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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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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:

Compound*	Quantity, g
$Al(NO_3)_3.9H_2O$	1580.
Na_2SO_4	44.0
NaCl	87.7
NaF	3.40
$Ca(NO_3)_2.4H_2O$	4.72
$Na_2B_4O_7.10H_2O$	1.91
$Cu(NO_3)_2.3H_2O$	0.10
$Fe(NO_3)_3.9H_2O$	0.81
NaOH (50 wt % aqueous solution)	1887.
$NaNO_3$	23.0
$NaNO_2$	523.
Na_2CO_3	405.
HEDTA	52.9
Na_4EDTA	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):

Compound*	Quantity, g
$Na_3PO_4.12H_2O$	589.
$Na_3C_6H_5O_7.2H_2O$ (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/SQRT(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 NO_3+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	0.01184809	-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, attapulgite 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 x 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 x 7 matrix **U** correspond to the intercept, cement, flyash, attapulgite clay, slag, flyash*attapulgite clay, attapulgite clay^2 terms in the final reduced model. Next, let the 1 x 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 <u>transformed</u> properties (denoted generally as y) from the fitted second-order polynomial models are given below:

<u>Mean Prediction</u>

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

<u>Individual Prediction</u>

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

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 $NO_3 + NO_2$	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

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	33.5
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
1.89	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	5.04	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

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	0.85	1.90	4.23	66	0.3	346	5.7	18.0	23.3	30.8

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	295	5.6	17.5	24.1	35.5

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	3.0	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

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

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

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	29.8	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

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

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	3.86	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

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	2.82	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
1.69	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
2.61	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
1.83	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
2.36	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	33.6	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
1.96	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	33.3	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	33.8	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
2.88	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	2.78	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	3.82	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	3.59	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	3.8	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	48.3
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	63	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	CS	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
2.32	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	696	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
2.37	3.20	1.83	0.86	52	0.2	660	5.8	27.3	39.3	50.0
3.11	1.96	1.94	2.89	65	0.2	822	5.9	28.3	37.5	50.0
1.93	5.33	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
2.35	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

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	1.18	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	3.79	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	38	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	790	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	3.85	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	28	0.8	552	5.6	26.9	37.8	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	23	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	3.87	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
2.39	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
2.78	2.92	0.69	2.50	21	3.1	581	5.7	26.6	36.9	52.4
2.62	3.24	0.69	2.58	22	3.2	600	5.8	26.0	37.1	52.4
2.15	5.16	1.12	0.81	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	3.34	31	0.8	629	5.8	28.8	37.8	52.5
2.95	2.67	1.82	2.28	58	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
2.28	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	2.79	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	2.83	1.58	2.06	43	0.3	666	5.8	28.7	39.4	52.6
2.41	3.86	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	23	2.8	609	5.8	27.9	37.4	52.6
2.42	3.84	1.33	1.89	37	0.6	645	5.8	27.1	39.6	52.6
2.39	3.97	0.57	0.50	15	8.1	717	5.6	22.5	35.8	52.6
2.38	4.02	1.48	0.68	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	0.99	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	1.85	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
2.88	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	4.96	1.23	0.99	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	1.87	21	2.5	655	5.8	29.3	36.6	53.3
2.48	3.90	1.85	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	41.3	53.4

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	28.8	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	0.08	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
2.38	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	2.98	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	2.19	36	0.4	680	5.8	29.4	39.7	54.1
2.51	4.08	0.90	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	1.10	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	3.92	1.46	1.59	42	0.4	728	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
2.48	4.26	1.60	0.32	47	0.3	854	5.9	29.3	43.0	54.2

Cement	Fly Ash	Att	Slag	CFR	DL	CS	Li	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	1.85	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	0.99	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	4.83	0.64	0.16	18	4.6	950	5.7	25.3	39.4	55.7
2.52	4.88	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	1.66	0.37	48	0.3	943	6.0	30.6	44.3	55.7
2.76	3.95	0.54	0.67	17	6.7	808	5.7	26.0	38.3	55.7
2.97	3.49	1.91	1.35	65	0.2	985	6.1	31.7	43.5	55.8
3.03	3.38	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	3.88	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	0.92	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	5.61	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	1.8	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

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

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	4.60	0.96	0.47	26	0.9	1058	6.0	32.1	44.0	60.0
3.14	4.89	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
3.38	4.53	1.51	0.24	42	0.2	1223	6.2	34.5	46.4	60.4

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
Attapulgite mix ratio:	< 1.5 lb/gal

Cement wt%	Fly Ash wt%	Attapulgite wt%	Slag wt%	Mix Ratio, lb/gal	Critical Flow Rate, gpm	Drainable Liquids, vol%	Compressive Strength, psi	Leachability Index	ΔT-10 hr °C	ΔT-24 hr °C	ΔT-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	15	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%	Attapulgite wt%	Slag wt%	Mix Ratio, lb/gal	Critical Flow Rate, gpm	Drainable Liquids, vol%	Compressive Strength, psi	Leachability Index	ΔT-10 hr °C	ΔT-24 hr °C	ΔT-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%	Attapulgite wt%	Slag wt%	Mix Ratio, lb/gal	Critical Flow Rate, gpm	Drainable Liquids, vol%	Compressive Strength, psi	Leachability Index	ΔT-10 hr °C	ΔT-24 hr °C	ΔT-100 hr °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%	Attapulgite wt%	Slag wt%	Mix Ratio, lb/gal	Critical Flow Rate, gpm	Drainable Liquids, vol%	Compressive Strength, psi	Leachability Index	ΔT-10 hr °C	ΔT-24 hr °C	ΔT-100 hr °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 2lb/gal
PORT2-H : Type II-LA Portland Cement 15lb/gal

BFS-L : Ground Granulated Blast Furnace Slag 2lb/gal
BFS-H : Ground Granulated Blast Furnace Slag 15lb/gal

FFLY-L : Class F Fly Ash 2lb/gal
FFLY-H : Class F Fly Ash 15lb/gal

PORT5-l : Type V Portland Cement 2lb/gal
PORT5-H : Type V Portland Cement 15lb/gal

HCEM-L : Class H Cement 2lb/gal
HCEM-H : Class H Cement 15lb/gal

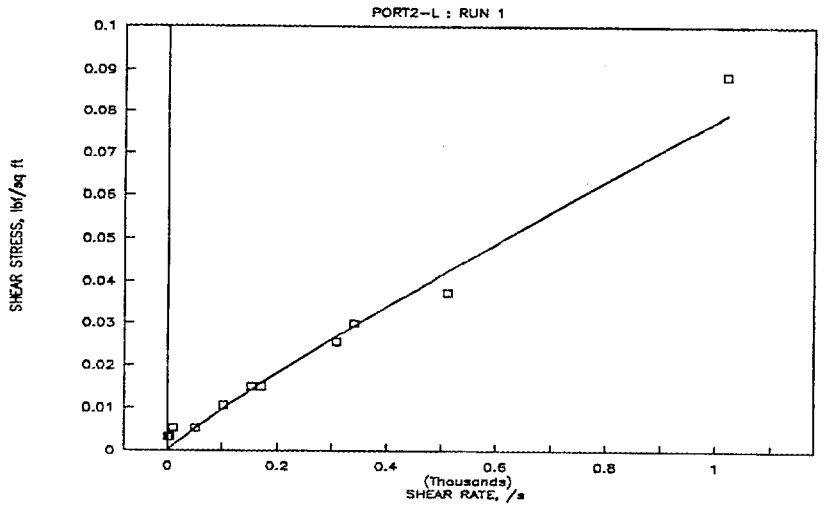
FANN VISCOMETER READINGS FOR PORT2-L

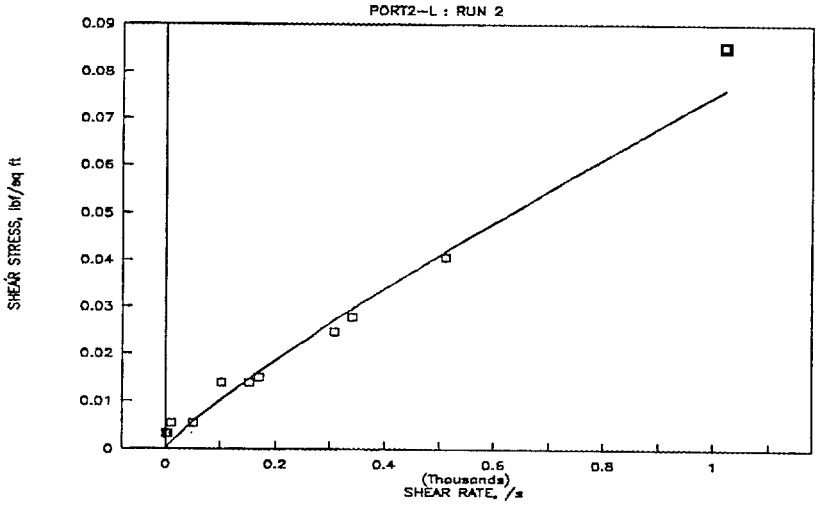
TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

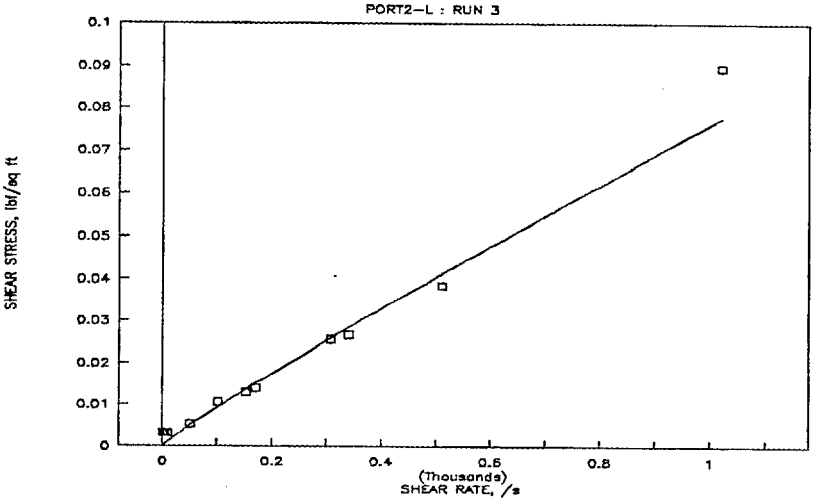
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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

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


PORT2-L : RUN 1
SHEAR STRESS, lbf/sq ft
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


PORT2-L : RUN 2
SHEAR STRESS, lbf/sq ft
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


PORT2-L : RUN 3
SHEAR STRESS, lbf/sq ft
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR PORT2-L

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID 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%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR PORT2-L
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
RUN 1	60.2	2	0.625	2	533	426	133
RUN 2	67.1	2	0.625	2	618	494	155
RUN 3	72.5	2	0.625	2	454	363	114
					AVERAGE	428	133.75
					STD. DEV.	53.57	16.74

THERMAL CYCLING FOR PORT2-L

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 10

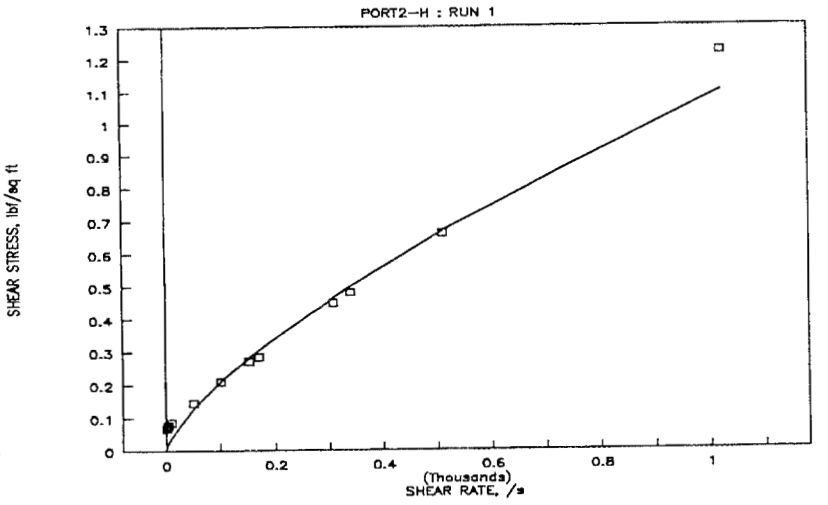
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	40.8	2	0.5	2	513	513	128
RUN 2	48.2	2	0.5	2	619	619	155
RUN 3	49.6	2	0.375	2	223	297	56
					AVERAGE	476.44	112.92
					STD. DEV.	133.84	41.85
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
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

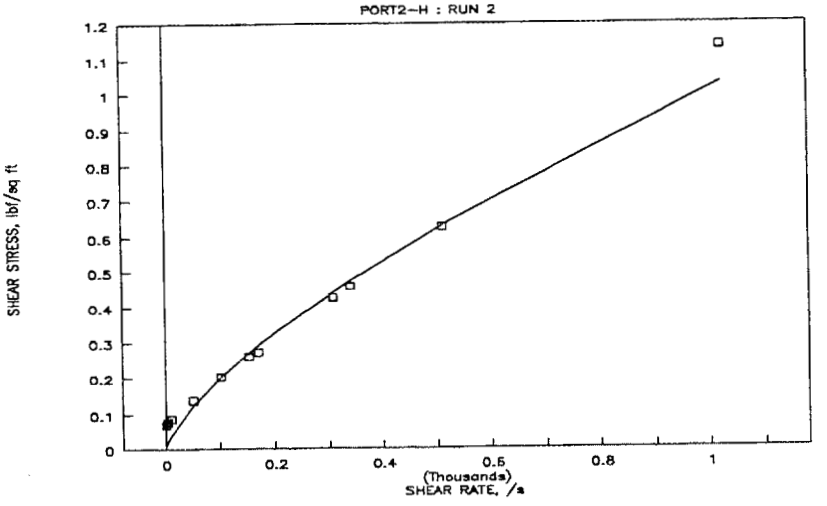
FANN VISCOMETER READINGS FOR PORT2-H

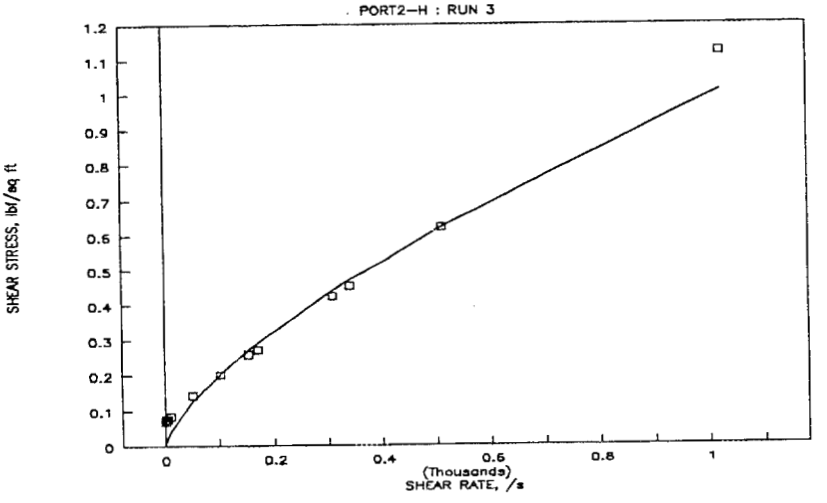
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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


PORT2-H : RUN 1
SHEAR STRESS, lbf/sq ft
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


PORT2-H : RUN 2
SHEAR STRESS, lbf/sq ft
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


PORT2-H : RUN 3
SHEAR STRESS, lbf/sq ft
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR PORT2–H

LIQUID DENSITY, g/mL: 1.21

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

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR PORT2-H
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
RUN 1	257	2	2	2	14080	3520	3520
RUN 2	257	2	2	2	13030	3258	3258
RUN 3	257.2	2	2	2	15120	3780	3780
					AVERAGE	3519.17	3519.17
					STD. DEV.	213.31	213.31

THERMAL CYCLING FOR PORT2-H

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 10

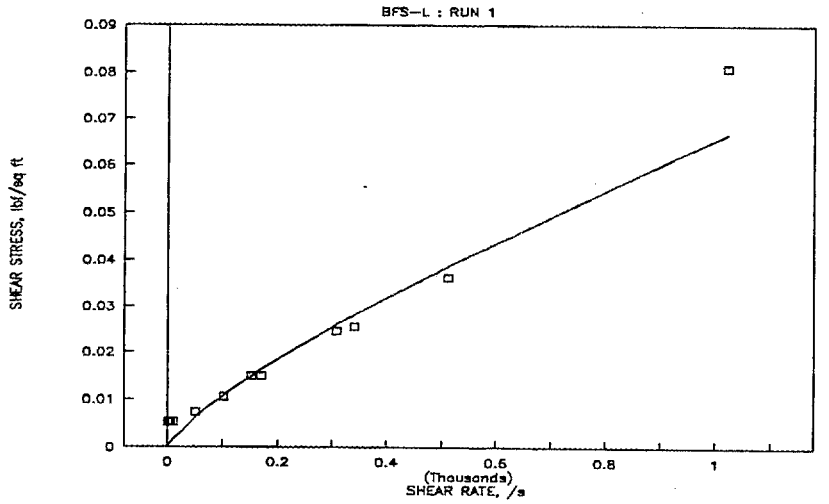
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	230	2	2	2	16670	4168	4168
RUN 2	231.4	2	2	2	15810	3953	3953
RUN 3	228.1	2	2	2	16990	4248	4248
					AVERAGE	4122.5	4122.5
					STD. DEV.	124.57	124.57
	COMPARATOR NOT SUBJECTED TO THERMAL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

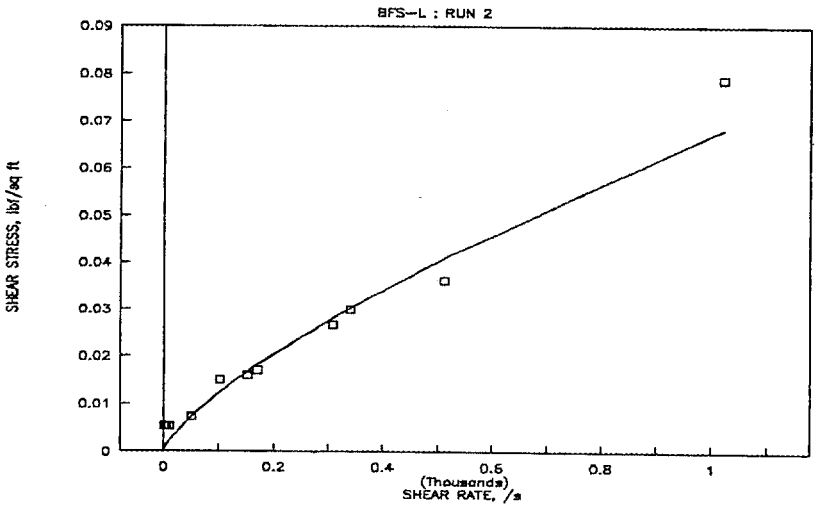
FANN VISCOMETER READINGS FOR BFS-L

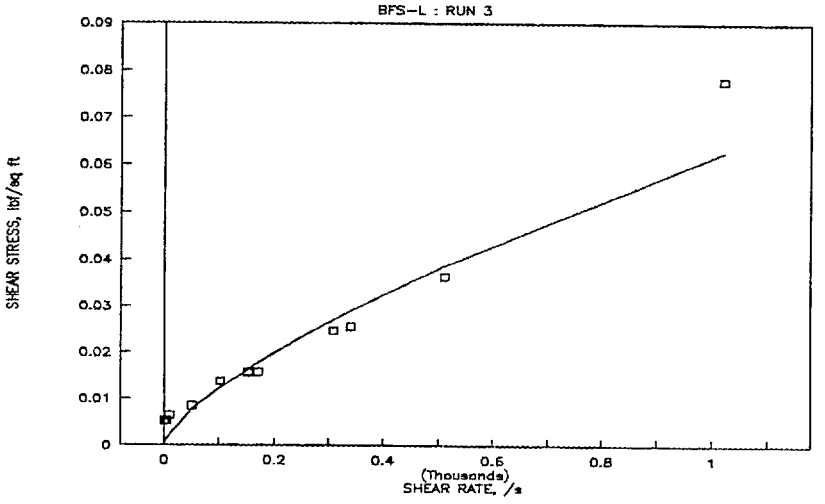
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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	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


BFS-L : RUN 1
SHEAR STRESS, lbf/sq ft
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


BFS-L : RUN 2
SHEAR STRESS, lbf/sq ft
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


BFS-L : RUN 3
SHEAR STRESS, lbf/sq ft
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR BFS-L

LIQUID DENSITY, g/mL: 1.21

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

TIME d	RUN 1 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID 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%

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

CURE TIME, d: 28

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

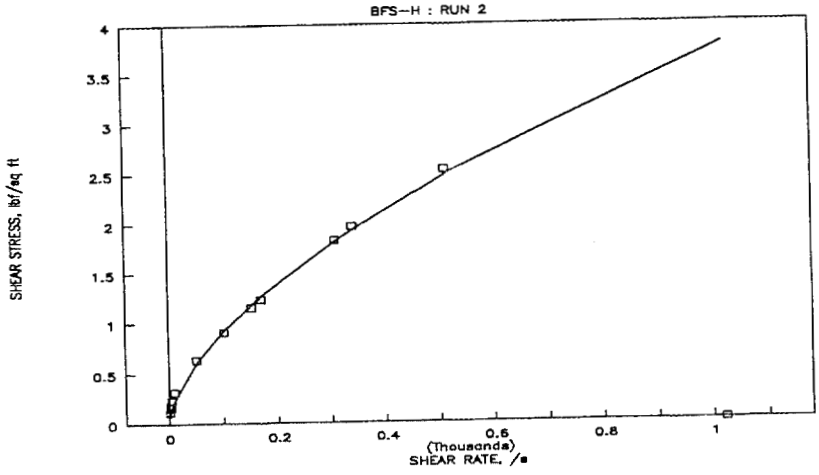
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	47.8	2	0.75	2	1306	871	327
RUN 2	46.2	2	0.625	2	1063	850	266
RUN 3	45.2	2	0.625	2	994	795	249
					AVERAGE	838.76	280.25
					STD. DEV.	31.89	33.45
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
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

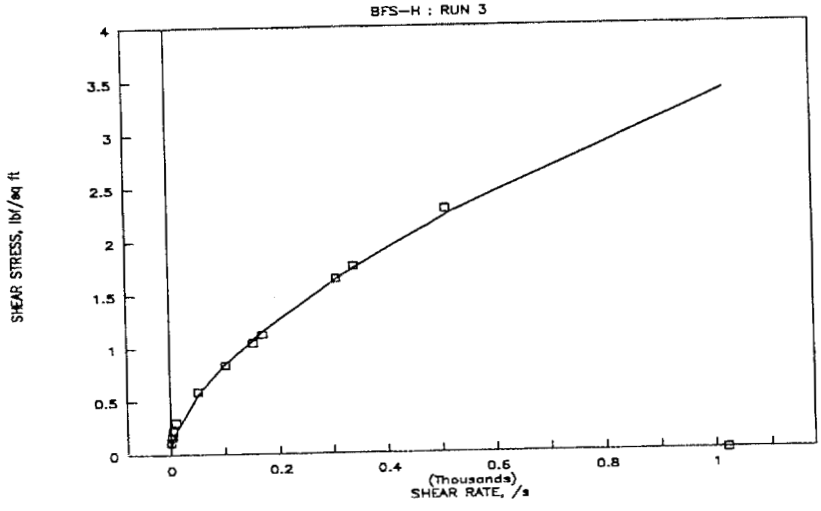
FANN VISCOMETER READINGS FOR BFS-H

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


BFS-H : RUN 2
SHEAR STRESS, lbf/sq ft
0
0.5
1
1.5
2
2.5
3
3.5
4
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


BFS-H : RUN 3
SHEAR STRESS, lbf/sq ft
0
0.5
1
1.5
2
2.5
3
3.5
4
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR BFS–H

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID 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%

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

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
RUN 1	245.1	2	2	2	19990	4998	4998
RUN 2	247	2	2	2	24470	6118	6118
RUN 3	246.8	2	1.75	2	21910	6260	5478
					AVERAGE	5791.67	5530.83
					STD. DEV.	564.57	458.79

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
	g	L	W	H	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

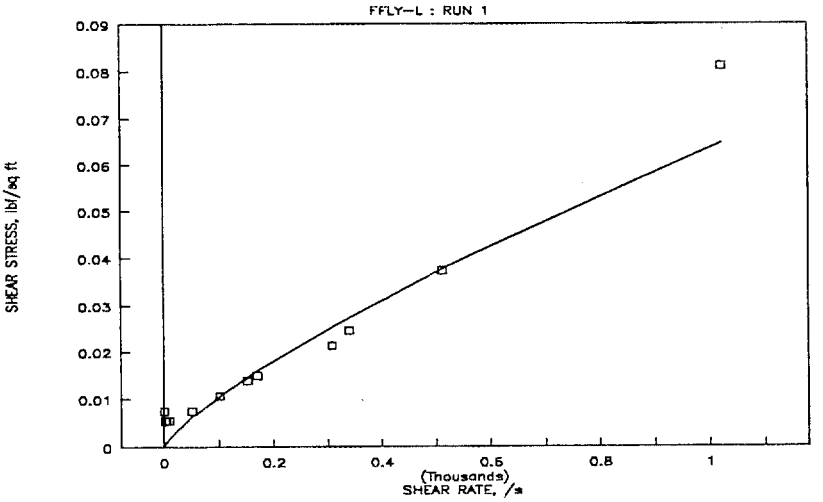
RPM	READING		
	RUN 1	RUN 2	RUN 3
600	52.0	50.3	51.4
300	26.7	25.9	26.0
200	18.4	18.0	18.0
100	10.3	10.0	10.4
181	17.3	16.7	16.7
90	9.7	10.0	9.5
60	7.3	7.2	7.3
30	4.8	4.8	4.8
6	2.2	2.5	2.7
3	1.8	2.5	2.3
1.8	1.8	2.3	1.7
0.9	1.5	1.8	1.5

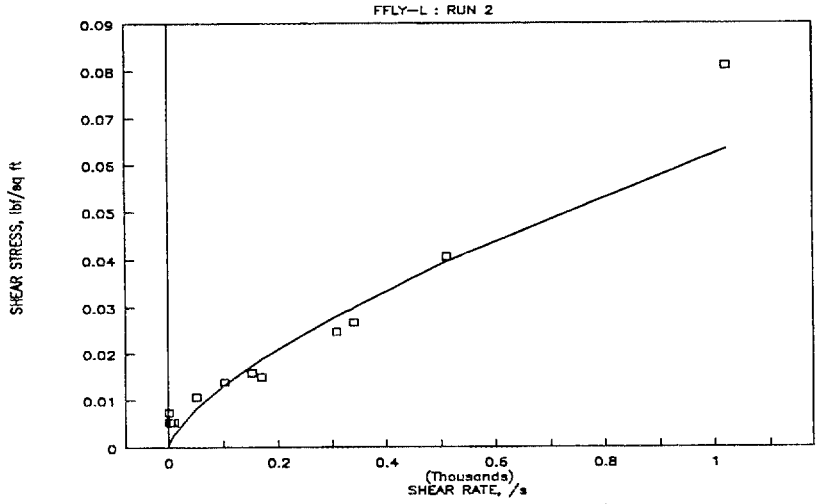
FANN VISCOMETER READINGS FOR FFLY-L

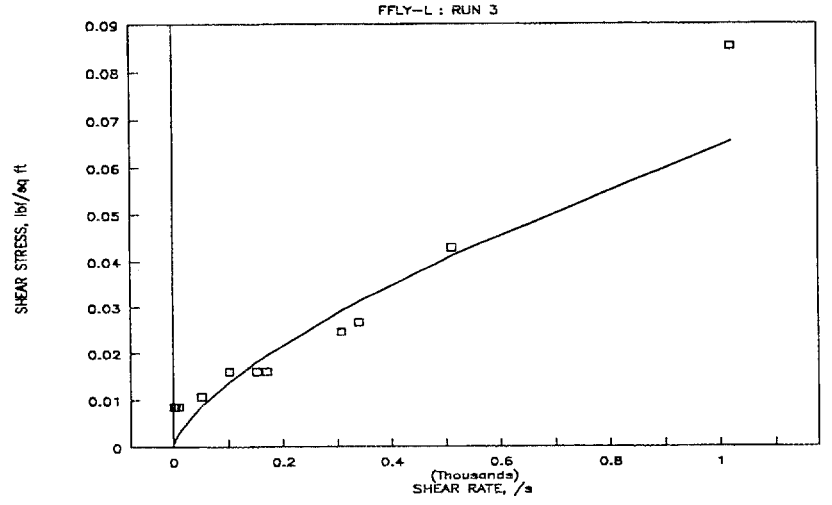
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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	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


FFLY-L : RUN 1
SHEAR STRESS, lbf/sq ft
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


FFLY-L : RUN 2
SHEAR STRESS, lbf/sq ft
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


FFLY-L : RUN 3
SHEAR STRESS, lbf/sq ft
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR FFLY-L

LIQUID DENSITY, g/mL: 1.21

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

TIME d	RUN 1 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID vol%
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%

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

CURE TIME, d: 28

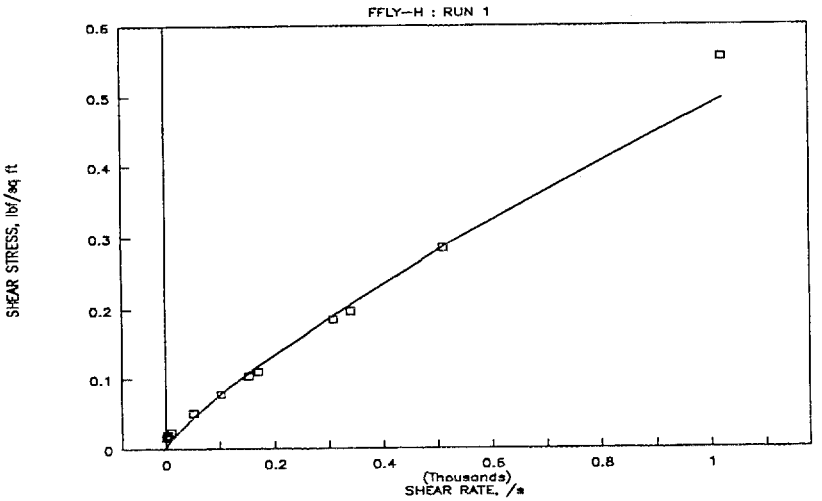
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
RUN 1	45.7	2	0.375	2	1607	2143	402
RUN 2	54.4	2	0.375	2	1682	2243	421
RUN 3	50.8	2	0.375	2	1583	2111	396
					AVERAGE	2165.33	406
					STD. DEV.	56.22	10.54

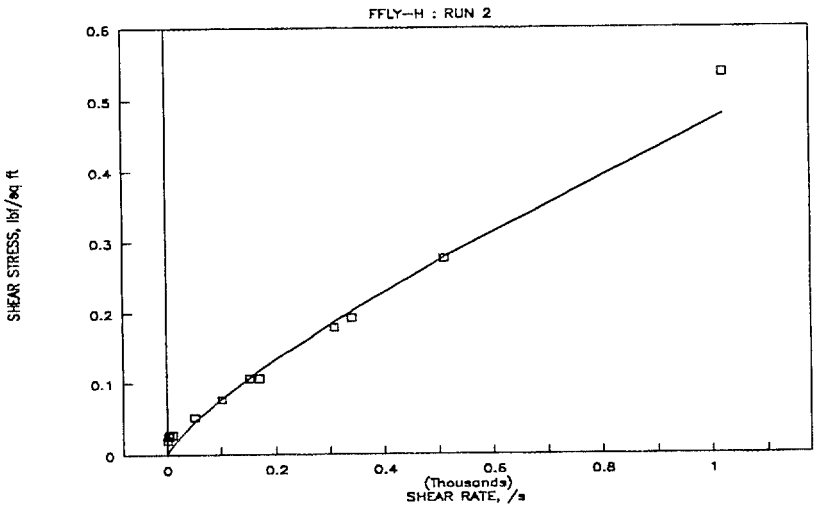
THERMAL CYCLING FOR FFLY-L

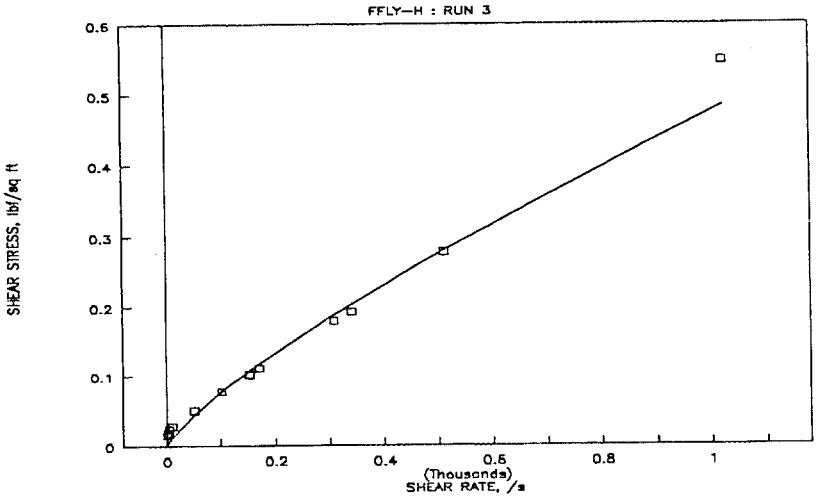
CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 11

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


FFLY-H : RUN 1
SHEAR STRESS, lbf/sq ft
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


FFLY-H : RUN 2
SHEAR STRESS, lbf/sq ft
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


FFLY-H : RUN 3
SHEAR STRESS, lbf/sq ft
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR FFLY-H

LIQUID DENSITY, g/mL: 1.21

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

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

CURE TIME, d: 28

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

THERMAL CYCLING FOR FFLY-H

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 10

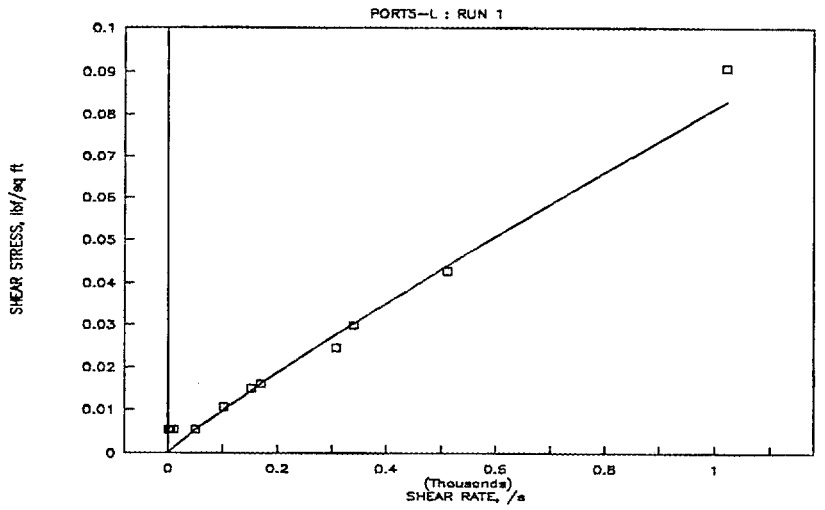
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	153.5	2	1.875	2	3649	973	912
RUN 2	152.1	2	1.875	2	3479	928	870
RUN 3	151	2	1.875	2	3451	920	863
					AVERAGE	940.36	881.58
					STD. DEV.	23.33	21.87
	COMPARATOR NOT SUBJECTED TO THERMAL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

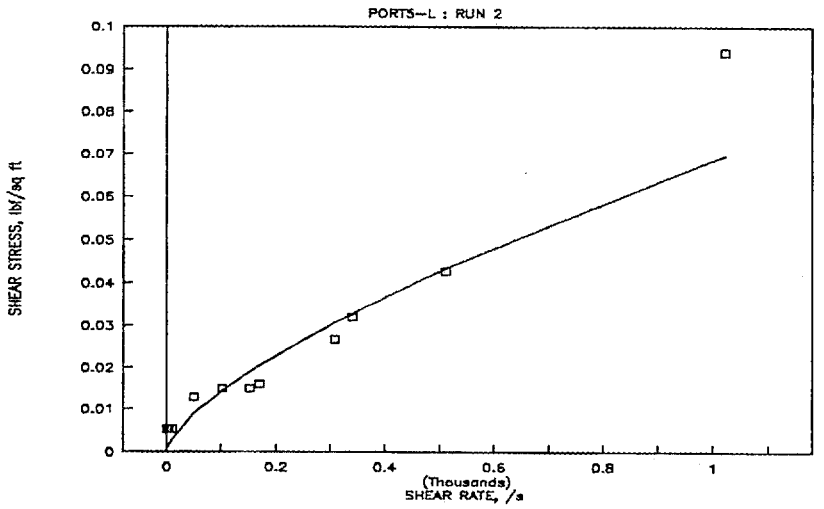
FANN VISCOMETER READINGS FOR PORT5-L

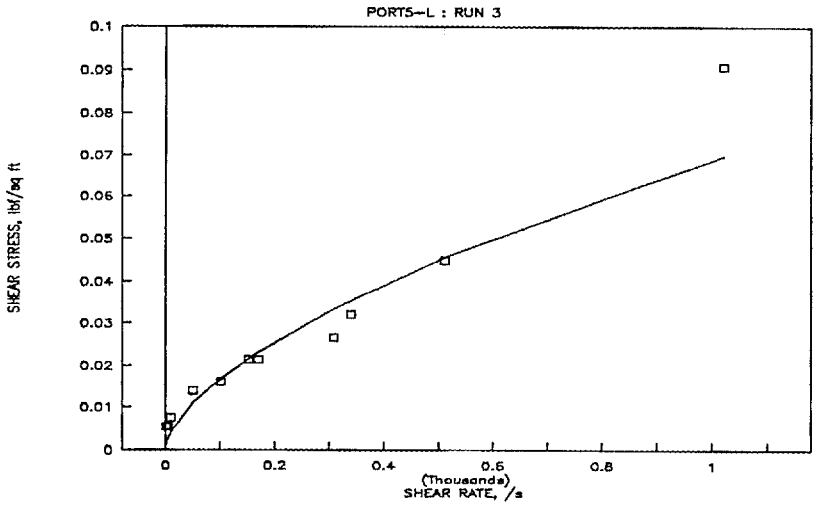
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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	8.8	8.5
300	4.0	4.0	4.2
200	2.8	3.0	3.0
100	1.5	1.5	2.0
181	2.3	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


PORTS-L : RUN 1
SHEAR STRESS, lbf/sq ft
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


PORTS-L : RUN 2
SHEAR STRESS, lbf/sq ft
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


PORTS-L : RUN 3
SHEAR STRESS, lbf/sq ft
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR PORT5-L

LIQUID DENSITY, g/mL: 1.21

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

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR PORT5-L
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
RUN 1	60	2	1.5	2	416	139	104
RUN 2	61.2	2	1.5	2	677	226	169
RUN 3	64	2	1.5625	2	675	216	169
					AVERAGE	193.44	147.33
					STD. DEV.	38.93	30.64

THERMAL CYCLING FOR PORT5-L

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 10

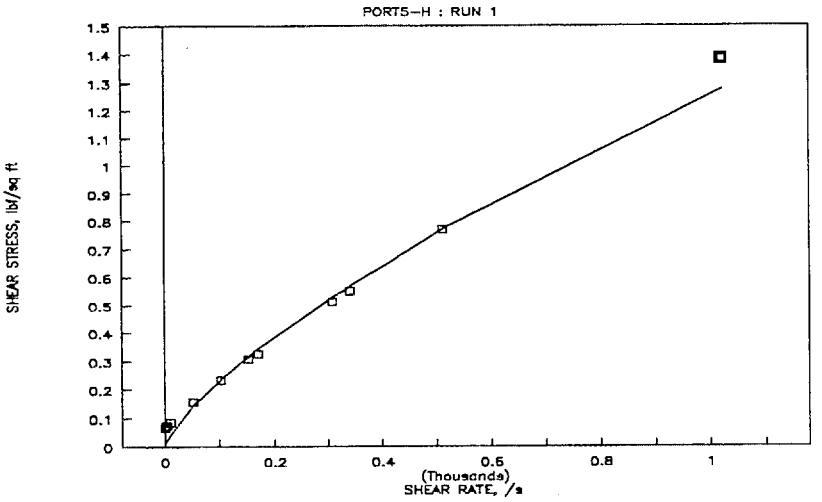
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1		2	1.5	2	1073	358	268
RUN 2		2	1.375	2	1135	413	284
RUN 3		2	1.5625	2	991	317	248
					AVERAGE	362.50	266.58
					STD. DEV.	39.18	14.74
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
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

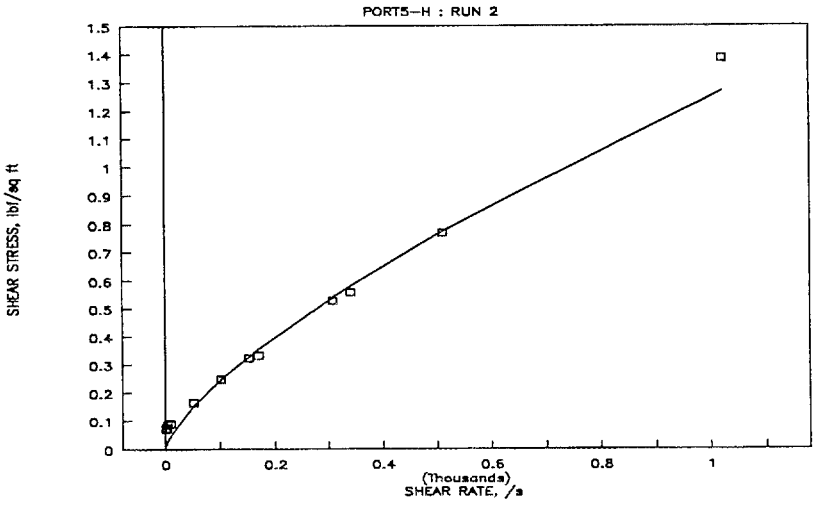
FANN VISCOMETER READINGS FOR PORT5-H

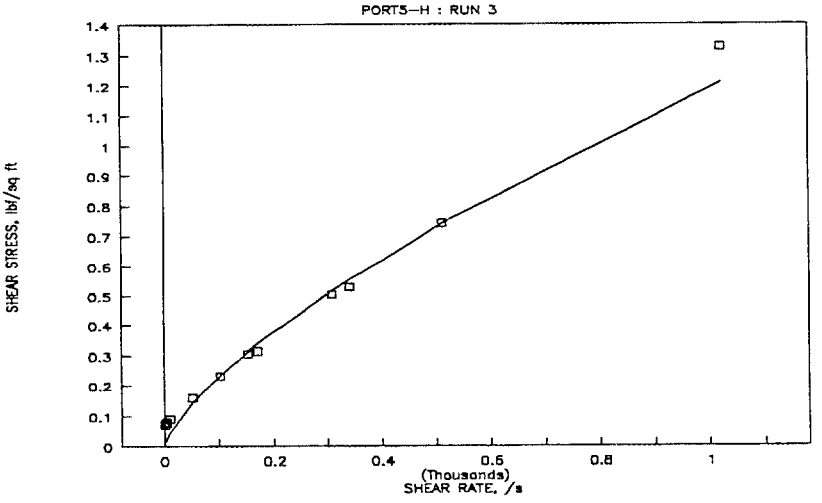
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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


PORT5-H : RUN 1
SHEAR STRESS, lbf/sq ft
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


PORT5-H : RUN 2
SHEAR STRESS, lbf/sq ft
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


PORT5-H : RUN 3
SHEAR STRESS, lbf/sq ft
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR PORT5-H

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. 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%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR PORT5-H
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
RUN 1	257.6	2	2	2	17740	4435	4435
RUN 2	259.6	2	2	2	16590	4148	4148
RUN 3	252.8	2	2	2	17280	4320	4320
					AVERAGE	4300.83	4300.83
					STD. DEV.	118.15	118.15

THERMAL CYCLING FOR PORT5-H

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 10

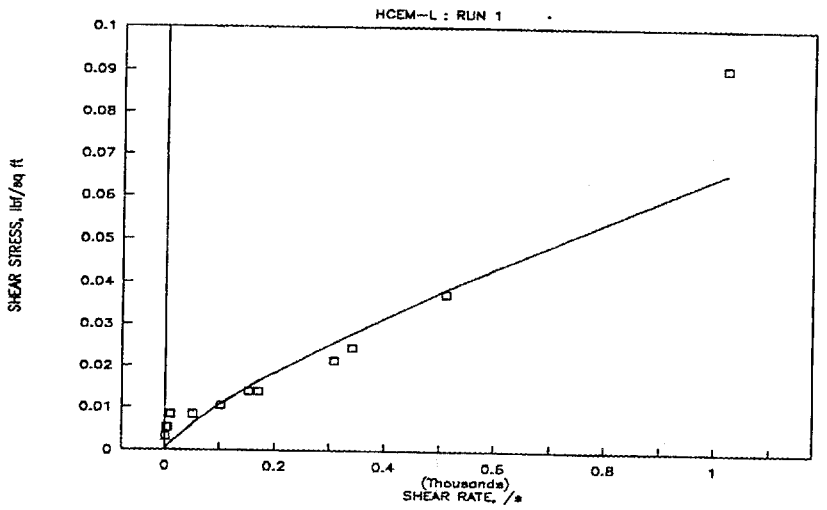
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1		2	2	2	17180	4295	4295
RUN 2		2	2	2	17650	4413	4413
RUN 3		2	2	2	18320	4580	4580
					AVERAGE	4429.17	4429.17
					STD. DEV.	116.95	116.95
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
RUN 1	256.1	2	2	2	16520	4130	4130
RUN 2	257.5	2	2	2	15940	3985	3985
RUN 3	255.6	2	2	2	17020	4255	4255
					AVERAGE	4123.33	4123.33
					STD. DEV.	110.33	110.33

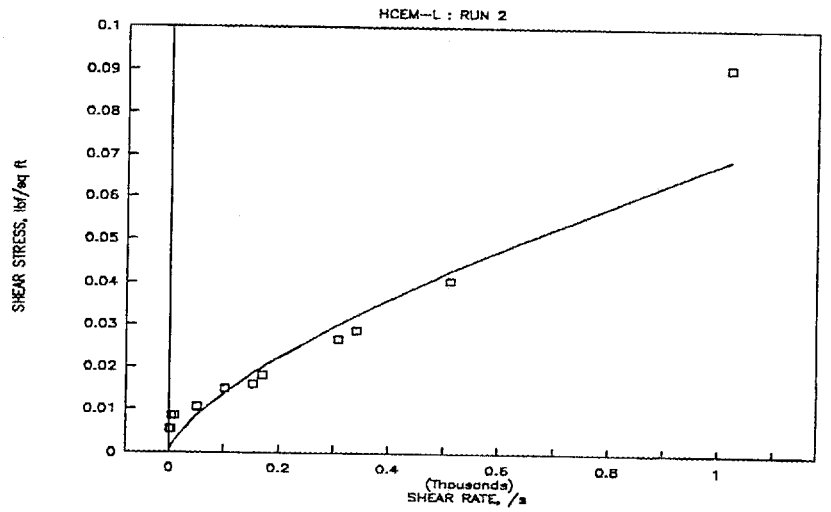
FANN VISCOMETER READINGS FOR HCEM-L

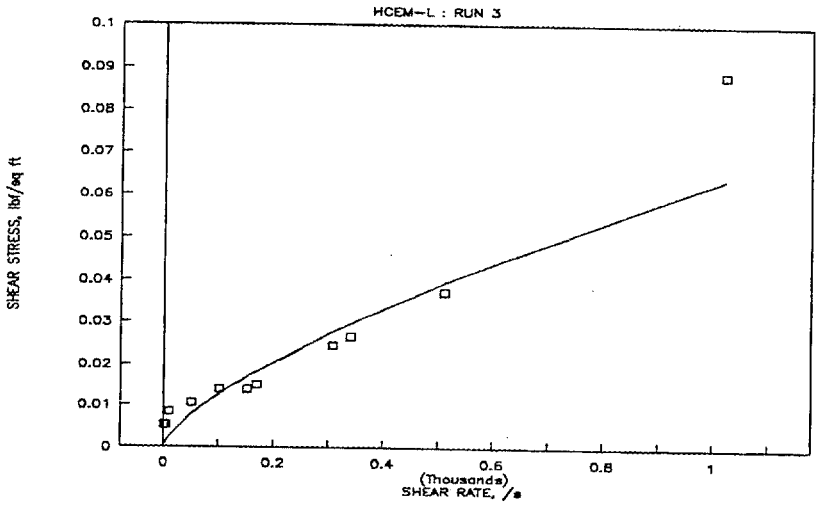
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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


HCEM-L : RUN 1
SHEAR STRESS, lbf/sq ft
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


HCEM-L : RUN 2
SHEAR STRESS, lbf/sq ft
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


HCEM-L : RUN 3
SHEAR STRESS, lbf/sq ft
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR HCEM-L

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID vol%
0.08333	347.39	234.3	76.29%	347.17	238.41	77.56%	355.59	263.85	83.78%
1	347.12	230.67	75.20%	347.08	238.46	77.60%	355.41	261.08	82.96%
7	346.97	225.75	73.65%	346.78	234.35	76.36%	355.32	260.21	82.71%
14	346.66	226.2	73.90%	346.49	233.63	76.22%	354.91	259.36	82.57%
21	346.61	222.33	72.65%	346.37	233.7	76.28%	354.66	259.33	82.64%
28	346.32	220.75	72.23%	346.12	233.87	76.42%	354.46	258.68	82.50%

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

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
RUN 1	50.9	2	0.4375	2	410	469	103
RUN 2	50.1	2	0.4375	2	505	577	126
RUN 3	41.6	2	0.4375	2	189	216	47
					AVERAGE	420.57	92
					STD. DEV.	151.29	33.10

THERMAL CYCLING FOR HCEM-L

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 11

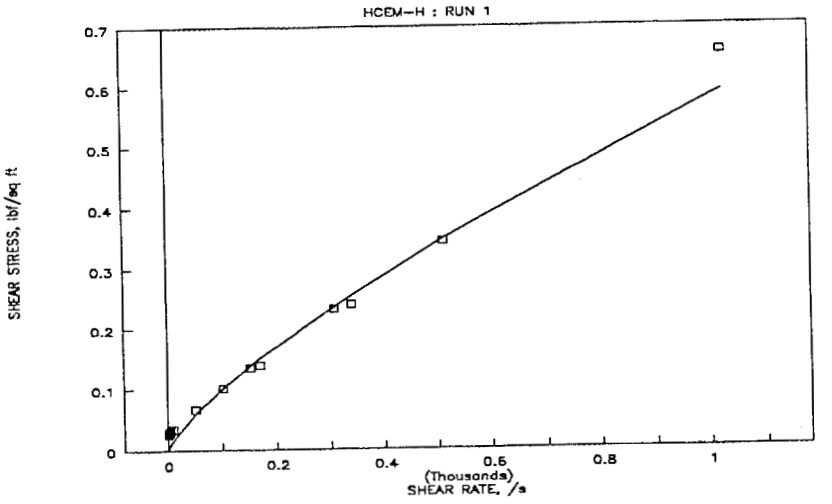
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	32.2	2	0.375	2	357	476	89
RUN 2	24.3	2	0.3125	2	217	347	54
RUN 3	32.9	0	0	0	0	ERR	0
					AVERAGE	411.60	71.75
					STD. DEV.	64.40	17.50
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
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

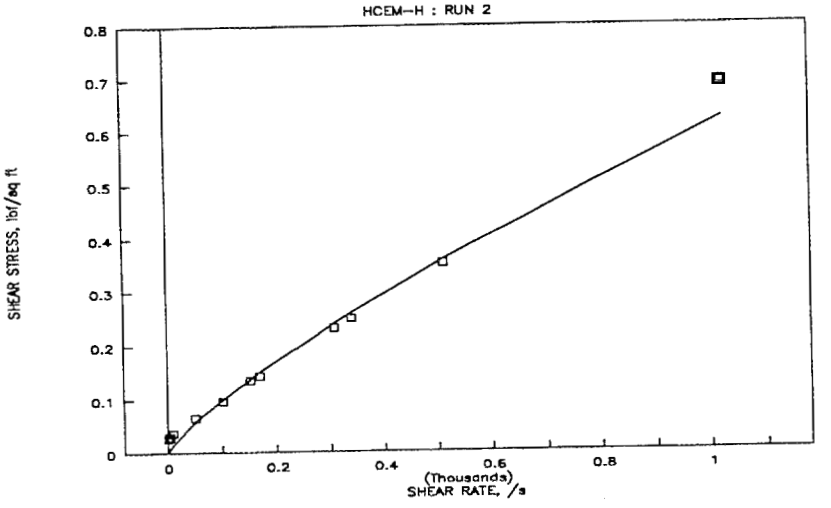
FANN VISCOMETER READINGS FOR HCEM-H

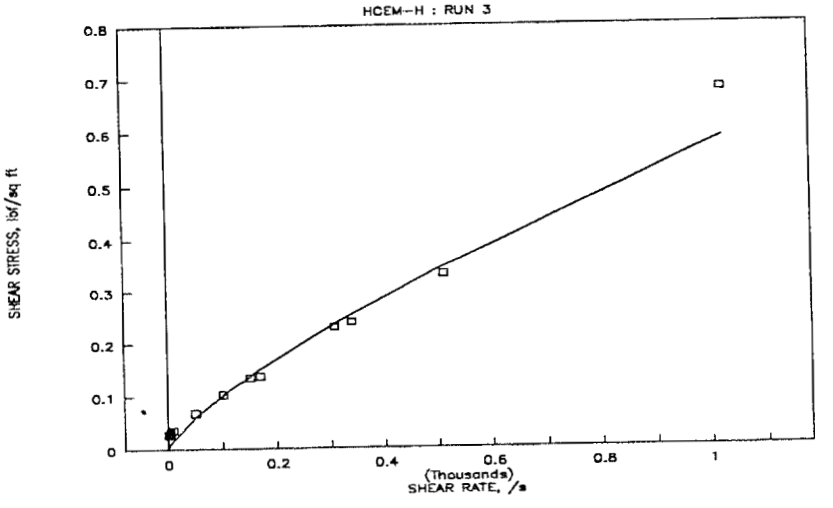
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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	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


HCEM-H : RUN 1
SHEAR STRESS, lbf/sq ft
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


HCEM-H : RUN 2
SHEAR STRESS, lbf/sq ft
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


HCEM-H : RUN 3
SHEAR STRESS, lbf/sq ft
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR HCEM-H

LIQUID DENSITY, g/mL: 1.21

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

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

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
RUN 1	235.9	2	1.8125	2	11410	3148	2853
RUN 2	240.9	2	1.4375	2	11970	4163	2993
RUN 3	238.7	2	1.4375	2	10650	3704	2663
					AVERAGE	3671.80	2835.83
					STD. DEV.	415.37	135.24

THERMAL CYCLING FOR HCEM-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	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	215	2	1.875	2	13120	3499	3280
RUN 2	218.6	2	1.875	2	11700	3120	2925
RUN 3	215.7	2	1.875	2	11090	2957	2773
					AVERAGE	3192	2992.5
					STD. DEV.	226.79	212.61
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
RUN 1	238.4	2	1.8125	2	11690	3225	2923
RUN 2	243.5	2	1.875	2	11740	3131	2935
RUN 3	241.9	2	1.875	2	10340	2757	2585
					AVERAGE	3037.609	2814.166
					STD. DEV.	201.8786	162.1256

Appendix H
DATA FOR PHASE II

Appendix H
DATA FOR PHASE II

Hanford Phase II :

T2/P62-H : Class F Fly Ash (13lb/gal), Type II-LA Portland Cement (2lb/gal)

T2/CL58 : Attapulgite Clay (1.73lb/gal), Type II-LA Portland Cement (0.27lb/gal)

T2/CL58-2 : Attapulgite Clay (2lb/gal), Type II-LA Portland Cement (13lb/gal)

T2/S24-H : Standard Slag GABSF (13lb/gal), Type II-LA Portland Cement (2lb/gal)

T2/S25-H : Takahashi GABFS (13lb/gal), Type II-LA Portland Cement (2lb/gal)

T2/P65-H : Ground Limestone (13lb/gal), Type II-LA Portland Cement (2lb/gal)

T2/AD44 : Sodium Silicate (13lb/gal), Type II-La Portland Cement (2lb/gal)

T2/C94 : Slaked Lime (4.47lb/gal), Type II-LA Portland Cement (0.53lb/gal)

T2/SIKA-L : Sika Liquid Admixtures (15%wt), Type II-LA Portland Cement (2lb/gal)

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

T2/MSTR-L : Masterbuilders Liquid Admixtures (15%wt), Type II-LA Portland Cement (2lb/gal)

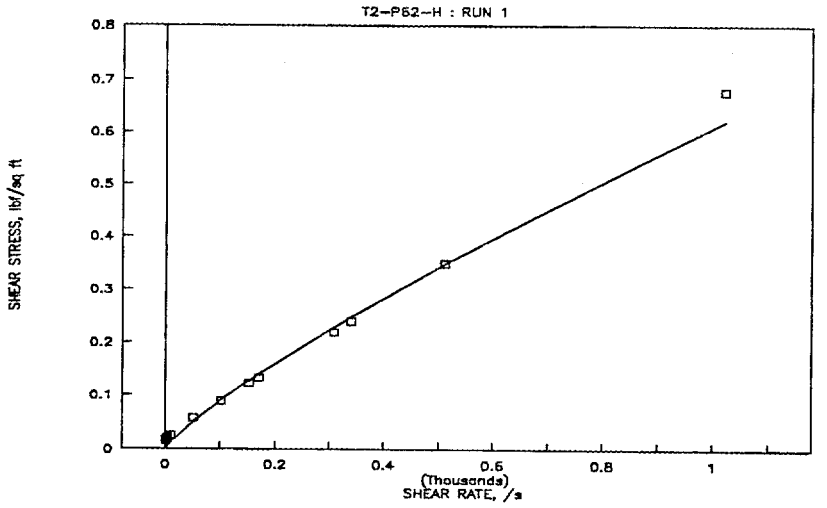
T2/MSTR-H : Masterbuilders Liquid Admixtures (15%wt), Type II-LA Portland Cement (15lb/gal)

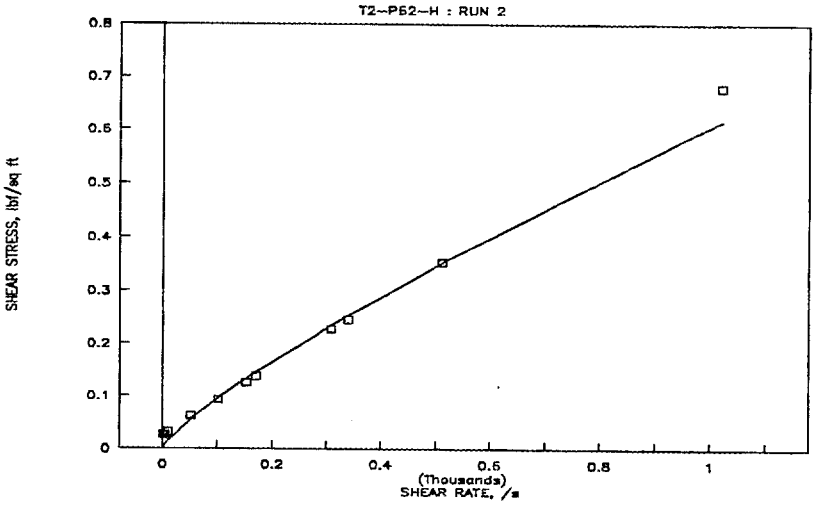
FANN VISCOMETER READINGS FOR T2/P62-H

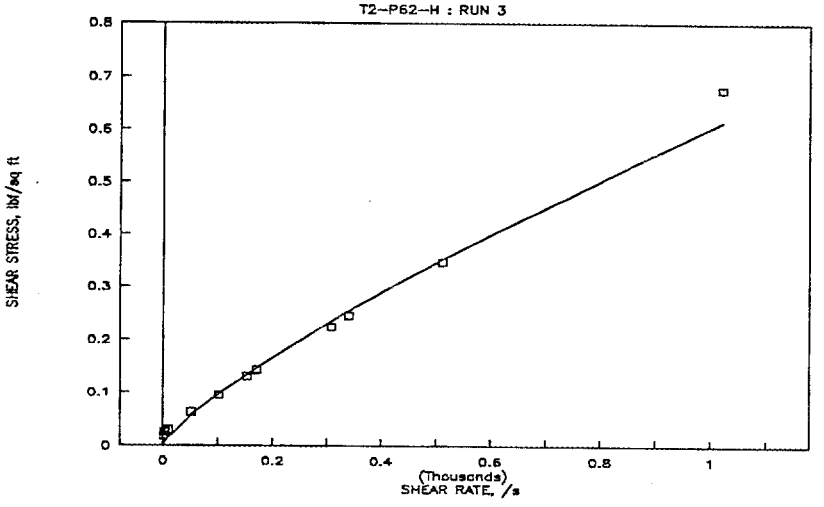
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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	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


T2-P62-H : RUN 1
SHEAR STRESS, lbf/sq ft
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


T2-P62-H : RUN 2
SHEAR STRESS, lbf/sq ft
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


T2-P62-H : RUN 3
SHEAR STRESS, lbf/sq ft
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR T2/P62-H

LIQUID DENSITY, g/mL: 1.21

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

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR T2/P62-H
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
RUN 1	211.6	2	1.875	2	14540	3877	3635
RUN 2	217.3	2	1.9375	2	14590	3765	3648
RUN 3	215.1	2	1.9375	2	12860	3319	3215
					AVERAGE	3653.73	3499.17
					STD. DEV.	241.28	201.00

THERMAL CYCLING FOR T2/P62-H

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 11

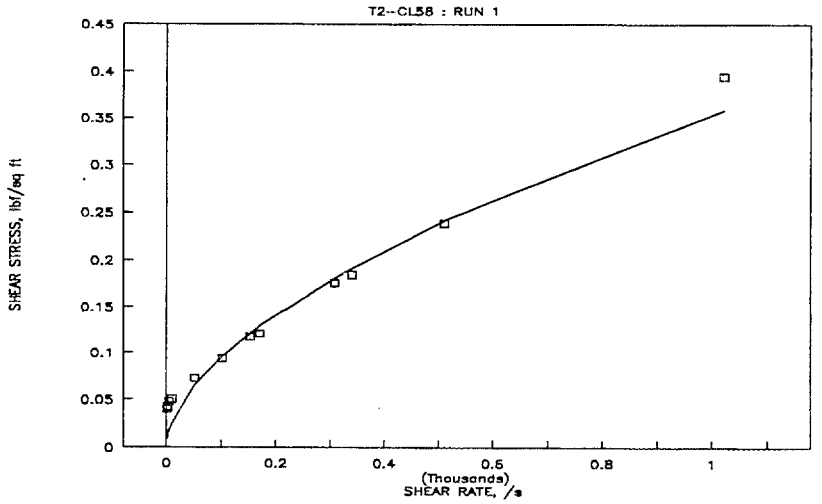
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	184.6	2	1.9375	2	12340	3185	3085
RUN 2	190.1	2	1.9375	2	10930	2821	2733
RUN 3	185.1	2	1.9375	2	10830	2795	2708
					AVERAGE	2933.33	2841.67
					STD. DEV.	177.93	172.37
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
RUN 1	212.3	2	1.875	2	12680	3381	3170
RUN 2	217.9	2	1.9375	2	13410	3461	3353
RUN 3	215.5	2	1.9375	2	13530	3492	3383
					AVERAGE	3444.53	3301.67
					STD. DEV.	46.44	93.90

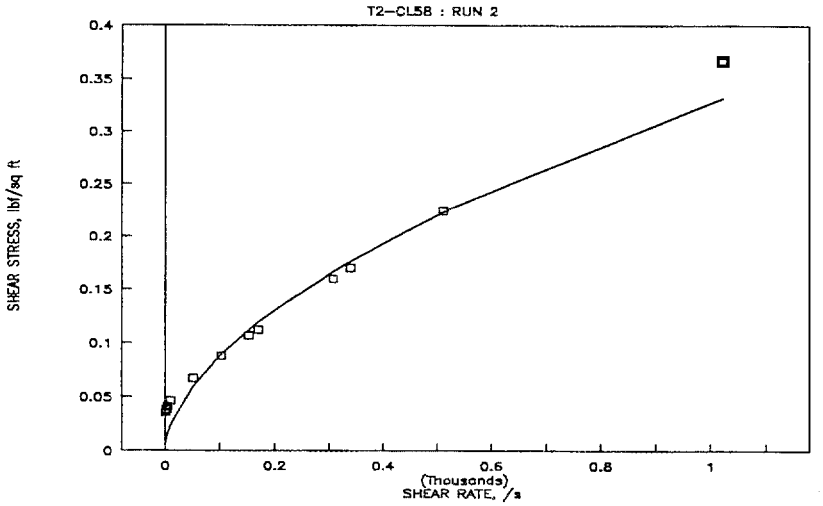
FANN VISCOMETER READINGS FOR T2/CL58

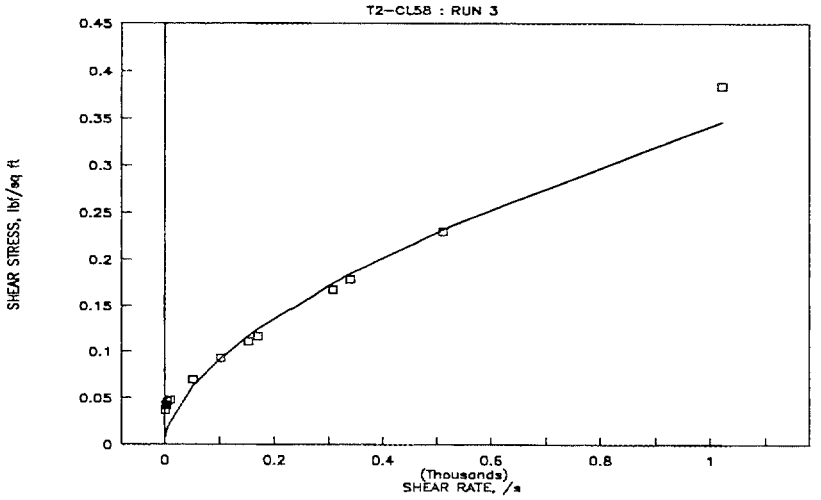
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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	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


T2--CL58 : RUN 1
SHEAR STRESS, lbf/sq ft
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


T2—CL58 : RUN 2
SHEAR STRESS, lbf/sq ft
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


T2—CL58 : RUN 3
SHEAR STRESS, lbf/sq ft
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR T2/CL58

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. 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%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR T2/CL58
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

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

THERMAL CYCLING FOR T2/CL58

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 10.5

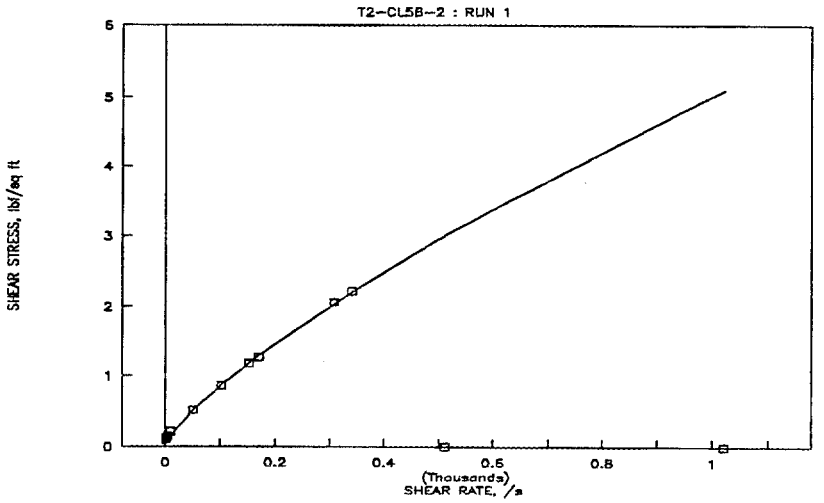
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	48.4	2	1.5	2	26	9	7
RUN 2	43.9	2	1.5	2	11	4	3
RUN 3	53.9	2	1.5	2		0	0
					AVERAGE	6.17	4.63
					STD. DEV.	2.5	1.88
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
RUN 1	133.4	2	1.625	2	20	6	5
RUN 2	119.3	2	1.5	2	14	5	4
RUN 3	133.3	2	1.625	2	14	4	4
					AVERAGE	5.04	4
					STD. DEV.	0.80	0.71

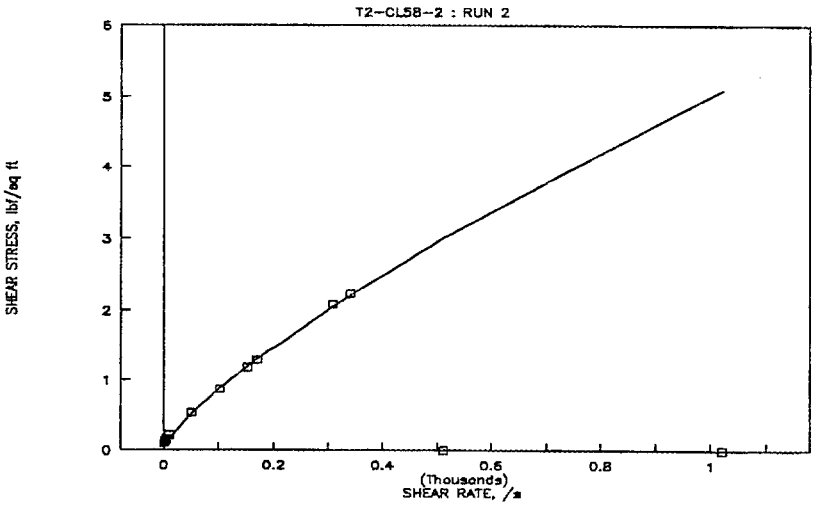
FANN VISCOMETER READINGS FOR T2/CL58-2

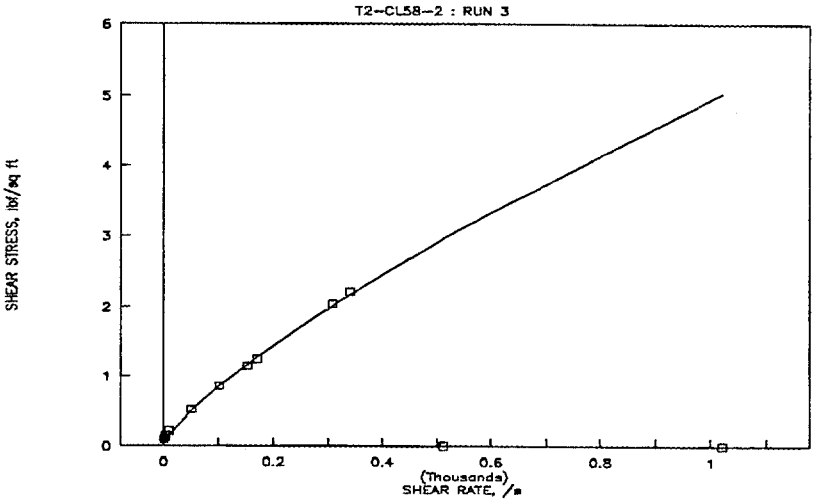
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

SHEAR RATE = K3*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			
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


T2-CL58-2 : RUN 1
SHEAR STRESS, lbf/sq ft
0
1
2
3
4
5
6
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


T2-CL58-2 : RUN 2
SHEAR STRESS, lbf/sq ft
0
1
2
3
4
5
6
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


T2-CL58-2 : RUN 3
SHEAR STRESS, lbf/sq ft
0
1
2
3
4
5
6
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

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

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR T2/CL58-2
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

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

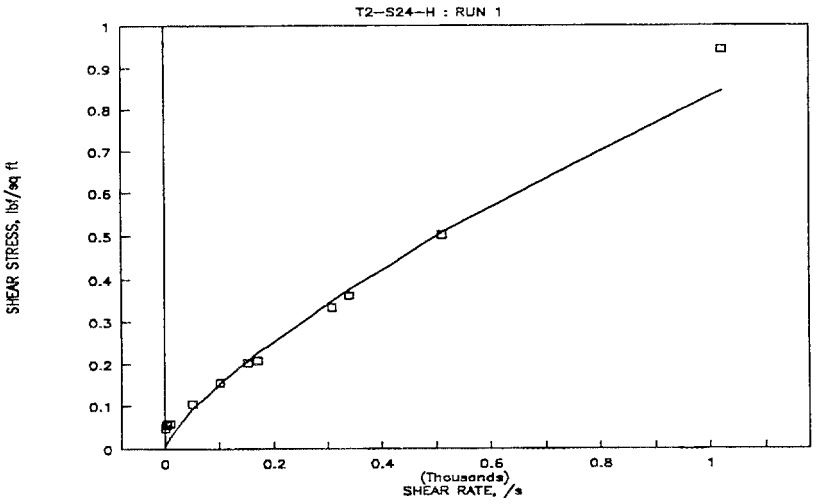
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	220.9	2	2	2	12300	3075	3075
RUN 2	219.4	2	2	2	12310	3078	3078
RUN 3	217.8	2	2	2	12480	3120	3120
					AVERAGE	3090.83	3090.83
					STD. DEV.	20.65	20.65
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
RUN 1	251.3	2	2	2	10940	2735	2735
RUN 2	248.5	2	2	2	10530	2633	2633
RUN 3	247.2	2	2	2	10720	2680	2680
					AVERAGE	2682.5	2682.5
					STD. DEV.	41.88	41.88

