78	568.21	
0	3	3	1.5	1.31	1.29	0.66	0
1	166.64	119.84	123.56	72.82	51.41	54.19	0.083333
2	407.74	389.01	373.8	178.18	166.89	163.95	0.291666
3	501.86	530.56	558.57	219.31	227.61	244.99	1
4	230.44	234.71	251.64	100.70	100.69	110.37	2
5	48	37.56	49.14	20.98	16.11	21.55	3
6	3	7.75	9.89	1.31	3.32	4.34	4
7	1.38	1.28	1.5	0.60	0.55	0.66	5
III-20	Nitrate	Initially:		1304.26	1302.32	1303.29	
0	5	2.5	4.5	2.19	1.07	1.97	0
1	216.01	179.38	170.33	94.40	76.95	74.71	0.083333
2	539.09	524.53	509.71	235.58	225.02	223.56	0.291666
3	732.36	753.72	785.3	320.04	323.35	344.43	1
4	411.04	422.52	436.48	179.62	181.26	191.44	2
5	90.67	77.06	101.27	39.62	33.06	44.42	3
6	27.21	20.44	31.67	11.89	8.77	13.89	4
7	7.35	7.28	7.22	3.21	3.12	3.17	5

III-20	Sulfate	Initially:		48.56	48.49	48.52	
	0	1	1	2	0.44	0.43	0.88
	1	15.4	15	15	6.73	6.44	6.58
	2	69.2	49.89	58.26	30.24	21.40	25.55
	3	126.1	117.07	120.13	55.11	50.22	52.69
	4	107.1	97.51	112.86	46.80	41.83	49.50
	5	64.72	48.9	67.86	28.28	20.98	29.76
	6	36.34	36.96	42.34	15.88	15.86	18.57
	7	16.96	17.29	11.59	7.41	7.42	5.08

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)			
Observed				Calculated (NEWBOX)			
				(No Washoff or Washout)			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
III-20	Chloride			0.00	0.00	0.00	0
	1	8.78	8.38	7.04	12.86	12.90	12.12
	2	25.20	26.28	25.57	22.60	22.67	21.34
	3	41.26	42.34	40.86	37.04	36.94	35.26
	4	50.29	50.16	49.28	46.49	46.19	44.60
	5	52.00	51.33	50.91	51.60	51.16	49.76
	6	52.44	51.54	51.13	54.53	53.96	52.90
	7	52.66	51.75	51.35	56.23	55.50	54.87

Added in 106-AN				Newbox Estimate		
Ao =	86.72	86.59	86.65	58.7	57.1	58

Per cent of 106-AN ion leachable:	68%	66%	67%
Eff. Diffusion Coefficient, sq cm/s:	1.39E-06	1.49E-06	1.26E-06
Std. Deviation, sq cm/s:	4.91E-07	6.27E-07	5.38E-07
Leachability Index:	5.857	5.827	5.900
Upper 95% Confidence Int.:	0.183	0.228	0.233
Lower 95% Confidence Int.:	0.128	0.149	0.151

III-20	Nitrite			0.00	0.00	0.00	0
	1	74.13	52.70	54.85	140.26	128.87	130.27
	2	252.32	219.58	218.80	280.52	257.74	260.55
	3	471.63	447.19	463.79	446.60	413.82	424.45
	4	572.33	547.88	574.16	542.38	509.50	529.58
	5	593.31	564.00	595.71	585.30	556.74	584.44
	6	594.62	567.32	600.05	604.58	580.06	614.47
	7	595.22	567.87	600.71	613.91	589.03	630.80

Added in 106-AN				Newbox Estimate			
Ao =	568.63	567.78	568.21	622	598	653	
Per cent of 106-AN ion leachable:				109%	105%	115%	
Eff. Diffusion Coefficient, sq cm/s:				2.02E-06	1.80E-06	1.51E-06	
Std. Deviation, sq cm/s:				4.45E-07	5.22E-07	4.62E-07	
Leachability Index:				5.695	5.745	5.821	
Upper 95% Confidence Int.:				0.105	0.144	0.153	
Lower 95% Confidence Int.:				0.084	0.108	0.113	
III-20	Nitrate						
				0.00	0.00	0.00	0
1	96.58	78.03	76.68	190.24	178.75	179.55	0.083333
2	332.16	303.05	300.24	380.49	357.50	359.10	0.291666
3	652.21	626.40	644.67	619.49	585.60	597.13	1
4	831.83	807.66	836.11	773.40	736.42	761.29	2
5	871.45	840.72	880.53	853.71	820.21	855.68	3
6	883.34	849.48	894.42	897.68	869.55	915.19	4
7	886.56	852.61	897.59	923.50	898.42	953.15	5

Added in 106-AN				Newbox Estimate			
Ao =	1304.26	1302.32	1303.29	956	931	1026	
Per cent of 106-AN ion leachable:				73%	71%	79%	
Eff. Diffusion Coefficient, sq cm/s:				1.50E-06	1.38E-06	1.12E-06	
Std. Deviation, sq cm/s:				3.55E-07	3.80E-07	3.08E-07	
Leachability Index:				5.824	5.860	5.951	
Upper 95% Confidence Int.:				0.113	0.135	0.135	
Lower 95% Confidence Int.:				0.090	0.103	0.103	
III-20	Sulfate						
				0.00	0.00	0.00	0
1	7.17	6.86	7.46	8.42	7.11	8.14	0.083333
2	37.41	28.27	33.01	29.45	24.87	28.50	0.291666
3	92.51	78.49	85.70	100.98	85.28	97.72	1
4	139.32	120.32	135.20	135.00	114.92	130.83	2
5	167.60	141.30	164.96	158.22	135.46	153.26	3
6	183.48	157.16	183.53	175.77	151.32	170.61	4
7	190.89	164.57	188.62	189.81	164.32	184.50	5

Added in 106-AN				Newbox Estimate		
Ao =	48.56	48.49	48.52	270	260	267

Per cent of 106-AN ion leachable:	556%	536%	550%
Eff. Diffusion Coefficient, sq cm/s:	3.80E-07	2.79E-07	3.61E-07
Std. Deviation, sq cm/s:	4.81E-08	3.06E-08	6.69E-08
Leachability Index:	6.420	6.554	6.442
Upper 95% Confidence Int.:	0.057	0.049	0.086
Lower 95% Confidence Int.:	0.050	0.044	0.072

III-20	Nitrate + Nitrite			0.00	0.00	0.00	0
1	170.71	130.72	131.53	329.96	308.41	309.97	0.083333
2	584.48	522.63	519.04	659.93	616.82	619.94	0.291666
3	1123.83	1073.59	1108.46	1066.28	1000.61	1020.98	1
4	1404.16	1355.54	1410.27	1316.70	1247.34	1290.01	2
5	1464.76	1404.71	1476.24	1441.13	1376.79	1438.73	3
6	1477.96	1416.81	1494.47	1504.13	1449.90	1528.97	4
7	1481.78	1420.48	1498.29	1537.20	1486.45	1582.44	5

	Added in 106-AN			Newbox Estimate		
Ao =	1872.88	1870.10	1871.49	1575	1523	1671

Per cent of 106-AN ion leachable:	84%	81%	89%
Eff. Diffusion Coefficient, sq cm/s:	1.70E-06	1.55E-06	1.28E-06
Std. Deviation, sq cm/s:	3.84E-07	4.39E-07	3.63E-07
Leachability Index:	5.770	5.810	5.893
Upper 95% Confidence Int.:	0.108	0.140	0.140
Lower 95% Confidence Int.:	0.086	0.106	0.106

Run III-20 : Nitrate

Run III-20 : Nitrite

Run III-20 : Nitrate + Nitrite

Run III-20 : Chloride

Run III-20 : Sulfate

ANSI/ANS-16.1-1986 Leaching Data

Phase III: Mixt. Exp't for 106-AN

Run No.: III-21

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio	10 lb/gal	Chloride	Nitrite	Nitrate	Sulfate
		5.32	34.87	79.99	2.98

Sample Cylinder Dimensions

After Curing 28 d

	Initially		Batch 1	Batch 2	Batch 3
Vol, cc	2.51	Dia., cm	2.51	2.51	2.51
23.01	4.65	Length, cm	4.39	4.25	4.33
Grout Density, lb/gal			13.46	13.47	13.45
mL of 106-AN in Sample Cylinder			15.36	15.37	15.35
Leach Vol + Boric Acid Vol Added, mL			449.6	438.6	444.9

Leachate Concentrations

Mass in Leachate

	mg/L			mg			Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
III-21	Chloride	Initially:		81.70	81.76	81.64	
0	1	1	1	0.45	0.44	0.44	0
1	14.28	14.75	12.72	6.42	6.47	5.66	0.083333
2	10.36	10.22	10.21	4.66	4.48	4.54	0.291666
3	17.06	18.42	21.48	7.67	8.08	9.56	1
4	14.5	15.72	18.11	6.52	6.89	8.06	2
5	10.25	11.09	12.97	4.61	4.86	5.77	3
6	8.03	9.04	9.4	3.61	3.96	4.18	4
7	6.37	6.19	7.97	2.86	2.71	3.55	5
III-21	Nitrite	Initially:		535.73	536.13	535.34	
0	2.38	4.07	2.11	1.07	1.79	0.94	0
1	93.9	90.56	77.32	42.22	39.72	34.40	0.083333
2	64.65	61.31	68.66	29.07	26.89	30.55	0.291666
3	105.92	116.14	134.06	47.62	50.94	59.64	1
4	92.35	97.44	112.79	41.52	42.74	50.18	2
5	63.67	66.71	78.67	28.63	29.26	35.00	3
6	48.96	50.37	58.65	22.01	22.09	26.09	4
7	36.77	39.41	44.77	16.53	17.29	19.92	5
III-21	Nitrate	Initially:		1228.81	1229.72	1227.90	
0	4.04	8.69	5.83	1.82	3.81	2.59	0
1	154.48	147.75	121.4	69.45	64.80	54.01	0.083333
2	105.98	98.38	109.73	47.65	43.15	48.82	0.291666
3	133.82	186	213.33	60.17	81.58	94.91	1
4	145.48	163.34	182.77	65.41	71.64	81.31	2
5	105.24	110.52	126.02	47.32	48.47	56.07	3
6	80.23	87.7	102.8	36.07	38.47	45.74	4
7	64.99	68.98	74.93	29.22	30.25	33.34	5

III-21	Sulfate	Initially:		45.75	45.78	45.71	
	0	2	2	0.90	0.88	0.89	0
	1	19.71	18.82	13.7	8.86	8.25	0.083333
	2	11.7	14.42	14.05	5.26	6.32	0.291666
	3	25.37	28.44	29.45	11.41	12.47	1
	4	23.02	21.43	26.28	10.35	9.40	2
	5	15.73	16.46	20.3	7.07	7.22	3
	6	13.24	4.87	16.46	5.95	2.14	4
	7	9.23	9.41	11.51	4.15	4.13	5

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)			
Observed				Calculated (NEWBOX)			
				(No Washoff or Washout)			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
III-21	Chloride						
				0.00	0.00	0.00	0
	1	6.87	6.91	6.10	6.27	6.27	0.083333
	2	11.53	11.39	10.65	11.36	11.43	0.291666
	3	19.20	19.47	20.20	19.66	19.98	1
	4	25.72	26.36	28.26	26.18	26.75	2
	5	30.33	31.23	34.03	30.53	31.41	3
	6	33.94	35.19	38.21	33.84	34.97	4
	7	36.80	37.91	41.76	36.41	37.85	5

Added in 106-AN				Newbox Estimate		
Ao =	81.70	81.76	81.64	49.4	55.5	55

Per cent of 106-AN ion leachable:	60%	68%	67%
Eff. Diffusion Coefficient, sq cm/s:	4.53E-07	3.53E-07	4.17E-07
Std. Deviation, sq cm/s:	2.41E-08	1.70E-08	4.86E-08
Leachability Index:	6.344	6.452	6.380
Upper 95% Confidence Int.:	0.023	0.021	0.052
Lower 95% Confidence Int.:	0.022	0.020	0.047

III-21	Nitrite						
				0.00	0.00	0.00	0
	1	43.29	41.50	35.34	39.56	38.19	0.083333
	2	72.35	68.40	65.89	71.57	69.22	0.291666
	3	119.98	119.33	125.53	123.82	121.05	1
	4	161.50	162.07	175.71	164.29	162.32	2
	5	190.12	191.33	210.71	191.47	190.96	3
	6	212.13	213.42	236.80	211.40	212.44	4
	7	228.67	230.71	256.72	227.41	230.18	5

Added in 106-AN				Newbox Estimate			
Ao =	535.73	536.13	535.34	302	341	370	
Per cent of 106-AN ion leachable:				56%	64%	69%	
Eff. Diffusion Coefficient, sq cm/s:				4.84E-07	3.43E-07	3.37E-07	
Std. Deviation, sq cm/s:				2.59E-08	1.41E-08	3.55E-08	
Leachability Index:				6.315	6.465	6.472	
Upper 95% Confidence Int.:				0.023	0.018	0.047	
Lower 95% Confidence Int.:				0.022	0.017	0.042	
III-21	Nitrate						
				0.00	0.00	0.00	0
1	71.27	68.61	56.60	60.14	65.48	67.77	0.083333
2	118.92	111.76	105.42	108.64	107.86	123.70	0.291666
3	179.08	193.34	200.33	188.67	190.03	217.80	1
4	244.49	264.98	281.65	251.72	261.94	293.47	2
5	291.81	313.46	337.71	294.40	310.09	346.11	3
6	327.88	351.92	383.45	326.41	349.25	386.90	4
7	357.10	382.18	416.79	351.63	378.78	419.80	5

Added in 106-AN				Newbox Estimate			
Ao =	1228.81	1229.72	1227.90	485	642	658	
Per cent of 106-AN ion leachable:				39%	52%	54%	
Eff. Diffusion Coefficient, sq cm/s:				4.30E-07	2.37E-07	2.85E-07	
Std. Deviation, sq cm/s:				4.58E-08	9.09E-09	4.11E-08	
Leachability Index:				6.367	6.625	6.545	
Upper 95% Confidence Int.:				0.047	0.016	0.066	
Lower 95% Confidence Int.:				0.043	0.016	0.057	
III-21	Sulfate						
				0.00	0.00	0.00	0
1	9.76	9.13	6.98	8.07	8.62	8.75	0.083333
2	15.02	15.46	13.24	14.86	15.65	15.96	0.291666
3	26.43	27.93	26.34	26.68	27.21	27.94	1
4	36.78	37.33	38.03	36.50	36.40	37.58	2
5	43.85	44.55	47.06	43.64	42.58	44.23	3
6	49.80	46.68	54.38	49.37	47.24	49.33	4
7	53.95	50.81	59.51	54.17	51.05	53.46	5

Added in 106-AN				Newbox Estimate		
Ao =	45.75	45.78	45.71	117	71.8	81

Per cent of 106-AN ion leachable:	256%	157%	177%
Eff. Diffusion Coefficient, sq cm/s:	1.30E-07	4.00E-07	3.24E-07
Std. Deviation, sq cm/s:	7.52E-09	2.13E-08	7.13E-08
Leachability Index:	6.886	6.398	6.489
Upper 95% Confidence Int.:	0.025	0.023	0.104
Lower 95% Confidence Int.:	0.024	0.022	0.084

III-21	Nitrate + Nitrite			0.00	0.00	0.00	0
1	114.56	110.12	91.94	99.58	97.87	105.60	0.083333
2	191.27	180.16	171.31	180.50	179.27	192.00	0.291666
3	299.06	312.68	325.86	312.76	314.93	336.00	1
4	405.99	427.06	457.36	416.23	425.39	451.20	2
5	481.93	504.79	548.42	485.47	501.94	529.92	3
6	540.01	565.35	620.25	536.82	561.05	591.36	4
7	585.77	612.89	673.51	576.05	609.50	640.32	5

	Added in 106-AN			Newbox Estimate		
Ao =	1764.54	1765.85	1763.23	778	969	960

Per cent of 106-AN ion leachable:	44%	55%	54%
Eff. Diffusion Coefficient, sq cm/s:	4.64E-07	2.81E-07	3.35E-07
Std. Deviation, sq cm/s:	3.86E-08	1.12E-08	3.94E-08
Leachability Index:	6.333	6.551	6.475
Upper 95% Confidence Int.:	0.037	0.017	0.053
Lower 95% Confidence Int.:	0.034	0.017	0.047

Run III-21 : Nitrate

Run III-21 : Nitrite

Run III-21 : Nitrate + Nitrite

Run III -21 : Chloride

Run III-21 : Sulfate

ANSI/ANS-16.1-1986 Leaching Data				Phase III: Mixt. Exp't for 106-AN			
Run No.:	III-22			Surrogate 106-AN Concentrations, mg/mL			
Mix Ratio	8 lb/gal			Chloride	Nitrite	Nitrate	Sulfate
				5.32	34.87	79.99	2.98
Sample Cylinder Dimensions				After Curing 28 d			
	Initially			Batch 1	Batch 2	Batch 3	
Vol, cc	2.51	Dia., cm	2.51	2.51	2.51	2.51	
23.01	4.65	Length,cm	4.18	4.08	4.07		
Grout Density, lb/gal				13.80	13.80	13.81	
mL of 106-AN in Sample Cylinder				17.50	17.50	17.51	
Leach Vol + Boric Acid Vol Added, mL				433.1	425.2	424.4	
Leachate Concentrations				Mass in Leachate			Time d
		mg/L			mg		
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	
III-22	Chloride	Initially:		93.07	93.07	93.14	
0	1.21	1.21	1	0.52	0.51	0.42	0
1	23.9	19.38	18.67	10.35	8.24	7.92	0.083333
2	19.7	21.64	20.41	8.53	9.20	8.66	0.291666
3	24.8	23.81	25.49	10.74	10.12	10.82	1
4	13.59	17.64	16.57	5.89	7.50	7.03	2
5	5.8	5.16	5.82	2.51	2.19	2.47	3
6	1.73	1	1	0.75	0.43	0.42	4
7	1	0.95	1	0.43	0.40	0.42	5
III-22	Nitrite	Initially:		610.30	610.30	610.74	
0	5.09	5.82	6.55	2.20	2.47	2.78	0
1	187.96	191.47	197.77	81.41	81.41	83.93	0.083333
2	148.43	157.06	167.7	64.29	66.78	71.17	0.291666
3	206.3	211.18	225.57	89.35	89.79	95.73	1
4	114.91	117.5	125.62	49.77	49.96	53.31	2
5	39.94	43.11	44.41	17.30	18.33	18.85	3
6	10.93	14.67	14.15	4.73	6.24	6.01	4
7	2.75	4.05	1	1.19	1.72	0.42	5
III-22	Nitrate	Initially:		1399.83	1399.83	1400.85	
0	13.11	15.64	17.16	5.68	6.65	7.28	0
1	423.53	450.57	472.55	183.43	191.58	200.55	0.083333
2	344.88	361.33	378.22	149.37	153.64	160.52	0.291666
3	475.46	493.15	510.18	205.92	209.69	216.52	1
4	279.39	287.79	305.34	121.00	122.37	129.59	2
5	105.53	116.9	115.69	45.71	49.71	49.10	3
6	33.42	41.27	35.1	14.47	17.55	14.90	4
7	10.8	13.2	14.88	4.68	5.61	6.32	5

III-22	Sulfate	Initially:		52.12	52.12	52.15	
0	1.65	2.66	2	0.71	1.13	0.85	0
1	38.87	38.87	38.38	16.83	16.53	16.29	0.083333
2	33.56	33.56	37	14.53	14.27	15.70	0.291666
3	53.33	53.33	53.17	23.10	22.68	22.57	1
4	37.59	37.59	41.8	16.28	15.98	17.74	2
5	21.51	21.51	27.29	9.32	9.15	11.58	3
6	11.29	11.29	14.99	4.89	4.80	6.36	4
7	9.8	9.8	9.45	4.24	4.17	4.01	5

Cumulative Amount Leached, mg Observed				(Adding Rinse to Interval 1) Calculated (NEWBOX) (No Washoff or Washout)			Time d
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	
III-22	Chloride						
				0.00	0.00	0.00	0
1	10.88	8.75	8.35	11.15	9.95	9.59	0.083333
2	19.41	17.96	17.01	19.21	17.37	16.76	0.291666
3	30.15	28.08	27.83	30.12	27.85	27.04	1
4	36.03	35.58	34.86	36.05	34.17	33.45	2
5	38.55	37.77	37.33	38.34	37.20	36.67	3
6	39.30	38.20	37.75	39.38	38.73	38.33	4
7	39.73	38.60	38.18	39.82	39.49	39.25	5

Added in 106-AN				Newbox Estimate		
Ao =	93.07	93.07	93.14	40.1	40.3	40.3

Per cent of 106-AN ion leachable:	43%	43%	43%
Eff. Diffusion Coefficient, sq cm/s:	2.36E-06	1.81E-06	1.66E-06
Std. Deviation, sq cm/s:	6.16E-08	2.48E-07	2.33E-07
Leachability Index:	5.627	5.742	5.780
Upper 95% Confidence Int.:	0.011	0.062	0.064
Lower 95% Confidence Int.:	0.011	0.054	0.056

III-22	Nitrite			0.00	0.00	0.00	0
1	83.61	83.89	86.71	86.22	86.89	91.39	0.083333
2	147.89	150.67	157.89	149.31	150.20	158.22	0.291666
3	237.24	240.46	253.62	234.90	237.08	249.95	1
4	287.01	290.42	306.93	282.45	285.86	301.44	2
5	304.31	308.75	325.78	302.10	306.53	323.61	3
6	309.04	314.99	331.78	310.66	315.57	333.16	4
7	310.23	316.71	332.21	314.15	319.77	337.59	5

Added in 106-AN				Newbox Estimate			
Ao =	610.30	610.30	610.74	317	323	341	
Per cent of 106-AN ion leachable:				52%	53%	56%	
Eff. Diffusion Coefficient, sq cm/s:				2.26E-06	2.18E-06	2.17E-06	
Std. Deviation, sq cm/s:				1.13E-07	1.10E-07	1.47E-07	
Leachability Index:				5.646	5.662	5.664	
Upper 95% Confidence Int.:				0.022	0.022	0.030	
Lower 95% Confidence Int.:				0.021	0.021	0.028	
III-22	Nitrate						
				0.00	0.00	0.00	0
1	189.11	198.23	207.83	195.98	203.30	213.07	0.083333
2	338.48	351.87	368.35	339.59	352.49	368.46	0.291666
3	544.40	561.56	584.87	538.56	558.11	582.33	1
4	665.40	683.93	714.46	653.75	677.15	704.88	2
5	711.11	733.63	763.56	704.62	728.94	757.75	3
6	725.58	751.18	778.45	727.80	752.90	780.98	4
7	730.26	756.79	784.77	738.28	763.72	792.19	5

Added in 106-AN				Newbox Estimate			
Ao =	1399.83	1399.83	1400.85	748	773	801	
Per cent of 106-AN ion leachable:				53%	55%	57%	
Eff. Diffusion Coefficient, sq cm/s:				2.07E-06	2.07E-06	2.12E-06	
Std. Deviation, sq cm/s:				1.03E-07	7.24E-08	8.17E-08	
Leachability Index:				5.684	5.684	5.674	
Upper 95% Confidence Int.:				0.022	0.015	0.017	
Lower 95% Confidence Int.:				0.021	0.015	0.016	
III-22	Sulfate						
				0.00	0.00	0.00	0
1	17.55	17.66	17.14	17.95	17.78	17.70	0.083333
2	32.08	31.93	32.84	32.03	31.67	31.86	0.291666
3	55.18	54.60	55.41	53.96	53.25	54.40	1
4	71.46	70.59	73.15	69.77	68.63	71.39	2
5	80.78	79.73	84.73	79.36	78.12	82.48	3
6	85.67	84.53	91.09	85.88	84.42	90.39	4
7	89.91	88.70	95.10	90.47	88.91	95.93	5

Added in 106-AN				Newbox Estimate		
Ao =	52.12	52.12	52.15	102	99.9	118

Per cent of 106-AN ion leachable:	196%	192%	226%
Eff. Diffusion Coefficient, sq cm/s:	8.85E-07	8.91E-07	6.24E-07
Std. Deviation, sq cm/s:	4.06E-08	3.79E-08	3.20E-08
Leachability Index:	6.053	6.050	6.205
Upper 95% Confidence Int.:	0.020	0.018	0.022
Lower 95% Confidence Int.:	0.019	0.018	0.021

III-22 Nitrate + Nitrite

				0.00	0.00	0.00	0
1	272.72	282.12	294.55	282.23	290.44	304.91	0.083333
2	486.37	502.54	526.23	488.84	503.06	526.46	0.291666
3	781.64	802.02	838.49	773.19	795.70	832.52	1
4	952.41	974.35	1021.39	936.14	963.38	1006.10	2
5	1015.42	1042.39	1089.33	1006.43	1035.72	1081.47	3
6	1034.62	1066.17	1110.23	1038.38	1068.60	1114.59	4
7	1040.49	1073.51	1116.97	1053.29	1082.85	1129.44	5

	Added in 106-AN			Newbox Estimate		
Ao =	2010.13	2010.13	2011.58	1065	1096	1142

Per cent of 106-AN ion leachable:	53%	55%	57%
Eff. Diffusion Coefficient, sq cm/s:	2.13E-06	2.11E-06	2.13E-06
Std. Deviation, sq cm/s:	1.07E-07	8.05E-08	9.85E-08
Leachability Index:	5.672	5.676	5.672
Upper 95% Confidence Int.:	0.022	0.016	0.020
Lower 95% Confidence Int.:	0.021	0.016	0.019

Run III-22 : Nitrate

Run III-22 : Nitrite

Run III-22 : Nitrate + Nitrite

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Run III-22 : Chloride

Run III-22 : Sulfate

ANSI/ANS-16.1-1986 Leaching Data				Phase III: Mixt. Exp't for 106-AN			
Run No.:	III-23			Surrogate 106-AN Concentrations, mg/mL			
Mix Ratio	9.5	lb/gal	Chloride	Nitrite	Nitrate	Sulfate	
			5.32	34.87	79.99	2.98	
Sample Cylinder Dimensions			After Curing 28 d				
	Initially			Batch 1	Batch 2	Batch 3	
	Vol, cc	2.51	Dia., cm	2.51	2.51	2.51	
	23.01	4.65	Length,cm	4.58	4.59	4.58	
	Grout Density, lb/gal			12.90	12.90	12.90	
mL of 106-AN in Sample Cylinder				15.10	15.10	15.10	
Leach Vol + Boric Acid Vol Added, mL				464.7	465.5	464.7	
Leachate Concentrations			Mass in Leachate				
		mg/L			mg		Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
III-23	Chloride	Initially:		80.31	80.31	80.31	
0	0.5	0.5	1	0.23	0.23	0.46	0
1	14.86	12.91	15.68	6.91	6.01	7.29	0.083333
2	15.95	16.21	15.58	7.41	7.55	7.24	0.291666
3	24.64	27.92	26.21	11.45	13.00	12.18	1
4	21.56	21.75	20.54	10.02	10.12	9.54	2
5	12.44	14.61	11.85	5.78	6.80	5.51	3
6	10.12	9.61	9.65	4.70	4.47	4.48	4
7	6.46	8.12	7.51	3.00	3.78	3.49	5
III-23	Nitrite	Initially:		526.61	526.61	526.61	
0	2.34	2.08	2	1.09	0.97	0.93	0
1	90.98	86.54	90.27	42.28	40.28	41.95	0.083333
2	103.84	106.19	97.82	48.25	49.43	45.46	0.291666
3	180.75	187.95	173.07	83.99	87.49	80.43	1
4	142.24	145.24	133.87	66.10	67.61	62.21	2
5	92.2	95.04	86.61	42.85	44.24	40.25	3
6	64.71	66.93	62.23	30.07	31.16	28.92	4
7	49.64	52.7	48.7	23.07	24.53	22.63	5
III-23	Nitrate	Initially:		1207.88	1207.88	1207.88	
0	4.37	6.34	6.76	2.03	2.95	3.14	0
1	149.82	144.07	144.31	69.62	67.06	67.06	0.083333
2	176.69	181.69	166.05	82.11	84.58	77.16	0.291666
3	307.28	321.28	294.36	142.79	149.56	136.79	1
4	242.98	255.69	233.4	112.91	119.02	108.46	2
5	164.05	166.27	156.17	76.23	77.40	72.57	3
6	115.95	119.97	110.42	53.88	55.85	51.31	4
7	92.41	91.46	84.16	42.94	42.57	39.11	5

III-23	Sulfate	Initially:		44.97	44.97	44.97	
0	2	2	2	0.93	0.93	0.93	0
1	12.78	9.11	6.74	5.94	4.24	3.13	0.083333
2	14.95	13.09	15.02	6.95	6.09	6.98	0.291666
3	31.85	30.68	27.27	14.80	14.28	12.67	1
4	21.68	28.17	25.55	10.07	13.11	11.87	2
5	15.44	17.73	15.45	7.17	8.25	7.18	3
6	12.47	14.76	13.84	5.79	6.87	6.43	4
7	8.28	8.86	9.38	3.85	4.12	4.36	5

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)			
Observed				Calculated (NEWBOX)			
				(No Washoff or Washout)			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
III-23	Chloride						
				0.00	0.00	0.00	0
1	7.14	6.24	7.75	8.03	8.27	8.27	0.083333
2	14.55	13.79	14.99	14.69	15.10	15.10	0.291666
3	26.00	26.78	27.17	25.86	26.50	26.50	1
4	36.02	36.91	36.72	34.93	35.73	35.65	2
5	41.80	43.71	42.22	41.27	42.16	42.08	3
6	46.50	48.18	46.71	46.17	47.06	47.06	4
7	49.50	51.96	50.20	50.19	51.15	51.15	5

Added in 106-AN				Newbox Estimate		
Ao =	80.31	80.31	80.31	80.3	80.3	80.3
Per cent of 106-AN ion leachable:				100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:				2.84E-07	2.99E-07	2.99E-07
Std. Deviation, sq cm/s:				1.57E-08	3.83E-08	1.28E-08
Leachability Index:				6.547	6.524	6.524
Upper 95% Confidence Int.:				0.024	0.058	0.018
Lower 95% Confidence Int.:				0.023	0.051	0.018