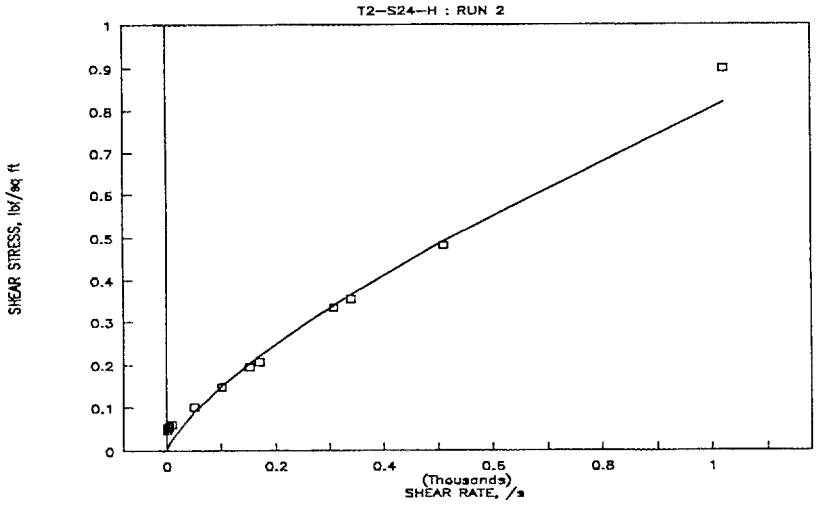
FANN VISCOMETER READINGS FOR T2/S24-H

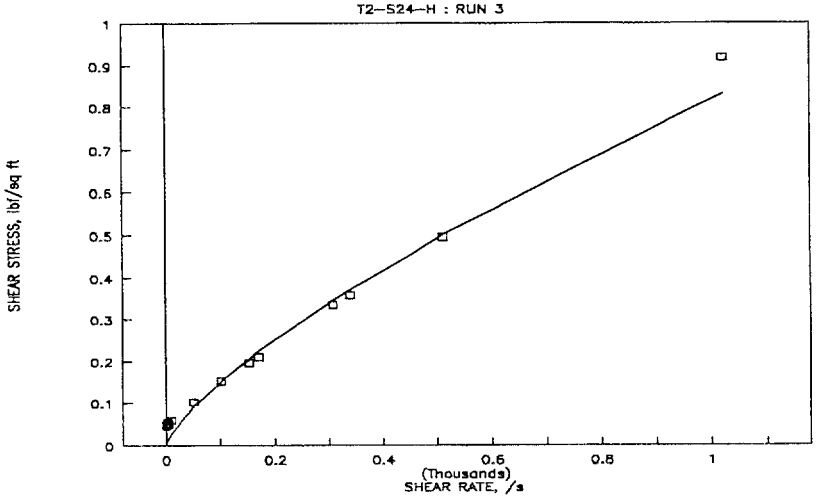
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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


T2-S24-H : RUN 1
SHEAR STRESS, lbf/sq ft
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


T2-S24-H : RUN 2
SHEAR STRESS, lbf/sq ft
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


T2-S24-H : RUN 3
SHEAR STRESS, lbf/sq ft
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR T2/S24-H

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID 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%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR T2/S24-H
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
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
					STD. DEV.	14.28	14.28

THERMAL CYCLING FOR T2/S24-H

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

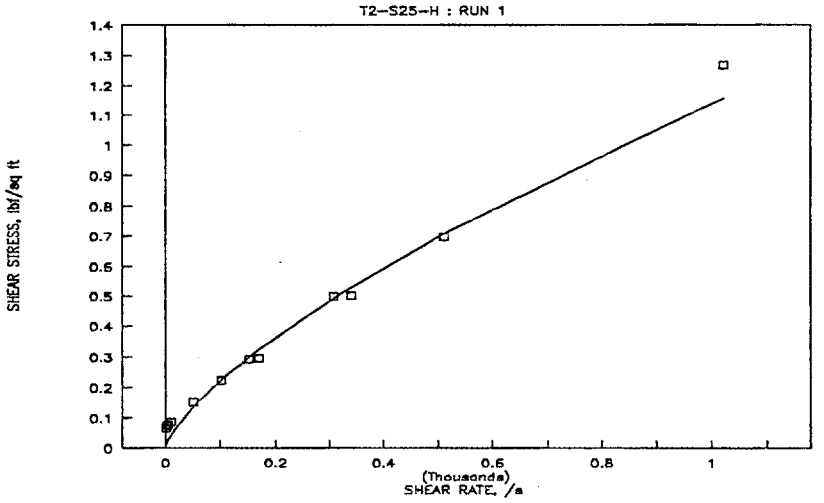
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	175.8	2	2	2	1844	461	461
RUN 2	175.2	2	2	2	1815	454	454
RUN 3	184.2	2	2	2	1270	318	318
					AVERAGE	410.75	410.75
					STD. DEV.	66.00	66.00
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
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

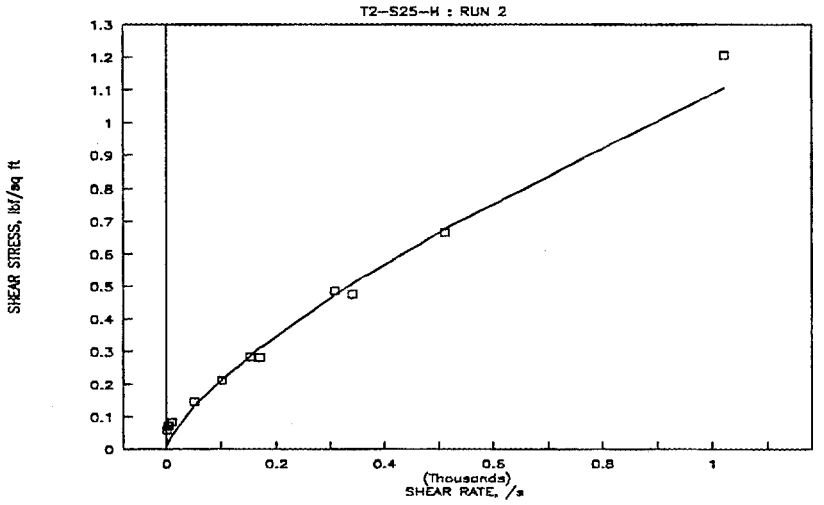
FANN VISCOMETER READINGS FOR T2/S25-H

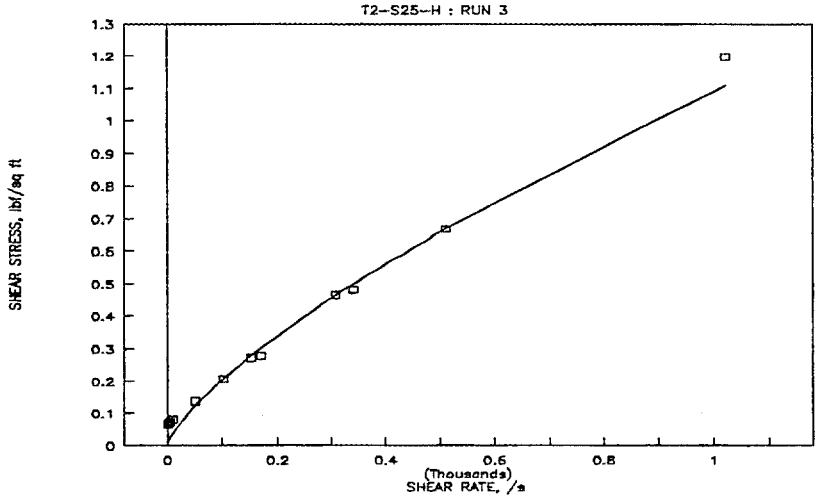
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

SHEAR RATE = K3*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	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


T2-S25-H : RUN 1
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)


T2-S25-H : RUN 2
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)


T2-S25-H : RUN 3
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)

PHASE SEPARATION FOR T2/S25-H

LIQUID DENSITY, g/mL: 1.21

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

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

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	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. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	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
					STD. DEV.	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
					STD. DEV.	2.25	2.25

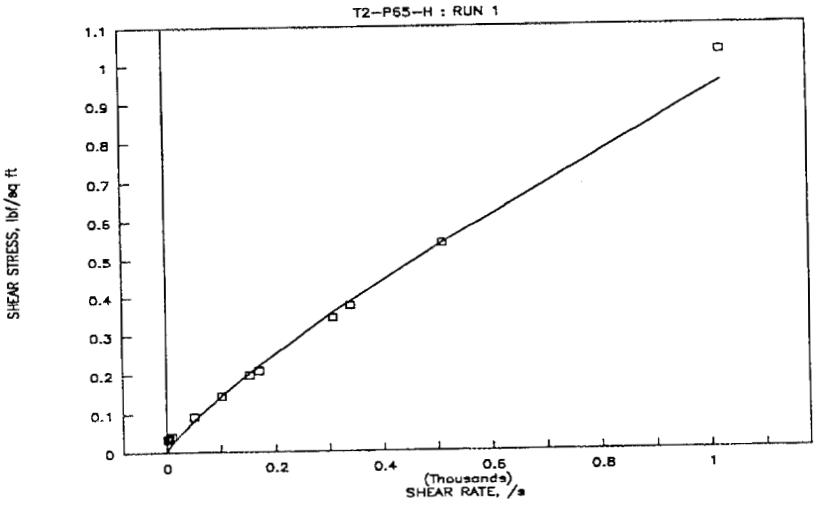
FANN VISCOMETER READINGS FOR T2/P65-H

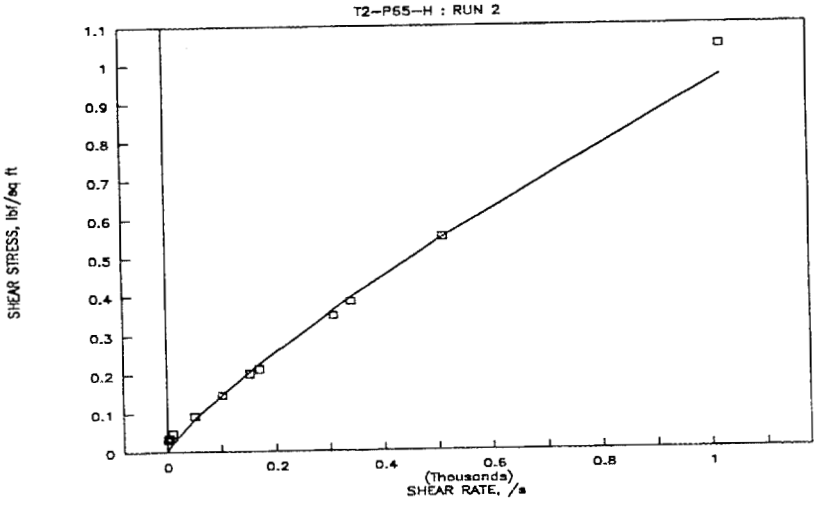
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386

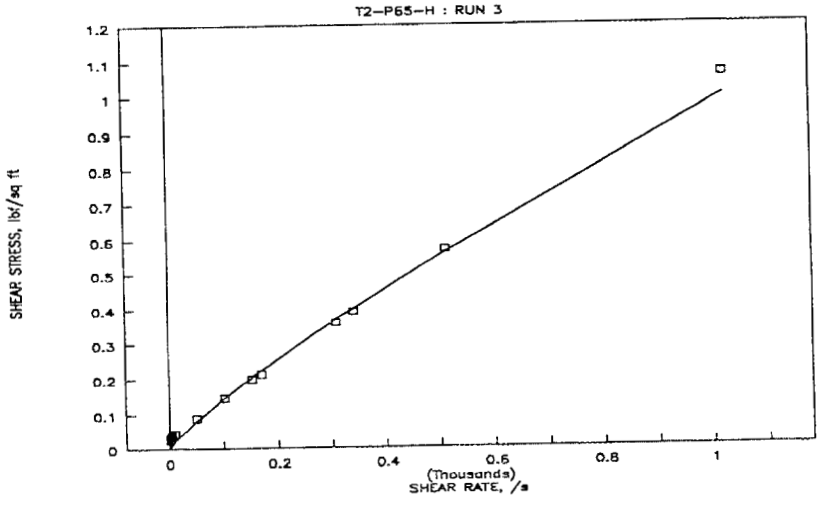
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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	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


T2-P65-H : RUN 1
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
0.2
0.4
0.6
0.8


T2-P65-H : RUN 2
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
0.2
0.4
0.6
0.8


T2-P65-H : RUN 3
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
0.2
0.4
0.6
0.8

PHASE SEPARATION FOR T2/P65-H

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID vol%
0.083333	469.45	20.36	6.66%	485.32	23.98	7.60%	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%
2	469.43	15.64	5.13%	485.06	20.94	6.72%	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%
14	469.08	16.69	5.58%	484.78	19.56	6.37%	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%
28	466.49	15.89	6.17%	484.52	19.15	6.32%	475.5	14.52	4.95%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR T2/P65-H
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

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

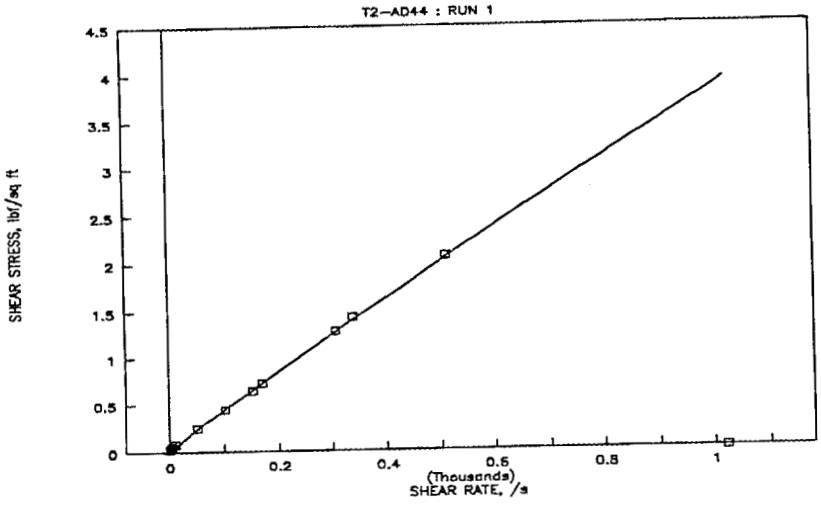
FANN VISCOMETER READINGS FOR T2/AD44

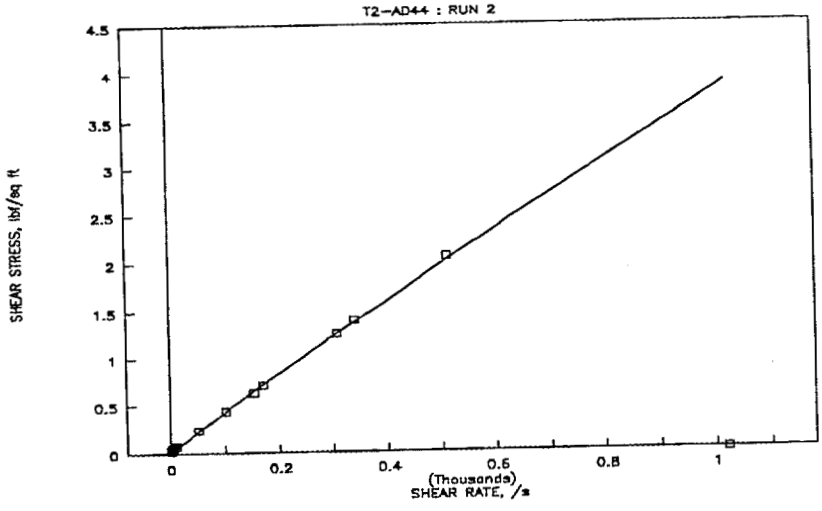
TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

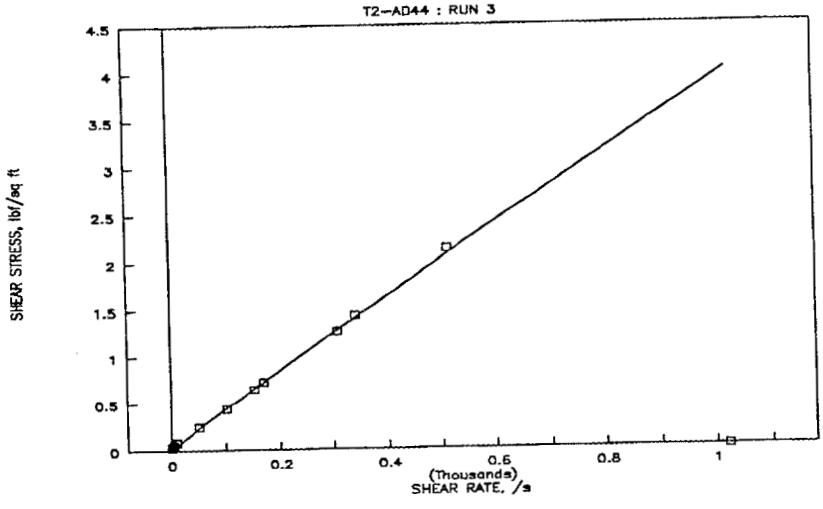
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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


T2-AD44 : RUN 1
SHEAR STRESS, lbf/sq ft
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


T2-AD44 : RUN 2
SHEAR STRESS, lbf/sq ft
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


T2-AD44 : RUN 3
SHEAR STRESS, lbf/sq ft
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID 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

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

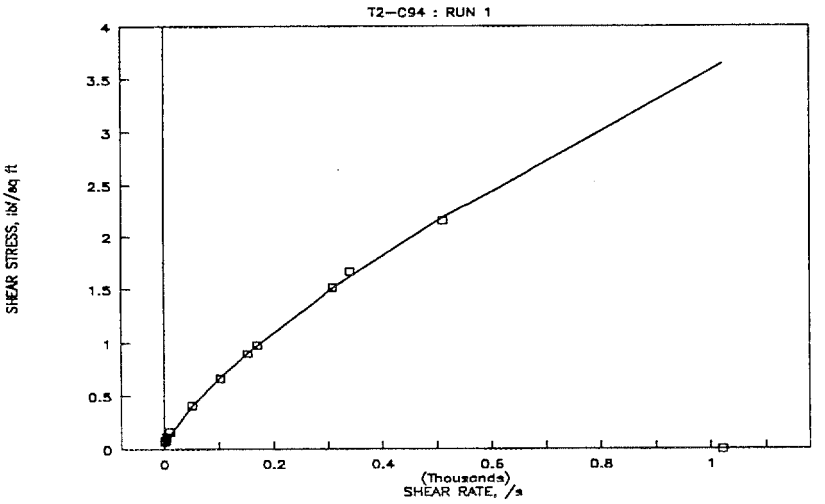
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1						ERR	0
RUN 2						ERR	0
RUN 3						ERR	0
					AVERAGE	ERR	0
					STD. DEV.	ERR	0
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
RUN 1						ERR	0
RUN 2						ERR	0
RUN 3						ERR	0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

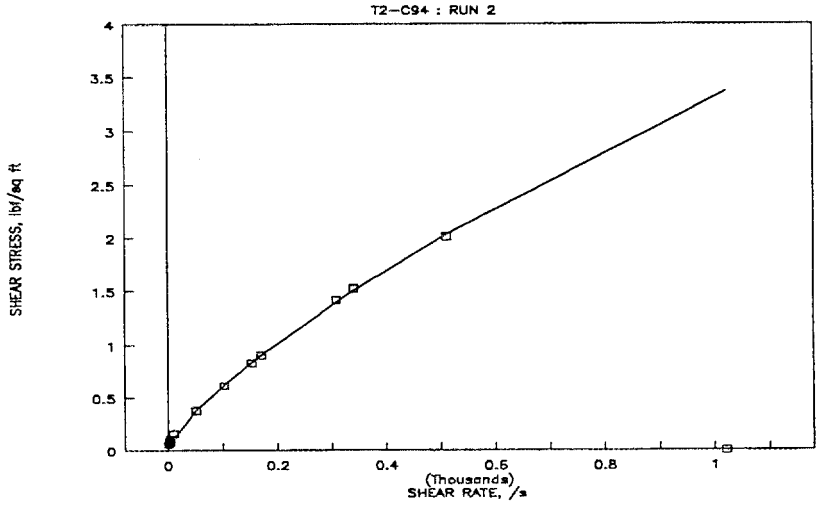
FANN VISCOMETER READINGS FOR T2/C94

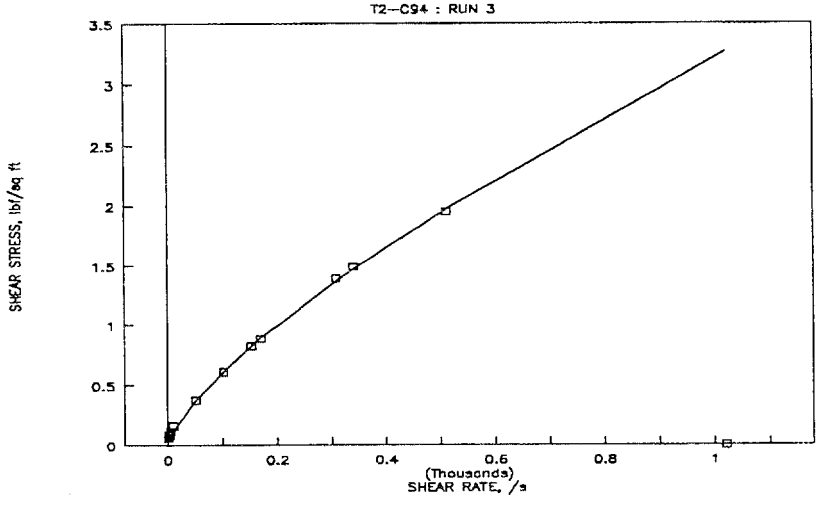
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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


T2—C94 : RUN 1
SHEAR STRESS, lbf/sq ft
0
0.5
1
1.5
2
2.5
3
3.5
4
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


T2—C94 : RUN 2
SHEAR STRESS, lbf/sq ft
0
0.5
1
1.5
2
2.5
3
3.5
4
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


T2—C94 : RUN 3
SHEAR STRESS, lbf/sq ft
0
0.5
1
1.5
2
2.5
3
3.5
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR T2/C94

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID 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. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
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/C94

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d:

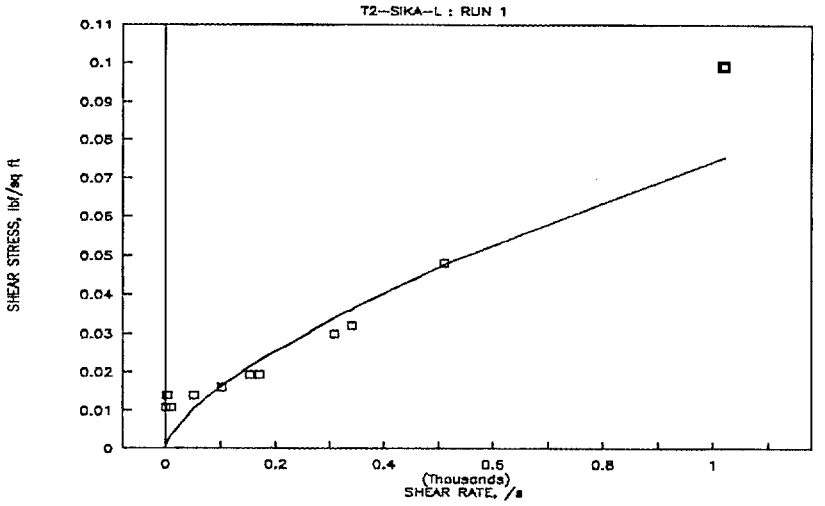
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1						ERR	0
RUN 2						ERR	0
RUN 3						ERR	0
					AVERAGE	ERR	0
					STD. DEV.	ERR	0
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
RUN 1						ERR	0
RUN 2						ERR	0
RUN 3						ERR	0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

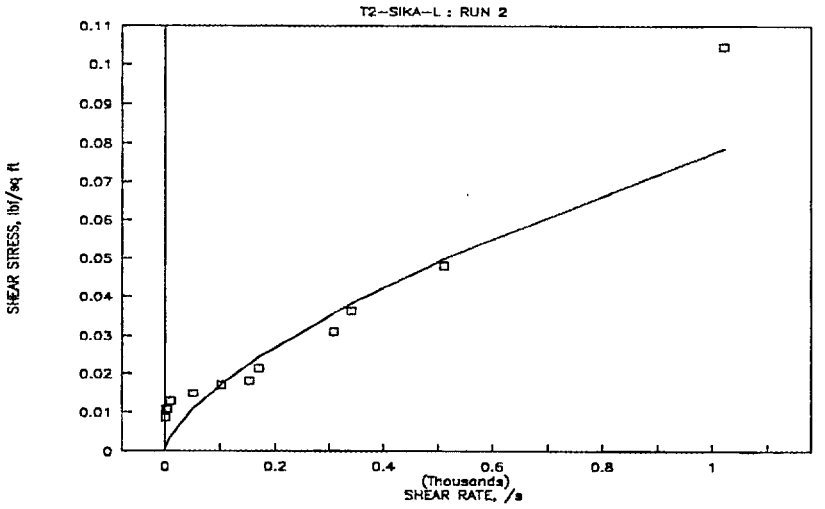
FANN VISCOMETER READINGS FOR T2/SIKA-L

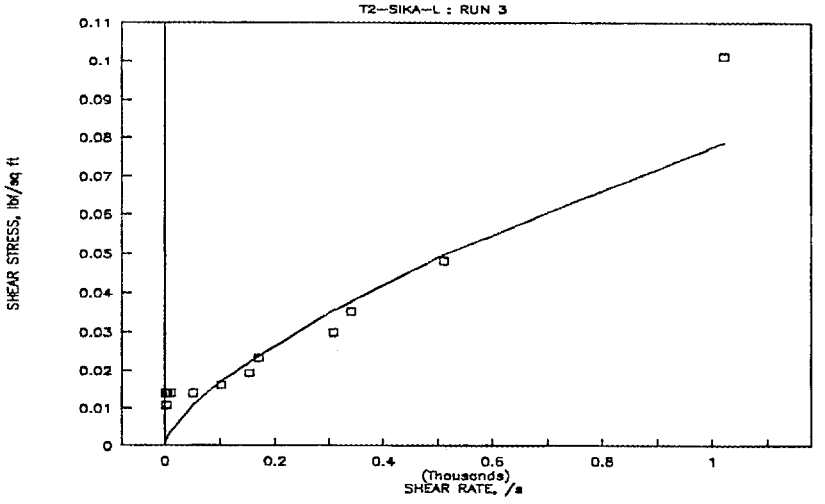
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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	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


T2--SIKA--L : RUN 1
SHEAR STRESS, lbf/sq ft
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


T2--SIKA--L : RUN 2
SHEAR STRESS, lbf/sq ft
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


T2--SIKA--L : RUN 3
SHEAR STRESS, lbf/sq ft
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID 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%

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

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
RUN 1		2	0.4375	2	328	375	82
RUN 2		2	0.4375	2	256	293	64
RUN 3		2	0.625	2	383	306	96
					AVERAGE	324.61	80.58
					STD. DEV.	35.98	13.00

THERMAL CYCLING FOR T2/SIKA-L

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 10

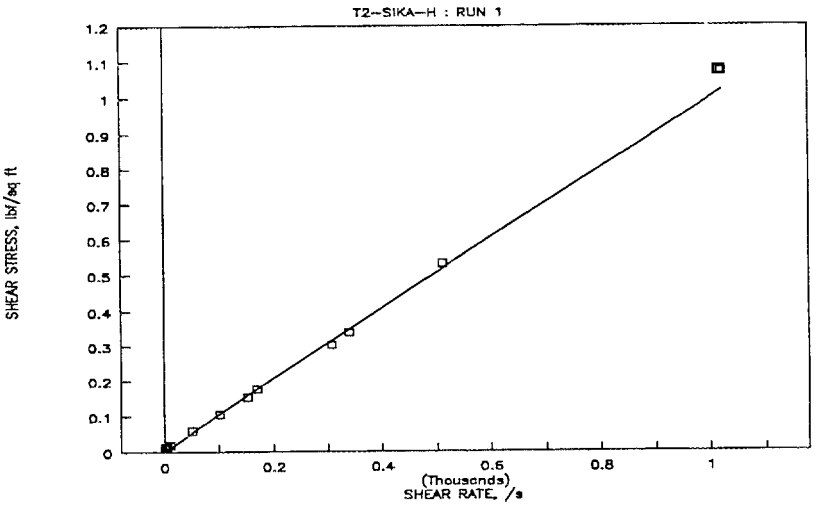
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	39.8	2	0.625	2	735	588	184
RUN 2	39.3	2	0.625	2	548	438	137
RUN 3	42.4	2	0.625	2	435	348	109
					AVERAGE	458.13	143.17
					STD. DEV.	98.97	30.93
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
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	82.17
					STD. DEV.	24.02	7.51

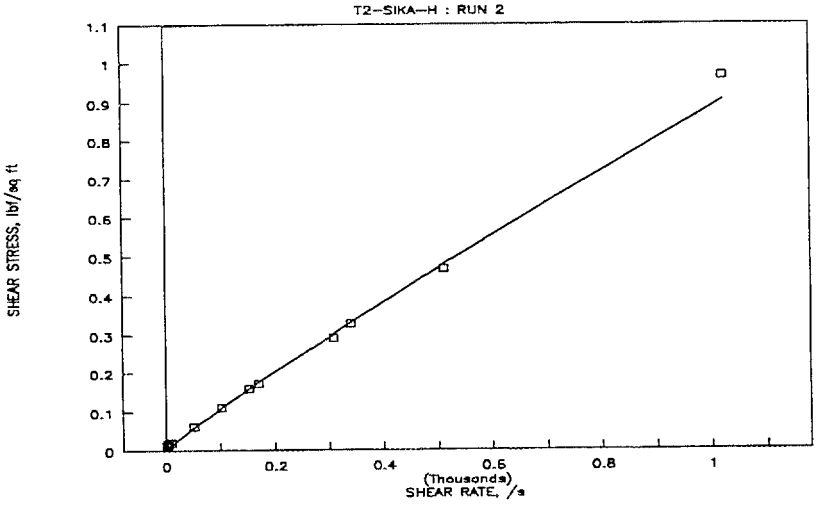
FANN VISCOMETER READINGS FOR T2/SIKA-H

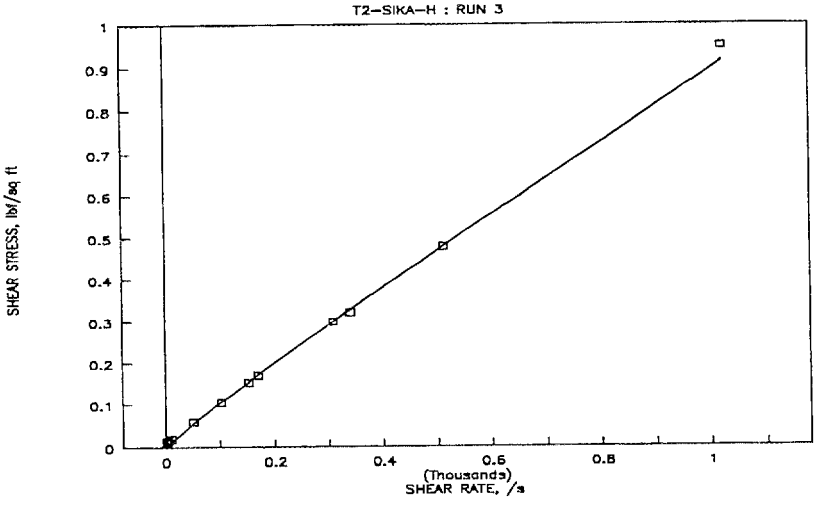
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

SHEAR RATE = K3*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	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


T2-SIKA-H : RUN 1
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)


T2-SIKA-H : RUN 2
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)


T2-SIKA-H : RUN 3
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)

PHASE SEPARATION FOR T2/SIKA-H

LIQUID DENSITY, g/mL: 1.21

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

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

CURE TIME, d: 28

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

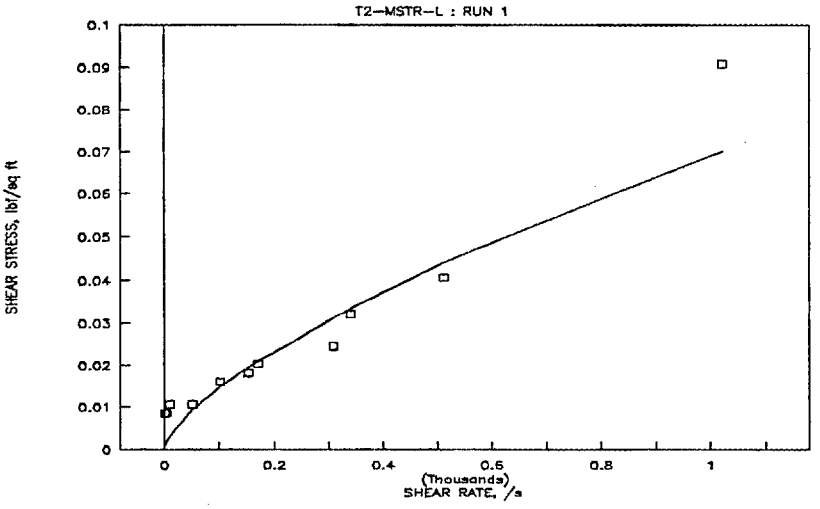
FANN VISCOMETER READINGS FOR T2/MSTR-L

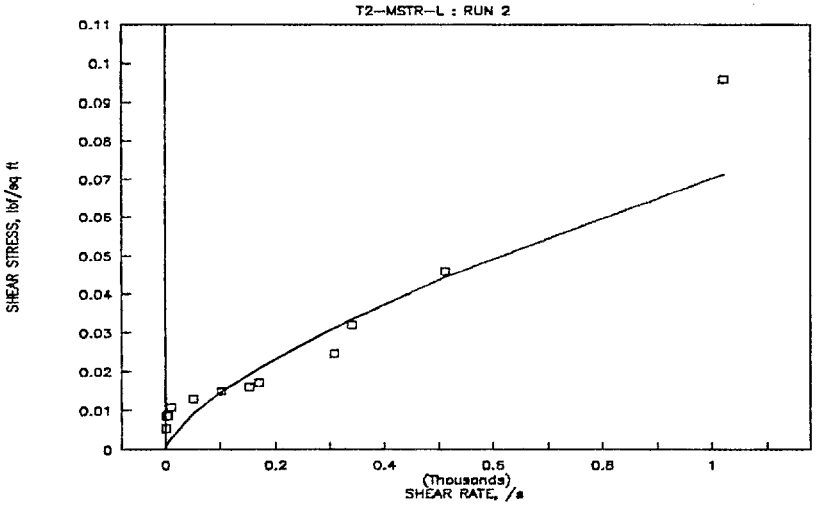
TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

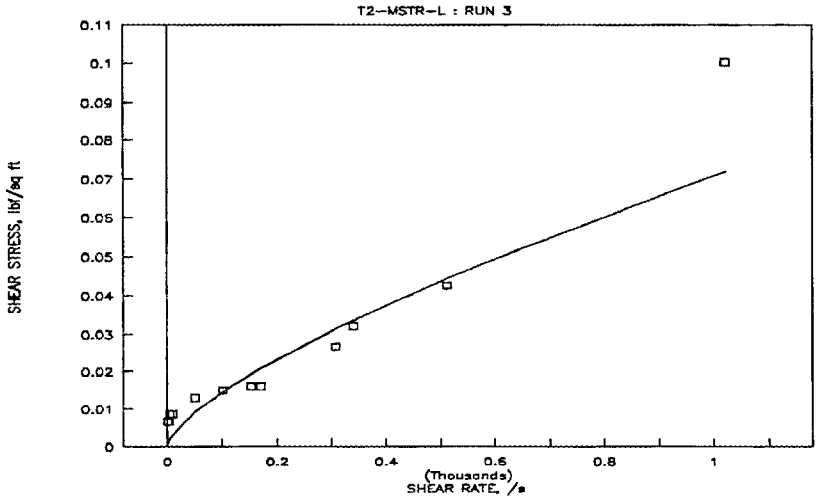
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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	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


T2—MSTR—L : RUN 1
SHEAR STRESS, lbf/sq ft
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


T2—MSTR—L : RUN 2
SHEAR STRESS, lbf/sq ft
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


T2—MSTR—L : RUN 3
SHEAR STRESS, lbf/sq ft
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR T2/MSTR-L

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	335.65	328.99	338.31
APPROX. INIT. GR. VOL., mL:	250	250	250
CALC'D GROUT VOLUME, mL:	249	243	250
(USING MEAS'D DENSITY AND MASS)			

TIME d	RUN 1 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID vol%
1	335.28	226.04	75.29%	328.64	254.9	86.75%	338.08	268.22	88.72%
2	334.65	225.46	75.31%	328.29	247.61	84.39%	337.81	265.16	87.80%
7	333.8	217.4	72.91%	327.79	201.76	68.98%	336.2	201.7	67.36%
14	333.75	206.38	69.26%	327.59	197.62	67.64%	335.91	195.94	65.55%
21	332.86	203.13	68.48%	327.67	192.23	65.78%	335.59	194.53	65.19%
28	332.85	201.75	68.02%	327.22	188.55	64.68%	335.51	193	64.71%

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

CURE TIME, d: 28

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

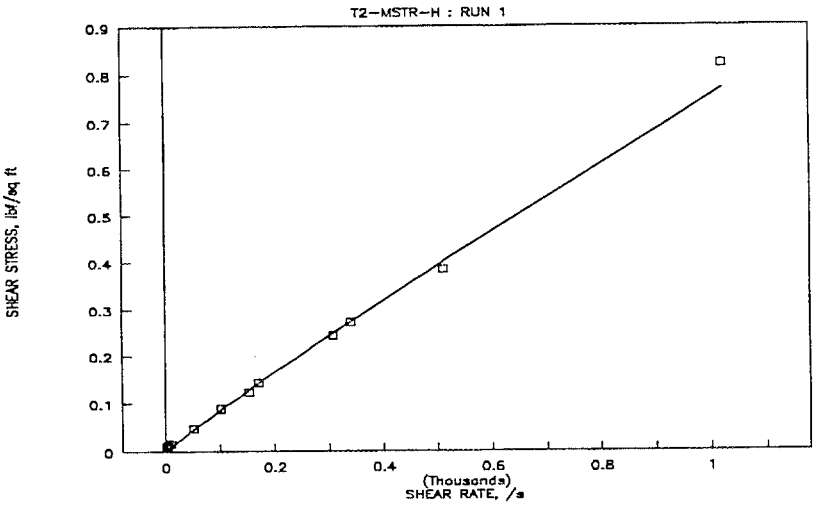
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	40.3	2	0.625	2	516	413	129
RUN 2	41.1	2	0.625	2	305	244	76
RUN 3	41.1	2	0.625	2	362	290	91
					AVERAGE	315.47	98.58
					STD. DEV.	71.30	22.28
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
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

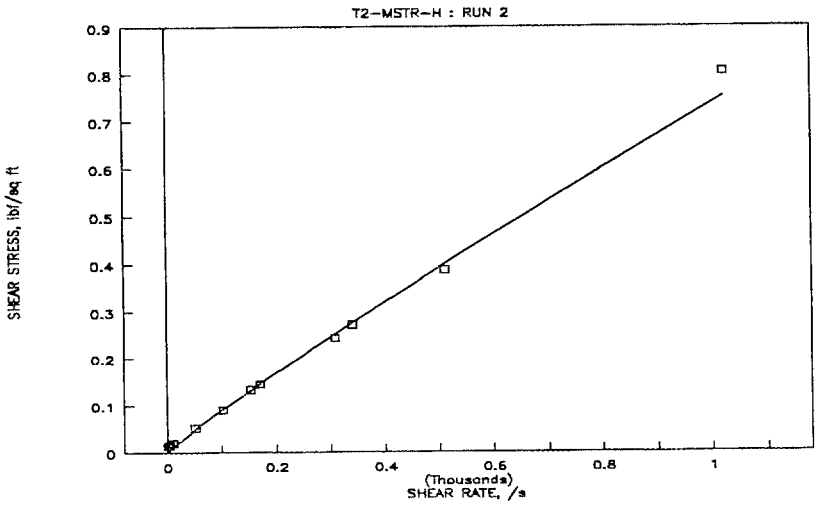
FANN VISCOMETER READINGS FOR T2/MSTR-H

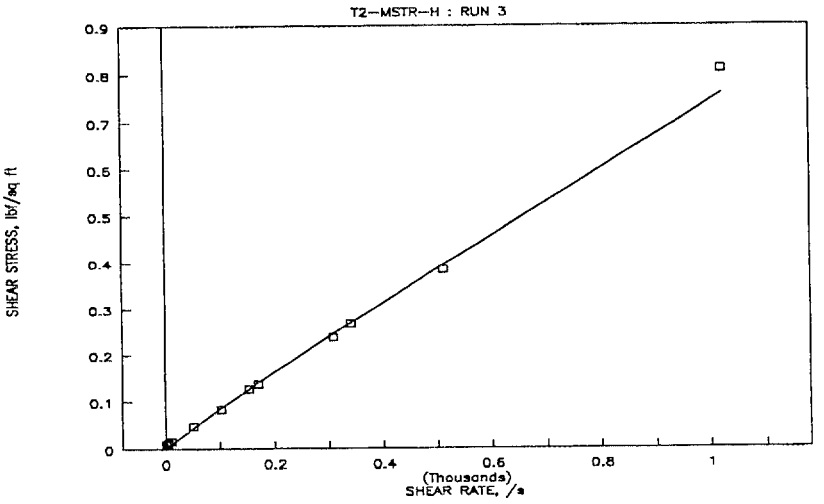
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

SHEAR RATE = K3*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	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


T2-MSTR-H : RUN 1
SHEAR STRESS, lbf/sq ft
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


T2-MSTR-H : RUN 2
SHEAR STRESS, lbf/sq ft
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


T2-MSTR-H : RUN 3
SHEAR STRESS, lbf/sq ft
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR T2/MSTR-H

LIQUID DENSITY, g/mL: 1.21

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

TIME d	RUN 1 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID 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 CALC'D	CORR'D
	g	L	W	H	lbf	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

THERMAL CYCLING FOR T2/MSTR-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	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	210.4	2	2	2	6572	1643	1643
RUN 2	204	2	2	2	9850	2463	2463
RUN 3	210.4	2	2	2	9760	2440	2440
					AVERAGE	2181.83	2181.83
					STD. DEV.	381.12	381.12
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
RUN 1	241	2	2	2	7210	1803	1803
RUN 2	231	2	2	2	6610	1653	1653
RUN 3	245.3	2	2	2	9090	2273	2273
					AVERAGE	1909.17	1909.17
					STD. DEV.	264.11	264.11

Appendix I
DATA FOR PHASE III

Appendix I
DATA FOR PHASE III

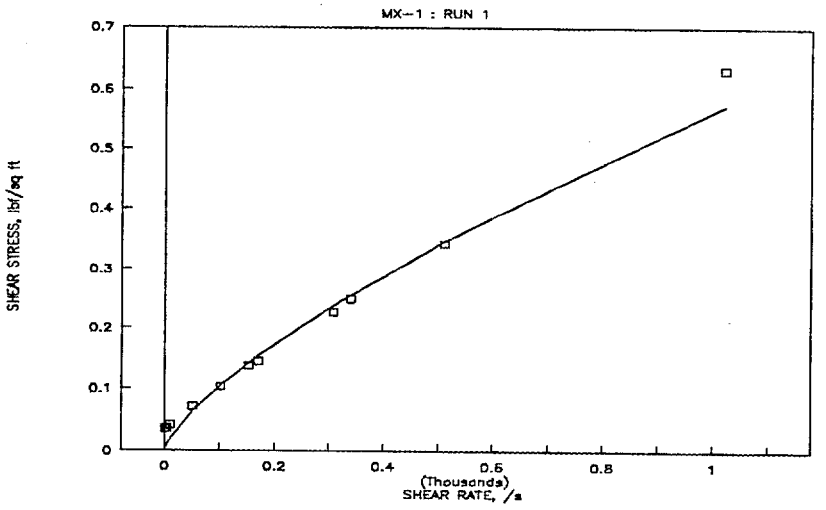
The experimental design for the larger region was MX-1 through MX-20. Runs MX-1 through MX-11 had been run when the design for the smaller region was adopted as the official design. This design added runs MX-21 through MX-35 to runs MX-1, MX-7, MX-15, and MX-20 from the design for the larger region. 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.

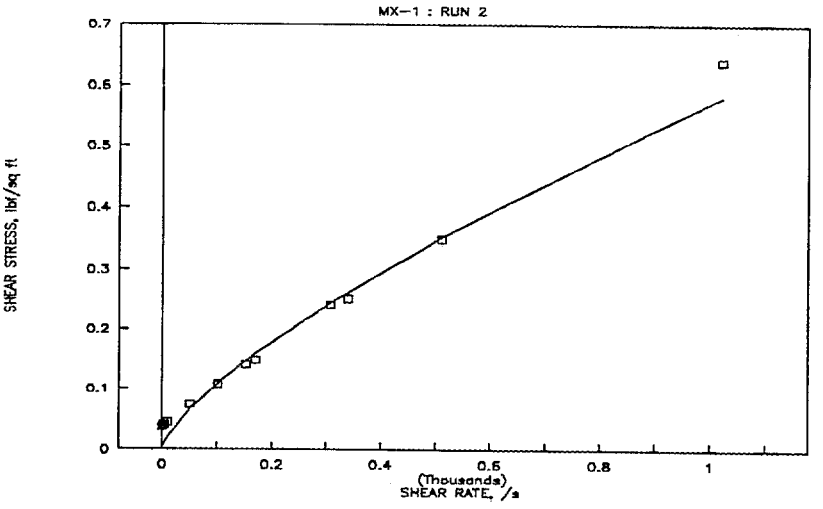
FANN VISCOMETER READINGS FOR MX1

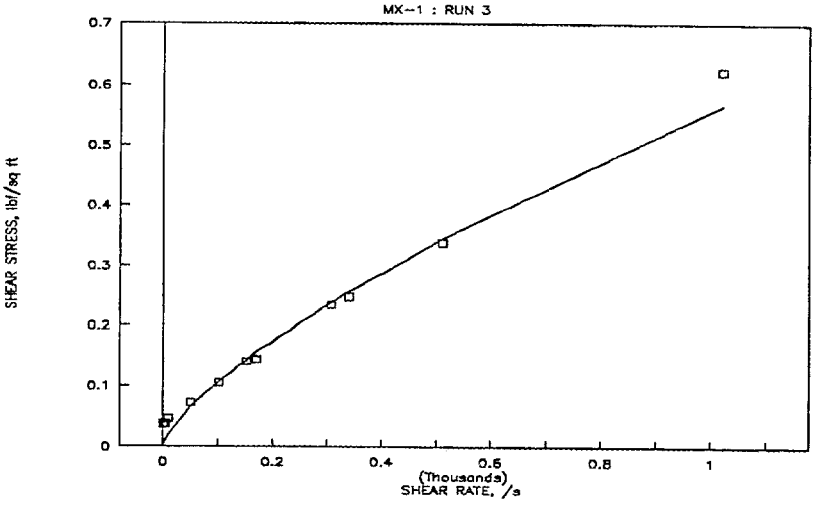
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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


MX-1 : RUN 1
SHEAR STRESS, lbf/sq ft
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-1 : RUN 2
SHEAR STRESS, lbf/sq ft
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-1 : RUN 3
SHEAR STRESS, lbf/sq ft
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR MX1

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID vol%
0.08	423.37	9.07	3.02%	419.81	11.51	3.84%	428.68	9.38	3.07%
1	422.17	7	2.73%	419.7	9.11	3.08%	428.7	7.61	2.49%
2	423.17	6.67	2.30%	419.65	8.95	3.04%	428.6	7.1	2.36%
7	423.15	6.75	2.33%	419.52	8.22	2.84%	428.51	5.91	2.01%
14	423.02	6.82	2.40%	419.46	9.36	3.24%	428.46	6.26	2.13%
21	422.85	6.55	2.36%	419.33	8.43	2.98%	428.27	5.37	1.91%
28	422.8	6.2	2.26%	419.11	7.11	2.61%	428.25	5.65	2.01%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX1
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
RUN 1	200.6	2	1.94	2	1080	279	270
RUN 2	206.4	2	2	2	1060	265	265
RUN 3	207.2	2	2	2	1030	258	258
					AVERAGE	267.07	264.17
					STD. DEV.	8.78	5.14

THERMAL CYCLING FOR MX1

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 12

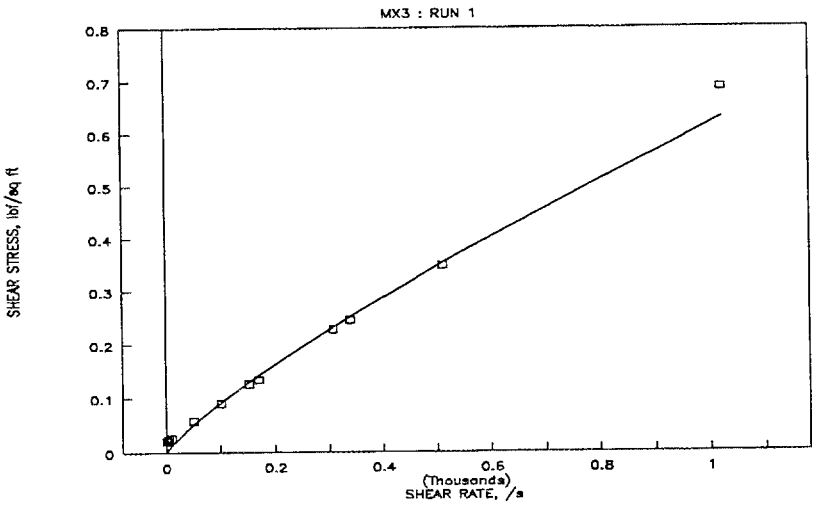
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1		2	1.94	2	1820	470	455
RUN 2		2	2	2	1977	494	494
RUN 3		2	2	2	2150	538	538
					AVERAGE	500.48	495.58
					STD. DEV.	28.04	33.69
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
RUN 1		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

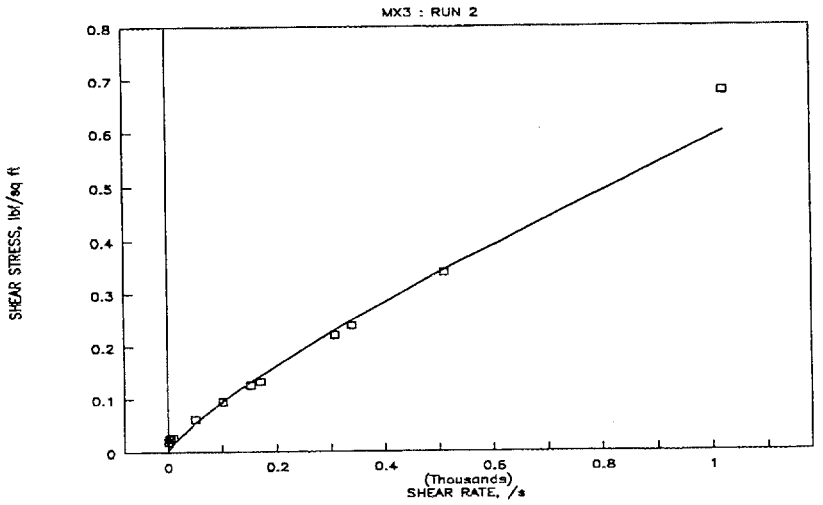
FANN VISCOMETER READINGS FOR MX3

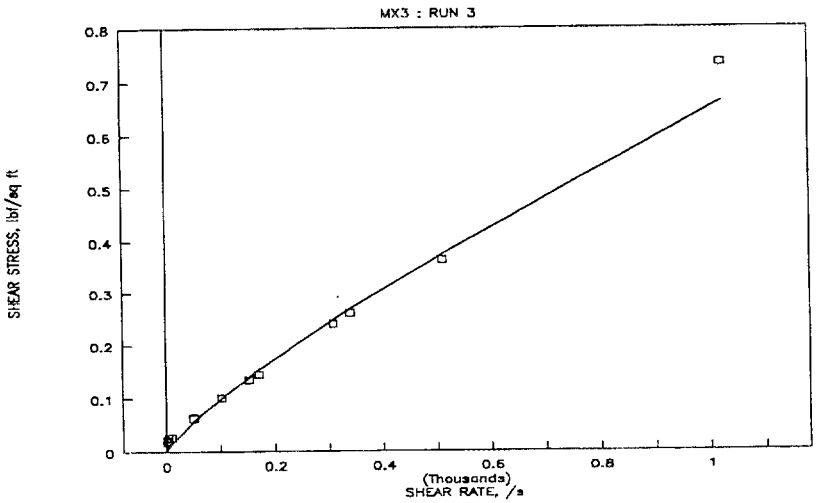
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

SHEAR RATE = K3*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	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


MX3 : RUN 1
SHEAR STRESS, lbf/sq ft
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX3 : RUN 2
SHEAR STRESS, lbf/sq ft
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX3 : RUN 3
SHEAR STRESS, lbf/sq ft
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR MX3

LIQUID DENSITY, g/mL: 1.21

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

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX3
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

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

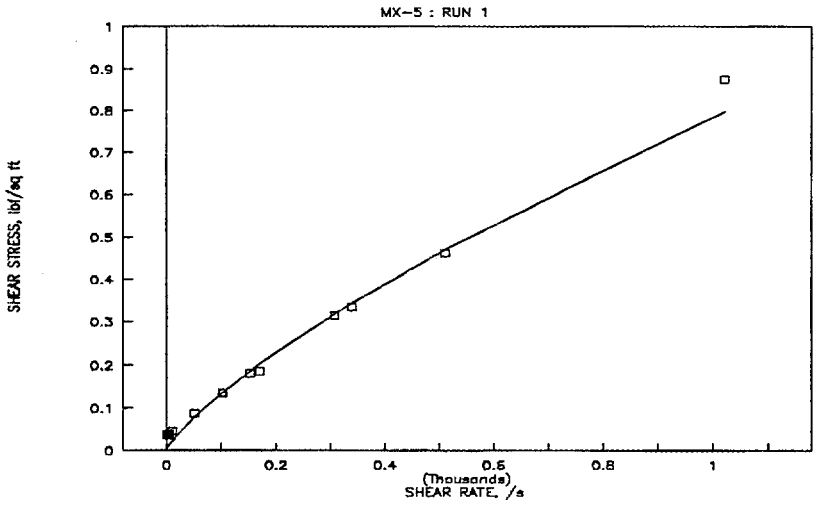
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	180.4	2	1.94	2	8620	2225	2155
RUN 2	184.2	2	1.94	2	7870	2031	1968
RUN 3	185.7	2	1.94	2	8770	2263	2193
					AVERAGE	2172.90	2105.00
					STD. DEV.	101.60	98.43
	COMPARATOR NOT SUBJECTED TO 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

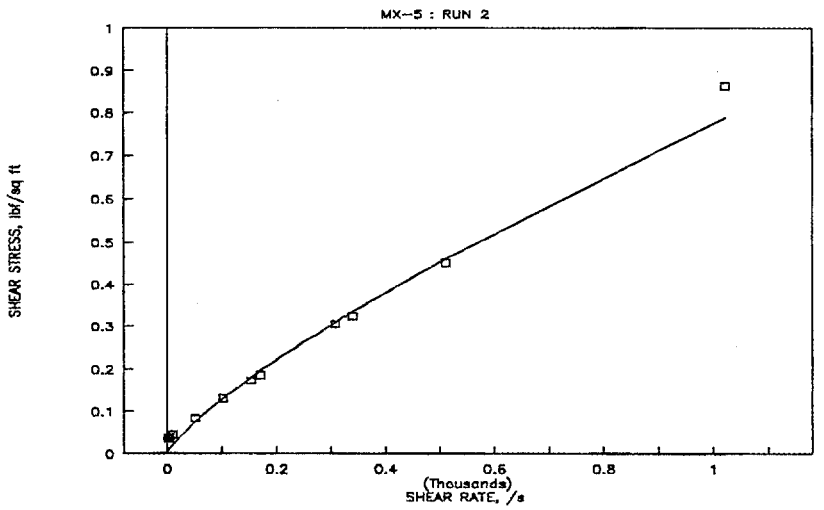
FANN VISCOMETER READINGS FOR MX5

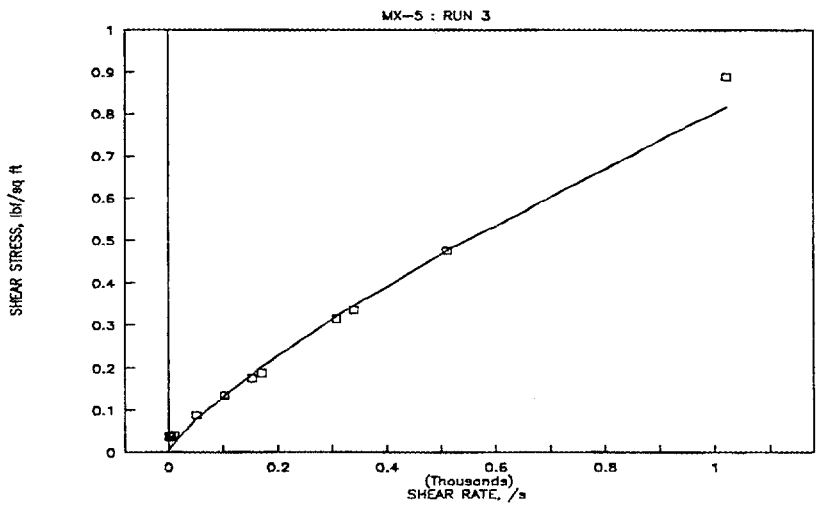
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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	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


MX-5 : RUN 1
SHEAR STRESS, lbf/sq ft
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-5 : RUN 2
SHEAR STRESS, lbf/sq ft
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-5 : RUN 3
SHEAR STRESS, lbf/sq ft
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR MX5

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID vol%
0.08	453.3	11.1	3.60%	453.86	13.66	4.43%	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%
2	453.07	4.57	1.55%	453.56	8.76	2.94%	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%
14	452.94	2.54	0.94%	453.06	4.29	1.66%	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%
28	452.7	0	0.19%	453	2.8	1.20%	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	CORR'D
	g	L	W	H	lbf	psi	psi
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

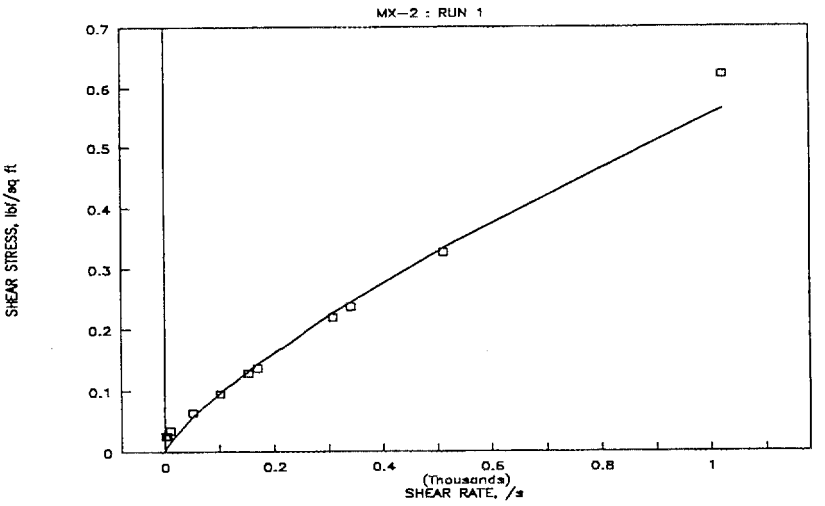
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	179.4	2	2	2	6740	1685	1685
RUN 2	180.3	2	1.94	2	7650	1974	1913
RUN 3	183.1	2	2	2	6030	1508	1508
					AVERAGE	1722.23	1701.67
					STD. DEV.	192.34	165.76
	COMPARATOR NOT SUBJECTED TO THERMAL 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

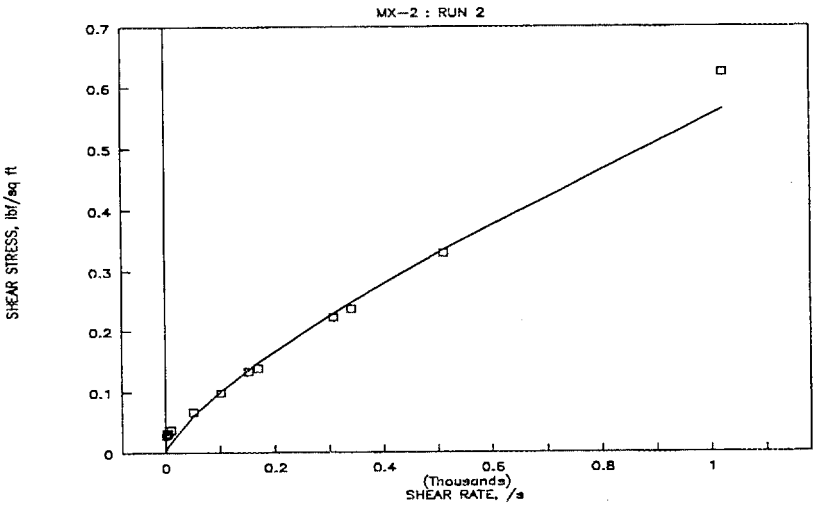
FANN VISCOMETER READINGS FOR MX2

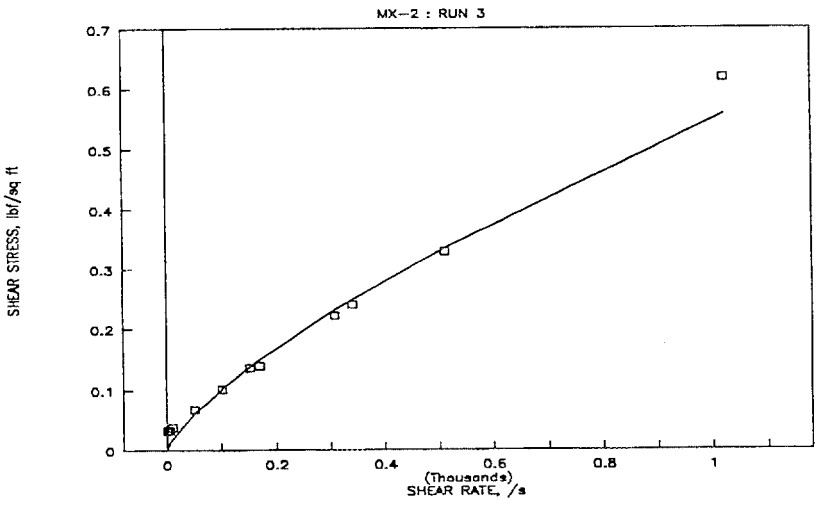
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

SHEAR RATE = K3*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	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


MX-2 : RUN 1
SHEAR STRESS, lbf/sq ft
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-2 : RUN 2
SHEAR STRESS, lbf/sq ft
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-2 : RUN 3
SHEAR STRESS, lbf/sq ft
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR MX2

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID vol%
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	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
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

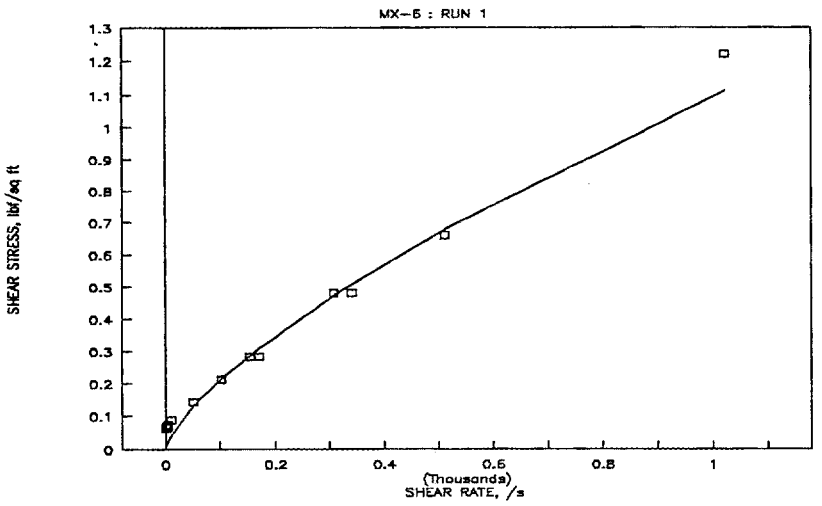
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1		2	2	2	1465	366	366
RUN 2		2	2	2	1547	387	387
RUN 3		2	1.94	2	1573	406	393
					AVERAGE	386.31	382.08
					STD. DEV.	16.20	11.51
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
RUN 1		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

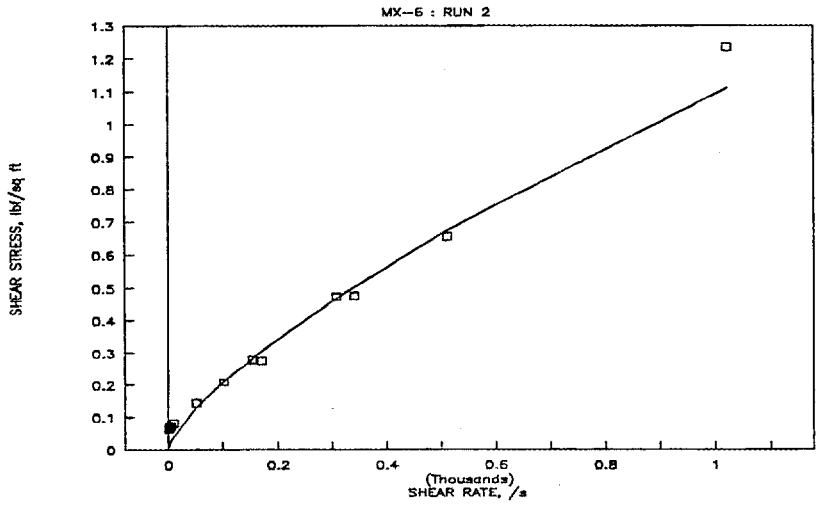
FANN VISCOMETER READINGS FOR MX6

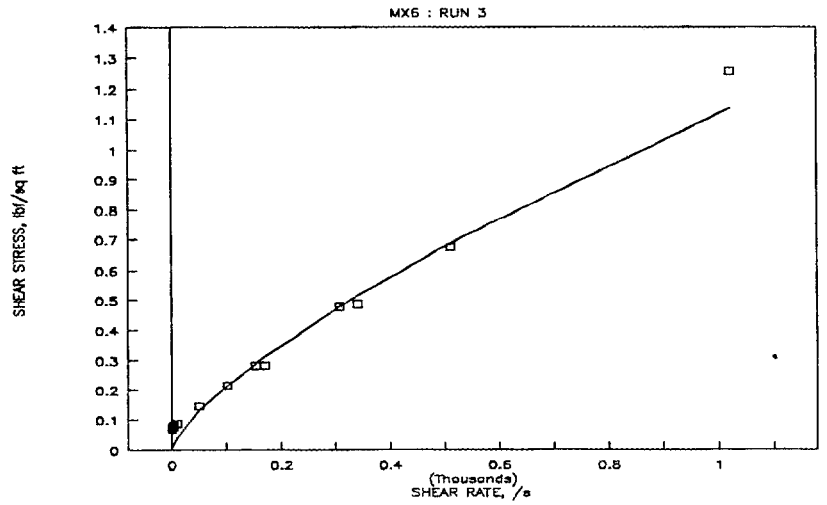
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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


MX-6 : RUN 1
SHEAR STRESS, lbf/sq ft
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-6 : RUN 2
SHEAR STRESS, lbf/sq ft
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX6 : RUN 3
SHEAR STRESS, lbf/sq ft
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR MX6

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID 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%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX6
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
RUN 1	246.1	2	2	2	7830	1958	1958
RUN 2	245.2	2	2	2	8310	2078	2078
RUN 3	248.2	2	2	2	8580	2145	2145
					AVERAGE	2060.00	2060.00
					STD. DEV.	77.54	77.54

THERMAL CYCLING FOR MX6

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 13

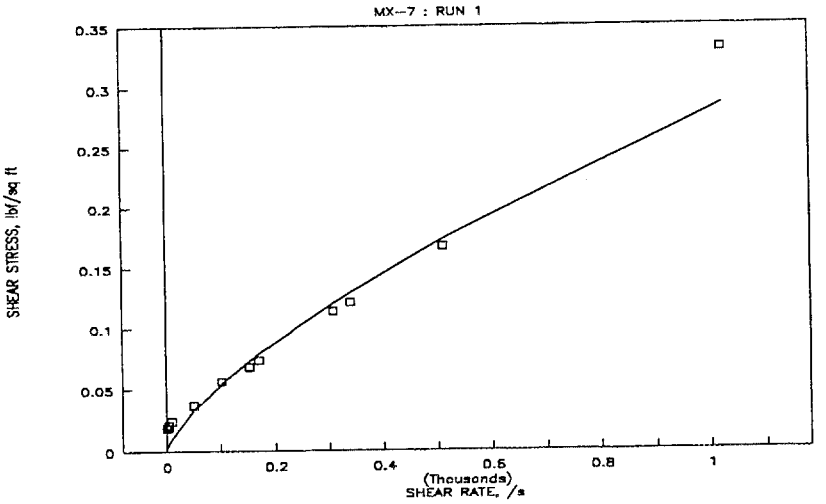
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	211.8	2	2	2	6880	1720	1720
RUN 2	213.2	2	2	2	6990	1748	1748
RUN 3	214.5	2	2	2	7320	1830	1830
					AVERAGE	1765.83	1765.83
					STD. DEV.	46.74	46.74
	COMPARATOR NOT SUBJECTED TO THERMAL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

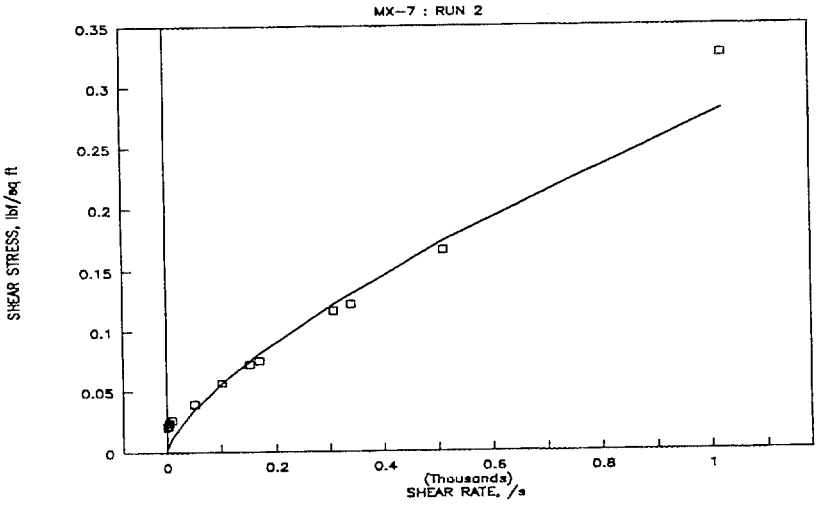
FANN VISCOMETER READINGS FOR MX7/PRF

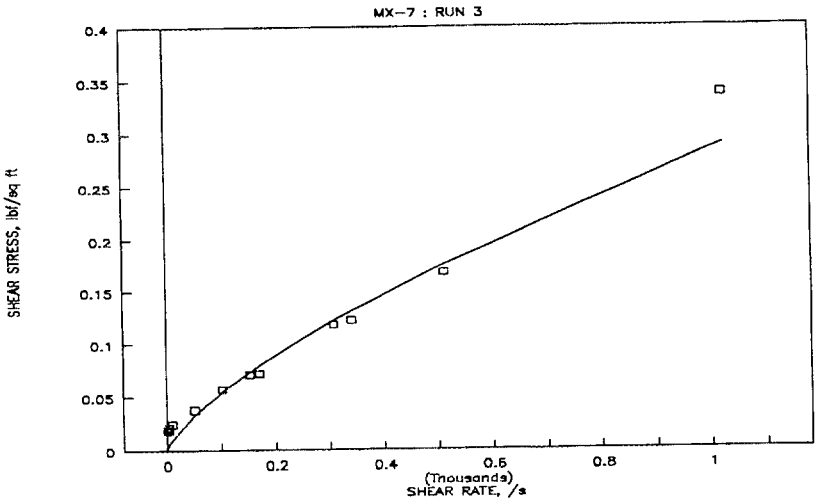
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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


MX-7 : RUN 1
SHEAR STRESS, lbf/sq ft
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-7 : RUN 2
SHEAR STRESS, lbf/sq ft
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-7 : RUN 3
SHEAR STRESS, lbf/sq ft
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR MX7/PRF

LIQUID DENSITY, g/mL: 1.21

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

(USING MEAS'D DENSITY AND MASS)

TIME d	RUN 1 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID 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%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX7/PRF
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