III-23	Nitrite			0.00	0.00	0.00	0
1	43.37	41.25	42.88	54.28	54.81	51.49	0.083333
2	91.62	90.68	88.33	99.08	100.13	93.81	0.291666
3	175.61	178.17	168.76	173.91	176.02	166.01	1
4	241.71	245.78	230.97	233.99	237.15	223.98	2
5	284.56	290.03	271.22	276.68	279.84	265.08	3
6	314.63	321.18	300.14	309.35	312.51	296.70	4
7	337.70	345.71	322.77	335.70	339.39	323.05	5

Added in 106-AN				Newbox Estimate			
Ao =	526.61	526.61	526.61	527	527	527	
Per cent of 106-AN ion leachable:				100%	100%	100%	
Eff. Diffusion Coefficient, sq cm/s:				2.99E-07	3.08E-07	2.69E-07	
Std. Deviation, sq cm/s:				3.11E-08	4.15E-08	2.27E-08	
Leachability Index:				6.524	6.511	6.570	
Upper 95% Confidence Int.:				0.046	0.061	0.037	
Lower 95% Confidence Int.:				0.042	0.053	0.034	
III-23	Nitrate						
				0.00	0.00	0.00	0
1	71.65	70.02	70.20	94.47	90.48	83.35	0.083333
2	153.76	154.59	147.37	161.87	166.70	153.42	0.291666
3	296.55	304.15	284.15	288.71	297.17	274.22	1
4	409.47	423.17	392.62	396.22	405.89	376.90	2
5	485.70	500.57	465.19	472.33	484.41	450.58	3
6	539.58	556.42	516.50	533.94	547.22	509.78	4
7	582.52	598.99	555.61	584.67	599.17	559.30	5

Added in 106-AN				Newbox Estimate			
Ao =	1207.88	1207.88	1207.88	1208	1208	1208	
Per cent of 106-AN ion leachable:				100%	100%	100%	
Eff. Diffusion Coefficient, sq cm/s:				1.47E-07	1.56E-07	1.32E-07	
Std. Deviation, sq cm/s:				1.31E-08	1.73E-08	1.13E-08	
Leachability Index:				6.833	6.807	6.879	
Upper 95% Confidence Int.:				0.039	0.050	0.038	
Lower 95% Confidence Int.:				0.036	0.044	0.035	
III-23	Sulfate						
				0.00	0.00	0.00	0
1	6.87	5.17	4.06	9.10	8.56	8.36	0.083333
2	13.82	11.27	11.04	16.43	15.60	15.17	0.291666
3	28.62	25.55	23.71	28.56	27.36	26.49	1
4	38.69	38.66	35.59	38.18	36.88	35.52	2
5	45.87	46.91	42.77	44.62	43.36	41.74	3
6	51.66	53.78	49.20	49.51	48.40	46.47	4
7	55.51	57.91	53.56	53.35	52.56	50.32	5

Added in 106-AN				Newbox Estimate		
Ao =	44.97	44.97	44.97	74	80	74

Per cent of 106-AN ion leachable:	165%	178%	165%
Eff. Diffusion Coefficient, sq cm/s:	4.29E-07	3.26E-07	3.60E-07
Std. Deviation, sq cm/s:	6.49E-08	9.68E-08	8.78E-08
Leachability Index:	6.368	6.487	6.444
Upper 95% Confidence Int.:	0.069	0.148	0.117
Lower 95% Confidence Int.:	0.060	0.110	0.092

III-23	Nitrate + Nitrite			0.00	0.00	0.00	0
1	115.02	111.27	113.08	141.49	144.96	134.39	0.083333
2	245.38	245.28	235.70	260.10	265.30	246.23	0.291666
3	472.17	482.32	452.92	461.24	471.65	440.44	1
4	651.18	668.96	623.59	629.44	643.31	599.96	2
5	770.26	790.60	736.41	749.09	764.69	716.14	3
6	854.21	877.60	816.64	842.72	860.06	808.04	4
7	920.22	944.70	878.38	922.49	941.56	884.34	5

	Added in 106-AN			Newbox Estimate		
Ao =	1734.49	1734.49	1734.49	1734	1734	1734

Per cent of 106-AN ion leachable:	100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:	1.86E-07	1.96E-07	1.67E-07
Std. Deviation, sq cm/s:	1.70E-08	2.24E-08	1.38E-08
Leachability Index:	6.730	6.708	6.777
Upper 95% Confidence Int.:	0.040	0.051	0.036
Lower 95% Confidence Int.:	0.037	0.046	0.034

Run III-23 : Nitrate

Run III-23 : Nitrite

Run III-23 : Nitrate + Nitrite

Run III-23 : Chloride

Run III-23 : Sulfate

ANSI/ANS-16.1-1986 Leaching Data				Phase III: Mixt. Exp't for 106-AN			
Run No.:	III-24			Surrogate	106-AN Concentrations, mg/mL		
Mix Ratio	10 lb/gal		Chloride	Nitrite	Nitrate	Sulfate	
			5.32	34.87	79.99	2.98	
Sample Cylinder Dimensions				After Curing 28 d			
	Initially			Batch 1	Batch 2	Batch 3	
	Vol, cc	2.50	Dia., cm	2.50	2.50	2.50	
	22.83	4.65	Length,cm	4.35	4.40	4.44	
	Grout Density, lb/gal			13.70	13.81	13.88	
mL of 106-AN in Sample Cylinder				15.51	15.64	15.72	
Leach Vol + Boric Acid Vol Added, mL				444.3	448.2	451.4	
Leachate Concentrations				Mass in Leachate			
		mg/L			mg		Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
III-24	Chloride	Initially:		82.49	83.16	83.58	
0	1	0.5	0.5	0.44	0.22	0.23	0
1	34.29	33.32	30.27	15.24	14.93	13.66	0.083333
2	33.81	34.6	36.01	15.02	15.51	16.25	0.291666
3	36.62	39.59	37.21	16.27	17.74	16.80	1
4	15.04	17.87	16.31	6.68	8.01	7.36	2
5	3.68	4.25	5.06	1.64	1.90	2.28	3
6	1	0.5	1	0.44	0.22	0.45	4
7	0.5	0.5	0.5	0.22	0.22	0.23	5
III-24	Nitrite	Initially:		540.95	545.29	548.06	
0	2.1	2.35	1.5	0.93	1.05	0.68	0
1	242.09	238.19	205.8	107.56	106.76	92.90	0.083333
2	244.93	259.58	261.85	108.82	116.34	118.20	0.291666
3	298.92	313.78	316.96	132.81	140.64	143.08	1
4	129.8	142.91	148.51	57.67	64.05	67.04	2
5	33.93	36.3	40.19	15.08	16.27	18.14	3
6	7.53	7.21	7.45	3.35	3.23	3.36	4
7	2.55	2.14	2.36	1.13	0.96	1.07	5
III-24	Nitrate	Initially:		1240.77	1250.74	1257.08	
0	8.49	6.59	6.2	3.77	2.95	2.80	0
1	405.27	374.67	337.78	180.06	167.93	152.47	0.083333
2	421.56	443.88	428.01	187.30	198.95	193.20	0.291666
3	521.59	547.69	532.6	231.74	245.47	240.42	1
4	259.36	282.64	289.56	115.23	126.68	130.71	2
5	78.81	79.46	90.91	35.02	35.61	41.04	3
6	19.73	22.34	26.56	8.77	10.01	11.99	4
7	7.71	6.67	8.64	3.43	2.99	3.90	5

III-24	Sulfate	Initially:		46.19	46.57	46.80	
0	2	2	2	0.89	0.90	0.90	0
1	47.89	42.09	25.15	21.28	18.86	11.35	0.083333
2	58.63	67.18	58.63	26.05	30.11	26.47	0.291666
3	93.97	91.33	96.79	41.75	40.93	43.69	1
4	67.45	71.51	71.53	29.97	32.05	32.29	2
5	42.98	28.45	37.83	19.10	12.75	17.08	3
6	19.2	24.24	23.09	8.53	10.86	10.42	4
7	14.81	11.01	13.63	6.58	4.93	6.15	5

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)			
Observed				Calculated (NEWBOX)			
				(No Washoff or Washout)			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
III-24	Chloride						
				0.00	0.00	0.00	0
1	15.68	15.16	13.89	17.41	17.34	16.52	0.083333
2	30.70	30.67	30.14	29.71	29.80	28.16	0.291666
3	46.97	48.41	46.94	45.53	46.41	44.63	1
4	53.65	56.42	54.30	53.07	55.02	53.21	2
5	55.29	58.32	56.59	55.51	58.21	56.57	3
6	55.73	58.55	57.04	56.30	59.42	57.92	4
7	55.96	58.77	57.26	56.59	59.90	58.45	5

Added in 106-AN				Newbox Estimate		
Ao =	82.49	83.16	83.58	56.7	60.2	58.8

Per cent of 106-AN ion leachable:	69%	72%	70%
Eff. Diffusion Coefficient, sq cm/s:	2.99E-06	2.60E-06	2.47E-06
Std. Deviation, sq cm/s:	3.88E-07	4.11E-07	4.91E-07
Leachability Index:	5.524	5.585	5.607
Upper 95% Confidence Int.:	0.059	0.072	0.093
Lower 95% Confidence Int.:	0.052	0.062	0.077

III-24	Nitrite			0.00	0.00	0.00	0
1	108.49	107.81	93.58	123.80	126.95	117.72	0.083333
2	217.32	224.15	211.77	212.92	219.02	204.95	0.291666
3	350.13	364.79	354.85	333.20	345.50	328.30	1
4	407.80	428.84	421.89	397.30	415.25	402.40	2
5	422.87	445.11	440.03	422.32	443.61	436.64	3
6	426.22	448.34	443.39	432.42	455.70	453.05	4
7	427.35	449.30	444.46	436.37	461.28	461.03	5

Added in 106-AN				Newbox Estimate			
Ao =	540.95	545.29	548.06	439	465	469	
Per cent of 106-AN ion leachable:				81%	85%	86%	
Eff. Diffusion Coefficient, sq cm/s:				2.46E-06	2.31E-06	1.93E-06	
Std. Deviation, sq cm/s:				3.97E-07	4.26E-07	4.68E-07	
Leachability Index:				5.609	5.636	5.714	
Upper 95% Confidence Int.:				0.074	0.086	0.117	
Lower 95% Confidence Int.:				0.063	0.072	0.092	
III-24	Nitrate						
				0.00	0.00	0.00	0
1	183.83	170.88	155.27	209.34	205.84	193.16	0.083333
2	371.13	369.83	348.48	362.81	359.39	338.23	0.291666
3	602.88	615.30	588.89	574.51	576.85	548.80	1
4	718.11	741.98	719.60	694.92	707.99	682.27	2
5	753.12	777.60	760.64	746.08	769.41	749.42	3
6	761.89	787.61	772.63	768.90	799.29	785.06	4
7	765.32	790.60	776.53	778.34	815.06	804.96	5

Added in 106-AN				Newbox Estimate			
Ao =	1240.77	1250.74	1257.08	787	830	829	
Per cent of 106-AN ion leachable:				63%	66%	66%	
Eff. Diffusion Coefficient, sq cm/s:				2.18E-06	1.88E-06	1.64E-06	
Std. Deviation, sq cm/s:				3.44E-07	3.87E-07	3.59E-07	
Leachability Index:				5.662	5.726	5.785	
Upper 95% Confidence Int.:				0.072	0.097	0.104	
Lower 95% Confidence Int.:				0.062	0.079	0.084	
III-24	Sulfate						
				0.00	0.00	0.00	0
1	22.17	19.76	12.26	27.43	27.02	24.53	0.083333
2	48.22	49.87	38.72	49.73	49.24	44.60	0.291666
3	89.97	90.81	82.41	86.52	85.65	78.05	1
4	119.94	122.86	114.70	115.51	114.50	104.81	2
5	139.04	135.61	131.78	134.92	134.19	123.10	3
6	147.57	146.47	142.20	149.63	149.08	137.37	4
7	154.15	151.41	148.35	161.23	160.99	148.74	5

Added in 106-AN				Newbox Estimate		
Ao =	46.19	46.57	46.80	223	229	223

Per cent of 106-AN ion leachable:	483%	492%	476%
Eff. Diffusion Coefficient, sq cm/s:	4.23E-07	3.90E-07	3.35E-07
Std. Deviation, sq cm/s:	5.03E-08	6.49E-08	9.94E-08
Leachability Index:	6.374	6.409	6.475
Upper 95% Confidence Int.:	0.053	0.077	0.148
Lower 95% Confidence Int.:	0.047	0.065	0.110

III-24 Nitrate + Nitrite

				0.00	0.00	0.00	0
1	292.33	278.69	248.85	333.20	332.30	309.98	0.083333
2	588.45	593.98	560.25	576.98	577.97	543.44	0.291666
3	953.00	980.09	943.74	908.95	921.91	876.77	1
4	1125.91	1170.82	1141.49	1092.70	1123.62	1084.29	2
5	1176.00	1222.71	1200.67	1168.65	1212.83	1185.46	3
6	1188.11	1235.95	1216.02	1200.50	1255.50	1238.64	4
7	1192.67	1239.90	1220.98	1213.98	1274.90	1265.87	5

	Added in 106-AN			Newbox Estimate		
Ao =	1781.72	1796.03	1805.13	1225	1293	1297

Per cent of 106-AN ion leachable:	69%	72%	72%
Eff. Diffusion Coefficient, sq cm/s:	2.29E-06	2.03E-06	1.74E-06
Std. Deviation, sq cm/s:	3.57E-07	4.02E-07	3.98E-07
Leachability Index:	5.640	5.693	5.759
Upper 95% Confidence Int.:	0.071	0.093	0.109
Lower 95% Confidence Int.:	0.061	0.076	0.087

Run III-24 : Nitrate

Run III-24 : Nitrite

Run III-24 : Nitrate + Nitrite

Run III-24 : Chloride

Run III-24 : Sulfate

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ANSI/ANS-16.1-1986 Leaching Data				Phase III: Mixt. Exp't for 106-AN			
Run No.:	III-25			Surrogate 106-AN Concentrations, mg/mL			
Mix Ratio	8 lb/gal			Chloride	Nitrite	Nitrate	Sulfate
				5.32	34.87	79.99	2.98
Sample Cylinder Dimensions				After Curing 28 d			
	Initially			Batch 1	Batch 2	Batch 3	
Vol, cc	2.51	Dia., cm	2.51	2.51	2.51	2.51	
23.01	4.65	Length,cm	3.87	3.84	3.68		
Grout Density, lb/gal			13.50	13.50	13.49		
mL of 106-AN in Sample Cylinder			17.12	17.12	17.11		
Leach Vol + Boric Acid Vol Added, mL			408.3	406	393.3		
Leachate Concentrations				Mass in Leachate			Time d
	mg/L			mg			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	
III-25	Chloride	Initially:		91.05	91.05	90.98	
0	1	2.08	1.09	0.41	0.84	0.43	0
1	13	23.41	20.13	5.31	9.50	7.92	0.083333
2	12.1	18.37	18.54	4.94	7.46	7.29	0.291666
3	14.58	22.35	20.39	5.95	9.07	8.02	1
4	15.73	13.61	13.39	6.42	5.53	5.27	2
5	7.27	4.8	4.73	2.97	1.95	1.86	3
6	2.61	1.89	1.18	1.07	0.77	0.46	4
7	1	0.5	1	0.41	0.20	0.39	5
III-25	Nitrite	Initially:		597.03	597.03	596.59	
0	6.33	8.37	4.52	2.58	3.40	1.78	0
1	196.93	220.19	204.95	80.41	89.40	80.61	0.083333
2	157.85	166.77	140.31	64.45	67.71	55.18	0.291666
3	200.02	226.96	199.48	81.67	92.15	78.46	1
4	133.49	126.42	120.27	54.50	51.33	47.30	2
5	55.91	45.89	45.99	22.83	18.63	18.09	3
6	18.09	12.94	15.52	7.39	5.25	6.10	4
7	4.86	3	5.76	1.98	1.22	2.27	5
III-25	Nitrate	Initially:		1369.40	1369.40	1368.39	
0	13.21	17.66	15.38	5.39	7.17	6.05	0
1	460.27	470.58	438.58	187.93	191.06	172.49	0.083333
2	361.72	358.41	320.69	147.69	145.51	126.13	0.291666
3	486.06	486.74	448.32	198.46	197.62	176.32	1
4	301.19	285.05	263.5	122.98	115.73	103.63	2
5	143.22	112.57	115.15	58.48	45.70	45.29	3
6	57.06	41.63	41.58	23.30	16.90	16.35	4
7	18.83	11.76	18.32	7.69	4.77	7.21	5

III-25	Sulfate	Initially:		50.98	50.98	50.95	
0	2	2	2	0.82	0.81	0.79	0
1	42.28	59.21	43.35	17.26	24.04	17.05	0.083333
2	47.29	41.58	46.3	19.31	16.88	18.21	0.291666
3	68.62	69.53	63.68	28.02	28.23	25.05	1
4	52.44	51.83	50.64	21.41	21.04	19.92	2
5	35.16	34.12	20.67	14.36	13.85	8.13	3
6	23.89	21.06	21.82	9.75	8.55	8.58	4
7	19.45	10.33	15.55	7.94	4.19	6.12	5

Cumulative Amount Leached, mg Observed				(Adding Rinse to Interval 1) Calculated (NEWBOX) (No Washoff or Washout)				Time d
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3		
III-25	Chloride							
				0.00	0.00	0.00		0
1	5.72	10.35	8.35	5.89	10.26	8.80	0.083333	
2	10.66	17.81	15.64	10.48	17.64	15.15	0.291666	
3	16.61	26.88	23.66	17.45	27.37	23.79		1
4	23.03	32.41	28.92	22.32	32.41	28.57		2
5	26.00	34.36	30.78	25.20	34.29	30.56		3
6	27.07	35.12	31.25	27.06	35.04	31.43		4
7	27.47	35.33	31.64	28.33	35.32	31.81		5

Added in 106-AN				Newbox Estimate		
Ao =	91.05	91.05	90.98	31	35.5	32.1

Per cent of 106-AN ion leachable:	34%	39%	35%
Eff. Diffusion Coefficient, sq cm/s:	1.01E-06	2.49E-06	2.16E-06
Std. Deviation, sq cm/s:	8.96E-08	8.01E-08	1.37E-07
Leachability Index:	5.996	5.604	5.666
Upper 95% Confidence Int.:	0.039	0.014	0.028
Lower 95% Confidence Int.:	0.036	0.013	0.026

III-25	Nitrite			0.00	0.00	0.00		0
1	82.99	92.80	82.38	83.98	93.85	80.85	0.083333	
2	147.44	160.50	137.57	145.67	161.32	139.36	0.291666	
3	229.11	252.65	216.02	231.27	252.17	218.44		1
4	283.61	303.98	263.33	281.01	300.93	261.95		2
5	306.44	322.61	281.41	303.30	320.31	280.18		3
6	313.83	327.86	287.52	313.63	328.32	288.12		4
7	315.81	329.08	289.78	318.48	331.66	291.35		5

Added in 106-AN				Newbox Estimate			
Ao =	597.03	597.03	596.59	323	334	294	
Per cent of 106-AN ion leachable:				54%	56%	49%	
Eff. Diffusion Coefficient, sq cm/s:				1.98E-06	2.34E-06	2.18E-06	
Std. Deviation, sq cm/s:				6.53E-08	6.53E-08	6.24E-08	
Leachability Index:				5.703	5.631	5.662	
Upper 95% Confidence Int.:				0.014	0.012	0.012	
Lower 95% Confidence Int.:				0.014	0.012	0.012	
III-25	Nitrate			0.00	0.00	0.00	0
1	193.32	198.23	178.54	195.58	199.46	177.68	0.083333
2	341.01	343.74	304.67	339.57	344.45	306.31	0.291666
3	539.47	541.36	480.99	541.31	541.70	483.99	1
4	662.45	657.09	584.63	661.43	652.83	584.10	2
5	720.92	702.79	629.92	716.87	699.20	627.20	3
6	744.22	719.69	646.27	743.82	719.81	646.43	4
7	751.91	724.47	653.48	756.91	728.64	655.71	5

Added in 106-AN				Newbox Estimate			
Ao =	1369.40	1369.40	1368.39	770	736	663	
Per cent of 106-AN ion leachable:				56%	54%	48%	
Eff. Diffusion Coefficient, sq cm/s:				1.87E-06	2.15E-06	2.05E-06	
Std. Deviation, sq cm/s:				3.58E-08	4.14E-08	3.38E-08	
Leachability Index:				5.728	5.668	5.688	
Upper 95% Confidence Int.:				0.008	0.008	0.007	
Lower 95% Confidence Int.:				0.008	0.008	0.007	
III-25	Sulfate			0.00	0.00	0.00	0
1	18.08	24.85	17.84	20.05	23.67	19.66	0.083333
2	37.39	41.73	36.05	36.34	42.16	35.28	0.291666
3	65.40	69.96	61.09	63.54	70.76	59.98	1
4	86.82	91.00	81.01	85.20	91.24	78.37	2
5	101.17	104.86	89.14	100.06	103.74	90.22	3
6	110.93	113.41	97.72	111.52	112.25	98.53	4
7	118.87	117.60	103.84	120.65	118.10	104.71	5

Added in 106-AN				Newbox Estimate		
Ao =	50.98	50.98	50.95	179	133	126

Per cent of 106-AN ion leachable:	351%	261%	247%
Eff. Diffusion Coefficient, sq cm/s:	3.30E-07	8.67E-07	6.45E-07
Std. Deviation, sq cm/s:	1.88E-08	3.15E-08	4.48E-08
Leachability Index:	6.481	6.062	6.190
Upper 95% Confidence Int.:	0.025	0.016	0.030
Lower 95% Confidence Int.:	0.023	0.015	0.028

III-25	Nitrate + Nitrite			0.00	0.00	0.00	0
1	276.31	291.02	260.93	279.81	293.45	257.43	0.083333
2	488.45	504.24	442.24	485.29	505.51	445.01	0.291666
3	768.58	794.01	697.02	772.75	794.68	701.48	1
4	946.06	961.06	847.95	942.17	954.26	845.03	2
5	1027.36	1025.40	911.33	1019.77	1020.66	907.24	3
6	1058.05	1047.55	933.79	1056.93	1048.51	934.03	4
7	1067.72	1053.55	943.26	1075.51	1061.36	946.47	5

	Added in 106-AN			Newbox Estimate		
Ao =	1966.43	1966.43	1964.97	1093	1071	957

Per cent of 106-AN ion leachable:	56%	54%	49%
Eff. Diffusion Coefficient, sq cm/s:	1.90E-06	2.20E-06	2.08E-06
Std. Deviation, sq cm/s:	4.21E-08	4.39E-08	4.16E-08
Leachability Index:	5.721	5.658	5.682
Upper 95% Confidence Int.:	0.009	0.009	0.009
Lower 95% Confidence Int.:	0.009	0.008	0.008

Run III-25 : Nitrate

Run III-25 : Nitrite

Run III-25 : Nitrate + Nitrite

Run III-25 : Chloride

Run III-25 : Sulfate

ANSI/ANS-16.1-1986 Leaching Data

Phase III: Mixt. Exp't for 106-AN

Run No.: III-26

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio 8 lb/gal

Chloride

Nitrite

Nitrate

Sulfate

5.32

34.87

79.99

2.98

Sample Cylinder Dimensions

After Curing 28 d

Initially

Batch 1

Batch 2

Batch 3

Vol, cc 2.51

Dia., cm

2.51

2.51

2.51

23.01

4.65 Length, cm

4.08

4.06

4.06

Grout Density, lb/gal

13.30

13.32

13.33

mL of 106-AN in Sample Cylinder

16.87

16.89

16.91

Leach Vol + Boric Acid Vol Added, mL

424.9

423.3

423.3

Leachate Concentrations

Mass in Leachate

mg/L

mg

Time

Interval

Batch 1

Batch 2

Batch 3

Batch 1

Batch 2

Batch 3

d

III-26

Chloride

Initially:

89.70

89.83

89.90

0

1

1.32

1

0.42

0.56

0.42

0

1

22.03

22.06

21.43

9.36

9.34

9.07

0.083333

2

18.36

32.99

17.5

7.80

13.96

7.41

0.291666

3

27.21

23.17

20.54

11.56

9.81

8.69

1

4

19.52

17.24

15.49

8.29

7.30

6.56

2

5

11.32

9.96

11.01

4.81

4.22

4.66

3

6

10.67

7.18

7.66

4.53

3.04

3.24

4

7

7.86

7.76

5.84

3.34

3.28

2.47

5

III-26

Nitrite

Initially:

588.18

589.07

589.51

0

11

9.47

7.98

4.67

4.01

3.38

0

1

138.18

162.08

152.67

58.71

68.61

64.63

0.083333

2

121.19

122.92

116.04

51.49

52.03

49.12

0.291666

3

197.01

167.14

155.25

83.71

70.75

65.72

1

4

143.9

115.84

111.29

61.14

49.04

47.11

2

5

83.93

72.05

70.53

35.66

30.50

29.86

3

6

68.65

50.74

51.25

29.17

21.48

21.69

4

7

53.79

44.64

39.48

22.86

18.90

16.71

5

III-26

Nitrate

Initially:

1349.11

1351.14

1352.16

0

17.1

18.83

18.47

7.27

7.97

7.82

0

1

223.6

290.35

265

95.01

122.91

112.17

0.083333

2

199.94

196.63

196.99

84.95

83.23

83.39

0.291666

3

315.29

298.06

273.34

133.97

126.17

115.70

1

4

236.2

201.57

195.24

100.36

85.32

82.65

2

5

146.06

114.63

117.61

62.06

48.52

49.78

3

6

113.2

83.16

92.69

48.10

35.20

39.24

4

7

94.4

65.66

75.48

40.11

27.79

31.95

5

III-26	Sulfate	Initially:		50.23	50.30	50.34	
0	3.2	2.84	2.22	1.36	1.20	0.94	0
1	23.43	23.81	32.58	9.96	10.08	13.79	0.083333
2	19	22.83	20.58	8.07	9.66	8.71	0.291666
3	40.49	39.42	34.02	17.20	16.69	14.40	1
4	28.93	29.54	21.68	12.29	12.50	9.18	2
5	22.99	16.92	17.87	9.77	7.16	7.56	3
6	13.56	10.95	12.23	5.76	4.64	5.18	4
7	10.95	10.15	11.23	4.65	4.30	4.75	5

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)			
Observed				Calculated (NEWBOX)			
				(No Washoff or Washout)			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time
		mg			mg		d
III-26	Chloride						
				0.00	0.00	0.00	0
1	9.79	9.90	9.49	9.68	11.56	8.99	0.083333
2	17.59	23.86	16.90	17.26	20.38	15.89	0.291666
3	29.15	33.67	25.60	29.15	33.32	26.30	1
4	37.44	40.97	32.15	37.75	41.82	33.42	2
5	42.25	45.18	36.81	43.13	46.36	37.47	3
6	46.79	48.22	40.06	46.81	49.00	39.96	4
7	50.13	51.51	42.53	49.41	50.53	41.56	5

Added in 106-AN				Newbox Estimate		
Ao =	89.70	89.83	89.90	56.6	52.8	44.5

Per cent of 106-AN ion leachable:	63%	59%	49%
Eff. Diffusion Coefficient, sq cm/s:	8.18E-07	1.40E-06	1.17E-06
Std. Deviation, sq cm/s:	2.85E-08	2.76E-07	1.09E-07
Leachability Index:	6.087	5.854	5.932
Upper 95% Confidence Int.:	0.015	0.092	0.041
Lower 95% Confidence Int.:	0.014	0.076	0.038

III-26	Nitrite			0.00	0.00	0.00	0
1	63.39	72.62	68.00	64.26	68.58	64.07	0.083333
2	114.88	124.65	117.12	115.50	120.90	113.20	0.291666
3	198.59	195.40	182.84	197.40	198.58	186.91	1
4	259.73	244.43	229.95	258.30	250.90	236.67	2
5	295.39	274.93	259.80	297.78	279.83	264.66	3
6	324.56	296.41	281.50	325.92	297.05	281.77	4
7	347.42	315.31	298.21	346.92	307.78	292.34	5

Added in 106-AN				Newbox Estimate			
Ao =	588.18	589.07	589.51	420	325	311	
Per cent of 106-AN ion leachable:				71%	55%	53%	
Eff. Diffusion Coefficient, sq cm/s:				6.52E-07	1.28E-06	1.22E-06	
Std. Deviation, sq cm/s:				1.10E-08	9.99E-08	9.10E-08	
Leachability Index:				6.186	5.893	5.914	
Upper 95% Confidence Int.:				0.007	0.034	0.033	
Lower 95% Confidence Int.:				0.007	0.032	0.030	
III-26	Nitrate						
				0.00	0.00	0.00	0
1	102.27	130.88	119.99	103.24	120.23	111.52	0.083333
2	187.23	214.11	203.38	186.54	211.91	196.93	0.291666
3	321.19	340.28	319.08	319.69	346.42	325.31	1
4	421.56	425.60	401.73	420.79	434.81	412.35	2
5	483.62	474.13	451.51	486.30	482.02	461.86	3
6	531.72	509.33	490.75	534.00	509.47	491.78	4
7	571.83	537.12	522.70	570.31	525.39	510.82	5

Added in 106-AN				Newbox Estimate			
Ao =	1349.11	1351.14	1352.16	712	549	544	
Per cent of 106-AN ion leachable:				53%	41%	40%	
Eff. Diffusion Coefficient, sq cm/s:				5.84E-07	1.39E-06	1.21E-06	
Std. Deviation, sq cm/s:				6.98E-09	1.13E-07	9.81E-08	
Leachability Index:				6.234	5.857	5.917	
Upper 95% Confidence Int.:				0.005	0.036	0.036	
Lower 95% Confidence Int.:				0.005	0.033	0.033	
III-26	Sulfate						
				0.00	0.00	0.00	0
1	11.32	11.28	14.73	11.16	11.83	12.90	0.083333
2	19.39	20.94	23.44	20.35	21.40	22.91	0.291666
3	36.59	37.63	37.84	36.06	36.89	38.23	1
4	48.88	50.14	47.02	48.79	48.81	49.06	2
5	58.65	57.30	54.58	57.72	56.72	55.55	3
6	64.41	61.93	59.76	64.62	62.47	59.75	4
7	69.07	66.23	64.52	70.45	66.99	62.65	5

Added in 106-AN				Newbox Estimate		
Ao =	50.23	50.30	50.34	119	87	69

Per cent of 106-AN ion leachable:	237%	173%	137%
Eff. Diffusion Coefficient, sq cm/s:	2.35E-07	5.09E-07	9.87E-07
Std. Deviation, sq cm/s:	9.63E-09	2.36E-08	1.06E-07
Leachability Index:	6.629	6.293	6.006
Upper 95% Confidence Int.:	0.018	0.020	0.048
Lower 95% Confidence Int.:	0.017	0.019	0.043

III-26 Nitrate + Nitrite

				0.00	0.00	0.00	0
1	165.66	203.49	188.00	168.37	188.78	175.51	0.083333
2	302.11	338.76	320.50	301.71	332.12	310.13	0.291666
3	519.78	535.68	501.92	516.41	545.38	512.05	1
4	681.29	670.04	631.68	679.13	685.22	648.37	2
5	779.01	749.06	711.32	783.09	762.13	725.05	3
6	856.28	805.74	772.25	859.93	806.70	771.91	4
7	919.25	852.43	820.91	916.43	832.92	800.88	5

	Added in 106-AN			Newbox Estimate		
Ao =	1937.30	1940.21	1941.67	1130	874	852

Per cent of 106-AN ion leachable:	58%	45%	44%
Eff. Diffusion Coefficient, sq cm/s:	6.10E-07	1.35E-06	1.22E-06
Std. Deviation, sq cm/s:	7.66E-09	1.04E-07	9.81E-08
Leachability Index:	6.215	5.870	5.914
Upper 95% Confidence Int.:	0.005	0.034	0.035
Lower 95% Confidence Int.:	0.005	0.031	0.033

Run III-26 : Nitrate

Run III-26 : Nitrite

Run III-26 : Nitrate + Nitrite

Run III-26 : Chloride

Run III-26 : Sulfate

ANSI/ANS-16.1-1986 Leaching Data				Phase III: Mixt. Exp't for 106-AN			
Run No.:	III-27			Surrogate 106-AN Concentrations, mg/mL			
Mix Ratio	10	lb/gal	Chloride	Nitrite	Nitrate	Sulfate	
			5.32	34.87	79.99	2.98	
Sample Cylinder Dimensions				After Curing 28 d			
	Initially			Batch 1	Batch 2	Batch 3	
Vol, cc	2.52	Dia., cm	2.52	2.52	2.52	2.52	
23.19	4.65	Length, cm	3.87	3.96	4.06		
Grout Density, lb/gal			14.52	14.52	14.52		
mL of 106-AN in Sample Cylinder			16.71	16.71	16.71		
Leach Vol + Boric Acid Vol Added, mL			410.3	417.5	425.4		
Leachate Concentrations				Mass in Leachate			Time d
		mg/L			mg		
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	
III-27	Chloride	Initially:		88.84	88.84	88.84	
0	1	2.81	1	0.41	1.17	0.43	0
1	17.24	17.4	16.24	7.07	7.26	6.91	0.083333
2	16.01	16.4	17.63	6.57	6.85	7.50	0.291666
3	10.59	10.19	20.4	4.35	4.25	8.68	1
4	7.81	9.87	7.79	3.20	4.12	3.31	2
5	5.59	6.51	4.58	2.29	2.72	1.95	3
6	3.94	2.69	1	1.62	1.12	0.43	4
7	1	1	1	0.41	0.42	0.43	5
III-27	Nitrite	Initially:		582.54	582.54	582.54	
0	1.76	7.3	3.78	0.72	3.05	1.61	0
1	183.34	200.16	195.83	75.22	83.57	83.31	0.083333
2	147.73	159.65	162.8	60.61	66.65	69.26	0.291666
3	176.93	189.25	220.21	72.59	79.01	93.68	1
4	111.26	124.36	118	45.65	51.92	50.20	2
5	51.69	58.98	51.96	21.21	24.62	22.10	3
6	22.77	24.95	19.9	9.34	10.42	8.47	4
7	6.68	10.42	7.5	2.74	4.35	3.19	5
III-27	Nitrate	Initially:		1336.16	1336.16	1336.16	
0	13.3	14.31	11.99	5.46	5.97	5.10	0
1	422.44	440.56	444.1	173.33	183.93	188.92	0.083333
2	328.44	364.05	364.1	134.76	151.99	154.89	0.291666
3	456.86	499.11	503.12	187.45	208.38	214.03	1
4	293.65	321.31	331.19	120.48	134.15	140.89	2
5	133.22	149.96	150.99	54.66	62.61	64.23	3
6	57.93	68.22	61.66	23.77	28.48	26.23	4
7	27.05	25.33	28.21	11.10	10.58	12.00	5

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III-27	Sulfate	Initially:		49.75	49.75	49.75	
0	2	2	2	0.82	0.84	0.85	0
1	37.76	36.23	45.67	15.49	15.13	19.43	0.083333
2	35.18	27.89	43.69	14.43	11.64	18.59	0.291666
3	42.22	52.58	45.78	17.32	21.95	19.47	1
4	28.11	29.39	32.47	11.53	12.27	13.81	2
5	14.84	15.9	18.18	6.09	6.64	7.73	3
6	8.13	11.13	7.92	3.34	4.65	3.37	4
7	5.22	7.49	6.72	2.14	3.13	2.86	5

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)			
Observed				Calculated (NEWBOX)			
				(No Washoff or Washout)			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
III-27	Chloride						
				0.00	0.00	0.00	0
1	7.48	8.44	7.33	7.33	8.00	8.28	0.083333
2	14.05	15.28	14.83	12.60	13.70	14.27	0.291666
3	18.40	19.54	23.51	19.50	21.24	22.45	1
4	21.60	23.66	26.83	23.06	25.06	26.91	2
5	23.90	26.38	28.77	24.39	26.45	28.75	3
6	25.51	27.50	29.20	24.87	26.97	29.53	4
7	25.92	27.92	29.62	25.07	27.19	29.86	5

Added in 106-AN				Newbox Estimate		
Ao =	88.84	88.84	88.84	25.2	27.3	30.1

Per cent of 106-AN ion leachable:	28%	31%	34%
Eff. Diffusion Coefficient, sq cm/s:	2.56E-06	2.62E-06	2.30E-06
Std. Deviation, sq cm/s:	5.70E-07	6.08E-07	3.22E-07
Leachability Index:	5.592	5.582	5.638
Upper 95% Confidence Int.:	0.106	0.111	0.064
Lower 95% Confidence Int.:	0.085	0.088	0.055

III-27	Nitrite						
				0.00	0.00	0.00	0
1	75.95	86.61	84.91	77.09	86.00	88.82	0.083333
2	136.56	153.27	154.17	133.74	149.11	153.57	0.291666
3	209.15	232.28	247.85	211.41	236.42	244.08	1
4	254.80	284.20	298.04	256.08	286.45	295.95	2
5	276.01	308.82	320.15	275.36	308.36	319.00	3
6	285.36	319.24	328.61	284.41	318.17	329.51	4
7	288.10	323.59	331.80	288.20	323.08	334.59	5

Added in 106-AN				Newbox Estimate			
Ao =	582.54	582.54	582.54	292	327	339	
Per cent of 106-AN ion leachable:				50%	56%	58%	
Eff. Diffusion Coefficient, sq cm/s:				2.06E-06	2.07E-06	2.06E-06	
Std. Deviation, sq cm/s:				7.63E-08	8.79E-08	9.83E-08	
Leachability Index:				5.686	5.684	5.686	
Upper 95% Confidence Int.:				0.016	0.018	0.021	
Lower 95% Confidence Int.:				0.015	0.018	0.020	
III-27	Nitrate			0.00	0.00	0.00	0
1	178.78	189.91	194.02	180.31	195.36	199.57	0.083333
2	313.54	341.90	348.91	313.90	341.07	349.03	0.291666
3	500.99	550.28	562.94	502.97	549.45	562.79	1
4	621.48	684.42	703.82	618.31	678.88	695.56	2
5	676.14	747.03	768.06	673.06	742.37	760.69	3
6	699.91	775.51	794.29	700.80	775.74	795.76	4
7	711.00	786.09	806.29	714.67	793.65	814.13	5

Added in 106-AN				Newbox Estimate			
Ao =	1336.16	1336.16	1336.16	730	814	835	
Per cent of 106-AN ion leachable:				55%	61%	62%	
Eff. Diffusion Coefficient, sq cm/s:				1.78E-06	1.68E-06	1.69E-06	
Std. Deviation, sq cm/s:				2.79E-08	5.11E-08	5.99E-08	
Leachability Index:				5.750	5.775	5.772	
Upper 95% Confidence Int.:				0.007	0.013	0.015	
Lower 95% Confidence Int.:				0.007	0.013	0.015	
III-27	Sulfate			0.00	0.00	0.00	0
1	16.31	15.96	20.28	17.01	16.25	21.02	0.083333
2	30.75	27.61	38.86	29.69	28.85	36.70	0.291666
3	48.07	49.56	58.34	48.16	47.83	59.22	1
4	59.60	61.83	72.15	59.89	61.01	73.15	2
5	65.69	68.47	79.89	65.82	68.64	79.98	3
6	69.03	73.11	83.26	69.12	73.45	83.57	4
7	71.17	76.24	86.11	70.95	76.68	85.41	5

Added in 106-AN				Newbox Estimate		
Ao =	49.75	49.75	49.75	73.3	82.9	87.6

Per cent of 106-AN ion leachable:	147%	167%	176%
Eff. Diffusion Coefficient, sq cm/s:	1.54E-06	1.09E-06	1.71E-06
Std. Deviation, sq cm/s:	7.41E-08	6.34E-08	1.24E-07
Leachability Index:	5.812	5.963	5.767
Upper 95% Confidence Int.:	0.021	0.025	0.032
Lower 95% Confidence Int.:	0.020	0.024	0.030

III-27 Nitrate + Nitrite

				0.00	0.00	0.00	0
1	254.73	276.52	278.93	257.29	281.33	288.56	0.083333
2	450.10	495.17	503.08	447.20	490.91	502.04	0.291666
3	710.15	782.56	810.78	713.68	785.91	807.02	1
4	876.28	968.63	1001.87	872.96	965.87	992.36	2
5	952.15	1055.86	1088.20	947.49	1051.30	1080.33	3
6	985.26	1094.76	1122.90	984.24	1093.44	1124.91	4
7	999.10	1109.68	1138.09	1002.62	1116.22	1148.37	5

	Added in 106-AN			Newbox Estimate		
Ao =	1918.70	1918.70	1918.70	1021	1139	1173

Per cent of 106-AN ion leachable:	53%	59%	61%
Eff. Diffusion Coefficient, sq cm/s:	1.85E-06	1.80E-06	1.80E-06
Std. Deviation, sq cm/s:	3.01E-08	3.90E-08	6.53E-08
Leachability Index:	5.733	5.745	5.745
Upper 95% Confidence Int.:	0.007	0.009	0.016
Lower 95% Confidence Int.:	0.007	0.009	0.015

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Run III-27 : Nitrate

Run III-27 : Nitrite

Run III-27 : Nitrate + Nitrite

Run III-27 : Chloride

Run III-27 : Sulfate

ANSI/ANS-16.1-1986 Leaching Data				Phase III: Mixt. Exp't for 106-AN			
Run No.:	III-28			Surrogate 106-AN Concentrations, mg/mL			
Mix Ratio	9 lb/gal			Chloride	Nitrite	Nitrate	Sulfate
				5.32	34.87	79.99	2.98
Sample Cylinder Dimensions				After Curing 28 d			
	Initially			Batch 1	Batch 2	Batch 3	
Vol, cc	2.51	Dia., cm	2.51	2.51	2.51	2.51	
23.01	4.65	Length,cm	4.08	4.25	4.25	4.25	
Grout Density, lb/gal				13.17	13.17	13.17	
mL of 106-AN in Sample Cylinder				15.82	15.82	15.82	
Leach Vol + Boric Acid Vol Added, mL				425	438.4	438.4	
Leachate Concentrations				Mass in Leachate			Time d
		mg/L			mg		
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	
III-28	Chloride	Initially:		84.15	84.15	84.15	
0	0.5	0.5	0.5	0.21	0.22	0.22	0
1	14.43	15.66	18.64	6.13	6.87	8.17	0.083333
2	12.02	11.27	11.11	5.11	4.94	4.87	0.291666
3	12.37	16.29	14.14	5.26	7.14	6.20	1
4	9.89	12.82	11.07	4.20	5.62	4.85	2
5	8.46	8.62	7.8	3.60	3.78	3.42	3
6	6.32	7.18	5.32	2.69	3.15	2.33	4
7	5.55	5.73	4.83	2.36	2.51	2.12	5
III-28	Nitrite	Initially:		551.78	551.78	551.78	
0	1.5	1.5	1.5	0.64	0.66	0.66	0
1	104.17	112.37	139.09	44.27	49.26	60.98	0.083333
2	83.71	86.06	86.03	35.58	37.73	37.72	0.291666
3	95.79	115.92	102.13	40.71	50.82	44.77	1
4	73.02	95.98	80.24	31.03	42.08	35.18	2
5	55.62	66.32	56.48	23.64	29.07	24.76	3
6	41.68	50.1	42.63	17.71	21.96	18.69	4
7	34.67	42.41	37.86	14.73	18.59	16.60	5
III-28	Nitrate	Initially:		1265.61	1265.61	1265.61	
0	4.37	4.85	5.8	1.86	2.13	2.54	0
1	164.50	182.14	220.43	69.93	79.85	96.64	0.083333
2	131.6	133.7	146.57	55.93	58.61	64.26	0.291666
3	165.23	200.31	168.64	70.22	87.82	73.93	1
4	118.3	159.1	125.6	50.28	69.75	55.06	2
5	88.21	107.34	94.47	37.49	47.06	41.42	3
6	67.58	80.67	69.3	28.72	35.37	30.38	4
7	59.15	71.14	56.46	25.14	31.19	24.75	5

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III-28	Sulfate	Initially:		47.12	47.12	47.12	
0	2	2	2	0.85	0.88	0.88	0
1	13.92	15.58	20.56	5.92	6.83	9.01	0.083333
2	17.77	16.36	15.26	7.55	7.17	6.69	0.291666
3	18.46	27.99	27.62	7.85	12.27	12.11	1
4	15.82	22.11	10.02	6.72	9.69	4.39	2
5	11.35	14.17	12.71	4.82	6.21	5.57	3
6	7.88	7.5	10.48	3.35	3.29	4.59	4
7	5.74	9.75	7.45	2.44	4.27	3.27	5

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)			
Observed				Calculated (NEWBOX)			
				(No Washoff or Washout)			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
III-28	Chloride						
				0.00	0.00	0.00	0
1	6.35	7.08	8.39	5.79	6.49	7.11	0.083333
2	11.45	12.03	13.26	10.30	11.61	12.47	0.291666
3	16.71	19.17	19.46	17.27	19.60	20.41	1
4	20.91	24.79	24.31	22.23	25.44	25.65	2
5	24.51	28.57	27.73	25.22	29.07	28.52	3
6	27.20	31.71	30.07	27.22	31.63	30.01	4
7	29.55	34.23	32.18	28.59	33.46	30.94	5

Added in 106-AN				Newbox Estimate		
Ao =	84.15	84.15	84.15	31.8	38.2	32.3

Per cent of 106-AN ion leachable:	38%	45%	38%
Eff. Diffusion Coefficient, sq cm/s:	9.39E-07	8.26E-07	1.43E-06
Std. Deviation, sq cm/s:	1.34E-07	6.01E-08	2.53E-07
Leachability Index:	6.027	6.083	5.845
Upper 95% Confidence Int.:	0.065	0.032	0.082
Lower 95% Confidence Int.:	0.056	0.030	0.069

III-28	Nitrite			0.00	0.00	0.00	0
1	44.91	49.92	61.63	41.96	46.78	52.32	0.083333
2	80.49	87.65	99.35	74.59	84.09	92.16	0.291666
3	121.20	138.47	144.12	124.32	142.35	151.20	1
4	152.23	180.55	179.30	159.40	185.69	190.08	2
5	175.87	209.62	204.06	180.04	212.67	211.44	3
6	193.58	231.58	222.75	193.58	232.18	222.48	4
7	208.32	250.18	239.35	202.69	246.25	229.68	5

Added in 106-AN				Newbox Estimate		
Ao =	551.78	551.78	551.78	222	287	240
Per cent of 106-AN ion leachable:				40%	52%	43%
Eff. Diffusion Coefficient, sq cm/s:				1.02E-06	7.59E-07	1.41E-06
Std. Deviation, sq cm/s:				1.11E-07	4.98E-08	2.59E-07
Leachability Index:				5.991	6.120	5.851
Upper 95% Confidence Int.:				0.049	0.029	0.085
Lower 95% Confidence Int.:				0.044	0.027	0.071

III-28	Nitrate			0.00	0.00	0.00	0
1	71.78	81.98	99.18	67.70	76.48	86.19	0.083333
2	127.71	140.59	163.44	120.12	137.27	151.32	0.291666
3	197.94	228.41	237.37	200.93	232.75	247.65	1
4	248.21	298.16	292.43	257.71	304.00	310.83	2
5	285.70	345.21	333.85	291.93	348.65	345.54	3
6	314.42	380.58	364.23	314.50	380.95	363.09	4
7	339.56	411.77	388.98	329.78	404.70	374.01	5

Added in 106-AN				Newbox Estimate		
Ao =	1265.61	1265.61	1265.61	364	475	390
Per cent of 106-AN ion leachable:				29%	38%	31%
Eff. Diffusion Coefficient, sq cm/s:				9.76E-07	7.37E-07	1.45E-06
Std. Deviation, sq cm/s:				8.94E-08	4.08E-08	2.53E-07
Leachability Index:				6.011	6.133	5.839
Upper 95% Confidence Int.:				0.040	0.024	0.081
Lower 95% Confidence Int.:				0.037	0.023	0.068

III-28	Sulfate			0.00	0.00	0.00	0
1	6.77	7.71	9.89	7.28	8.27	9.21	0.083333
2	14.32	14.88	16.58	13.11	15.07	16.38	0.291666
3	22.16	27.15	28.69	22.36	26.54	27.42	1
4	28.89	36.84	33.08	29.35	35.79	35.24	2
5	33.71	43.06	38.65	33.84	42.26	39.95	3
6	37.06	46.34	43.25	37.07	47.26	43.07	4
7	39.50	50.62	46.51	39.52	51.35	45.24	5

Added in 106-AN				Newbox Estimate		
Ao =	47.12	47.12	47.12	48.2	81.9	49.5

Per cent of 106-AN ion leachable:	102%	174%	105%
Eff. Diffusion Coefficient, sq cm/s:	6.33E-07	2.79E-07	1.00E-06
Std. Deviation, sq cm/s:	4.66E-08	1.50E-08	1.11E-07
Leachability Index:	6.199	6.554	6.000
Upper 95% Confidence Int.:	0.032	0.023	0.050
Lower 95% Confidence Int.:	0.030	0.022	0.044

III-28 Nitrate + Nitrite

				0.00	0.00	0.00	0
1	116.69	131.90	160.81	109.58	123.28	139.01	0.083333
2	208.20	228.24	262.79	194.55	220.69	244.05	0.291666
3	319.13	366.88	381.49	325.23	375.17	399.42	1
4	400.44	478.70	471.73	417.82	489.32	501.31	2
5	461.57	554.83	537.91	472.32	561.62	556.67	3
6	508.01	612.16	586.98	508.06	612.61	585.60	4
7	547.88	661.94	628.33	532.67	650.66	603.21	5

	Added in 106-AN			Newbox Estimate		
Ao =	1817.40	1817.40	1817.40	586	761	629

Per cent of 106-AN ion leachable:	32%	42%	35%
Eff. Diffusion Coefficient, sq cm/s:	9.93E-07	7.48E-07	1.44E-06
Std. Deviation, sq cm/s:	9.72E-08	4.40E-08	2.56E-07
Leachability Index:	6.003	6.126	5.842
Upper 95% Confidence Int.:	0.043	0.026	0.082
Lower 95% Confidence Int.:	0.039	0.024	0.069

Run III-28 : Nitrate

Run III-28 : Nitrite

Run III-28 : Nitrate + Nitrite

Run III-28 : Chloride

Run III-28 : Sulfate

ANSI/ANS-16.1-1986 Leaching Data				Phase III: Mixt. Exp't for 106-AN			
Run No.:	III-29			Surrogate 106-AN Concentrations, mg/mL			
Mix Ratio	7.5	lb/gal	Chloride	Nitrite	Nitrate	Sulfate	
			5.32	34.87	79.99	2.98	
Sample Cylinder Dimensions			After Curing 28 d				
	Initially			Batch 1	Batch 2	Batch 3	
	Vol, cc	2.51	Dia., cm	2.51	2.51	2.51	
	23.01	4.65	Length,cm	4.49	4.52	4.50	
	Grout Density, lb/gal			12.95	12.97	12.94	
mL of 106-AN in Sample Cylinder				16.89	16.92	16.88	
Leach Vol + Boric Acid Vol Added, mL				457.6	460	458.4	
Leachate Concentrations			Mass in Leachate				
		mg/L			mg		Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
III-29	Chloride	Initially:		89.83	89.97	89.76	
0	0.5	1.18	1.31	0.23	0.54	0.60	0
1	24.28	24.8	29.06	11.11	11.41	13.32	0.083333
2	22.4	20.73	20.95	10.25	9.54	9.60	0.291666
3	26.4	29.98	29.61	12.08	13.79	13.57	1
4	23.77	24.87	23.41	10.88	11.44	10.73	2
5	12.78	13.68	13.83	5.85	6.29	6.34	3
6	7.09	7.77	8.61	3.24	3.57	3.95	4
7	3.45	4.65	5.92	1.58	2.14	2.71	5
III-29	Nitrite	Initially:		589.07	589.98	588.61	
0	5.89	6.38	5.56	2.70	2.93	2.55	0
1	198.91	216.35	216.06	91.02	99.52	99.04	0.083333
2	169.82	186.69	175.77	77.71	85.88	80.57	0.291666
3	248.88	262.27	260.32	113.89	120.64	119.33	1
4	199.47	209.49	202.59	91.28	96.37	92.87	2
5	112.21	114.36	111.5	51.35	52.61	51.11	3
6	70.93	72.43	72.34	32.46	33.32	33.16	4
7	39.48	42.5	45.84	18.07	19.55	21.01	5
III-29	Nitrate	Initially:		1351.14	1353.23	1350.10	
0	12.1	10.18	9.92	5.54	4.68	4.55	0
1	331.62	363.84	362.49	151.75	167.37	166.17	0.083333
2	286.3	310.28	285.03	131.01	142.73	130.66	0.291666
3	408.08	451.79	432.02	186.74	207.82	198.04	1
4	354.59	372.15	360.61	162.26	171.19	165.30	2
5	203.84	211.42	211.74	93.28	97.25	97.06	3
6	119.74	140.33	137.11	54.79	64.55	62.85	4
7	77.42	91.46	81.46	35.43	42.07	37.34	5

III-29	Sulfate	Initially:			50.30	50.38	50.26	
	0	2	2	2	0.92	0.92	0.92	0
	1	33.11	32.97	30.25	15.15	15.17	13.87	0.083333
	2	24.84	16.32	31.24	11.37	7.51	14.32	0.291666
	3	44.08	44.33	44.46	20.17	20.39	20.38	1
	4	40.03	41.14	42.78	18.32	18.92	19.61	2
	5	24.62	28.67	27.23	11.27	13.19	12.48	3
	6	20.92	18.03	15.5	9.57	8.29	7.11	4
	7	13.01	16.83	15.78	5.95	7.74	7.23	5

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)				
Observed				Calculated (NEWBOX)				
				(No Washoff or Washout)				
		mg			mg			Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3		d
III-29	Chloride							
				0.00	0.00	0.00		0
1	11.34	11.95	13.92	11.72	12.05	13.03	0.083333	
2	21.59	21.49	23.53	20.78	21.42	23.05	0.291666	
3	33.67	35.28	37.10	34.61	35.96	38.13		1
4	44.55	46.72	47.83	44.27	46.24	48.47		2
5	50.40	53.01	54.17	49.89	52.47	55.47		3
6	53.64	56.58	58.12	53.45	56.53	57.97		4
7	55.22	58.72	60.83	55.81	59.28	60.22		5

	Added in 106-AN			Newbox Estimate		
Ao =	89.83	89.97	89.76	60.4	65.5	64.2

Per cent of 106-AN ion leachable:	67%	73%	72%
Eff. Diffusion Coefficient, sq cm/s:	1.12E-06	1.00E-06	1.23E-06
Std. Deviation, sq cm/s:	6.01E-08	2.91E-08	7.48E-08
Leachability Index:	5.951	6.000	5.910
Upper 95% Confidence Int.:	0.023	0.012	0.026
Lower 95% Confidence Int.:	0.022	0.012	0.025

III-29	Nitrite						
				0.00	0.00	0.00	0
1	93.72	102.46	101.59	95.92	104.70	101.94	0.083333
2	171.43	188.33	182.16	171.13	186.06	181.16	0.291666
3	285.31	308.98	301.49	287.76	311.81	304.15	1
4	376.59	405.34	394.36	372.24	401.71	391.12	2
5	427.94	457.95	445.47	424.01	455.20	443.20	3
6	460.40	491.27	478.63	459.44	490.48	478.10	4
7	478.46	510.82	499.65	483.42	514.95	501.37	5

Added in 106-AN				Newbox Estimate			
Ao =	589.07	589.98	588.61	545	569	554	
Per cent of 106-AN ion leachable:				93%	96%	94%	
Eff. Diffusion Coefficient, sq cm/s:				9.07E-07	1.00E-06	1.00E-06	
Std. Deviation, sq cm/s:				2.57E-08	2.52E-08	1.50E-08	
Leachability Index:				6.042	6.000	6.000	
Upper 95% Confidence Int.:				0.012	0.011	0.006	
Lower 95% Confidence Int.:				0.012	0.011	0.006	
III-29	Nitrate						
				0.00	0.00	0.00	0
1	157.29	172.05	170.71	159.36	174.72	168.49	0.083333
2	288.30	314.78	301.37	285.12	312.00	301.09	0.291666
3	475.03	522.60	499.41	483.84	529.36	509.47	1
4	637.29	693.79	664.71	629.76	687.44	661.01	2
5	730.57	791.04	761.77	720.96	786.24	755.73	3
6	785.37	855.60	824.62	784.32	854.88	821.53	4
7	820.79	897.67	861.97	829.44	903.76	868.39	5

Added in 106-AN				Newbox Estimate			
Ao =	1351.14	1353.23	1350.10	960	1040	997	
Per cent of 106-AN ion leachable:				71%	77%	74%	
Eff. Diffusion Coefficient, sq cm/s:				8.05E-07	8.27E-07	8.33E-07	
Std. Deviation, sq cm/s:				2.60E-08	1.75E-08	2.19E-08	
Leachability Index:				6.094	6.082	6.079	
Upper 95% Confidence Int.:				0.014	0.009	0.011	
Lower 95% Confidence Int.:				0.013	0.009	0.011	
III-29	Sulfate						
				0.00	0.00	0.00	0
1	16.07	16.09	14.78	15.16	14.39	15.50	0.083333
2	27.43	23.59	29.10	27.74	26.25	28.37	0.291666
3	47.60	43.99	49.48	48.62	46.35	50.07	1
4	65.92	62.91	69.09	65.49	62.70	67.58	2
5	77.19	76.10	81.58	77.08	74.25	79.67	3
6	86.76	84.39	88.68	86.09	83.25	89.13	4
7	92.71	92.13	95.92	93.38	90.60	96.88	5

Added in 106-AN				Newbox Estimate		
Ao =	50.30	50.38	50.26	143	150	155

Per cent of 106-AN ion leachable:	483%	492%	476%
Eff. Diffusion Coefficient, sq cm/s:	4.23E-07	3.90E-07	3.35E-07
Std. Deviation, sq cm/s:	5.03E-08	6.49E-08	9.94E-08
Leachability Index:	6.374	6.409	6.475
Upper 95% Confidence Int.:	0.053	0.077	0.148
Lower 95% Confidence Int.:	0.047	0.065	0.110

III-24 Nitrate + Nitrite

				0.00	0.00	0.00	0
1	292.33	278.69	248.85	333.20	332.30	309.98	0.083333
2	588.45	593.98	560.25	576.98	577.97	543.44	0.291666
3	953.00	980.09	943.74	908.95	921.91	876.77	1
4	1125.91	1170.82	1141.49	1092.70	1123.62	1084.29	2
5	1176.00	1222.71	1200.67	1168.65	1212.83	1185.46	3
6	1188.11	1235.95	1216.02	1200.50	1255.50	1238.64	4
7	1192.67	1239.90	1220.98	1213.98	1274.90	1265.87	5

	Added in 106-AN			Newbox Estimate		
Ao =	1781.72	1796.03	1805.13	1225	1293	1297

Per cent of 106-AN ion leachable:	69%	72%	72%
Eff. Diffusion Coefficient, sq cm/s:	2.29E-06	2.03E-06	1.74E-06
Std. Deviation, sq cm/s:	3.57E-07	4.02E-07	3.98E-07
Leachability Index:	5.640	5.693	5.759
Upper 95% Confidence Int.:	0.071	0.093	0.109
Lower 95% Confidence Int.:	0.061	0.076	0.087

Run III-29 : Nitrate

Run III-29 : Nitrite

Run III-29 : Nitrate + Nitrite

Run III-29 : Chloride

Run III-29 : Sulfate

ANSI/ANS-16.1-1986 Leaching Data				Phase III: Mixt. Exp't for 106-AN			
Run No.:	III-30	Surrogate		106-AN Concentrations, mg/mL			
Mix Ratio	6 lb/gal	Chloride	Nitrite	Nitrate	Sulfate		
		5.32	34.87	79.99	2.98		
Sample Cylinder Dimensions		After Curing 28 d					
	Initially		Batch 1	Batch 2	Batch 3		
Vol, cc	2.51	Dia., cm	2.51	2.51	2.51		
23.01	4.65	Length, cm	3.52	3.46	3.54		
Grout Density, lb/gal			12.35	12.40	12.38		
mL of 106-AN in Sample Cylinder			17.62	17.69	17.66		
Leach Vol + Boric Acid Vol Added, mL			380.3	375.6	381.9		
Leachate Concentrations			Mass in Leachate				
		mg/L		mg			Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
III-30	Chloride	Initially:		93.70	94.08	93.93	
0	1	1.73	1	0.38	0.65	0.38	0
1	19.68	26.68	25.05	7.48	10.02	9.57	0.083333
2	13.41	15.95	16.56	5.10	5.99	6.32	0.291666
3	13.37	17.66	15.31	5.08	6.63	5.85	1
4	10.78	12.16	10.57	4.10	4.57	4.04	2
5	5.09	8.14	8.12	1.94	3.06	3.10	3
6	6.42	7	5.85	2.44	2.63	2.23	4
7	4.44	5.38	4.96	1.69	2.02	1.89	5
III-30	Nitrite	Initially:		614.44	616.93	615.93	
0	11.11	11.76	12.04	4.23	4.42	4.60	0
1	180.33	229.98	215.22	68.58	86.38	82.19	0.083333
2	107.55	134.84	130.71	40.90	50.65	49.92	0.291666
3	114.81	137.65	132.24	43.66	51.70	50.50	1
4	81.16	98.73	90.29	30.87	37.08	34.48	2
5	43.18	61.25	57.73	16.42	23.01	22.05	3
6	44.47	50.42	48.33	16.91	18.94	18.46	4
7	31.79	40.68	35.63	12.09	15.28	13.61	5
III-30	Nitrate	Initially:		1409.34	1415.05	1412.77	
0	25.68	26.95	25.88	9.77	10.12	9.88	0
1	286.41	351.29	336.79	108.92	131.94	128.62	0.083333
2	185.32	207.34	210.74	70.48	77.88	80.48	0.291666
3	183.75	234.8	221.1	69.88	88.19	84.44	1
4	125.32	147.62	149.3	47.66	55.45	57.02	2
5	82.74	100.94	96.88	31.47	37.91	37.00	3
6	64.68	77.92	71.07	24.60	29.27	27.14	4
7	49.12	53.02	60.49	18.68	19.91	23.10	5