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

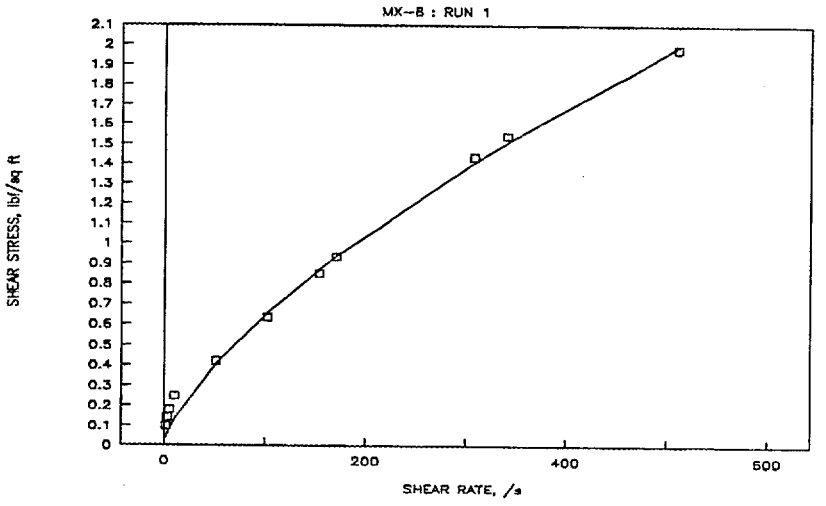
TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

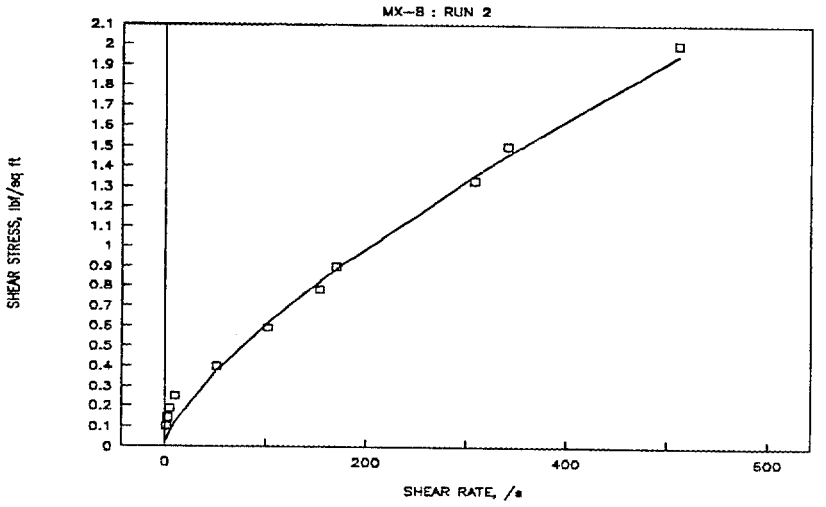
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

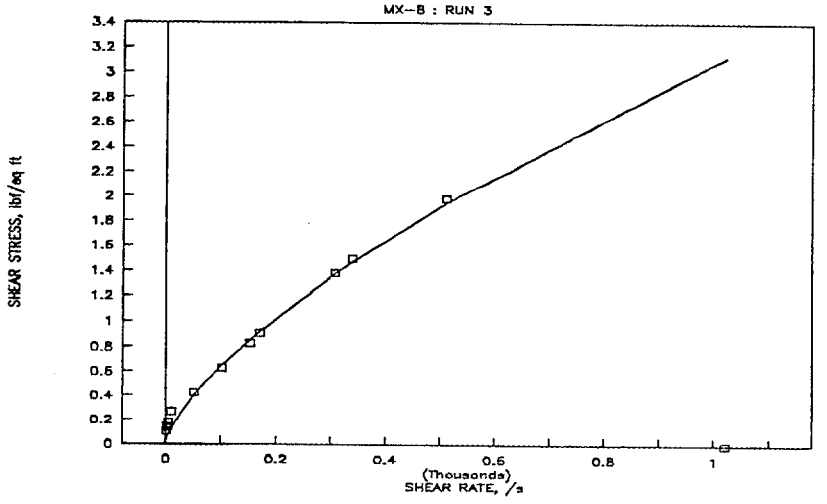
SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)

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


MX-8 : RUN 1
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
0
200
400
600
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
2.1


MX-8 : RUN 2
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
0
200
400
600
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
2.1


MX-8 : RUN 3
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)
0
0.2
0.4
0.6
0.8
1
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
3.2
3.4

PHASE SEPARATION FOR MX8

LIQUID DENSITY, g/mL: 1.21

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

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

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

CURE TIME, d: 28

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

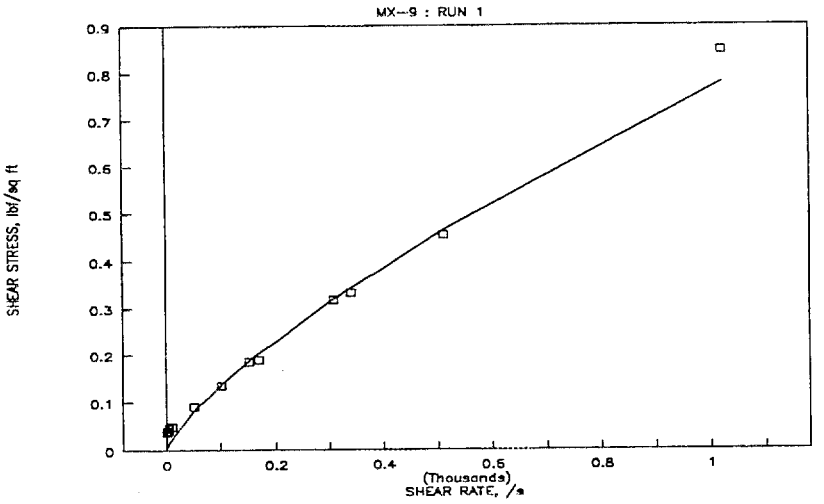
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	203	2	2	2	15830	3958	3958
RUN 2	203.9	2	2	2	15310	3828	3828
RUN 3	202.5	2	2	2	15590	3898	3898
					AVERAGE	3894.17	3894.17
					STD. DEV.	53.12	53.12
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
RUN 1	237.9	2	2	2	13880	3470	3470
RUN 2	238.4	2	2	2	12480	3120	3120
RUN 3	239.2	2	2	2	14230	3558	3558
					AVERAGE	3382.50	3382.50
					STD. DEV.	189.02	189.02

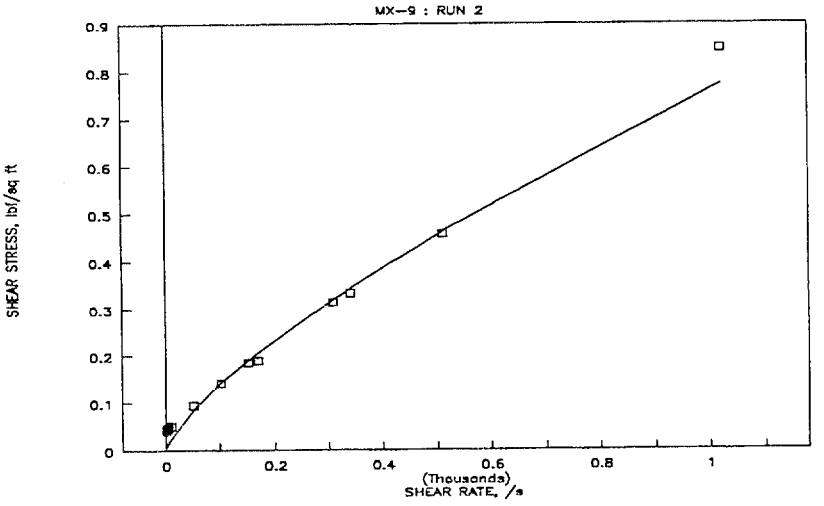
FANN VISCOMETER READINGS FOR MX9

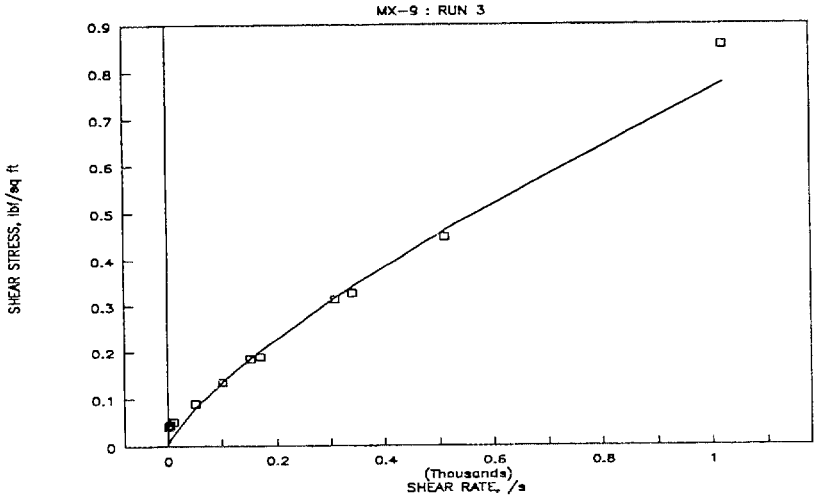
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

SHEAR RATE = K3*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	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


MX-9 : RUN 1
SHEAR STRESS, lbf/sq ft
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-9 : RUN 2
SHEAR STRESS, lbf/sq ft
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-9 : RUN 3
SHEAR STRESS, lbf/sq ft
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR MX9

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	441	438.4	437.2
APPROX. INIT. GR. VOL., mL:	250	250	250
CALC'D GROUT VOLUME, mL:	258	257	256
(USING MEAS'D DENSITY AND MASS)			

TIME d	RUN 1 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID vol%
0.08	440.88	7.48	2.43%	438.04	7.44	2.51%	437.14	8.94	2.91%
1	440.85	2.15	0.74%	438.08	2.18	0.81%	437.12	3.52	1.16%
2	440.82	1.72	0.61%	437.98	1.48	0.61%	437.06	2.46	0.84%
7	440.68	1.58	0.61%	437.94	1.34	0.58%	437.01	2.51	0.87%
14	440.66	1.26	0.51%	437.76	0.86	0.48%	436.88	2.28	0.84%
21	440.54	1.04	0.48%	437.61	0.61	0.45%	436.78	1.98	0.78%
28	440.45	0.45	0.32%	437.37	0.07	0.35%	436.63	1.83	0.78%

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

CURE TIME, d: 28

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

THERMAL CYCLING FOR MX9

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	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

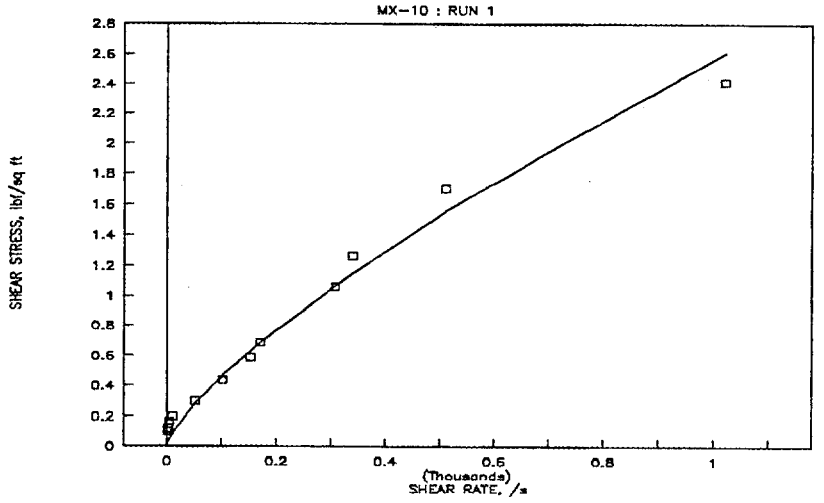
FANN VISCOMETER READINGS FOR MX10

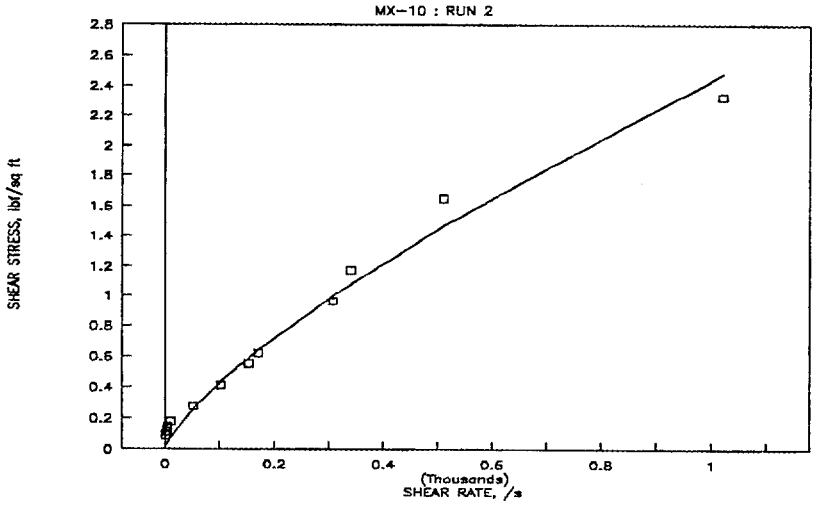
TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

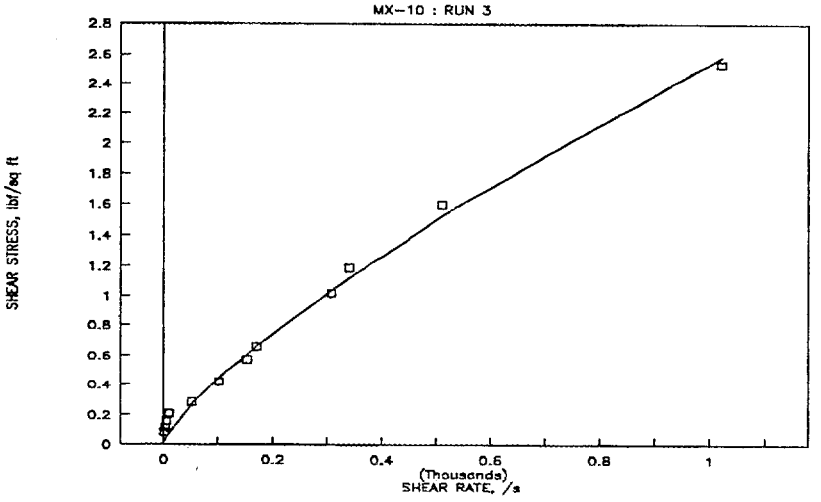
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

SHEAR RATE = K3*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	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


MX-10 : RUN 1
SHEAR STRESS, lbf/sq ft
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-10 : RUN 2
SHEAR STRESS, lbf/sq ft
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-10 : RUN 3
SHEAR STRESS, lbf/sq ft
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID 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%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX10
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
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
					STD. DEV.	5.89	5.89

THERMAL CYCLING FOR MX10

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 11

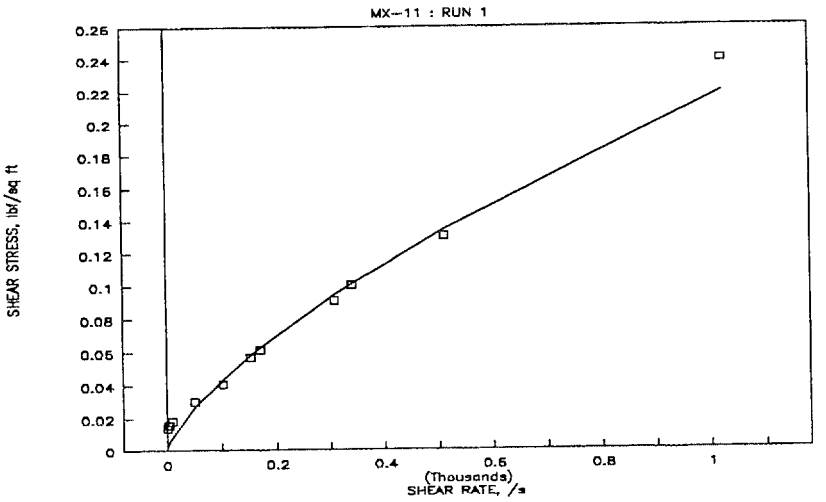
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	142.9	2	1.9375	2	2455	634	614
RUN 2	144.7	2	1.9375	2	2290	591	573
RUN 3	142.2	2	1.9375	2	2685	693	671
					AVERAGE	639.14	619.17
					STD. DEV.	41.80	40.50
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
RUN 1	215.2	2	2	2	1189	297	297
RUN 2	215.4	2	2	2	1197	299	299
RUN 3	216	2	2	2	1201	300	300
					AVERAGE	298.92	298.92
					STD. DEV.	1.25	1.25

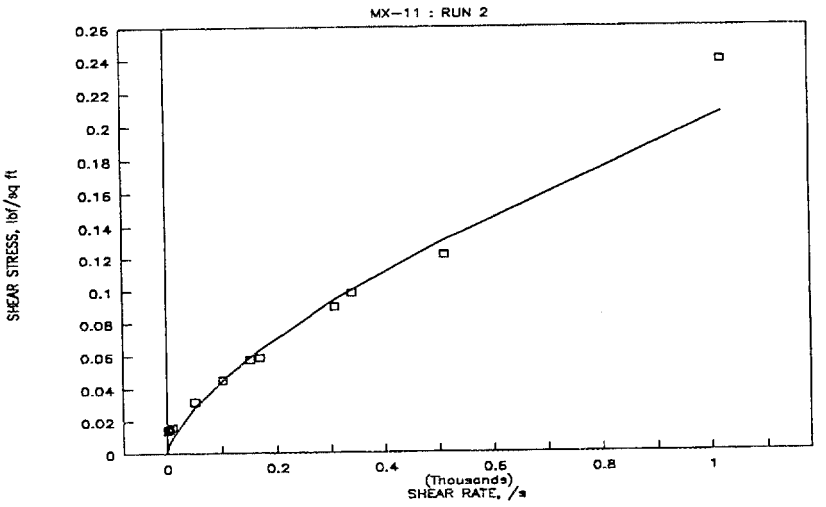
FANN VISCOMETER READINGS FOR MX11

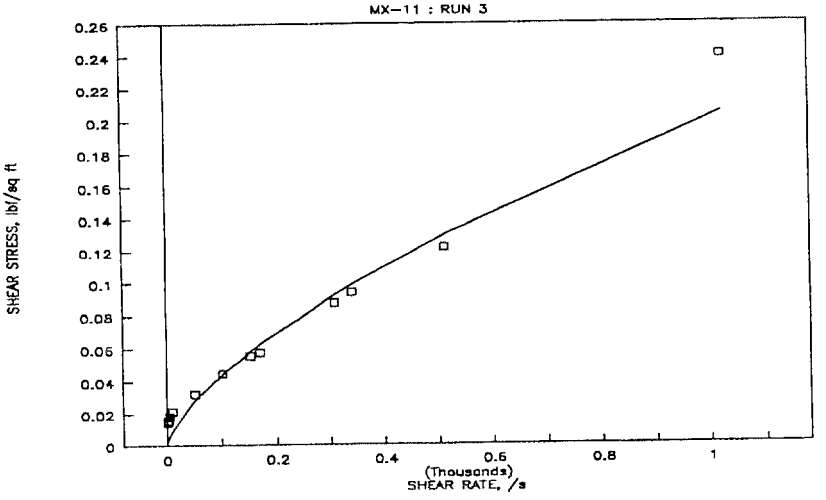
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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


MX-11 : RUN 1
SHEAR STRESS, lbf/sq ft
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-11 : RUN 2
SHEAR STRESS, lbf/sq ft
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-11 : RUN 3
SHEAR STRESS, lbf/sq ft
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR MX11

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID vol%
0.08333	422.55	55.15	18.21%	432.87	48.17	15.56%	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%
2	422.37	52.17	17.28%	432.67	44.17	14.34%	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%
14	422.14	48.84	16.26%	432.36	40.76	13.34%	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%
28	421.35	43.35	14.71%	431.72	36.22	12.08%	424.32	45.62	15.30%

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

CURE TIME, d: 28

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

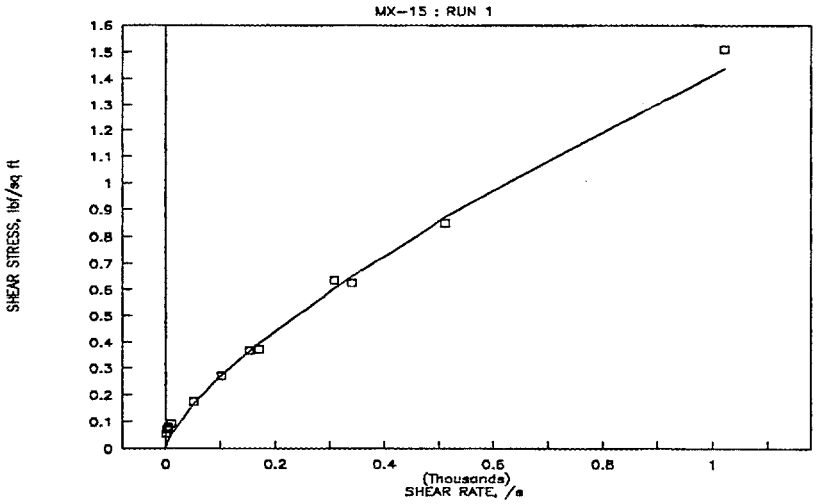
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	134	2	1.8125	2	1036	286	259
RUN 2	136.6	2	1.8125	2	1257	347	314
RUN 3	135.4	2	1.8125	2	983	271	246
					AVERAGE	301.24	273
					STD. DEV.	32.73	29.67
	COMPARATOR NOT SUBJECTED TO THERMAL 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

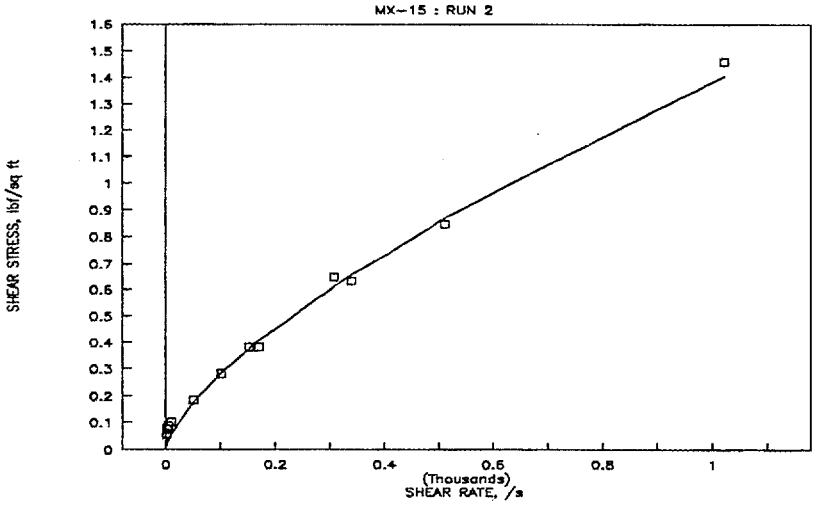
FANN VISCOMETER READINGS FOR MX15

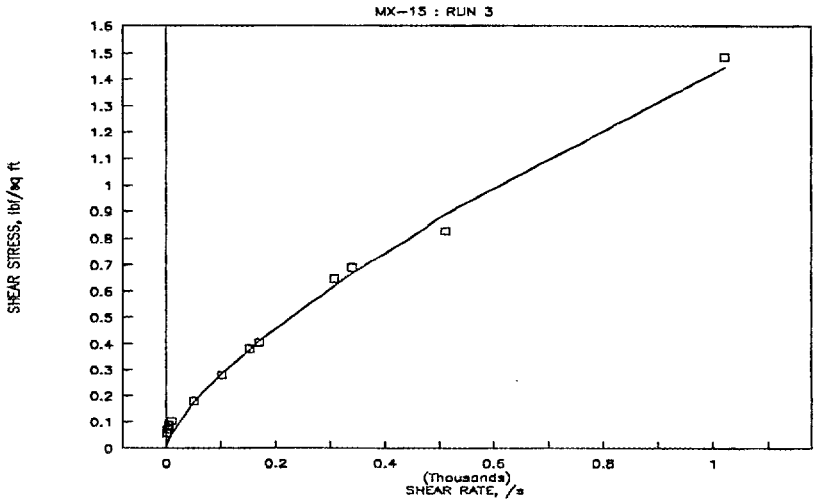
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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	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


MX-15 : RUN 1
SHEAR STRESS, lbf/sq ft
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-15 : RUN 2
SHEAR STRESS, lbf/sq ft
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-15 : RUN 3
SHEAR STRESS, lbf/sq ft
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR MX15

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	428.4	432.2	432
APPROX. INIT. GR. VOL., mL:	250	250	250
CALC'D GROUT VOLUME, mL:	260	262	262
(USING MEAS'D DENSITY AND MASS)			

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

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

CURE TIME, d: 28

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

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

FANN VISCOMETER READINGS FOR MX20

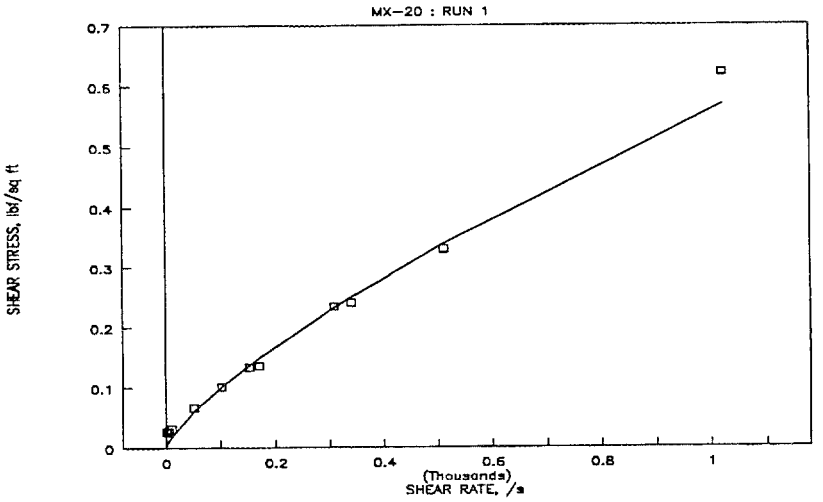
TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

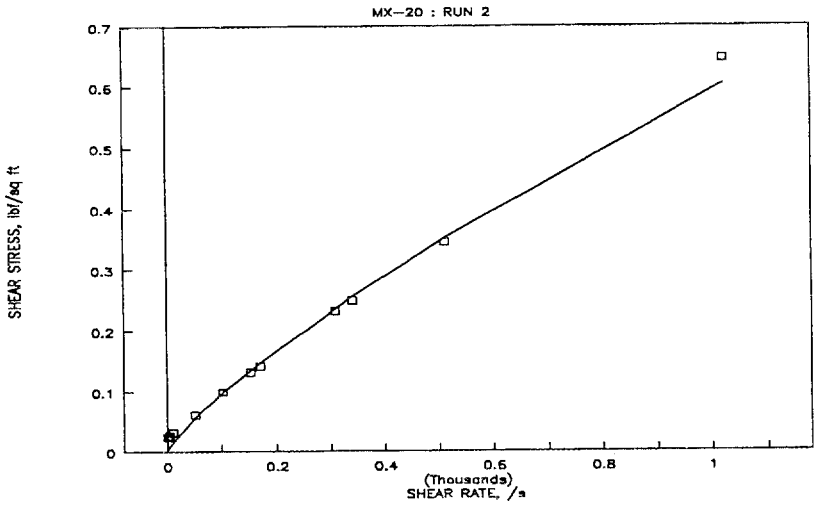
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

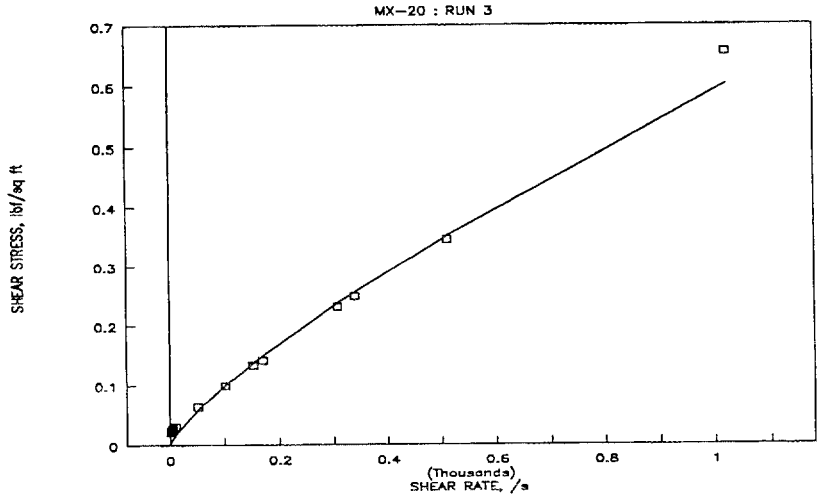
SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)

lbf/sq ft = dynes/sq cm * 0.002089

RPM	READING		
	RUN 1	RUN 2	RUN 3
600	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


MX-20 : RUN 1
SHEAR STRESS, lbf/sq ft
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-20 : RUN 2
SHEAR STRESS, lbf/sq ft
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-20 : RUN 3
SHEAR STRESS, lbf/sq ft
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR MX20

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID vol%
0.08333	408.71	9.91	3.24%	414.12	10.62	3.45%	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%
2	408.52	0.72	0.29%	414	4.2	1.42%	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%
14	408.4	1.5	0.59%	413.75	3.25	1.19%	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%
28	408.24	1.24	0.56%	413.52	3.02	1.19%	411.08	0.48	0.32%

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

CURE TIME, d: 28

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

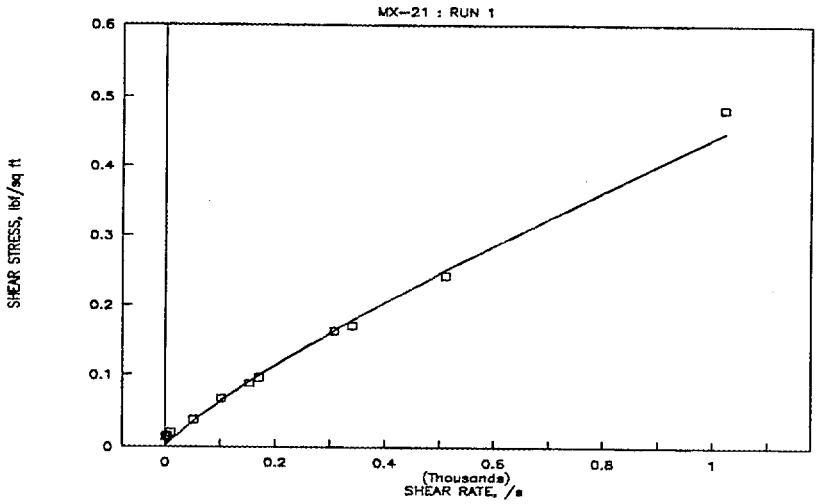
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	133.9	2	1.875	2	3886	1036	972
RUN 2	134.1	2	1.875	2	3212	857	803
RUN 3	135.4	2	1.875	2	3326	887	832
					AVERAGE	926.58	868.67
					STD. DEV.	78.55	73.64
	COMPARATOR NOT SUBJECTED TO THERMAL 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

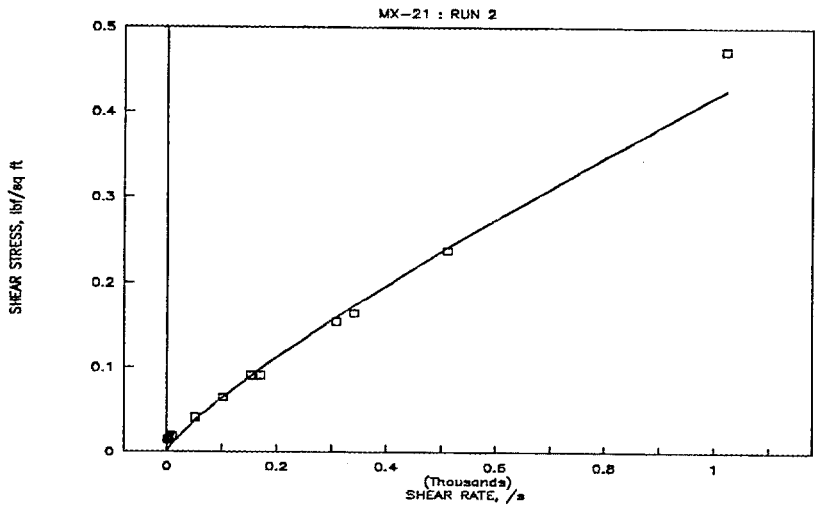
FANN VISCOMETER READINGS FOR MX21

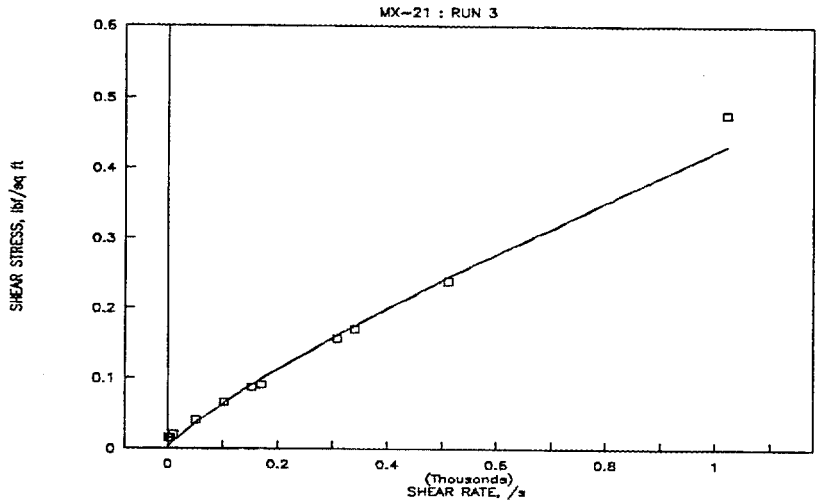
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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	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


MX-21 : RUN 1
SHEAR STRESS, lbf/sq ft
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-21 : RUN 2
SHEAR STRESS, lbf/sq ft
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-21 : RUN 3
SHEAR STRESS, lbf/sq ft
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID vol%
0.08333	409.49	21.69	7.08%	410.28	23.58	7.69%	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%
2	409.17	6.37	2.18%	410.05	10.35	3.45%	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%
14	408.85	2.25	0.95%	409.8	7	2.44%	416	5.4	1.89%
21	408.8	0	0.23%	409.67	6.17	2.21%	415.34	5.44	2.11%
28	408.7	0	0.26%	409.55	4.55	1.73%	415.28	3.08	1.38%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX21
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	UCS CORR'D
	g	L	W	H	lbf	psi	psi
RUN 1	201.1	2	1.9375	2	8500	2194	2125
RUN 2	197.2	2	1.9375	2	7650	1974	1913
RUN 3	193.8	2	1.9375	2	7120	1837	1780
					AVERAGE	2001.72	1939.17
					STD. DEV.	146.69	142.10

THERMAL CYCLING FOR MX21

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 11

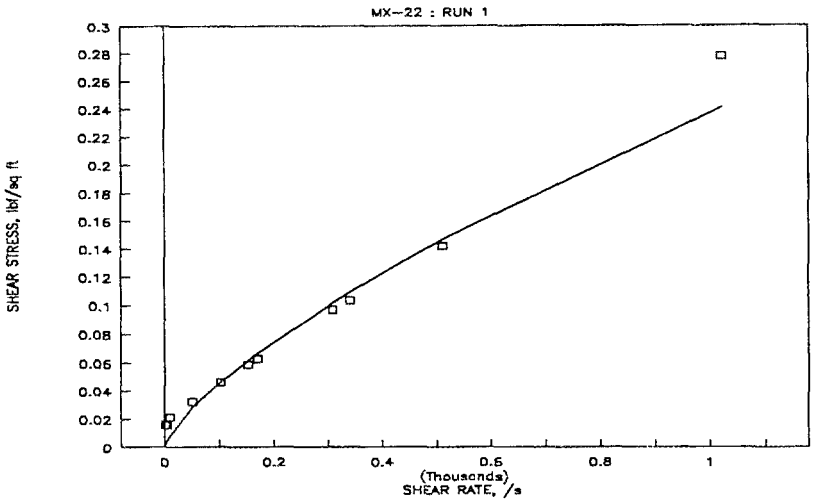
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	160.3	2	1.875	2	8740	2331	2185
RUN 2	156.3	2	1.875	2	8340	2224	2085
RUN 3	154.3	2	1.875	2	7610	2029	1903
					AVERAGE	2194.67	2057.5
					STD. DEV.	124.76	116.96
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
RUN 1	207.2	2	1.875	2	7940	2117	1985
RUN 2	200	2	1.875	2	8140	2171	2035
RUN 3	198.9	2	1.875	2	7140	1904	1785
					AVERAGE	2064	1935
					STD. DEV.	115.21	108.01

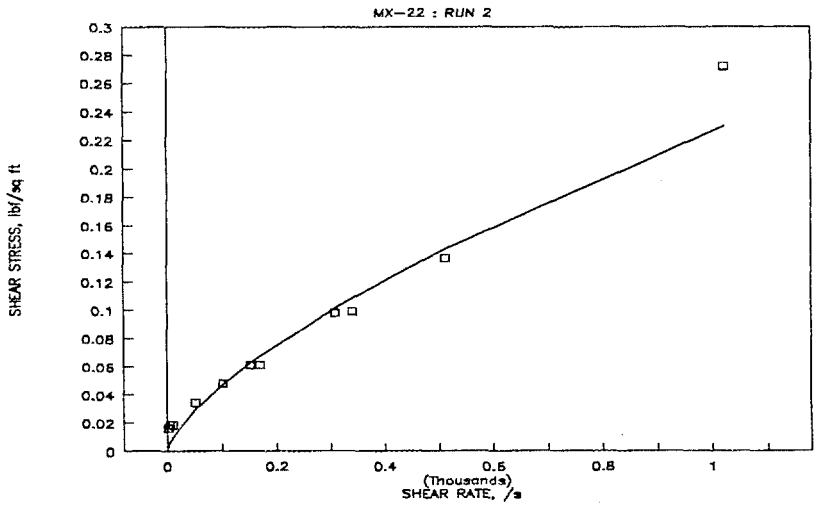
FANN VISCOMETER READINGS FOR MX22

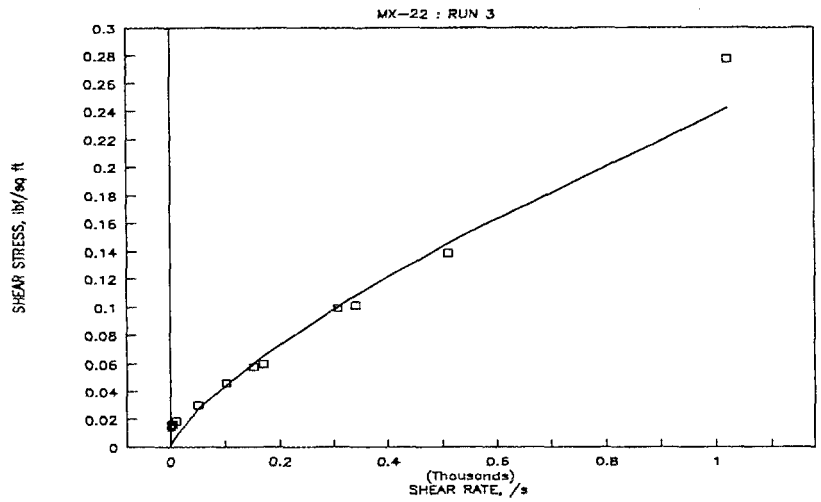
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

SHEAR RATE = K3*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	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


MX—22 : RUN 1
SHEAR STRESS, lbf/sq ft
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX—22 : RUN 2
SHEAR STRESS, lbf/sq ft
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX—22 : RUN 3
SHEAR STRESS, lbf/sq ft
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR MX22

LIQUID DENSITY, g/mL: 1.21

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

TIME d	RUN 1 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID 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. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
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

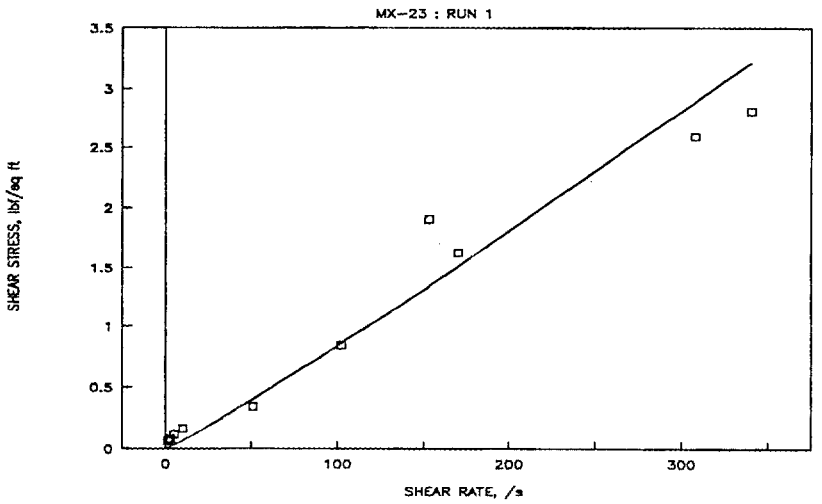
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	133.5	2	1.8125	2	1611	444	403
RUN 2	136.6	2	1.8125	2	1198	330	300
RUN 3	133.9	2	1.8125	2	1464	404	366
					AVERAGE	392.92	356.08
					STD. DEV.	47.15	42.73
	COMPARATOR NOT SUBJECTED TO THERMAL 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

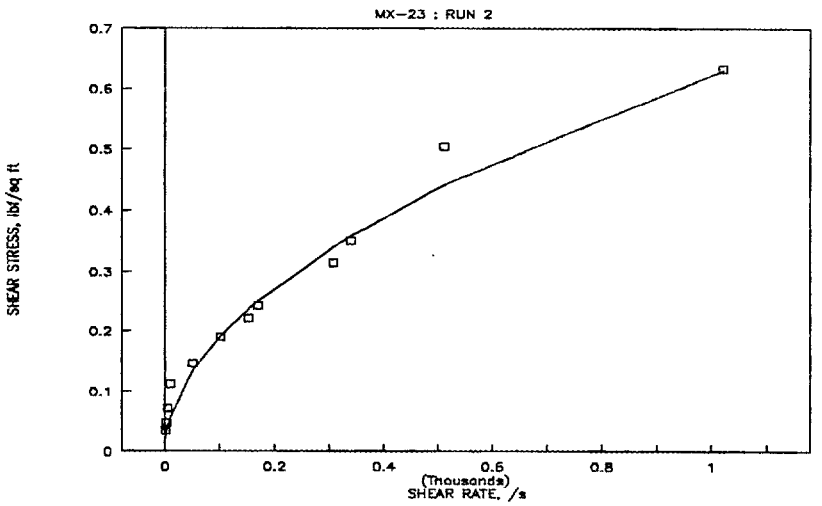
FANN VISCOMETER READINGS FOR MX23

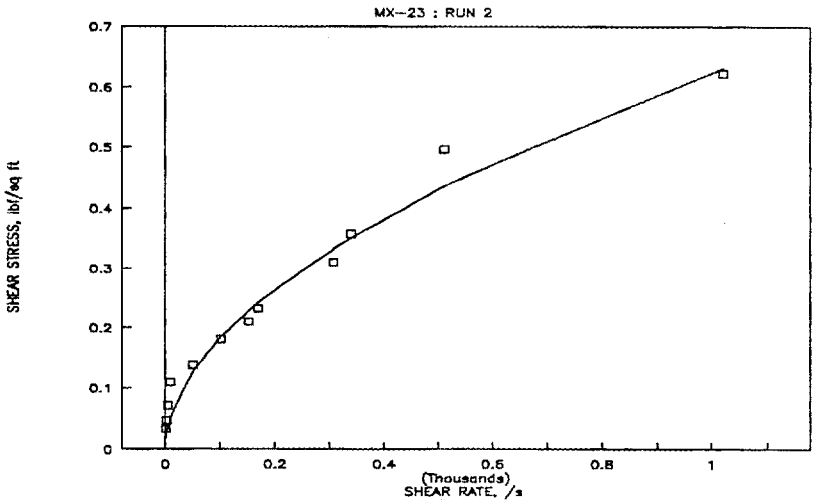
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

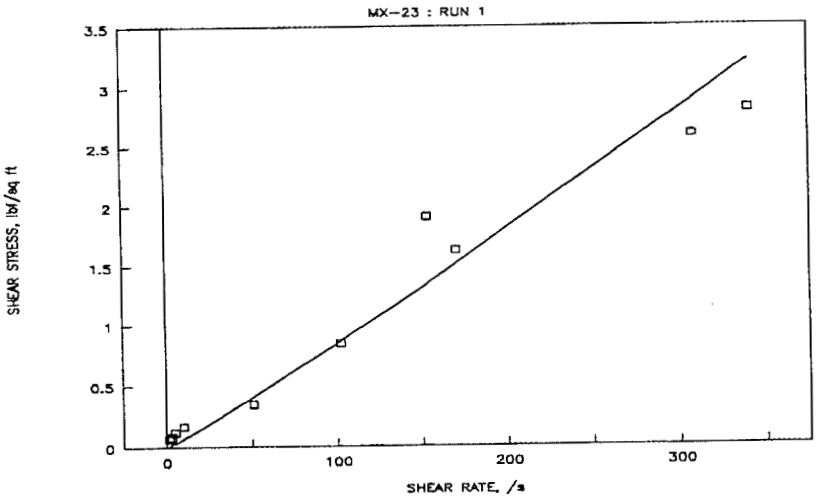
SHEAR RATE = K3*RPM, SHEAR STRESS = K1*K2*(FANN VISCOMETER READING)
lbf/sq ft = dynes/sq cm * 0.002089

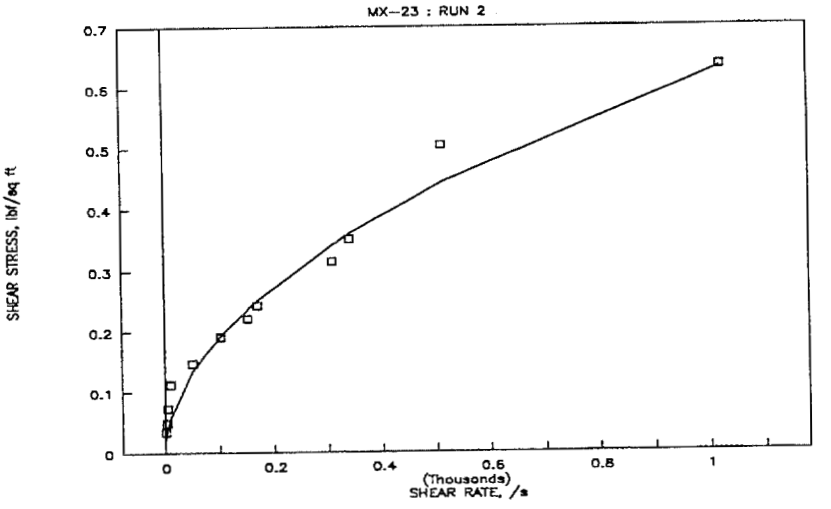
RPM	READING		
	RUN 1	RUN 2	RUN 3
600		59.3	58.5
300		47.2	46.5
200	263.0	32.8	33.5
100	152.5	22.7	21.8
181	243.0	29.4	29.0
90	178.5	20.7	19.7
60	79.5	17.8	17.0
30	32.5	13.7	13.0
6	15.5	10.5	10.3
3	11.3	6.8	6.7
1.8	7.8	4.5	4.5
0.9	6.3	3.2	3.2

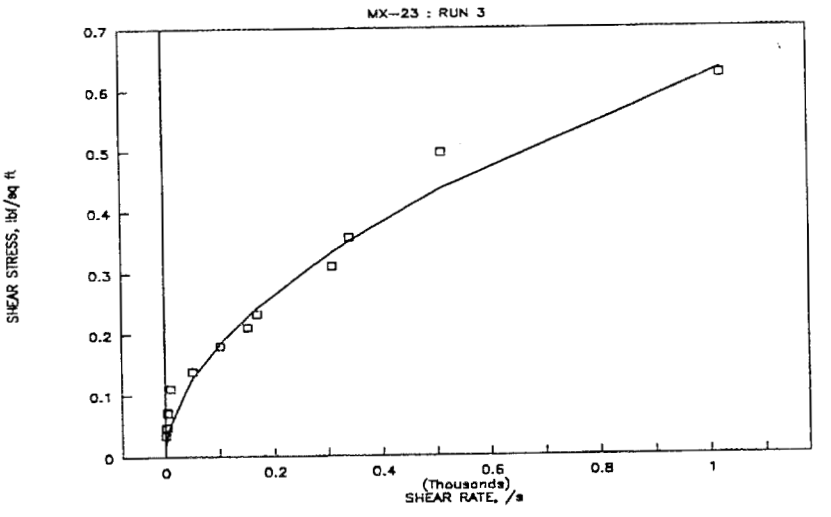

MX-23 : RUN 1
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
0
0.5
1
1.5
2
2.5
3
3.5
0
100
200
300


MX-23 : RUN 2
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
0.2
0.4
0.6
0.8
1


MX-23 : RUN 2
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
0.2
0.4
0.6
0.8
1


MX-23 : RUN 1
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
0
0.5
1
1.5
2
2.5
3
3.5
0
100
200
300


MX-23 : RUN 2
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
0.2
0.4
0.6
0.8
1


MX-23 : RUN 3
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
0.2
0.4
0.6
0.8
1

PHASE SEPARATION FOR MX23

LIQUID DENSITY, g/mL: 1.21

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

TIME d	RUN 1 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID 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%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX23
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
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
					STD. DEV.	7.02	7.02

THERMAL CYCLING FOR MX23

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 10

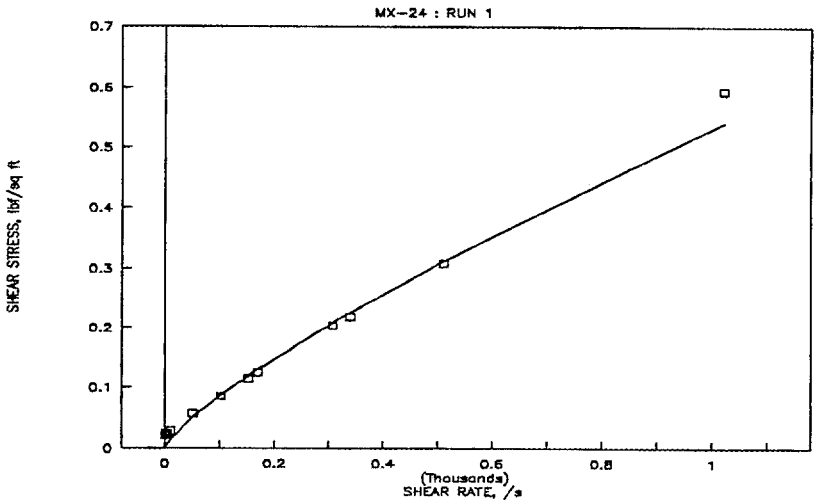
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	140.1	2	2	2	4240	1060	1060
RUN 2	140	2	2	2	4165	1041	1041
RUN 3	135.7	2	2	2	4421	1105	1105
					AVERAGE	1068.83	1068.83
					STD. DEV.	26.86	26.86
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
RUN 1	195.6	2	2	2	3984	996	996
RUN 2	194.7	2	2	2	3863	966	966
RUN 3	185.8	2	2	2	4238	1060	1060
					AVERAGE	1007.08	1007.08
					STD. DEV.	39.07	39.07

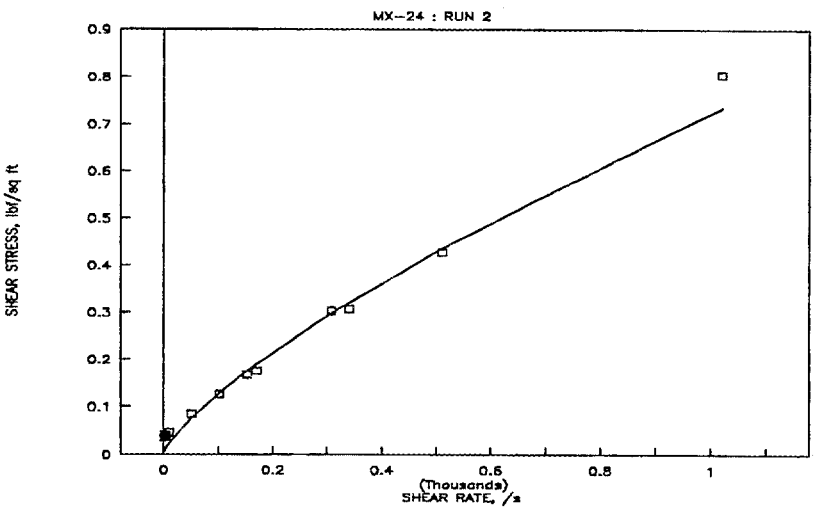
FANN VISCOMETER READINGS FOR MX24

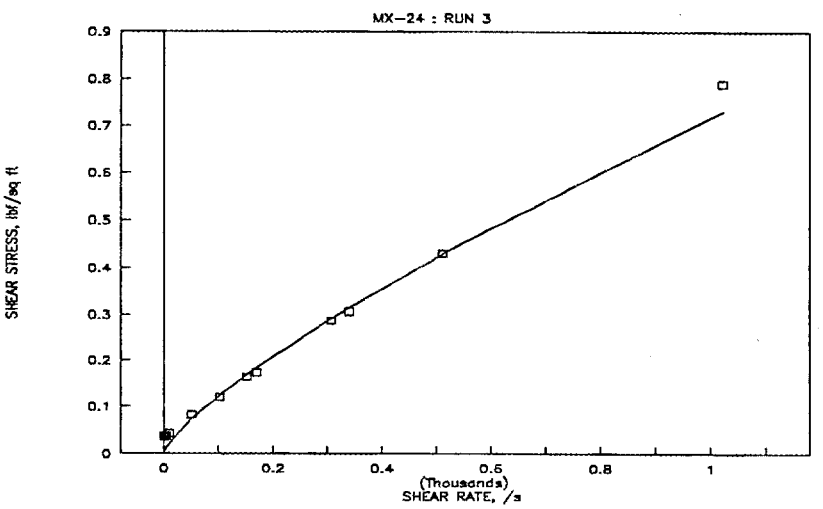
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

SHEAR RATE = K3*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	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


MX-24 : RUN 1
SHEAR STRESS, lbf/sq ft
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-24 : RUN 2
SHEAR STRESS, lbf/sq ft
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-24 : RUN 3
SHEAR STRESS, lbf/sq ft
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR MX24

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	417.5	412	418.8
APPROX. INIT. GR. VOL., mL:	250	250	250
CALC'D GROUT VOLUME, mL:	254	249	251
(USING MEAS'D DENSITY AND MASS)			

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

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

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	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. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	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

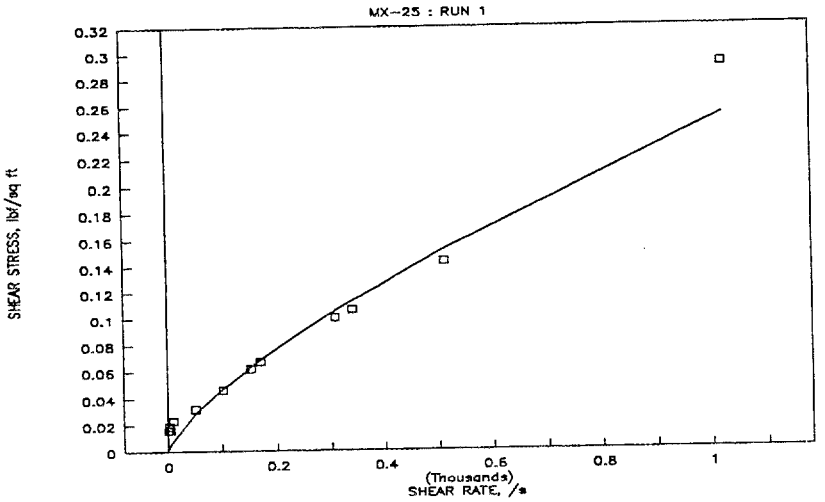
FANN VISCOMETER READINGS FOR MX25

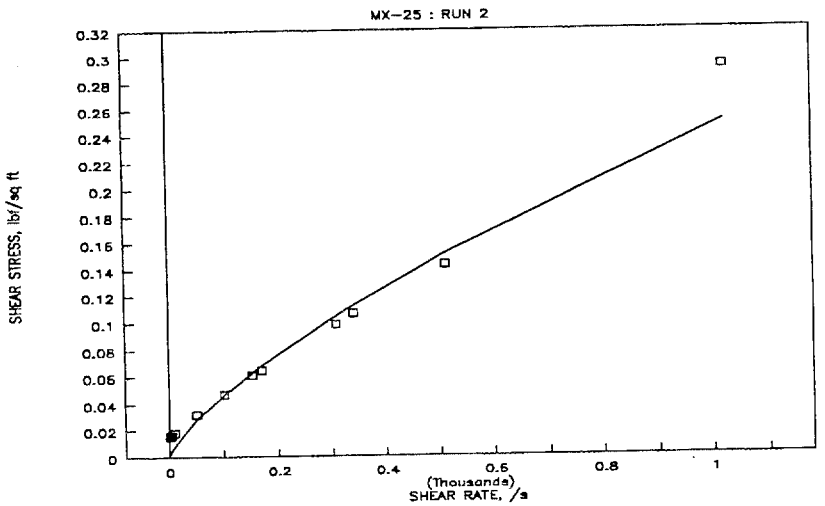
TORSION SPRING ASSEMBLY: F1 K1, dyne-cm/deg: 386

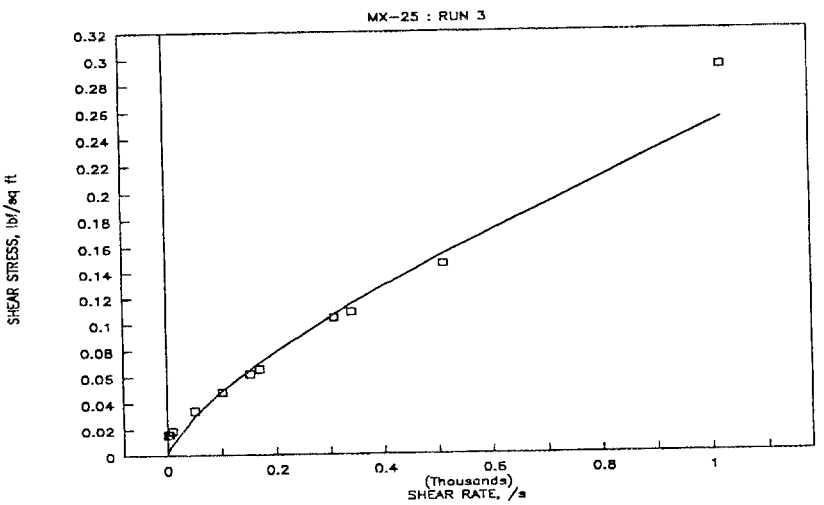
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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


MX-25 : RUN 1
SHEAR STRESS, lbf/sq ft
0.32
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-25 : RUN 2
SHEAR STRESS, lbf/sq ft
0.32
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-25 : RUN 3
SHEAR STRESS, lbf/sq ft
0.32
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR MX25

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID 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. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	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

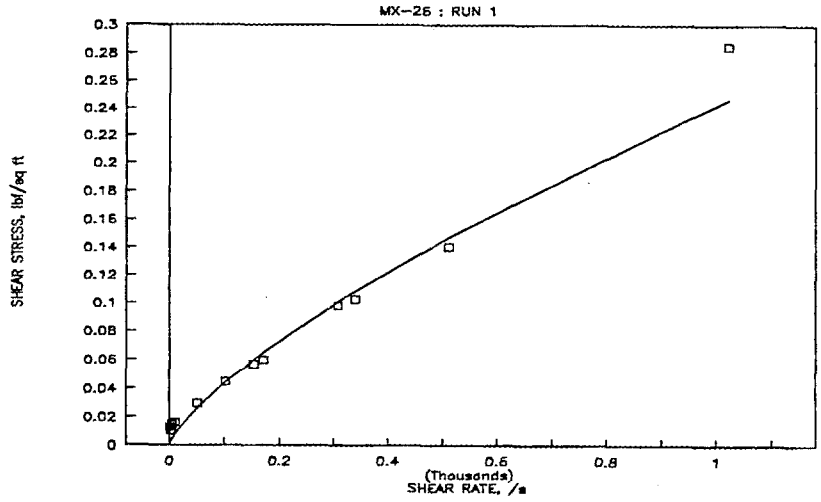
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	138.9	2	1.8125	2	2992	825	748
RUN 2	130.2	2	1.75	2	2428	694	607
RUN 3	134	2	1.75	2	3009	860	752
					AVERAGE	792.94	702.42
					STD. DEV.	71.55	67.49
	COMPARATOR NOT SUBJECTED TO THERMAL 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

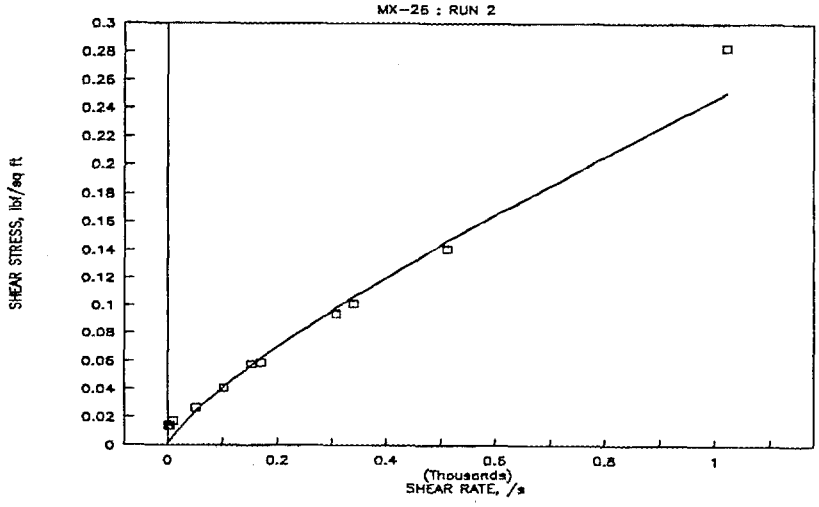
FANN VISCOMETER READINGS FOR MX26

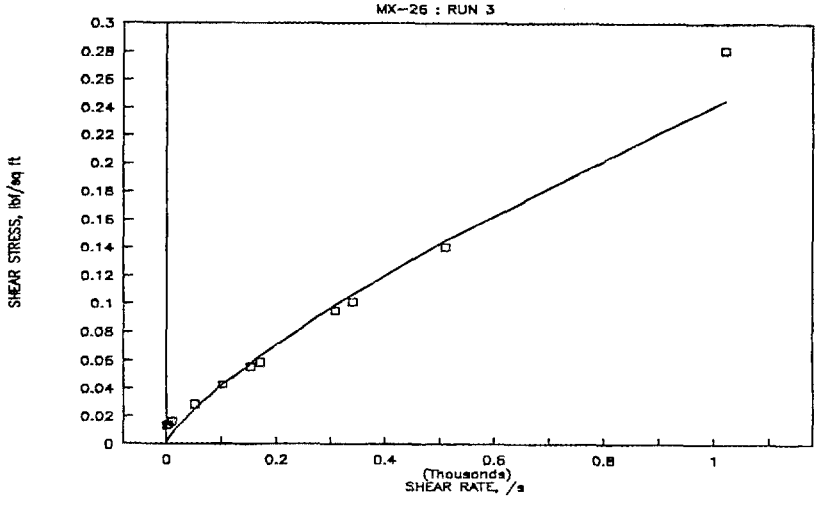
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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	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


MX-26 : RUN 1
SHEAR STRESS, lbf/sq ft
0.3
0.28
0.25
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-26 : RUN 2
SHEAR STRESS, lbf/sq ft
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-26 : RUN 3
SHEAR STRESS, lbf/sq ft
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID 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. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
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

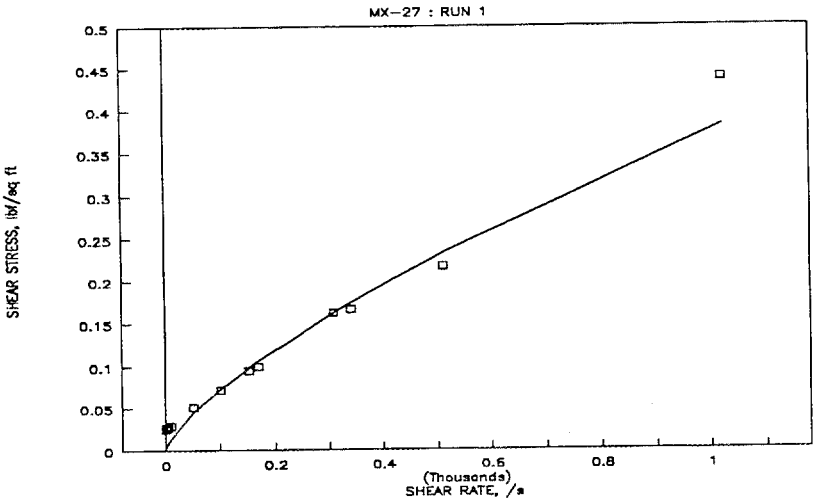
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	123.1	2	1.75	2	1571	449	393
RUN 2	127.8	2	1.6875	2	1607	476	402
RUN 3	120.4	2	1.6875	2	1510	447	378
					AVERAGE	457.47	390.67
					STD. DEV.	13.22	10.01
	COMPARATOR NOT SUBJECTED TO THERMAL 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

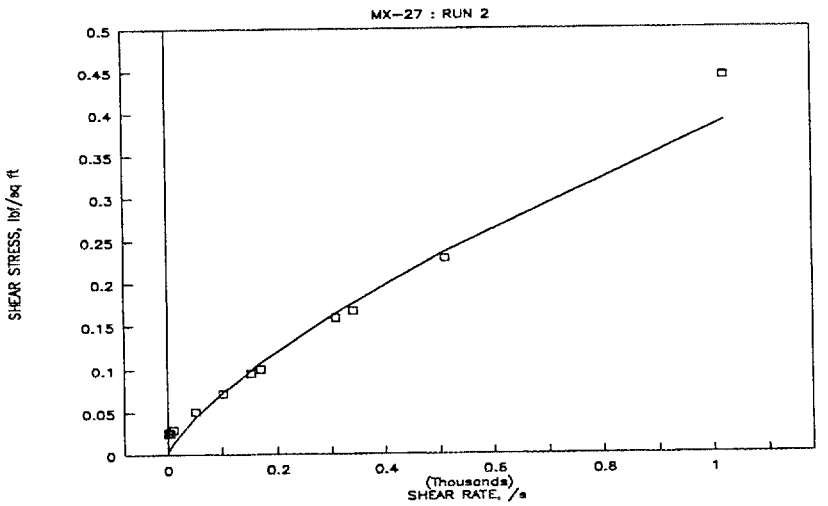
FANN VISCOMETER READINGS FOR MX27

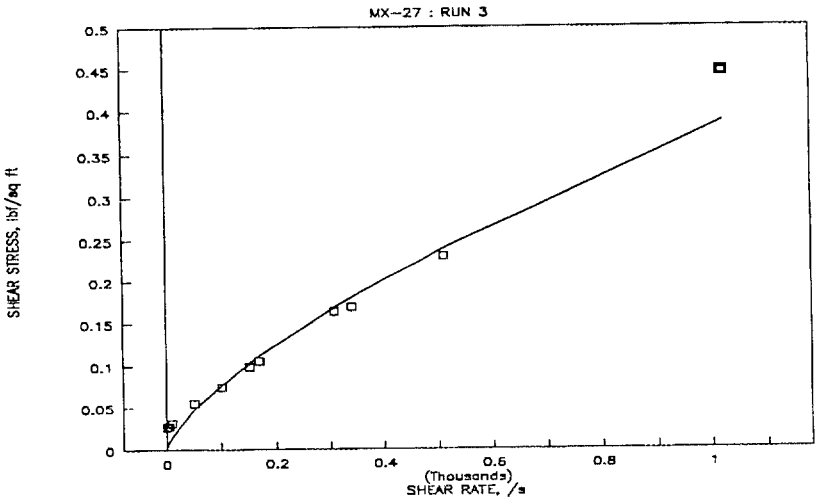
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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	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


MX-27 : RUN 1
SHEAR STRESS, lbf/sq ft
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-27 : RUN 2
SHEAR STRESS, lbf/sq ft
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-27 : RUN 3
SHEAR STRESS, lbf/sq ft
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID vol%
0.08333	448.34	19.24	6.20%	440.35	19.35	6.38%	445.51	19.81	6.43%
1	448.25	16.15	5.24%	440.49	17.69	5.79%	445.5	16.2	5.27%
2	448.06	15.26	5.01%	440.32	16.62	5.49%	445.38	15.18	4.98%
8	447.77	13.57	4.56%	440.15	15.05	5.04%	445.23	14.13	4.69%
14	447.83	13.83	4.63%	440.04	14.24	4.81%	444.88	13.58	4.62%
21	447.76	13.86	4.66%	439.86	11.86	4.09%	444.77	12.77	4.40%
28	447.69	12.69	4.31%	439.82	9.82	3.43%	444.69	12.19	4.24%

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

CURE TIME, d: 28

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

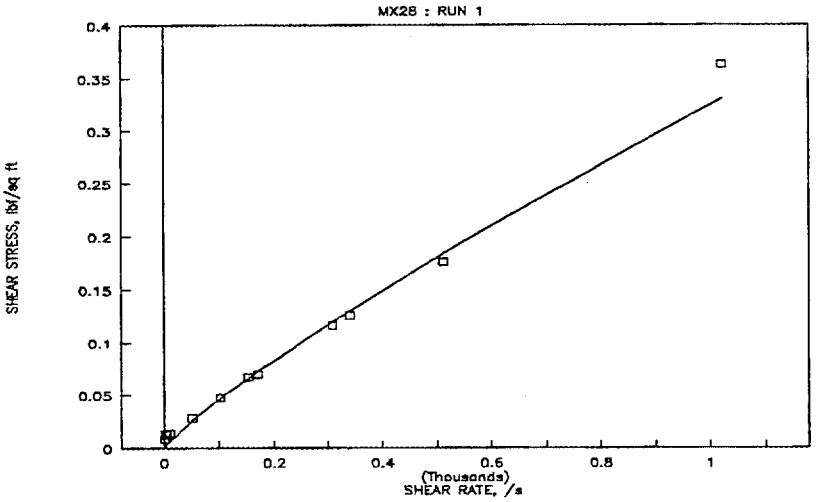
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	160.3	2	1.9375	2	2038	526	510
RUN 2	161.6	2	1.9375	2	1626	420	407
RUN 3	164.5	2	1.9375	2	2113	545	528
					AVERAGE	496.95	481.42
					STD. DEV.	55.25	53.52
	COMPARATOR NOT SUBJECTED TO THERMAL 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

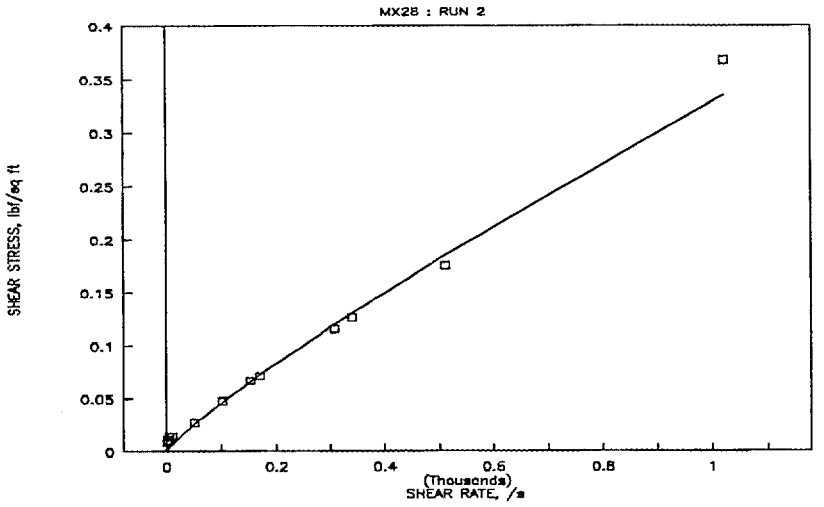
FANN VISCOMETER READINGS FOR MX28

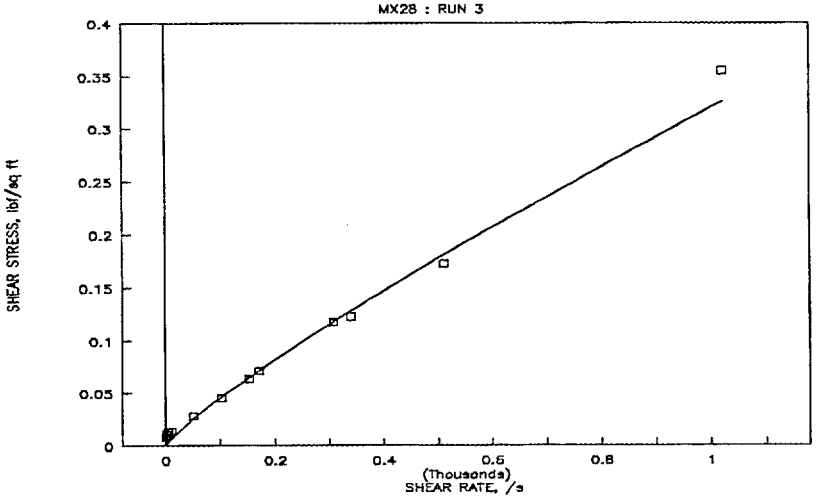
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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


MX28 : RUN 1
SHEAR STRESS, lbf/sq ft
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX28 : RUN 2
SHEAR STRESS, lbf/sq ft
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX28 : RUN 3
SHEAR STRESS, lbf/sq ft
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID vol%
0.08	403.27	40.97	13.34%	396.48	43.28	14.30%	409.27	47.87	15.32%
1	403.15	35.45	11.59%	396.39	35.99	11.93%	409.26	40.66	13.02%
2	403.07	28.87	9.49%	396.34	30.04	9.98%	409.14	35.34	11.36%
7	402.96	21.36	7.09%	395.94	22.04	7.48%	408.96	26.76	8.68%
14	402.78	21.28	7.12%	395.77	22.37	7.64%	408.58	26.18	8.62%
21	402.67	18.07	6.12%	395.65	19.05	6.59%	408.55	25.35	8.36%
28	402.51	14.71	5.08%	395.48	17.18	6.03%	408.34	24.04	8.01%

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

CURE TIME, d: 28

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

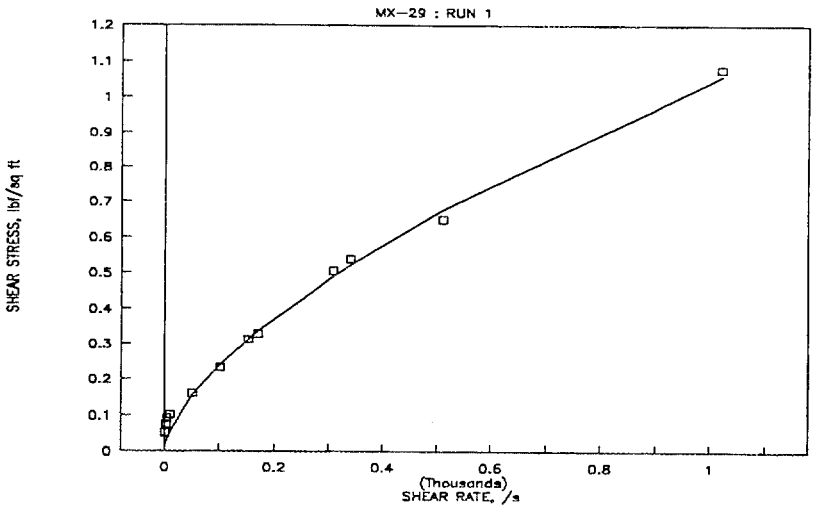
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	143	2	1.88	2	4920	1312	1230
RUN 2	143.1	2	1.88	2	4548	1213	1137
RUN 3	143.2	2	1.88	2	4691	1251	1173
					AVERAGE	1258.58	1179.92
					STD. DEV.	40.86	38.30
	COMPARATOR NOT SUBJECTED TO THERMAL 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

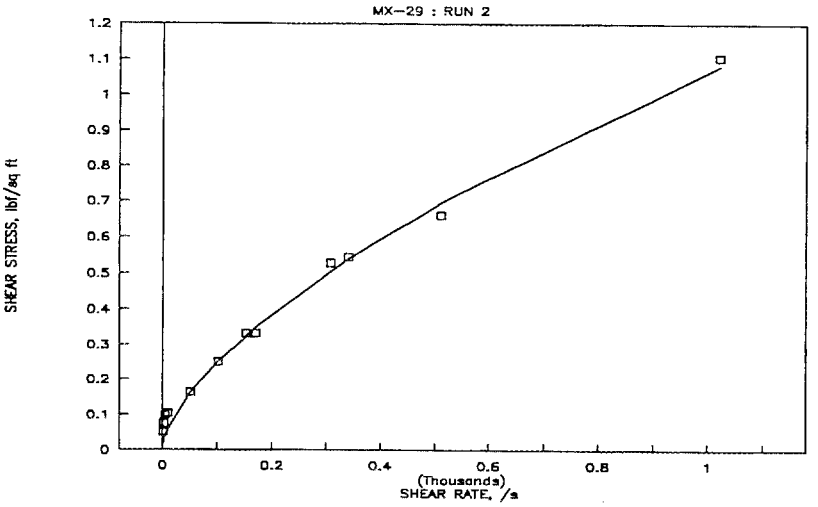
FANN VISCOMETER READINGS FOR MX29

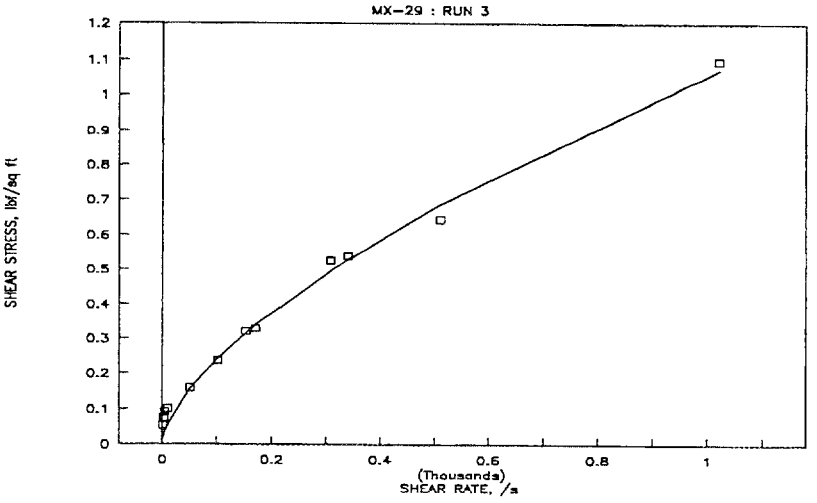
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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	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


MX-29 : RUN 1
SHEAR STRESS, lbf/sq ft
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-29 : RUN 2
SHEAR STRESS, lbf/sq ft
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-29 : RUN 3
SHEAR STRESS, lbf/sq ft
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR MX29

LIQUID DENSITY, g/mL: 1.21

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

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX29
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
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
					STD. DEV.	8.39	8.39

THERMAL CYCLING FOR MX29

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 12

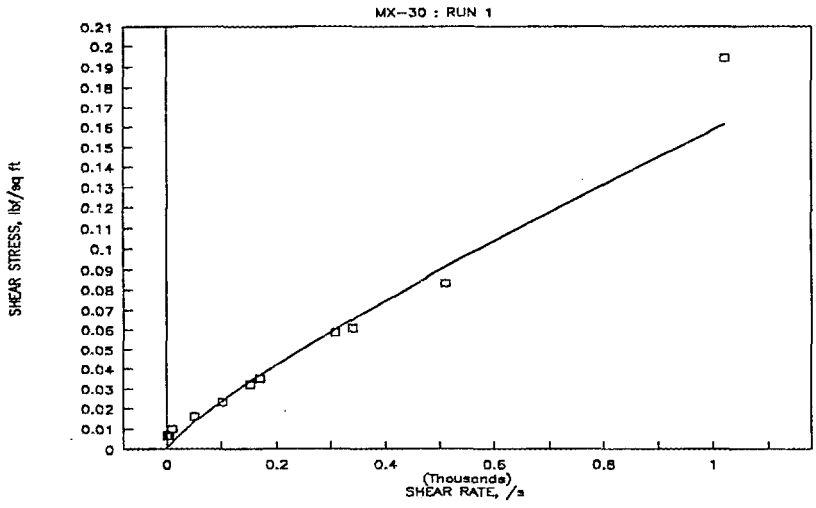
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	121.5	2	2	2	2193	548	548
RUN 2	119.6	2	2	2	2116	529	529
RUN 3	121.8	2	2	2	1795	449	449
					AVERAGE	508.67	508.67
					STD. DEV.	43.09	43.09
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
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

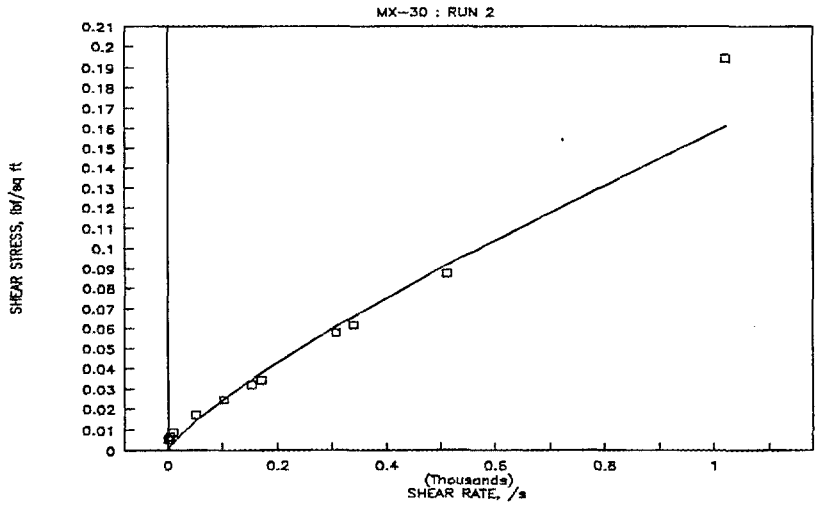
FANN VISCOMETER READINGS FOR MX30

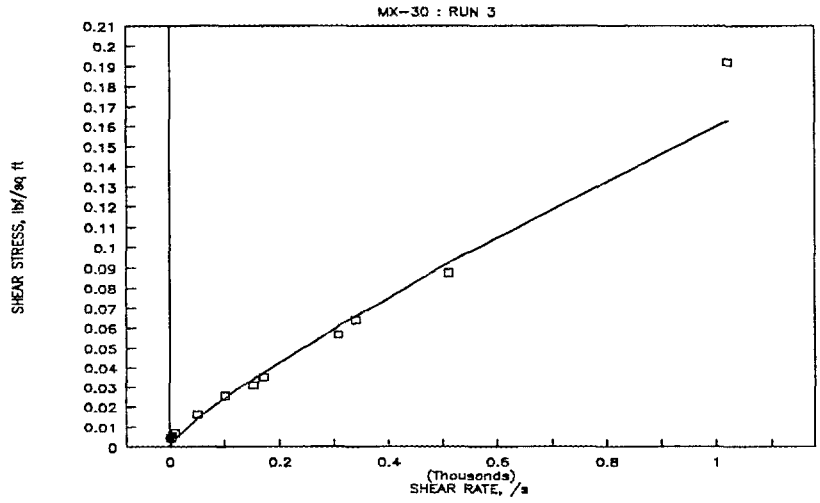
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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	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


MX-30 : RUN 1
SHEAR STRESS, lbf/sq ft
0.21
0.2
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-30 : RUN 2
SHEAR STRESS, lbf/sq ft
0.21
0.2
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-30 : RUN 3
SHEAR STRESS, lbf/sq ft
0.21
0.2
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR MX30

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID vol%
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. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	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

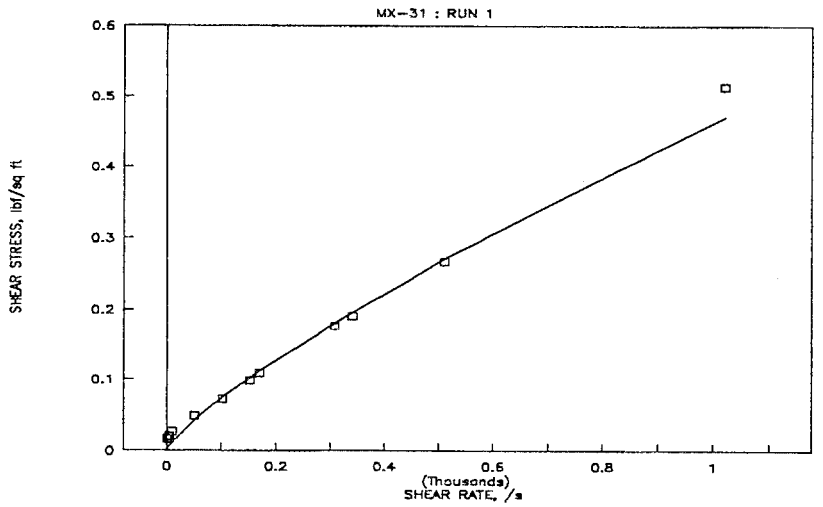
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	102.9	2	1.5	2	2115	705	529
RUN 2	106.3	2	1.5	2	1865	622	466
RUN 3	106.8	2	1.56	2	1605	514	401
					AVERAGE	613.42	465.42
					STD. DEV.	78.36	52.05
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
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

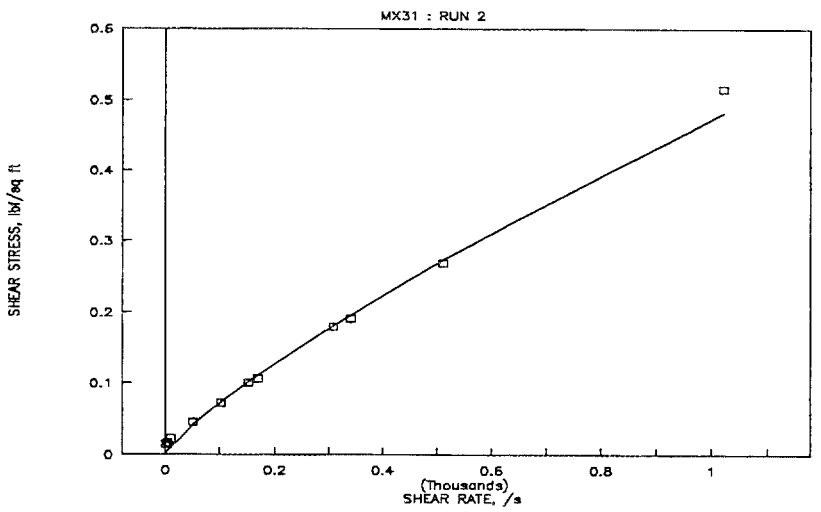
FANN VISCOMETER READINGS FOR MX31

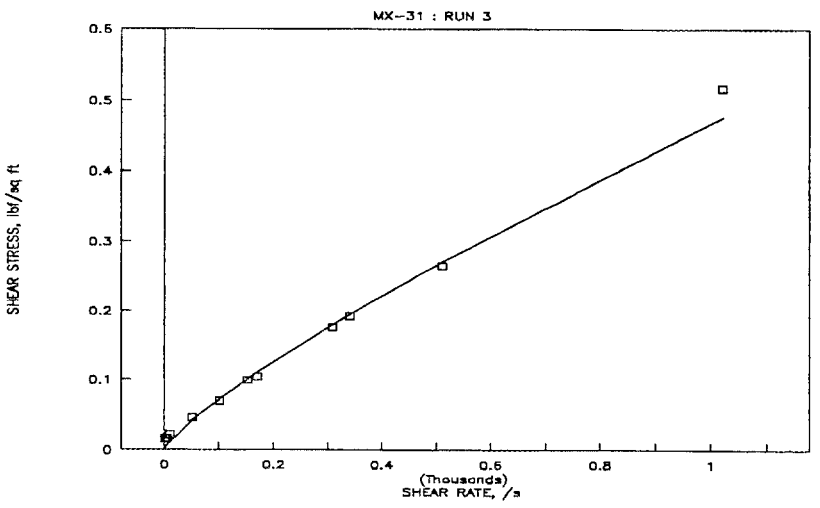
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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


MX-31 : RUN 1
SHEAR STRESS, lbf/sq ft
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX31 : RUN 2
SHEAR STRESS, lbf/sq ft
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-31 : RUN 3
SHEAR STRESS, lbf/sq ft
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR MX31

LIQUID DENSITY, g/mL: 1.21

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

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

CURE TIME, d: 28

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

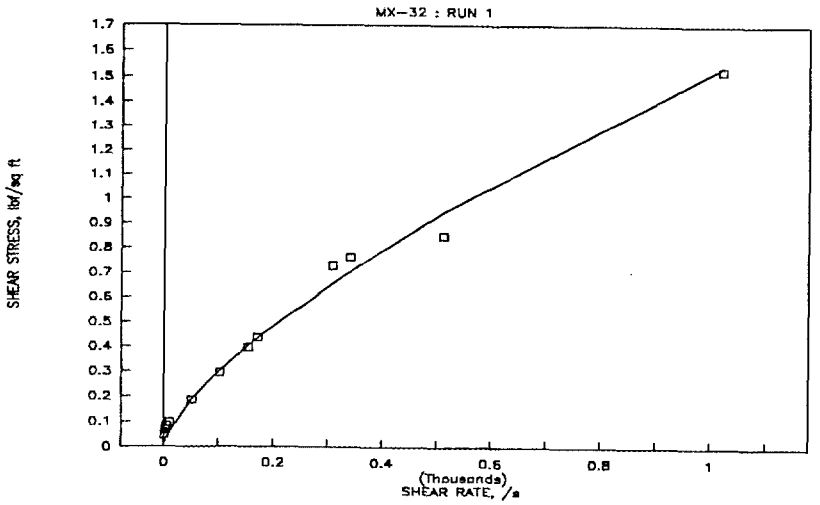
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	125.8	2	1.94	2	1796	463	449
RUN 2	125.6	2	1.94	2	1796	463	449
RUN 3	126.2	2	1.94	2	1754	453	439
					AVERAGE	459.87	445.50
					STD. DEV.	5.11	4.95
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
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

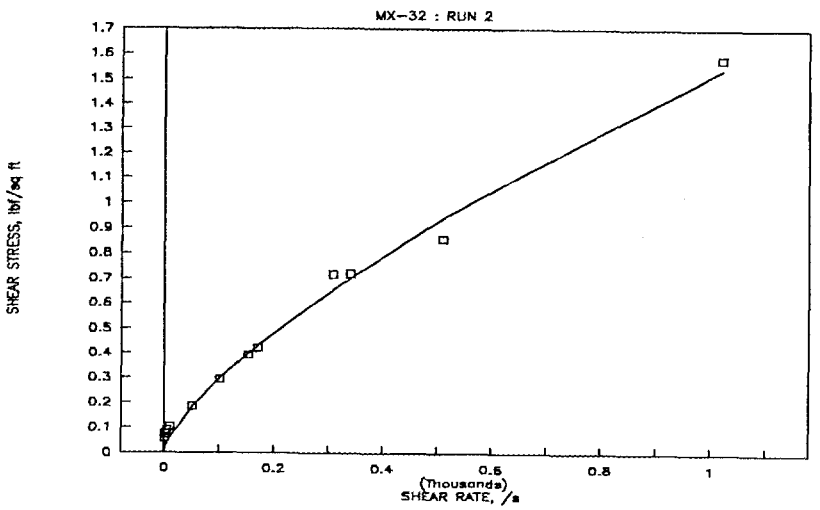
FANN VISCOMETER READINGS FOR MX32

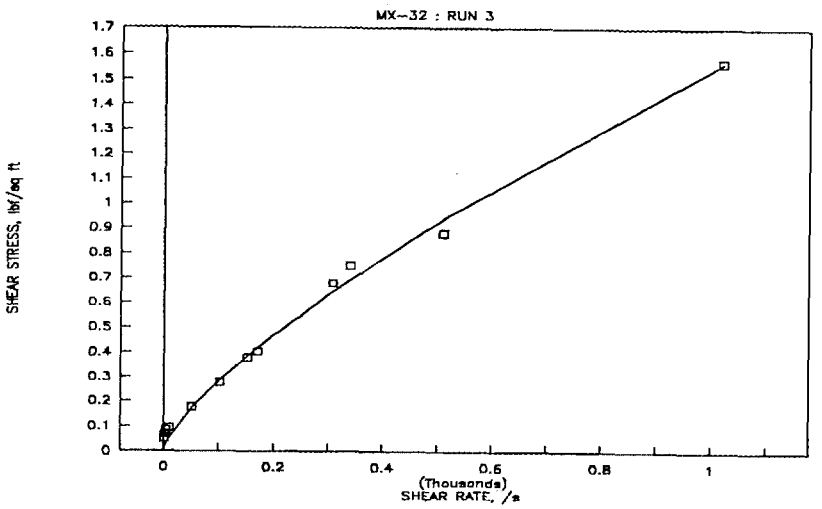
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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


MX-32 : RUN 1
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)


MX-32 : RUN 2
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)


MX-32 : RUN 3
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)

PHASE SEPARATION FOR MX32

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID 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%

UNCONFINED COMPRESSIVE STRENGTH (UCS) FOR MX32
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
RUN 1	193.8	2	2	2	6820	1705	1705
RUN 2	192.8	2	2	2	6720	1680	1680
RUN 3	191.1	2	2	2	6190	1548	1548
					AVERAGE	1644.17	1644.17
					STD. DEV.	69.11	69.11

THERMAL CYCLING FOR MX32

CURE TIME, d: 28

CUBE LIFE AFTER TESTING, d: 13

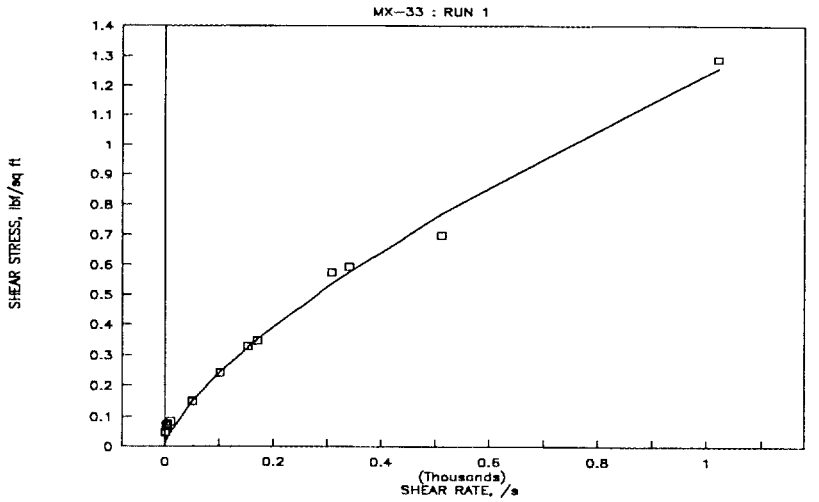
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	144.6	2	2	2	8400	2100	2100
RUN 2	146.8	2	2	2	6970	1743	1743
RUN 3	146.1	2	2	2	8030	2008	2008
					AVERAGE	1950.00	1950.00
					STD. DEV.	151.51	151.51
	COMPARATOR NOT SUBJECTED TO THERMAL 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

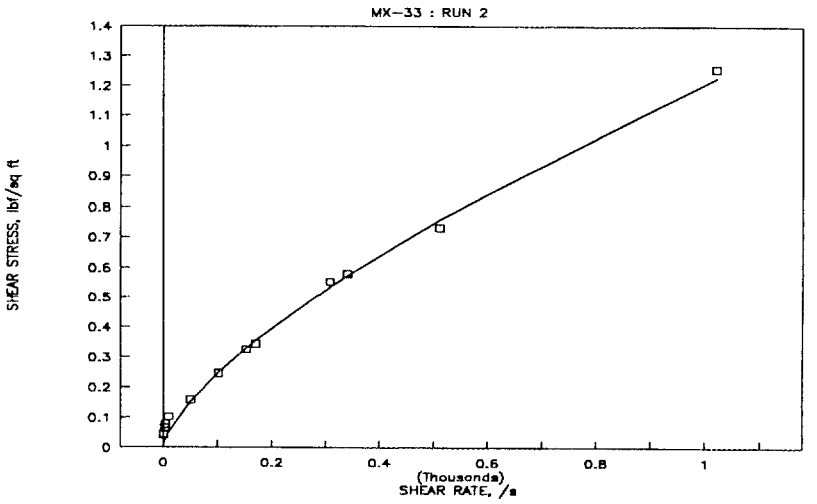
FANN VISCOMETER READINGS FOR MX33

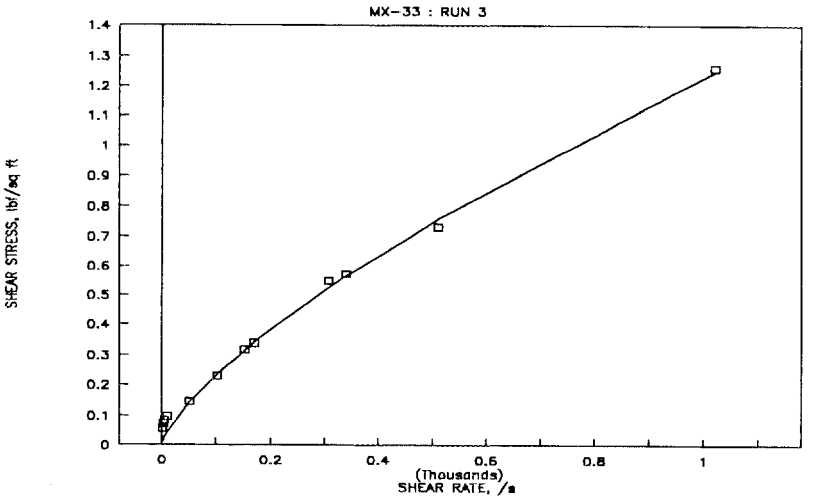
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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


MX-33 : RUN 1
SHEAR STRESS, lbf/sq ft
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-33 : RUN 2
SHEAR STRESS, lbf/sq ft
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-33 : RUN 3
SHEAR STRESS, lbf/sq ft
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID 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 MX33
ASSUME 2-in. CUBES INITIALLY

CURE TIME, d: 28

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

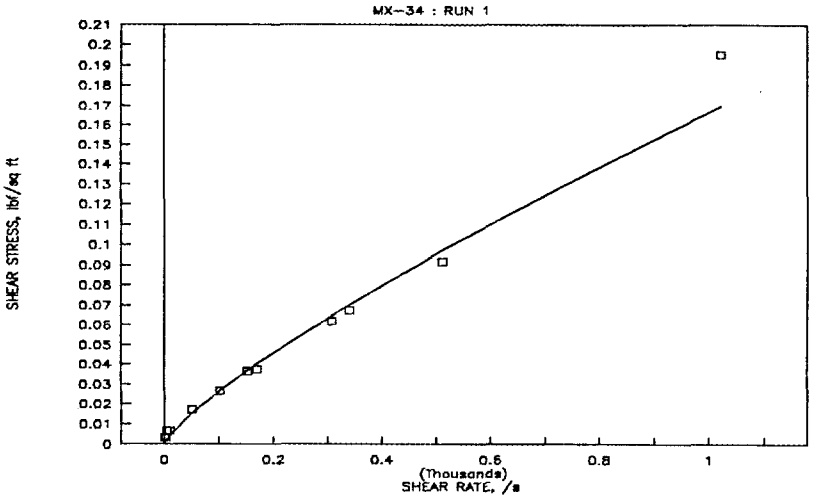
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	132.4	2	2	2	3350	838	838
RUN 2	133.8	2	2	2	3534	884	884
RUN 3	131.1	2	2	2	3628	907	907
					AVERAGE	876	876
					STD. DEV.	28.86	28.86
	COMPARATOR NOT SUBJECTED TO THERMAL CYCLING						
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

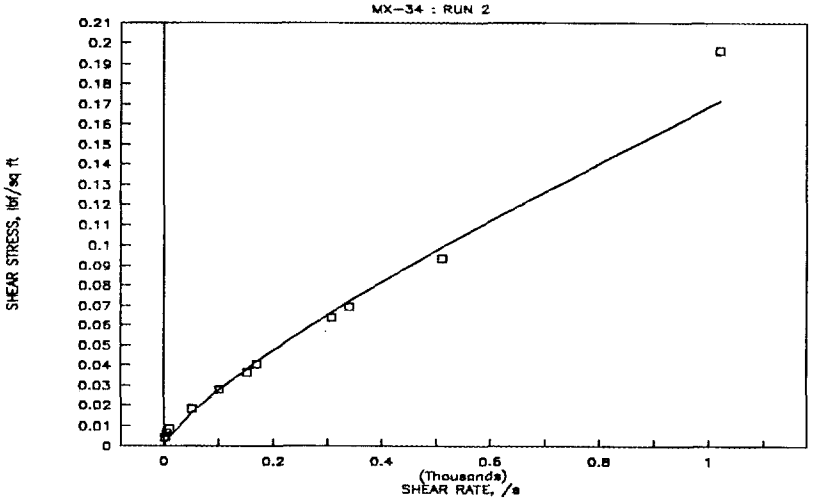
FANN VISCOMETER READINGS FOR MX34

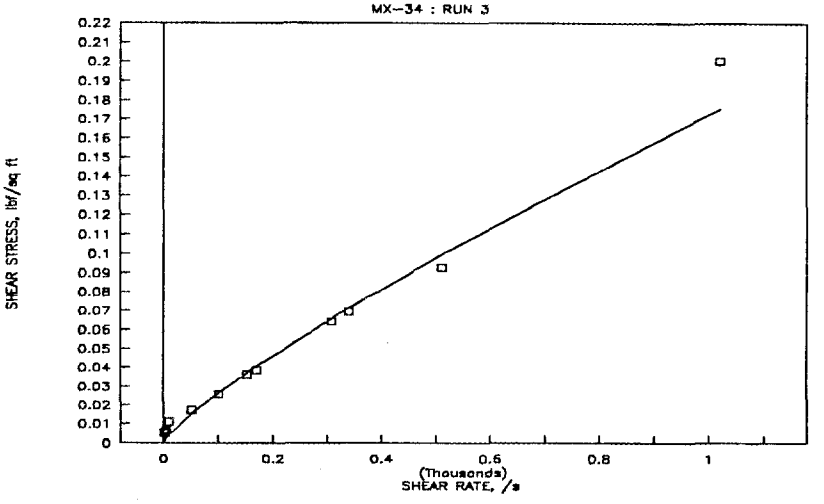
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

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	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


MX-34 : RUN 1
SHEAR STRESS, lbf/sq ft
0.21
0.2
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-34 : RUN 2
SHEAR STRESS, lbf/sq ft
0.21
0.2
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s


MX-34 : RUN 3
SHEAR STRESS, lbf/sq ft
0.22
0.21
0.2
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1
(Thousands)
SHEAR RATE, /s

PHASE SEPARATION FOR MX34

LIQUID DENSITY, g/mL: 1.21

	RUN 1	RUN 2	RUN 3
INITIAL MASS, g:	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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID vol%
0.08333	414.43	75.33	23.66%	419.2	71.94	22.47%	409.24	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. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	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

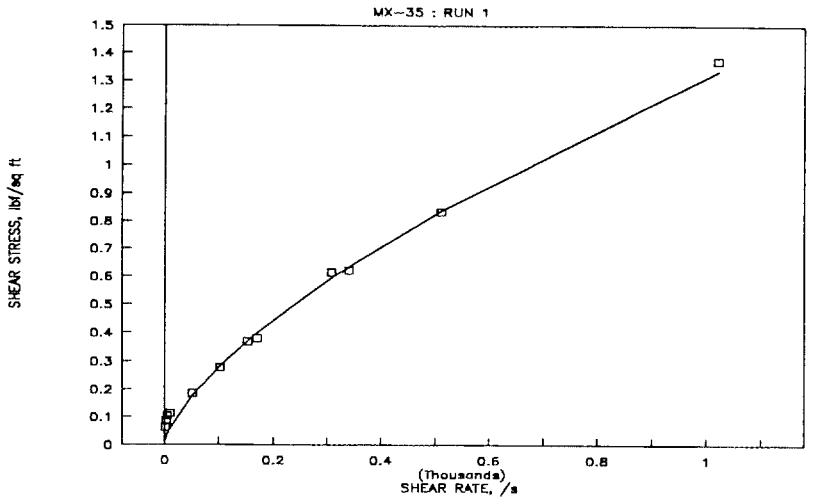
	MASS	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS	CORR'D UCS
	g	L	W	H	lbf	psi	psi
	AFTER THERMAL CYCLING						
RUN 1	103.6	2	1.6875	2	429	127	107
RUN 2	106.9	2	1.625	2	1259	387	315
RUN 3	101.1	2	1.5	2	1012	337	253
					AVERAGE	283.94	225
					STD. DEV.	112.76	86.99
	COMPARATOR NOT SUBJECTED TO THERMAL 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

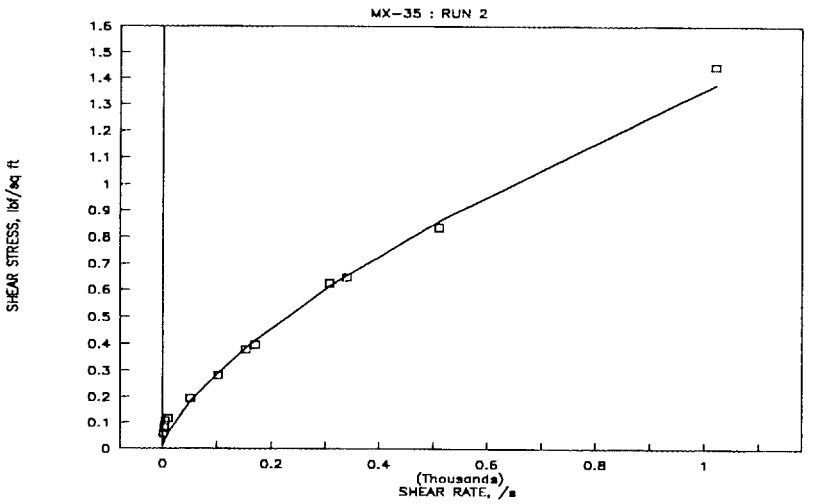
FANN VISCOMETER READINGS FOR MX35

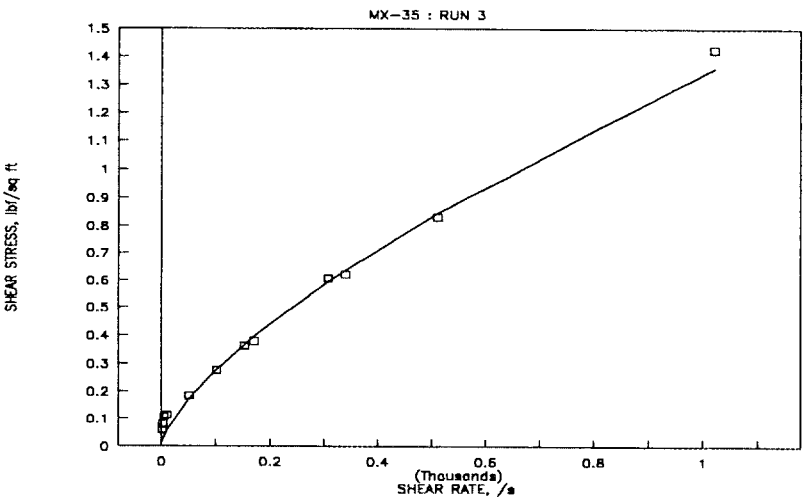
TORSION SPRING ASSEMBLY:	F1	K1, dyne-cm/deg:	386
	RUN 1	RUN 2	RUN 3
ROTOR:	1	1	1
BOB:	1	1	1
K2, /cc:	0.01323	0.01323	0.01323
K3, /s/RPM:	1.7023	1.7023	1.7023

SHEAR RATE = K3*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	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


MX-35 : RUN 1
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)


MX-35 : RUN 2
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)


MX-35 : RUN 3
SHEAR STRESS, lbf/sq ft
SHEAR RATE, /s
(Thousands)

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 MEAS'D TOTAL g	RUN 1 MEAS'D LIQUID g	RUN 1 FREE ST. LIQUID vol%	RUN 2 MEAS'D TOTAL g	RUN 2 MEAS'D LIQUID g	RUN 2 FREE ST. LIQUID vol%	RUN 3 MEAS'D TOTAL g	RUN 3 MEAS'D LIQUID g	RUN 3 FREE ST. LIQUID 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	DIMENSIONS, in. (CRUSHED SIDE)			FORCE	UCS CALC'D	CORR'D
	g	L	W	H	lbf	psi	psi
RUN 1	210.2	2	2	2	2738	685	685
RUN 2	209.6	2	1.375	2	2546	926	637
RUN 3	203	2	1.5	2	2459	820	615
					AVERAGE	809.99	645.25
					STD. DEV.	98.75	29.14

THERMAL CYCLING FOR MX35

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	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

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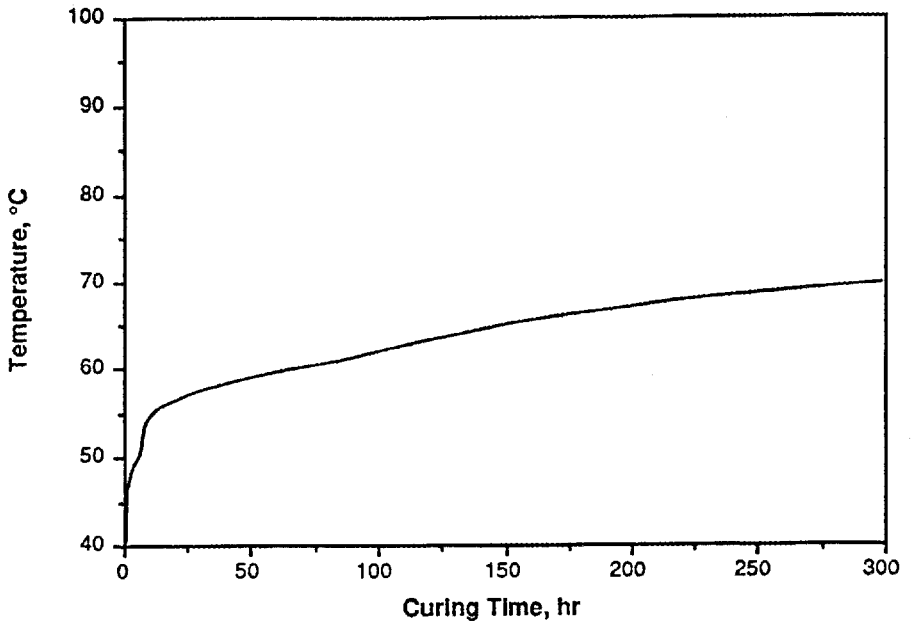
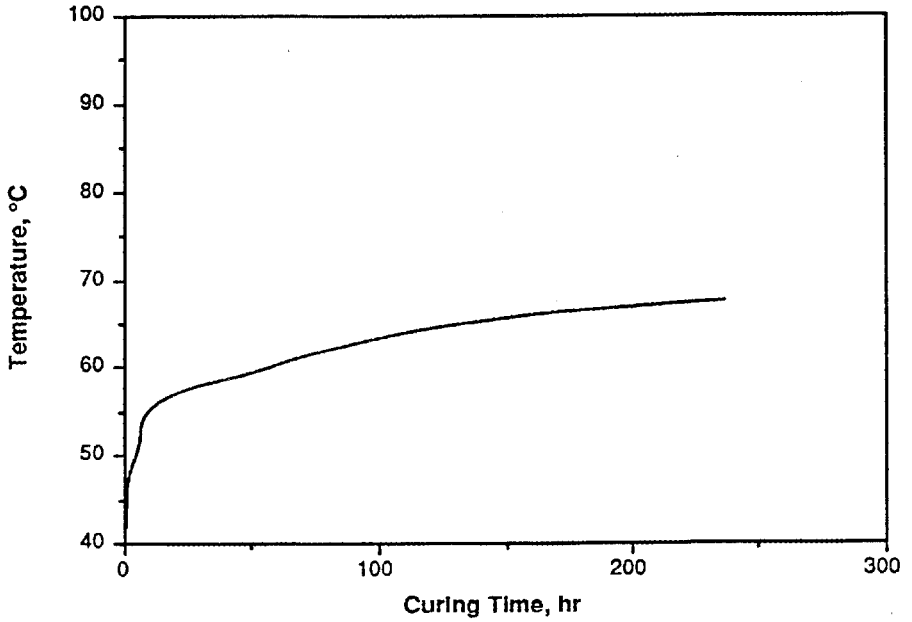
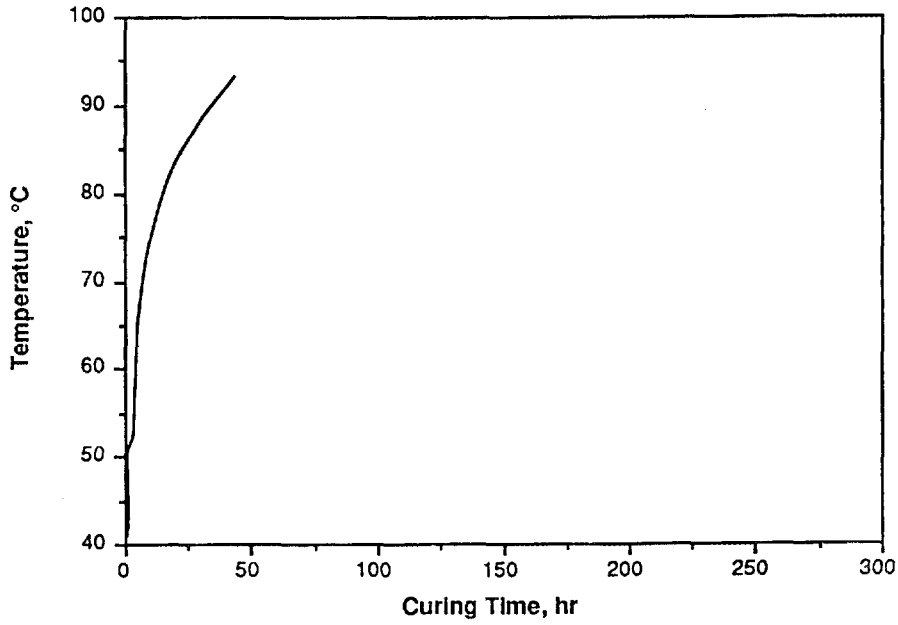
ADIABATIC CALORIMETRY DATA



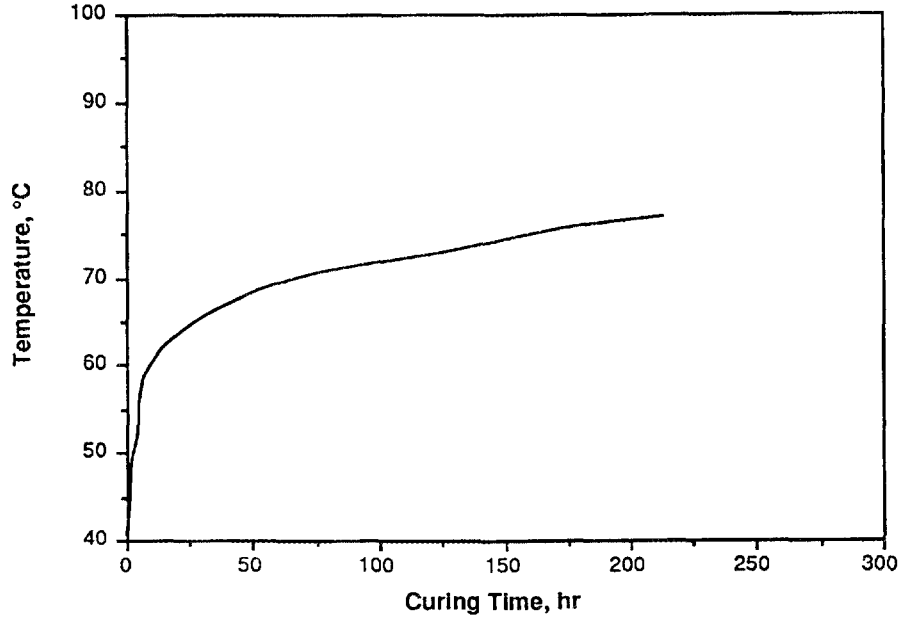
Data from "ORNL.01"



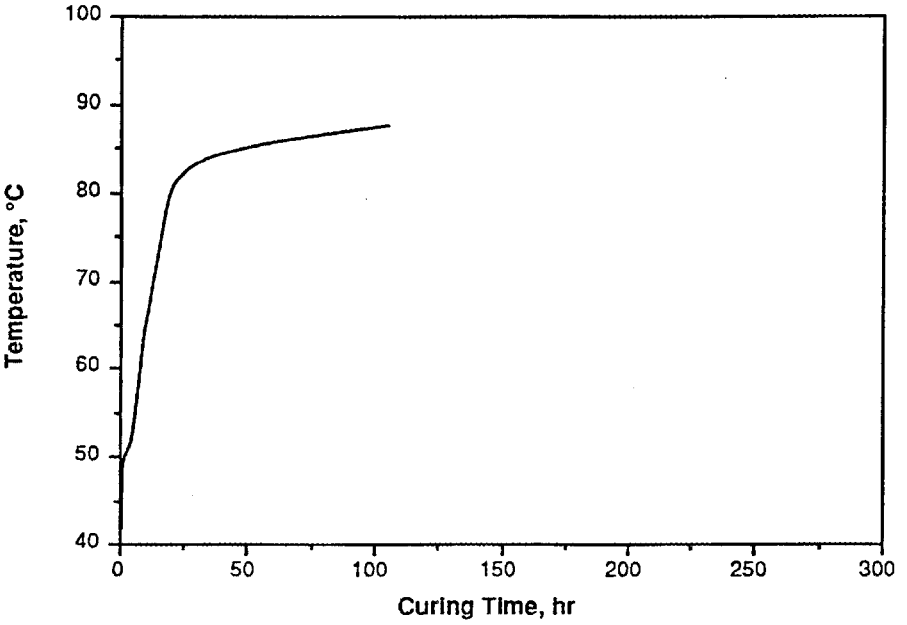
Data from "ORNL.02"



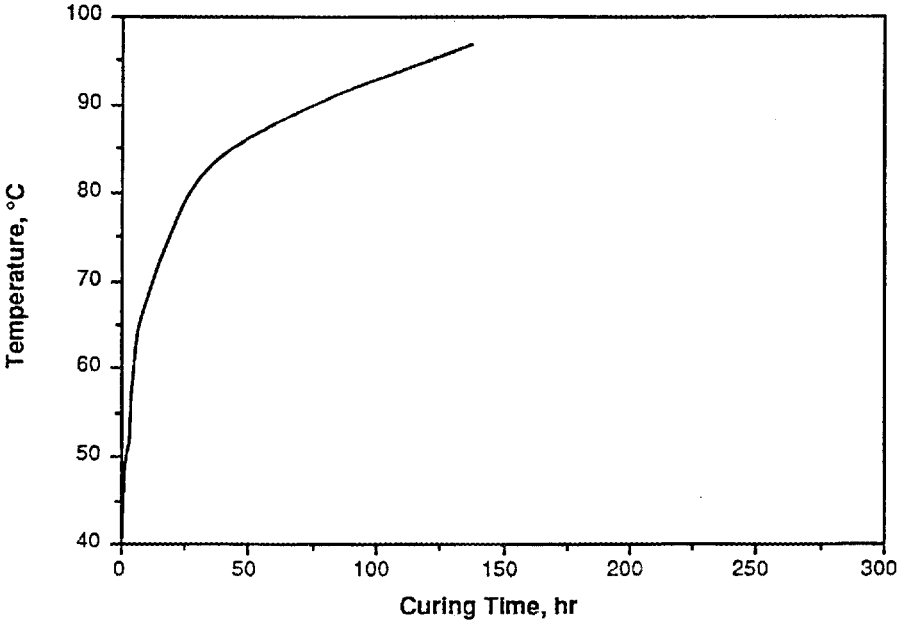
Data from "ORNL.03"



Data from "ORNL.04"



Data from "ORNL.05"



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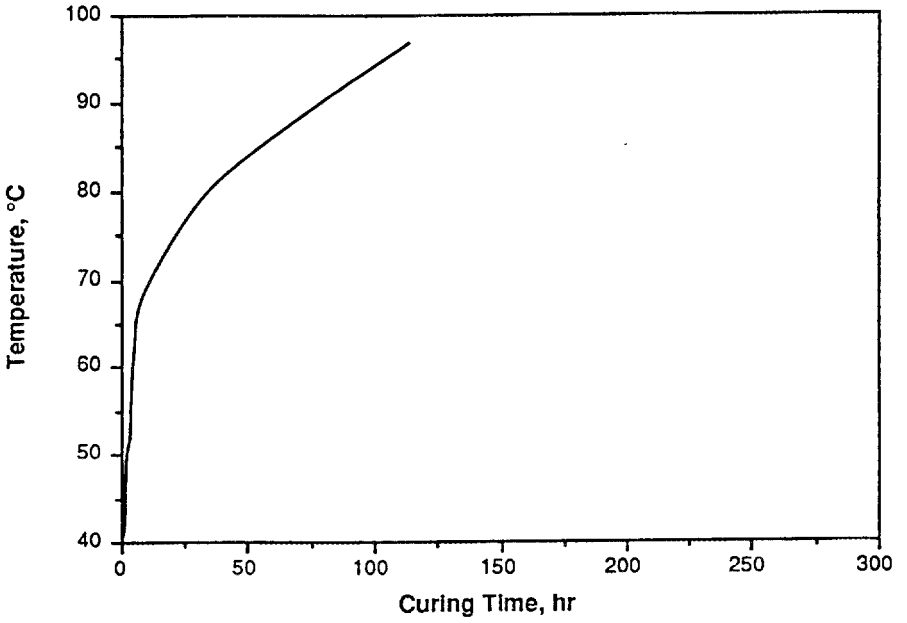
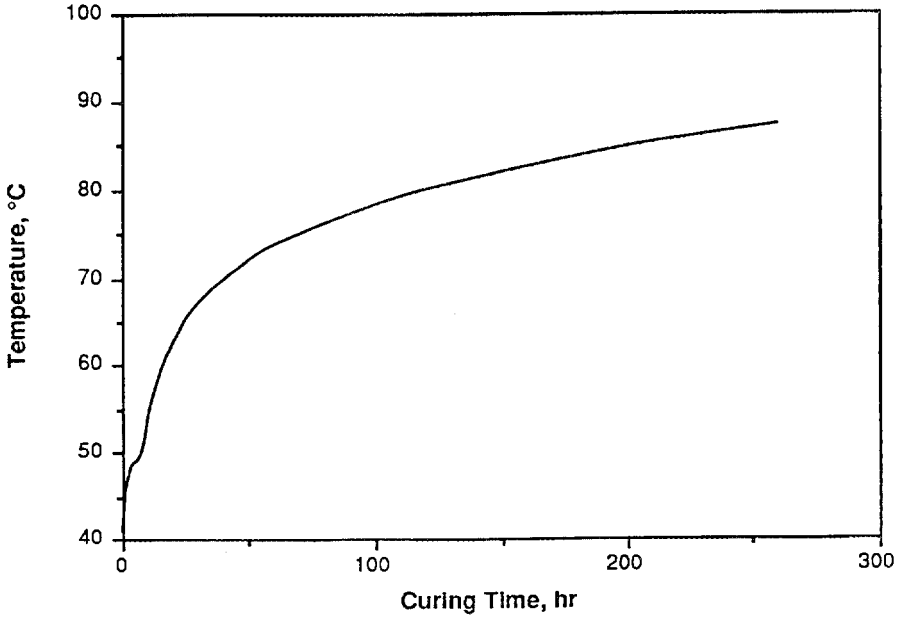


Data from "ORNL.07"



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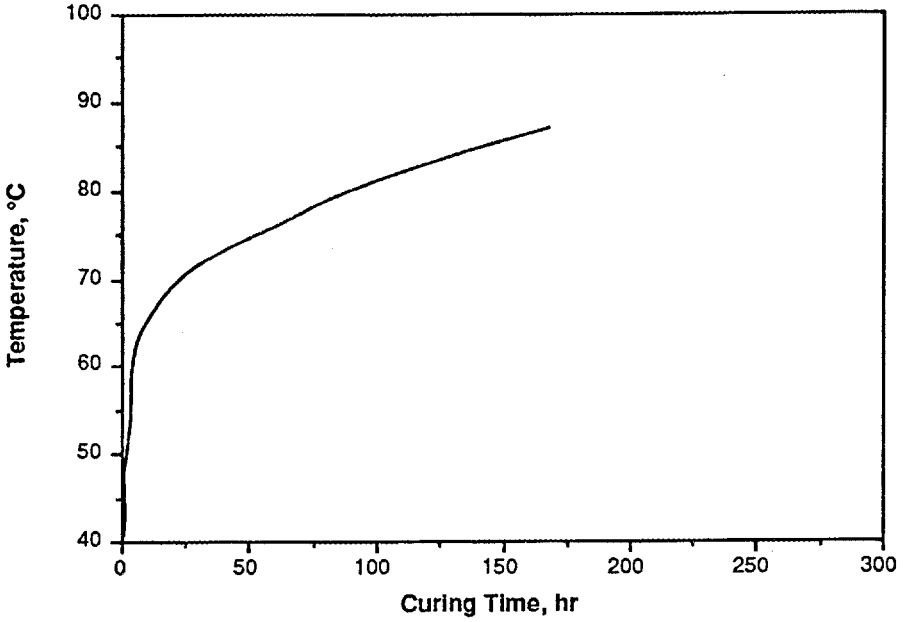
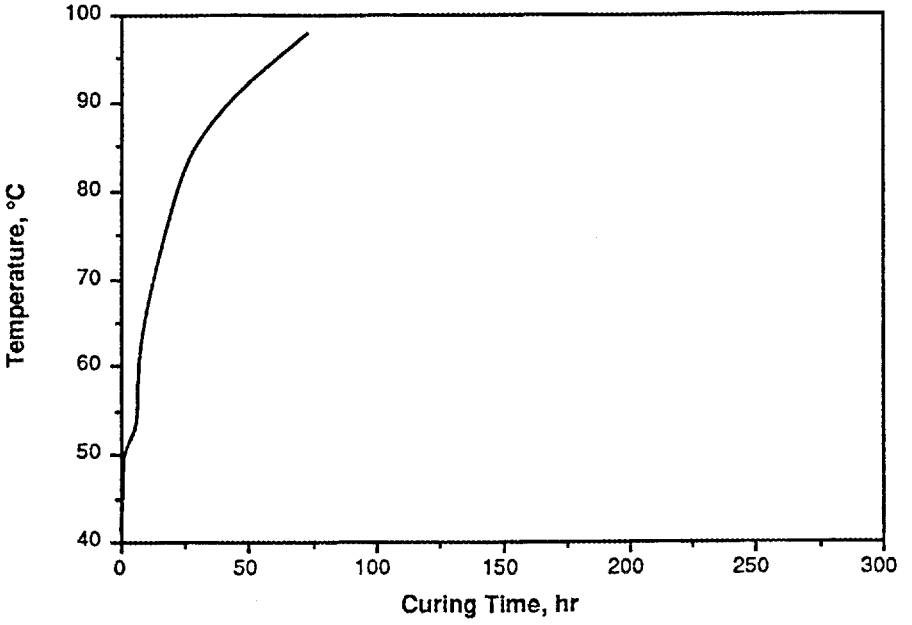
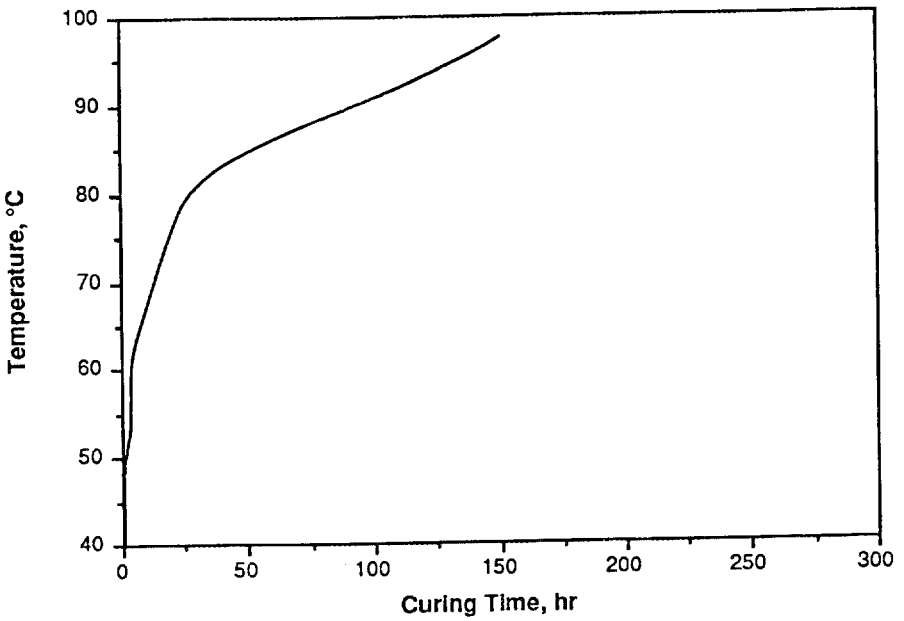


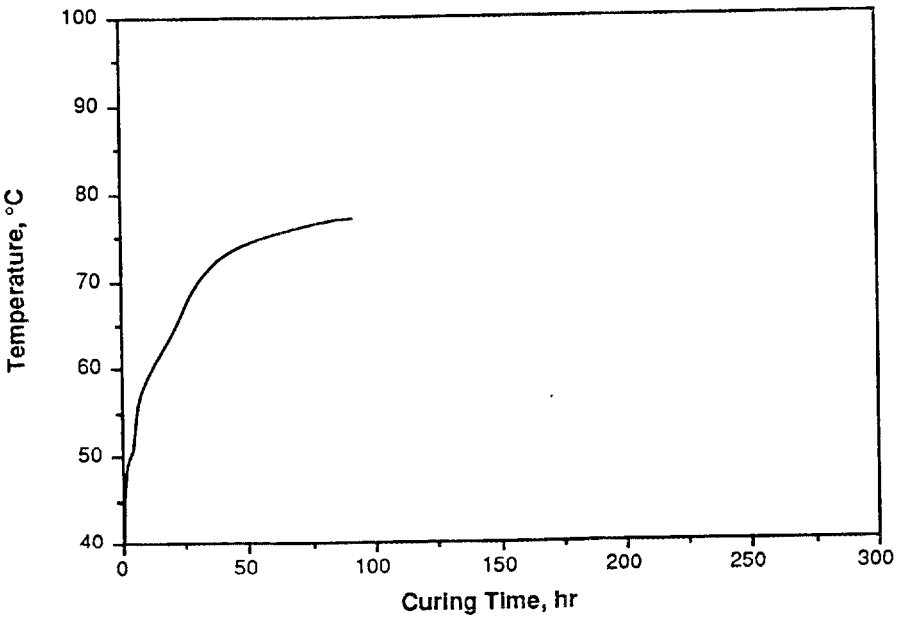
Data from "ORNL.09"



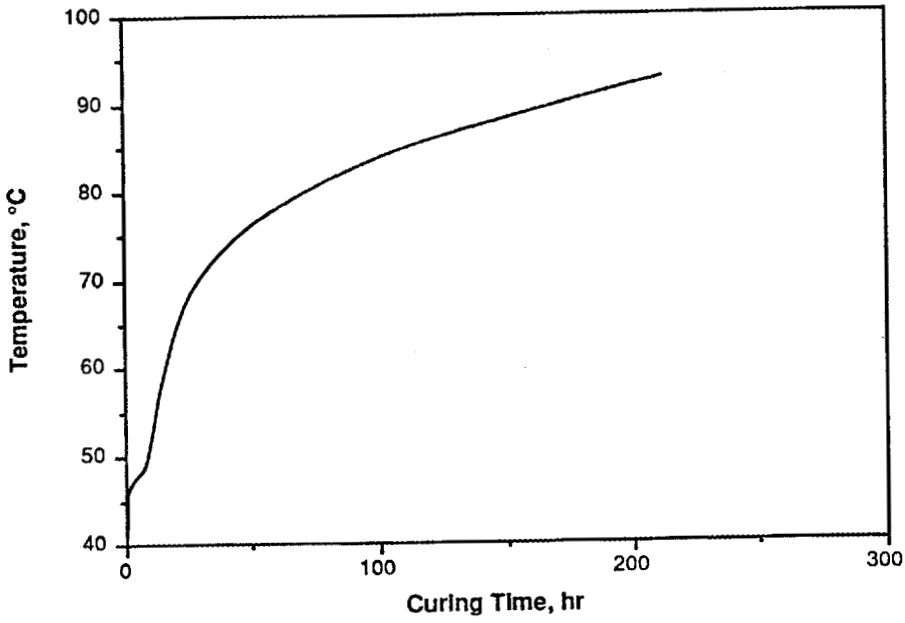
Data from "ORNL.10"



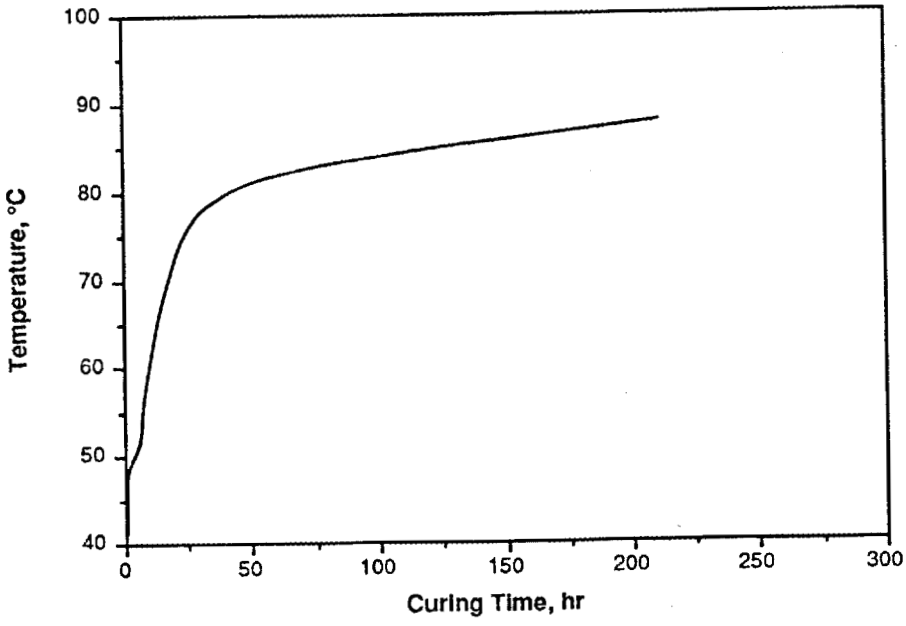
Data from "ORNL.11"



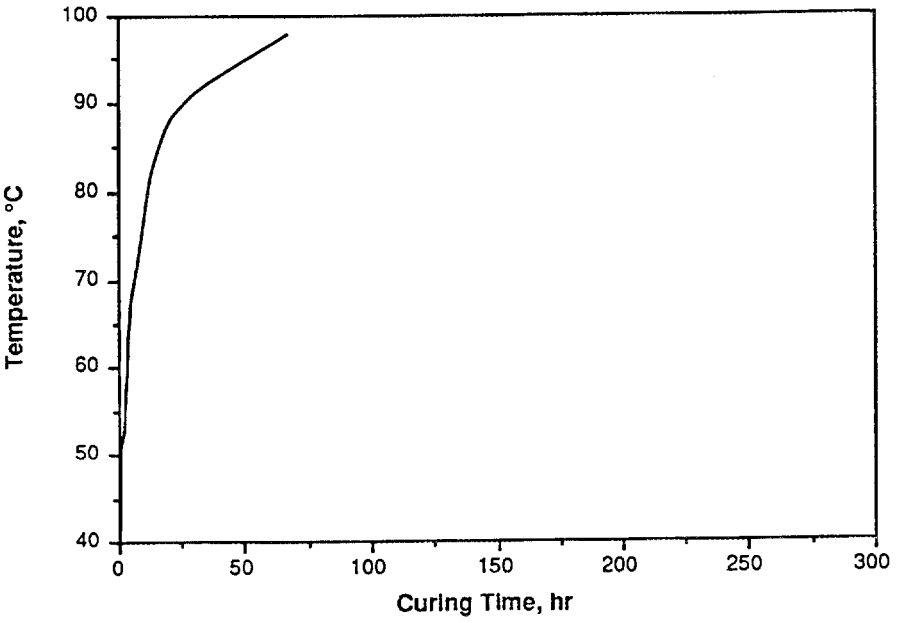
Data from "ORNL.12"



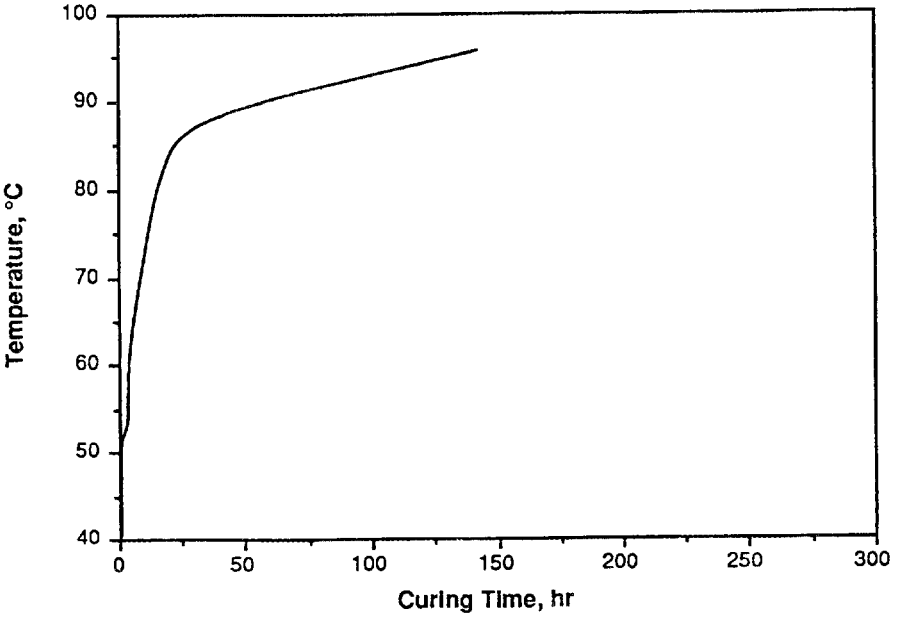
Data from "ORNL.13"



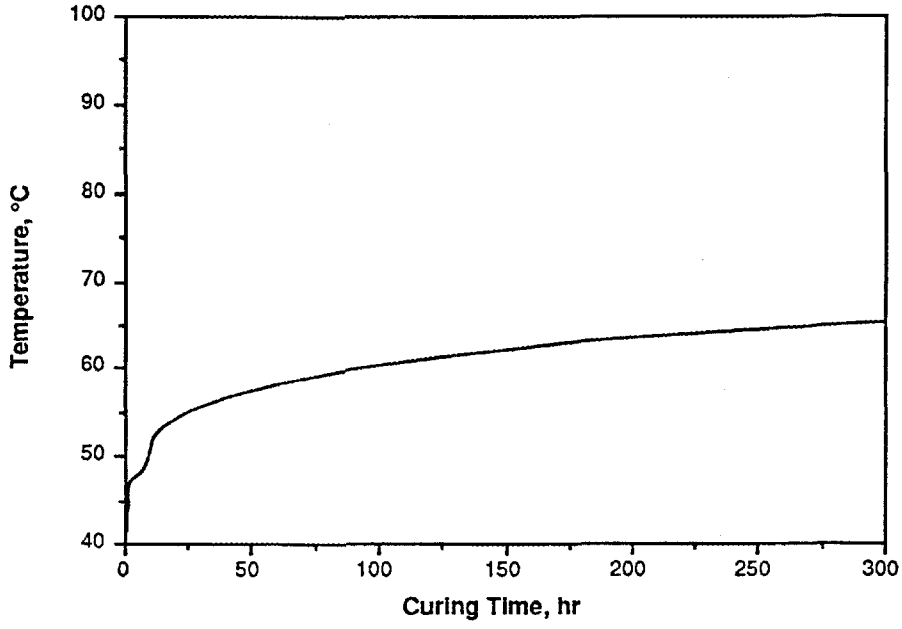
Data from "ORNL.14"



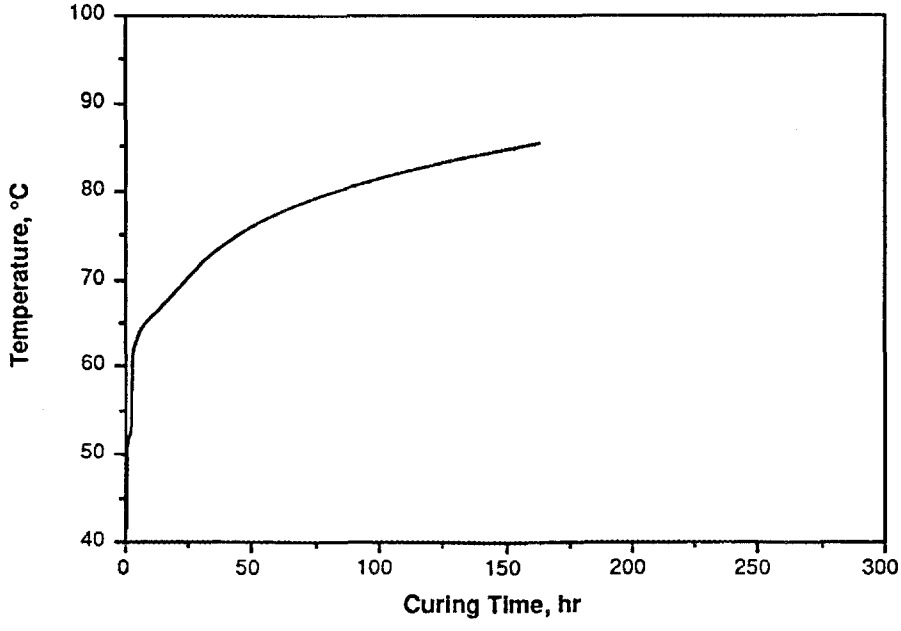
Data from "ORNL.15"



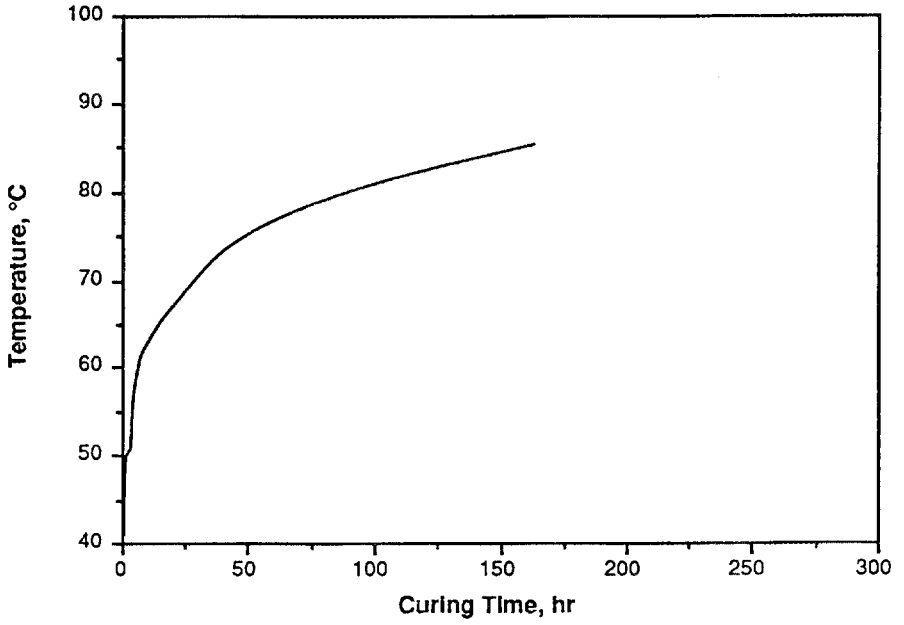
Data from "ORNL.16"



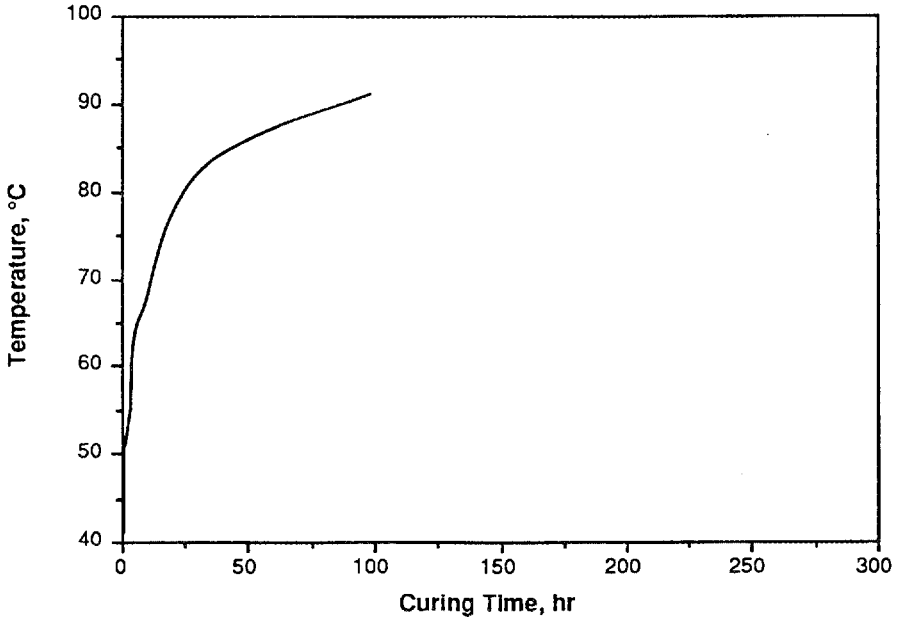
Data from "ORNL.17 Corr"