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Added in 106-AN				Newbox Estimate			
Ao =	614.44	616.93	615.93	222	272	261	
Per cent of 106-AN ion leachable:				36%	44%	42%	
Eff. Diffusion Coefficient, sq cm/s:				2.25E-06	2.29E-06	2.39E-06	
Std. Deviation, sq cm/s:				5.66E-07	5.91E-07	6.05E-07	
Leachability Index:				5.648	5.640	5.622	
Upper 95% Confidence Int.:				0.122	0.125	0.123	
Lower 95% Confidence Int.:				0.095	0.097	0.096	
III-30	Nitrate						
				0.00	0.00	0.00	0
1	118.69	142.07	138.50	103.89	122.55	120.41	0.083333
2	189.17	219.94	218.99	178.10	209.84	207.10	0.291666
3	259.05	308.13	303.42	276.57	326.80	322.81	1
4	306.70	363.58	360.44	328.33	388.72	385.15	2
5	338.17	401.49	397.44	348.61	413.23	409.49	3
6	362.77	430.76	424.58	356.57	423.12	419.74	4
7	381.45	450.67	447.68	359.83	426.99	424.01	5

Added in 106-AN				Newbox Estimate			
Ao =	1409.34	1415.05	1412.77	362	430	427	
Per cent of 106-AN ion leachable:				26%	30%	30%	
Eff. Diffusion Coefficient, sq cm/s:				2.33E-06	2.28E-06	2.27E-06	
Std. Deviation, sq cm/s:				5.78E-07	5.40E-07	5.49E-07	
Leachability Index:				5.633	5.642	5.644	
Upper 95% Confidence Int.:				0.120	0.114	0.116	
Lower 95% Confidence Int.:				0.094	0.090	0.092	
III-30	Sulfate						
				0.00	0.00	0.00	0
1	7.95	10.30	9.23	7.48	8.85	8.84	0.083333
2	14.60	16.44	16.45	13.11	15.51	15.58	0.291666
3	20.33	23.74	25.01	21.28	25.09	25.55	1
4	25.29	29.68	31.35	26.55	31.18	32.25	2
5	28.59	33.31	35.23	29.33	34.28	36.00	3
6	30.95	36.20	38.29	30.92	36.04	38.27	4
7	32.97	38.42	40.77	31.81	37.00	39.70	5

Added in 106-AN				Newbox Estimate		
Ao =	52.47	52.68	52.60	33.1	38.3	42.1

L-90

Per cent of 106-AN ion leachable:	63%	73%	80%
Eff. Diffusion Coefficient, sq cm/s:	1.39E-06	1.45E-06	1.19E-06
Std. Deviation, sq cm/s:	2.26E-07	2.57E-07	1.07E-07
Leachability Index:	5.857	5.839	5.924
Upper 95% Confidence Int.:	0.075	0.082	0.040
Lower 95% Confidence Int.:	0.064	0.069	0.036

III-30	Nitrate + Nitrite			0.00	0.00	0.00	0
1	191.49	232.86	225.29	166.14	200.36	196.08	0.083333
2	302.87	361.39	355.69	285.48	343.06	335.74	0.291666
3	416.41	501.28	490.63	444.02	534.28	522.88	1
4	494.94	593.81	582.13	528.84	635.51	621.95	2
5	542.83	654.73	641.18	562.19	675.58	661.17	3
6	584.33	702.93	686.78	575.64	691.75	676.99	4
7	615.10	738.13	723.49	580.91	698.08	683.18	5

	Added in 106-AN			Newbox Estimate		
Ao =	2023.78	2031.98	2028.70	585	703	688

Per cent of 106-AN ion leachable:	29%	35%	34%
Eff. Diffusion Coefficient, sq cm/s:	2.30E-06	2.28E-06	2.31E-06
Std. Deviation, sq cm/s:	5.66E-07	5.59E-07	5.62E-07
Leachability Index:	5.638	5.642	5.636
Upper 95% Confidence Int.:	0.119	0.118	0.117
Lower 95% Confidence Int.:	0.093	0.093	0.092

Run III-30 : Nitrate

Run III-30 : Nitrite

Run III-30 : Nitrate + Nitrite

Run III-30 : Chloride

Run III-30 : Sulfate

ANSI/ANS-16.1-1986 Leaching Data				Phase III: Mixt. Exp't for 106-AN			
Run No.:	III-31			Surrogate 106-AN Concentrations, mg/mL			
Mix Ratio	7.75	lb/gal	Chloride	Nitrite	Nitrate	Sulfate	
			5.32	34.87	79.99	2.98	
Sample Cylinder Dimensions			After Curing 28 d				
	Initially			Batch 1	Batch 2	Batch 3	
	Vol, cc	2.51	Dia., cm	2.51	2.51	2.51	
	23.01	4.65	Length,cm	4.33	4.27	4.28	
	Grout Density, lb/gal			12.80	12.80	12.79	
mL of 106-AN in Sample Cylinder				16.46	16.46	16.45	
Leach Vol + Boric Acid Vol Added, mL				444.8	440.1	440.9	
Leachate Concentrations			Mass in Leachate				
	mg/L			mg			Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
III-31	Chloride	Initially:		87.54	87.54	87.47	
0	1	1	0.73	0.44	0.44	0.32	0
1	18.27	23.26	20.42	8.13	10.24	9.00	0.083333
2	9.8	8.8	6.03	4.36	3.87	2.66	0.291666
3	12.55	9.24	6.77	5.58	4.07	2.98	1
4	5.89	6.96	5.24	2.62	3.06	2.31	2
5	2.4	3.52	4.17	1.07	1.55	1.84	3
6	3.9	3.27	4	1.73	1.44	1.76	4
7	3.12	2.83	0.5	1.39	1.25	0.22	5
III-31	Nitrite	Initially:		574.04	574.04	573.60	
0	4.53	3	5.27	2.01	1.32	2.32	0
1	166.85	191.41	159.94	74.21	84.24	70.52	0.083333
2	72.14	73.73	52.02	32.09	32.45	22.94	0.291666
3	73.19	69.22	49.06	32.55	30.46	21.63	1
4	48.08	49.96	42.83	21.39	21.99	18.88	2
5	26.96	36.16	32.7	11.99	15.91	14.42	3
6	26.01	25.27	27.63	11.57	11.12	12.18	4
7	22.1	23.68	13.41	9.83	10.42	5.91	5
III-31	Nitrate	Initially:		1316.68	1316.68	1315.65	
0	10.04	15.88	11.53	4.47	6.99	5.08	0
1	283.9	323.43	246.61	126.28	142.34	108.73	0.083333
2	125.15	132.6	100.66	55.67	58.36	44.38	0.291666
3	127.57	135.3	83.93	56.74	59.55	37.00	1
4	83.9	101.07	71.56	37.32	44.48	31.55	2
5	55.47	68.18	54.74	24.67	30.01	24.13	3
6	43.19	52.61	39.57	19.21	23.15	17.45	4
7	35.78	41.21	35.72	15.91	18.14	15.75	5

III-31	Sulfate	Initially:		49.02	49.02	48.98	
0	1.8	1.32	2	0.80	0.58	0.88	0
1	20.24	34.4	26.99	9.00	15.14	11.90	0.083333
2	18.22	16.52	15.43	8.10	7.27	6.80	0.291666
3	16.66	18.39	9.34	7.41	8.09	4.12	1
4	10.95	16.16	7.6	4.87	7.11	3.35	2
5	6.93	8.37	4.89	3.08	3.68	2.16	3
6	4.72	6.64	4.5	2.10	2.92	1.98	4
7	4.84	5.35	4.57	2.15	2.35	2.01	5

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)			
Observed				Calculated (NEWBOX)			
				(No Washoff or Washout)			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
III-31	Chloride						
		mg			mg		
0				0.00	0.00	0.00	0
1	8.57	10.68	9.33	7.06	7.63	6.31	0.083333
2	12.93	14.55	11.98	12.14	13.09	10.84	0.291666
3	18.51	18.62	14.97	19.08	20.43	16.83	1
4	21.13	21.68	17.28	22.80	24.33	19.85	2
5	22.20	23.23	19.12	24.26	25.60	20.95	3
6	23.93	24.67	20.88	24.87	26.16	21.36	4
7	25.32	25.91	21.10	25.12	26.37	21.51	5

Added in 106-AN				Newbox Estimate		
Ao =	87.54	87.54	87.47	25.3	26.5	21.6
Per cent of 106-AN ion leachable:				29%	30%	25%
Eff. Diffusion Coefficient, sq cm/s:				2.42E-06	2.58E-06	2.68E-06
Std. Deviation, sq cm/s:				6.54E-07	1.14E-06	1.33E-06
Leachability Index:				5.616	5.588	5.572
Upper 95% Confidence Int.:				0.132	0.244	0.286
Lower 95% Confidence Int.:				0.101	0.155	0.171

III-31	Nitrite			0.00	0.00	0.00	0
1	76.23	85.56	72.84	55.55	56.98	38.69	0.083333
2	108.32	118.01	95.78	95.95	99.00	68.64	0.291666
3	140.87	148.47	117.41	150.89	157.74	115.02	1
4	162.26	170.46	136.29	180.99	192.28	147.68	2
5	174.25	186.37	150.71	193.11	208.34	167.44	3
6	185.82	197.49	162.89	198.36	213.84	180.13	4
7	195.65	207.92	168.80	200.38	217.14	188.66	5

Added in 106-AN				Newbox Estimate			
Ao =	574.04	574.04	573.60	202	220	208	
Per cent of 106-AN ion leachable:				35%	38%	36%	
Eff. Diffusion Coefficient, sq cm/s:				2.36E-06	2.05E-06	9.99E-07	
Std. Deviation, sq cm/s:				9.68E-07	9.79E-07	4.98E-07	
Leachability Index:				5.627	5.688	6.000	
Upper 95% Confidence Int.:				0.221	0.271	0.288	
Lower 95% Confidence Int.:				0.146	0.166	0.172	
III-31	Nitrate						
				0.00	0.00	0.00	0
1	130.74	149.33	113.81	94.52	100.21	68.04	0.083333
2	186.41	207.69	158.19	163.90	174.64	120.20	0.291666
3	243.15	267.23	195.20	259.13	280.98	197.96	1
4	280.47	311.71	226.75	312.94	346.42	250.45	2
5	305.15	341.72	250.89	335.95	379.14	278.96	3
6	324.36	364.87	268.33	345.86	392.23	296.46	4
7	340.27	383.01	284.08	350.46	400.41	306.83	5

Added in 106-AN				Newbox Estimate			
Ao =	1316.68	1316.68	1315.65	354	409	324	
Per cent of 106-AN ion leachable:				27%	31%	25%	
Eff. Diffusion Coefficient, sq cm/s:				2.20E-06	1.81E-06	1.30E-06	
Std. Deviation, sq cm/s:				8.90E-07	7.67E-07	6.17E-07	
Leachability Index:				5.658	5.742	5.886	
Upper 95% Confidence Int.:				0.217	0.230	0.269	
Lower 95% Confidence Int.:				0.144	0.150	0.165	
III-31	Sulfate						
				0.00	0.00	0.00	0
1	9.80	15.72	12.78	9.25	11.93	9.62	0.083333
2	17.91	22.99	19.58	16.09	20.74	16.56	0.291666
3	25.32	31.08	23.70	25.91	33.29	25.91	1
4	30.19	38.20	27.05	31.85	40.95	30.84	2
5	33.27	41.88	29.21	34.70	44.69	32.74	3
6	35.37	44.80	31.19	36.13	46.13	33.49	4
7	37.52	47.16	33.21	36.85	46.99	33.80	5

Added in 106-AN				Newbox Estimate		
Ao =	49.02	49.02	48.98	37.6	47.9	34

Per cent of 106-AN ion leachable:	77%	98%	69%
Eff. Diffusion Coefficient, sq cm/s:	1.83E-06	1.87E-06	2.49E-06
Std. Deviation, sq cm/s:	2.83E-07	5.29E-07	1.14E-06
Leachability Index:	5.738	5.728	5.604
Upper 95% Confidence Int.:	0.071	0.140	0.256
Lower 95% Confidence Int.:	0.061	0.105	0.160

III-31	Nitrate + Nitrite			0.00	0.00	0.00	0
1	206.97	234.89	186.66	144.07	158.00	108.15	0.083333
2	294.73	325.70	253.97	250.84	274.63	191.10	0.291666
3	384.03	415.71	312.61	401.80	439.53	315.53	1
4	442.73	482.17	363.04	491.92	539.22	400.05	2
5	479.40	528.09	401.59	533.82	587.50	447.30	3
6	510.18	562.37	431.22	553.91	605.68	476.18	4
7	535.92	590.93	452.88	564.24	616.34	494.03	5

	Added in 106-AN			Newbox Estimate		
Ao =	1890.73	1890.73	1889.25	574	627	525

Per cent of 106-AN ion leachable:	30%	33%	28%
Eff. Diffusion Coefficient, sq cm/s:	1.93E-06	1.92E-06	1.25E-06
Std. Deviation, sq cm/s:	8.96E-07	8.51E-07	6.07E-07
Leachability Index:	5.714	5.717	5.903
Upper 95% Confidence Int.:	0.261	0.245	0.277
Lower 95% Confidence Int.:	0.162	0.156	0.168

Run III-31 : Nitrate

Run III-31 : Nitrite

Run III-31 : Nitrate + Nitrite

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Run III-31 : Chloride

Run III-31 : Sulfate

ANSI/ANS-16.1-1986 Leaching Data

Phase III: Mixt. Exp't for 106-AN

Run No.: III-32

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio	10 lb/gal	Chloride	Nitrite	Nitrate	Sulfate
		5.32	34.87	79.99	2.98

Sample Cylinder Dimensions

After Curing 28 d

	Initially		Batch 1	Batch 2	Batch 3
Vol, cc	2.51	Dia., cm	2.51	2.51	2.51
23.01	4.65	Length, cm	4.52	4.56	4.56
Grout Density, lb/gal			13.45	13.47	13.42
mL of 106-AN in Sample Cylinder			15.35	15.37	15.32
Leach Vol + Boric Acid Vol Added, mL			460	463.1	463.1

Leachate Concentrations

Mass in Leachate

Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
III-32	Chloride	Initially:		81.64	81.76	81.46	
0	1	1	1	0.46	0.46	0.46	0
1	9.6	13.26	12.6	4.42	6.14	5.84	0.083333
2	18.27	17.89	18.55	8.40	8.28	8.59	0.291666
3	29.98	30.11	30.2	13.79	13.94	13.99	1
4	21.73	24.57	20.15	10.00	11.38	9.33	2
5	14.88	12.21	15.52	6.84	5.65	7.19	3
6	10.69	9.32	8.34	4.92	4.32	3.86	4
7	7.78	4.76	6.21	3.58	2.20	2.88	5
III-32	Nitrite	Initially:		535.34	536.13	534.14	
0	2.11	1.5	2.09	0.97	0.69	0.97	0
1	72.51	77.22	83.62	33.35	35.76	38.72	0.083333
2	129.08	153.8	145.68	59.38	71.22	67.46	0.291666
3	247.54	279.13	254.04	113.87	129.27	117.65	1
4	193.95	212.93	188.92	89.22	98.61	87.49	2
5	118.16	117.74	116.33	54.35	54.53	53.87	3
6	84.97	79.2	76.14	39.09	36.68	35.26	4
7	57.42	53.28	56.1	26.41	24.67	25.98	5
III-32	Nitrate	Initially:		1227.90	1229.72	1225.16	
0	3.9	5.36	5.55	1.79	2.48	2.57	0
1	121.15	125.4	128.59	55.73	58.07	59.55	0.083333
2	202.5	234.42	212.14	93.15	108.56	98.24	0.291666
3	390.19	435.4	401.67	179.49	201.63	186.01	1
4	299.94	346.45	303.12	137.97	160.44	140.37	2
5	195	201.96	187.3	89.70	93.53	86.74	3
6	156.01	143.44	118.67	71.76	66.43	54.96	4
7	110.49	100.97	98.84	50.83	46.76	45.77	5

L-100

III-32	Sulfate	Initially:		45.71	45.78	45.61	
0	2	2	2	0.92	0.93	0.93	0
1	10.27	9.46	11.36	4.72	4.38	5.26	0.083333
2	20.44	15.15	27.93	9.40	7.02	12.93	0.291666
3	38.72	32.31	36.16	17.81	14.96	16.75	1
4	31.91	34.48	28.77	14.68	15.97	13.32	2
5	25.63	19.5	23.88	11.79	9.03	11.06	3
6	25.35	22.68	18.94	11.66	10.50	8.77	4
7	21.49	20.97	17.07	9.89	9.71	7.91	5

Cumulative Amount Leached, mg
Observed

(Adding Rinse to Interval 1)
Calculated (NEWBOX)
(No Washoff or Washout)

Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time
	mg			mg			
III-32	Chloride						
				0.00	0.00	0.00	0
1	4.88	6.60	6.30	8.12	8.75	8.56	0.083333
2	13.28	14.88	14.89	14.85	15.95	15.65	0.291666
3	27.07	28.82	28.87	26.11	27.89	27.47	1
4	37.07	40.20	38.21	35.25	37.55	36.92	2
5	43.91	45.85	45.39	41.62	44.25	43.52	3
6	48.83	50.17	49.26	46.59	49.41	48.66	4
7	52.41	52.37	52.13	50.67	53.58	52.73	5

	Added in 106-AN			Newbox Estimate		
Ao =	81.64	81.76	81.46	81.6	81.8	81.5

Per cent of 106-AN ion leachable:	100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:	2.78E-07	3.23E-07	3.12E-07
Std. Deviation, sq cm/s:	6.14E-08	4.41E-08	4.29E-08
Leachability Index:	6.556	6.491	6.506
Upper 95% Confidence Int.:	0.105	0.062	0.062
Lower 95% Confidence Int.:	0.084	0.054	0.054

III-32	Nitrite			0.00	0.00	0.00	0
1	34.33	36.46	39.69	64.74	73.43	69.95	0.083333
2	93.70	107.68	107.16	117.70	132.39	126.02	0.291666
3	207.57	236.95	224.80	204.91	228.34	218.41	1
4	296.79	335.55	312.29	273.39	302.30	289.96	2
5	351.14	390.08	366.16	319.93	351.08	338.02	3
6	390.23	426.76	401.42	355.24	387.53	373.80	4
7	416.64	451.43	427.40	383.06	415.40	402.10	5

Added in 106-AN				Newbox Estimate			
Ao =	535.34	536.13	534.14	535	536	534	
Per cent of 106-AN ion leachable:				100%	100%	100%	
Eff. Diffusion Coefficient, sq cm/s:				4.18E-07	5.39E-07	4.90E-07	
Std. Deviation, sq cm/s:				1.41E-07	2.06E-07	1.44E-07	
Leachability Index:				6.379	6.268	6.310	
Upper 95% Confidence Int.:				0.172	0.202	0.146	
Lower 95% Confidence Int.:				0.123	0.137	0.109	
III-32	Nitrate						
				0.00	0.00	0.00	0
1	57.52	60.55	62.12	99.22	111.07	102.04	0.083333
2	150.67	169.11	160.36	181.74	202.95	187.43	0.291666
3	330.16	370.75	346.38	324.19	360.39	331.98	1
4	468.13	531.19	486.75	442.08	488.31	452.03	2
5	557.83	624.72	573.49	525.58	579.33	537.78	3
6	629.60	691.14	628.45	591.90	650.67	605.15	4
7	680.42	737.90	674.22	647.16	709.71	661.50	5

Added in 106-AN				Newbox Estimate			
Ao =	1227.90	1229.72	1225.16	1228	1230	1225	
Per cent of 106-AN ion leachable:				100%	100%	100%	
Eff. Diffusion Coefficient, sq cm/s:				1.81E-07	2.28E-07	1.93E-07	
Std. Deviation, sq cm/s:				4.33E-08	6.19E-08	4.17E-08	
Leachability Index:				6.742	6.642	6.714	
Upper 95% Confidence Int.:				0.115	0.133	0.102	
Lower 95% Confidence Int.:				0.091	0.102	0.083	

III-32	Sulfate						
				0.00	0.00	0.00	0
1	5.64	5.31	6.19	11.22	9.69	11.73	0.083333
2	15.05	12.32	19.12	20.23	17.60	21.25	0.291666
3	32.86	27.29	35.87	35.02	30.69	36.55	1
4	47.54	43.25	49.19	46.41	41.14	48.37	2
5	59.33	52.28	60.25	54.06	48.28	56.19	3
6	70.99	62.79	69.02	59.76	53.81	61.88	4
7	80.87	72.50	76.93	64.26	58.14	66.30	5

Added in 106-AN				Newbox Estimate			
Ao =	45.71	45.78	45.61	85	85	85	

Per cent of 106-AN ion leachable:	186%	186%	186%
Eff. Diffusion Coefficient, sq cm/s:	4.95E-07	3.67E-07	5.52E-07
Std. Deviation, sq cm/s:	2.26E-07	1.54E-07	1.96E-07
Leachability Index:	6.305	6.435	6.258
Upper 95% Confidence Int.:	0.255	0.228	0.184
Lower 95% Confidence Int.:	0.159	0.149	0.129

III-32	Nitrate + Nitrite			0.00	0.00	0.00	0
1	91.85	97.01	101.81	163.43	183.66	170.80	0.083333
2	244.38	276.79	267.52	299.71	333.77	311.34	0.291666
3	537.73	607.69	571.18	528.90	588.08	550.57	1
4	764.92	866.74	799.04	715.78	791.17	744.06	2
5	908.97	1014.80	939.65	848.00	934.21	879.50	3
6	1019.82	1117.90	1029.87	952.02	1043.71	985.04	4
7	1097.06	1189.33	1101.62	1036.64	1132.01	1072.99	5

	Added in 106-AN			Newbox Estimate		
Ao =	1763.23	1765.85	1759.30	1763	1766	1759

Per cent of 106-AN ion leachable:	100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:	2.40E-07	3.05E-07	2.65E-07
Std. Deviation, sq cm/s:	6.40E-08	9.11E-08	6.17E-08
Leachability Index:	6.620	6.516	6.577
Upper 95% Confidence Int.:	0.130	0.149	0.111
Lower 95% Confidence Int.:	0.100	0.111	0.089

Run III-32 : Nitrate

Run III-32 : Nitrite

Run III-32 : Nitrate + Nitrite

Run III-32 : Chloride

Run III-32 : Sulfate

ANSI/ANS-16.1-1986 Leaching Data

Phase III: Mixt. Exp't for 106-AN

Run No.: III-33

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio	8.5 lb/gal	Chloride	Nitrite	Nitrate	Sulfate
		5.32	34.87	79.99	2.98

Sample Cylinder Dimensions

After Curing 28 d

Initially		Batch 1	Batch 2	Batch 3
Vol, cc	2.51	2.51	2.51	2.51
23.01	4.65	4.56	4.57	4.52
Grout Density, lb/gal		12.98	13.00	12.98
mL of 106-AN in Sample Cylinder		16.02	16.04	16.02
Leach Vol + Boric Acid Vol Added, mL		463.1	463.9	460

Leachate Concentrations				Mass in Leachate			Time d
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	

III-32	Chloride	Initially:		85.17	85.31	85.17	
0	0.5	0.5	0.5	0.23	0.23	0.23	0
1	19.01	25.4	17.21	8.80	11.78	7.92	0.083333
2	15.32	17.12	16.54	7.09	7.94	7.61	0.291666
3	21.2	20.93	23.91	9.82	9.71	11.00	1
4	15.18	15.46	15.46	7.03	7.17	7.11	2
5	9.82	10	10.32	4.55	4.64	4.75	3
6	7.71	7.34	7.74	3.57	3.41	3.56	4
7	5.12	6.25	6.31	2.37	2.90	2.90	5

III-33	Nitrite	Initially:		558.52	559.38	558.52	
0	1.5	1.5	1.89	0.69	0.70	0.87	0
1	169.39	184.48	144.2	78.44	85.58	66.33	0.083333
2	131.97	138.06	135.52	61.12	64.05	62.34	0.291666
3	175.16	170.41	182.6	81.12	79.05	84.00	1
4	121.2	122.06	133.18	56.13	56.62	61.26	2
5	82.12	62.35	86.53	38.03	28.92	39.80	3
6	63.02	60.62	67.03	29.18	28.12	30.83	4
7	50.02	50.08	53.26	23.16	23.23	24.50	5

III-33	Nitrate	Initially:		1281.07	1283.04	1281.07	
0	4.2	5.25	2.93	1.95	2.44	1.35	0
1	222.04	235.31	189.19	102.83	109.16	87.03	0.083333
2	192.83	183.72	181.96	89.30	85.23	83.70	0.291666
3	242.27	239.4	252.69	112.20	111.06	116.24	1
4	173.65	168.82	189.36	80.42	78.32	87.11	2
5	112.53	90.67	127.65	52.11	42.06	58.72	3
6	85.18	87.14	94.85	39.45	40.42	43.63	4
7	60.23	69.79	77.64	27.89	32.38	35.71	5

III-33	Sulfate	Initially:			47.69	47.77	47.69	
	0	1	2	2	0.46	0.93	0.92	0
	1	21.01	25.02	15.79	9.73	11.61	7.26	0.083333
	2	27	27.6	20.06	12.50	12.80	9.23	0.291666
	3	36.63	34.39	24.99	16.96	15.95	11.50	1
	4	23.59	23.44	22.74	10.92	10.87	10.46	2
	5	15.08	15.73	13.5	6.98	7.30	6.21	3
	6	12.12	11.77	14.26	5.61	5.46	6.56	4
	7	9.06	9.49	8.41	4.20	4.40	3.87	5

Cumulative Amount Leached, mg Observed				(Adding Rinse to Interval 1) Calculated (NEWBOX) (No Washoff or Washout)				Time d
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3		
III-33	Chloride							
				0.00	0.00	0.00	0	
1	9.04	12.02	8.15	8.81	10.75	8.62	0.083333	
2	16.13	19.96	15.76	15.64	18.88	15.41	0.291666	
3	25.95	29.67	26.75	26.19	30.78	26.16	1	
4	32.98	36.84	33.87	33.63	38.53	34.10	2	
5	37.52	41.48	38.61	38.06	42.59	38.98	3	
6	41.10	44.88	42.17	40.93	44.84	42.40	4	
7	43.47	47.78	45.08	42.91	46.08	44.84	5	

	Added in 106-AN			Newbox Estimate		
Ao =	85.17	85.31	85.17	47.1	47.8	51.9

Per cent of 106-AN ion leachable:	55%	56%	61%
Eff. Diffusion Coefficient, sq cm/s:	1.04E-06	1.54E-06	8.08E-07
Std. Deviation, sq cm/s:	4.74E-08	2.21E-07	3.60E-08
Leachability Index:	5.983	5.812	6.093
Upper 95% Confidence Int.:	0.020	0.065	0.019
Lower 95% Confidence Int.:	0.019	0.057	0.018

III-33	Nitrite						
				0.00	0.00	0.00	0
1	79.14	86.28	67.20	76.18	81.18	69.93	0.083333
2	140.25	150.32	129.54	135.30	142.80	125.27	0.291666
3	221.37	229.38	213.54	224.37	233.95	212.78	1
4	277.50	286.00	274.80	285.01	293.72	277.13	2
5	315.53	314.92	314.60	319.88	325.46	317.89	3
6	344.71	343.04	345.44	341.10	343.54	346.63	4
7	367.88	366.28	369.94	354.74	354.24	367.22	5

Added in 106-AN				Newbox Estimate			
Ao =	558.52	559.38	558.52	379	369	429	
Per cent of 106-AN ion leachable:				68%	66%	77%	
Eff. Diffusion Coefficient, sq cm/s:				1.22E-06	1.48E-06	7.75E-07	
Std. Deviation, sq cm/s:				7.06E-08	1.53E-07	3.01E-08	
Leachability Index:				5.914	5.830	6.111	
Upper 95% Confidence Int.:				0.025	0.046	0.017	
Lower 95% Confidence Int.:				0.024	0.042	0.016	
III-33	Nitrate						
				0.00	0.00	0.00	0
1	104.77	111.60	88.38	104.03	106.81	92.37	0.083333
2	194.07	196.82	172.08	184.88	188.86	166.89	0.291666
3	306.27	307.88	288.31	308.31	312.18	286.01	1
4	386.68	386.20	375.42	394.55	395.26	376.47	2
5	438.80	428.26	434.14	444.67	441.70	435.71	3
6	478.24	468.68	477.77	477.02	470.08	479.02	4
7	506.14	501.06	513.48	497.50	487.10	512.15	5