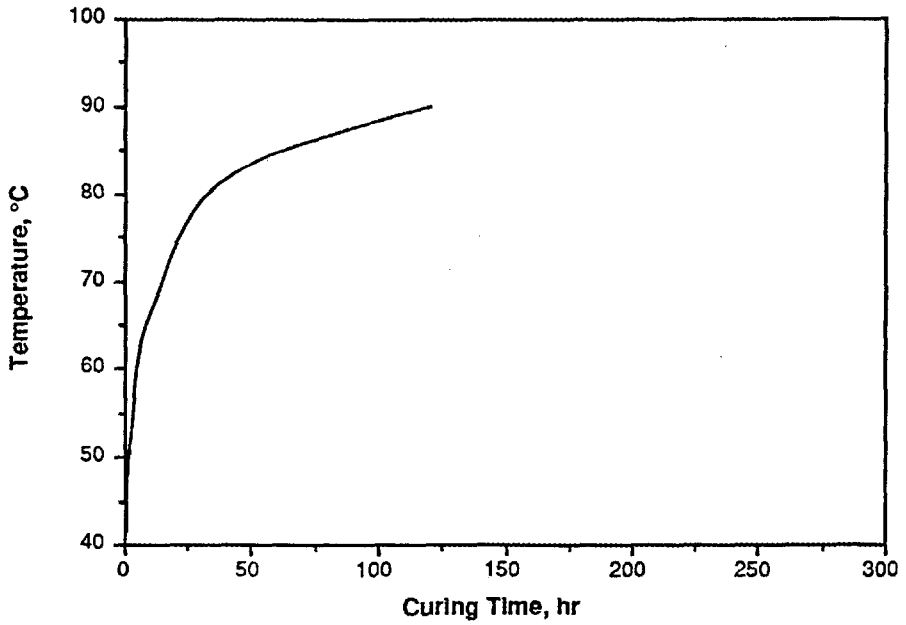
Data from "ORNL.18"



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 mg/L			Mass in Leachate mg			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time 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

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				(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
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

	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	456.84	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

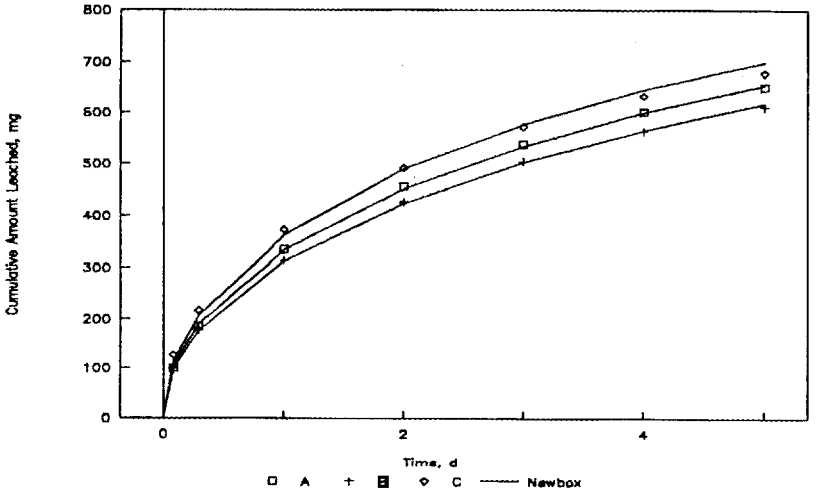
BFS-HIGH Nitrate + Nitrite

				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

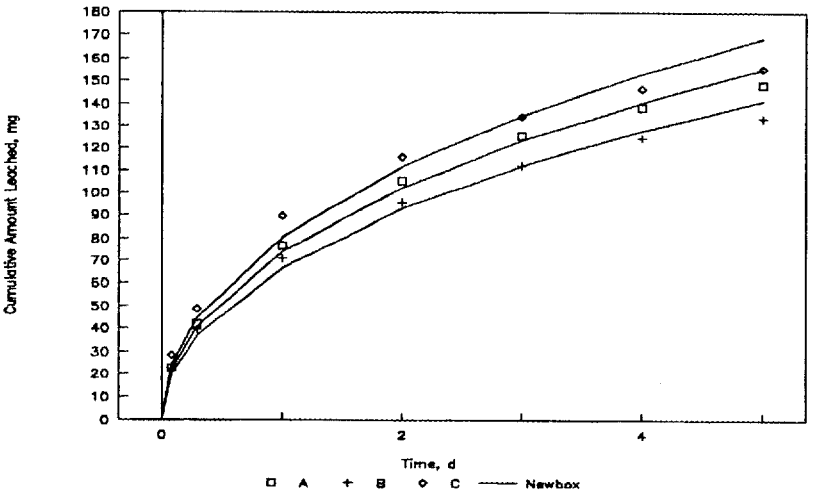
	Added in 106-AN			Newbox Estimate		
Ao =	1579.36	1568.96	1560.63	1579.36	1568.96	1560.63

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

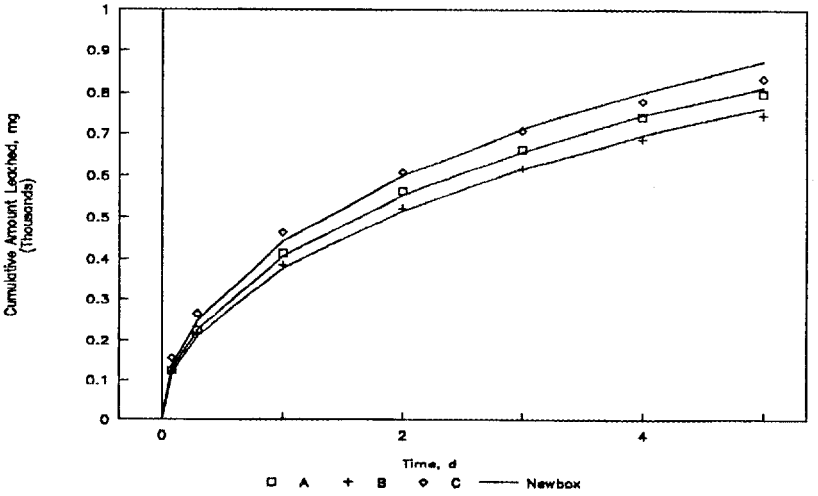
BFS—HIGH : Nitrate

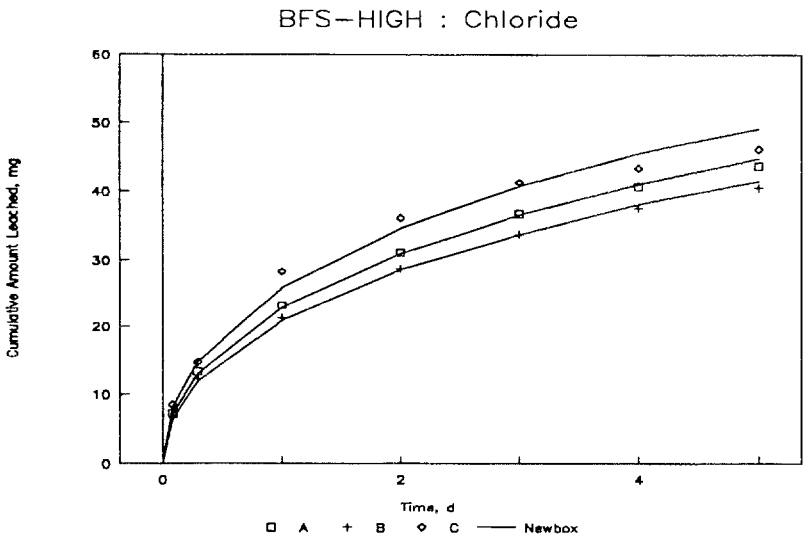


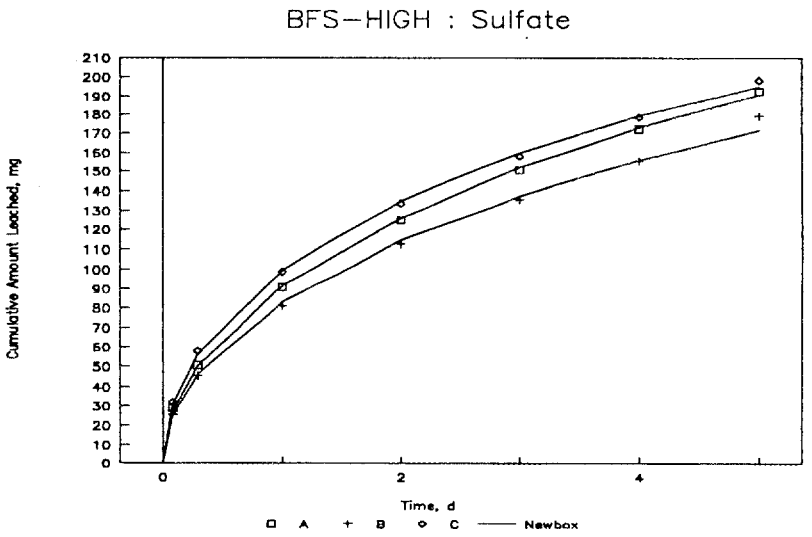
BFS—HIGH : Nitrite



BFS—HIGH : Nitrate + Nitrite




BFS–HIGH : Chloride
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
0
2
4
Time, d
A
B
C
Newbox


BFS–HIGH : Sulfate
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
0
2
4
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate mg			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time 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

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		Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	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

	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

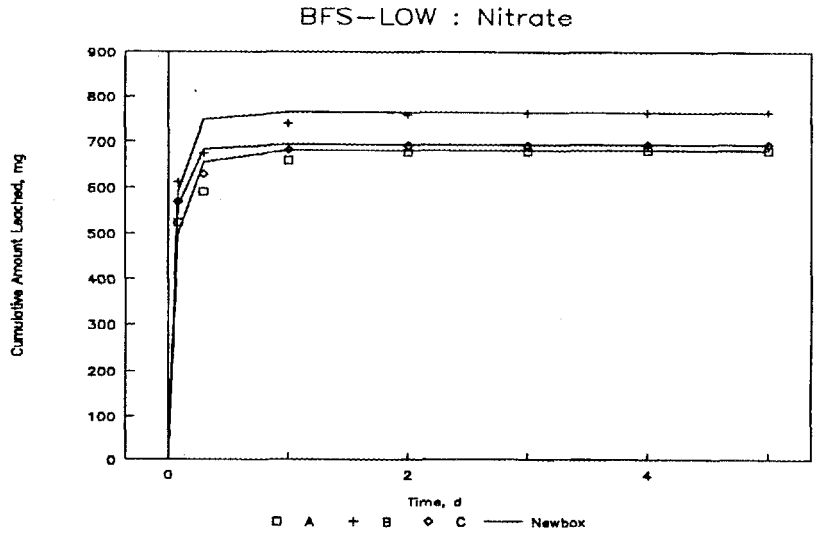
Per cent of 106-AN ion leachable:	157%	182%	144%
Eff. Diffusion Coefficient, sq cm/s:	8.59E-06	9.25E-06	7.78E-06
Std. Deviation, sq cm/s:	4.23E-06	4.60E-06	3.27E-06
Leachability Index:	5.066	5.034	5.109
Upper 95% Confidence Int.:	0.283	0.287	0.229
Lower 95% Confidence Int.:	0.170	0.171	0.149

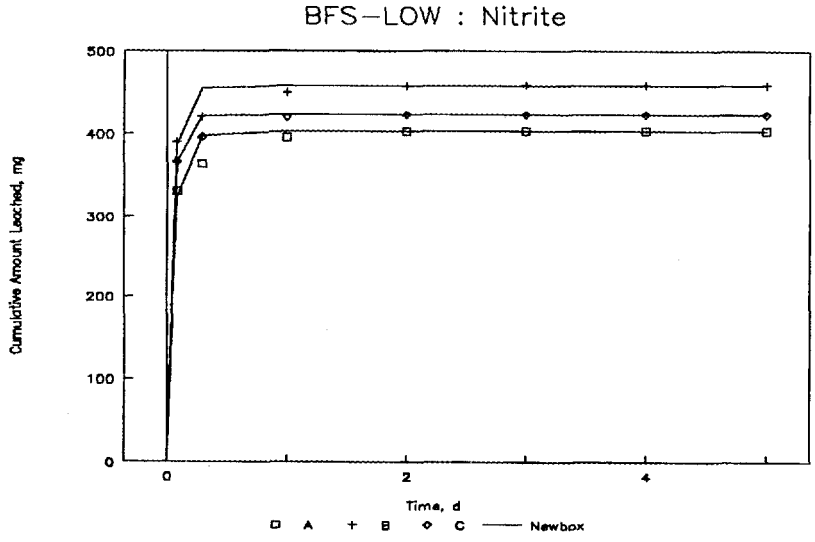
BFS-LOW Nitrate + Nitrite

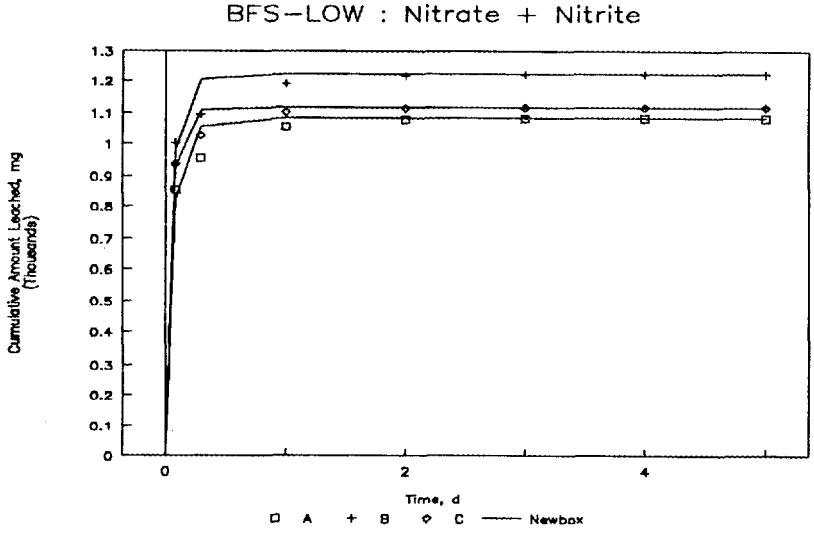
				0.00	0.00	0.00	0
1	854.56	1002.88	936.39	822.43	977.55	924.09	0.083333
2	955.10	1095.31	1026.58	1056.79	1207.85	1108.46	0.291666
3	1055.22	1191.15	1102.88	1084.98	1225.00	1117.40	1
4	1079.88	1218.82	1114.53	1085.00	1225.00	1117.40	2
5	1083.25	1223.21	1116.12	1085.00	1225.00	1117.40	3
6	1084.22	1224.36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

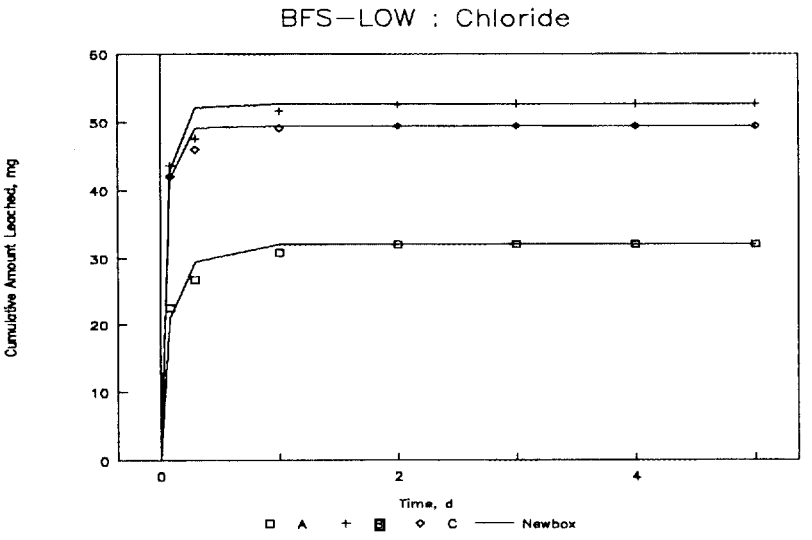
		Added in 106-AN			Newbox Estimate	
Ao =	2319.28	2330.11	2319.28	1085	1225	1117.4

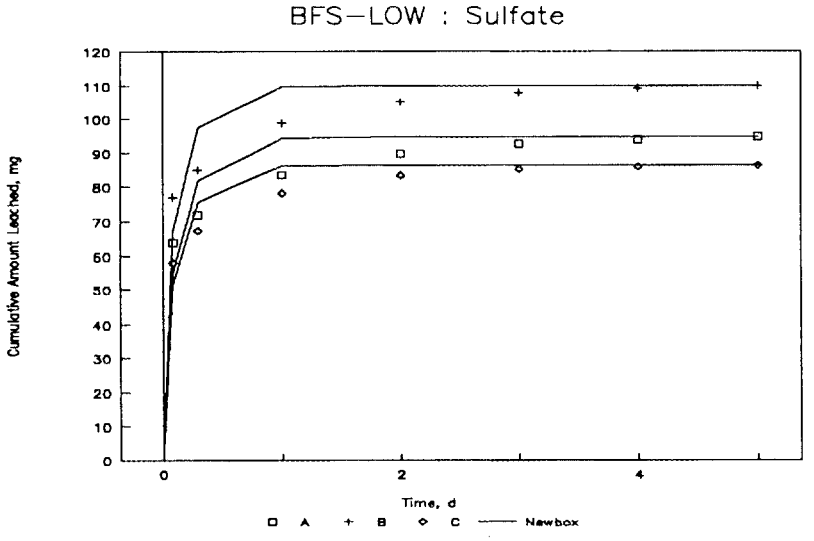
Per cent of 106-AN ion leachable:	47%	53%	48%
Eff. Diffusion Coefficient, sq cm/s:	1.88E-05	2.13E-05	2.15E-05
Std. Deviation, sq cm/s:	6.21E-06	7.19E-06	5.75E-06
Leachability Index:	4.727	4.672	4.667
Upper 95% Confidence Int.:	0.169	0.173	0.131
Lower 95% Confidence Int.:	0.121	0.123	0.100


BFS–LOW : Nitrate
Cumulative Amount Leached, mg
900
800
700
600
500
400
300
200
100
0
0
2
4
Time, d
A
B
C
Newbox


BFS–LOW : Nitrite
Cumulative Amount Leached, mg
500
400
300
200
100
0
0
2
4
Time, d
A
B
C
Newbox


BFS–LOW : Nitrate + Nitrite
Cumulative Amount Leached, mg
(Thousands)
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
Time, d
A
B
C
Newbox


BFS—LOW : Chloride
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
0
2
4
Time, d
A
B
C
Newbox


BFS—LOW : Sulfate
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
70
80
90
100
110
120
0
2
4
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate mg			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time 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			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

	Added in 106-AN			Newbox Estimate		
Ao =	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

	Added in 106-AN			Newbox Estimate		
Ao =	960.01	965.81	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

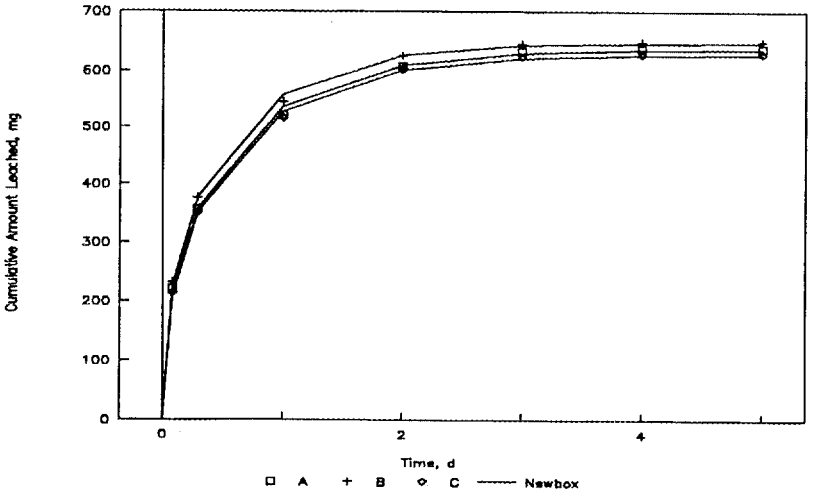
FFLY-HIG Sulfate

				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

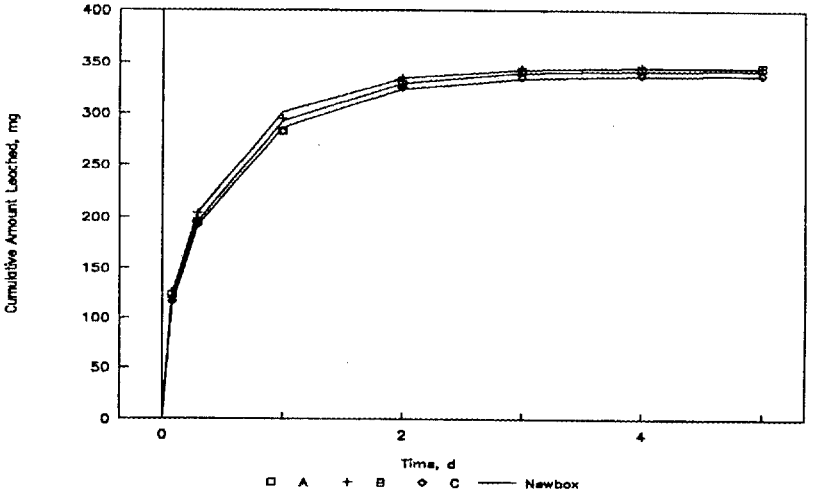
	Added in 106-AN			Newbox Estimate		
Ao =	35.74	35.96	35.88	101	94.8	101

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	

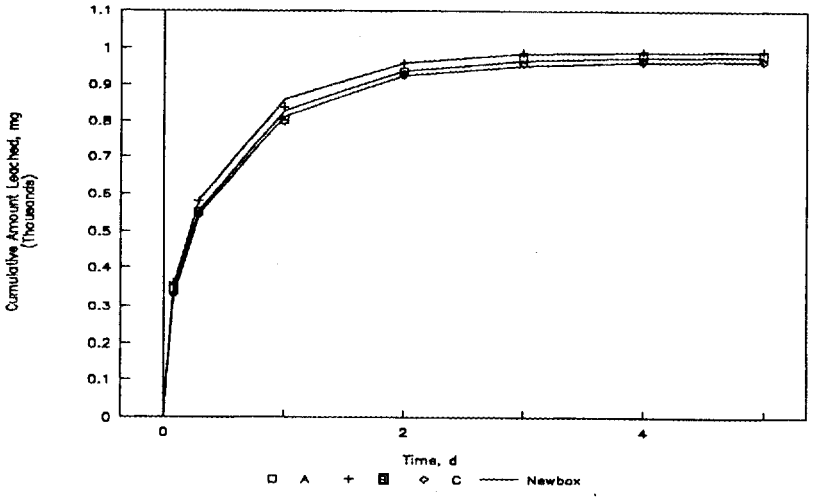
FFLY–HIGH : Nitrate



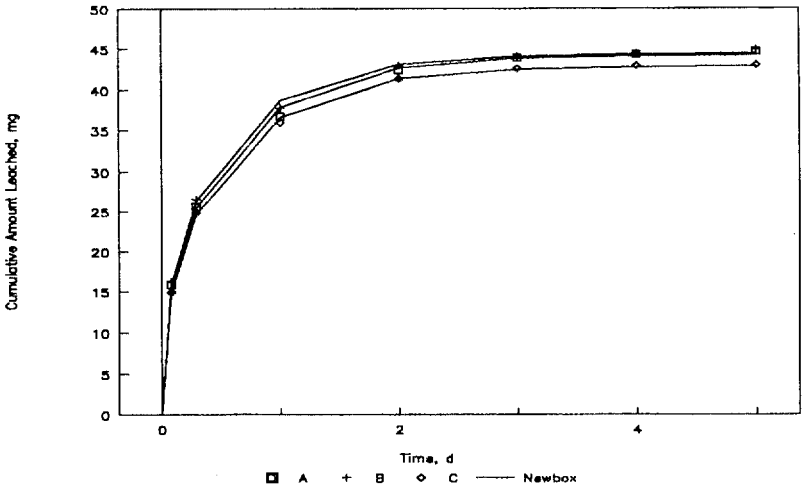
FFLY–HIGH : Nitrite



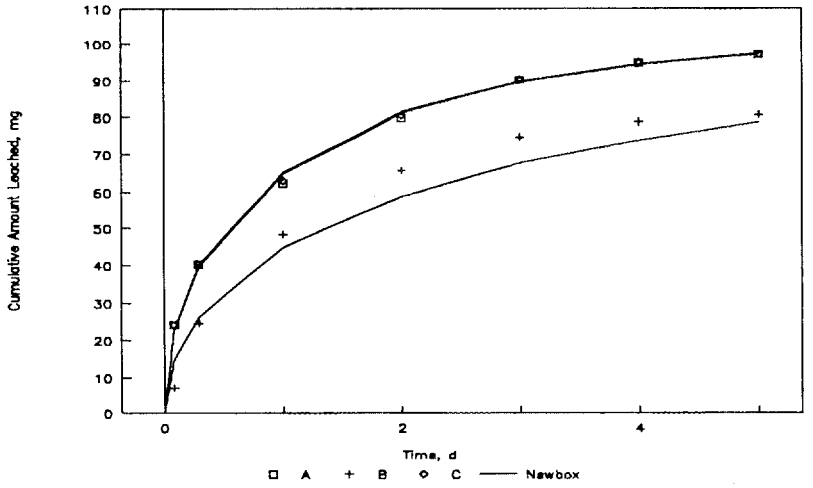
FFLY–HIGH : Nitrate + Nitrite



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 mg/L			Mass in Leachate mg			
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

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				(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
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

	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

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

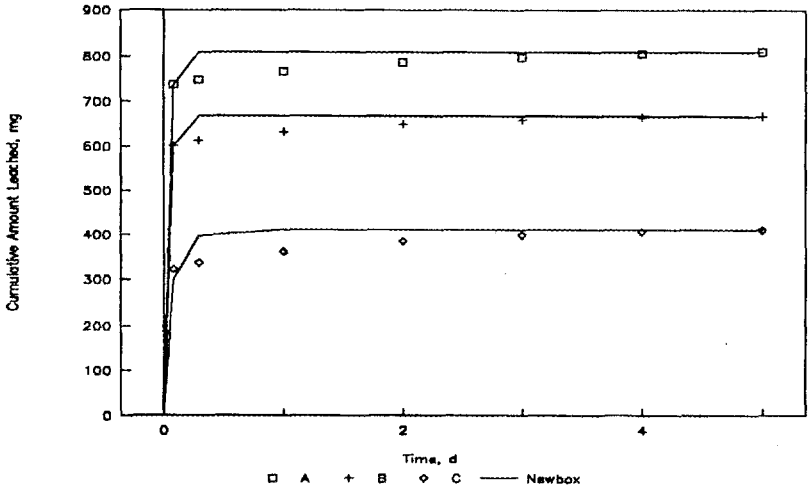
FFLY-LO Nitrate + Nitrite

				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

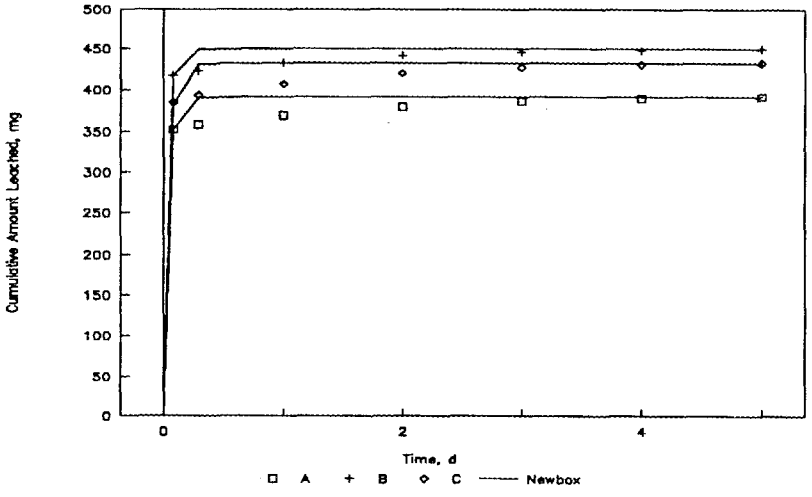
	Added in 106-AN			Newbox Estimate		
Ao =	2352.09	2334.04	2363.36	1201	1118	847

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

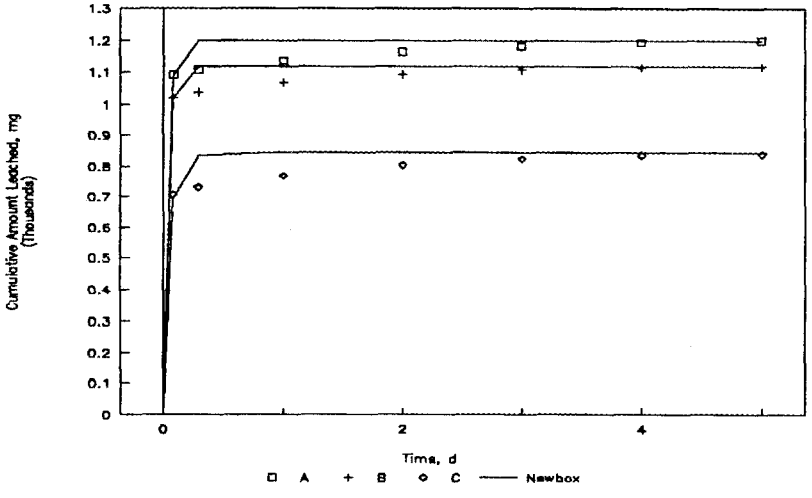
FFLY–LOW : Nitrate

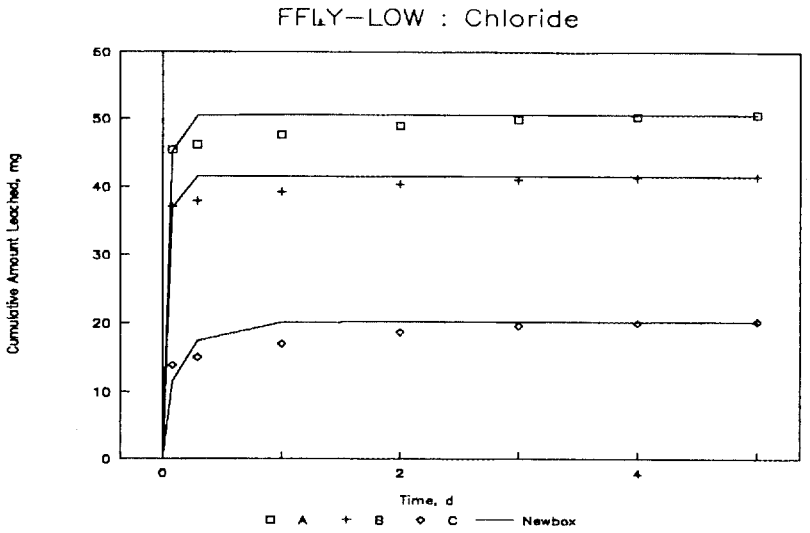


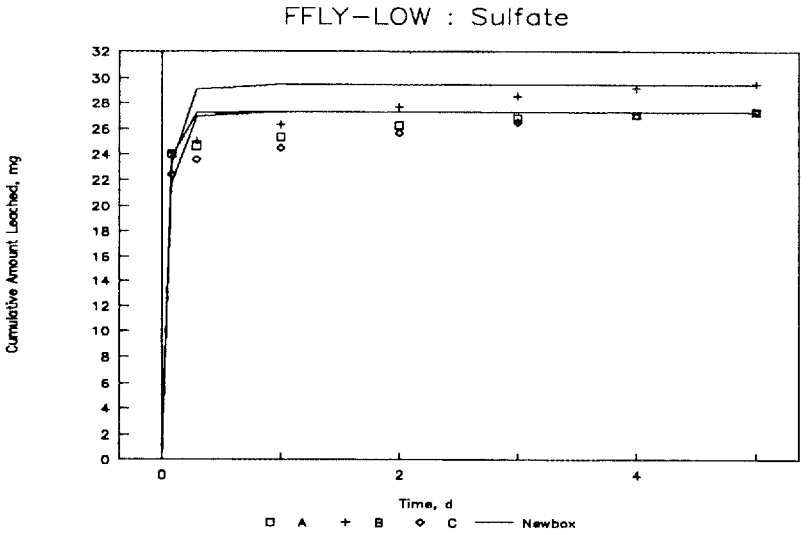
FFLY–LOW : Nitrite



FFLY–LOW : Nitrate + Nitrite




FFLY–LOW : Chloride
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
0
2
4
Time, d
A
B
C
Newbox


FFLY–LOW : Sulfate
Cumulative Amount Leached, mg
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
0
2
4
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate 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				(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
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	

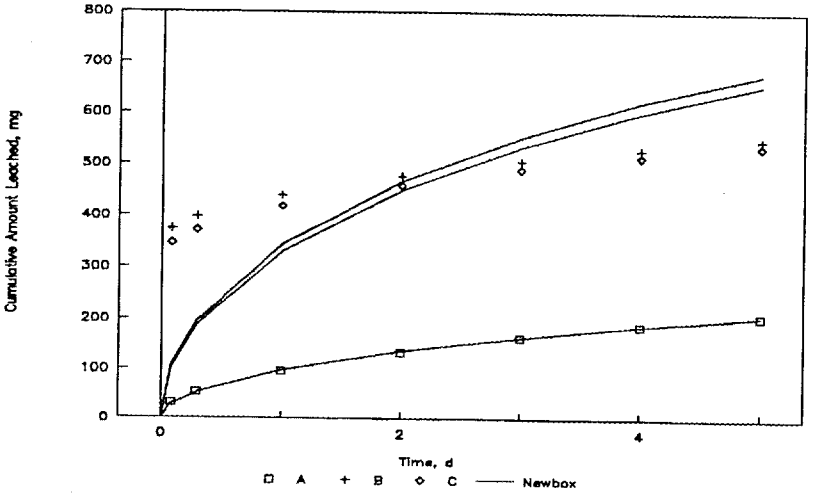
HCEM-HI Nitrate + Nitrite

				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

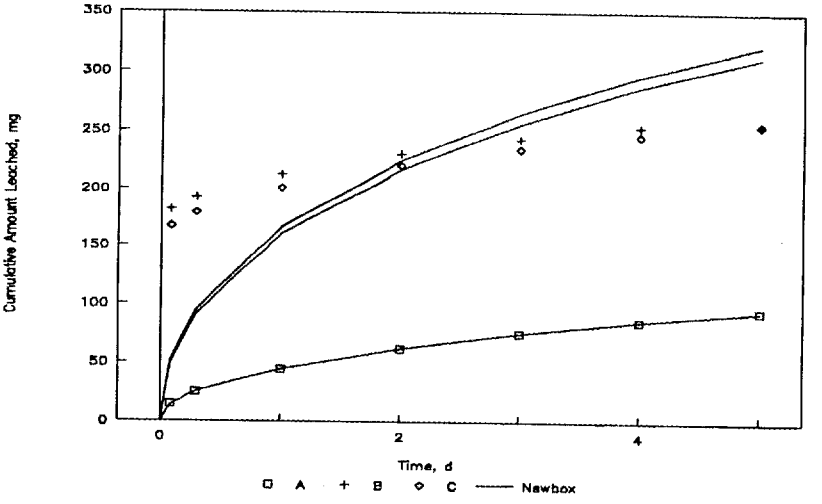
		Added in 106-AN			Newbox Estimate	
Ao =	1694.85	1695.89	1695.89	991	1695.89	1695.89

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

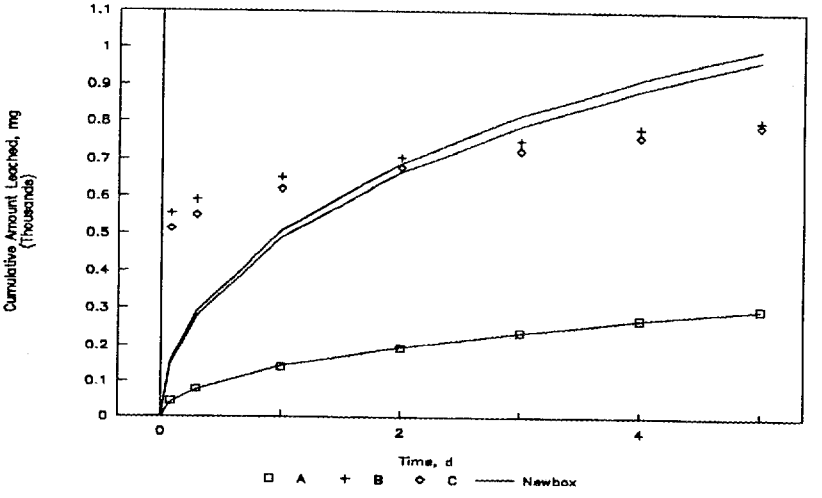
HCEM—HIGH : Nitrate

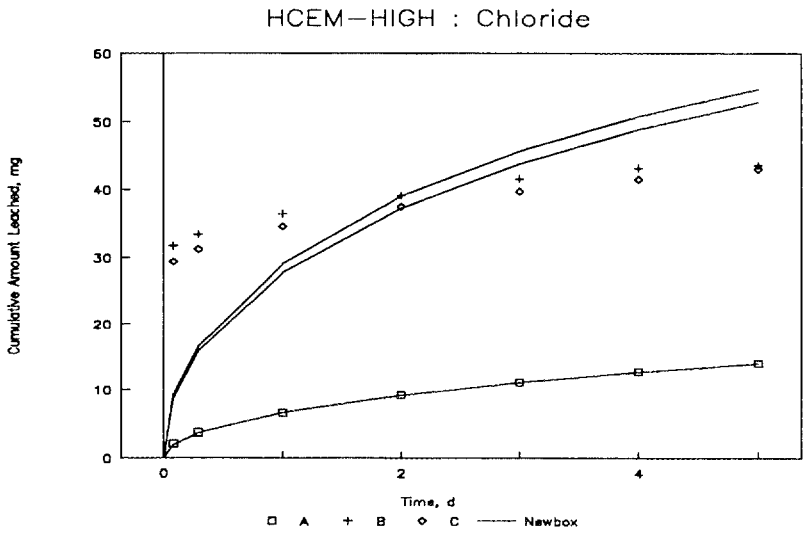


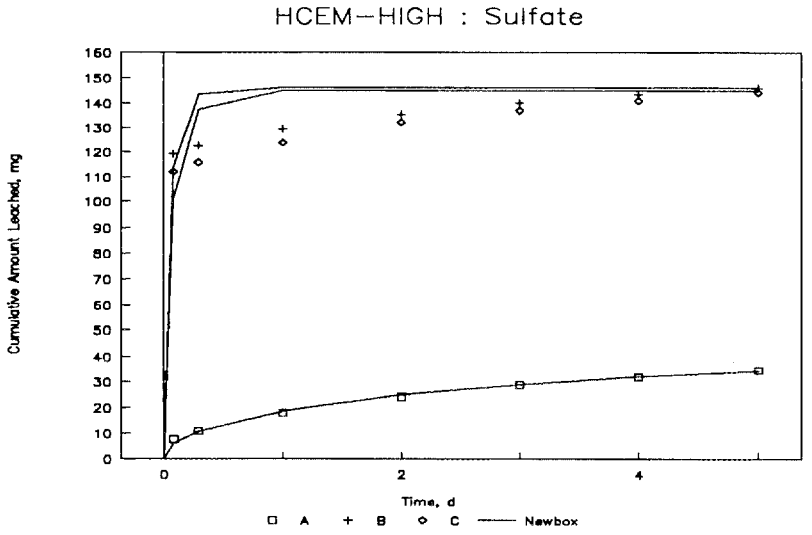
HCEM—HIGH : Nitrite



HCEM—HIGH : Nitrate + Nitrite




HCEM—HIGH : Chloride
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
0
2
4
Time, d
A
B
C
Newbox


HCEM—HIGH : Sulfate
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
0
2
4
Time, d
A
B
C
Newbox

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

Run No.: HCEM-LO

Mix Ratio 2 lb/gal

Surrogate 106-AN Concentrations, mg/mL			
Chloride	Nitrite	Nitrate	Sulfate
5.32	34.87	79.99	2.98

Sample Cylinder Dimensions

	Initially		After Curing 28 d 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 mg/L			Mass in Leachate mg			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time 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

HCEM-LO Sulfate		Initially:		64.06	63.95	63.95	
0	489.94	491.97	406.37	89.95	91.80	71.07	0
1	22.93	25.46	23.44	4.21	4.75	4.10	0.083333
2	13.41	13.56	13.27	2.46	2.53	2.32	0.291666
3	8.71	9.8	5.94	1.60	1.83	1.04	1
4	2.27	1.3	0.6	0.42	0.24	0.10	2
5	1	1	0.21	0.18	0.19	0.04	3
6	1	1	1	0.18	0.19	0.17	4
7	1	1	1	0.18	0.19	0.17	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
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	87.2	

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

		Added in 106-AN			Newbox Estimate		
Ao =	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

		Added in 106-AN			Newbox Estimate		
Ao =	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

		Added in 106-AN			Newbox Estimate	
Ao =	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

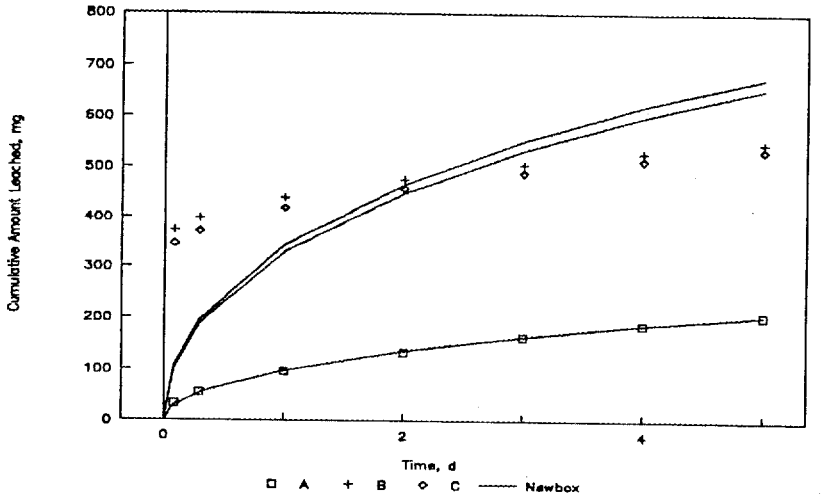
HCEM-LO Nitrate + Nitrite

				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

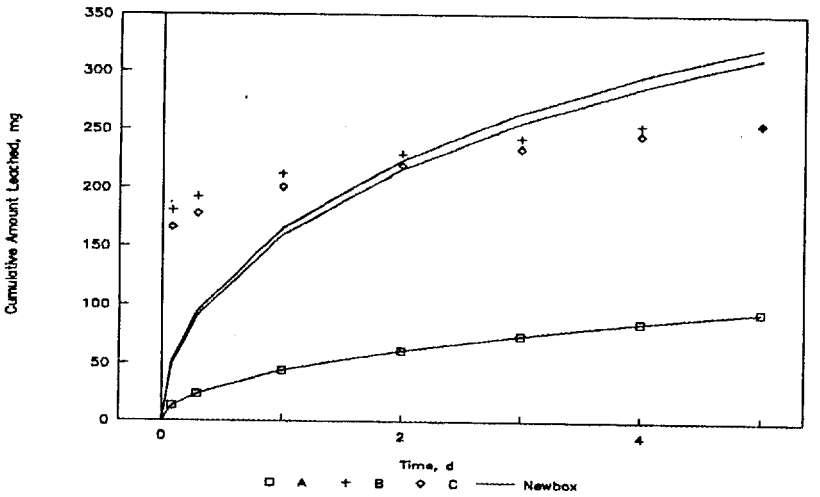
		Added in 106-AN			Newbox Estimate	
Ao =	2471.00	2466.67	2466.67	1775	1623	1466

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

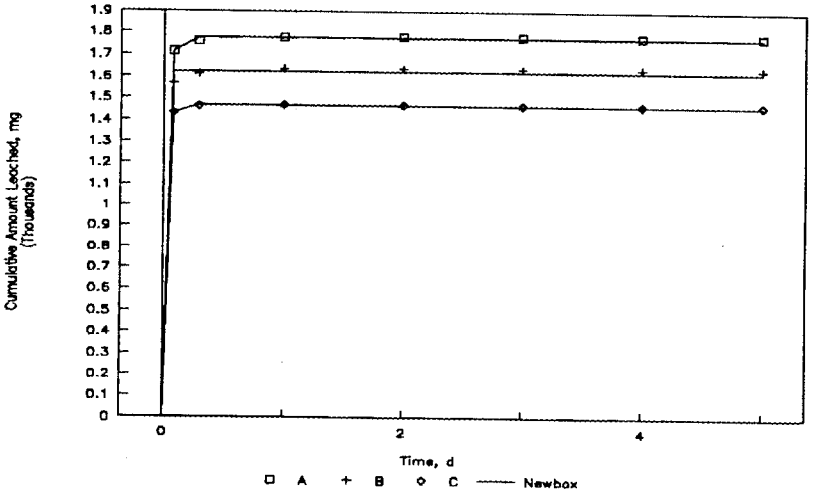
HCEM—HIGH : Nitrate

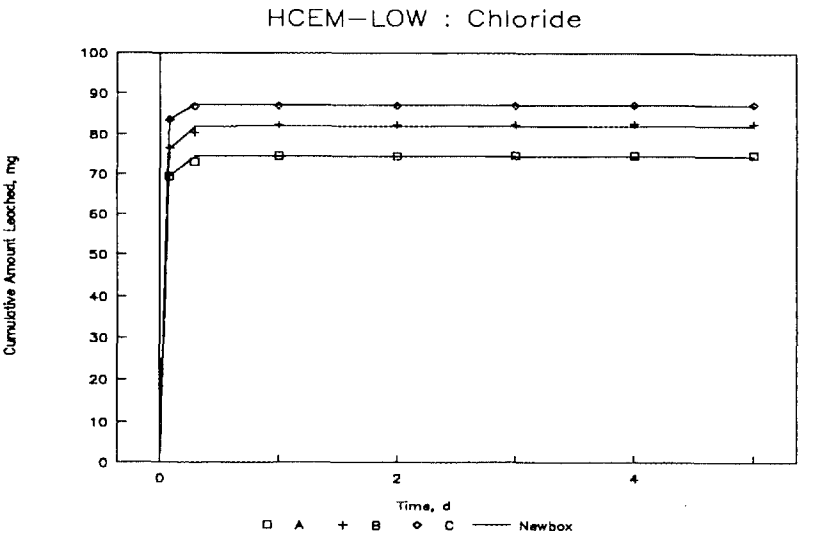


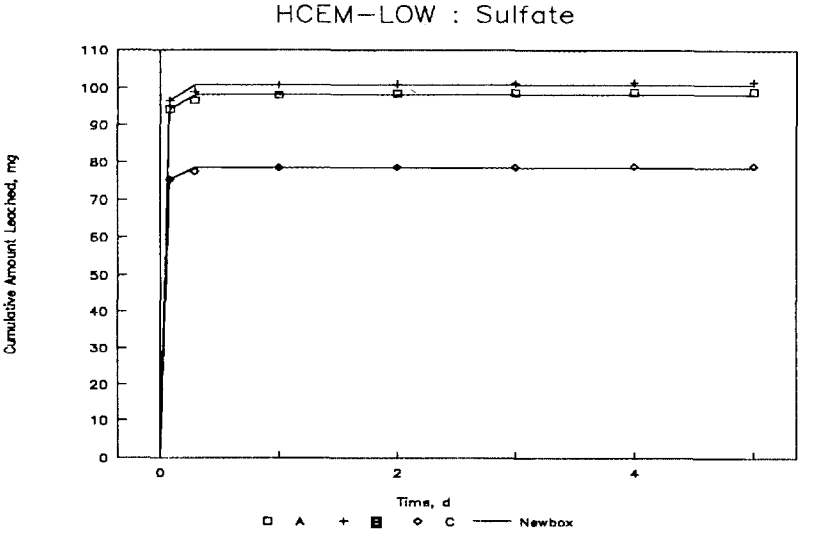
HCEM—HIGH : Nitrite



HCEM—LOW : Nitrate + Nitrite




HCEM—LOW : Chloride
Cumulative Amount Leached, mg
100
90
80
70
60
50
40
30
20
10
0
0
2
4
Time, d
A
B
C
Newbox


HCEM—LOW : Sulfate
Cumulative Amount Leached, mg
110
100
90
80
70
60
50
40
30
20
10
0
0
2
4
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate mg			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time 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 (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
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

	Added in 106-AN			Newbox Estimate		
Ao =	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

	Added in 106-AN			Newbox Estimate		
Ao =	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

	Added in 106-AN			Newbox Estimate		
Ao =	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

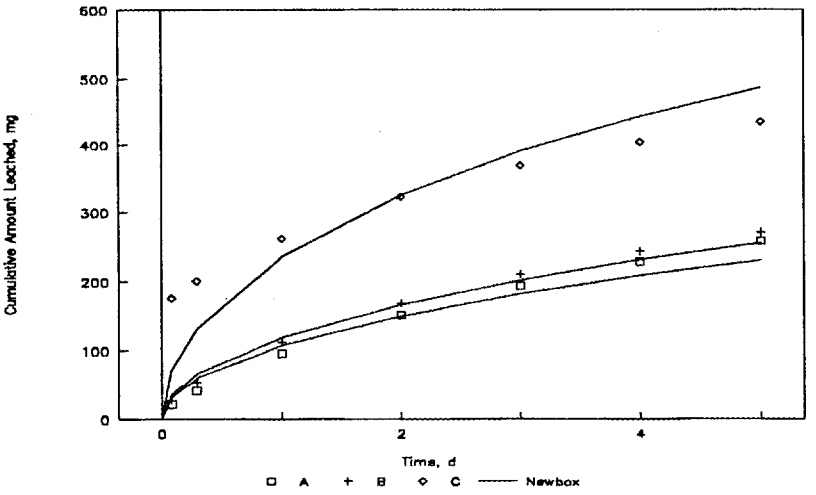
PORT2-HI Nitrate + Nitrite

				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

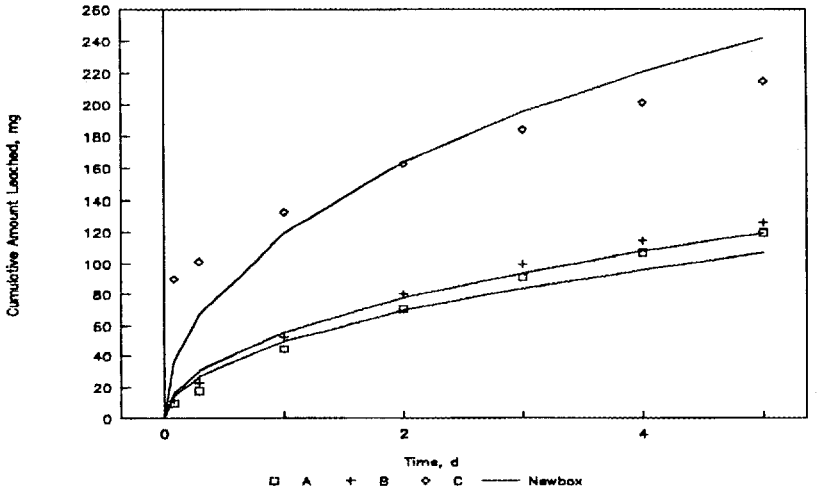
	Added in 106-AN			Newbox Estimate		
Ao =	1633.46	1628.26	1628.26	1633.47	1628.26	1628.26

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

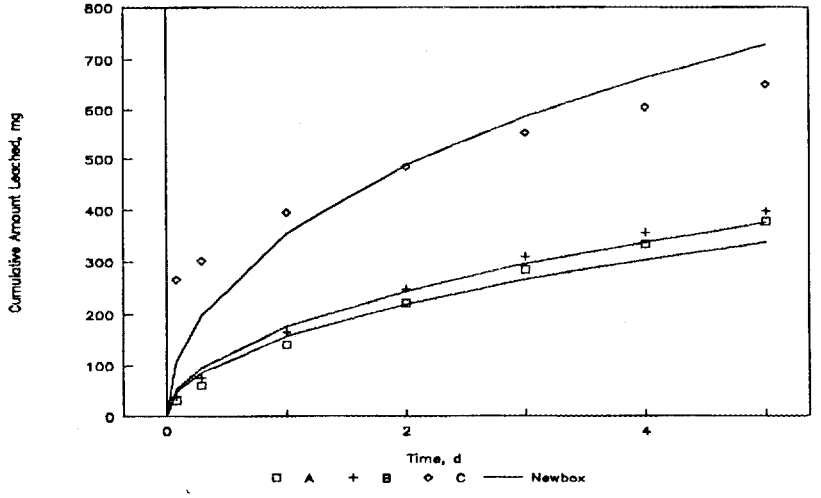
PORT2—HIGH : Nitrate

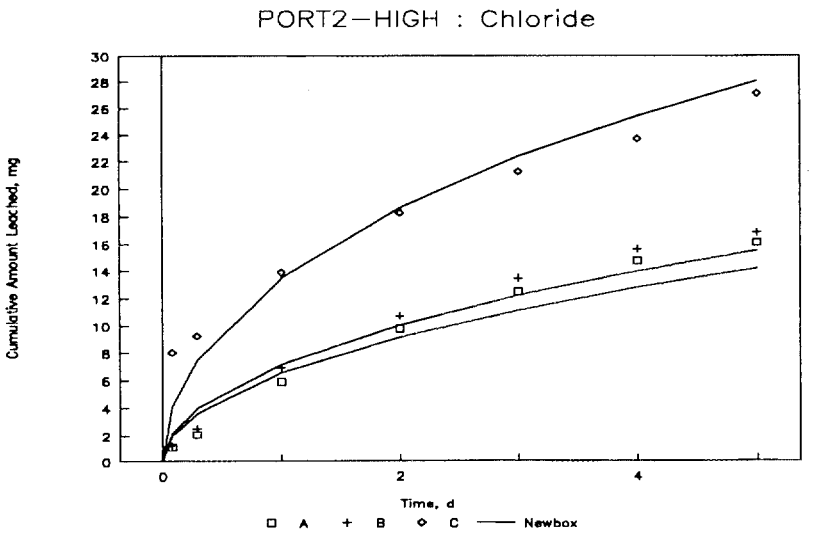


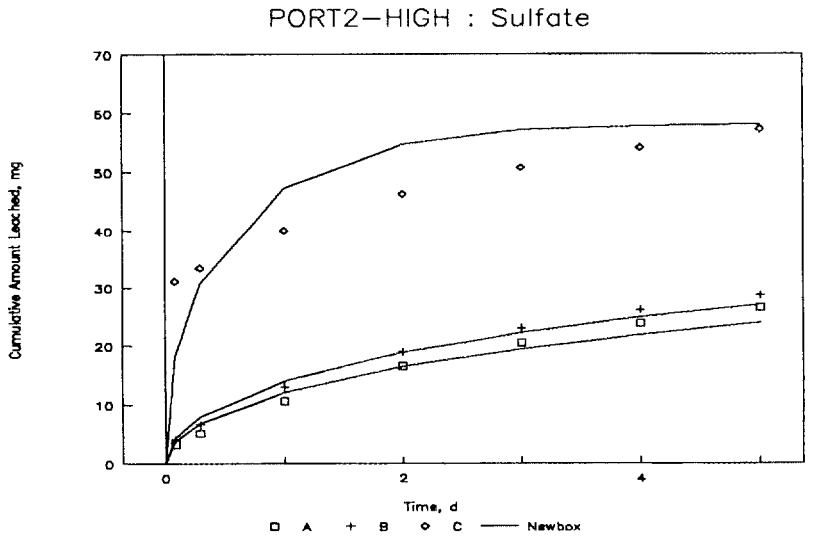
PORT2—HIGH : Nitrite



PORT2—HIGH : Nitrate + Nitrite




PORT2—HIGH : Chloride
Cumulative Amount Leached, mg
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
2
4
Time, d
A
B
C
Newbox


PORT2—HIGH : Sulfate
Cumulative Amount Leached, mg
70
60
50
40
30
20
10
0
0
2
4
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate 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

PORT2-L	Sulfate	Initially:		61.35	61.24	61.24	
0	477.4	348.2	362	85.93	78.87	79.42	0
1	20.99	21.02	23.73	3.78	4.76	5.21	0.083333
2	11.93	12.98	12.7	2.15	2.94	2.79	0.291666
3	11.37	14.08	13.89	2.05	3.19	3.05	1
4	2.09	6.24	5.59	0.38	1.41	1.23	2
5	0.43	2.57	2.26	0.08	0.58	0.50	3
6	0.41	1.44	1.15	0.07	0.33	0.25	4
7	0	0	0	0.00	0.00	0.00	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
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

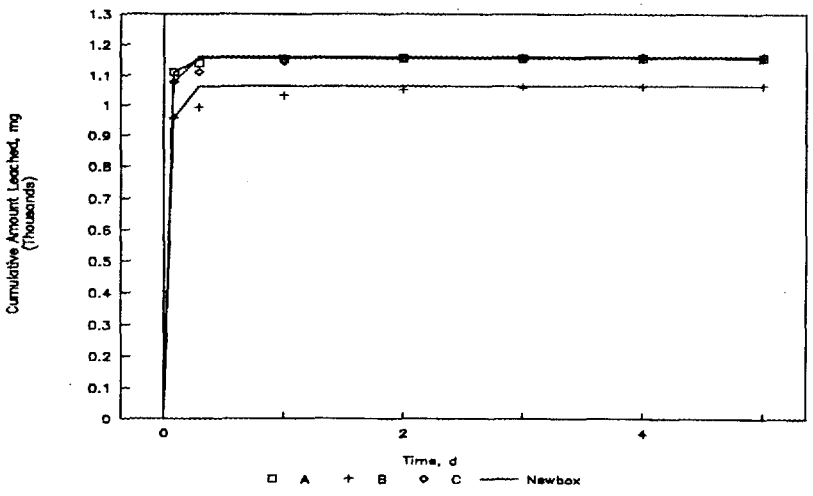
PORT2-L Nitrate + Nitrite

				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

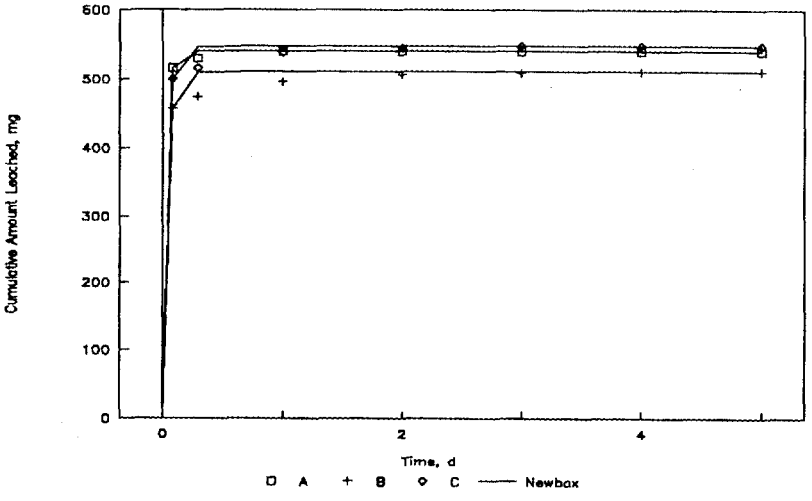
	Added in 106-AN			Newbox Estimate		
Ao =	2366.27	2361.90	2361.90	1698	1575	1709

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

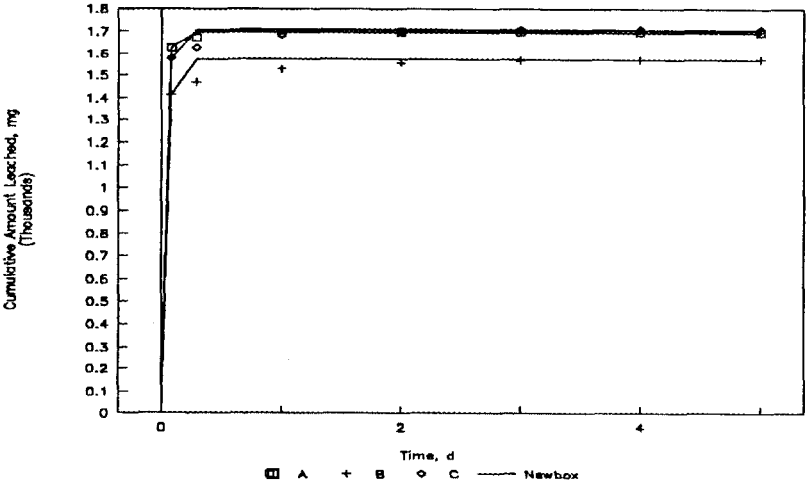
PORT2—LOW : Nitrate

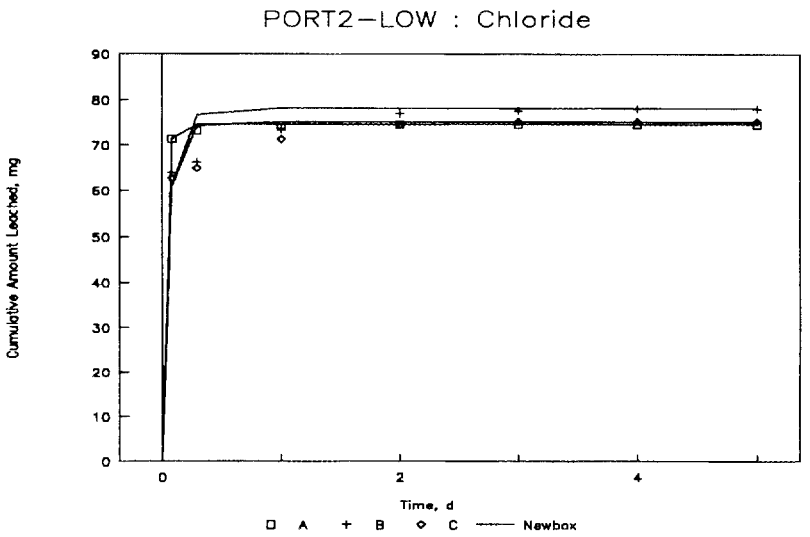


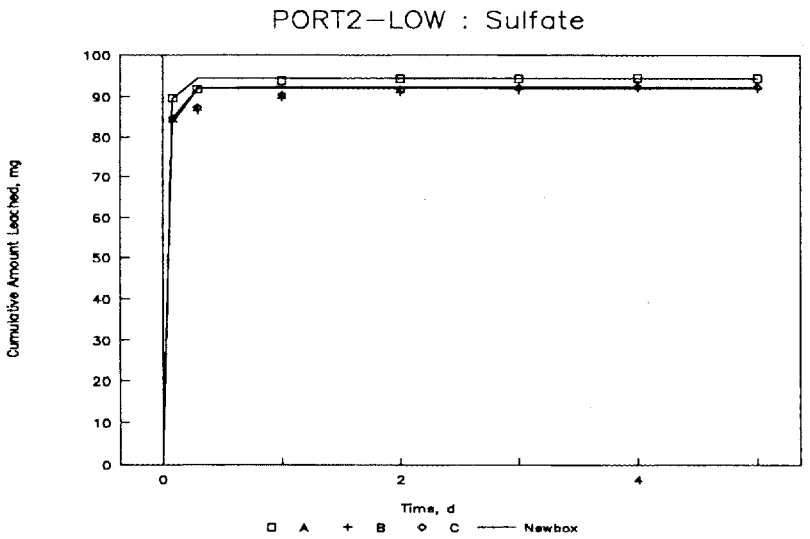
PORT2—LOW : Nitrite



PORT2—LOW : Nitrate + Nitrite




PORT2—LOW : Chloride
Cumulative Amount Leached, mg
90
80
70
60
50
40
30
20
10
0
0
2
4
Time, d
A
B
C
Newbox


PORT2—LOW : Sulfate
Cumulative Amount Leached, mg
100
90
80
70
60
50
40
30
20
10
0
0
2
4
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate mg			Time
Interval	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

TYPE5-HI	Sulfate	Initially:		42.35	42.30	42.35	
0	84.45	60.23	135.39	39.87	28.43	63.81	0
1	9.53	11.11	9.36	4.50	5.25	4.41	0.083333
2	4.52	6.08	5.25	2.13	2.87	2.47	0.291666
3	11.56	13.62	12.29	5.46	6.43	5.79	1
4	11.49	13.01	11.79	5.42	6.14	5.56	2
5	8.16	9.03	8.4	3.85	4.26	3.96	3
6	6.39	7.28	7.01	3.02	3.44	3.30	4
7	5.59	5.48	5.43	2.64	2.59	2.56	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
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	75.63	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

	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

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

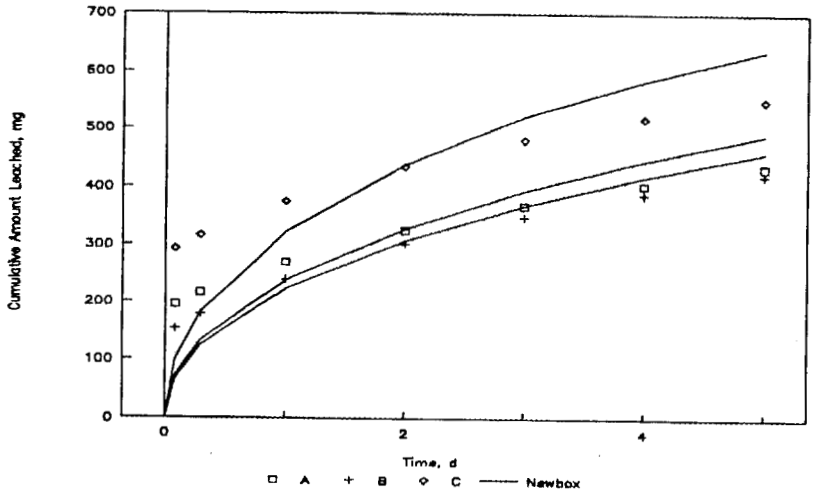
TYPE5-HI Nitrate + Nitrite

				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

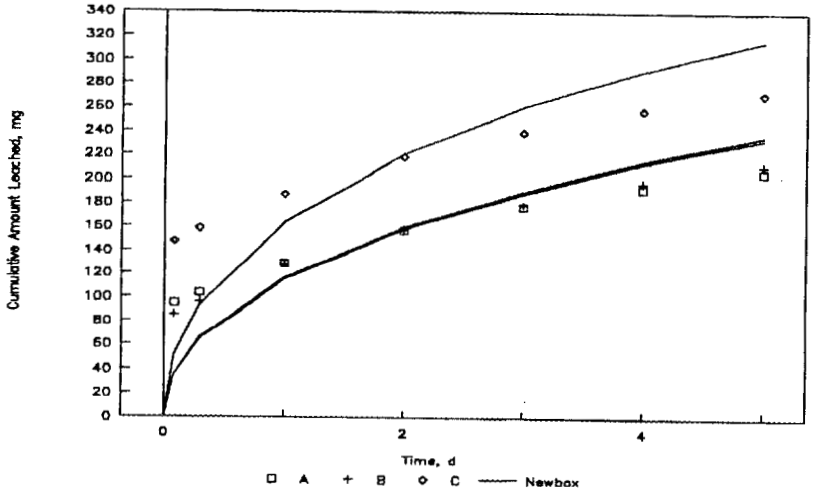
	Added in 106-AN			Newbox Estimate		
Ao =	1633.46	1631.38	1633.46	1633.47	1631.39	1633.47

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

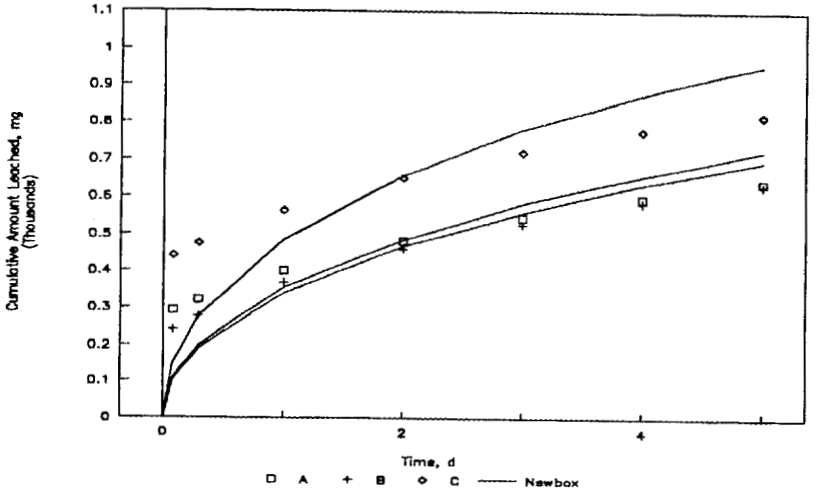
TYPE5—HIGH : Nitrate

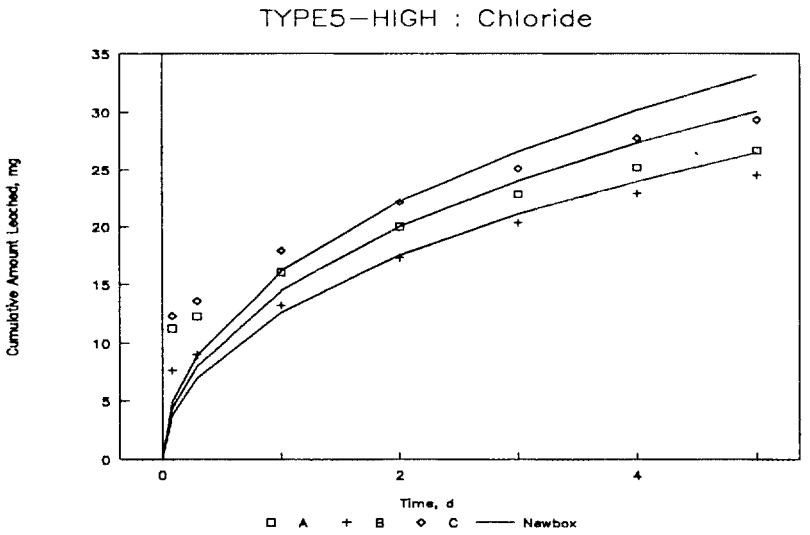


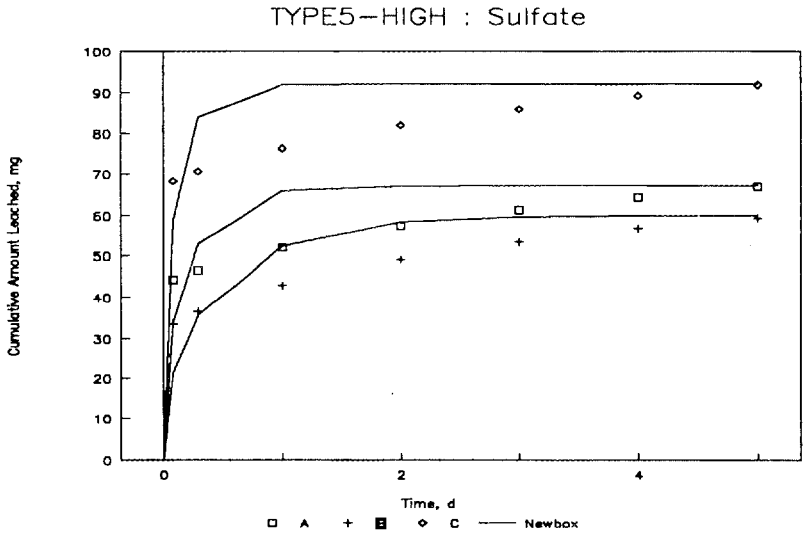
TYPE5—HIGH : Nitrite



TYPE5—HIGH : Nitrate + Nitrite




TYPE5—HIGH : Chloride
Cumulative Amount Leached, mg
35
30
25
20
15
10
5
0
0
2
4
Time, d
A
B
C
Newbox


TYPE5—HIGH : Sulfate
Cumulative Amount Leached, mg
100
90
80
70
60
50
40
30
20
10
0
0
2
4
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate mg			Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	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

TYPE5-LO Sulfate		Initially:		63.20	63.44	63.26	
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)			
		mg			mg		Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	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