Added in 106-AN				Newbox Estimate			
Ao =	1281.07	1283.04	1281.07	539	516	637	
Per cent of 106-AN ion leachable:				42%	40%	50%	
Eff. Diffusion Coefficient, sq cm/s:				1.13E-06	1.30E-06	6.09E-07	
Std. Deviation, sq cm/s:				6.09E-08	1.09E-07	1.97E-08	
Leachability Index:				5.947	5.886	6.215	
Upper 95% Confidence Int.:				0.023	0.037	0.014	
Lower 95% Confidence Int.:				0.022	0.034	0.013	
III-33	Sulfate						
				0.00	0.00	0.00	0
1	10.19	12.53	8.18	11.98	13.41	8.90	0.083333
2	22.70	25.34	17.41	21.71	23.99	16.29	0.291666
3	39.66	41.29	28.91	37.48	40.61	28.73	1
4	50.58	52.17	39.37	49.74	52.68	38.95	2
5	57.57	59.46	45.58	57.84	60.13	46.18	3
6	63.18	64.92	52.14	63.97	65.23	51.86	4
7	67.38	69.33	56.01	68.66	68.84	56.49	5

Added in 106-AN				Newbox Estimate		
Ao =	47.69	47.77	47.69	90.1	78.4	96.4

Per cent of 106-AN ion leachable:	189%	164%	202%
Eff. Diffusion Coefficient, sq cm/s:	5.09E-07	8.68E-07	2.38E-07
Std. Deviation, sq cm/s:	5.09E-08	5.35E-08	1.29E-08
Leachability Index:	6.293	6.061	6.623
Upper 95% Confidence Int.:	0.044	0.027	0.023
Lower 95% Confidence Int.:	0.040	0.025	0.022

III-33 Nitrate + Nitrite

				0.00	0.00	0.00	0
1	183.91	197.87	155.58	180.03	187.41	162.18	0.083333
2	334.33	347.15	301.62	319.23	331.50	291.50	0.291666
3	527.64	537.26	501.85	532.67	545.43	498.20	1
4	664.18	672.20	650.22	680.22	688.64	654.02	2
5	754.33	743.18	748.74	766.53	767.31	753.66	3
6	822.96	811.73	823.21	822.21	813.28	824.68	4
7	874.01	867.34	833.42	857.47	840.68	877.68	5

	Added in 106-AN			Newbox Estimate		
Ao =	1839.59	1842.42	1839.59	928	884	1060

Per cent of 106-AN ion leachable:	50%	48%	58%
Eff. Diffusion Coefficient, sq cm/s:	1.13E-06	1.37E-06	6.81E-07
Std. Deviation, sq cm/s:	6.77E-08	1.26E-07	2.31E-08
Leachability Index:	5.947	5.863	6.167
Upper 95% Confidence Int.:	0.026	0.041	0.015
Lower 95% Confidence Int.:	0.025	0.037	0.014

Run III-33 : Nitrate

Run III-33 : Nitrite

Run III-33 : Nitrate + Nitrite

Run III-33 : Chloride

Run III-33 : Sulfate

ANSI/ANS-16.1-1986 Leaching Data Phase III: Mixt. Exp't for 106-AN

Run No.: III-34 Surrogate 106-AN Concentrations, mg/mL

Mix Ratio	6 lb/gal	Chloride	Nitrite	Nitrate	Sulfate
		5.32	34.87	79.99	2.98

Sample Cylinder Dimensions After Curing 28 d

	Initially		Batch 1	Batch 2	Batch 3
Vol, cc	2.51	Dia., cm	2.51	2.51	2.51
23.01	4.65	Length, cm	3.63	3.63	3.58
Grout Density, lb/gal			13.15	13.15	13.15
mL of 106-AN in Sample Cylinder			18.76	18.76	18.76
Leach Vol + Boric Acid Vol Added, mL			389.1	389.1	385.2

Leachate Concentrations				Mass in Leachate			Time d
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	

III-34	Chloride	Initially:		99.77	99.77	99.77	
0	0.5	1	1.29	0.19	0.39	0.50	0
1	22.28	32.67	22.86	8.67	12.71	8.81	0.083333
2	22	22.09	24.59	8.56	8.60	9.47	0.291666
3	21.65	21.08	18.32	8.42	8.20	7.06	1
4	9.88	12.81	11.56	3.84	4.98	4.45	2
5	4.2	1.61	3.56	1.63	0.63	1.37	3
6	0.5	0.5	0.5	0.19	0.19	0.19	4
7	0.5	0.5	0.5	0.19	0.19	0.19	5

III-34	Nitrite	Initially:		654.24	654.24	654.24	
0	6.49	3	7.39	2.53	1.17	2.85	0
1	351.42	422.42	322.23	136.74	164.36	124.12	0.083333
2	270.48	288.13	254.79	105.24	112.11	98.15	0.291666
3	295.46	334.25	295.81	114.96	130.06	113.95	1
4	109.99	123.7	115.29	42.80	48.13	44.41	2
5	16.61	16.23	17.56	6.46	6.32	6.76	3
6	1.94	1.72	1.32	0.75	0.67	0.51	4
7	1.5	1.5	3	0.58	0.58	1.16	5

III-34	Nitrate	Initially:		1500.64	1500.64	1500.64	
0	20.97	18.27	17.64	8.16	7.11	6.79	0
1	614.46	660.73	576.4	239.09	257.09	222.03	0.083333
2	467.11	511.17	484	181.75	198.90	186.44	0.291666
3	549.63	616.94	599.01	213.86	240.05	230.74	1
4	224.93	251.01	228.79	87.52	97.67	88.13	2
5	43.6	48.46	41.57	16.96	18.86	16.01	3
6	8.98	7.67	4.18	3.49	2.98	1.61	4
7	1.59	1.49	2.5	0.62	0.58	0.96	5

III-34	Sulfate	Initially:			55.87	55.87	55.87	
	0	2	2	2	0.78	0.78	0.77	0
	1	49.33	56.13	44.81	19.19	21.84	17.26	0.083333
	2	45.51	39.66	38.65	17.71	15.43	14.89	0.291666
	3	69.01	76.55	56.16	26.85	29.79	21.63	1
	4	40.7	48.96	50.05	15.84	19.05	19.28	2
	5	24.58	27.37	26.19	9.56	10.65	10.09	3
	6	12.5	11.35	11.4	4.86	4.42	4.39	4
	7	4.76	5.22	5.16	1.85	2.03	1.99	5

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)			
Observed				Calculated (NEWBOX)			
				(No Washoff or Washout)			
		mg			mg		Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
III-34	Chloride						
				0.00	0.00	0.00	0
1	8.86	13.10	9.30	9.73	12.78	10.21	0.083333
2	17.42	21.70	18.77	16.58	21.35	17.29	0.291666
3	25.85	29.90	25.83	25.41	31.17	26.21	1
4	29.69	34.88	30.28	29.73	34.70	30.30	2
5	31.33	35.51	31.66	31.20	35.49	31.59	3
6	31.52	35.70	31.85	31.71	35.66	32.01	4
7	31.72	35.90	32.04	31.90	35.69	32.14	5

Added in 106-AN				Newbox Estimate		
Ao =	99.77	99.77	99.77	32	35.7	32.2

Per cent of 106-AN ion leachable:	32%	36%	32%
Eff. Diffusion Coefficient, sq cm/s:	2.71E-06	3.94E-06	2.95E-06
Std. Deviation, sq cm/s:	3.24E-07	3.48E-07	4.52E-07
Leachability Index:	5.567	5.405	5.530
Upper 95% Confidence Int.:	0.054	0.039	0.070
Lower 95% Confidence Int.:	0.048	0.036	0.060

III-34	Nitrite							
				0.00	0.00	0.00	0	
1	139.26	165.53	126.97	144.20	166.94	132.33	0.083333	
2	244.51	277.64	225.11	241.02	278.54	223.18	0.291666	
3	359.47	407.70	339.06	355.14	406.41	332.59	1	
4	402.27	455.83	383.47	398.40	452.45	378.02	2	
5	408.73	462.15	390.23	408.70	462.21	390.26	3	
6	409.48	462.81	390.74	411.18	464.54	393.42	4	
7	410.07	463.40	391.90	411.79	464.86	394.61	5	

Added in 106-AN				Newbox Estimate			
Ao =	654.24	654.24	654.24	412	465	395	
Per cent of 106-AN ion leachable:				63%	71%	60%	
Eff. Diffusion Coefficient, sq cm/s:				3.72E-06	3.95E-06	3.36E-06	
Std. Deviation, sq cm/s:				2.06E-07	8.39E-08	2.23E-07	
Leachability Index:				5.429	5.403	5.474	
Upper 95% Confidence Int.:				0.024	0.009	0.029	
Lower 95% Confidence Int.:				0.023	0.009	0.027	
III-34	Nitrate						
				0.00	0.00	0.00	0
1	247.25	264.20	228.82	253.26	273.40	244.48	0.083333
2	429.00	463.10	415.26	426.38	461.21	413.32	0.291666
3	642.36	703.15	646.00	636.55	692.22	625.72	1
4	730.38	800.81	734.13	723.49	791.11	721.22	2
5	747.34	819.67	750.14	746.93	819.37	750.25	3
6	750.84	822.65	751.75	753.73	827.68	759.42	4
7	751.46	823.23	752.72	755.24	830.17	762.47	5

Added in 106-AN				Newbox Estimate			
Ao =	1500.64	1500.64	1500.64	756	831	764	
Per cent of 106-AN ion leachable:				50%	55%	51%	
Eff. Diffusion Coefficient, sq cm/s:				3.37E-06	3.23E-06	3.01E-06	
Std. Deviation, sq cm/s:				1.35E-07	1.79E-07	2.95E-07	
Leachability Index:				5.472	5.491	5.521	
Upper 95% Confidence Int.:				0.017	0.024	0.043	
Lower 95% Confidence Int.:				0.017	0.023	0.040	
III-34	Sulfate						
				0.00	0.00	0.00	0
1	19.97	22.62	18.03	21.42	22.77	18.69	0.083333
2	37.68	38.05	32.92	37.91	40.25	33.29	0.291666
3	64.53	67.84	54.55	62.58	66.70	55.86	1
4	80.37	86.89	73.83	79.28	84.87	71.93	2
5	89.93	97.54	83.92	88.73	95.34	81.69	3
6	94.80	101.95	88.31	94.61	102.01	88.41	4
7	96.65	103.98	90.30	98.28	106.38	93.03	5

Added in 106-AN				Newbox Estimate		
Ao =	55.87	55.87	55.87	105	115	105

Per cent of 106-AN ion leachable:	188%	206%	188%
Eff. Diffusion Coefficient, sq cm/s:	1.14E-06	1.06E-06	8.38E-07
Std. Deviation, sq cm/s:	7.70E-08	7.64E-08	5.52E-08
Leachability Index:	5.943	5.975	6.077
Upper 95% Confidence Int.:	0.029	0.032	0.029
Lower 95% Confidence Int.:	0.028	0.029	0.027

III-34 Nitrate + Nitrite

				0.00	0.00	0.00	0
1	386.51	429.73	355.79	398.63	440.64	376.68	0.083333
2	673.50	740.74	640.38	668.67	740.02	636.29	0.291666
3	1002.33	1110.85	985.06	993.65	1099.01	958.49	1
4	1132.65	1256.65	1117.60	1123.41	1245.46	1099.89	2
5	1156.07	1281.82	1140.38	1157.31	1283.04	1141.62	3
6	1160.32	1285.47	1142.50	1165.49	1292.11	1153.21	4
7	1161.53	1286.63	1144.61	1167.83	1294.70	1157.84	5

	Added in 106-AN			Newbox Estimate		
Ao =	2154.88	2154.88	2154.88	1169	1296	1159

Per cent of 106-AN ion leachable:	54%	60%	54%
Eff. Diffusion Coefficient, sq cm/s:	3.50E-06	3.48E-06	3.13E-06
Std. Deviation, sq cm/s:	1.51E-07	1.41E-07	2.73E-07
Leachability Index:	5.456	5.458	5.504
Upper 95% Confidence Int.:	0.019	0.017	0.038
Lower 95% Confidence Int.:	0.018	0.017	0.035

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Run III-34 : Nitrate

Run III-34 : Nitrite

Run III-34 : Nitrate + Nitrite

Run III-34 : Chloride

Run III-34 : Sulfate

ANSI/ANS-16.1-1986 Leaching Data				Phase III: Mixt. Exp't for 106-AN			
Run No.:	III-35			Surrogate 106-AN Concentrations, mg/mL			
Mix Ratio	9.5 lb/gal		Chloride	Nitrite	Nitrate	Sulfate	
			5.32	34.87	79.99	2.98	
Sample Cylinder Dimensions				After Curing 28 d			
	Initially			Batch 1	Batch 2	Batch 3	
	Vol, cc	2.51	Dia., cm	2.51	2.51	2.51	
	23.01	4.65	Length,cm	4.57	4.53	4.34	
	Grout Density, lb/gal			14.02	14.00	14.01	
mL of 106-AN in Sample Cylinder				16.41	16.39	16.40	
Leach Vol + Boric Acid Vol Added, mL				463.9	458.4	460.8	
Leachate Concentrations				Mass in Leachate			
		mg/L			mg		Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
III-35	Chloride	Initially:		87.28	87.16	87.22	
0	0.87	0.83	0.88	0.40	0.38	0.41	0
1	16.22	15.25	16.51	7.52	6.99	7.61	0.083333
2	15.66	15	17.16	7.26	6.88	7.91	0.291666
3	19.18	22.36	18	8.90	10.25	8.29	1
4	16.74	16.97	15.85	7.77	7.78	7.30	2
5	10.38	10	9.41	4.82	4.58	4.34	3
6	4.77	7.05	5.46	2.21	3.23	2.52	4
7	0.97	1	2.62	0.45	0.46	1.21	5
III-35	Nitrite	Initially:		572.33	571.51	571.92	
0	6.35	8.7	6.45	2.95	3.99	2.97	0
1	243.56	215.93	202.14	112.99	98.98	93.15	0.083333
2	231.32	169.26	232.48	107.31	77.59	107.13	0.291666
3	288.03	265.76	296.03	133.62	121.82	136.41	1
4	214.95	189.72	204.43	99.72	86.97	94.20	2
5	107.23	84.04	110.1	49.74	38.52	50.73	3
6	54.35	53.36	58.12	25.21	24.46	26.78	4
7	20.22	16.01	23.84	9.38	7.34	10.99	5
III-35	Nitrate	Initially:		1312.75	1310.88	1311.82	
0	14.7	18.44	15.94	6.82	8.45	7.35	0
1	500.36	450.74	400.71	232.12	206.62	184.65	0.083333
2	477.6	418.74	457.23	221.56	191.95	210.69	0.291666
3	599.46	536.21	574.55	278.09	245.80	264.75	1
4	444.81	401.99	431.64	206.35	184.27	198.90	2
5	193.5	205.59	226.86	89.76	94.24	104.54	3
6	121.51	107.78	126.96	56.37	49.41	58.50	4
7	43.61	52.78	70.8	20.23	24.19	32.62	5

III-35	Sulfate	Initially:		48.87	48.80	48.84	
0	2	1.45	2	0.93	0.66	0.92	0
1	42	32.49	29.24	19.48	14.89	13.47	0.083333
2	48.28	37.72	49.01	22.40	17.29	22.58	0.291666
3	74.14	54.72	55.92	34.39	25.08	25.77	1
4	60.67	48.9	64.09	28.14	22.42	29.53	2
5	32.59	36.77	25.38	15.12	16.86	11.70	3
6	10	15.79	24.14	4.64	7.24	11.12	4
7	22.9	13.85	9.66	10.62	6.35	4.45	5

Cumulative Amount Leached, mg Observed				(Adding Rinse to Interval 1) Calculated (NEWBOX) (No Washoff or Washout)			Time d
Interval	Batch 1	Batch 2 mg	Batch 3	Batch 1	Batch 2 mg	Batch 3	
III-35	Chloride						
				0.00	0.00	0.00	0
1	7.93	7.37	8.01	8.32	7.97	8.75	0.083333
2	15.19	14.25	15.92	14.74	14.28	15.40	0.291666
3	24.09	24.50	24.22	24.68	24.30	25.23	1
4	31.86	32.28	31.52	31.64	31.64	31.60	2
5	36.67	36.86	35.85	35.77	36.28	34.97	3
6	38.88	40.09	38.37	38.46	39.56	36.91	4
7	39.33	40.55	39.58	40.26	41.91	38.02	5

	Added in 106-AN			Newbox Estimate		
Ao =	67.28	87.16	87.22	44	48.9	39.6

Per cent of 106-AN ion leachable:	50%	56%	45%
Eff. Diffusion Coefficient, sq cm/s:	1.06E-06	7.79E-07	1.47E-06
Std. Deviation, sq cm/s:	7.01E-08	5.28E-08	1.69E-07
Leachability Index:	5.975	6.108	5.833
Upper 95% Confidence Int.:	0.029	0.030	0.051
Lower 95% Confidence Int.:	0.027	0.028	0.046

III-35	Nitrite						
				0.00	0.00	0.00	0
1	115.93	102.97	96.12	123.63	104.37	111.15	0.083333
2	223.24	180.56	203.25	217.93	184.24	197.73	0.291666
3	356.86	302.38	339.66	358.23	302.82	329.94	1
4	456.58	389.35	433.86	451.38	381.71	422.37	2
5	506.32	427.88	484.59	501.98	425.32	477.36	3
6	531.53	452.34	511.37	531.30	450.80	512.46	4
7	540.91	459.67	522.36	548.55	466.48	535.86	5

Added in 106-AN				Newbox Estimate			
Ao =	572.33	571.51	571.92	575	490	585	
Per cent of 106-AN ion leachable:				100%	86%	102%	
Eff. Diffusion Coefficient, sq cm/s:				1.41E-06	1.37E-06	1.06E-06	
Std. Deviation, sq cm/s:				8.07E-08	5.08E-08	1.18E-07	
Leachability Index:				5.851	5.863	5.975	
Upper 95% Confidence Int.:				0.025	0.016	0.050	
Lower 95% Confidence Int.:				0.024	0.015	0.045	
III-35	Nitrate						
				0.00	0.00	0.00	0
1	238.94	215.07	191.99	255.50	225.57	219.49	0.083333
2	460.49	407.02	402.68	450.05	399.00	390.74	0.291666
3	738.58	652.82	667.44	738.36	656.49	654.86	1
4	944.93	837.09	866.34	928.22	827.79	844.20	2
5	1034.70	931.34	970.87	1029.02	922.49	957.56	3
6	1091.06	980.74	1029.38	1087.62	977.82	1033.54	4
7	1111.30	1004.94	1062.00	1122.78	1011.86	1085.40	5

Added in 106-AN				Newbox Estimate			
Ao =	1312.75	1310.88	1311.82	1172	1064	1206	
Per cent of 106-AN ion leachable:				89%	81%	92%	
Eff. Diffusion Coefficient, sq cm/s:				1.45E-06	1.36E-06	9.62E-07	
Std. Deviation, sq cm/s:				8.64E-08	6.43E-08	9.27E-08	
Leachability Index:				5.839	5.866	6.017	
Upper 95% Confidence Int.:				0.026	0.020	0.043	
Lower 95% Confidence Int.:				0.024	0.020	0.039	
III-35	Sulfate						
				0.00	0.00	0.00	0
1	20.41	15.56	14.40	23.32	17.08	19.20	0.083333
2	42.81	32.85	36.98	42.61	31.55	35.25	0.291666
3	77.20	57.93	62.75	74.17	56.58	62.51	1
4	105.35	80.35	92.28	99.29	77.79	85.30	2
5	120.47	97.20	103.97	116.38	93.30	101.52	3
6	125.10	104.44	115.10	129.44	105.54	114.21	4
7	135.73	110.79	119.55	139.90	116.14	124.79	5

Added in 106-AN				Newbox Estimate		
Ao =	48.87	48.80	48.84	201	272	235

Per cent of 106-AN ion leachable:	411%	557%	481%
Eff. Diffusion Coefficient, sq cm/s:	3.86E-07	1.08E-07	1.82E-07
Std. Deviation, sq cm/s:	3.98E-08	8.36E-09	2.36E-08
Leachability Index:	6.413	6.967	6.740
Upper 95% Confidence Int.:	0.046	0.034	0.058
Lower 95% Confidence Int.:	0.041	0.031	0.052

III-35	Nitrate + Nitrite			0.00	0.00	0.00	0
1	354.87	318.04	288.11	380.19	330.79	331.45	0.082003
2	683.74	587.58	605.93	669.70	583.93	589.84	0.291666
3	1095.44	955.20	1007.09	1096.98	959.75	987.23	1
4	1401.51	1226.44	1300.19	1379.50	1211.34	1268.78	2
5	1541.02	1359.21	1455.46	1531.23	1348.00	1436.29	3
6	1622.60	1433.08	1540.75	1618.43	1430.31	1546.78	4
7	1652.21	1464.61	1584.36	1669.01	1478.46	1619.84	5

	Added in 106-AN			Newbox Estimate		
Ao =	1885.08	1882.39	1883.74	1744	1553	1782

Per cent of 106-AN ion leachable:	93%	83%	95%
Eff. Diffusion Coefficient, sq cm/s:	1.45E-06	1.37E-06	1.03E-06
Std. Deviation, sq cm/s:	8.54E-08	5.68E-08	1.06E-07
Leachability Index:	5.839	5.863	5.987
Upper 95% Confidence Int.:	0.026	0.018	0.046
Lower 95% Confidence Int.:	0.024	0.017	0.041

Run III-35 : Nitrate

Run III-35 : Nitrite

Run III-35 : Nitrate + Nitrite

Run III-35 : Chloride

Run III-35 : Sulfate

Appendix M
LEACH DATA FOR PHASE III

Appendix M
LEACH DATA FOR PHASE III

ANSI/ANS-16.1-1986 Leaching Data				Phase II: Additives for 106-AN			
Run No.:	T2-AD44			Surrogate 106-AN Concentrations, mg/mL			
Mix Ratio	15	lb/gal	Chloride	Nitrite	Nitrate	Sulfate	
			5.32	34.87	79.99	2.98	
Sample Cylinder Dimensions				After Curing 28 d			
	Initially			Batch 1	Batch 2	Batch 3	
Vol, cc	2.50	Dia., cm		2.44	2.39	2.28	
	22.83	4.65	Length, cm	4.11	4.44	4.23	
Grout Density, lb/gal				12.45	12.44	12.45	
mL of 106-AN in Sample Cylinder				11.28	11.27	11.28	
Leach Vol + Boric Acid Vol Added, mL				412.8	427.3	388.8	
Leachate Concentrations				Mass in Leachate			Time d
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	
	mg/L			mg			
T2-AD44	Chloride	Initially:		59.97	59.93	59.97	
0	9.04	7.55	8.5	3.73	3.23	3.30	0
1	57.98	39.58	33.83	23.93	16.91	13.15	0.083333
2	7.92	16.32	2.99	3.27	6.97	1.16	0.291666
3	2.7	5.49	3.57	1.11	2.35	1.39	1
4	0.5	0.5	0.5	0.21	0.21	0.19	2
5	0.5	0.5	0.5	0.21	0.21	0.19	3
6	0.5	0.5	0.5	0.21	0.21	0.19	4
7	0.5	0.5	0.5	0.21	0.21	0.19	5
T2-AD44	Nitrite	Initially:		393.27	392.96	393.27	
0	38.21	33.81	46.13	15.77	14.45	17.94	0
1	248.65	275.61	255.07	102.64	117.77	99.17	0.083333
2	66.07	142.02	88.95	27.27	60.69	34.58	0.291666
3	5.25	48.89	8.61	2.17	20.89	3.35	1
4	1.5	1.5	1.5	0.62	0.64	0.58	2
5	1.5	1.5	1.5	0.62	0.64	0.58	3
6	1.5	1.5	1.5	0.62	0.64	0.58	4
7	1.5	1.5	1.5	0.62	0.64	0.58	5
T2-AD44	Nitrate	Initially:		902.05	901.33	902.05	
0	73.43	63.72	73.22	30.31	27.23	28.47	0
1	640.03	644.96	637.32	264.20	275.59	247.79	0.083333
2	136.21	272.2	172.91	56.23	116.31	67.23	0.291666
3	8.4	82.56	11.6	3.47	35.28	4.51	1
4	2.5	2.5	2.5	1.03	1.07	0.97	2
5	2.5	2.5	2.5	1.03	1.07	0.97	3
6	2.5	2.5	2.5	1.03	1.07	0.97	4
7	2.5	2.5	2.5	1.03	1.07	0.97	5

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T2-AD44	Sulfate	Initially:		33.58	33.56	33.58	
0	10.85	6.1	8.08	4.48	2.61	3.14	0
1	57.2	45.47	15.09	23.61	19.43	5.87	0.083333
2	23.49	31.11	29.61	9.70	13.29	11.51	0.291666
3	2.87	21.54	4.23	1.18	9.20	1.64	1
4	1	1	1	0.41	0.43	0.39	2
5	1	1	1	0.41	0.43	0.39	3
6	1	1	1	0.41	0.43	0.39	4
7	1	1	1	0.41	0.43	0.39	5

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)			
Observed				Calculated (NEWBOX)			
				(No Washoff or Washout)			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
T2-AD44	Chloride						
				0.00	0.00	0.00	0
1	27.67	20.14	16.46	27.53	19.82	16.31	0.083333
2	30.94	27.11	17.62	32.07	27.77	19.02	0.291666
3	32.05	29.46	19.01	32.20	29.79	19.10	1
4	32.26	29.67	19.20	32.20	29.80	19.10	2
5	32.46	29.89	19.40	32.20	29.80	19.10	3
6	32.67	30.10	19.59	32.20	29.80	19.10	4
7	32.88	30.31	19.79	32.20	29.80	19.10	5

Added in 106-AN				Newbox Estimate		
Ao =	59.97	59.93	59.97	32.2	29.8	19.1

Per cent of 106-AN ion leachable:	54%	50%	32%
Eff. Diffusion Coefficient, sq cm/s:	4.30E-05	1.85E-05	3.84E-05
Std. Deviation, sq cm/s:	7.67E-06	1.83E-06	1.36E-05
Leachability Index:	4.367	4.732	4.416
Upper 95% Confidence Int.:	0.083	0.044	0.184
Lower 95% Confidence Int.:	0.069	0.040	0.129

T2-AD44	Nitrite			0.00	0.00	0.00	0
1	118.42	132.22	117.11	118.31	132.23	116.84	0.083333
2	145.69	192.90	151.69	146.91	192.64	151.79	0.291666
3	147.86	213.79	155.04	149.00	214.57	156.00	1
4	148.48	214.43	155.62	149.00	215.00	156.00	2
5	149.10	215.07	156.20	149.00	215.00	156.00	3
6	149.71	215.71	156.79	149.00	215.00	156.00	4
7	150.33	216.35	157.37	149.00	215.00	156.00	5

M-5

Added in 106-AN				Newbox Estimate			
Ao =	393.27	392.96	393.27	149	215	156	
Per cent of 106-AN ion leachable:				38%	55%	40%	
Eff. Diffusion Coefficient, sq cm/s:				3.25E-05	1.49E-05	2.42E-05	
Std. Deviation, sq cm/s:				1.71E-06	3.25E-07	9.12E-07	
Leachability Index:				4.488	4.827	4.617	
Upper 95% Confidence Int.:				0.023	0.009	0.016	
Lower 95% Confidence Int.:				0.022	0.009	0.016	
T2-AD44 Nitrate							
				0.00	0.00	0.00	0
1	294.52	302.82	276.26	294.41	300.50	276.15	0.083333
2	350.74	419.13	343.49	353.15	423.62	344.75	0.291666
3	354.21	454.41	348.00	356.00	455.77	350.00	1
4	355.24	455.48	348.97	356.00	456.00	350.00	2
5	356.28	456.54	349.94	356.00	456.00	350.00	3
6	357.31	457.61	350.91	356.00	456.00	350.00	4
7	358.34	458.68	351.88	356.00	456.00	350.00	5

Added in 106-AN				Newbox Estimate			
Ao =	902.05	901.33	902.05	356	456	350	
Per cent of 106-AN ion leachable:				39%	51%	39%	
Eff. Diffusion Coefficient, sq cm/s:				3.77E-05	1.81E-05	2.87E-05	
Std. Deviation, sq cm/s:				1.61E-06	6.85E-07	9.04E-07	
Leachability Index:				4.424	4.742	4.542	
Upper 95% Confidence Int.:				0.018	0.016	0.014	
Lower 95% Confidence Int.:				0.018	0.016	0.013	
T2-AD44 Sulfate							
				0.00	0.00	0.00	0
1	28.09	22.04	9.01	28.06	22.21	10.72	0.083333
2	37.79	35.33	20.52	37.97	35.07	17.15	0.291666
3	38.97	44.53	22.17	39.80	44.60	22.51	1
4	39.39	44.96	22.55	39.80	45.55	23.25	2
5	39.80	45.39	22.94	39.80	45.60	23.30	3
6	40.21	45.82	23.33	39.80	45.60	23.30	4
7	40.62	46.24	23.72	39.80	45.60	23.30	5

Added in 106-AN				Newbox Estimate		
Ao =	33.58	33.56	33.58	39.8	45.6	23.3

M-6

Per cent of 106-AN ion leachable:	119%	136%	69%
Eff. Diffusion Coefficient, sq cm/s:	2.22E-05	8.20E-06	6.48E-06
Std. Deviation, sq cm/s:	2.15E-06	4.10E-07	2.81E-06
Leachability Index:	4.654	5.086	5.188
Upper 95% Confidence Int.:	0.043	0.022	0.238
Lower 95% Confidence Int.:	0.039	0.021	0.153

T2-AD44 Nitrate + Nitrite

				0.00	0.00	0.00	0
1	412.93	435.03	393.36	412.59	432.80	393.16	0.083333
2	496.43	612.03	495.18	499.95	616.65	496.89	0.291666
3	502.07	668.20	503.03	505.00	670.33	506.00	1
4	503.72	669.91	504.59	505.00	671.00	506.00	2
5	505.37	671.62	506.14	505.00	671.00	506.00	3
6	507.02	673.33	507.70	505.00	671.00	506.00	4
7	508.67	675.04	509.25	505.00	671.00	506.00	5

	Added in 106-AN			Newbox Estimate		
Ao =	1295.33	1294.29	1295.33	505	671	506

Per cent of 106-AN ion leachable:	39%	52%	39%
Eff. Diffusion Coefficient, sq cm/s:	3.61E-05	1.70E-05	2.72E-05
Std. Deviation, sq cm/s:	1.66E-06	5.24E-07	9.21E-07
Leachability Index:	4.443	4.770	4.566
Upper 95% Confidence Int.:	0.020	0.013	0.015
Lower 95% Confidence Int.:	0.019	0.013	0.014