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

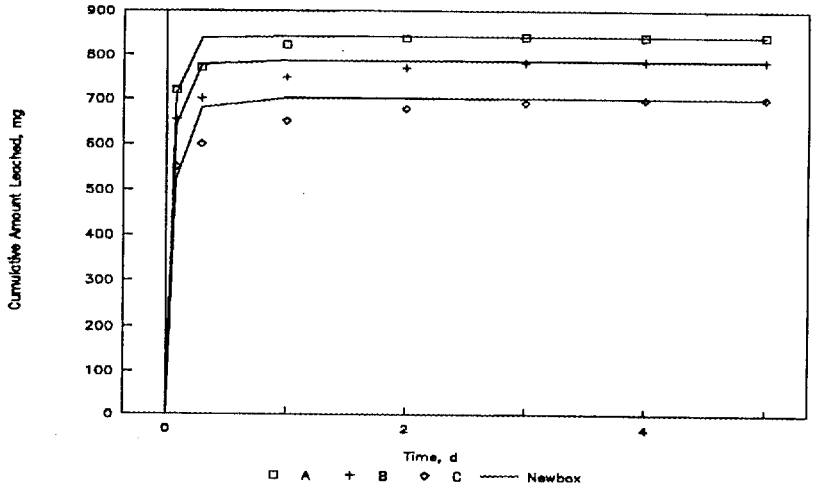
TYPE5-LO Nitrate + Nitrite

				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

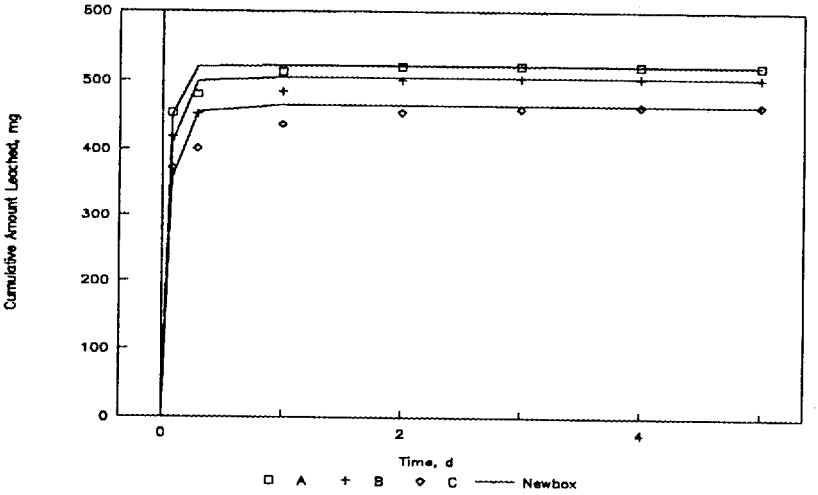
	Added in 106-AN			Newbox Estimate		
Ao =	2437.78	2446.80	2440.04	1363	1291	1166

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

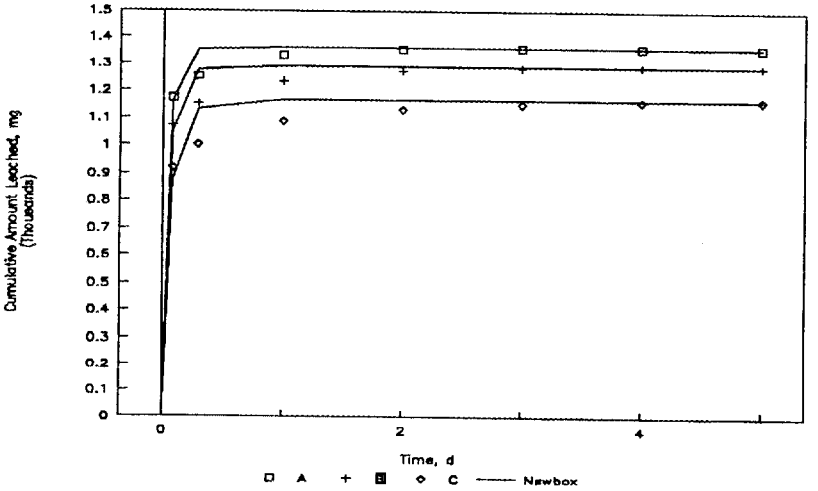
TYPE 5 – LOW : Nitrate

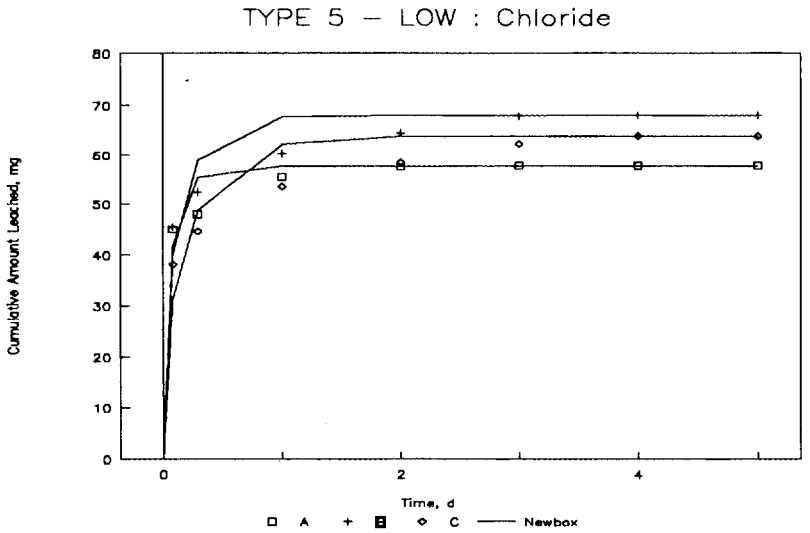


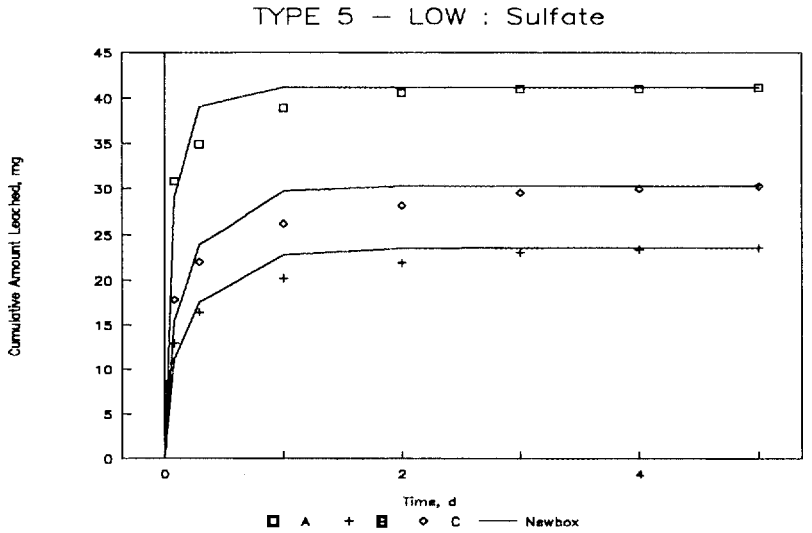
TYPE 5 – LOW : Nitrite



TYPE 5 – LOW : Nitrate + Nitrite




TYPE 5 – LOW : Chloride
Cumulative Amount Leached, mg
80
70
60
50
40
30
20
10
0
0
2
4
Time, d
A
C
Newbox


TYPE 5 – LOW : Sulfate
Cumulative Amount Leached, mg
45
40
35
30
25
20
15
10
5
0
0
2
4
Time, d
A
C
Newbox

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 mg/L			Mass in Leachate 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 (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-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	261.66	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

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

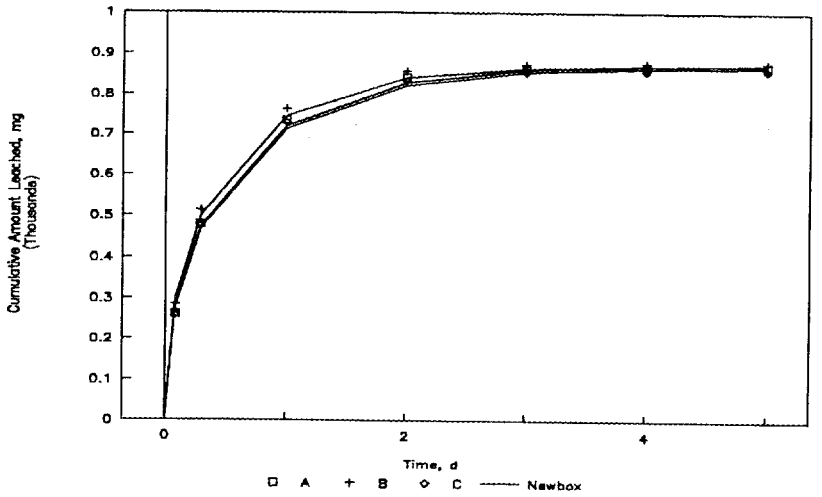
III-01 Nitrate + Nitrite

				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

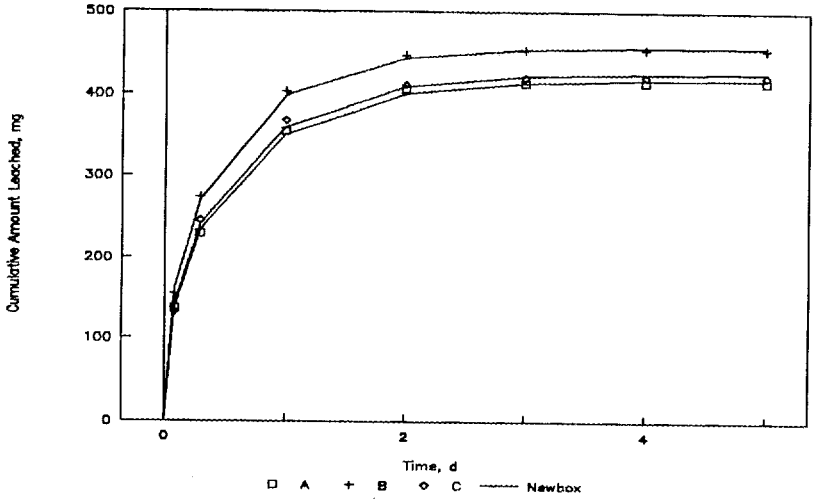
	Added in 106-AN			Newbox Estimate		
Ao =	1943.51	1942.12	1939.35	1289	1330	1294

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

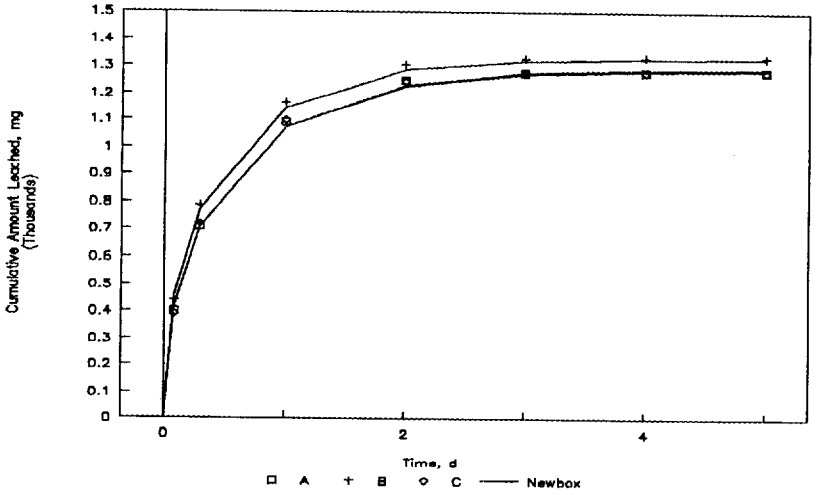
Run III–01 : Nitrate

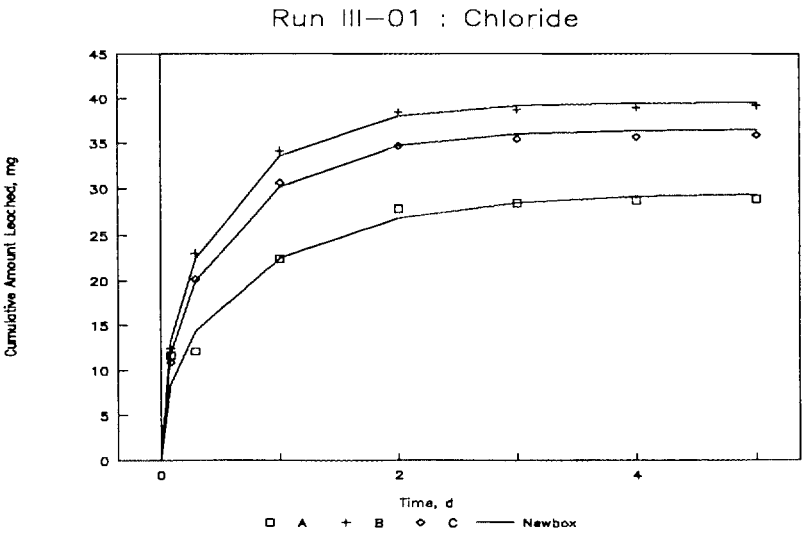


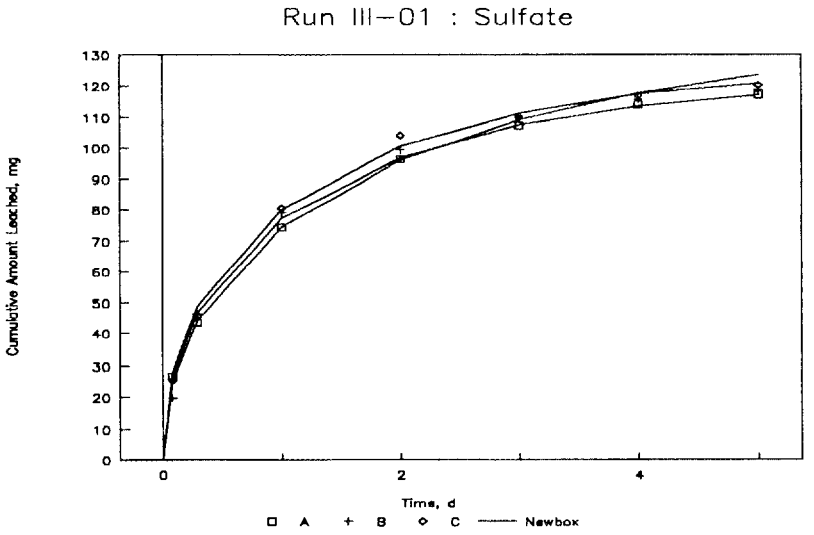
Run III–01 : Nitrite



Run III–01 : Nitrate + Nitrite




Run III–01 : Chloride
Cumulative Amount Leached, mg
45
40
35
30
25
20
15
10
5
0
0
2
4
Time, d
A
B
C
Newbox


Run III–01 : Sulfate
Cumulative Amount Leached, mg
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
2
4
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate mg			Time
Interval		Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
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	7.88	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)			
		mg			mg		Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	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

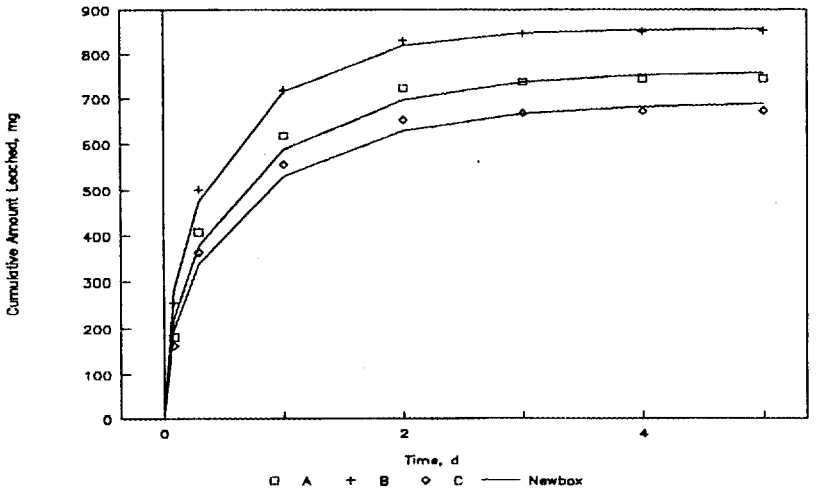
III-07 Nitrate + Nitrite

				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

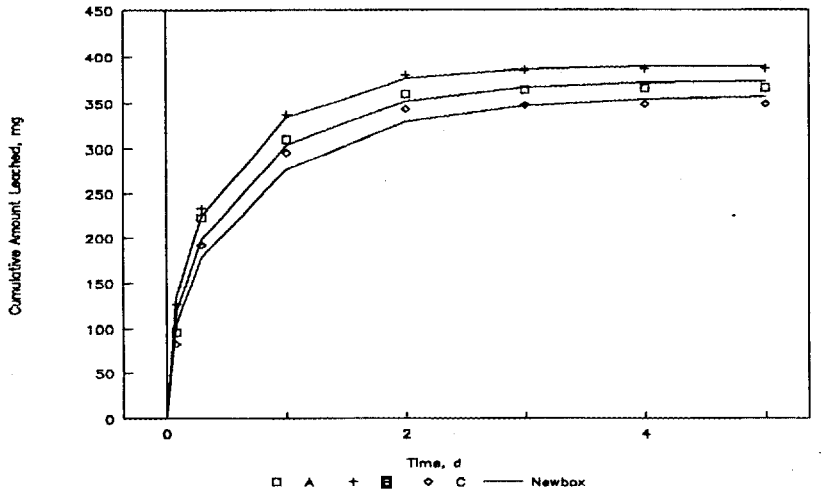
	Added in 106-AN			Newbox Estimate		
Ao =	1969.58	1968.13	1969.58	1135	1247	1050

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

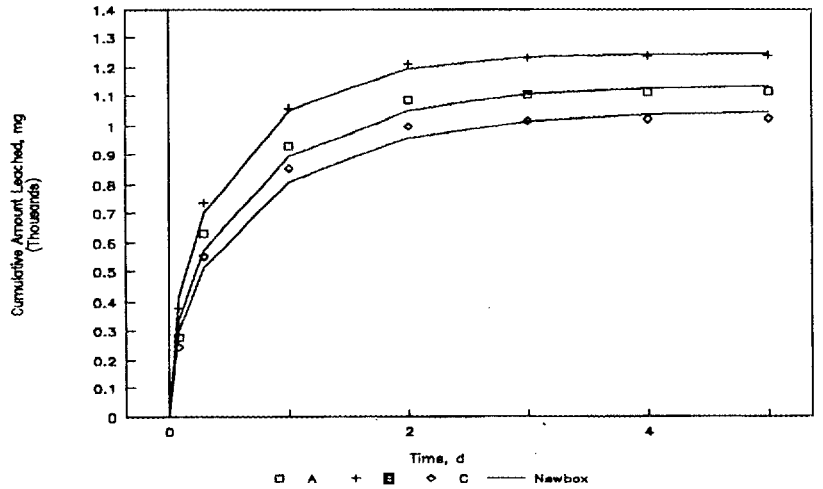
Run III–07 : Nitrate

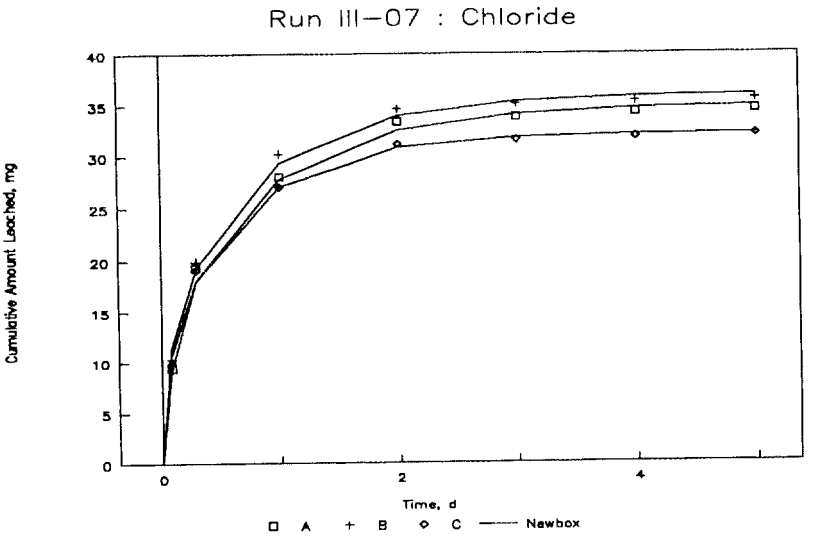


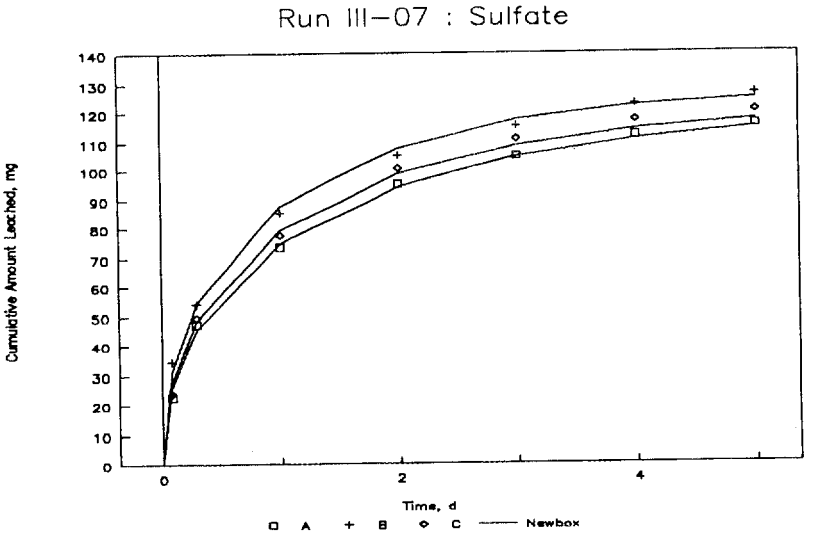
Run III–07 : Nitrite



Run III–07 : Nitrate + Nitrite




Run III–07 : Chloride
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox


Run III–07 : Sulfate
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate mg			Time
Interval		Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
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

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 (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-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

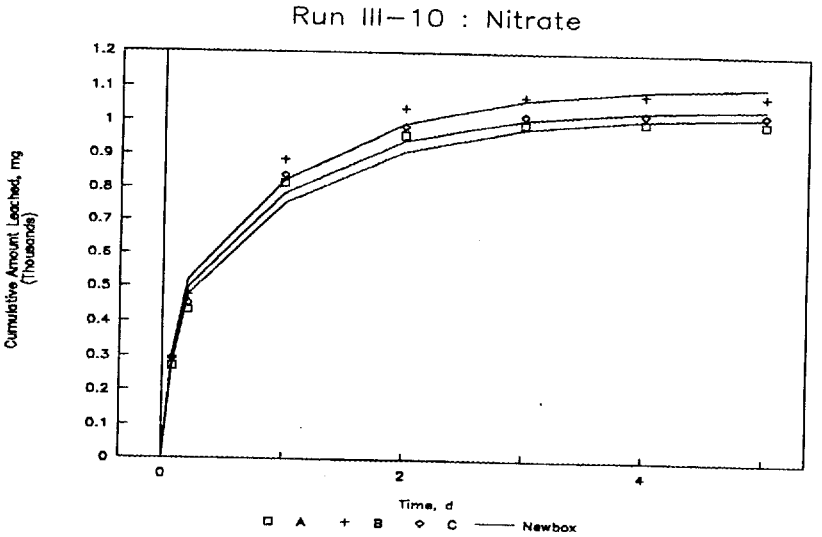
Per cent of 106-AN ion leachable:	440%	349%	387%
Eff. Diffusion Coefficient, sq cm/s:	5.29E-07	1.05E-06	1.04E-06
Std. Deviation, sq cm/s:	7.98E-08	1.77E-07	1.11E-07
Leachability Index:	6.277	5.979	5.983
Upper 95% Confidence Int.:	0.069	0.078	0.048
Lower 95% Confidence Int.:	0.059	0.066	0.043

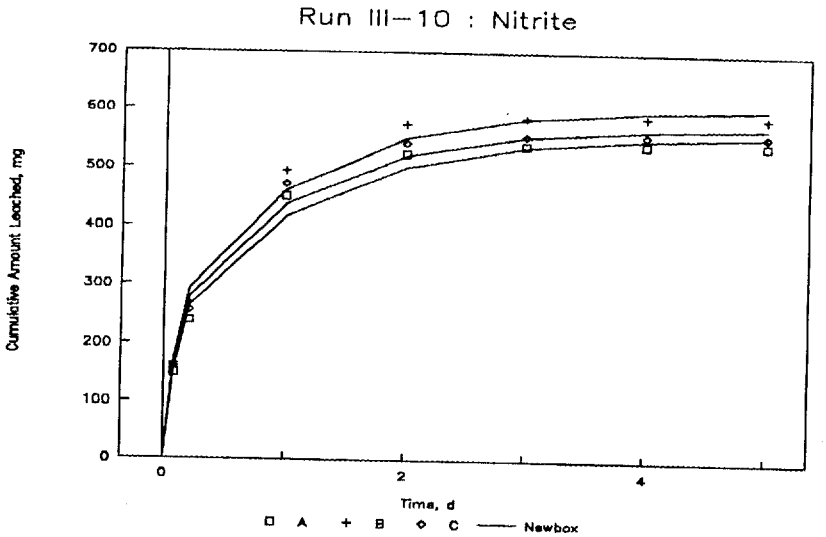
III-10 Nitrate + Nitrite

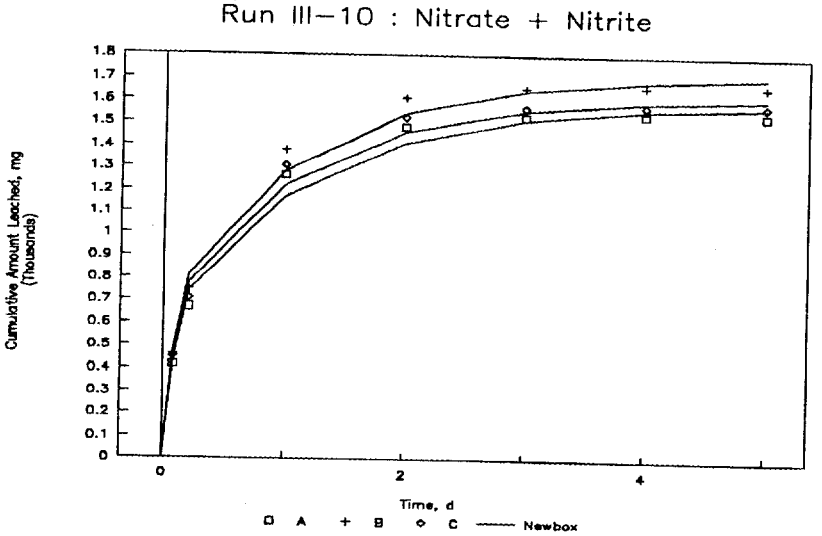
				0.00	0.00	0.00	0
1	418.47	461.98	452.91	426.13	471.20	450.13	0.083333
2	671.84	744.63	708.48	738.95	812.95	776.75	0.208333
3	1264.88	1378.14	1309.61	1169.87	1282.42	1220.38	1
4	1483.18	1612.76	1525.62	1412.46	1543.04	1462.50	2
5	1530.48	1660.31	1570.65	1514.60	1648.33	1558.38	3
6	1539.96	1670.54	1580.55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

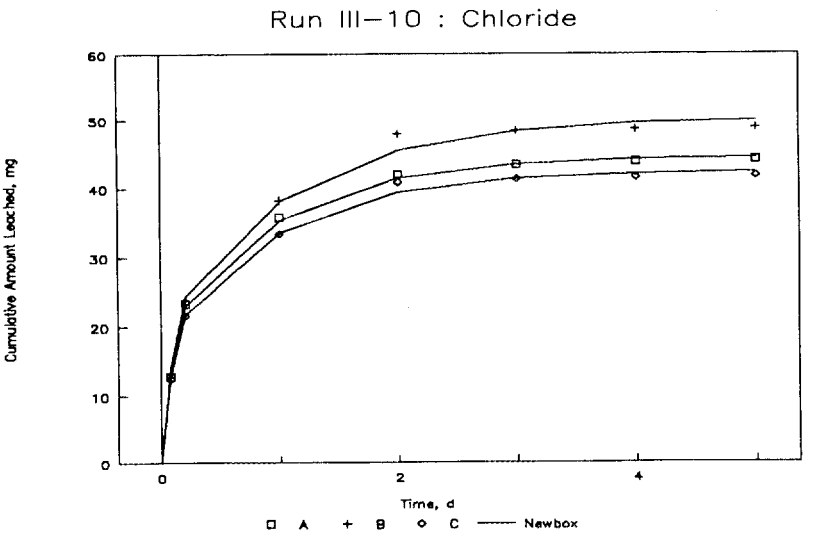
	Added in 106-AN			Newbox Estimate		
Ao =	1866.26	1868.95	1871.64	1596	1726	1625

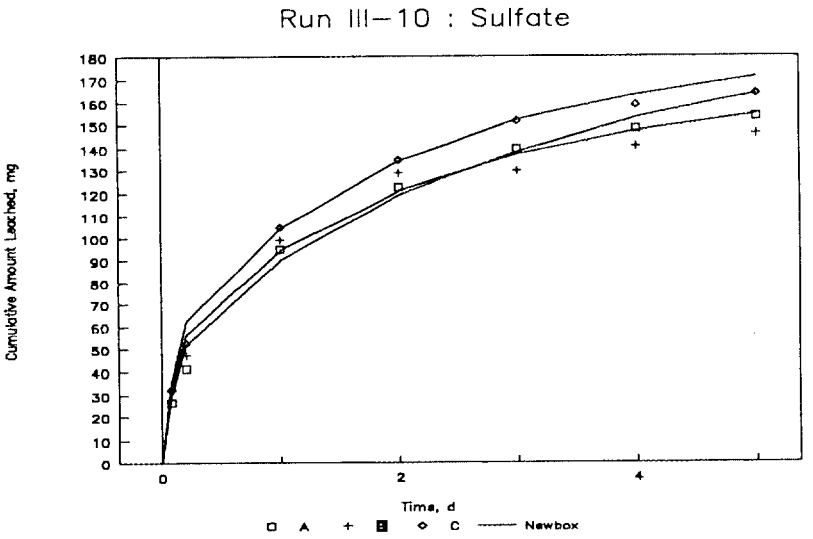
Per cent of 106-AN ion leachable:	86%	92%	87%
Eff. Diffusion Coefficient, sq cm/s:	2.22E-06	2.34E-06	2.43E-06
Std. Deviation, sq cm/s:	4.20E-07	4.12E-07	4.29E-07
Leachability Index:	5.654	5.631	5.614
Upper 95% Confidence Int.:	0.088	0.081	0.082
Lower 95% Confidence Int.:	0.073	0.069	0.069


Run III–10 : Nitrate
Cumulative Amount Leached, mg (Thousands)
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
Time, d
A
B
C
Newbox


Run III–10 : Nitrite
Cumulative Amount Leached, mg
700
600
500
400
300
200
100
0
0
2
4
Time, d
A
B
C
Newbox


Run III–10 : Nitrate + Nitrite
Cumulative Amount Leached, mg (Thousands)
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
Time, d
A
B
C
Newbox


Run III–10 : Chloride
Cumulative Amount Leached, mg
60
50
40
30
20
10
0
0
2
4
Time, d
A
B
C
Newbox


Run III–10 : Sulfate
Cumulative Amount Leached, mg
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
2
4
Time, d
A
B
C
Newbox

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	Dia., cm	2.50	2.50	2.50
22.83	4.65	Length,cm	4.46	4.48	4.53
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 mg/L			Mass in Leachate 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)			
		mg			mg		Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	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

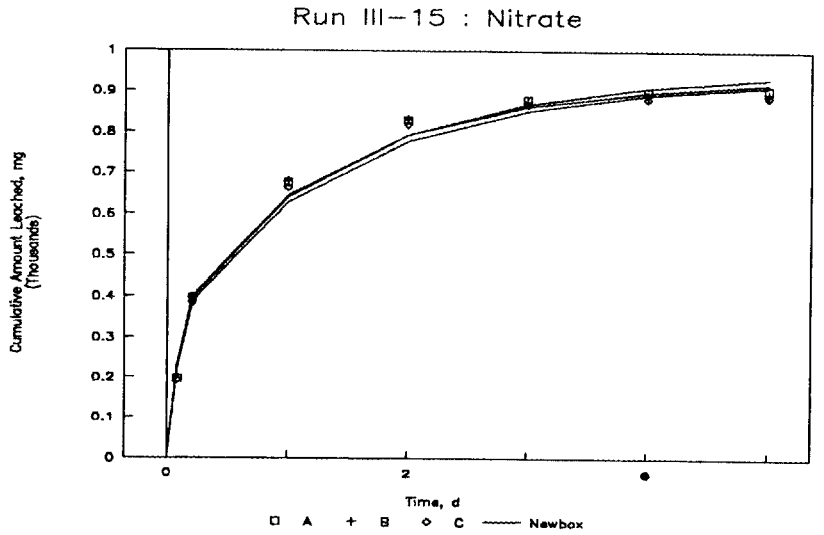
III-15	Nitrite						
				0.00	0.00	0.00	0
1	129.55	143.20	135.51	151.80	159.35	153.43	0.083333
2	261.81	276.53	262.21	264.00	275.18	266.86	0.208333
3	449.31	451.17	448.89	422.40	434.53	425.66	1
4	539.82	541.09	537.73	516.60	523.32	518.79	2
5	566.47	564.12	565.04	559.80	560.36	559.99	3
6	570.70	569.44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

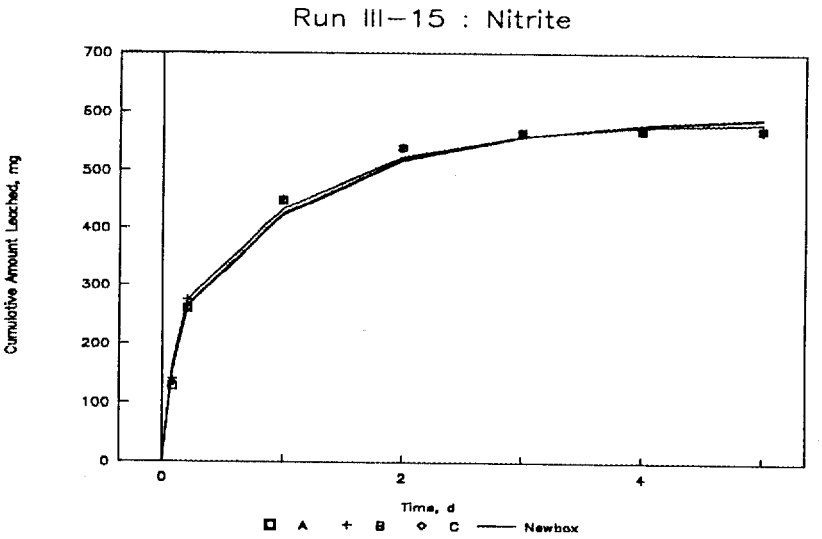
		Added in 106-AN			Newbox Estimate		
Ao =		542.53	542.13	541.74	600	588	597
Per cent of 106-AN ion leachable:					111%	108%	110%
Eff. Diffusion Coefficient, sq cm/s:					1.96E-06	2.29E-06	2.05E-06
Std. Deviation, sq cm/s:					3.51E-07	2.96E-07	3.07E-07
Leachability Index:					5.708	5.640	5.688
Upper 95% 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

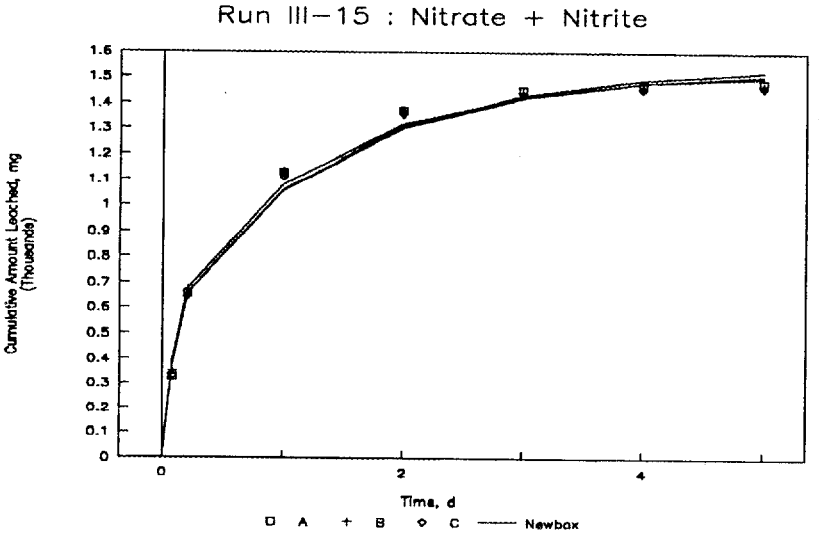
		Added in 106-AN			Newbox Estimate		
Ao =		1244.40	1243.49	1242.58	956	937	938
Per cent of 106-AN ion leachable:					77%	75%	75%
Eff. Diffusion Coefficient, sq cm/s:					1.70E-06	1.83E-06	1.70E-06
Std. Deviation, sq cm/s:					2.71E-07	2.73E-07	2.74E-07
Leachability Index:					5.770	5.738	5.770
Upper 95% 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

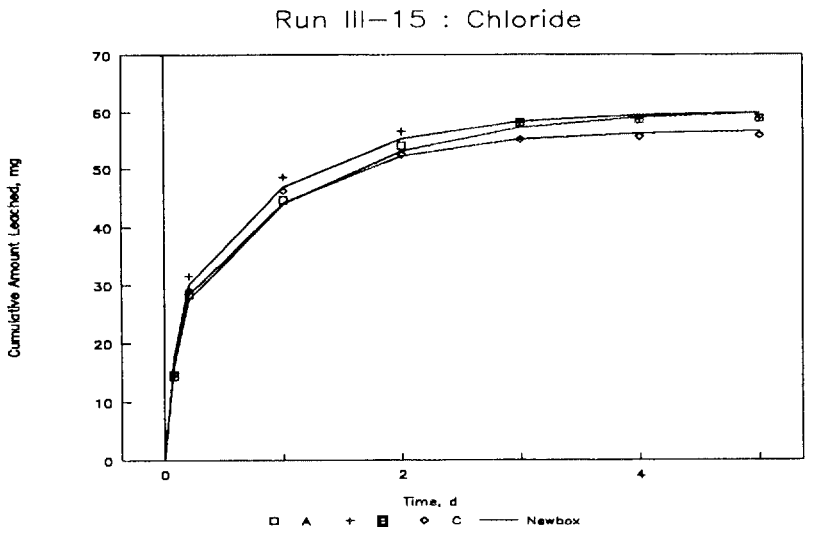
		Added in 106-AN			Newbox Estimate		
Ao =		46.33	46.30	46.26	333	310	310

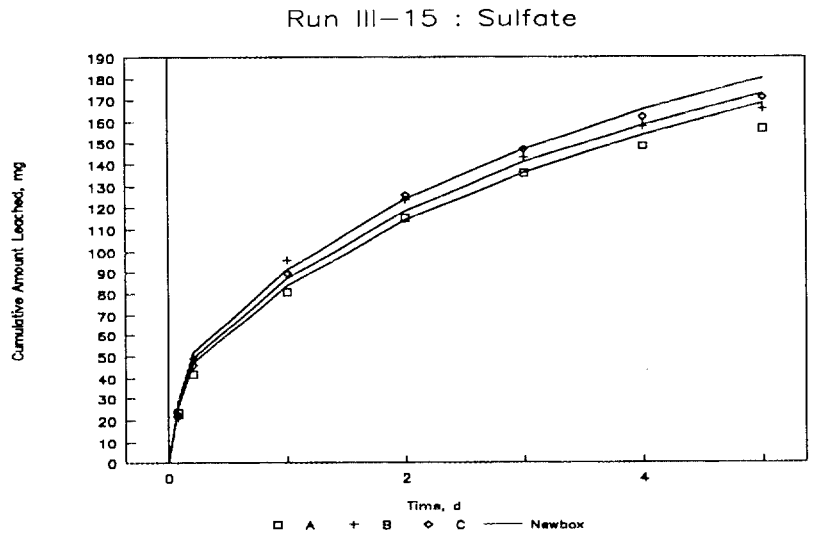
Per cent of 106-AN ion leachable:				719%	670%	670%	
Eff. Diffusion Coefficient, sq cm/s:				1.52E-07	2.07E-07	2.32E-07	
Std. Deviation, sq cm/s:				1.17E-08	2.46E-08	1.84E-08	
Leachability Index:				6.818	6.684	6.635	
Upper 95% Confidence Int.:				0.034	0.053	0.035	
Lower 95% Confidence Int.:				0.031	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
Cumulative Amount Leached, mg
(Thousands)
Time, d
A
B
C
Newbox


Run III−15 : Nitrite
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox


Run III−15 : Nitrate + Nitrite
Cumulative Amount Leached, mg
(Thousands)
Time, d
A
B
C
Newbox


Run III–15 : Chloride
Cumulative Amount Leached, mg
70
60
50
40
30
20
10
0
0
2
4
Time, d
A
B
C
Newbox


Run III–15 : Sulfate
Cumulative Amount Leached, mg
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
2
4
Time, d
A
B
C
Newbox

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	4.65	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 mg/L			Mass in Leachate mg			Time
Interval		Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	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	0
1	15.4	15	15	6.73	6.44	6.58	0.083333
2	69.2	49.89	58.26	30.24	21.40	25.55	0.291666
3	126.1	117.07	120.13	55.11	50.22	52.69	1
4	107.1	97.51	112.86	46.80	41.83	49.50	2
5	64.72	48.9	67.86	28.28	20.98	29.76	3
6	36.34	36.96	42.34	15.88	15.86	18.57	4
7	16.96	17.29	11.59	7.41	7.42	5.08	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-20	Chloride						
				0.00	0.00	0.00	0
1	8.78	8.38	7.04	12.86	12.90	12.12	0.083333
2	25.20	26.28	25.57	22.60	22.67	21.34	0.291666
3	41.26	42.34	40.86	37.04	36.94	35.26	1
4	50.29	50.16	49.28	46.49	46.19	44.60	2
5	52.00	51.33	50.91	51.60	51.16	49.76	3
6	52.44	51.54	51.13	54.53	53.96	52.90	4
7	52.66	51.75	51.35	56.23	55.50	54.87	5
		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	0.083333
2	252.32	219.58	218.80	280.52	257.74	260.55	0.291666
3	471.63	447.19	463.79	446.60	413.82	424.45	1
4	572.33	547.88	574.16	542.38	509.50	529.58	2
5	593.31	564.00	595.71	585.30	556.74	584.44	3
6	594.62	567.32	600.05	604.58	580.06	614.47	4
7	595.22	567.87	600.71	613.91	589.03	630.80	5

		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

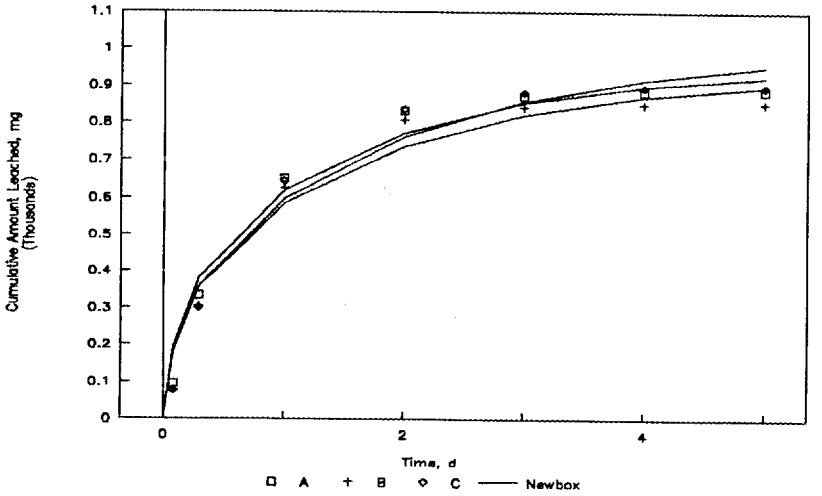
III-20 Nitrate + Nitrite

				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

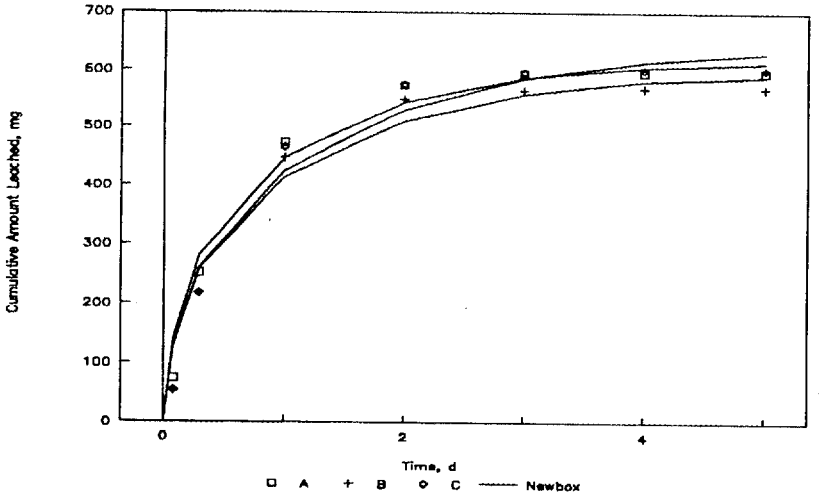
	Added in 106-AN			Newbox Estimate		
Ao =	1872.88	1870.10	1871.49	1575	1523	1671

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

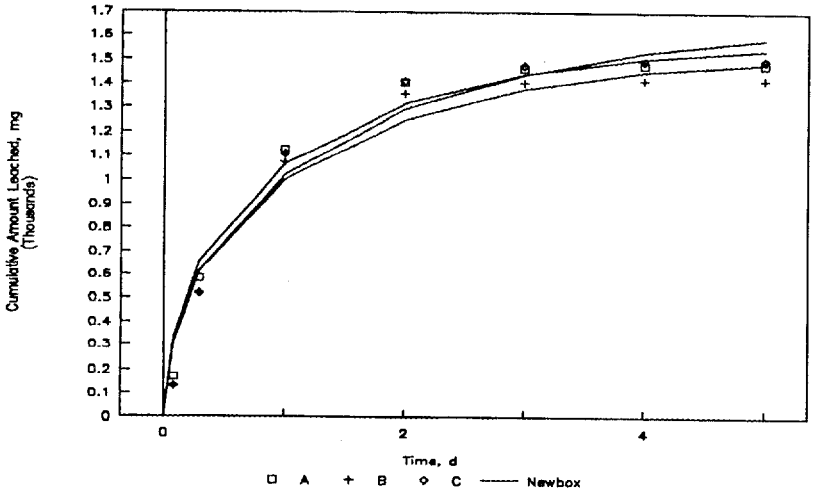
Run III–20 : Nitrate

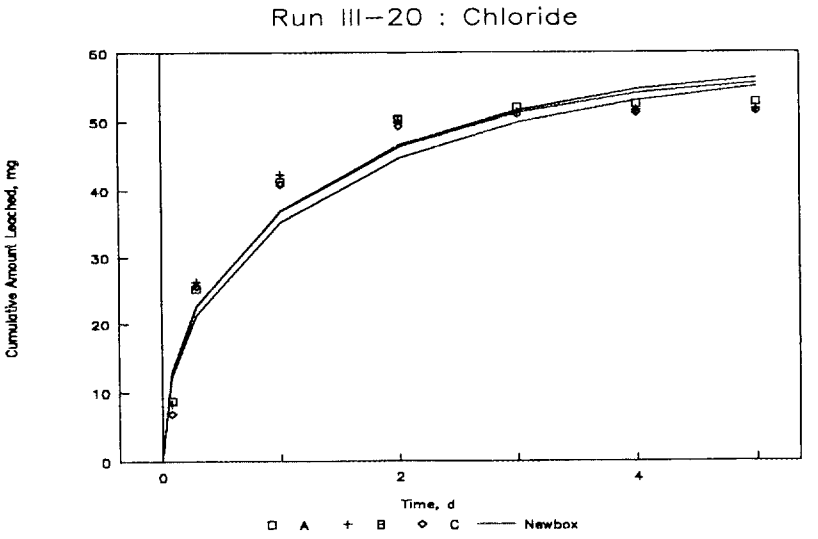


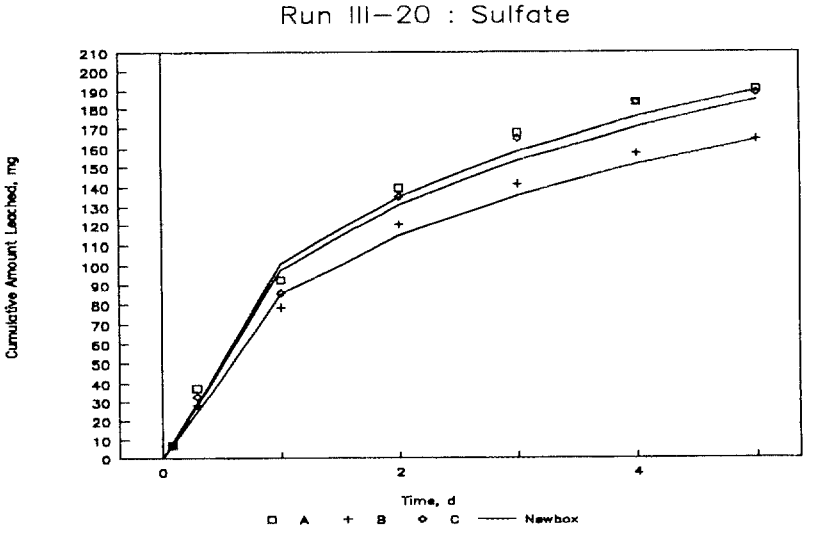
Run III–20 : Nitrite



Run III–20 : Nitrate + Nitrite




Run III–20 : Chloride
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
0
2
4
Time, d
A
B
C
Newbox


Run III–20 : Sulfate
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
0
2
4
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate 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	2	0.90	0.88	0.89	0
1	19.71	18.82	13.7	8.86	8.25	6.10	0.083333
2	11.7	14.42	14.05	5.26	6.32	6.25	0.291666
3	25.37	28.44	29.45	11.41	12.47	13.10	1
4	23.02	21.43	26.28	10.35	9.40	11.69	2
5	15.73	16.46	20.3	7.07	7.22	9.03	3
6	13.24	4.87	16.46	5.95	2.14	7.32	4
7	9.23	9.41	11.51	4.15	4.13	5.12	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-21	Chloride						
				0.00	0.00	0.00	0
1	6.87	6.91	6.10	6.27	6.27	6.71	0.083333
2	11.53	11.39	10.65	11.36	11.43	12.21	0.291666
3	19.20	19.47	20.20	19.66	19.98	21.18	1
4	25.72	26.36	28.26	26.18	26.75	28.27	2
5	30.33	31.23	34.03	30.53	31.41	33.06	3
6	33.94	35.19	38.21	33.84	34.97	36.69	4
7	36.80	37.91	41.76	36.41	37.85	39.55	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	40.70	0.083333
2	72.35	68.40	65.89	71.57	69.22	74.37	0.291666
3	119.98	119.33	125.53	123.82	121.05	129.87	1
4	161.50	162.07	175.71	164.29	162.32	174.27	2
5	190.12	191.33	210.71	191.47	190.96	204.98	3
6	212.13	213.42	236.80	211.40	212.44	228.29	4
7	228.67	230.71	256.72	227.41	230.18	247.53	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

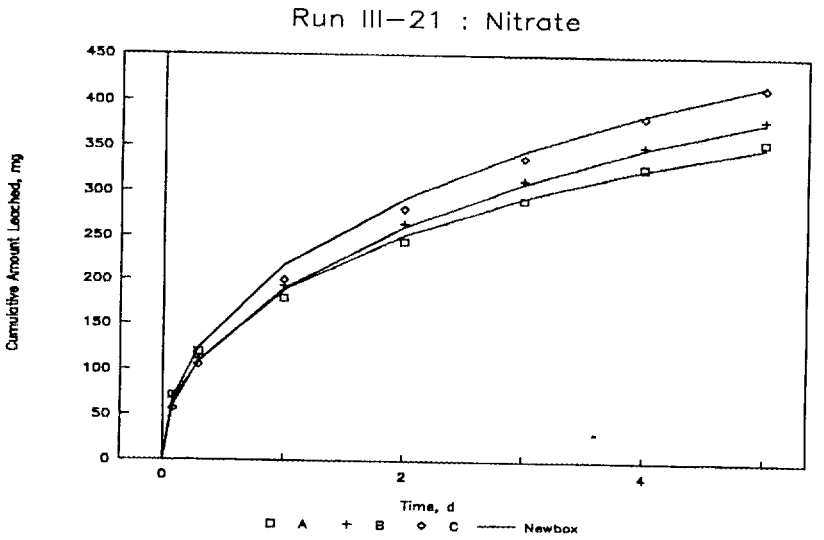
Per cent of 106-AN ion leachable:	256%	157%	177%
Eff. Diffusion Coefficient, sq cm/s:	1.30E-07	4.00E-07	3.24E-07
Std. Deviation, sq cm/s:	7.52E-09	2.13E-08	7.13E-08
Leachability Index:	6.886	6.398	6.489
Upper 95% Confidence Int.:	0.025	0.023	0.104
Lower 95% Confidence Int.:	0.024	0.022	0.084

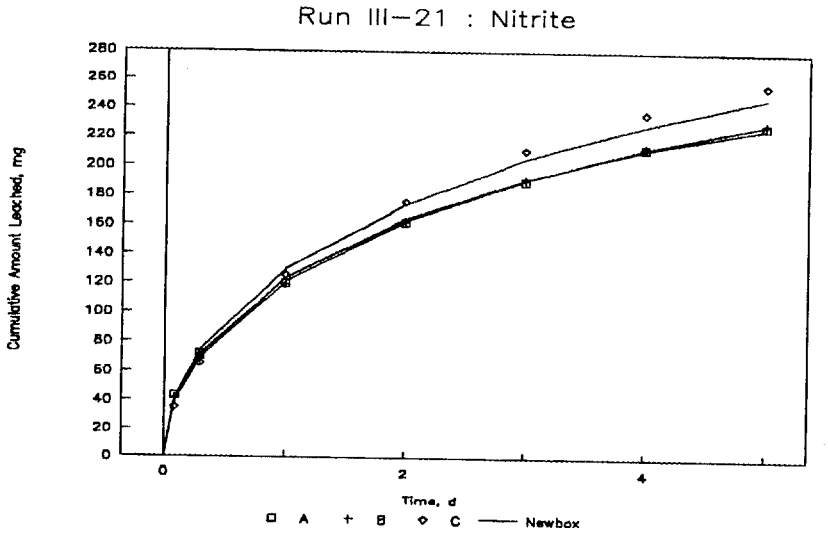
III-21 Nitrate + Nitrite

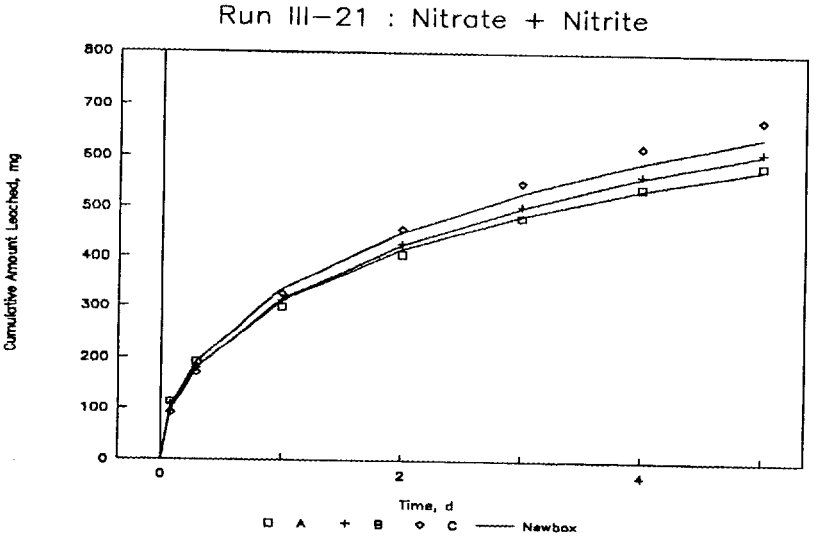
				0.00	0.00	0.00	0
1	114.56	110.12	91.94	99.58	97.87	105.60	0.083333
2	191.27	180.16	171.31	180.50	179.27	192.00	0.291666
3	299.06	312.68	325.86	312.76	314.93	336.00	1
4	405.99	427.06	457.36	416.23	425.39	451.20	2
5	481.93	504.79	548.42	485.47	501.94	529.92	3
6	540.01	565.35	620.25	536.82	561.05	591.36	4
7	585.77	612.89	673.51	578.05	609.50	640.32	5

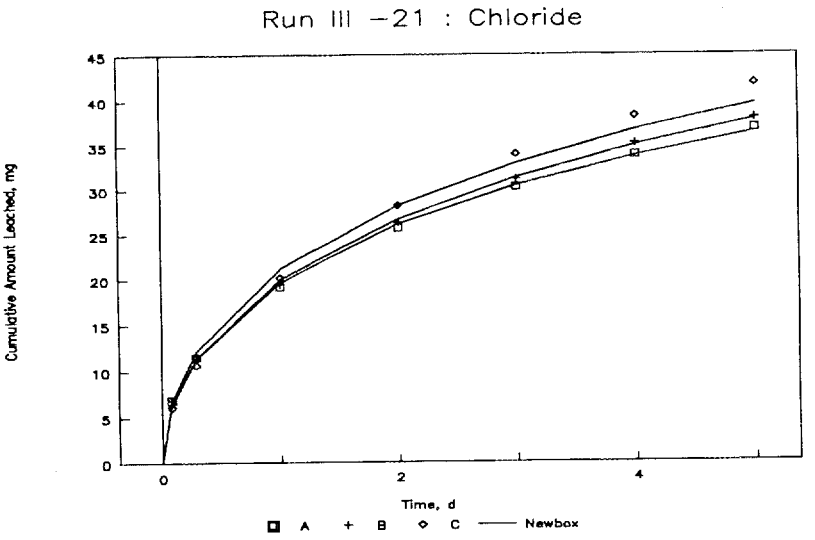
	Added in 106-AN			Newbox Estimate		
Ao =	1764.54	1765.85	1763.23	778	969	960

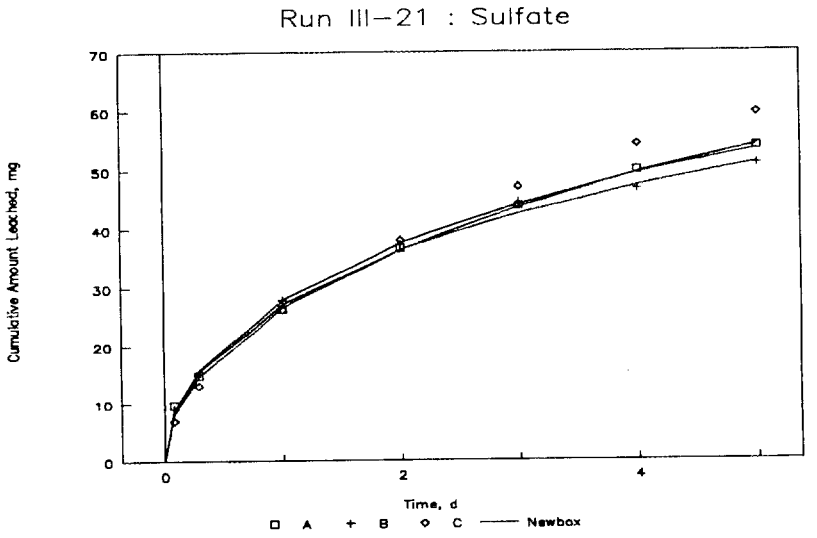
Per cent of 106-AN ion leachable:	44%	55%	54%
Eff. Diffusion Coefficient, sq cm/s:	4.64E-07	2.81E-07	3.35E-07
Std. Deviation, sq cm/s:	3.86E-08	1.12E-08	3.94E-08
Leachability Index:	6.333	6.551	6.475
Upper 95% Confidence Int.:	0.037	0.017	0.053
Lower 95% Confidence Int.:	0.034	0.017	0.047


Run III–21 : Nitrate
Cumulative Amount Leached, mg
450
400
350
300
250
200
150
100
50
0
0
2
4
Time, d
A
B
C
Newbox


Run III–21 : Nitrite
Cumulative Amount Leached, mg
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
0
2
4
Time, d
A
B
C
Newbox


Run III–21 : Nitrate + Nitrite
Cumulative Amount Leached, mg
800
700
600
500
400
300
200
100
0
0
2
4
Time, d
A
B
C
Newbox


Run III -21 : Chloride
Cumulative Amount Leached, mg
45
40
35
30
25
20
15
10
5
0
0
2
4
Time, d
A
B
C
Newbox


Run III-21 : Sulfate
Cumulative Amount Leached, mg
70
60
50
40
30
20
10
0
0
2
4
Time, d
A
B
C
Newbox

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
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 mg/L			Mass in Leachate mg			Time
Interval		Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
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 (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-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

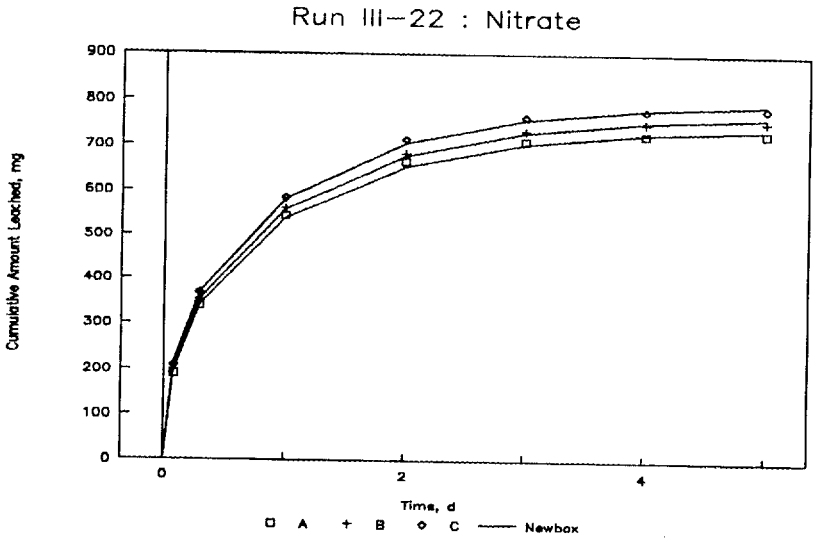
Per cent of 106-AN ion leachable:	196%	192%	226%
Eff. Diffusion Coefficient, sq cm/s:	8.85E-07	8.91E-07	6.24E-07
Std. Deviation, sq cm/s:	4.06E-08	3.79E-08	3.20E-08
Leachability Index:	6.053	6.050	6.205
Upper 95% Confidence Int.:	0.020	0.018	0.022
Lower 95% Confidence Int.:	0.019	0.018	0.021

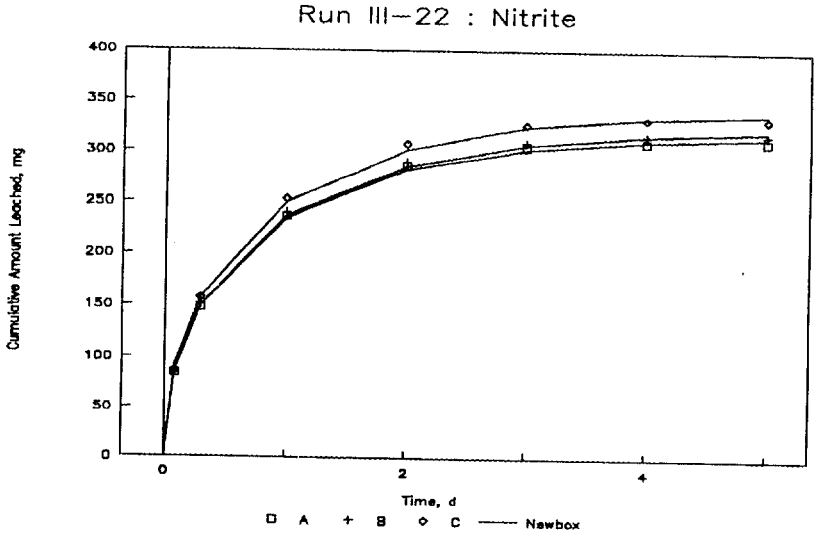
III-22 Nitrate + Nitrite

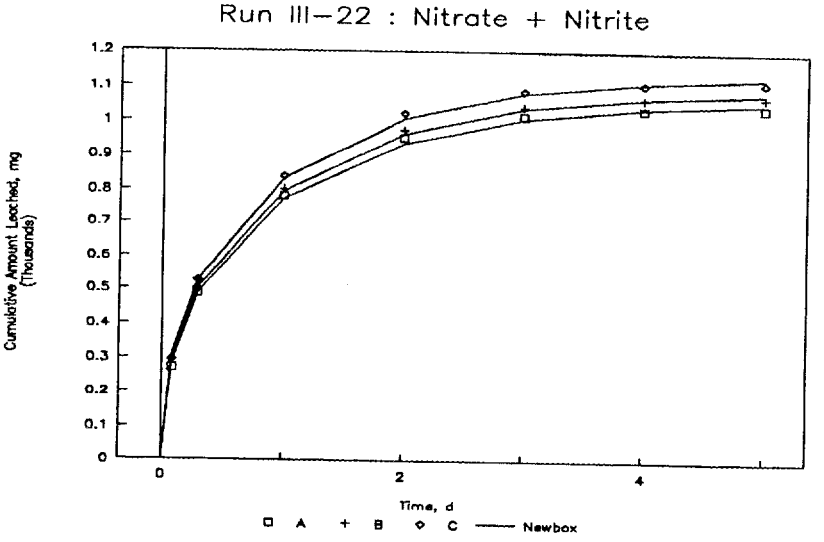
				0.00	0.00	0.00	0
1	272.72	282.12	294.55	282.23	290.44	304.91	0.083333
2	486.37	502.54	526.23	488.84	503.06	526.46	0.291666
3	781.64	802.02	838.49	773.19	795.70	832.52	1
4	952.41	974.35	1021.39	936.14	963.38	1006.10	2
5	1015.42	1042.39	1089.33	1006.43	1035.72	1081.47	3
6	1034.62	1066.17	1110.23	1038.38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

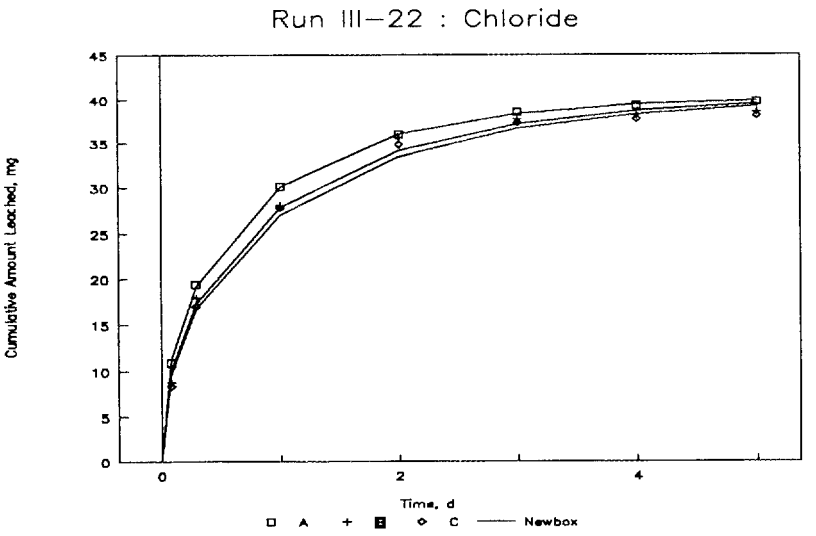
	Added in 106-AN			Newbox Estimate		
Ao =	2010.13	2010.13	2011.58	1065	1096	1142

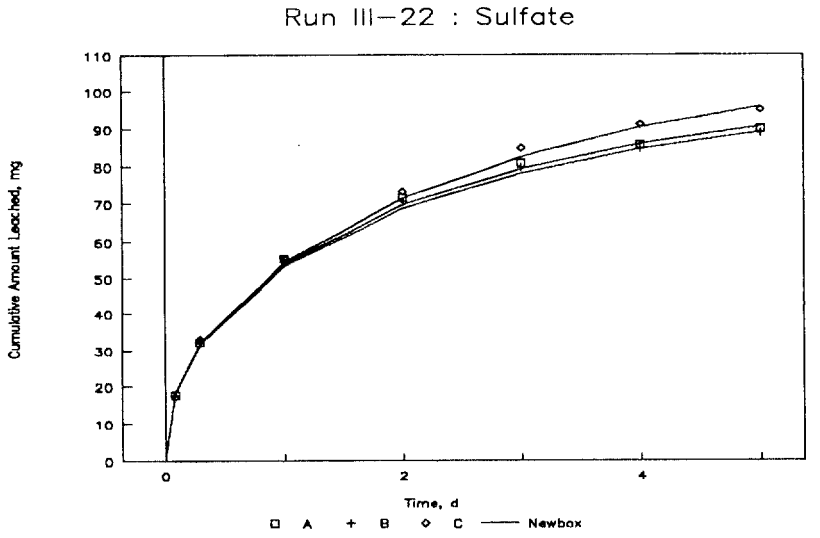
Per cent of 106-AN ion leachable:	53%	55%	57%
Eff. Diffusion Coefficient, sq cm/s:	2.13E-06	2.11E-06	2.13E-06
Std. Deviation, sq cm/s:	1.07E-07	8.05E-08	9.85E-08
Leachability Index:	5.672	5.676	5.672
Upper 95% Confidence Int.:	0.022	0.016	0.020
Lower 95% Confidence Int.:	0.021	0.016	0.019


Run III–22 : Nitrate
Cumulative Amount Leached, mg
900
800
700
600
500
400
300
200
100
0
0
2
4
Time, d
A
B
C
Newbox


Run III–22 : Nitrite
Cumulative Amount Leached, mg
400
350
300
250
200
150
100
50
0
0
2
4
Time, d
A
B
C
Newbox


Run III–22 : Nitrate + Nitrite
Cumulative Amount Leached, mg
(Thousands)
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
Time, d
A
B
C
Newbox


Run III–22 : Chloride
Cumulative Amount Leached, mg
45
40
35
30
25
20
15
10
5
0
0
2
4
Time, d
A
B
C
Newbox


Run III–22 : Sulfate
Cumulative Amount Leached, mg
110
100
90
80
70
60
50
40
30
20
10
0
0
2
4
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate 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)			
		mg			mg		Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	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

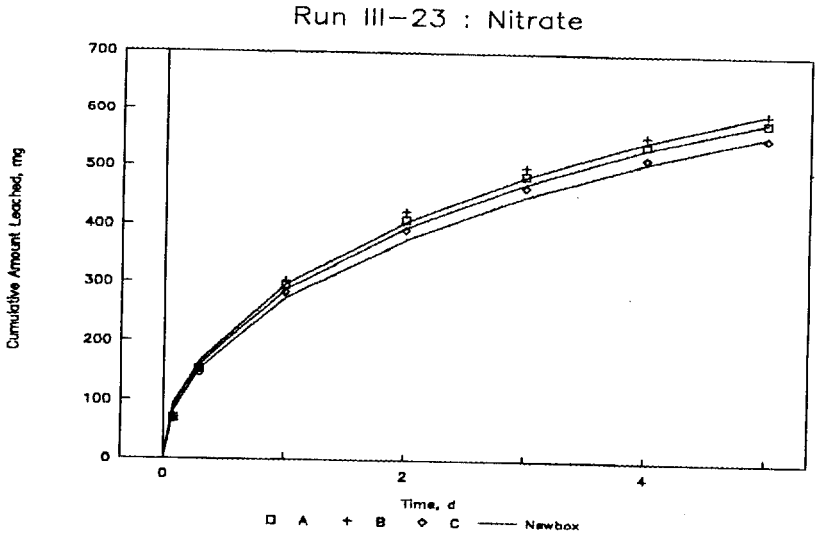
III-23	Nitrite						
				0.00	0.00	0.00	0
1	43.37	41.25	42.88	54.28	54.81	51.49	0.083333
2	91.62	90.68	88.33	99.08	100.13	93.81	0.291666
3	175.61	178.17	168.76	173.91	176.02	166.01	1
4	241.71	245.78	230.97	233.99	237.15	223.98	2
5	284.56	290.03	271.22	276.68	279.84	265.08	3
6	314.63	321.18	300.14	309.35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

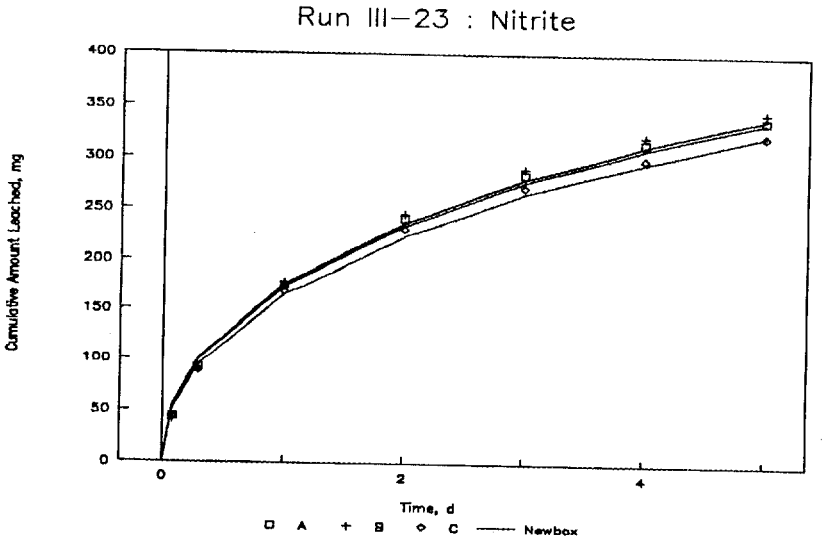
		Added in 106-AN			Newbox Estimate		
Ao =		526.61	526.61	526.61	527	527	527
Per cent of 106-AN ion leachable:					100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:					2.99E-07	3.08E-07	2.69E-07
Std. Deviation, sq cm/s:					3.11E-08	4.15E-08	2.27E-08
Leachability Index:					6.524	6.511	6.570
Upper 95% 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