M-7

T2/AD44 : Nitrate

T2/AD44 : Nitrite

T2/AD44 : Nitrate + Nitrite

T2/AD44 : Chloride

T2/AD44 : Sulfate

M-9

ANSI/ANS-16.1-1986 Leaching Data

Phase II: Additives for 106-AN

Run No.: T2/CL58 Surrogate 106-AN Concentrations, mg/mL
 Mix Ratio 2 lb/gal Chloride Nitrite Nitrate Sulfate
 5.32 34.87 79.99 2.98

Sample Cylinder Dimensions

After Curing 28 d

	Initially		Batch 1	Batch 2	Batch 3
Vol, cc	2.50	Dia., cm	2.44	2.44	2.44
22.83	4.65	Length, cm	3.97	3.33	4.11
Grout Density, lb/gal			11.00	11.10	11.00
mL of 106-AN in Sample Cylinder			20.76	20.95	20.76
Leach Vol + Boric Acid Vol Added, mL			401.9	352.9	412.7

Leachate Concentrations

Mass in Leachate

Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
T2/CL58	Chloride	Initially:		110.39	111.40	110.39	
0	3.1	5	5	1.25	1.76	2.06	0
1	51.93	50.6	56.54	20.87	17.86	23.33	0.083333
2	44.27	42.98	45.62	17.79	15.17	18.83	0.291666
3	42.26	37.06	42.19	16.98	13.08	17.41	1
4	3.94	2.67	2.3	1.58	0.94	0.95	2
5	0	0	0	0.00	0.00	0.00	3
6	0	0	0.96	0.00	0.00	0.40	4
7	0	0	0	0.00	0.00	0.00	6
T2/CL58	Nitrite	Initially:		723.90	730.48	723.90	
0	18.68	15	12.35	7.51	5.29	5.10	0
1	622.65	547.95	616.35	250.24	193.37	254.37	0.083333
2	410.65	366.51	429.05	165.04	129.34	177.07	0.291666
3	258.58	228.33	272.85	103.92	80.58	112.61	1
4	19.51	14.8	18.11	7.84	5.22	7.47	2
5	0.69	0	0	0.28	0.00	0.00	3
6	0	0	0	0.00	0.00	0.00	4
7	0	0	0	0.00	0.00	0.00	6
T2/CL58	Nitrate	Initially:		1660.40	1675.50	1660.40	
0	36.63	21.82	24.64	14.72	7.70	10.17	0
1	1049.37	913.04	1038.1	421.74	322.21	428.42	0.083333
2	734.97	662.46	759.44	295.38	233.78	313.42	0.291666
3	539.54	470.47	541.52	216.84	166.03	223.49	1
4	46.47	39.34	52.6	18.68	13.88	21.71	2
5	11.26	5.61	9.87	4.53	1.98	4.07	3
6	5.19	4.34	6.88	2.09	1.53	2.84	4
7	7.82	5.88	7.22	3.14	2.08	2.98	6

M-10

T2/CL58	Sulfate	Initially:		61.82	62.38	61.82	
0	1.25	0.18	0.42	0.50	0.06	0.17	0
1	43.7	40.72	38.48	17.56	14.37	15.88	0.083333
2	35.44	37.13	29.07	14.24	13.10	12.00	0.291666
3	39.73	44.68	37.85	15.97	15.77	15.62	1
4	10.43	9.18	9.88	4.19	3.24	4.08	2
5	0.66	0	1.81	0.27	0.00	0.75	3
6	0	0	0	0.00	0.00	0.00	4
7	0	0	0	0.00	0.00	0.00	6

**Cumulative Amount Leached, mg
Observed**

(Adding Rinse to Interval 1)
Calculated (NEWBOX)
(No Washoff or Washout)

		mg			mg			Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d	
T2/CL58	Chloride							
				0.00	0.00	0.00	0	
1	22.12	19.62	25.40	23.81	20.94	26.71	0.083333	
2	39.91	34.79	44.22	38.90	33.82	43.41	0.291666	
3	56.89	47.87	61.64	54.23	45.97	59.35	1	
4	58.48	48.81	62.59	57.97	48.51	62.62	2	
5	58.48	48.81	62.59	58.44	48.75	62.94	3	
6	58.48	48.81	62.98	58.49	48.80	62.99	4	
7	58.48	48.81	62.98	58.50	48.80	63.00	6	

		Added in 106-AN			Newbox Estimate	
Ao =	110.39	111.40	110.39	58.5	48.8	63

Per cent of 106-AN ion leachable:	53%	44%	57%
Eff. Diffusion Coefficient, sq cm/s:	5.26E-06	5.50E-06	5.88E-06
Std. Deviation, sq cm/s:	6.98E-07	6.88E-07	5.90E-07
Leachability Index:	5.279	5.260	5.230
Upper 95% Confidence Int.:	0.060	0.056	0.044
Lower 95% Confidence Int.:	0.053	0.050	0.040

T2/CL58	Nitrite						
				0.00	0.00	0.00	0
1	257.75	198.67	259.46	264.73	204.93	269.03	0.083333
2	422.79	328.01	436.53	414.47	320.44	424.43	0.291666
3	526.71	408.58	549.14	523.57	404.89	543.07	1
4	534.56	413.81	556.61	534.27	413.59	556.44	2
5	534.83	413.81	556.61	534.78	413.99	556.97	3
6	534.83	413.81	556.61	534.80	414.00	557.00	4
7	534.83	413.81	556.61	534.80	414.00	557.00	6

M-11

Added in 106-AN				Newbox Estimate		
Ao =	723.90	730.48	723.90	534.8	414	557
Per cent of 106-AN ion leachable:				74%	57%	77%
Eff. Diffusion Coefficient, sq cm/s:				8.43E-06	7.82E-06	8.06E-06
Std. Deviation, sq cm/s:				4.75E-07	5.12E-07	6.27E-07
Leachability Index:				5.074	5.107	5.094
Upper 95% Confidence Int.:				0.024	0.029	0.034
Lower 95% Confidence Int.:				0.023	0.027	0.032

T2/CL58 Nitrate

				0.00	0.00	0.00	0
1	436.46	329.91	438.59	448.44	343.79	456.17	0.083333
2	731.85	563.69	752.01	716.14	547.52	731.08	0.291666
3	948.69	729.72	975.50	941.83	720.54	967.73	1
4	967.37	743.61	997.21	975.05	746.75	1003.98	2
5	971.89	745.59	1001.28	976.02	748.85	1006.80	3
6	973.98	747.12	1004.12	976.99	748.99	1006.99	4
7	977.12	749.19	1007.10	977.00	749.00	1007.00	6

Added in 106-AN				Newbox Estimate		
Ao =	1660.40	1675.50	1660.40	977	749	1007
Per cent of 106-AN ion leachable:				59%	45%	61%
Eff. Diffusion Coefficient, sq cm/s:				7.04E-06	6.50E-06	6.90E-06
Std. Deviation, sq cm/s:				4.20E-07	5.34E-07	5.20E-07
Leachability Index:				5.153	5.187	5.161
Upper 95% Confidence Int.:				0.026	0.036	0.033
Lower 95% Confidence Int.:				0.025	0.033	0.031

T2/CL58 Sulfate

				0.00	0.00	0.00	0
1	18.07	14.43	16.05	19.24	16.32	16.93	0.083333
2	32.31	27.54	28.05	32.04	27.25	28.37	0.291666
3	48.28	43.30	43.67	46.59	40.08	41.90	1
4	52.47	46.54	47.75	51.49	44.97	47.00	2
5	52.73	46.54	48.50	52.44	46.13	48.16	3
6	52.73	46.54	48.50	52.65	46.41	48.40	4
7	52.73	46.54	48.50	52.70	46.50	48.50	6

Added in 106-AN				Newbox Estimate		
Ao =	61.82	62.38	61.82	52.7	46.5	48.5

M-12

Per cent of 106-AN ion leachable:	85%	75%	78%
Eff. Diffusion Coefficient, sq cm/s:	4.09E-06	3.43E-06	3.74E-06
Std. Deviation, sq cm/s:	4.05E-07	6.63E-07	3.50E-07
Leachability Index:	5.388	5.464	5.427
Upper 95% Confidence Int.:	0.044	0.090	0.041
Lower 95% Confidence Int.:	0.040	0.075	0.038

T2/CL58 Nitrate + Nitrite

				0.00	0.00	0.00	0
1	694.21	528.58	698.06	712.15	548.94	724.13	0.083333
2	1154.64	891.70	1188.55	1130.98	867.60	1155.80	0.291666
3	1475.40	1138.31	1524.64	1466.64	1125.78	1510.82	1
4	1501.92	1157.41	1553.82	1508.98	1160.67	1560.87	2
5	1506.72	1159.39	1557.89	1511.85	1162.88	1563.84	3
6	1508.81	1160.92	1560.73	1511.99	1162.99	1563.98	4
7	1511.95	1163.00	1563.71	1512.00	1163.00	1564.00	6

	Added in 106-AN			Newbox Estimate		
Ao =	2384.30	2405.98	2384.30	1512	1163	1564

Per cent of 106-AN ion leachable:	63%	48%	66%
Eff. Diffusion Coefficient, sq cm/s:	7.50E-06	6.94E-06	7.29E-06
Std. Deviation, sq cm/s:	4.17E-07	5.19E-07	5.47E-07
Leachability Index:	5.125	5.159	5.137
Upper 95% Confidence Int.:	0.024	0.033	0.033
Lower 95% Confidence Int.:	0.023	0.030	0.031

M-13

T2/CL58 : Nitrate

T2/CL58 : Nitrite

T2/CL58 : Nitrate + Nitrite

M-14

T2/CL58 : Chloride

T2/CL58 : Sulfate

M-15

ANSI/ANS-16.1-1986 Leaching Data

Phase II: Additives for 106-AN

Run No.: T2/CL582

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio 15 lb/gal

Chloride

Nitrite

Nitrate

Sulfate

5.32

34.87

79.99

2.98

Sample Cylinder Dimensions

After Curing 28 d

Initially

Batch 1

Batch 2

Batch 3

Vol, cc

2.50

Dia., cm

2.51

2.51

2.51

22.83

4.65

Length, cm

4.62

4.69

4.61

Grout Density, lb/gal

15.70

15.75

15.80

mL of 106-AN in Sample Cylinder

14.22

14.27

14.31

Leach Vol + Boric Acid Vol Added, mL

468

473.5

467.2

Leachate Concentrations

Mass in Leachate

mg/L

mg

Time

Interval

Batch 1

Batch 2

Batch 3

Batch 1

Batch 2

Batch 3

d

T2/CL582

Chloride

Initially:

75.63

75.87

76.11

0

1

0.63

1

0.47

0.30

0.47

0

1

8.47

7.73

8.91

3.96

3.66

4.16

0.083333

2

7.32

6.17

7.16

3.43

2.92

3.35

0.291666

3

12.24

10.75

13.66

5.73

5.09

6.38

1

4

13.29

10.01

12.08

6.22

4.74

5.64

2

5

14.85

12.22

13.44

6.95

5.79

6.28

3

6

5.44

4.55

4.8

2.55

2.15

2.24

4

7

4.68

3.79

4.23

2.19

1.79

1.98

5

T2/CL582

Nitrite

Initially:

495.94

497.52

499.10

0

5.99

6.25

3

2.80

2.96

1.40

0

1

63.8

56.05

58.85

29.86

26.54

27.49

0.083333

2

52.66

44.77

51.63

24.64

21.20

24.12

0.291666

3

99.26

83.89

100.48

46.45

39.72

46.94

1

4

94.94

75.95

88.42

44.43

35.96

41.31

2

5

113.44

92.14

103.36

53.09

43.63

48.29

3

6

41.69

33.51

37.21

19.51

15.87

17.38

4

7

35.38

28.14

31.82

16.56

13.32

14.87

5

T2/CL582

Nitrate

Initially:

1137.53

1141.15

1144.77

0

16.83

18.23

22.04

7.88

8.63

10.30

0

1

135.43

117.28

120.5

63.38

55.53

56.30

0.083333

2

111.38

92.64

107.47

52.13

43.87

50.21

0.291666

3

223.68

180.35

209.01

104.68

85.40

97.65

1

4

200.4

162.94

188.42

93.79

77.15

88.03

2

5

246.05

200.02

221.5

115.15

94.71

103.48

3

6

90.95

79.81

84.85

42.56

37.79

39.64

4

7

78.23

62.6

68.24

36.61

29.64

31.88

5

M-16

T2/CL582	Sulfate	Initially:		42.35	42.49	42.62	
0	5.44	5.17	7.11	2.55	2.45	3.32	0
1	25	19.63	30.76	11.70	9.29	14.37	0.083333
2	15.68	11.14	13.94	7.34	5.27	6.51	0.291666
3	36.23	26.91	29.72	16.96	12.74	13.89	1
4	28.13	25.88	28.1	13.16	12.25	13.13	2
5	38.28	32.04	34.78	17.92	15.17	16.25	3
6	9.87	9.3	10.44	4.62	4.40	4.88	4
7	7.66	7.73	10.24	3.58	3.66	4.78	5

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)			Time d
Observed				Calculated (NEWBOX)			
				(No Washoff or Washout)			
		mg			mg		
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	

T2/CL582	Chloride						
				0.00	0.00	0.00	0
1	4.43	3.96	4.63	4.53	3.79	4.51	0.083333
2	7.86	6.88	7.98	8.39	7.03	8.30	0.291666
3	13.59	11.97	14.36	15.05	12.67	14.92	1
4	19.81	16.71	20.00	20.72	17.60	20.63	2
5	26.76	22.50	26.28	24.88	21.17	24.74	3
6	29.30	24.65	28.52	28.21	24.05	28.08	4
7	31.49	26.44	30.50	31.01	26.55	30.90	5

Added in 106-AN				Newbox Estimate		
Ao =	75.63	75.87	76.11	75.63	75.87	76.11

Per cent of 106-AN ion leachable:	100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:	9.92E-08	6.91E-08	9.66E-08
Std. Deviation, sq cm/s:	1.05E-08	5.12E-09	6.23E-09
Leachability Index:	7.004	7.160	7.015
Upper 95% Confidence Int.:	0.047	0.032	0.028
Lower 95% Confidence Int.:	0.043	0.030	0.026

T2/CL582	Nitrite						
				0.00	0.00	0.00	0
1	32.66	29.50	28.90	34.47	28.91	32.19	0.083333
2	57.31	50.70	53.02	63.48	53.23	59.39	0.291666
3	103.76	90.42	99.96	113.57	96.02	106.31	1
4	148.19	126.38	141.27	155.73	132.34	146.24	2
5	201.28	170.01	189.56	185.98	159.21	175.18	3
6	220.79	185.88	206.95	210.28	180.60	198.64	4
7	237.35	199.20	221.81	231.11	199.01	218.11	5

M-17

Added in 106-AN				Newbox Estimate			
Ao =	495.94	497.52	499.10	495.94	497.52	499.1	
Per cent of 106-AN ion leachable:				100%	100%	100%	
Eff. Diffusion Coefficient, sq cm/s:				1.34E-07	9.38E-08	1.15E-07	
Std. Deviation, sq cm/s:				1.56E-08	7.57E-09	1.25E-08	
Leachability Index:				6.872	7.028	6.939	
Upper 95% Confidence Int.:				0.052	0.035	0.048	
Lower 95% Confidence Int.:				0.046	0.033	0.043	
T2/CL582 Nitrate							
				0.00	0.00	0.00	0
1	71.26	64.16	66.59	74.51	61.96	69.03	0.083333
2	123.38	108.03	116.80	137.64	114.12	127.07	0.291666
3	228.07	193.42	214.45	246.84	206.55	228.95	1
4	321.85	270.58	302.48	338.98	285.29	315.96	2
5	437.00	365.29	405.97	404.96	343.49	378.92	3
6	479.57	403.08	445.61	458.42	390.27	429.29	4
7	516.18	432.72	477.49	503.93	430.21	472.79	5

Added in 106-AN				Newbox Estimate			
Ao =	1137.53	1141.15	1144.77	1137.53	1141.15	1144.77	
Per cent of 106-AN ion leachable:				100%	100%	100%	
Eff. Diffusion Coefficient, sq cm/s:				1.19E-07	8.18E-08	1.00E-07	
Std. Deviation, sq cm/s:				1.30E-08	6.80E-09	9.27E-09	
Leachability Index:				6.924	7.088	6.998	
Upper 95% Confidence Int.:				0.049	0.037	0.041	
Lower 95% Confidence Int.:				0.044	0.034	0.037	
T2/CL582 Sulfate							
				0.00	0.00	0.00	0
1	14.25	11.74	17.69	14.20	11.35	14.51	0.083333
2	21.58	17.02	24.21	25.35	20.33	25.82	0.291666
3	38.54	29.76	38.09	42.51	34.32	43.21	1
4	51.70	42.01	51.22	54.76	44.48	55.54	2
5	69.62	57.18	67.47	62.17	50.82	62.87	3
6	74.24	61.59	72.35	67.08	55.11	67.70	4
7	77.82	65.25	77.13	70.43	58.15	70.90	5

Added in 106-AN				Newbox Estimate		
Ao =	42.35	42.49	42.62	78	66	78

M-18

Per cent of 106-AN ion leachable:	184%	155%	183%
Eff. Diffusion Coefficient, sq cm/s:	9.93E-07	8.86E-07	1.03E-06
Std. Deviation, sq cm/s:	2.62E-07	2.56E-07	2.50E-07
Leachability Index:	6.003	6.053	5.986
Upper 95% Confidence Int.:	0.128	0.143	0.116
Lower 95% Confidence Int.:	0.099	0.108	0.092

T2/CL582 Nitrate + Nitrite

				0.00	0.00	0.00	0
1	103.92	93.66	95.49	108.95	90.95	101.26	0.083333
2	180.69	158.73	169.82	200.92	168.78	187.40	0.291666
3	331.83	283.84	314.42	359.36	303.15	335.35	1
4	470.05	396.96	443.76	493.30	417.86	461.93	2
5	638.29	535.30	595.53	591.31	501.43	553.98	3
6	700.36	588.95	652.56	669.72	570.26	627.96	4
7	753.53	631.92	699.30	735.06	629.25	690.43	5

	Added in 106-AN			Newbox Estimate		
Ao =	1633.46	1638.67	1643.87	1633.46	1638.67	1643.87

Per cent of 106-AN ion leachable:	100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:	1.24E-07	8.53E-08	1.05E-07
Std. Deviation, sq cm/s:	1.38E-08	7.08E-09	1.01E-08
Leachability Index:	6.908	7.069	6.980
Upper 95% Confidence Int.:	0.050	0.037	0.043
Lower 95% Confidence Int.:	0.045	0.034	0.039

T2/CL582 : Nitrate

T2/CL582 : Nitrite

T2/CL582 : Nitrate + Nitrite

T2/CL582 : Chloride

T2/CL582 : Sulfate

ANSI/ANS-16.1-1986 Leaching Data

Phase II: Additives for 106-AN

Run No.: T2-P62

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio	15 lb/gal	Chloride	Nitrite	Nitrate	Sulfate
		5.32	34.87	79.99	2.98

Sample Cylinder Dimensions

After Curing 28 d

Initially		Batch 1	Batch 2	Batch 3
Vol, cc	2.50	2.55	2.55	2.55
22.83	4.65	4.06	4.11	4.06
Grout Density, lb/gal		14.10	14.13	14.10
mL of 106-AN in Sample Cylinder		12.77	12.80	12.77
Leach Vol + Boric Acid Vol Added, mL		431.9	435.9	431.9

Leachate Concentrations

Mass in Leachate

Interval	mg/L			mg			Time
	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
T2-P62	Chloride	Initially:		67.92	68.07	67.92	
0	0.58	0.59	0.59	0.25	0.26	0.25	0
1	9.89	10.36	9.78	4.27	4.52	4.22	0.083333
2	4.72	3.8	3.82	2.04	1.66	1.65	0.291666
3	3.91	3.27	3.32	1.69	1.43	1.43	1
4	2.37	2.26	2.4	1.02	0.99	1.04	2
5	1.57	1.77	1.54	0.68	0.77	0.67	3
6	1.23	1.28	1.26	0.53	0.56	0.54	4
7	1.2	2.13	1.09	0.52	0.93	0.47	5
T2-P62	Nitrite	Initially:		445.40	446.34	445.40	
0	3.46	3.08	2.48	1.49	1.34	1.07	0
1	103.51	110.95	100.04	44.71	48.36	43.21	0.083333
2	43.34	36	38.4	18.72	15.69	16.58	0.291666
3	30.69	28.14	30.22	13.26	12.27	13.05	1
4	18.98	18.55	18.09	8.20	8.09	7.81	2
5	10.34	9.84	11	4.47	4.29	4.75	3
6	8.16	7.8	7.43	3.52	3.40	3.21	4
7	5.57	5.6	6.4	2.41	2.44	2.76	5
T2-P62	Nitrate	Initially:		1021.60	1023.77	1021.60	
0	9.47	7.65	7.26	4.09	3.33	3.14	0
1	131.62	139.83	130.81	56.85	60.95	56.50	0.083333
2	57.17	53.75	53.45	24.69	23.43	23.09	0.291666
3	46.82	43.99	45.54	20.22	19.18	19.67	1
4	30.15	29.96	29.88	13.02	13.06	12.91	2
5	19.08	18.99	18.81	8.24	8.28	8.12	3
6	15.05	14.15	14.85	6.50	6.17	6.41	4
7	11.96	11.86	11.86	5.17	5.17	5.12	5

M-22

T2-P62	Sulfate	Initially:		38.03	38.12	38.03	
0	1.76	1.39	1.53	0.76	0.61	0.66	0
1	17.58	18.91	17.93	7.59	8.24	7.74	0.083333
2	10.07	9.58	9.26	4.35	4.18	4.00	0.291666
3	8.97	8.08	7.95	3.87	3.52	3.43	1
4	5.68	5.72	5.52	2.45	2.49	2.38	2
5	3.92	3.64	3.35	1.69	1.59	1.45	3
6	3.38	3	2.82	1.46	1.31	1.22	4
7	2.57	1.99	1.96	1.11	0.87	0.85	5

Cumulative Amount Leached, mg
Observed

(Adding Rinse to Interval 1)
Calculated (NEWBOX)
(No Washoff or Washout)

Interval	Batch 1	Batch 2	Batch 1	Batch 2	Batch 3	Time d
T2-P62	Chloride					
0			0.00	0.00	0.00	0
1	4.52	4.77	3.60	2.90	3.03	0.083333
2	6.56	6.43	6.09	5.08	5.21	0.291666
3	8.25	7.85	9.16	8.16	8.18	1
4	9.27	8.84	10.48	10.07	9.82	2
5	9.95	9.61	10.85	10.99	10.49	3
6	10.48	10.17	10.96	11.47	10.78	4
7	11.00	11.10	10.99	11.72	10.90	5

Ao =	Added in 106-AN	Newbox Estimate
67.92	68.07	67.92
	11	12
		11

Per cent of 106-AN ion leachable:	16%	18%	16%
Eff. Diffusion Coefficient, sq cm/s:	3.45E-06	1.78E-06	2.33E-06
Std. Deviation, sq cm/s:	1.42E-06	9.88E-07	1.23E-06
Leachability Index:	5.462	5.749	5.632
Upper 95% Confidence Int.:	0.221	0.336	0.312
Lower 95% Confidence Int.:	0.146	0.187	0.180

T2-P62	Nitrite			0.00	0.00	0.00	
0							0
1	46.20	49.71	44.28	39.29	41.38	36.55	0.083333
2	64.92	65.40	60.86	64.31	67.01	60.26	0.291666
3	78.17	77.66	73.92	89.73	90.82	85.00	1
4	86.37	85.75	81.73	96.03	95.52	91.79	2
5	90.84	90.04	86.48	96.90	95.95	92.81	3
6	94.36	93.44	89.69	96.98	96.00	92.97	4
7	96.77	95.88	92.45	97.00	96.00	93.00	5

M-23

Added in 106-AN				Newbox Estimate		
Ao =	445.40	446.34	445.40	97	96	93
Per cent of 106-AN ion leachable:				22%	22%	21%
Eff. Diffusion Coefficient, sq cm/s:				5.64E-06	6.57E-06	5.27E-06
Std. Deviation, sq cm/s:				2.33E-06	3.10E-06	2.34E-06
Leachability Index:				5.249	5.182	5.278
Upper 95% Confidence Int.:				0.223	0.266	0.245
Lower 95% Confidence Int.:				0.147	0.164	0.156

T2-P62 Nitrate

				0.00	0.00	0.00	0
1	60.94	64.29	59.63	48.51	50.54	46.85	0.083333
2	85.63	87.72	82.72	81.32	84.28	78.71	0.291666
3	105.85	106.89	102.39	119.96	123.06	116.24	1
4	118.87	119.95	115.29	134.55	136.50	130.55	2
5	127.11	128.23	123.42	137.89	139.30	133.92	3
6	133.61	134.40	129.83	138.72	139.86	134.73	4
7	138.78	139.57	134.95	138.94	139.97	134.93	5

Added in 106-AN				Newbox Estimate		
Ao =	1021.60	1023.77	1021.60	139	140	135
Per cent of 106-AN ion leachable:				14%	14%	13%
Eff. Diffusion Coefficient, sq cm/s:				3.99E-06	4.34E-06	3.95E-06
Std. Deviation, sq cm/s:				1.74E-06	2.05E-06	1.76E-06
Leachability Index:				5.399	5.363	5.403
Upper 95% Confidence Int.:				0.240	0.268	0.246
Lower 95% Confidence Int.:				0.154	0.165	0.156

T2-P62 Sulfate

				0.00	0.00	0.00	0
1	8.35	8.85	8.40	6.41	6.90	6.53	0.083333
2	12.70	13.02	12.40	11.09	11.80	11.18	0.291666
3	16.58	16.55	15.84	17.54	18.17	17.25	1
4	19.03	19.04	18.22	21.17	21.32	20.31	2
5	20.72	20.63	19.67	22.73	22.40	21.38	3
6	22.18	21.93	20.89	23.42	22.79	21.78	4
7	23.29	22.80	21.73	23.74	22.93	21.91	5

Added in 106-AN				Newbox Estimate		
Ao =	38.03	38.12	38.03	24	23	22

M-24

Per cent of 106-AN ion leachable:	63%	60%	58%
Eff. Diffusion Coefficient, sq cm/s:	2.20E-06	2.86E-06	2.77E-06
Std. Deviation, sq cm/s:	7.91E-07	1.09E-06	1.06E-06
Leachability Index:	5.658	5.544	5.557
Upper 95% Confidence Int.:	0.187	0.202	0.202
Lower 95% Confidence Int.:	0.130	0.137	0.137

T2-P62 Nitrate + Nitrite

				0.00	0.00	0.00	0
1	107.14	113.99	103.91	87.56	91.80	83.45	0.083333
2	150.55	153.11	143.58	145.61	151.28	138.85	0.291666
3	184.02	184.56	176.30	210.28	214.76	201.55	1
4	205.24	205.70	197.02	231.04	232.70	222.76	2
5	217.95	218.27	209.89	235.06	235.53	226.86	3
6	227.97	227.84	219.52	235.76	235.91	227.77	4
7	235.55	235.45	227.40	235.98	235.98	227.95	5

	Added in 106-AN			Newbox Estimate		
Ao =	1467.00	1470.12	1467.00	236	236	228

Per cent of 106-AN ion leachable:	16%	16%	16%
Eff. Diffusion Coefficient, sq cm/s:	4.61E-06	5.14E-06	4.44E-06
Std. Deviation, sq cm/s:	2.04E-06	2.46E-06	1.99E-06
Leachability Index:	5.336	5.289	5.352
Upper 95% Confidence Int.:	0.244	0.272	0.248
Lower 95% Confidence Int.:	0.155	0.166	0.157

T2/P62 : Nitrate

T2/P62 : Nitrite

T2/P62 : Nitrate + Nitrite

T2/P62 : Chloride

T2/P62 : Sulfate

M-27

ANSI/ANS-16.1-1986 Leaching Data

Phase II: Additives for 106-AN

Run No.: T2-P65

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio	15 lb/gal	Chloride	Nitrite	Nitrate	Sulfate
		5.32	34.87	79.99	2.98

Sample Cylinder Dimensions

After Curing 28 d

	Initially		Batch 1	Batch 2	Batch 3
Vol, cc	2.50	Dia., cm	2.55	2.55	2.55
22.83	4.65	Length, cm	4.37	4.33	4.26
Grout Density, lb/gal			15.45	15.50	15.50
mL of 106-AN in Sample Cylinder			14.00	14.04	14.04
Leach Vol + Boric Acid Vol Added, mL			456.7	453.5	447.9

Leachate Concentrations

Mass in Leachate

Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
T2-P65 Chloride							
	Initially:			74.43	74.67	74.67	
0	0.5	0.5	2.48	0.23	0.23	1.11	0
1	13.79	14.82	19.14	6.30	6.72	8.57	0.083333
2	12.19	11.85	15.8	5.57	5.37	7.08	0.291666
3	14.09	12.06	18.26	6.43	5.47	8.18	1
4	4.37	6.31	5.63	2.00	2.86	2.52	2
5	0.61	0.97	0.5	0.28	0.44	0.22	3
6	0.77	0.5	0.5	0.35	0.23	0.22	4
7	0.54	0.5	0.5	0.25	0.23	0.22	5
T2-P65 Nitrite							
	Initially:			488.04	489.62	489.62	
0	3.33	3	3.95	1.52	1.36	1.77	0
1	172.09	163.14	178.88	78.59	73.98	80.12	0.083333
2	142.29	133.32	143.68	64.98	60.46	64.35	0.291666
3	160.65	144.89	161.75	73.37	65.71	72.45	1
4	62.26	75.7	63.15	28.43	34.33	28.28	2
5	15.05	9.68	11.82	6.87	4.39	5.29	3
6	6.2	4.94	0.84	2.83	2.24	0.38	4
7	2.81	3	1.5	1.28	1.36	0.67	5
T2-P65 Nitrate							
	Initially:			1119.41	1123.04	1123.04	
0	8.85	8.23	8.13	4.04	3.73	3.64	0
1	361.61	357.96	380.67	165.15	162.33	170.50	0.083333
2	311.88	288.69	304.94	142.44	130.92	136.58	0.291666
3	358.19	330.89	363.9	163.59	150.06	162.99	1
4	144.44	140.55	140.28	65.97	63.74	62.83	2
5	26.41	24.18	25.64	12.06	10.97	11.48	3
6	4.68	2.38	4.55	2.14	1.08	2.04	4
7	1.47	0.94	0.54	0.67	0.43	0.24	5

M-28

T2-P65	Sulfate	Initially:		41.68	41.81	41.81	
0	1.08	0.48	0.72	0.49	0.22	0.32	0
1	26.34	26.81	29.1	12.03	12.16	13.03	0.083333
2	27.54	24.24	28.74	12.58	10.99	12.87	0.291666
3	39.34	36.74	39.6	17.97	16.66	17.74	1
4	31.86	31.7	30.39	14.55	14.38	13.61	2
5	16.38	15.4	15.8	7.48	6.98	7.08	3
6	7.18	6.56	7.16	3.28	2.97	3.21	4
7	3.5	3.47	3.86	1.60	1.57	1.73	5

Cumulative Amount Leached, mg
Observed

(Adding Rinse to Interval 1)
Calculated (NEWBOX)
(No Washoff or Washout)

Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
T2-P65	Chloride						
				0.00	0.00	0.00	0
1	6.53	6.95	9.68	7.02	7.12	9.98	0.083333
2	12.09	12.32	16.76	11.90	12.04	16.69	0.291666
3	18.53	17.79	24.94	17.89	18.06	24.50	1
4	20.52	20.65	27.46	20.44	20.58	27.31	2
5	20.80	21.09	27.68	21.12	21.24	27.93	3
6	21.15	21.32	27.91	21.31	21.44	28.07	4
7	21.40	21.55	28.13	21.38	21.48	28.09	5

Ao =	Added in 106-AN	Newbox Estimate
74.43	74.67	74.67
	21.4	21.5
		28.1

Per cent of 106-AN ion leachable:	29%	29%	38%
Eff. Diffusion Coefficient, sq cm/s:	3.59E-06	3.64E-06	4.23E-06
Std. Deviation, sq cm/s:	3.90E-07	1.94E-07	2.26E-07
Leachability Index:	5.445	5.439	5.373
Upper 95% Confidence Int.:	0.048	0.023	0.023
Lower 95% Confidence Int.:	0.044	0.022	0.022

T2-P65	Nitrite			0.00	0.00	0.00	0
1	80.11	75.34	81.89	84.18	78.40	85.43	0.083333
2	145.10	135.81	146.24	142.71	133.04	144.33	0.291666
3	218.47	201.51	218.69	215.49	201.64	215.73	1
4	246.90	235.84	246.98	246.57	232.26	244.80	2
5	253.77	240.23	252.27	255.37	241.08	252.20	3
6	256.61	242.47	252.65	257.96	243.78	254.23	4
7	257.89	243.83	253.32	258.74	244.76	254.75	5

M-29

Added in 106-AN				Newbox Estimate		
Ao =	488.04	489.62	489.62	259	245	255
Per cent of 106-AN ion leachable:				53%	50%	52%
Eff. Diffusion Coefficient, sq cm/s:				3.51E-06	3.37E-06	3.72E-06
Std. Deviation, sq cm/s:				2.32E-07	2.02E-07	2.33E-07
Leachability Index:				5.454	5.472	5.429
Upper 95% Confidence Int.:				0.029	0.026	0.027
Lower 95% Confidence Int.:				0.027	0.025	0.026

T2-P65 Nitrate

				0.00	0.00	0.00	0
1	169.19	166.07	174.14	180.72	170.73	182.37	0.083333
2	311.62	296.99	310.73	306.84	290.51	308.58	0.291666
3	475.21	447.05	473.72	464.47	442.27	464.26	1
4	541.18	510.79	536.55	534.29	511.11	530.42	2
5	553.24	521.75	548.03	554.56	532.24	548.77	3
6	555.37	522.83	550.07	560.19	538.75	553.78	4
7	556.05	523.26	550.31	562.44	540.92	555.44	5

Added in 106-AN				Newbox Estimate		
Ao =	1119.41	1123.04	1123.04	563	542	556
Per cent of 106-AN ion leachable:				50%	48%	50%
Eff. Diffusion Coefficient, sq cm/s:				3.42E-06	3.27E-06	3.55E-06
Std. Deviation, sq cm/s:				3.10E-07	3.08E-07	2.46E-07
Leachability Index:				5.467	5.486	5.450
Upper 95% Confidence Int.:				0.040	0.042	0.030
Lower 95% Confidence Int.:				0.037	0.038	0.028

T2-P65 Sulfate

				0.00	0.00	0.00	0
1	12.52	12.38	13.36	14.03	13.30	14.66	0.083333
2	25.10	23.37	26.23	25.13	23.81	26.11	0.291666
3	43.07	40.03	43.97	42.59	40.14	43.59	1
4	57.62	54.41	57.58	55.28	52.13	55.98	2
5	65.10	61.39	64.65	63.21	59.52	63.27	3
6	68.38	64.37	67.86	68.64	64.65	68.13	4
7	69.98	65.94	69.59	72.56	68.39	71.34	5

Added in 106-AN				Newbox Estimate		
Ao =	41.68	41.81	41.81	83.5	77.8	78.4

M-30

Per cent of 106-AN ion leachable:	200%	186%	188%
Eff. Diffusion Coefficient, sq cm/s:	8.41E-07	8.66E-07	1.04E-06
Std. Deviation, sq cm/s:	8.32E-08	7.54E-08	8.30E-08
Leachability Index:	6.075	6.063	5.982
Upper 95% Confidence Int.:	0.044	0.038	0.035
Lower 95% Confidence Int.:	0.040	0.035	0.032

T2-P65 Nitrate + Nitrite

				0.00	0.00	0.00	0
1	249.30	241.41	256.03	265.18	252.00	267.63	0.083333
2	456.72	432.79	456.97	449.09	426.70	452.54	0.291666
3	693.68	648.56	692.41	678.97	643.14	680.43	1
4	788.08	746.63	783.52	779.95	735.90	775.32	2
5	807.01	761.98	800.30	808.69	762.18	801.27	3
6	811.98	765.30	802.72	817.72	769.91	808.57	4
7	813.94	767.09	803.63	820.18	772.23	810.19	5

	Added in 106-AN			Newbox Estimate		
Ao =	1607.45	1612.65	1612.65	821	773	811

Per cent of 106-AN ion leachable:	51%	48%	50%
Eff. Diffusion Coefficient, sq cm/s:	3.45E-06	3.51E-06	3.60E-06
Std. Deviation, sq cm/s:	2.83E-07	2.12E-07	2.40E-07
Leachability Index:	5.463	5.455	5.444
Upper 95% Confidence Int.:	0.036	0.026	0.029
Lower 95% Confidence Int.:	0.033	0.025	0.027

M-31

T2/P65 : Nitrate

T2/P65 : Nitrite

T2/P65 : Nitrate + Nitrite

M-32

T2/P65 : Chloride

T2/P65 : Sulfate

M-33

ANSI/ANS-16.1-1986 Leaching Data

Phase II: Additives for 106-AN

Run No.: T2/S24

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio	15 lb/gal	Chloride	Nitrite	Nitrate	Sulfate
		5.32	34.87	79.99	2.98

Sample Cylinder Dimensions

After Curing 28 d

	Initially		Batch 1	Batch 2	Batch 3
Vol, cc	2.55	Dia., cm	2.55	2.55	2.55
23.75	4.65	Length, cm	4.45	4.55	4.55
Grout Density, lb/gal			15.82	15.93	15.90
mL of 106-AN in Sample Cylinder			14.91	15.01	14.98
Leach Vol + Boric Acid Vol Added, mL			463.6	471.6	471.6

Leachate Concentrations

Mass in Leachate

Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
T2/S24	Chloride	Initially:		79.29	79.84	79.69	
0	1.43	1.78	1.32	0.66	0.84	0.62	0
1	20.29	20.3	20.1	9.41	9.57	9.48	0.083333
2	18.99	18.36	3.04	8.80	8.66	1.43	0.291666
3	25.13	17.3	25.09	11.65	8.16	11.83	1
4	9.28	14.58	9.52	4.30	6.88	4.49	2
5	1.75	1.72	1.7	0.81	0.81	0.80	3
6	0.27	0.51	0.71	0.13	0.24	0.33	4
7	0	0.1	0.26	0.00	0.05	0.12	5
T2/S24	Nitrite	Initially:		519.92	523.53	522.55	
0	2.55	4.7	2.72	1.18	2.22	1.28	0
1	100.43	102.63	103.48	46.56	48.40	48.80	0.083333
2	87.01	91.96	10.59	40.34	43.37	4.99	0.291666
3	138.54	81.73	158.24	64.23	38.54	74.63	1
4	44.87	50.53	49.95	20.80	23.83	23.56	2
5	8.14	7.74	8.59	3.77	3.65	4.05	3
6	0.8	0.58	1.42	0.37	0.27	0.67	4
7	0	0	0.23	0.00	0.00	0.11	5
T2/S24	Nitrate	Initially:		1192.53	1200.82	1198.56	
0	10.28	9.44	11.03	4.77	4.45	5.20	0
1	314.54	321.31	321.27	145.82	151.53	151.51	0.083333
2	100.08	285.53	36.08	46.40	134.66	17.02	0.291666
3	476.16	167.79	543.29	220.75	79.13	256.22	1
4	157.97	156.87	162.1	73.23	73.98	76.45	2
5	42.11	37.98	43.47	19.52	17.91	20.50	3
6	12.9	12.82	13.51	5.98	6.05	6.37	4
7	4.84	4.71	3.07	2.24	2.22	1.45	5

M-34

T2/S24	Sulfate	Initially:		44.40	44.71	44.62	
0	4.72	4.09	3.24	2.19	1.93	1.53	0
1	26.53	30.37	27.18	12.30	14.32	12.82	0.083333
2	10.62	35.08	6.58	4.92	16.54	3.10	0.291666
3	51.02	30.72	59.54	23.65	14.49	28.08	1
4	27.7	29.72	29.14	12.84	14.02	13.74	2
5	14.91	14.9	23.09	6.91	7.03	10.89	3
6	6.89	7.19	7.58	3.19	3.39	3.57	4
7	5.66	7.93	3.53	2.62	3.74	1.66	5

Cumulative Amount Leached, mg Observed				(Adding Rinse to Interval 1) Calculated (NEWBOX) (No Washoff or Washout)				Time d
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3		
T2/S24	Chloride							
		mg			mg			
				0.00	0.00	0.00		0
1	10.07	10.41	10.10	11.06	10.71	8.09	0.083333	
2	18.87	19.07	11.54	18.87	18.35	14.01	0.291666	
3	30.52	27.23	23.37	29.05	28.27	22.20		1
4	34.83	34.11	27.86	33.98	33.17	26.76		2
5	35.64	34.92	28.66	35.62	34.81	28.69		3
6	35.76	35.16	28.99	36.21	35.38	29.54		4
7	35.76	35.20	29.12	36.39	35.59	29.90		5

Added in 106-AN				Newbox Estimate		
Ao =	79.29	79.84	79.69	36.5	35.7	30.2
Per cent of 106-AN ion leachable:				46%	45%	38%
Eff. Diffusion Coefficient, sq cm/s:				3.01E-06	2.98E-06	2.33E-06
Std. Deviation, sq cm/s:				3.97E-07	3.08E-07	7.57E-07
Leachability Index:				5.521	5.525	5.633
Upper 95% Confidence Int.:				0.059	0.046	0.165
Lower 95% Confidence Int.:				0.052	0.042	0.119

T2/S24	Nitrite			0.00	0.00	0.00	0
1	47.74	50.62	50.08	52.89	52.97	40.97	0.083333
2	88.08	93.99	55.08	90.95	89.68	71.57	0.291666
3	152.31	132.53	129.70	141.46	134.92	115.60	1
4	173.11	156.36	153.26	167.63	153.92	142.63	2
5	176.88	160.01	157.31	177.14	159.07	155.89	3
6	177.25	160.28	157.98	180.80	160.52	162.69	4
7	177.25	160.28	158.09	182.09	160.84	166.09	5

Ao =	Added in 106-AN			Newbox Estimate		
	519.92	523.53	522.55	183	161	170
Per cent of 106-AN ion leachable:	35%			31%	33%	
Eff. Diffusion Coefficient, sq cm/s:	2.73E-06			3.66E-06	1.84E-06	
Std. Deviation, sq cm/s:	4.76E-07			3.35E-07	6.96E-07	
Leachability Index:	5.565			5.436	5.735	
Upper 95% Confidence Int.:	0.081			0.040	0.199	
Lower 95% Confidence Int.:	0.068			0.037	0.136	

T2/S24	Nitrate						
				0.00	0.00	0.00	0
1	150.59	155.98	156.71	136.50	158.57	130.61	0.083333
2	196.98	290.64	173.73	238.06	266.91	229.31	0.291666
3	417.73	369.77	429.94	381.11	397.58	375.29	1
4	490.97	443.75	506.39	467.38	448.72	471.03	2
5	510.49	461.66	526.89	507.23	460.82	521.85	3
6	516.47	467.70	533.26	526.89	464.07	550.81	4
7	518.71	469.93	534.71	536.17	464.54	567.36	5

Ao =	Added in 106-AN			Newbox Estimate		
	1192.53	1200.82	1198.56	546	465	591
Per cent of 106-AN ion leachable:	46%			39%	49%	
Eff. Diffusion Coefficient, sq cm/s:	1.98E-06			3.97E-06	1.52E-06	
Std. Deviation, sq cm/s:	5.39E-07			7.38E-07	5.57E-07	
Leachability Index:	5.704			5.401	5.818	
Upper 95% Confidence Int.:	0.134			0.086	0.191	
Lower 95% Confidence Int.:	0.102			0.072	0.132	

T2/S24	Sulfate						
				0.00	0.00	0.00	0
1	14.49	16.25	14.35	12.73	17.00	14.67	0.083333
2	19.41	32.80	17.45	23.03	29.95	26.07	0.291666
3	43.06	47.28	45.53	39.78	49.06	43.47	1
4	55.91	61.30	59.27	52.60	61.70	55.56	2
5	62.82	68.33	70.16	61.12	68.48	62.62	3
6	66.01	71.72	73.73	67.49	72.38	67.18	4
7	68.64	75.46	75.40	72.35	74.65	70.15	5

Ao =	Added in 106-AN			Newbox Estimate		
	44.40	44.71	44.62	93.6	78	76

M-36

Per cent of 106-AN ion leachable:	211%	174%	170%
Eff. Diffusion Coefficient, sq cm/s:	5.45E-07	1.48E-06	1.15E-06
Std. Deviation, sq cm/s:	9.38E-08	1.54E-07	4.22E-07
Leachability Index:	6.263	5.829	5.941
Upper 95% Confidence Int.:	0.079	0.046	0.192
Lower 95% Confidence Int.:	0.067	0.042	0.133

T2/S24	Nitrate + Nitrite			0.00	0.00	0.00	0
1	198.33	206.60	206.80	189.95	211.59	171.91	0.083333
2	285.06	384.62	228.81	329.88	356.82	301.60	0.291666
3	570.04	502.30	559.65	523.45	532.73	491.61	1
4	664.07	600.11	659.65	635.10	602.84	613.00	2
5	687.37	621.67	684.20	683.68	619.74	675.58	3
6	693.72	627.99	691.24	706.15	624.75	710.27	4
7	695.97	630.21	692.80	716.30	625.37	729.12	5

	Added in 106-AN			Newbox Estimate		
Ao =	1712.44	1724.35	1721.10	725	626	754

Per cent of 106-AN ion leachable:	42%	36%	44%
Eff. Diffusion Coefficient, sq cm/s:	2.19E-06	3.89E-06	1.65E-06
Std. Deviation, sq cm/s:	4.97E-07	6.12E-07	6.26E-07
Leachability Index:	5.659	5.409	5.782
Upper 95% Confidence Int.:	0.108	0.072	0.200
Lower 95% Confidence Int.:	0.086	0.062	0.136

T2/S24 : Nitrate

T2/S24 : Nitrite

T2/S24 : Nitrate + Nitrite

T2/S24 : Chloride

T2/S24 : Sulfate

M-39

ANSI/ANS-16.1-1986 Leaching Data

Phase II: Additives for 106-AN

Run No.: T2-S25

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio	15 lb/gal	Chloride	Nitrite	Nitrate	Sulfate
		5.32	34.87	79.99	2.98

Sample Cylinder Dimensions

After Curing 28 d

	Initially		Batch 1	Batch 2	Batch 3
Vol, cc	2.50	Dia., cm	2.55	2.55	2.55
	22.83	Length, cm	4.66	4.55	4.55
Grout Density, lb/gal			15.77	15.80	15.79
mL of 106-AN in Sample Cylinder			14.29	14.31	14.30
Leach Vol + Boric Acid Vol Added, mL			480.5	471.6	471.6

Leachate Concentrations

Mass in Leachate

Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
mg/L							
T2-S25	Chloride	Initially:		75.97	76.11	76.06	
0	1.12	1.07	1.93	0.54	0.50	0.91	0
1	36.29	36.05	35.99	17.44	17.00	16.97	0.083333
2	33.88	31.16	31.91	16.28	14.70	15.05	0.291666
3	46.03	40.5	40.64	22.12	19.10	19.17	1
4	24.83	23.25	16.56	11.93	10.96	7.81	2
5	6.25	7.14	5.51	3.00	3.37	2.60	3
6	1	0.87	0.62	0.48	0.41	0.29	4
7	0.5	0.5	0.17	0.24	0.24	0.08	5
mg							
T2-S25	Nitrite	Initially:		498.15	499.10	498.78	
0	5.56	5.88	5.84	2.67	2.77	2.75	0
1	178.14	170.28	180.62	85.60	80.30	85.18	0.083333
2	140.38	136.37	144.95	67.45	64.31	68.36	0.291666
3	183.81	177.11	183.31	88.32	83.53	86.45	1
4	115.45	109.81	100.89	55.47	51.79	47.58	2
5	49.91	49.07	42.26	23.98	23.14	19.93	3
6	3	6.33	11.42	1.44	2.99	5.39	4
7	3	3	10.43	1.44	1.41	4.92	5
T2-S25	Nitrate	Initially:		1142.60	1144.77	1144.05	
0	13.89	13.39	12.34	6.67	6.31	5.82	0
1	415.72	395.3	418.12	199.75	186.42	197.19	0.083333
2	273.3	265.17	284.05	131.32	125.05	133.96	0.291666
3	408.27	397.39	402.01	196.17	187.41	189.59	1
4	210.98	204.82	196.64	101.38	96.59	92.74	2
5	69.27	68.18	60.98	33.28	32.15	28.76	3
6	24.69	25.56	19.66	11.86	12.05	9.27	4
7	10.3	10.2	7.96	4.95	4.81	3.75	5

M-40

T2-S25	Sulfate	Initially:		42.54	42.62	42.59	
0	2.75	2.7	2.42	1.32	1.27	1.14	0
1	46.04	46.16	46.77	22.12	21.77	22.06	0.083333
2	31.57	32.1	34.69	15.17	15.14	16.36	0.291666
3	55.51	54.78	57.73	26.67	25.83	27.23	1
4	40.53	39.97	44.49	19.47	18.85	20.98	2
5	27.61	24.2	25.94	13.27	11.41	12.23	3
6	23.19	20.73	16.34	11.14	9.78	7.71	4
7	15.21	12.52	8.64	7.31	5.90	4.07	5

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)			
Observed				Calculated (NEWBOX)			
				(No Washoff or Washout)			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
T2-S25	Chloride						
				0.00	0.00	0.00	0
1	17.98	17.51	17.88	19.89	18.60	19.11	0.083333
2	34.25	32.20	32.93	34.42	32.12	32.78	0.291666
3	56.37	51.30	52.10	54.53	50.59	50.54	1
4	68.30	62.27	59.91	65.86	60.77	59.30	2
5	71.31	65.63	62.51	70.70	64.91	62.30	3
6	71.79	66.04	62.80	72.79	66.61	63.32	4
7	72.03	66.28	62.88	73.76	67.36	63.71	5

Added in 106-AN				Newbox Estimate		
Ao =	75.97	76.11	76.06	74.5	67.9	63.9

Per cent of 106-AN ion leachable:	98%	89%	84%
Eff. Diffusion Coefficient, sq cm/s:	2.32E-06	2.43E-06	2.97E-06
Std. Deviation, sq cm/s:	2.90E-07	1.94E-07	2.67E-07
Leachability Index:	5.634	5.614	5.528
Upper 95% Confidence Int.:	0.056	0.035	0.040
Lower 95% Confidence Int.:	0.050	0.032	0.036

T2-S25	Nitrite			0.00	0.00	0.00	0
1	88.27	83.08	87.93	89.85	84.64	89.79	0.083333
2	155.72	147.39	156.29	155.31	146.45	154.72	0.291666
3	244.04	230.91	242.74	245.82	232.04	242.90	1
4	299.51	282.70	290.32	296.59	280.55	290.70	2
5	323.50	305.84	310.25	317.63	300.83	309.76	3
6	324.94	308.83	315.64	326.99	309.71	317.51	4
7	326.38	310.24	320.56	330.99	313.83	320.74	5

M-41

Ao =	Added in 106-AN			Newbox Estimate		
	498.15	499.10	498.78	334	317	323
Per cent of 106-AN ion leachable:	67%			64%	65%	
Eff. Diffusion Coefficient, sq cm/s:	2.36E-06			2.30E-06	2.51E-06	
Std. Deviation, sq cm/s:	1.09E-07			9.46E-08	5.97E-08	
Leachability Index:	5.627			5.638	5.600	
Upper 95% Confidence Int.:	0.020			0.018	0.010	
Lower 95% Confidence Int.:	0.019			0.017	0.010	

T2-S25 Nitrate

				0.00	0.00	0.00	0
1	206.43	192.74	203.00	200.50	188.64	199.86	0.083333
2	337.75	317.79	336.96	344.50	323.57	341.96	0.291666
3	533.92	505.20	526.55	535.35	505.01	526.55	1
4	635.30	601.79	619.29	633.19	598.67	616.86	2
5	668.58	633.95	648.04	668.33	633.39	647.40	3
6	680.45	646.00	657.32	681.42	646.49	658.02	4
7	685.39	650.81	661.07	686.24	651.73	662.01	5

Ao =	Added in 106-AN			Newbox Estimate		
	1142.60	1144.77	1144.05	689	655	664
Per cent of 106-AN ion leachable:	60%			57%	58%	
Eff. Diffusion Coefficient, sq cm/s:	2.81E-06			2.71E-06	3.00E-06	
Std. Deviation, sq cm/s:	1.08E-07			9.16E-08	7.64E-08	
Leachability Index:	5.551			5.567	5.524	
Upper 95% Confidence Int.:	0.016			0.014	0.011	
Lower 95% Confidence Int.:	0.016			0.014	0.011	

T2-S25 Sulfate

				0.00	0.00	0.00	0
1	23.44	23.04	23.20	21.51	21.58	22.55	0.083333
2	38.61	38.18	39.56	38.50	38.56	40.19	0.291666
3	65.29	64.01	66.78	65.76	64.98	67.66	1
4	84.76	82.86	87.76	86.04	84.07	87.32	2
5	98.03	94.28	100.00	99.05	95.85	99.29	3
6	109.17	104.05	107.70	108.23	103.91	107.23	4
7	116.48	109.96	111.78	114.94	109.49	112.77	5

Ao =	Added in 106-AN			Newbox Estimate		
	42.54	42.62	42.59	137	124	126

M-42

Per cent of 106-AN ion leachable:	322%	291%	296%
Eff. Diffusion Coefficient, sq cm/s:	7.43E-07	9.15E-07	9.74E-07
Std. Deviation, sq cm/s:	3.94E-08	4.35E-08	2.91E-08
Leachability Index:	6.129	6.039	6.012
Upper 95% Confidence Int.:	0.023	0.021	0.013
Lower 95% Confidence Int.:	0.022	0.020	0.012

T2-S25 Nitrate + Nitrite

				0.00	0.00	0.00	0
1	294.70	275.82	290.94	290.25	273.13	288.90	0.083333
2	493.47	465.18	493.26	499.76	470.45	495.96	0.291666
3	777.96	736.12	769.29	780.81	737.75	770.07	1
4	934.81	884.50	909.61	929.00	879.66	908.11	2
5	992.08	939.79	958.30	985.21	935.06	957.41	3
6	1005.38	954.83	972.95	1007.69	957.42	975.15	4
7	1011.77	961.05	981.63	1015.87	966.17	982.06	5

	Added in 106-AN			Newbox Estimate		
Ao =	1640.75	1643.87	1642.83	1022	972	986

Per cent of 106-AN ion leachable:	62%	59%	60%
Eff. Diffusion Coefficient, sq cm/s:	2.66E-06	2.58E-06	2.83E-06
Std. Deviation, sq cm/s:	7.49E-08	6.07E-08	3.14E-08
Leachability Index:	5.575	5.589	5.548
Upper 95% Confidence Int.:	0.012	0.010	0.005
Lower 95% Confidence Int.:	0.012	0.010	0.005

M-43

T2/S25 : Nitrate

T2/S25 : Nitrite

T2/S25 : Nitrate + Nitrite

T2/S25 : Chloride

T2/S25 : Sulfate

M-45

ANSI/ANS-16.1-1986 Leaching Data

Phase II: Additives for 106-AN

Run No.: T2-SIKA (HIGH) Surrogate 106-AN Concentrations, mg/mL
 Mix Ratio 15 lb/gal Chloride Nitrite Nitrate Sulfate
 5.32 34.87 79.99 2.98

Sample Cylinder Dimensions

After Curing 28 d

	Initially		Batch 1	Batch 2	Batch 3
Vol, cc	2.50	Dia., cm	2.53	2.53	2.52
	22.83	4.65	4.42	4.16	4.28
Grout Density, lb/gal			13.62	15.50	15.50
mL of 106-AN in Sample Cylinder			12.34	14.04	14.04
Leach Vol + Boric Acid Vol Added, mL			456.4	435.7	443.1

Leachate Concentrations

Mass in Leachate

Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
T2-SIKA (Chloride	Initially:			65.61	74.67	74.67	
0	0.64	1	0.7	0.29	0.44	0.31	0
1	8.35	7.29	20.73	3.81	3.18	9.19	0.083333
2	4.76	3.22	4.54	2.17	1.40	2.01	0.291666
3	5.45	5	5.53	2.49	2.18	2.45	1
4	6.6	6.67	6.64	3.01	2.91	2.94	2
5	2.13	2.37	2.28	0.97	1.03	1.01	3
6	1.69	1.78	1.7	0.77	0.78	0.75	4
7	1.36	1.43	1	0.62	0.62	0.44	5

Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
T2-SIKA (Nitrite	Initially:			430.23	489.62	489.62	
0	4.4	4.54	5.55	2.01	1.98	2.46	0
1	60.95	53.36	83.74	27.82	23.25	37.11	0.083333
2	34.38	23.98	30.84	15.69	10.45	13.67	0.291666
3	41.3	37.95	41.62	18.85	16.53	18.44	1
4	52.26	53.83	54.17	23.85	23.45	24.00	2
5	16.46	17.6	16.31	7.51	7.67	7.23	3
6	12.49	14.34	13.5	5.70	6.25	5.98	4
7	11.27	12.62	3	5.14	5.50	1.33	5

Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
T2-SIKA (Nitrate	Initially:			986.82	1123.04	1123.04	
0	10.69	9.58	12.44	4.88	4.17	5.51	0
1	167.63	148.32	154.96	76.51	64.62	68.66	0.083333
2	88.54	62.89	83	40.41	27.40	36.78	0.291666
3	100.3	110.15	113.21	45.78	47.99	50.16	1
4	153.16	143.69	143.23	69.90	62.61	63.47	2
5	43.05	47.1	44.75	19.65	20.52	19.83	3
6	34.04	36.73	34.93	15.54	16.00	15.48	4
7	32.51	34.75	32.03	14.84	15.14	14.19	5

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T2-SIKA (Sulfate	Initially:			36.74	41.81	41.81	
0	6.24	10.67	8.81	2.85	4.65	3.90	0
1	76.97	73.02	81.8	35.13	31.81	36.25	0.083333
2	57.69	23.53	34.93	26.33	10.25	15.48	0.291666
3	41.79	37.23	47.16	19.07	16.22	20.90	1
4	56.54	58.71	62.76	25.80	25.58	27.81	2
5	18.69	18.85	17.93	8.53	8.21	7.94	3
6	18.83	17.08	15.54	8.59	7.44	6.89	4
7	13.78	14.26	13.14	6.29	6.21	5.82	5

Cumulative Amount Leached, mg Observed				(Adding Rinse to Interval 1) Calculated (NEWBOX) (No Washoff or Washout)			Time d
Interval	Batch 1	mg Batch 2	Batch 3	Batch 1	mg Batch 2	Batch 3	
T2-SIKA (Chloride							
				0.00	0.00	0.00	0
1	4.10	3.61	9.50	3.44	2.77	6.26	0.083333
2	6.28	5.01	11.51	5.99	4.88	10.60	0.291666
3	8.76	7.19	13.96	9.66	8.01	16.01	1
4	11.78	10.10	16.90	11.90	10.10	18.43	2
5	12.75	11.13	17.91	12.97	11.25	18.93	3
6	13.52	11.91	18.66	13.52	11.93	18.53	4
7	14.14	12.53	19.11	13.80	12.35	17.64	5

Added in 106-AN				Newbox Estimate		
Ao =	65.61	74.67	74.67	14.1	13	19.2

Per cent of 106-AN ion leachable:	21%	17%	26%
Eff. Diffusion Coefficient, sq cm/s:	1.84E-06	1.34E-06	3.43E-06
Std. Deviation, sq cm/s:	3.78E-07	3.05E-07	1.71E-06
Leachability Index:	5.735	5.874	5.465
Upper 95% Confidence Int.:	0.097	0.109	0.286
Lower 95% Confidence Int.:	0.079	0.087	0.171

T2-SIKA (Nitrite							
				0.00	0.00	0.00	0
1	29.83	25.23	39.56	25.06	19.67	29.81	0.083333
2	45.52	35.68	53.23	43.85	34.92	51.48	0.291666
3	64.37	52.21	71.67	71.17	58.30	81.18	1
4	88.22	75.66	95.67	88.56	74.57	98.23	2
5	95.73	83.33	102.90	97.42	84.15	105.49	3
6	101.43	89.58	108.88	102.17	90.33	108.24	4
7	106.57	95.08	110.21	104.76	94.45	108.13	5

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Ao =	Added in 106-AN			Newbox Estimate		
	430.23	489.62	489.62	108	103	110
Per cent of 106-AN ion leachable:	25%			21%	22%	
Eff. Diffusion Coefficient, sq cm/s:	1.65E-06			1.06E-06	2.27E-06	
Std. Deviation, sq cm/s:	3.19E-07			2.09E-07	7.41E-07	
Leachability Index:	5.782			5.973	5.644	
Upper 95% Confidence Int.:	0.090			0.092	0.166	
Lower 95% Confidence Int.:	0.075			0.076	0.120	