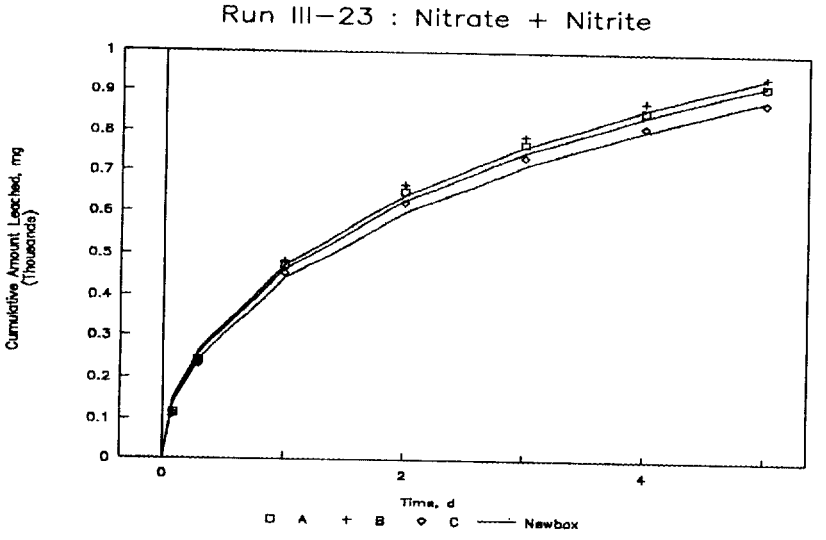
		Added in 106-AN			Newbox Estimate		
Ao =		1207.88	1207.88	1207.88	1208	1208	1208
Per cent of 106-AN ion leachable:					100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:					1.47E-07	1.56E-07	1.32E-07
Std. Deviation, sq cm/s:					1.31E-08	1.73E-08	1.13E-08
Leachability Index:					6.833	6.807	6.879
Upper 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

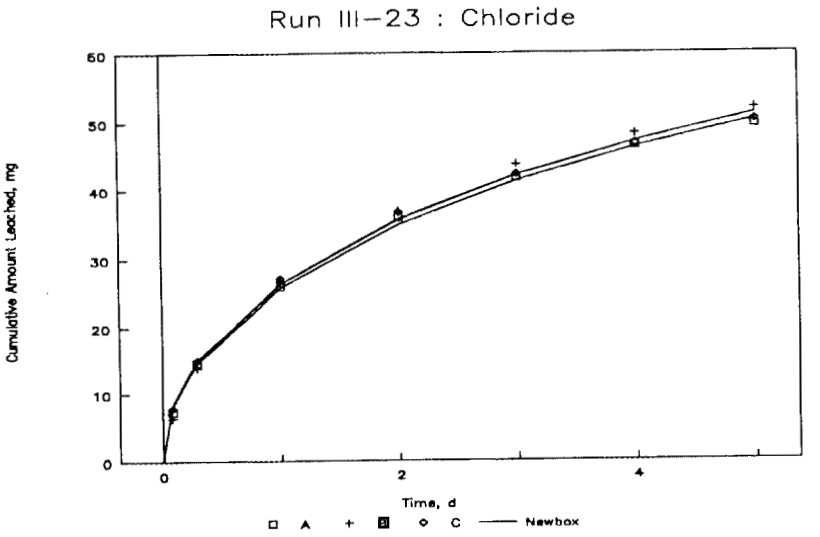
		Added in 106-AN			Newbox Estimate		
Ao =		44.97	44.97	44.97	74	80	74

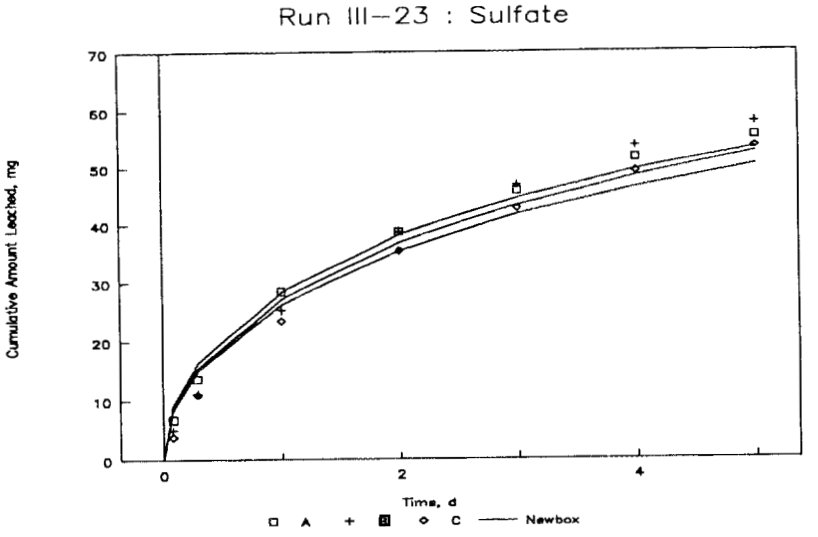
Per cent of 106-AN ion leachable:				165%	178%	165%	
Eff. Diffusion Coefficient, sq cm/s:				4.29E-07	3.26E-07	3.60E-07	
Std. Deviation, sq cm/s:				6.49E-08	9.68E-08	8.78E-08	
Leachability Index:				6.368	6.487	6.444	
Upper 95% Confidence Int.:				0.069	0.148	0.117	
Lower 95% Confidence Int.:				0.060	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
Cumulative Amount Leached, mg
700
600
500
400
300
200
100
0
0
2
4
Time, d
A
B
C
Newbox


Run III−23 : Nitrite
Cumulative Amount Leached, mg
400
350
300
250
200
150
100
50
0
0
2
4
Time, d
A
B
C
Newbox


Run III−23 : Nitrate + Nitrite
Cumulative Amount Leached, mg
(Thousands)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
Time, d
A
B
C
Newbox


Run III-23 : Chloride
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
0
2
4
Time, d
A
C
Newbox


Run III-23 : Sulfate
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
70
0
2
4
Time, d
A
C
Newbox

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 mg/L			Mass in Leachate 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)			
		mg			mg		Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	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	28.46	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

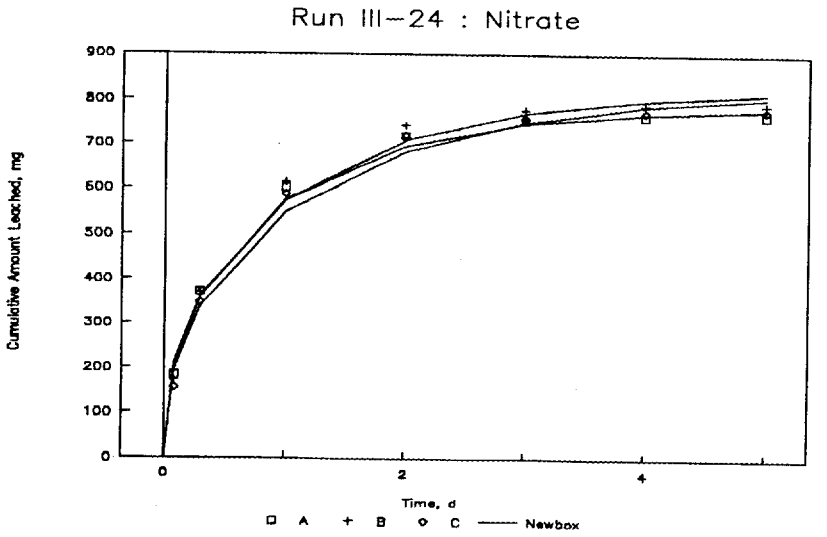
Per cent of 106-AN ion leachable:	483%	492%	476%
Eff. Diffusion Coefficient, sq cm/s:	4.23E-07	3.90E-07	3.35E-07
Std. Deviation, sq cm/s:	5.03E-08	6.49E-08	9.94E-08
Leachability Index:	6.374	6.409	6.475
Upper 95% Confidence Int.:	0.053	0.077	0.148
Lower 95% Confidence Int.:	0.047	0.065	0.110

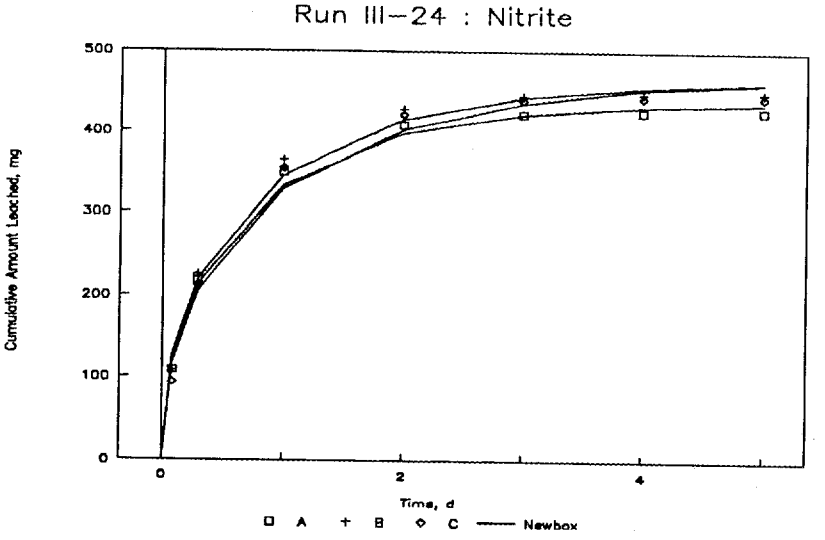
III-24 Nitrate + Nitrite

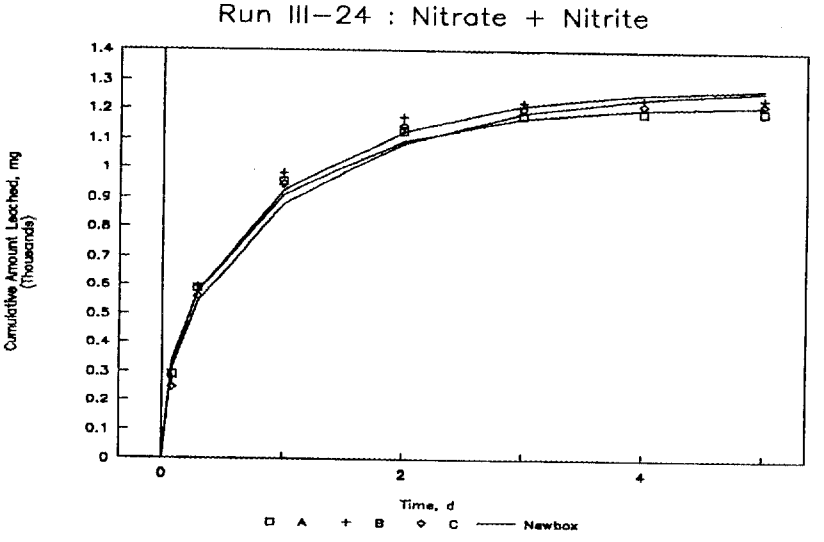
				0.00	0.00	0.00	0
1	292.33	278.69	248.85	333.20	332.30	309.98	0.083333
2	588.45	593.98	560.25	576.98	577.97	543.44	0.291666
3	953.00	980.09	943.74	908.95	921.91	876.77	1
4	1125.91	1170.82	1141.49	1092.70	1123.62	1084.29	2
5	1176.00	1222.71	1200.67	1168.65	1212.83	1185.46	3
6	1188.11	1235.95	1216.02	1200.50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

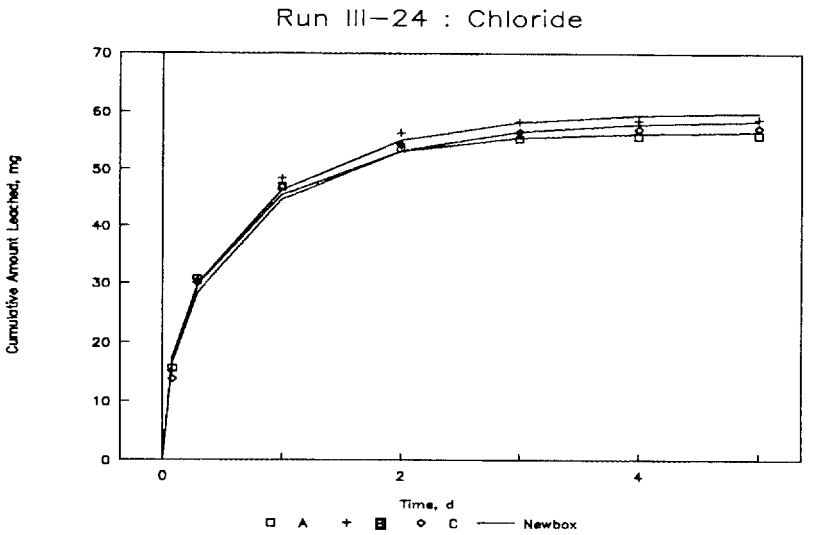
	Added in 106-AN			Newbox Estimate		
Ao =	1781.72	1796.03	1805.13	1225	1293	1297

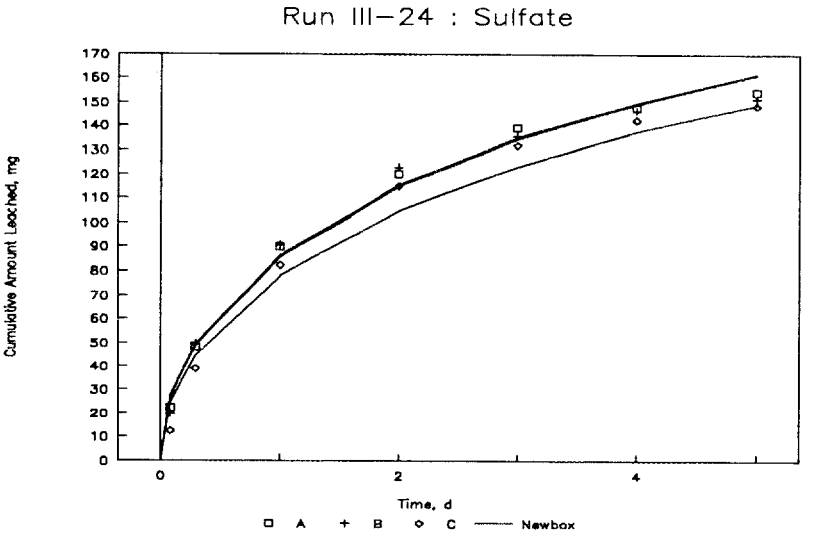
Per cent of 106-AN ion leachable:	69%	72%	72%
Eff. Diffusion Coefficient, sq cm/s:	2.29E-06	2.03E-06	1.74E-06
Std. Deviation, sq cm/s:	3.57E-07	4.02E-07	3.98E-07
Leachability Index:	5.640	5.693	5.759
Upper 95% Confidence Int.:	0.071	0.093	0.109
Lower 95% Confidence Int.:	0.061	0.076	0.087


Run III–24 : Nitrate
Cumulative Amount Leached, mg
900
800
700
600
500
400
300
200
100
0
0
2
4
Time, d
A
B
C
Newbox


Run III–24 : Nitrite
Cumulative Amount Leached, mg
500
400
300
200
100
0
0
2
4
Time, d
A
B
C
Newbox


Run III–24 : Nitrate + Nitrite
Cumulative Amount Leached, mg
(Thousands)
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
Time, d
A
B
C
Newbox


Run III–24 : Chloride
Cumulative Amount Leached, mg
70
60
50
40
30
20
10
0
0
2
4
Time, d
A
B
C
Newbox


Run III–24 : Sulfate
Cumulative Amount Leached, mg
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
2
4
Time, d
A
B
C
Newbox

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
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 mg/L			Mass in Leachate mg			Time
Interval		Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
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 (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-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

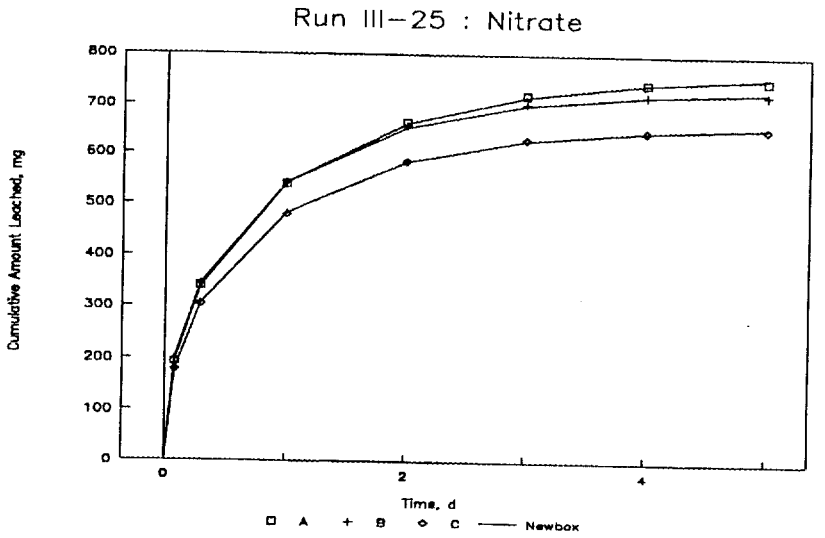
Per cent of 106-AN ion leachable:	351%	261%	247%
Eff. Diffusion Coefficient, sq cm/s:	3.30E-07	8.67E-07	6.45E-07
Std. Deviation, sq cm/s:	1.88E-08	3.15E-08	4.48E-08
Leachability Index:	6.481	6.062	6.190
Upper 95% Confidence Int.:	0.025	0.016	0.030
Lower 95% Confidence Int.:	0.023	0.015	0.028

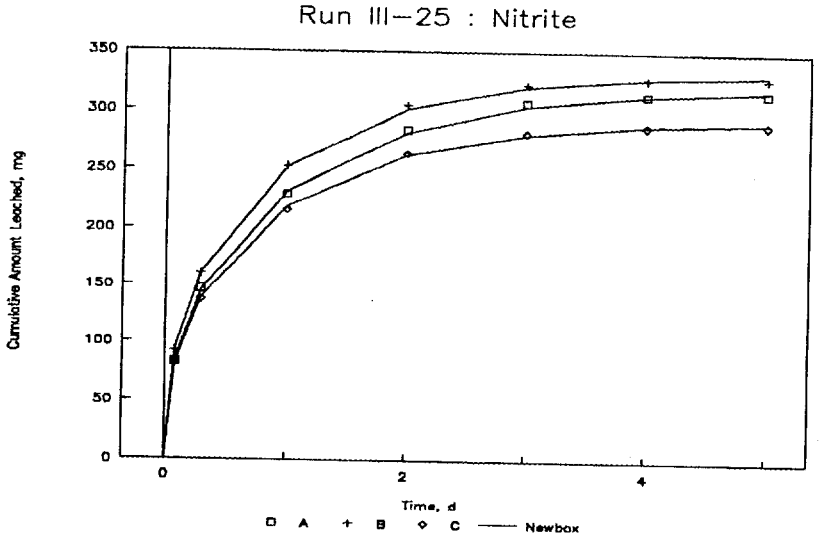
III-25 Nitrate + Nitrite

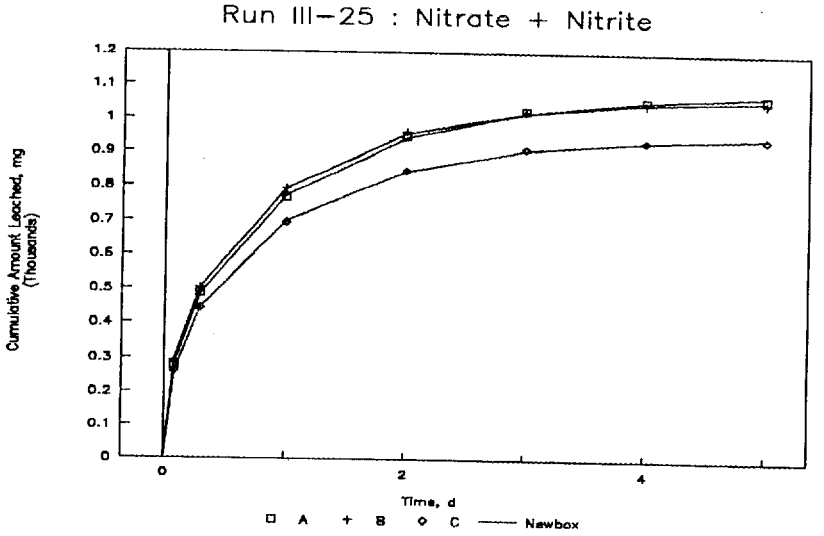
				0.00	0.00	0.00	0
1	276.31	291.02	260.93	279.81	293.45	257.43	0.083333
2	488.45	504.24	442.24	485.29	505.51	445.01	0.291666
3	768.58	794.01	697.02	772.75	794.68	701.48	1
4	946.06	961.06	847.95	942.17	954.26	845.03	2
5	1027.36	1025.40	911.33	1019.77	1020.66	907.24	3
6	1058.05	1047.55	933.79	1056.93	1048.51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

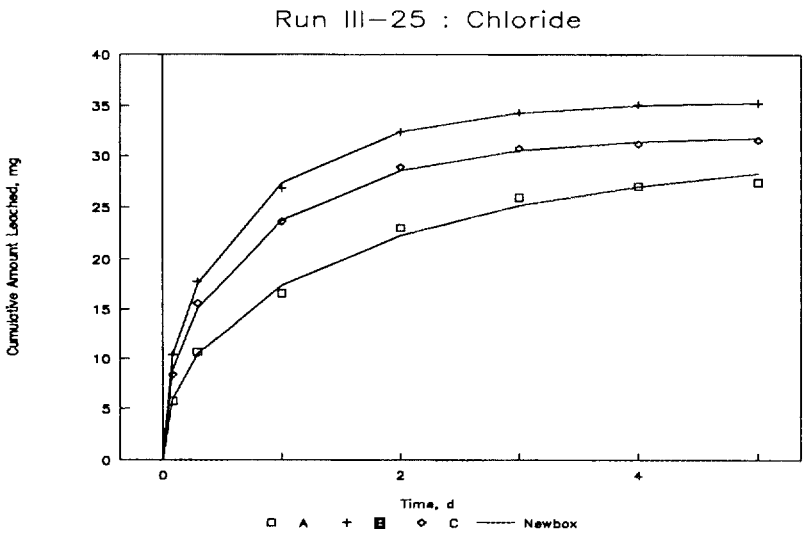
	Added in 106-AN			Newbox Estimate		
Ao =	1966.43	1966.43	1964.97	1093	1071	957

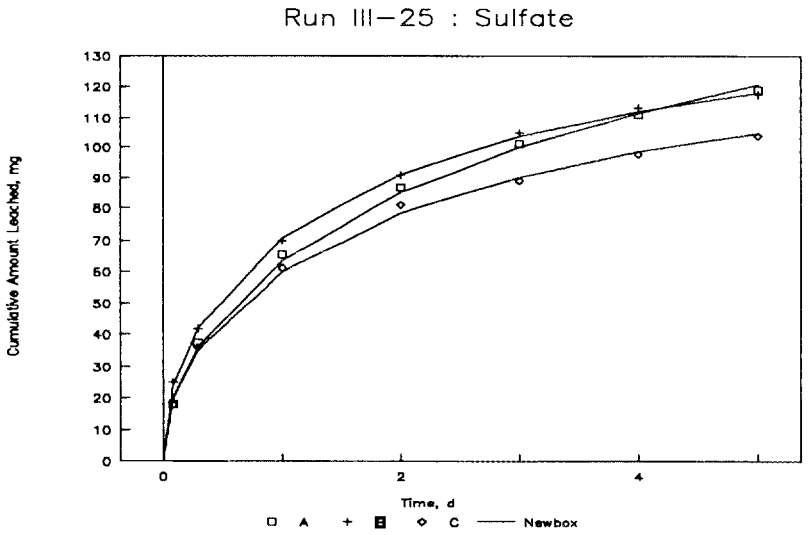
Per cent of 106-AN ion leachable:	56%	54%	49%
Eff. Diffusion Coefficient, sq cm/s:	1.90E-06	2.20E-06	2.08E-06
Std. Deviation, sq cm/s:	4.21E-08	4.39E-08	4.16E-08
Leachability Index:	5.721	5.658	5.682
Upper 95% Confidence Int.:	0.009	0.009	0.009
Lower 95% Confidence Int.:	0.009	0.008	0.008


Run III–25 : Nitrate
Cumulative Amount Leached, mg
800
700
600
500
400
300
200
100
0
0
2
4
Time, d
A
B
C
Newbox


Run III–25 : Nitrite
Cumulative Amount Leached, mg
350
300
250
200
150
100
50
0
0
2
4
Time, d
A
B
C
Newbox


Run III–25 : Nitrate + Nitrite
Cumulative Amount Leached, mg
(Thousands)
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
Time, d
A
B
C
Newbox


Run III–25 : Chloride
Cumulative Amount Leached, mg
0
5
10
15
20
25
30
35
40
0
2
4
Time, d
A
B
C
Newbox


Run III–25 : Sulfate
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
70
80
90
100
110
120
130
0
2
4
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate 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)			
		mg			mg		Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	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

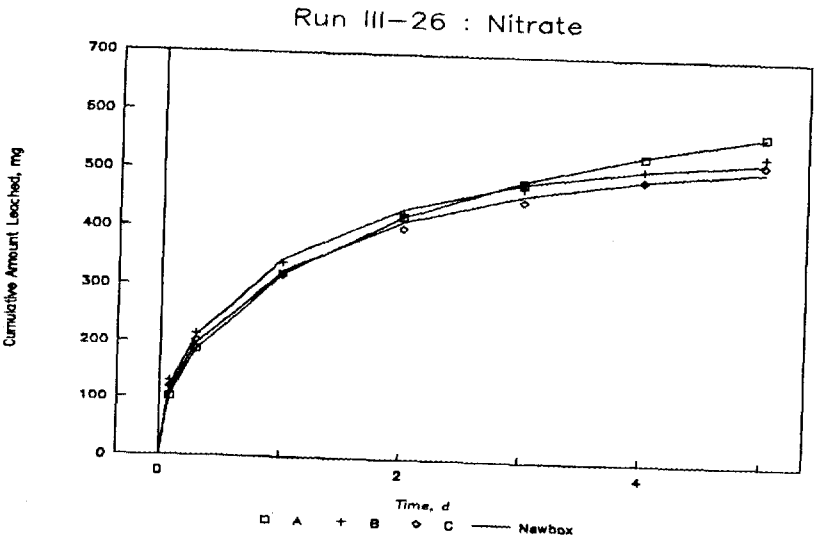
Per cent of 106-AN ion leachable:	237%	173%	137%
Eff. Diffusion Coefficient, sq cm/s:	2.35E-07	5.09E-07	9.87E-07
Std. Deviation, sq cm/s:	9.63E-09	2.36E-08	1.06E-07
Leachability Index:	6.629	6.293	6.006
Upper 95% Confidence Int.:	0.018	0.020	0.048
Lower 95% Confidence Int.:	0.017	0.019	0.043

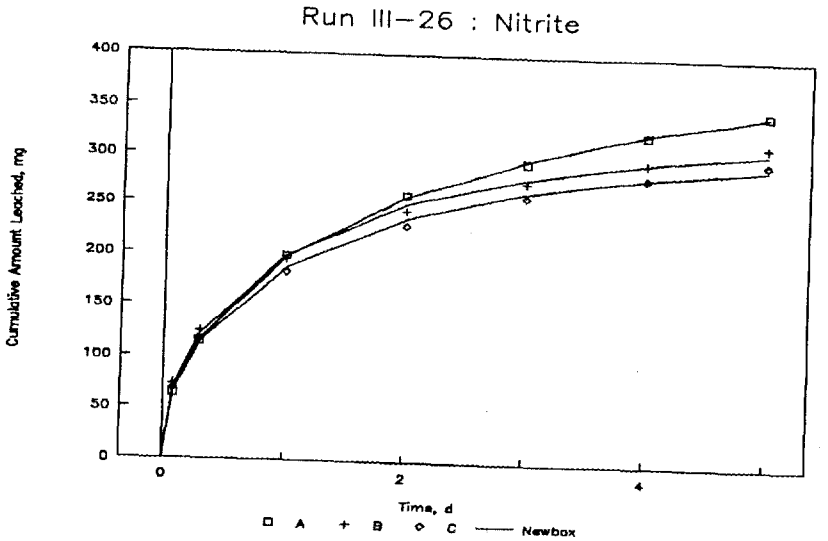
III-26 Nitrate + Nitrite

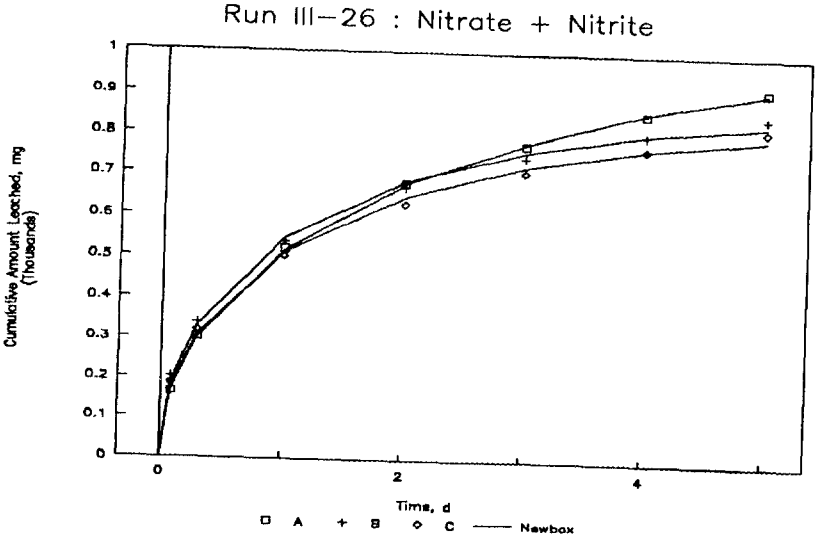
				0.00	0.00	0.00	0
1	165.66	203.49	188.00	168.37	188.78	175.51	0.083333
2	302.11	338.76	320.50	301.71	332.12	310.13	0.291666
3	519.78	535.68	501.92	516.41	545.38	512.05	1
4	681.29	670.04	631.68	679.13	685.22	648.37	2
5	779.01	749.06	711.32	783.09	762.13	725.05	3
6	856.28	805.74	772.25	859.93	806.70	771.91	4
7	919.25	852.43	820.91	916.43	832.92	800.88	5

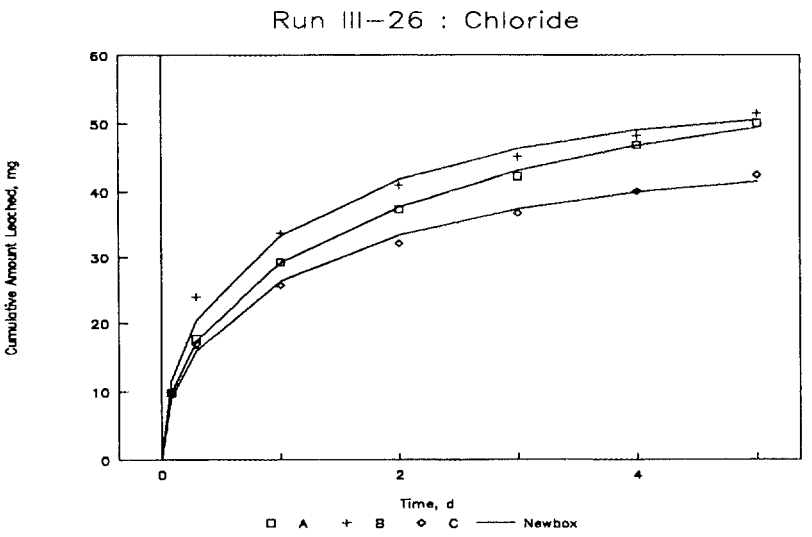
	Added in 106-AN			Newbox Estimate		
Ao =	1937.30	1940.21	1941.67	1130	874	852

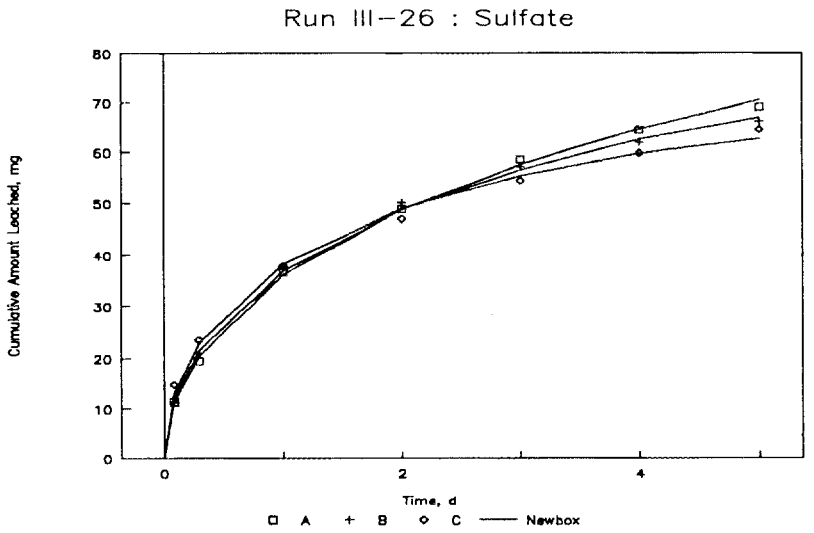
Per cent of 106-AN ion leachable:	58%	45%	44%
Eff. Diffusion Coefficient, sq cm/s:	6.10E-07	1.35E-06	1.22E-06
Std. Deviation, sq cm/s:	7.66E-09	1.04E-07	9.81E-08
Leachability Index:	6.215	5.870	5.914
Upper 95% Confidence Int.:	0.005	0.034	0.035
Lower 95% Confidence Int.:	0.005	0.031	0.033


Run III–26 : Nitrate
Cumulative Amount Leached, mg
700
600
500
400
300
200
100
0
0
2
4
Time, d
A
B
C
Newbox


Run III–26 : Nitrite
Cumulative Amount Leached, mg
400
350
300
250
200
150
100
50
0
0
2
4
Time, d
A
B
C
Newbox


Run III–26 : Nitrate + Nitrite
Cumulative Amount Leached, mg
(Thousands)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
Time, d
A
B
C
Newbox


Run III-26 : Chloride
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
0
2
4
Time, d
A
B
C
Newbox


Run III-26 : Sulfate
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
70
80
0
2
4
Time, d
A
B
C
Newbox

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
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 mg/L			Mass in Leachate mg			Time
Interval		Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
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

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)			
		mg			mg		Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	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

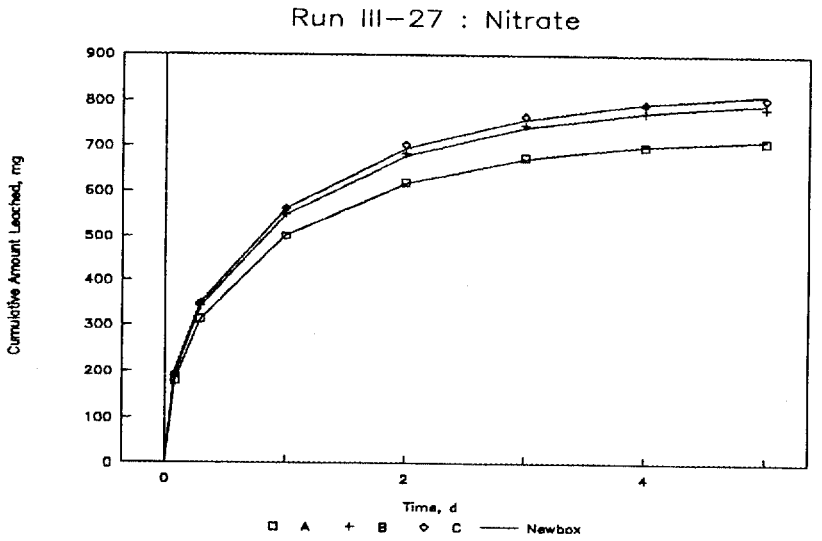
III-27	Nitrite						
				0.00	0.00	0.00	0
1	75.95	86.61	84.91	77.09	86.00	88.82	0.083333
2	136.56	153.27	154.17	133.74	149.11	153.57	0.291666
3	209.15	232.28	247.85	211.41	236.42	244.08	1
4	254.80	284.20	298.04	256.08	286.45	295.95	2
5	276.01	308.82	320.15	275.36	308.36	319.00	3
6	285.36	319.24	328.61	284.41	318.17	329.51	4
7	288.10	323.59	331.80	288.20	323.08	334.59	5

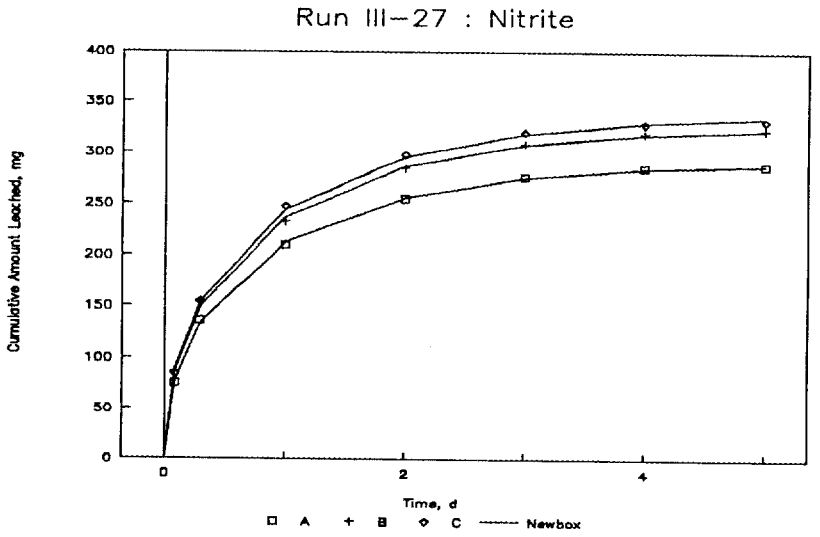
		Added in 106-AN			Newbox Estimate		
Ao =		582.54	582.54	582.54	292	327	339
Per cent of 106-AN ion leachable:					50%	56%	58%
Eff. Diffusion Coefficient, sq cm/s:					2.06E-06	2.07E-06	2.06E-06
Std. Deviation, sq cm/s:					7.63E-08	8.79E-08	9.83E-08
Leachability Index:					5.686	5.684	5.686
Upper 95% 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

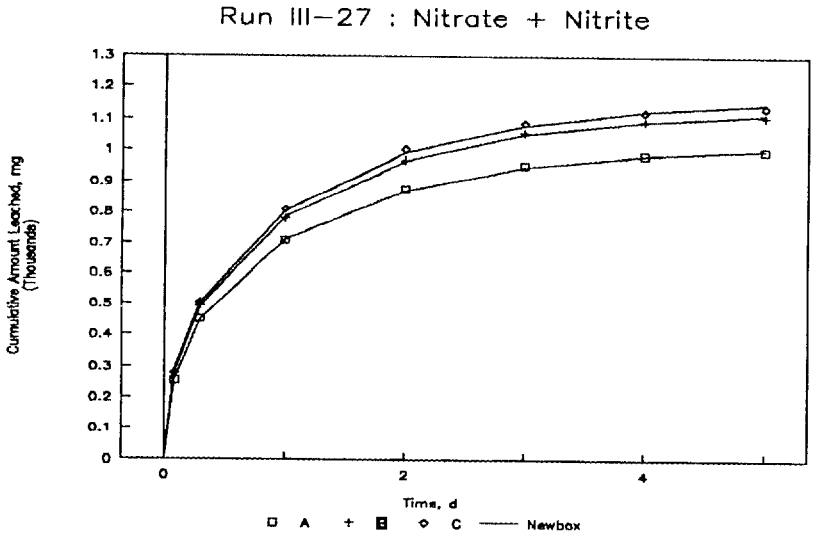
		Added in 106-AN			Newbox Estimate		
Ao =		1336.16	1336.16	1336.16	730	814	835
Per cent of 106-AN ion leachable:					55%	61%	62%
Eff. Diffusion Coefficient, sq cm/s:					1.78E-06	1.68E-06	1.69E-06
Std. Deviation, sq cm/s:					2.79E-08	5.11E-08	5.99E-08
Leachability Index:					5.750	5.775	5.772
Upper 95% 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

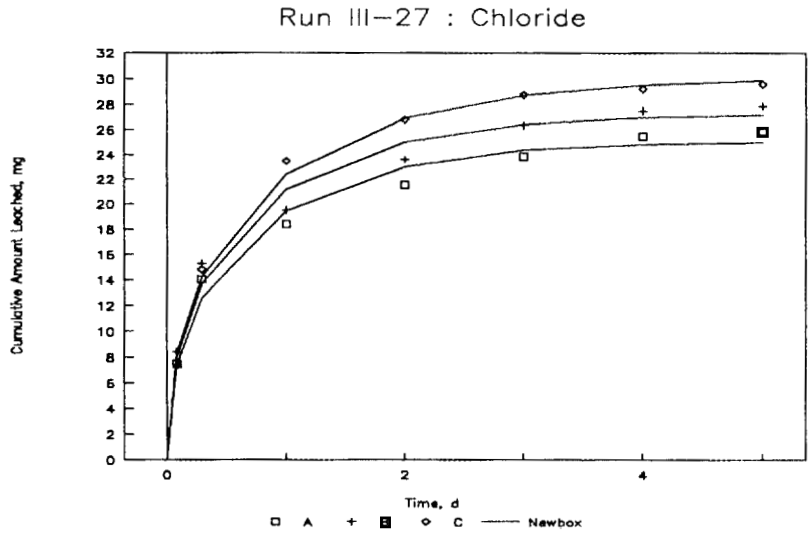
		Added in 106-AN			Newbox Estimate		
Ao =		49.75	49.75	49.75	73.3	82.9	87.6

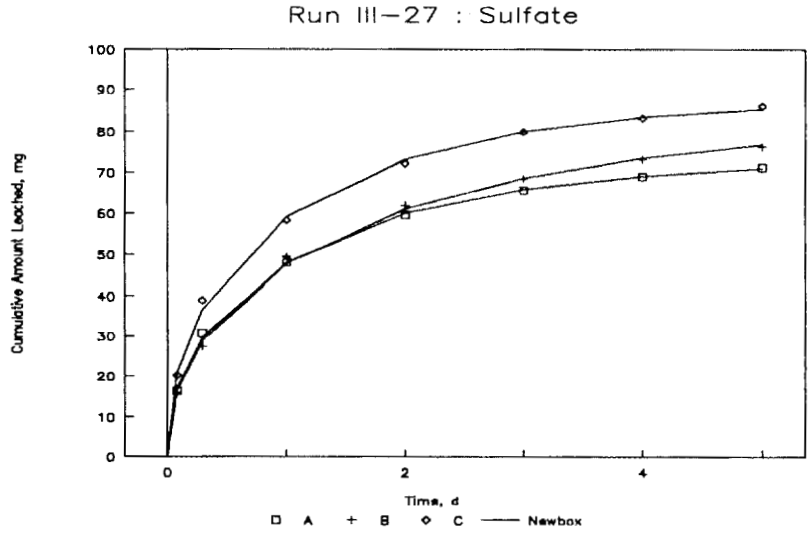
Per cent of 106-AN ion leachable:				147%	167%	176%	
Eff. Diffusion Coefficient, sq cm/s:				1.54E-06	1.09E-06	1.71E-06	
Std. Deviation, sq cm/s:				7.41E-08	6.34E-08	1.24E-07	
Leachability Index:				5.812	5.963	5.767	
Upper 95% Confidence Int.:				0.021	0.025	0.032	
Lower 95% Confidence Int.:				0.020	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	


Run III–27 : Nitrate
Cumulative Amount Leached, mg
900
800
700
600
500
400
300
200
100
0
0
2
4
Time, d
A
B
C
Newbox


Run III–27 : Nitrite
Cumulative Amount Leached, mg
400
350
300
250
200
150
100
50
0
0
2
4
Time, d
A
B
C
Newbox


Run III–27 : Nitrate + Nitrite
Cumulative Amount Leached, mg (Thousands)
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
Time, d
A
B
C
Newbox


Run III−27 : Chloride
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox


Run III−27 : Sulfate
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox

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
23.01	4.65	Length,cm	4.08	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 mg/L			Mass in Leachate mg			Time
Interval		Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
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		164.53	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

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)			
		mg			mg		Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	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

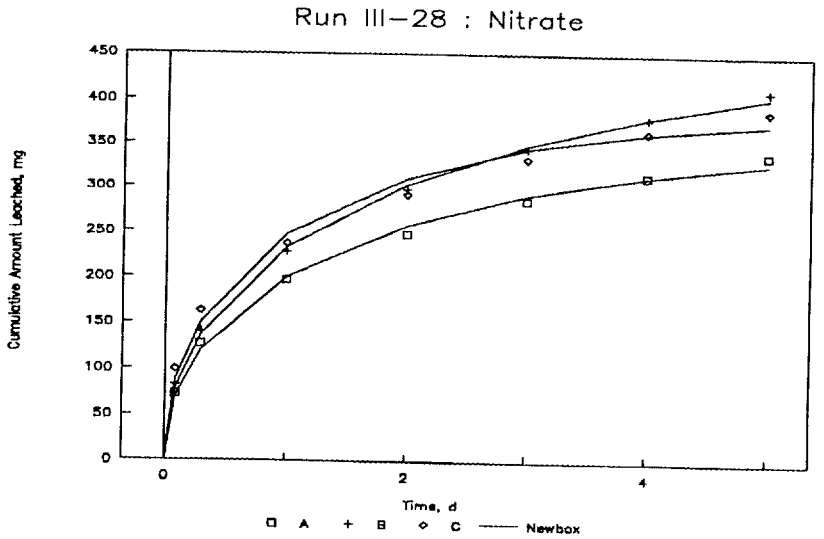
Per cent of 106-AN ion leachable:				102%	174%	105%	
Eff. Diffusion Coefficient, sq cm/s:				6.33E-07	2.79E-07	1.00E-06	
Std. Deviation, sq cm/s:				4.66E-08	1.50E-08	1.11E-07	
Leachability Index:				6.199	6.554	6.000	
Upper 95% Confidence Int.:				0.032	0.023	0.050	
Lower 95% Confidence Int.:				0.030	0.022	0.044	

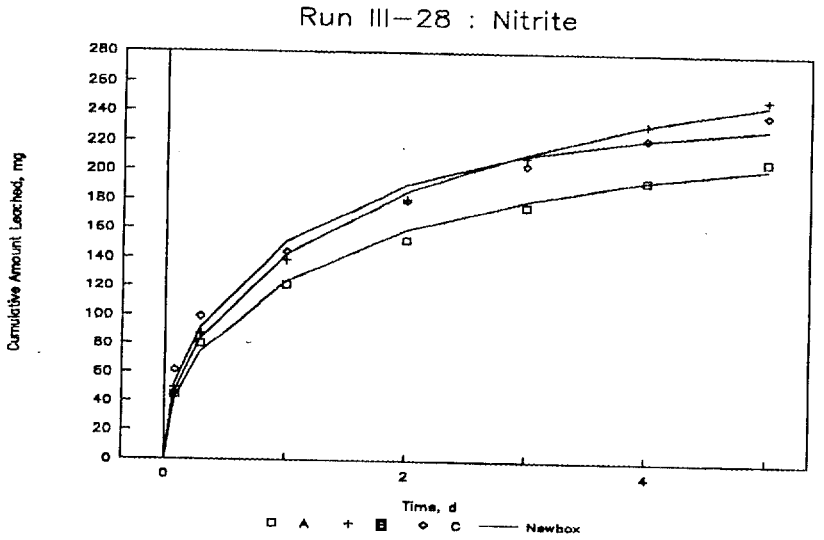
III-28 Nitrate + Nitrite

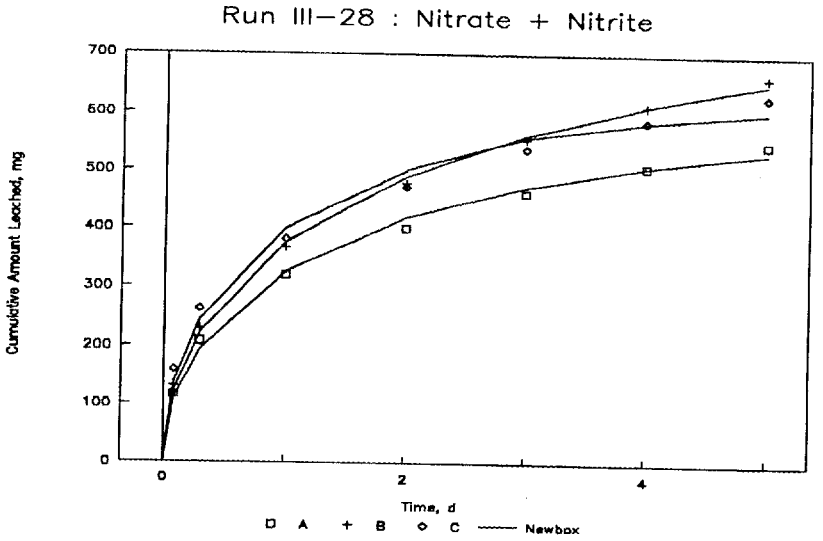
				0.00	0.00	0.00	0
1	116.69	131.90	160.81	109.58	123.28	139.01	0.083333
2	208.20	228.24	262.79	194.55	220.69	244.05	0.291666
3	319.13	366.88	381.49	325.23	375.17	399.42	1
4	400.44	478.70	471.73	417.82	489.32	501.31	2
5	461.57	554.83	537.91	472.32	561.62	556.67	3
6	508.01	612.16	586.98	508.06	612.61	585.60	4
7	547.88	661.94	628.33	532.67	650.66	603.21	5

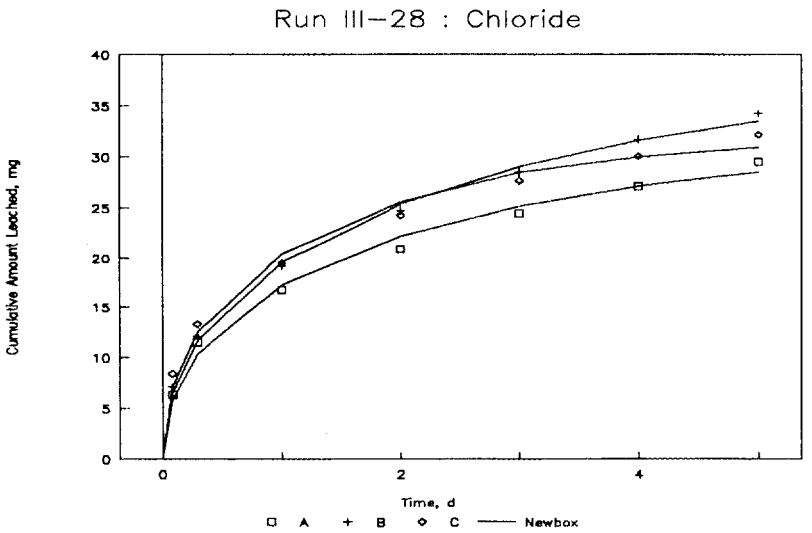
	Added in 106-AN			Newbox Estimate		
Ao =	1817.40	1817.40	1817.40	586	761	629

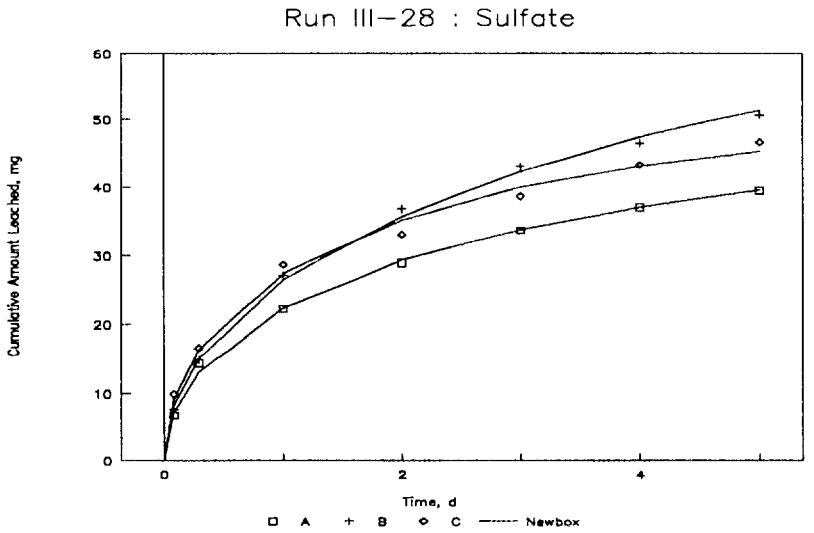
Per cent of 106-AN ion leachable:	32%	42%	35%
Eff. Diffusion Coefficient, sq cm/s:	9.93E-07	7.48E-07	1.44E-06
Std. Deviation, sq cm/s:	9.72E-08	4.40E-08	2.56E-07
Leachability Index:	6.003	6.126	5.842
Upper 95% Confidence Int.:	0.043	0.026	0.082
Lower 95% Confidence Int.:	0.039	0.024	0.069


Run III–28 : Nitrate
Cumulative Amount Leached, mg
450
400
350
300
250
200
150
100
50
0
0
2
4
Time, d
A
B
C
Newbox


Run III–28 : Nitrite
Cumulative Amount Leached, mg
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
0
2
4
Time, d
A
B
C
Newbox


Run III–28 : Nitrate + Nitrite
Cumulative Amount Leached, mg
700
600
500
400
300
200
100
0
0
2
4
Time, d
A
B
C
Newbox


Run III-28 : Chloride
Cumulative Amount Leached, mg
0
5
10
15
20
25
30
35
40
0
2
4
Time, d
A
B
C
Newbox


Run III-28 : Sulfate
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
0
2
4
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate 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

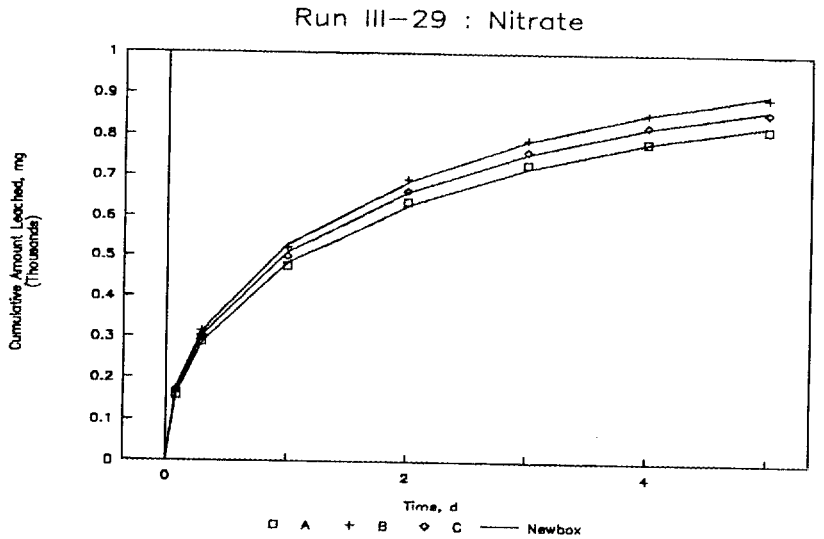
Per cent of 106-AN ion leachable:	483%	492%	476%
Eff. Diffusion Coefficient, sq cm/s:	4.23E-07	3.90E-07	3.35E-07
Std. Deviation, sq cm/s:	5.03E-08	6.49E-08	9.94E-08
Leachability Index:	6.374	6.409	6.475
Upper 95% Confidence Int.:	0.053	0.077	0.148
Lower 95% Confidence Int.:	0.047	0.065	0.110

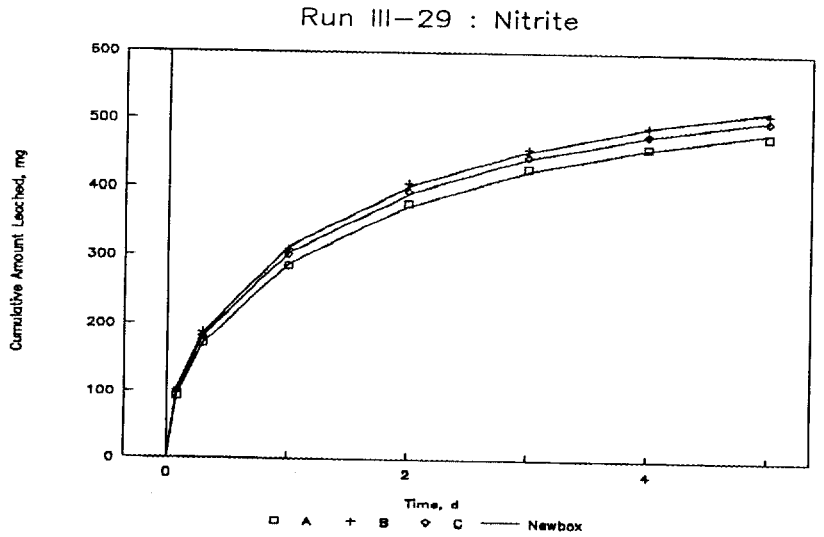
III-24 Nitrate + Nitrite

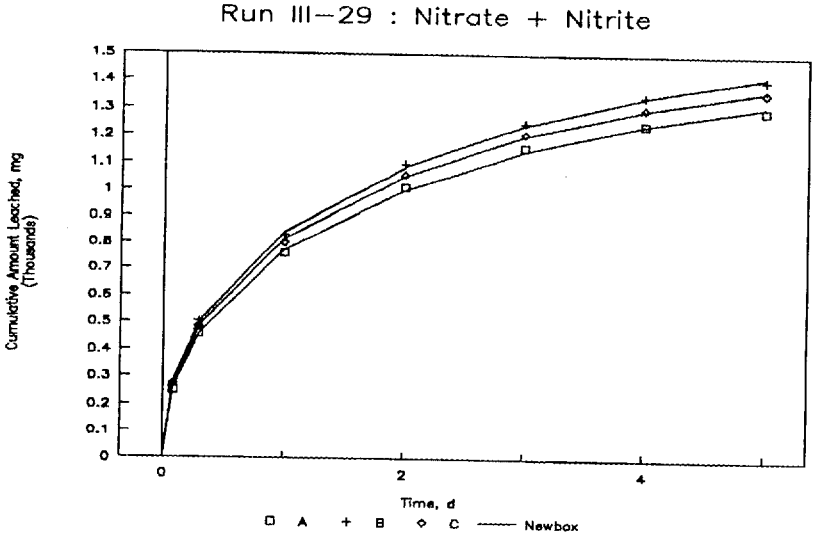
				0.00	0.00	0.00	0
1	292.33	278.69	248.85	333.20	332.30	309.98	0.083333
2	588.45	593.98	560.25	576.98	577.97	543.44	0.291666
3	953.00	980.09	943.74	908.95	921.91	876.77	1
4	1125.91	1170.82	1141.49	1092.70	1123.62	1084.29	2
5	1176.00	1222.71	1200.67	1168.65	1212.83	1185.46	3
6	1188.11	1235.95	1216.02	1200.50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

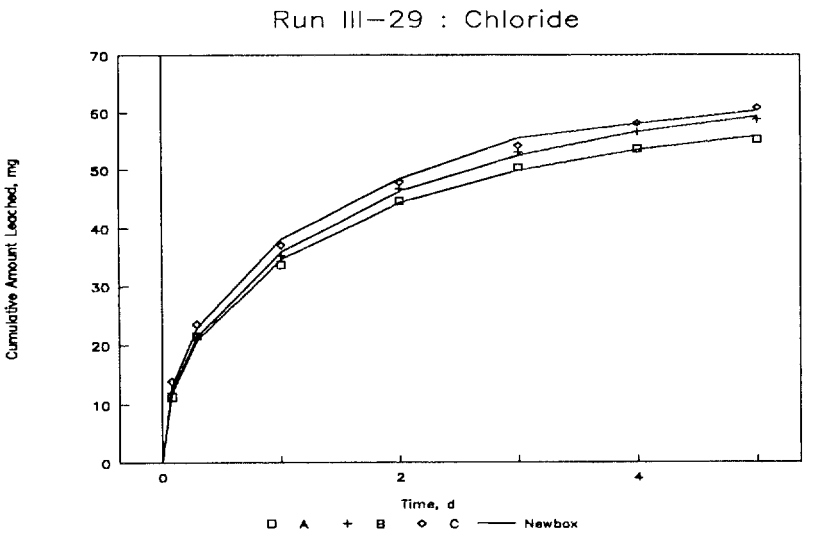
	Added in 106-AN			Newbox Estimate		
Ao =	1781.72	1796.03	1805.13	1225	1293	1297

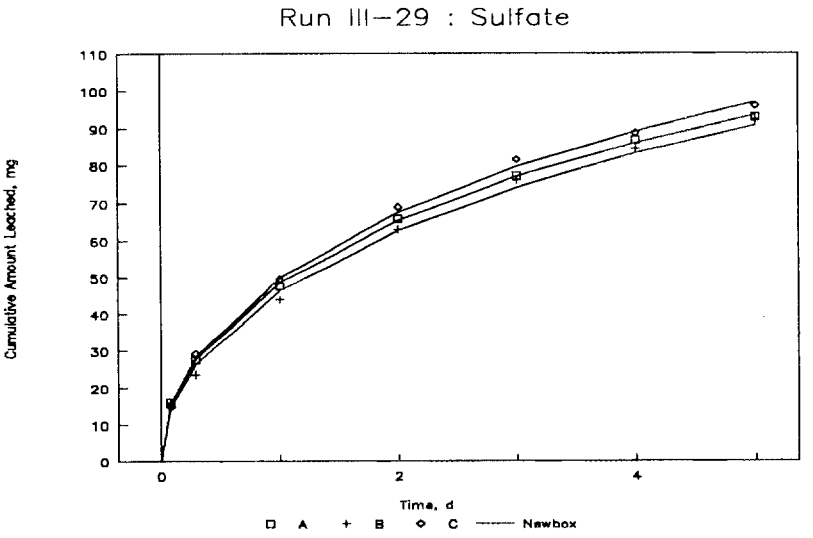
Per cent of 106-AN ion leachable:	69%	72%	72%
Eff. Diffusion Coefficient, sq cm/s:	2.29E-06	2.03E-06	1.74E-06
Std. Deviation, sq cm/s:	3.57E-07	4.02E-07	3.98E-07
Leachability Index:	5.640	5.693	5.759
Upper 95% Confidence Int.:	0.071	0.093	0.109
Lower 95% Confidence Int.:	0.061	0.076	0.087


Run III–29 : Nitrate
Cumulative Amount Leached, mg (Thousands)
Time, d
A
B
C
Newbox


Run III–29 : Nitrite
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox


Run III–29 : Nitrate + Nitrite
Cumulative Amount Leached, mg (Thousands)
Time, d
A
B
C
Newbox


Run III–29 : Chloride
Cumulative Amount Leached, mg
70
60
50
40
30
20
10
0
0
2
4
Time, d
A
B
C
Newbox


Run III–29 : Sulfate
Cumulative Amount Leached, mg
110
100
90
80
70
60
50
40
30
20
10
0
0
2
4
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate 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

III-30	Sulfate	Initially:		52.47	52.68	52.60	
0	1.81	2.24	2.78	0.69	0.84	1.06	0
1	19.1	25.18	21.39	7.26	9.46	8.17	0.083333
2	17.47	16.34	18.91	6.64	6.14	7.22	0.291666
3	15.07	19.45	22.4	5.73	7.31	8.55	1
4	13.06	15.81	16.62	4.97	5.94	6.35	2
5	8.66	9.67	10.16	3.29	3.63	3.88	3
6	6.2	7.69	8.01	2.36	2.89	3.06	4
7	5.32	5.91	6.48	2.02	2.22	2.47	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-30	Chloride						
				0.00	0.00	0.00	0
1	7.86	10.67	9.95	6.26	7.96	7.52	0.083333
2	12.96	16.66	16.27	11.10	14.08	13.30	0.291666
3	18.05	23.29	22.12	18.32	23.32	22.04	1
4	22.15	27.86	26.16	23.22	29.64	28.04	2
5	24.08	30.92	29.26	26.01	33.28	31.50	3
6	26.53	33.55	31.49	27.78	35.56	33.71	4
7	28.21	35.57	33.39	28.89	37.08	35.15	5
		Added in 106-AN			Newbox Estimate		
Ao =	93.70	94.08	93.93	31	40	38	

Per cent of 106-AN ion leachable:	33%	43%	40%
Eff. Diffusion Coefficient, sq cm/s:	1.10E-06	1.05E-06	1.05E-06
Std. Deviation, sq cm/s:	2.49E-07	2.72E-07	2.88E-07
Leachability Index:	5.959	5.979	5.979
Upper 95% Confidence Int.:	0.108	0.126	0.135
Lower 95% Confidence Int.:	0.086	0.098	0.103

III-30	Nitrite						
				0.00	0.00	0.00	0
1	72.80	90.80	86.79	62.38	77.52	75.17	0.083333
2	113.71	141.44	136.71	107.45	133.01	128.93	0.291666
3	157.37	193.14	187.21	167.61	206.72	199.93	1
4	188.23	230.23	221.69	199.80	245.89	237.25	2
5	204.65	253.23	243.74	212.68	261.39	251.60	3
6	221.57	272.17	262.20	218.00	267.65	257.09	4
7	233.66	287.45	275.80	220.45	270.10	259.43	5

		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

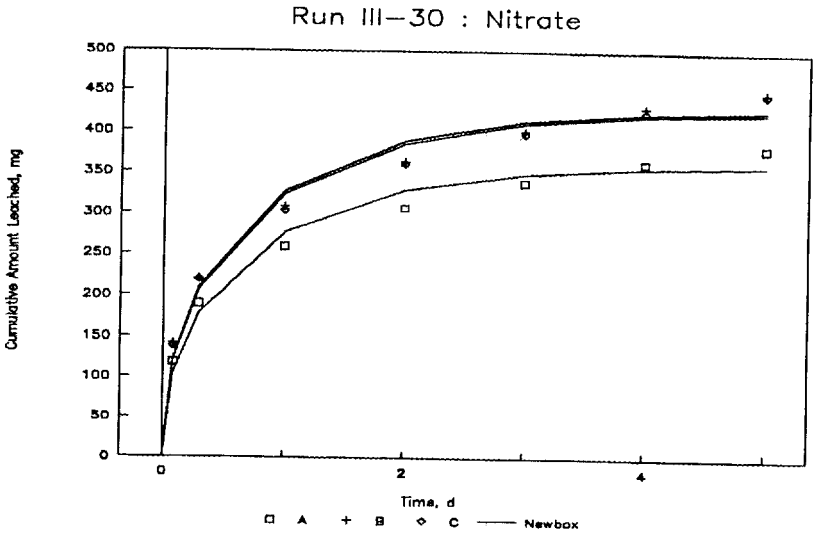
Per cent of 106-AN ion leachable:	63%	73%	80%
Eff. Diffusion Coefficient, sq cm/s:	1.39E-06	1.45E-06	1.19E-06
Std. Deviation, sq cm/s:	2.26E-07	2.57E-07	1.07E-07
Leachability Index:	5.857	5.839	5.924
Upper 95% Confidence Int.:	0.075	0.082	0.040
Lower 95% Confidence Int.:	0.064	0.069	0.036

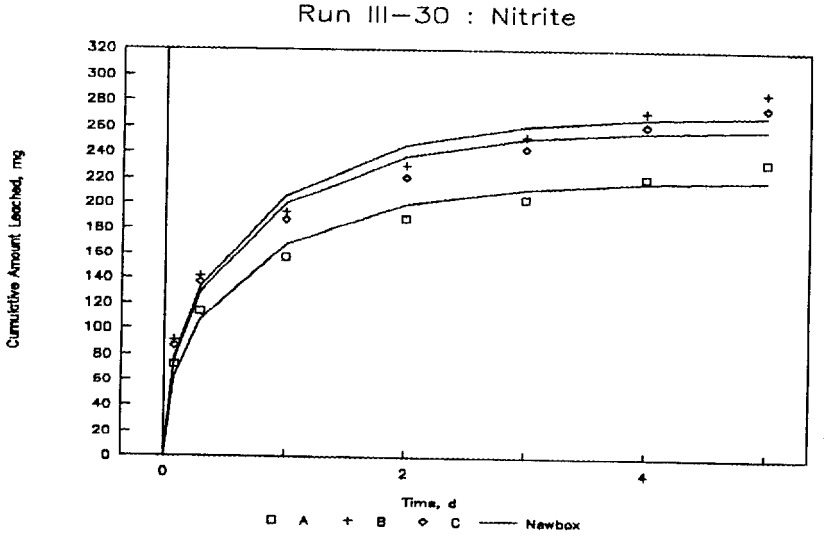
III-30 Nitrate + Nitrite

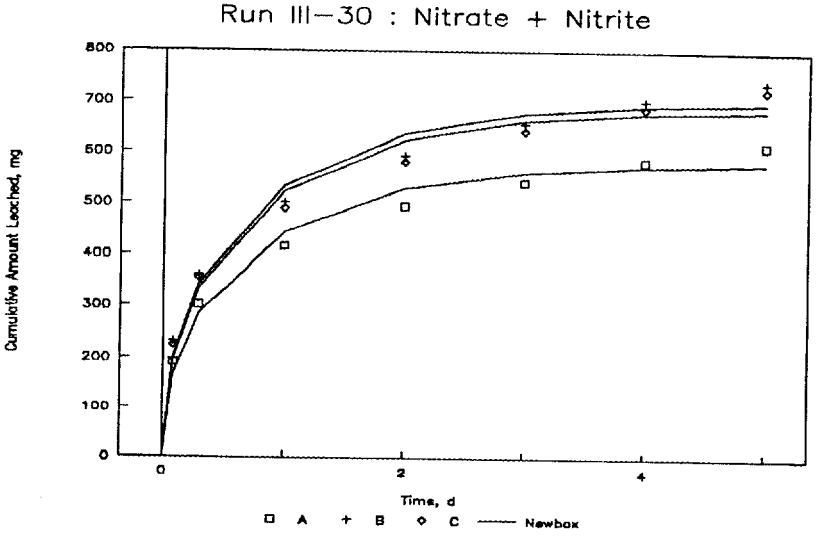
				0.00	0.00	0.00	0
1	191.49	232.86	225.29	166.14	200.36	196.08	0.083333
2	302.87	361.39	355.69	285.48	343.06	335.74	0.291666
3	416.41	501.28	490.63	444.02	534.28	522.88	1
4	494.94	593.81	582.13	528.84	635.51	621.95	2
5	542.83	654.73	641.18	562.19	675.58	661.17	3
6	584.33	702.93	686.78	575.64	691.75	676.99	4
7	615.10	738.13	723.49	580.91	698.08	683.18	5

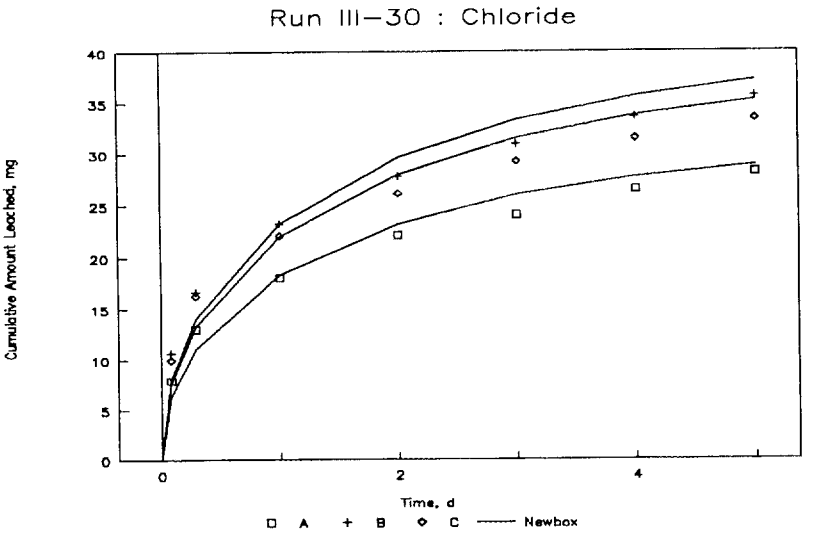
	Added in 106-AN			Newbox Estimate		
Ao =	2023.78	2031.98	2028.70	585	703	688