T2-SIKA (Nitrate

				0.00	0.00	0.00	0
1	81.39	68.80	74.17	65.93	53.93	61.66	0.083333
2	121.79	96.20	110.95	115.74	95.63	108.25	0.291666
3	167.57	144.19	161.12	188.69	159.29	176.89	1
4	237.47	206.80	224.58	236.16	203.22	222.08	2
5	257.12	227.32	244.41	260.77	229.07	246.92	3
6	272.66	243.32	259.89	274.54	245.47	261.42	4
7	287.50	258.46	274.08	282.45	256.32	269.79	5

Ao =	Added in 106-AN			Newbox Estimate		
	986.82	1123.04	1123.04	293	278	279
Per cent of 106-AN ion leachable:	30%			25%	25%	
Eff. Diffusion Coefficient, sq cm/s:	1.55E-06			1.10E-06	1.45E-06	
Std. Deviation, sq cm/s:	3.46E-07			2.08E-07	2.60E-07	
Leachability Index:	5.811			5.959	5.838	
Upper 95% Confidence Int.:	0.106			0.088	0.083	
Lower 95% Confidence Int.:	0.085			0.073	0.070	

T2-SIKA (Sulfate

				0.00	0.00	0.00	0
1	37.98	36.46	40.15	33.28	25.20	30.63	0.083333
2	64.31	46.72	55.63	57.92	44.18	53.38	0.291666
3	83.38	62.94	76.52	92.24	71.93	85.61	1
4	109.18	88.52	104.33	112.23	89.80	105.16	2
5	117.71	96.73	112.28	121.13	99.01	114.76	3
6	126.31	104.17	119.16	125.26	104.23	119.43	4
7	132.60	110.38	124.99	127.19	107.12	121.16	5

Ao =	Added in 106-AN			Newbox Estimate		
	36.74	41.81	41.81	129	111	123

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Per cent of 106-AN ion leachable:	351%	265%	294%
Eff. Diffusion Coefficient, sq cm/s:	2.09E-06	1.54E-06	1.89E-06
Std. Deviation, sq cm/s:	4.98E-07	5.13E-07	5.32E-07
Leachability Index:	5.679	5.813	5.723
Upper 95% Confidence Int.:	0.114	0.170	0.139
Lower 95% Confidence Int.:	0.090	0.122	0.105

T2-SIKA (Nitrate + Nitrite

				0.00	0.00	0.00	0
1	111.21	94.02	113.74	90.80	73.53	91.24	0.083333
2	167.31	131.87	164.18	159.20	130.68	159.39	0.291666
3	231.94	196.40	232.79	259.60	217.55	257.95	1
4	325.69	282.46	320.25	324.00	277.75	319.94	2
5	352.85	310.65	347.31	357.20	313.18	351.89	3
6	374.09	332.90	368.77	376.00	335.66	369.22	4
7	394.07	353.54	384.29	386.40	350.90	377.30	5

	Added in 106-AN			Newbox Estimate		
Ao =	1417.06	1612.65	1612.65	400	381	385

Per cent of 106-AN ion leachable:	28%	24%	24%
Eff. Diffusion Coefficient, sq cm/s:	1.58E-06	1.09E-06	1.70E-06
Std. Deviation, sq cm/s:	3.40E-07	2.08E-07	3.76E-07
Leachability Index:	5.802	5.963	5.771
Upper 95% Confidence Int.:	0.102	0.089	0.105
Lower 95% Confidence Int.:	0.083	0.074	0.085

T2/SIKA-HIGH : Nitrate

T2/SIKA-HIGH : Nitrite

T2/SIKA-HIGH : Nitrate + Nitrite

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T2/SIKA-HIGH : Chloride

T2/SIKA-HIGH : Sulfate

M-51

ANSI/ANS-16.1-1986 Leaching Data

Phase II: Additives for 106-AN

Run No.: T2/SIKAL

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio 2 lb/gal

Chloride

Nitrite

Nitrate

Sulfate

5.32

34.87

79.99

2.98

Sample Cylinder Dimensions

After Curing 28 d

Initially

Batch 1

Batch 2

Batch 3

Vol, cc

2.53

Dia., cm

2.53

2.53

2.53

23.38

4.65

Length, cm

0.94

1.19

1.36

Grout Density, lb/gal

11.22

11.25

11.31

mL of 106-AN in Sample Cylinder

21.69

21.74

21.86

Leach Vol + Boric Acid Vol Added, mL

177.5

197.2

210.6

Leachate Concentrations

Mass in Leachate

mg/L

mg

Time

Interval

Batch 1

Batch 2

Batch 3

Batch 1

Batch 2

Batch 3

d

T2/SIKAL	Chloride	Initially:		115.32	115.63	116.25	
0	65.76	190.67	66.95	11.67	37.60	14.10	0
1	5.94	11.41	24.86	1.05	2.25	5.24	0.083333
2	3.53	4.78	28.37	0.63	0.94	5.97	0.291666
3	3.52	7.87	6.59	0.62	1.55	1.39	1
4	2.99	2.57	12.46	0.53	0.51	2.62	2
5	3	3	3	0.53	0.59	0.63	3
6	3.36	2.69	2.91	0.60	0.53	0.61	5
7	3	3	3	0.53	0.59	0.63	6

T2/SIKAL	Nitrite	Initially:		756.20	758.23	762.27	
0	798.62	1026.02	836.76	141.76	202.33	176.22	0
1	45.78	52.17	59.02	8.13	10.29	12.43	0.083333
2	21.06	19.84	49.44	3.74	3.91	10.41	0.291666
3	25.07	29.42	27.08	4.45	5.80	5.70	1
4	21.6	19.96	33.55	3.83	3.94	7.07	2
5	20	15	15	3.55	2.96	3.16	3
6	23.21	21	20.86	4.12	4.14	4.39	5
7	10	10	10	1.78	1.97	2.11	6

T2/SIKAL	Nitrate	Initially:		1734.50	1739.14	1748.41	
0	1550.7	2196.44	1634.82	275.25	433.14	344.29	0
1	113.23	87.7	91.59	20.10	17.29	19.29	0.083333
2	47.8	45.85	44.83	8.48	9.04	9.44	0.291666
3	67.53	59.39	48.5	11.99	11.71	10.21	1
4	49.52	45.37	50.18	8.79	8.95	10.57	2
5	35.3	31.09	31.29	6.27	6.13	6.59	3
6	61.1	52.53	53.16	10.85	10.36	11.20	5
7	20.69	18.73	21.91	3.67	3.69	4.61	6

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T2/SIKAL	Sulfate	Initially:		64.58	64.75	65.09	
0	256.26	247.57	277.45	45.49	48.82	58.43	0
1	13.37	11.43	11.95	2.37	2.25	2.52	0.083333
2	3.59	3.37	0	0.64	0.66	0.00	0.291666
3	2.84	2.42	1.99	0.50	0.48	0.42	1
4	2.46	0.96	2.13	0.44	0.19	0.45	2
5	1.57	0.9	0.72	0.28	0.18	0.15	3
6	2.77	3.36	1.54	0.49	0.66	0.32	5
7	0.44	0	0.42	0.08	0.00	0.09	6

Cumulative Amount Leached, mg			(Adding Rinse to Interval 1)			Time d
Observed			Calculated (NEWBOX)			
			(No Washoff or Washout)			
Interval	Batch 1	mg Batch 2	Batch 3	Batch 1	mg Batch 2	Batch 3

T2/SIKAL	Chloride						
				0.00	0.00	0.00	0
1	12.73	39.85	19.34	11.89	39.69	17.91	0.083333
2	13.35	40.79	25.31	15.70	44.51	26.77	0.291666
3	13.98	42.34	26.70	16.20	44.60	31.04	1
4	14.51	42.85	29.32	16.20	44.60	31.20	2
5	15.04	43.44	29.95	16.20	44.60	31.20	3
6	15.64	43.97	30.57	16.20	44.60	31.20	5
7	16.17	44.57	31.20	16.20	44.60	31.20	6

Added in 106-AN				Newbox Estimate		
Ao =	115.32	115.63	116.25	16.2	44.6	31.2

Per cent of 106-AN ion leachable:	14%	39%	27%
Eff. Diffusion Coefficient, sq cm/s:	7.82E-06	2.17E-05	6.16E-06
Std. Deviation, sq cm/s:	5.73E-06	1.03E-05	2.61E-06
Leachability Index:	5.107	4.663	5.210
Upper 95% Confidence Int.:	0.541	0.267	0.231
Lower 95% Confidence Int.:	0.234	0.164	0.150

T2/SIKAL	Nitrite						
				0.00	0.00	0.00	0
1	149.88	212.62	188.65	148.77	212.21	186.52	0.083333
2	153.62	216.53	199.06	170.49	234.77	219.67	0.291666
3	158.07	222.33	204.77	171.00	235.00	221.00	1
4	161.90	226.27	211.83	171.00	235.00	221.00	2
5	165.45	229.23	214.99	171.00	235.00	221.00	3
6	169.57	233.37	219.38	171.00	235.00	221.00	5
7	171.35	235.34	221.49	171.00	235.00	221.00	6

M-53

Ao =	Added in 106-AN			Newbox Estimate		
	756.20	758.23	762.27	171	235	221
Per cent of 106-AN ion leachable:	23%			31%	29%	
Eff. Diffusion Coefficient, sq cm/s:	1.42E-05			2.34E-05	2.02E-05	
Std. Deviation, sq cm/s:	7.68E-06			1.12E-05	9.72E-06	
Leachability Index:	4.849			4.631	4.694	
Upper 95% Confidence Int.:	0.325			0.273	0.273	
Lower 95% Confidence Int.:	0.184			0.166	0.166	

T2/SIKAL Nitrate

				0.00	0.00	0.00	0
1	295.35	450.43	363.58	290.84	448.00	360.67	0.083333
2	303.83	459.47	373.02	343.28	499.50	414.75	0.291666
3	315.82	471.19	383.24	345.00	500.00	416.00	1
4	324.61	480.13	393.81	345.00	500.00	416.00	2
5	330.87	486.26	400.39	345.00	500.00	416.00	3
6	341.72	496.62	411.59	345.00	500.00	416.00	5
7	345.39	500.32	416.20	345.00	500.00	416.00	6

Ao =	Added in 106-AN			Newbox Estimate		
	1734.50	1739.14	1748.41	345	500	416
Per cent of 106-AN ion leachable:	20%			29%	24%	
Eff. Diffusion Coefficient, sq cm/s:	1.24E-05			2.25E-05	2.26E-05	
Std. Deviation, sq cm/s:	7.12E-06			1.11E-05	1.30E-05	
Leachability Index:	4.905			4.649	4.646	
Upper 95% Confidence Int.:	0.353			0.283	0.356	
Lower 95% Confidence Int.:	0.192			0.170	0.193	

T2/SIKAL Sulfate

				0.00	0.00	0.00	0
1	47.86	51.07	60.95	47.89	51.11	61.03	0.083333
2	48.50	51.74	60.95	50.29	53.29	62.40	0.291666
3	49.00	52.22	61.37	50.30	53.30	62.40	1
4	49.44	52.41	61.82	50.30	53.30	62.40	2
5	49.72	52.58	61.97	50.30	53.30	62.40	3
6	50.21	53.25	62.29	50.30	53.30	62.40	5
7	50.29	53.25	62.38	50.30	53.30	62.40	6

Ao =	Added in 106-AN			Newbox Estimate		
	64.58	64.75	65.09	50.3	53.3	62.4

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Per cent of 106-AN ion leachable:	78%	82%	96%
Eff. Diffusion Coefficient, sq cm/s:	2.33E-05	3.44E-05	5.01E-05
Std. Deviation, sq cm/s:	7.70E-06	1.08E-05	1.69E-05
Leachability Index:	4.632	4.464	4.300
Upper 95% Confidence Int.:	0.168	0.158	0.172
Lower 95% Confidence Int.:	0.121	0.116	0.123

T2/SIKAL Nitrate + Nitrite

				0.00	0.00	0.00	0
1	445.23	663.05	552.23	438.93	660.19	545.49	0.083333
2	457.45	676.01	572.09	514.42	735.26	634.81	0.291666
3	473.89	693.52	588.00	517.00	736.00	638.00	1
4	486.51	706.40	605.64	517.00	736.00	638.00	2
5	496.33	715.49	615.39	517.00	736.00	638.00	3
6	511.29	729.99	630.97	517.00	736.00	638.00	5
7	516.74	735.66	637.69	517.00	736.00	638.00	6

	Added in 106-AN			Newbox Estimate		
Ao =	2490.71	2497.37	2510.68	517	736	638

Per cent of 106-AN ion leachable:	21%	29%	25%
Eff. Diffusion Coefficient, sq cm/s:	1.28E-05	2.26E-05	2.13E-05
Std. Deviation, sq cm/s:	7.41E-06	1.11E-05	1.16E-05
Leachability Index:	4.892	4.647	4.671
Upper 95% Confidence Int.:	0.357	0.283	0.327
Lower 95% Confidence Int.:	0.193	0.170	0.184

T2/SIKA-LOW : Nitrate

T2/SIKA-LOW : Nitrite

T2/SIKA-LOW : Nitrate + Nitrite

T2/SIKA-LOW : Chloride

T2/SIKA-LOW : Sulfate

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ANSI/ANS-16.1-1986 Leaching Data

Phase II: Additives for 106-AN

Run No.: T2/MSTR-2H

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio	15 lb/gal	Chloride	Nitrite	Nitrate	Sulfate
		5.32	34.87	79.99	2.98

Sample Cylinder Dimensions

After Curing 28 d

Initially			Batch 1	Batch 2	Batch 3
Vol, cc	2.50	Dia., cm	2.53	2.53	2.53
	22.83	4.65	4.57	4.38	4.35
Grout Density, lb/gal			15.68	15.63	15.80
mL of 106-AN in Sample Cylinder			14.20	14.16	14.31
Leach Vol + Boric Acid Vol Added, mL			468.3	453.2	450.8

Leachate Concentrations

Mass in Leachate

Interval	mg/L			mg			Time d
	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	
T2/MSTR- Chloride							
	Initially:			75.53	75.29	76.11	
0	5.02	2.88	1.06	2.35	1.31	0.48	0
1	7.55	7.59	9.87	3.54	3.44	4.45	0.083333
2	5.87	6.4	7.28	2.75	2.90	3.28	0.291666
3	9.65	9.9	9.2	4.52	4.49	4.15	1
4	7.56	7.81	7.14	3.54	3.54	3.22	2
5	5.37	5.47	4.89	2.51	2.48	2.20	3
6	4.35	4.62	3.78	2.04	2.09	1.70	4
7	3.4	3.16	2.92	1.59	1.43	1.32	5
T2/MSTR- Nitrite							
	Initially:			495.31	493.73	499.10	
0	12.08	25.15	9.46	5.66	11.40	4.26	0
1	56.13	57.79	74.23	26.29	26.19	33.46	0.083333
2	43.09	46.17	55.35	20.18	20.92	24.95	0.291666
3	74.37	75.96	74.75	34.83	34.43	33.70	1
4	58.72	61.01	55.55	27.50	27.65	25.04	2
5	41.4	42.84	38.56	19.39	19.42	17.38	3
6	31.74	32.39	29.86	14.86	14.68	13.46	4
7	24.36	23.36	23.04	11.41	10.59	10.39	5
T2/MSTR- Nitrate							
	Initially:			1136.08	1132.45	1144.77	
0	21.93	22.08	25.52	10.27	10.01	11.50	0
1	133.71	135.35	173.01	62.62	61.34	77.99	0.083333
2	101.43	108.05	128.04	47.50	48.97	57.72	0.291666
3	175.47	176.15	183.31	82.17	79.83	82.64	1
4	138.19	143.93	132.2	64.71	65.23	59.60	2
5	99.61	103.05	90.83	46.65	46.70	40.95	3
6	76.48	84.74	74.89	35.82	38.40	33.76	4
7	60.72	58.06	57.21	28.44	26.31	25.79	5

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T2/MSTR- Sulfate		Initially:			42.30	42.16	42.62	
0	18.08	30.2	14.18	8.47	13.69	6.39		0
1	45.65	46.51	54.43	21.38	21.08	24.54	0.083333	
2	30.36	31.11	38.23	14.22	14.10	17.23	0.291666	
3	48.76	50.48	54.25	22.83	22.88	24.46		1
4	40.78	44.2	38.5	19.10	20.03	17.36		2
5	29.43	32.9	26.98	13.78	14.91	12.16		3
6	25.98	25.98	21.41	12.17	11.77	9.65		4
7	20.37	21.37	20.04	9.54	9.68	9.03		5

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)			
Observed				Calculated (NEWBOX)			
				(No Washoff or Washout)			
				mg			Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d

T2/MSTR- Chloride					0.00	0.00	0.00	0
1	5.89	4.75	4.93	3.56	3.32	3.25	0.083333	
2	8.64	7.65	8.21	6.59	6.15	6.04	0.291666	
3	13.15	12.13	12.36	11.93	11.14	10.96		1
4	16.69	15.67	15.58	16.54	15.43	15.15		2
5	19.21	18.15	17.78	19.86	18.67	18.34		3
6	21.25	20.24	19.48	22.66	21.23	20.93		4
7	22.84	21.68	20.80	25.00	23.49	23.14		5

Added in 106-AN				Newbox Estimate		
Ao =	75.53	75.29	76.11	75.53	75.29	76.11

Per cent of 106-AN ion leachable:	100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:	6.12E-08	5.26E-08	4.93E-08
Std. Deviation, sq cm/s:	1.45E-08	9.48E-09	1.15E-08
Leachability Index:	7.213	7.279	7.307
Upper 95% Confidence Int.:	0.113	0.084	0.112
Lower 95% Confidence Int.:	0.090	0.070	0.089

T2/MSTR- Nitrite					0.00	0.00	0.00	0
1	31.94	37.59	37.73	24.37	25.77	25.75	0.083333	
2	52.12	58.51	62.68	45.12	47.69	47.66	0.291666	
3	86.95	92.94	96.38	81.73	85.91	85.85		1
4	114.45	120.59	121.42	112.93	118.99	118.79		2
5	133.84	140.00	138.80	136.21	143.18	143.24		3
6	148.70	154.68	152.26	155.03	162.93	162.71		4
7	160.11	165.27	162.65	170.88	179.72	179.68		5

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Added in 106-AN				Newbox Estimate		
Ao =	495.31	493.73	499.10	495.31	493.73	499.1

Per cent of 106-AN ion leachable:	100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:	6.70E-08	7.43E-08	7.22E-08
Std. Deviation, sq cm/s:	9.01E-09	1.37E-08	1.57E-08
Leachability Index:	7.174	7.129	7.141
Upper 95% Confidence Int.:	0.061	0.086	0.103
Lower 95% Confidence Int.:	0.053	0.071	0.083

T2/MSTR- Nitrate

				0.00	0.00	0.00	0
1	72.89	71.35	89.50	57.26	56.96	61.70	0.083333
2	120.39	120.32	147.22	106.00	105.54	114.13	0.291666
3	202.56	200.15	229.85	190.86	190.25	206.06	1
4	267.27	265.38	289.45	264.71	263.86	283.90	2
5	313.92	312.08	330.40	319.24	317.09	341.14	3
6	349.74	350.48	364.16	362.41	361.25	388.08	4
7	378.17	376.80	389.95	399.90	398.62	428.14	5

Added in 106-AN				Newbox Estimate		
Ao =	1136.08	1132.45	1144.77	1136.08	1132.45	1144.77

Per cent of 106-AN ion leachable:	100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:	7.03E-08	6.88E-08	7.89E-08
Std. Deviation, sq cm/s:	8.42E-09	7.85E-09	1.65E-08
Leachability Index:	7.153	7.162	7.103
Upper 95% Confidence Int.:	0.054	0.051	0.099
Lower 95% Confidence Int.:	0.048	0.046	0.080

T2/MSTR- Sulfate

				0.00	0.00	0.00	0
1	29.84	34.76	30.93	23.36	25.73	26.11	0.083333
2	44.06	48.86	48.16	41.71	45.69	45.99	0.291666
3	66.90	71.74	72.62	70.09	76.25	75.64	1
4	85.99	91.77	89.98	90.68	97.55	95.28	2
5	99.78	106.68	102.14	103.22	110.01	106.02	3
6	111.94	118.46	111.79	111.67	118.05	112.36	4
7	121.48	128.14	120.82	117.48	123.28	116.14	5

Added in 106-AN				Newbox Estimate		
Ao =	42.30	42.16	42.62	132	134	122

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Per cent of 106-AN ion leachable:	312%	318%	286%
Eff. Diffusion Coefficient, sq cm/s:	9.38E-07	1.10E-06	1.38E-06
Std. Deviation, sq cm/s:	1.67E-07	2.52E-07	2.39E-07
Leachability Index:	6.028	5.958	5.859
Upper 95% Confidence Int.:	0.082	0.109	0.080
Lower 95% Confidence Int.:	0.069	0.087	0.067

T2/MSTR- Nitrate + Nitrite

				0.00	0.00	0.00	0
1	104.83	108.94	127.22	81.57	82.77	87.45	0.083333
2	172.51	178.83	209.90	151.07	153.35	161.76	0.291666
3	289.51	293.08	326.23	272.44	276.45	290.96	1
4	381.72	385.96	410.87	376.85	382.15	402.75	2
5	447.76	452.08	469.20	455.16	460.21	484.94	3
6	498.44	505.16	516.42	517.15	523.63	550.70	4
7	538.28	542.06	552.60	570.98	577.29	606.59	5

	Added in 106-AN			Newbox Estimate		
Ao =	1631.38	1626.18	1643.87	1631.38	1626.18	1643.87

Per cent of 106-AN ion leachable:	100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:	6.93E-08	7.05E-08	7.68E-08
Std. Deviation, sq cm/s:	8.61E-09	9.61E-09	1.63E-08
Leachability Index:	7.159	7.152	7.114
Upper 95% Confidence Int.:	0.056	0.062	0.100
Lower 95% Confidence Int.:	0.050	0.054	0.081

T2/MSTR-2H : Nitrate

T2/MSTR-2H : Nitrite

T2/MSTR-2H : Nitrate + Nitrite

T2/MSTR-2H : Chloride

T2/MSTR-2H : Sulfate

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ANSI/ANS-16.1-1986 Leaching Data

Phase II: Additives for 106-AN

Run No.: T2/MSTR-L

Surrogate 106-AN Concentrations, mg/mL

Mix Ratio	2 lb/gal	Chloride	Nitrite	Nitrate	Sulfate
		5.32	34.87	79.99	2.98

Sample Cylinder Dimensions

After Curing 28 d

Initially		Batch 1	Batch 2	Batch 3
Vol, cc	2.53	2.53	2.51	2.50
23.38	4.65	0.74	0.71	0.75
Length, cm				
Grout Density, lb/gal		11.25	11.27	11.27
mL of 106-AN in Sample Cylinder		21.74	21.78	21.78
Leach Vol + Boric Acid Vol Added, mL		161	156.7	158.8

Leachate Concentrations

Mass in Leachate

Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
T2/MSTR- Chloride Initially: mg/L							
0	157.53	177.86	182.22	115.63	115.84	115.84	0
1	6.88	12.05	5.12	25.36	27.87	28.94	0.083333
2	5.08	6.05	3.6	1.11	1.89	0.81	0.291666
3	5.96	7.78	0	0.82	0.95	0.57	1
4	3.64	3.25	4.47	0.96	1.22	0.00	2
5	2.01	1.63	3.06	0.59	0.51	0.71	3
6	1.37	0	2.26	0.32	0.26	0.49	4
7	0.99	0.53	1.66	0.22	0.00	0.36	5
T2/MSTR- Nitrite Initially: mg							
0	1125.67	1232.42	1238.65	758.23	759.57	759.57	0
1	51.43	58.76	36.42	181.23	193.12	196.70	0.083333
2	32.39	41.69	24.57	8.28	9.21	5.78	0.291666
3	44.88	56.89	21.9	5.21	6.53	3.90	1
4	27.38	32.4	33.95	7.23	8.91	3.48	2
5	13.87	10.71	22.36	4.41	5.08	5.39	3
6	8.35	4.95	16.98	2.23	1.68	3.55	4
7	5.46	2.21	12.13	1.34	0.78	2.70	5
T2/MSTR- Nitrate Initially: mg							
0	2763.46	2998.54	3013.82	1739.14	1742.23	1742.23	0
1	119.84	129.54	86.7	444.92	469.87	478.59	0.083333
2	71.2	90.74	51.21	19.29	20.30	13.77	0.291666
3	105.85	130.93	97.01	11.46	14.22	8.13	1
4	57.77	63.69	80.13	17.04	20.52	15.41	2
5	26.99	25.75	47.93	9.30	9.98	12.72	3
6	18.37	10.21	35.2	4.35	4.04	7.61	4
7	9.48	4.04	24.13	2.96	1.60	5.59	5

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T2/MSTR- Sulfate			Initially:					
0	345.89	371.73	369.57	64.75	64.86	64.86	0	
1	10.93	12.45	7.31	55.69	58.25	58.69	0.083333	
2	6.59	7.64	3.04	1.76	1.95	1.16	0.291666	
3	7.22	9.15	10.61	1.06	1.20	0.48	1	
4	4.56	3.64	4.14	1.16	1.43	1.68	2	
5	2.43	0	2.95	0.73	0.57	0.66	3	
6	1.91	0	1.9	0.39	0.00	0.47	4	
7	1.07	1.26	1.72	0.31	0.00	0.30	5	
				0.17	0.20	0.27		

Cumulative Amount Leached, mg				(Adding Rinse to Interval 1)				
Observed				Calculated (NEWBOX)				
				(No Washoff or Washout)				
mg				mg				Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3		d
T2/MSTR- Chloride								
				0.00	0.00	0.00		0
1	26.47	29.76	29.75	26.40	29.75	29.76	0.083333	
2	27.29	30.71	30.32	29.47	32.77	32.09	0.291666	
3	28.25	31.93	30.32	29.50	32.80	32.10		1
4	28.83	32.44	31.03	29.50	32.80	32.10		2
5	29.16	32.69	31.52	29.50	32.80	32.10		3
6	29.38	32.69	31.88	29.50	32.80	32.10		4
7	29.54	32.77	32.14	29.50	32.80	32.10		5

M-65

Added in 106-AN				Newbox Estimate		
Ao =	758.23	759.57	759.57	211	225.7	223
Per cent of 106-AN ion leachable:				28%	30%	29%
Eff. Diffusion Coefficient, sq cm/s:				1.13E-05	1.02E-05	1.19E-05
Std. Deviation, sq cm/s:				4.35E-06	3.45E-06	5.42E-06
Leachability Index:				4.946	4.990	4.926
Upper 95% Confidence Int.:				0.203	0.172	0.255
Lower 95% Confidence Int.:				0.138	0.123	0.160

T2/MSTR- Nitrate

				0.00	0.00	0.00	0
1	464.21	490.17	492.36	462.97	488.70	490.31	0.083333
2	475.67	504.39	500.49	510.49	540.66	545.45	0.291666
3	492.72	524.91	515.90	511.00	541.20	546.00	1
4	502.02	534.89	528.62	511.00	541.20	546.00	2
5	506.36	538.92	536.24	511.00	541.20	546.00	3
6	509.32	540.52	541.83	511.00	541.20	546.00	4
7	510.85	541.15	545.66	511.00	541.20	546.00	5

Added in 106-AN				Newbox Estimate		
Ao =	1739.14	1742.23	1742.23	511	541.2	546
Per cent of 106-AN ion leachable:				29%	31%	31%
Eff. Diffusion Coefficient, sq cm/s:				1.18E-05	1.09E-05	1.15E-05
Std. Deviation, sq cm/s:				4.17E-06	3.59E-06	5.28E-06
Leachability Index:				4.927	4.964	4.938
Upper 95% Confidence Int.:				0.182	0.168	0.256
Lower 95% Confidence Int.:				0.128	0.121	0.160

T2/MSTR- Sulfate

				0.00	0.00	0.00	0
1	57.45	60.20	59.85	57.50	60.17	59.88	0.083333
2	58.51	61.40	60.33	61.29	63.59	63.69	0.291666
3	59.67	62.83	62.02	61.30	63.60	63.70	1
4	60.41	63.40	62.67	61.30	63.60	63.70	2
5	60.80	63.40	63.14	61.30	63.60	63.70	3
6	61.10	63.40	63.44	61.30	63.60	63.70	4
7	61.28	63.60	63.72	61.30	63.60	63.70	5

Added in 106-AN				Newbox Estimate		
Ao =	64.75	64.86	64.86	61.3	63.6	63.7

M-66

Per cent of 106-AN ion leachable:	95%	98%	98%
Eff. Diffusion Coefficient, sq cm/s:	1.44E-05	1.43E-05	1.49E-05
Std. Deviation, sq cm/s:	4.45E-06	3.26E-06	5.37E-06
Leachability Index:	4.842	4.845	4.828
Upper 95% Confidence Int.:	0.155	0.109	0.188
Lower 95% Confidence Int.:	0.114	0.087	0.131

T2/MSTR- Nitrate + Nitrite

				0.00	0.00	0.00	0
1	653.72	692.50	694.84	651.97	691.07	692.87	0.083333
2	670.40	713.25	706.88	721.28	766.23	768.23	0.291666
3	694.67	742.68	725.76	722.00	767.00	769.00	1
4	708.38	757.74	743.88	722.00	767.00	769.00	2
5	714.96	763.45	755.04	722.00	767.00	769.00	3
6	719.26	765.83	763.32	722.00	767.00	769.00	4
7	721.66	766.81	769.08	722.00	767.00	769.00	5

	Added in 106-AN			Newbox Estimate		
Ao =	2497.37	2501.80	2501.80	722	767	769

Per cent of 106-AN ion leachable:	29%	31%	31%
Eff. Diffusion Coefficient, sq cm/s:	1.17E-05	1.08E-05	1.17E-05
Std. Deviation, sq cm/s:	4.29E-06	3.61E-06	5.34E-06
Leachability Index:	4.933	4.968	4.932
Upper 95% Confidence Int.:	0.192	0.171	0.255
Lower 95% Confidence Int.:	0.133	0.123	0.159

M-67

T2/MSTR-LOW : Nitrate

T2/MSTR-LOW : Nitrite

T2/MSTR-LOW : Nitrate + Nitrite

T2/MSTR-LOW : Chloride

T2/MSTR-LOW : Sulfate

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