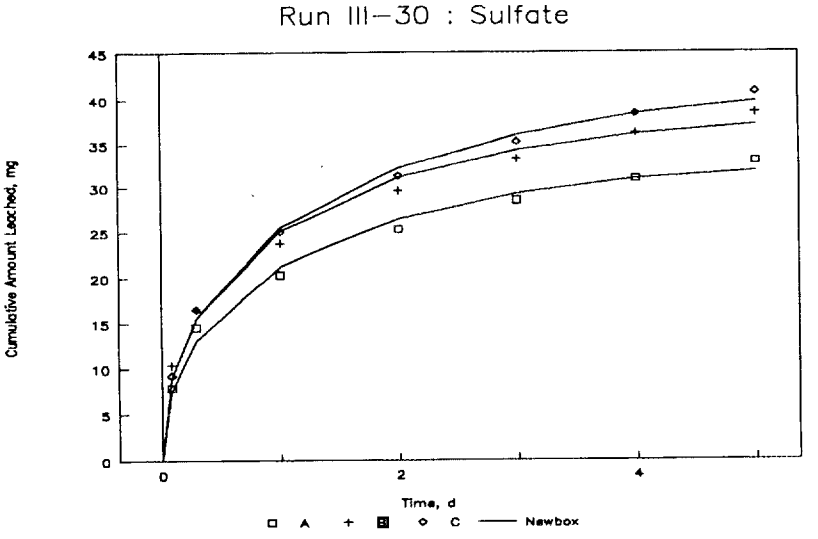
Per cent of 106-AN ion leachable:	29%	35%	34%
Eff. Diffusion Coefficient, sq cm/s:	2.30E-06	2.28E-06	2.31E-06
Std. Deviation, sq cm/s:	5.66E-07	5.59E-07	5.62E-07
Leachability Index:	5.638	5.642	5.636
Upper 95% Confidence Int.:	0.119	0.118	0.117
Lower 95% Confidence Int.:	0.093	0.093	0.092


Run III–30 : Nitrate
Cumulative Amount Leached, mg
500
450
400
350
300
250
200
150
100
50
0
0
2
4
Time, d
A
B
C
Newbox


Run III–30 : Nitrite
Cumulative Amount Leached, mg
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
0
2
4
Time, d
A
B
C
Newbox


Run III–30 : Nitrate + Nitrite
Cumulative Amount Leached, mg
800
700
600
500
400
300
200
100
0
0
2
4
Time, d
A
B
C
Newbox


Run III–30 : Chloride
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox


Run III–30 : Sulfate
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate 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)			
		mg			mg		Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
III-31	Chloride						
				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

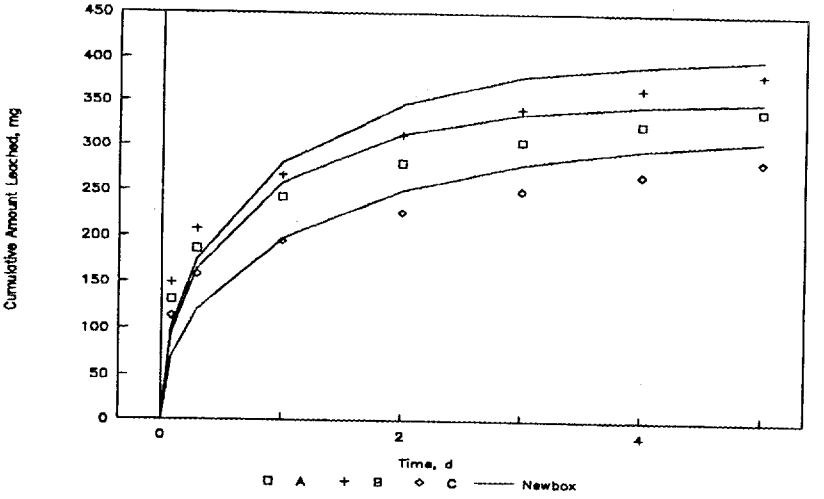
III-31 Nitrate + Nitrite

				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

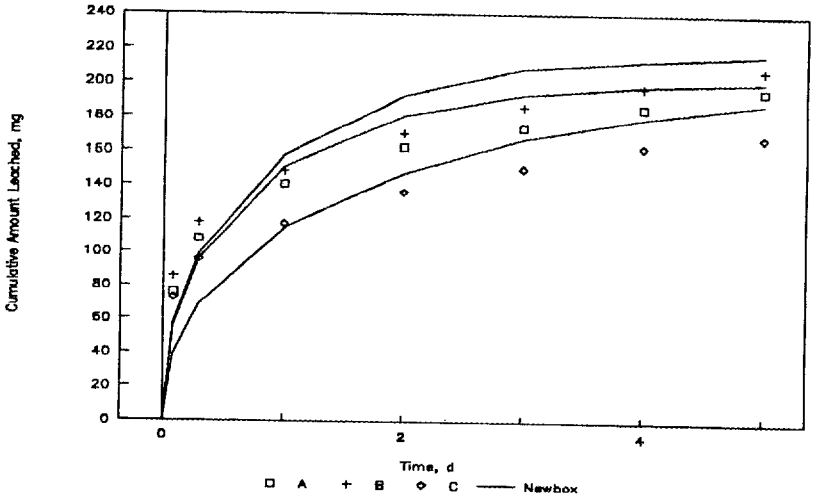
	Added in 106-AN			Newbox Estimate		
Ao =	1890.73	1890.73	1889.25	574	627	525

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

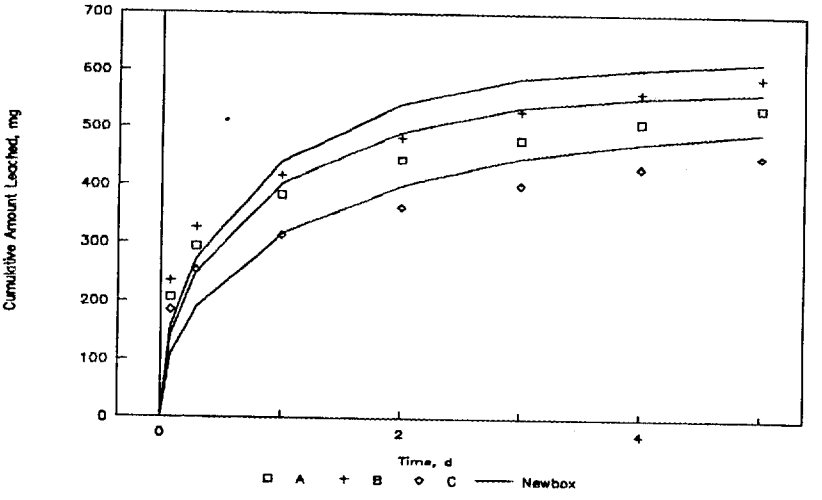
Run III–31 : Nitrate

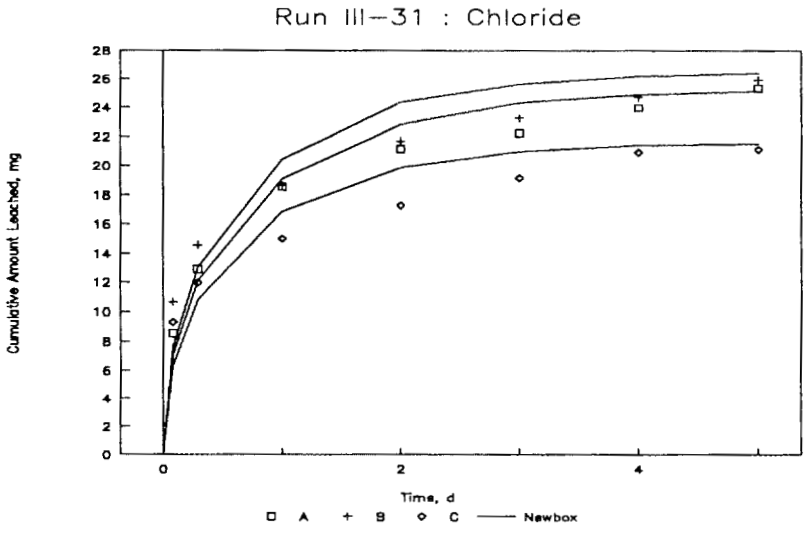


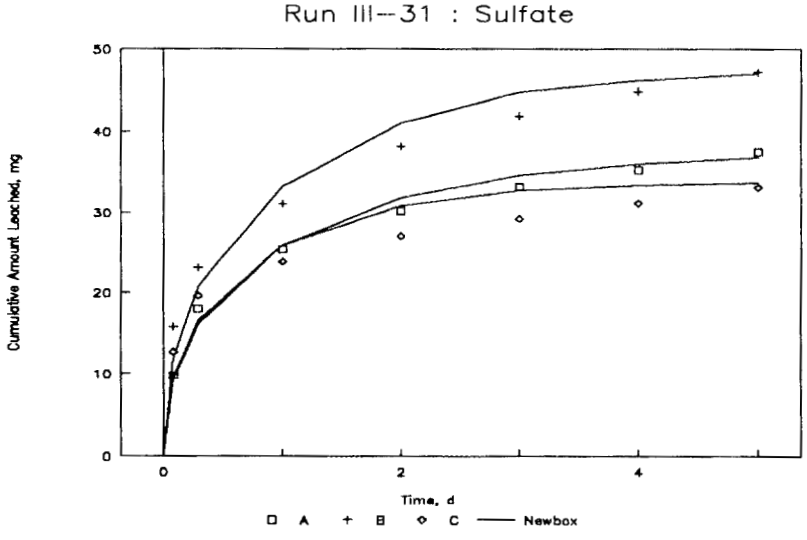
Run III–31 : Nitrite



Run III–31 : Nitrate + Nitrite




Run III-31 : Chloride
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox


Run III-31 : Sulfate
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate mg			Time
Interval		Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	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

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 (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-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

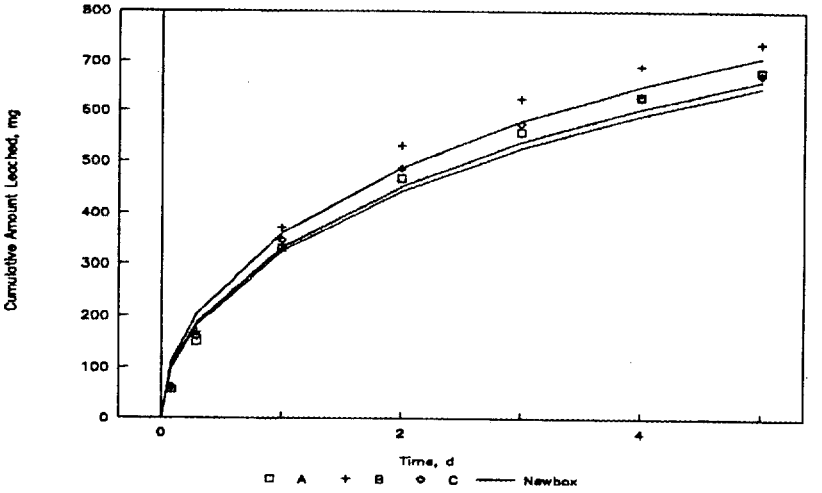
		Added in 106-AN			Newbox Estimate		
Ao =		535.34	536.13	534.14	535	536	534	
Per cent of 106-AN ion leachable:					100%	100%	100%	
Eff. Diffusion Coefficient, sq cm/s:					4.18E-07	5.39E-07	4.90E-07	
Std. Deviation, sq cm/s:					1.41E-07	2.06E-07	1.44E-07	
Leachability Index:					6.379	6.268	6.310	
Upper 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

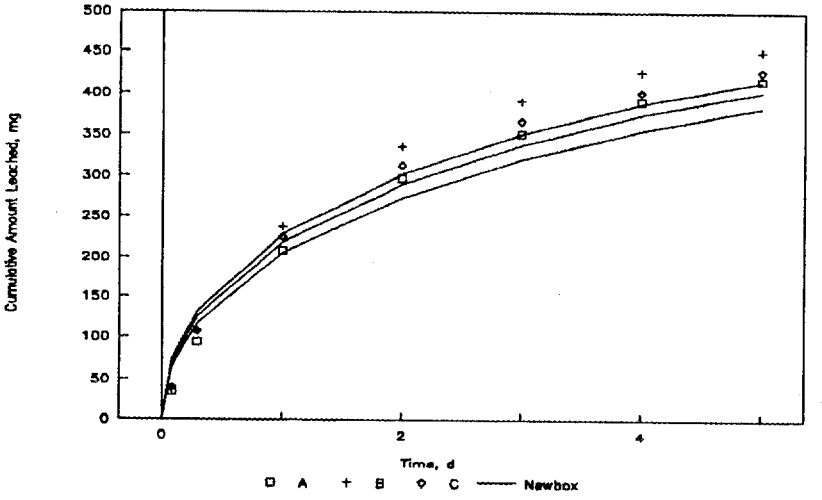
		Added in 106-AN			Newbox Estimate		
Ao =		45.71	45.78	45.61	85	85	85

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	

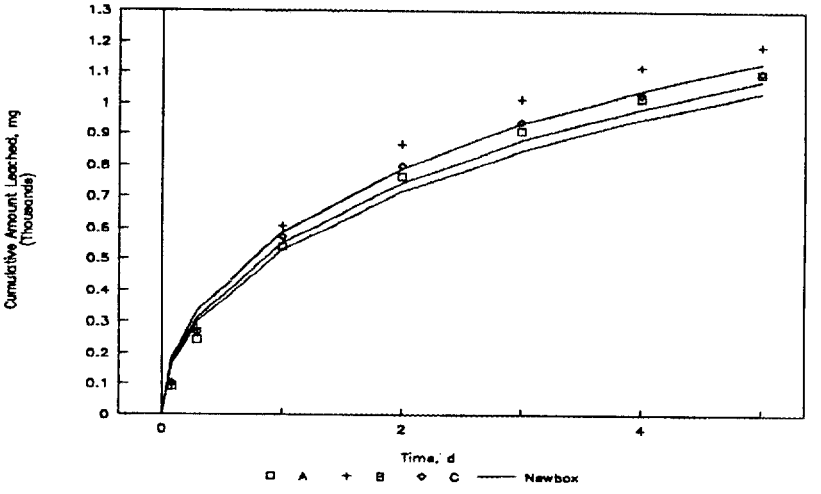
Run III–32 : Nitrate

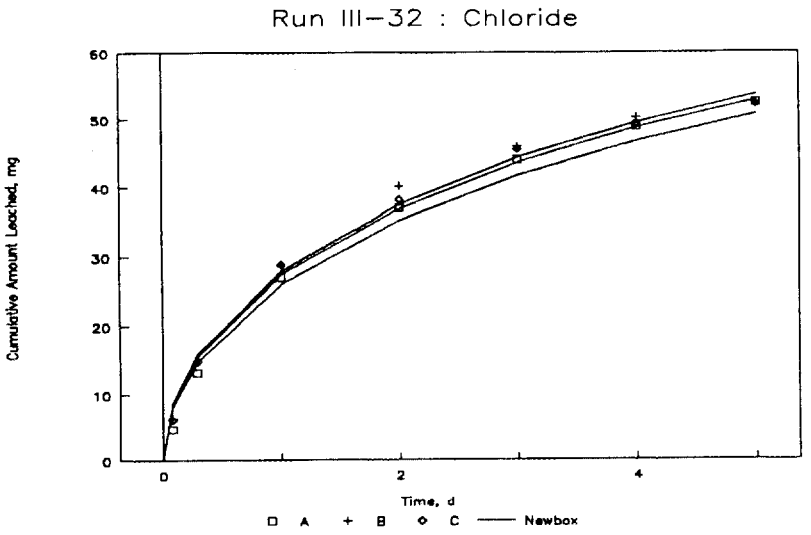


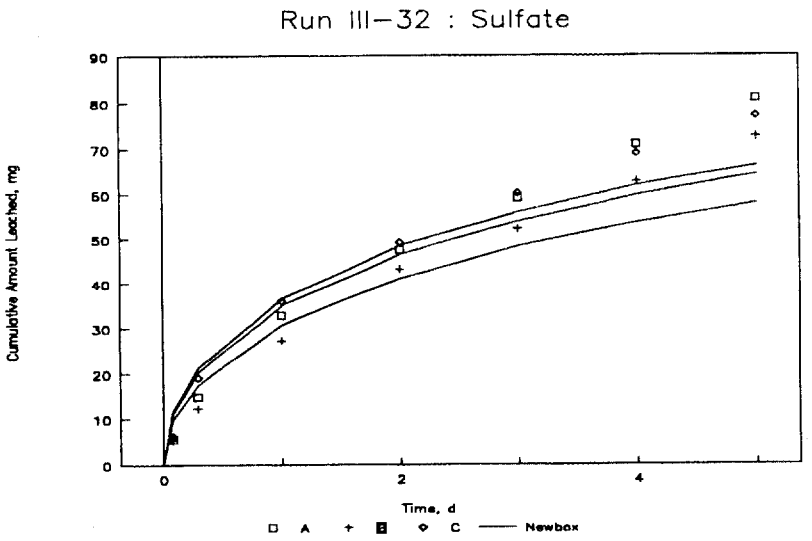
Run III–32 : Nitrite



Run III–32 : Nitrate + Nitrite




Run III–32 : Chloride
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
0
2
4
Time, d
A
B
C
Newbox


Run III–32 : Sulfate
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
70
80
90
0
2
4
Time, d
A
B
C
Newbox

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	Dia., cm	2.51	2.51	2.51
23.01	4.65	Length,cm	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 mg/L			Mass in Leachate mg			Time
Interval		Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
III-33	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
		0						
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 (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-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

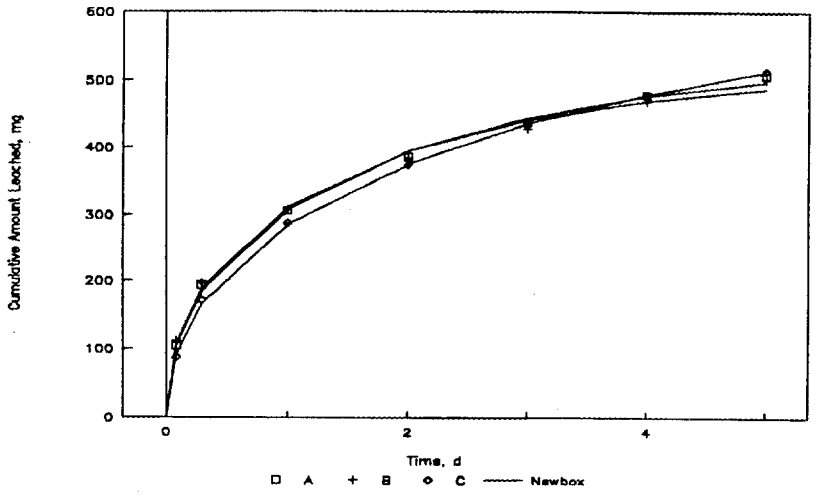
III–33 Nitrate + Nitrite

				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	883.42	857.47	840.68	877.68	5

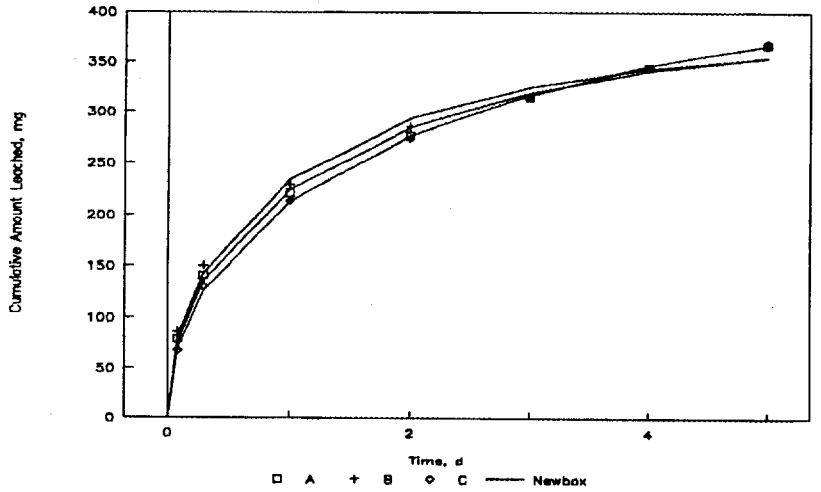
	Added in 106–AN			Newbox Estimate		
Ao =	1839.59	1842.42	1839.59	928	884	1060

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

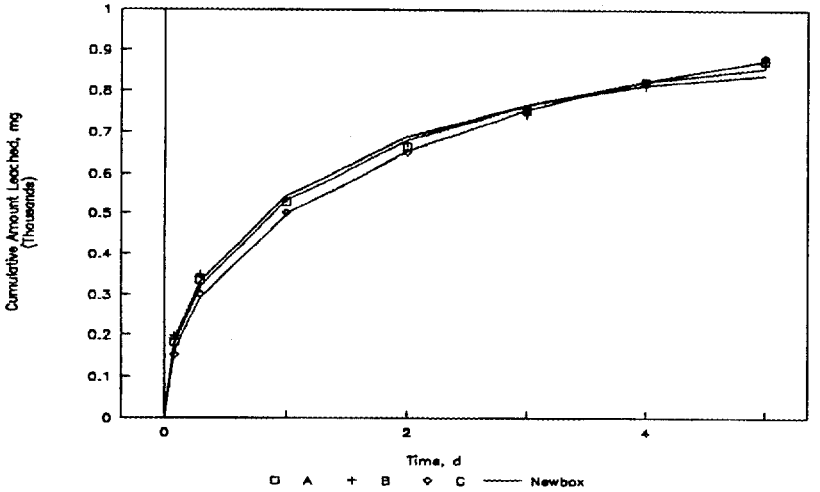
Run III–33 : Nitrate

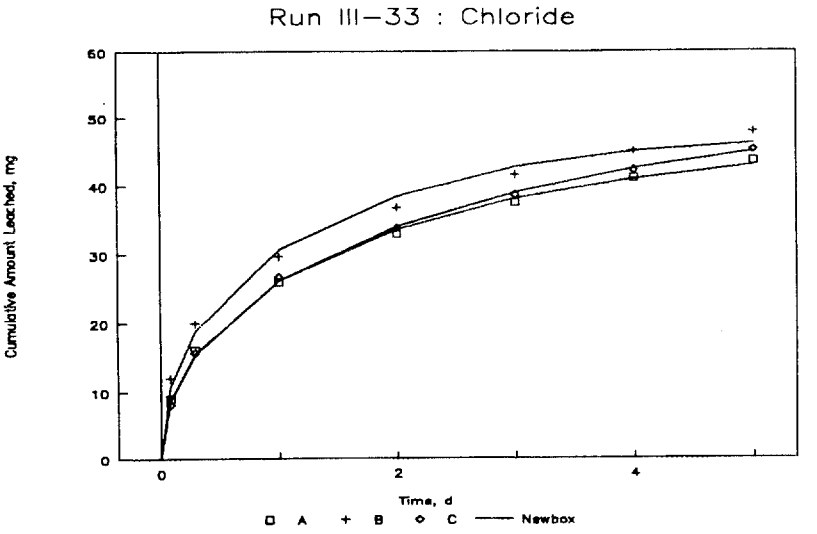


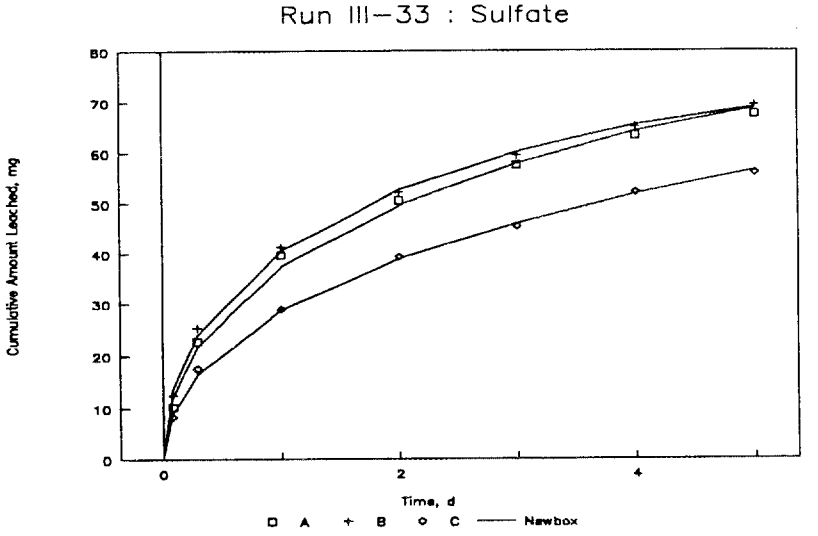
Run III–33 : Nitrite



Run III–33 : Nitrate + Nitrite




Run III–33 : Chloride
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
0
2
4
Time, d
A
B
C
Newbox


Run III–33 : Sulfate
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
70
80
0
2
4
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate mg			
Interval		Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
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	642.86	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

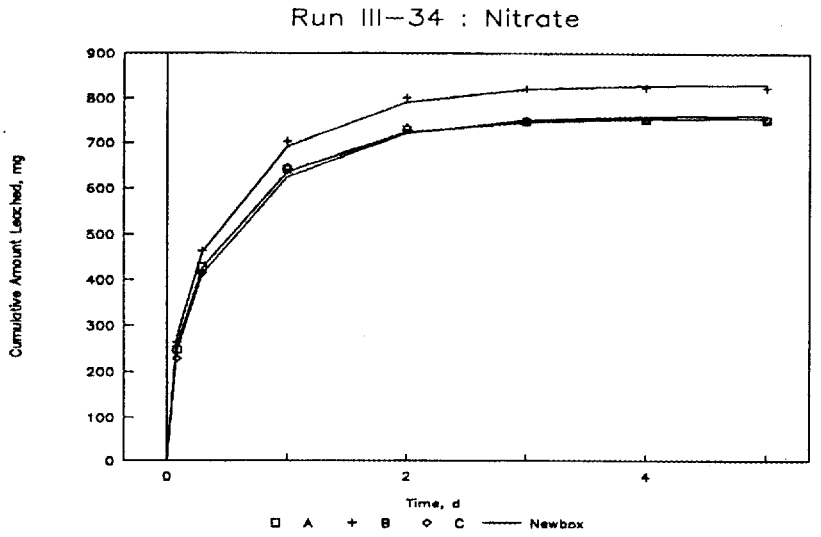
Per cent of 106-AN ion leachable:	188%	206%	188%
Eff. Diffusion Coefficient, sq cm/s:	1.14E-06	1.06E-06	8.38E-07
Std. Deviation, sq cm/s:	7.70E-08	7.64E-08	5.52E-08
Leachability Index:	5.943	5.975	6.077
Upper 95% Confidence Int.:	0.029	0.032	0.029
Lower 95% Confidence Int.:	0.028	0.029	0.027

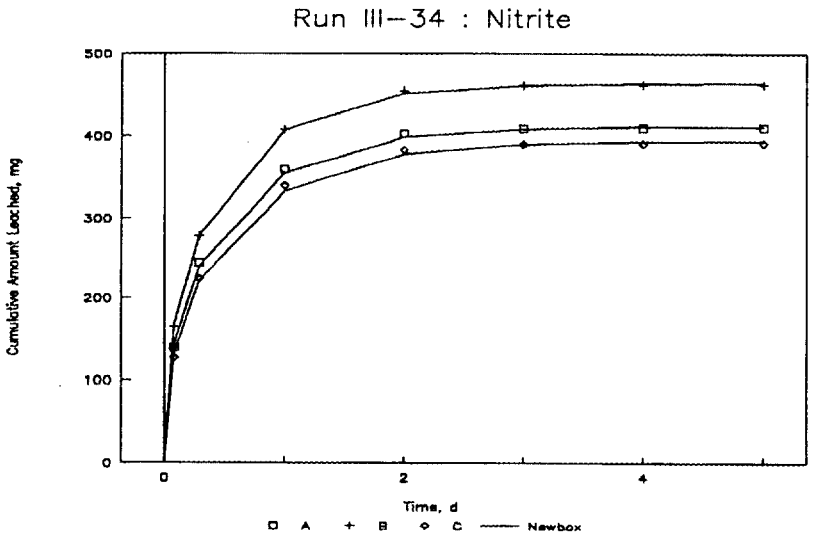
III-34 Nitrate + Nitrite

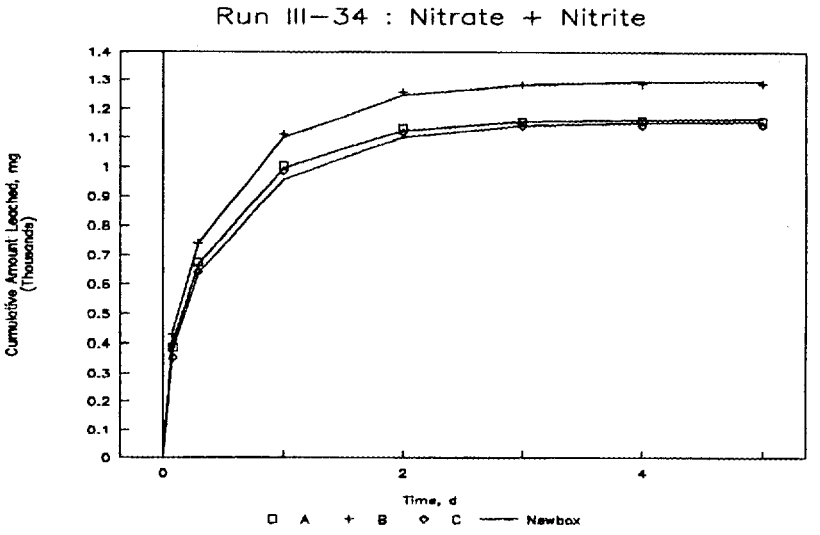
				0.00	0.00	0.00	0
1	386.51	429.73	355.79	398.63	440.64	376.68	0.083333
2	673.50	740.74	640.38	668.67	740.02	636.29	0.291666
3	1002.33	1110.85	985.06	993.65	1099.01	958.49	1
4	1132.65	1256.65	1117.60	1123.41	1245.46	1099.89	2
5	1156.07	1281.82	1140.38	1157.31	1283.04	1141.62	3
6	1160.32	1285.47	1142.50	1165.49	1292.11	1153.21	4
7	1161.53	1286.63	1144.61	1167.83	1294.70	1157.84	5

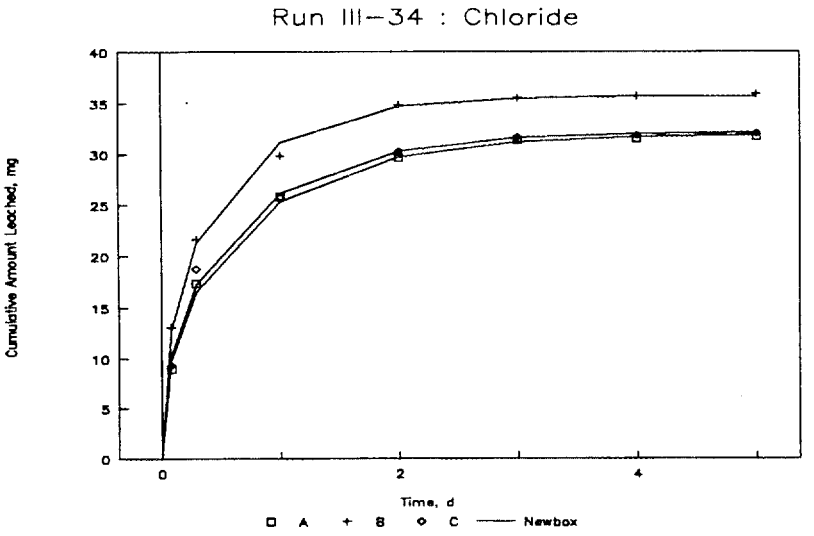
	Added in 106-AN			Newbox Estimate		
Ao =	2154.88	2154.88	2154.88	1169	1296	1159

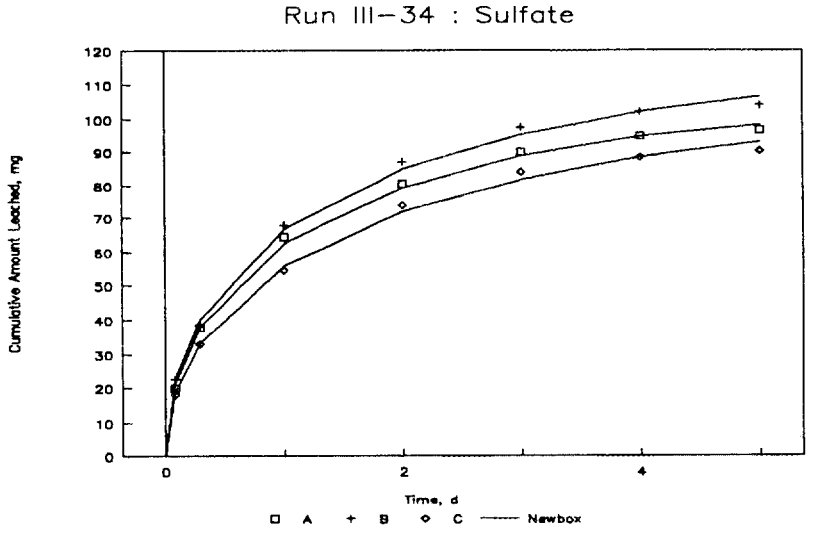
Per cent of 106-AN ion leachable:	54%	60%	54%
Eff. Diffusion Coefficient, sq cm/s:	3.50E-06	3.48E-06	3.13E-06
Std. Deviation, sq cm/s:	1.51E-07	1.41E-07	2.73E-07
Leachability Index:	5.456	5.458	5.504
Upper 95% Confidence Int.:	0.019	0.017	0.038
Lower 95% Confidence Int.:	0.018	0.017	0.035


Run III–34 : Nitrate
Cumulative Amount Leached, mg
900
800
700
600
500
400
300
200
100
0
0
2
4
Time, d
A
B
C
Newbox


Run III–34 : Nitrite
Cumulative Amount Leached, mg
500
400
300
200
100
0
0
2
4
Time, d
A
B
C
Newbox


Run III–34 : Nitrate + Nitrite
Cumulative Amount Leached, mg
(Thousands)
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
Time, d
A
B
C
Newbox


Run III-34 : Chloride
Cumulative Amount Leached, mg
0
5
10
15
20
25
30
35
40
0
2
4
Time, d
A
B
C
Newbox


Run III-34 : Sulfate
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
70
80
90
100
110
120
0
2
4
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate 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 (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-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 =	87.28	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

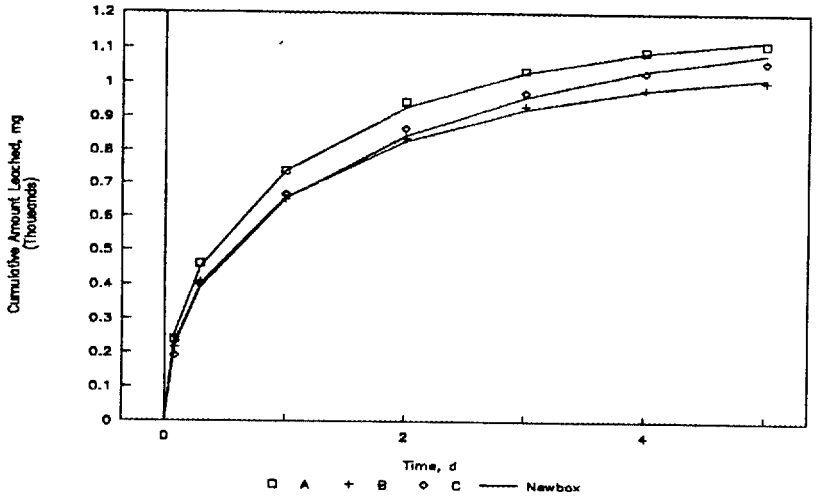
III-35 Nitrate + Nitrite

				0.00	0.00	0.00	0
1	354.87	318.04	288.11	380.19	330.79	331.45	0.083333
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

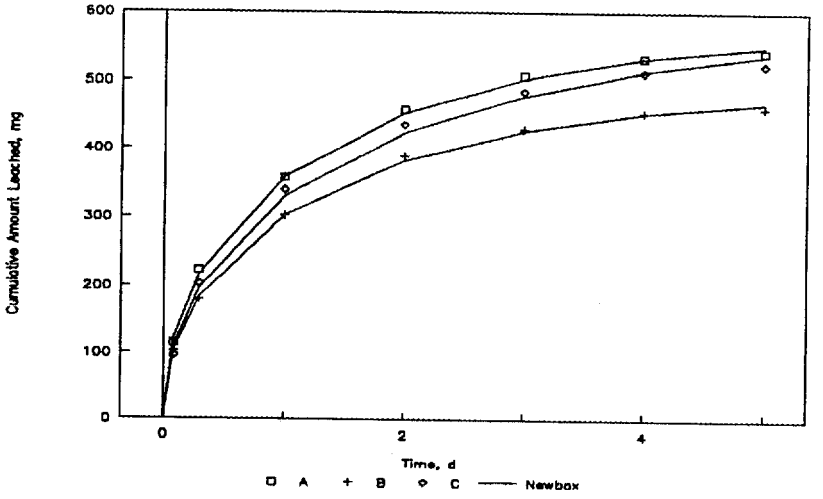
	Added in 106-AN			Newbox Estimate		
Ao =	1885.08	1882.39	1883.74	1744	1553	1782

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

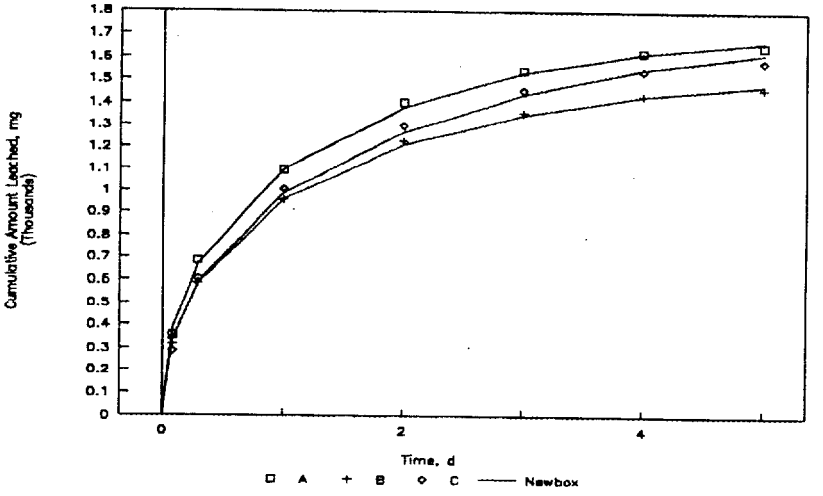
Run III–35 : Nitrate

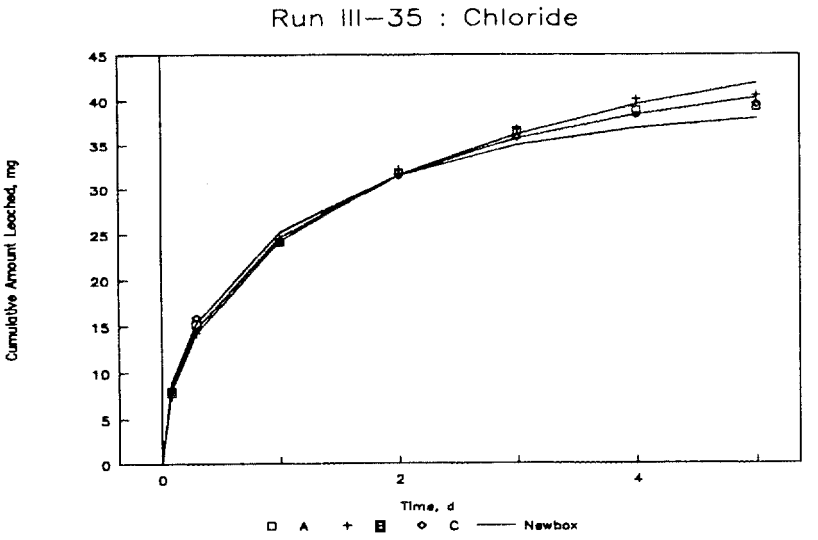


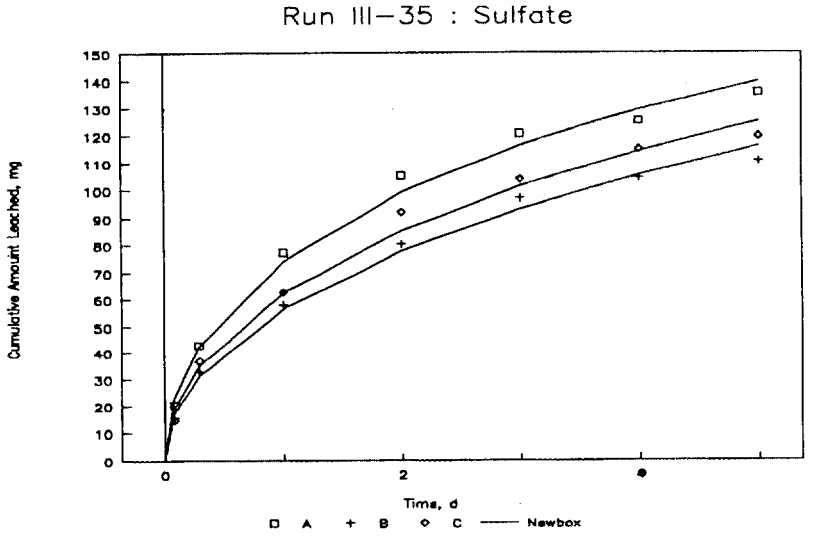
Run III–35 : Nitrite



Run III–35 : Nitrate + Nitrite




Run III–35 : Chloride
Cumulative Amount Leached, mg
45
40
35
30
25
20
15
10
5
0
0
2
4
Time, d
A
B
C
Newbox


Run III–35 : Sulfate
Cumulative Amount Leached, mg
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
2
Time, d
A
B
C
Newbox

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	Initially		After Curing 28 d 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 mg/L			Mass in Leachate mg			Time
Interval		Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
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

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)			
		mg			mg		Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	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

		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

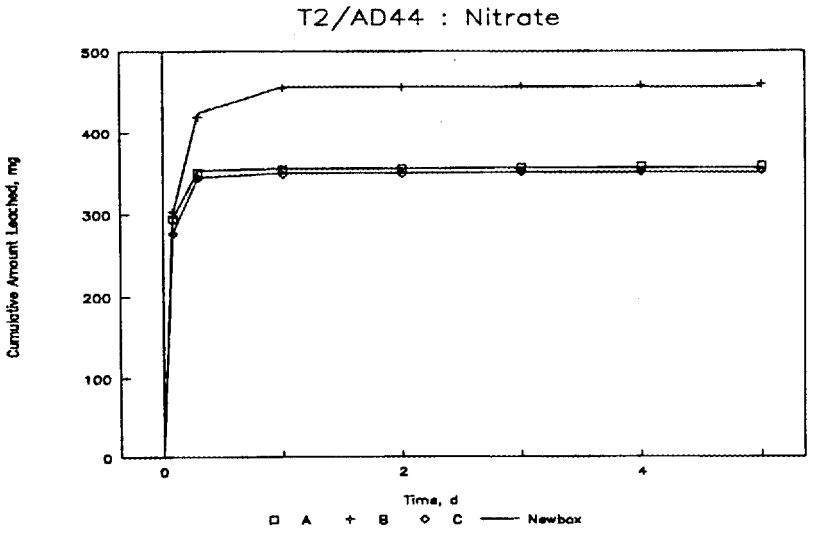
Per cent of 106-AN ion leachable:	119%	136%	69%
Eff. Diffusion Coefficient, sq cm/s:	2.22E-05	8.20E-06	6.48E-06
Std. Deviation, sq cm/s:	2.15E-06	4.10E-07	2.81E-06
Leachability Index:	4.654	5.086	5.188
Upper 95% Confidence Int.:	0.043	0.022	0.238
Lower 95% Confidence Int.:	0.039	0.021	0.153

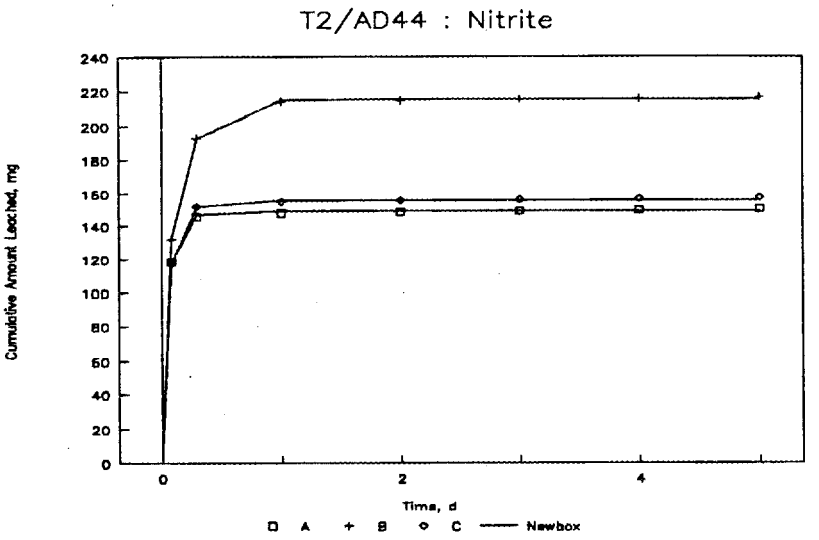
T2-AD44 Nitrate + Nitrite

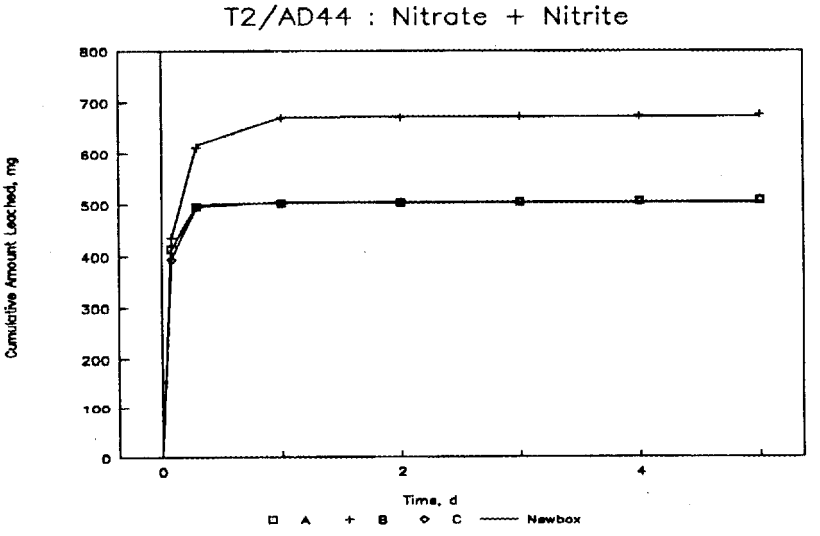
				0.00	0.00	0.00	0
1	412.93	435.03	393.36	412.59	432.80	393.16	0.083333
2	496.43	612.03	495.18	499.95	616.65	496.89	0.291666
3	502.07	668.20	503.03	505.00	670.33	506.00	1
4	503.72	669.91	504.59	505.00	671.00	506.00	2
5	505.37	671.62	506.14	505.00	671.00	506.00	3
6	507.02	673.33	507.70	505.00	671.00	506.00	4
7	508.67	675.04	509.25	505.00	671.00	506.00	5

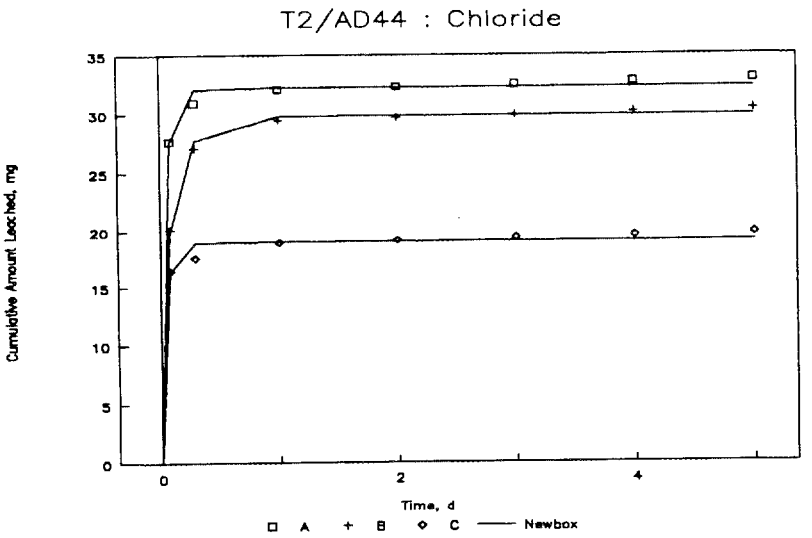
	Added in 106-AN			Newbox Estimate		
Ao =	1295.33	1294.29	1295.33	505	671	506

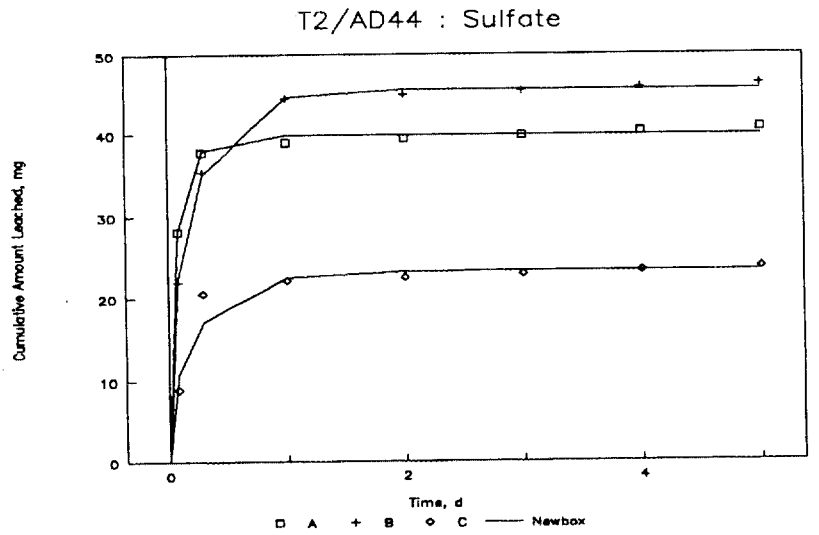
Per cent of 106-AN ion leachable:	39%	52%	39%
Eff. Diffusion Coefficient, sq cm/s:	3.61E-05	1.70E-05	2.72E-05
Std. Deviation, sq cm/s:	1.66E-06	5.24E-07	9.21E-07
Leachability Index:	4.443	4.770	4.566
Upper 95% Confidence Int.:	0.020	0.013	0.015
Lower 95% Confidence Int.:	0.019	0.013	0.014


T2/AD44 : Nitrate
Cumulative Amount Leached, mg
500
400
300
200
100
0
0
2
4
Time, d
A
B
C
Newbox


T2/AD44 : Nitrite
Cumulative Amount Leached, mg
240
220
200
180
160
140
120
100
80
60
40
20
0
0
2
4
Time, d
A
B
C
Newbox


T2/AD44 : Nitrate + Nitrite
Cumulative Amount Leached, mg
800
700
600
500
400
300
200
100
0
0
2
4
Time, d
A
B
C
Newbox


T2/AD44 : Chloride
Cumulative Amount Leached, mg
35
30
25
20
15
10
5
0
0
2
4
Time, d
A
B
C
Newbox


T2/AD44 : Sulfate
Cumulative Amount Leached, mg
50
40
30
20
10
0
0
2
4
Time, d
A
B
C
Newbox

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 mg/L		Mass in Leachate mg			Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	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

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 (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/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

	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

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

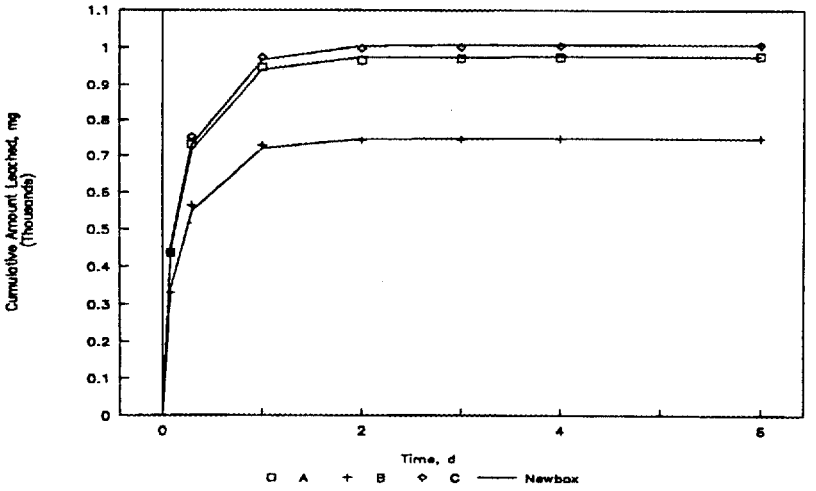
T2/CL58 Nitrate + Nitrite

				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

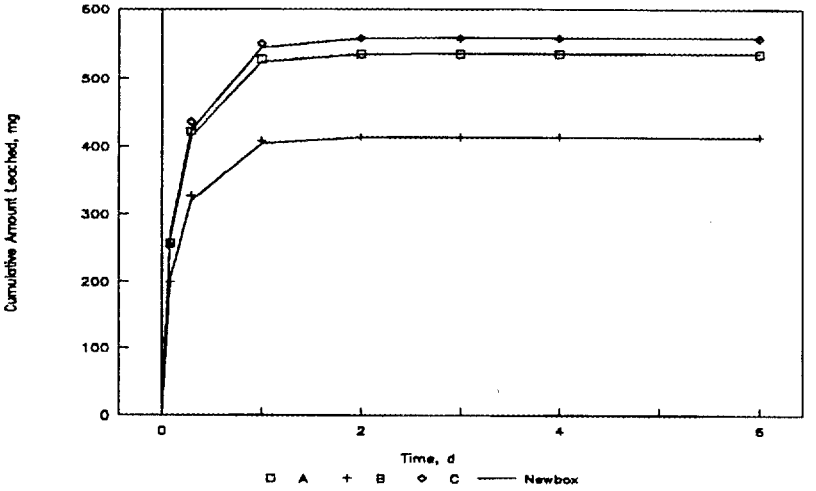
	Added in 106-AN			Newbox Estimate		
Ao =	2384.30	2405.98	2384.30	1512	1163	1564

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

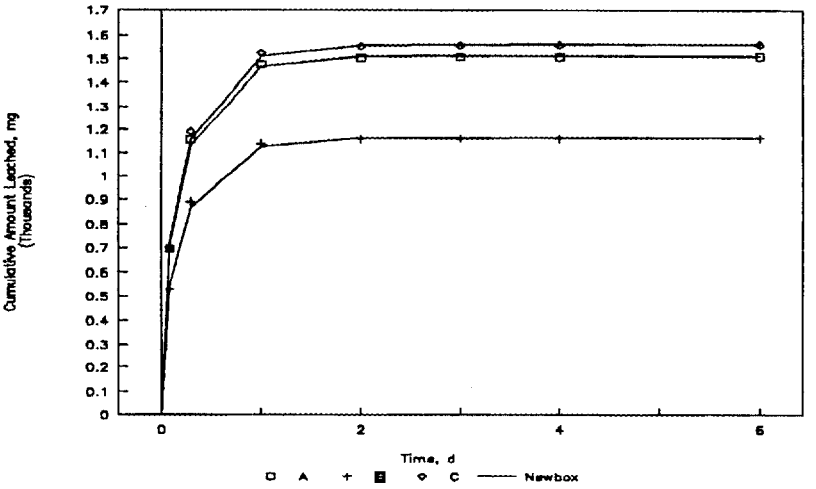
T2/CL58 : Nitrate

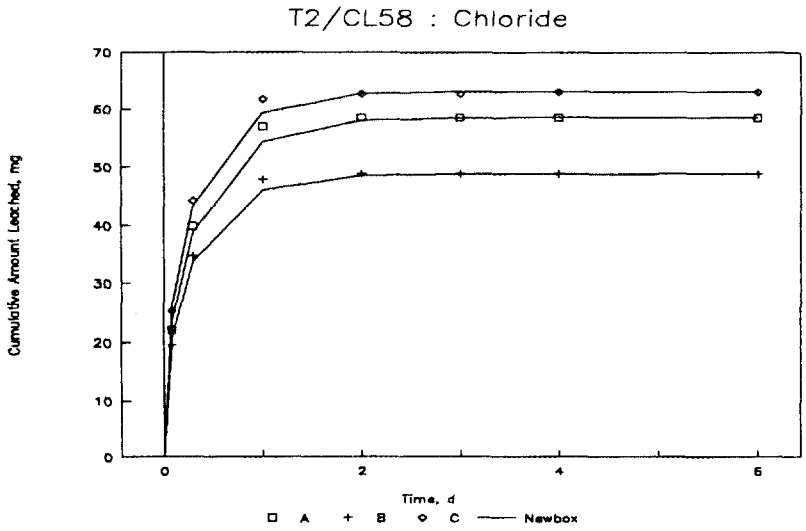


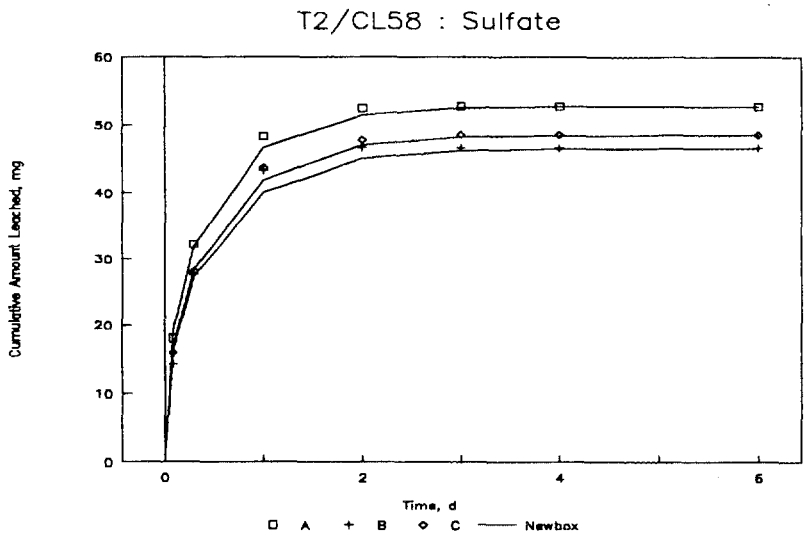
T2/CL58 : Nitrite



T2/CL58 : Nitrate + Nitrite




T2/CL58 : Chloride
Cumulative Amount Leached, mg
70
60
50
40
30
20
10
0
0
2
4
6
Time, d
A
B
C
Newbox


T2/CL58 : Sulfate
Cumulative Amount Leached, mg
60
50
40
30
20
10
0
0
2
4
6
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate 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

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)

	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/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

	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

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

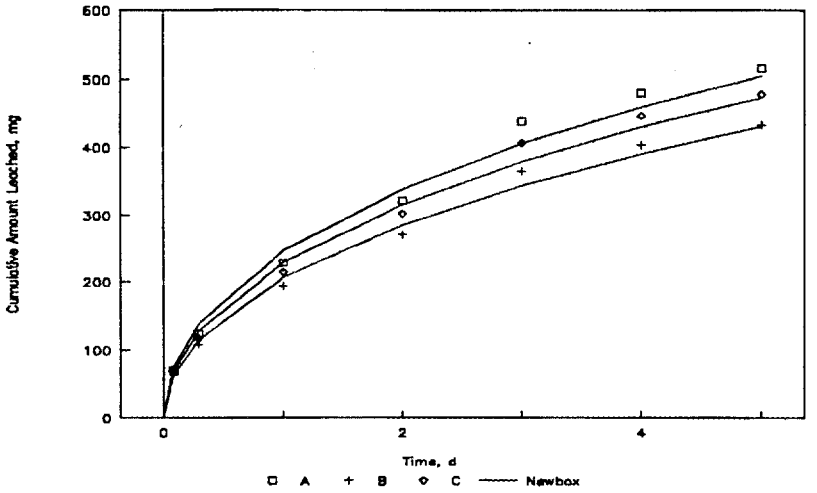
T2/CL582 Nitrate + Nitrite

				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

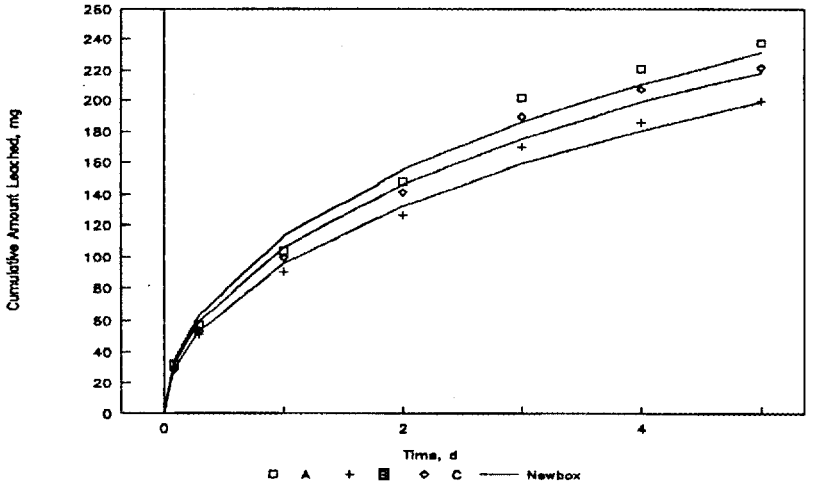
	Added in 106-AN			Newbox Estimate		
Ao =	1633.46	1638.67	1643.87	1633.46	1638.67	1643.87

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

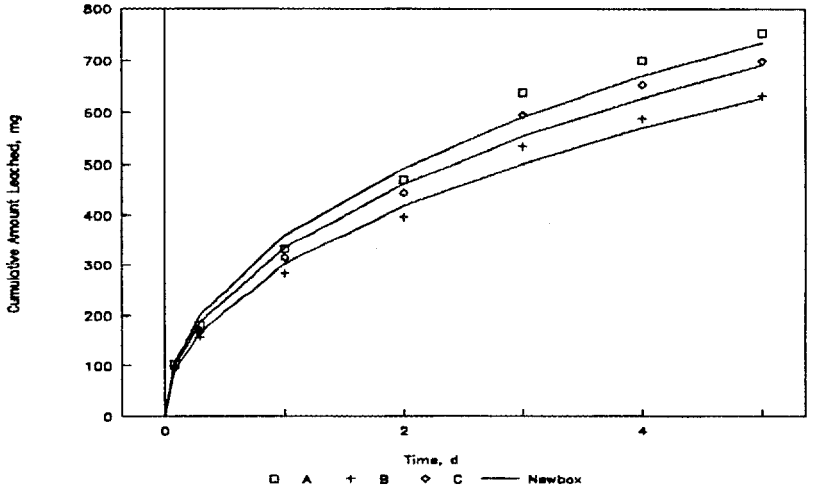
T2/CL582 : Nitrate

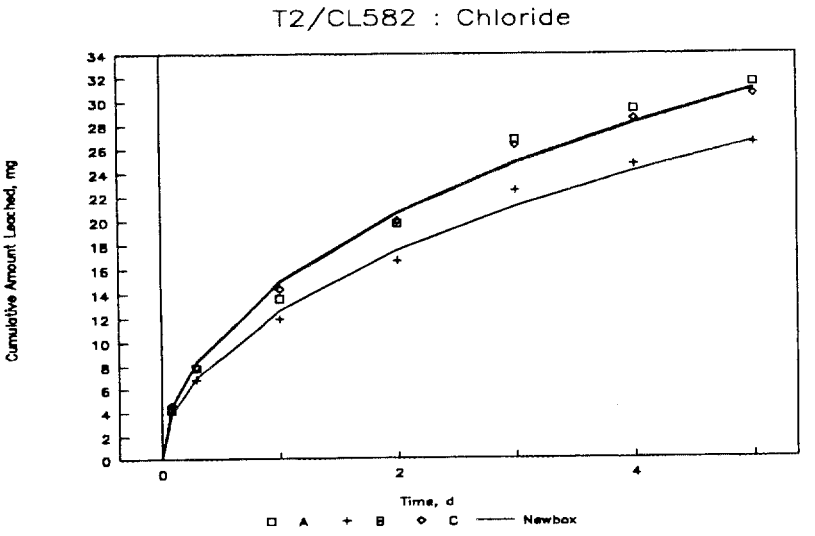


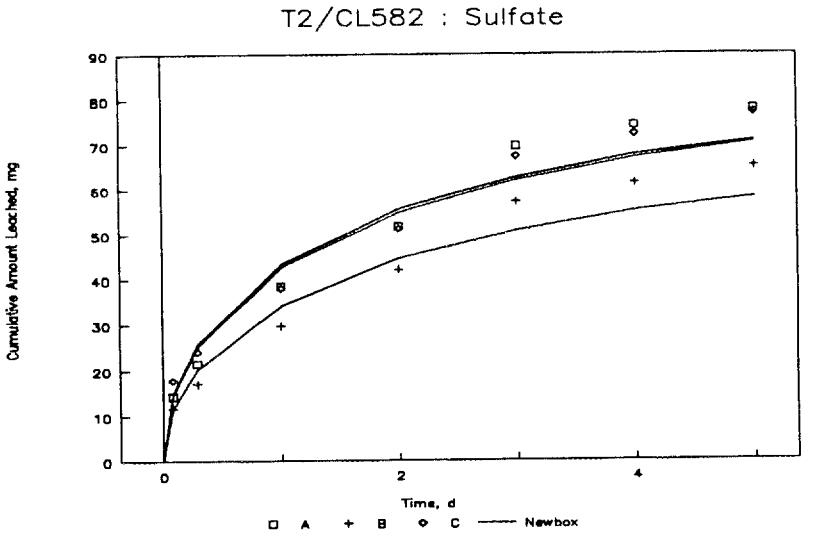
T2/CL582 : Nitrite



T2/CL582 : Nitrate + Nitrite




T2/CL582 : Chloride
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox


T2/CL582 : Sulfate
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox

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	Dia., cm	2.55	2.55	2.55
22.83	4.65	Length,cm	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 mg/L		Mass in Leachate mg			Time
Interval	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

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 (Adding Rinse to Interval 1)

	Observed			Calculated (NEWBOX) (No Washoff or Washout)			
		mg			mg		Time
Interval	Batch 1	Batch 2		Batch 1	Batch 2	Batch 3	d
T2-P62	Chloride						
				0.00	0.00	0.00	0
1	4.52	4.77	4.48	3.60	2.90	3.03	0.083333
2	6.56	6.43	6.13	6.09	5.08	5.21	0.291666
3	8.25	7.85	7.56	9.16	8.16	8.18	1
4	9.27	8.84	8.60	10.48	10.07	9.82	2
5	9.95	9.61	9.26	10.85	10.99	10.49	3
6	10.48	10.17	9.81	10.96	11.47	10.78	4
7	11.00	11.10	10.28	10.99	11.72	10.90	5
		Added in 106-AN			Newbox Estimate		
Ao =	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
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

		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

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

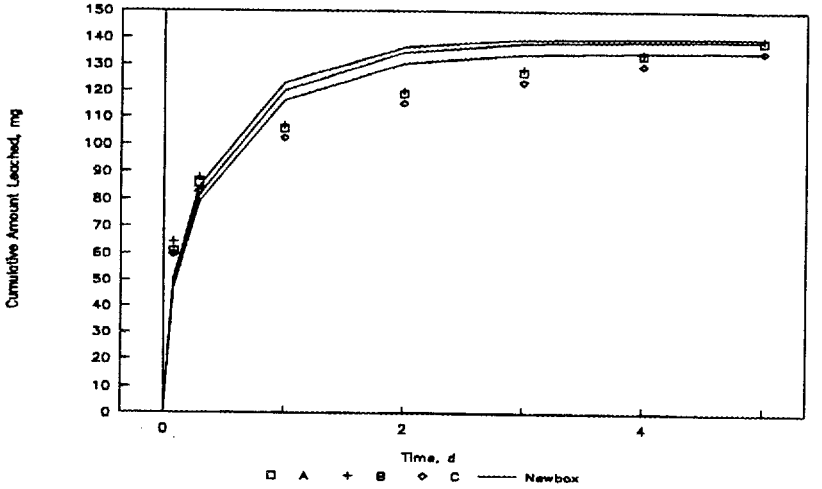
T2-P62 Nitrate + Nitrite

				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

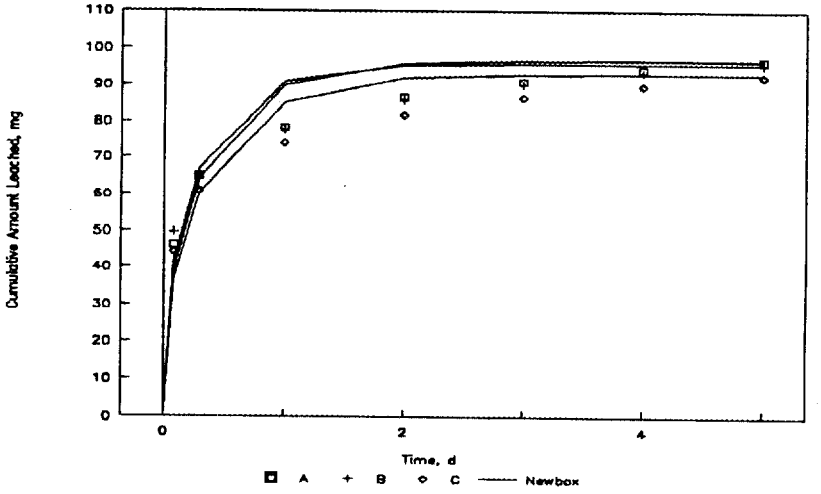
	Added in 106-AN			Newbox Estimate		
Ao =	1467.00	1470.12	1467.00	236	236	228

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

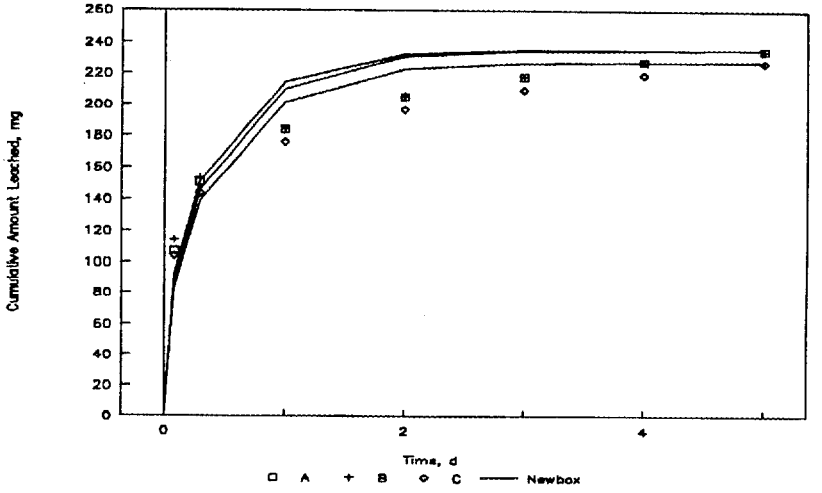
T2/P62 : Nitrate

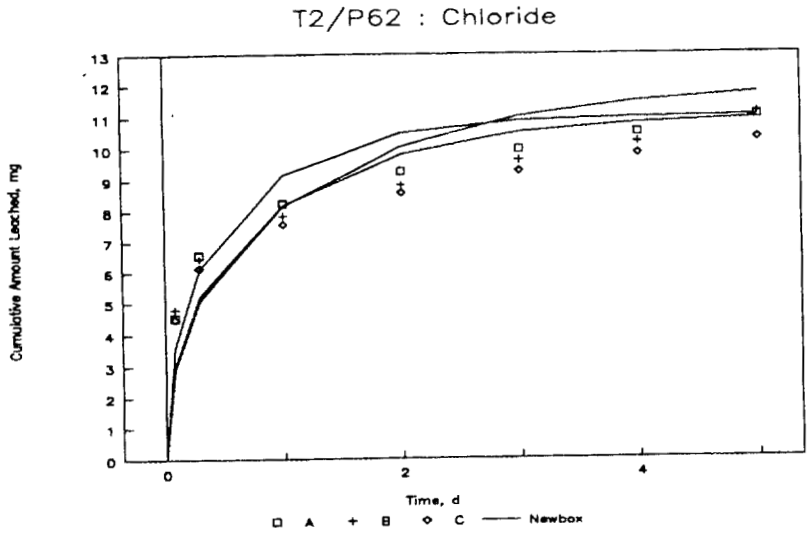


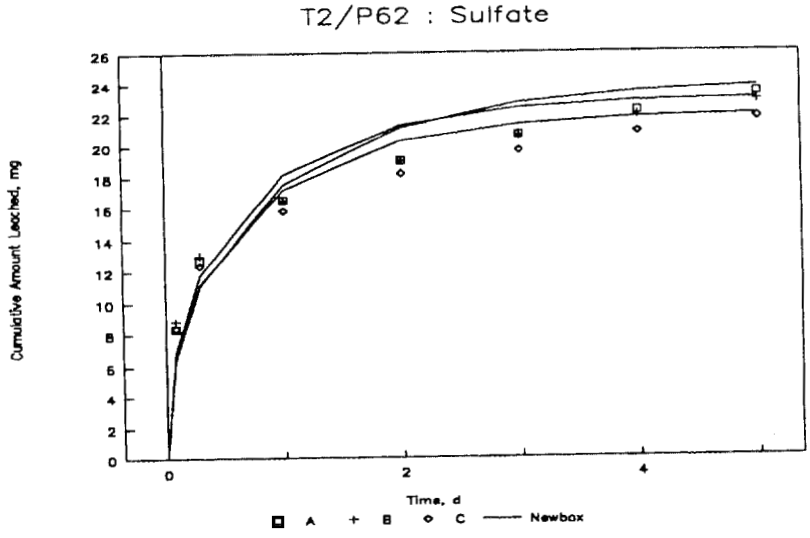
T2/P62 : Nitrite



T2/P62 : Nitrate + Nitrite




T2/P62 : Chloride
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox


T2/P62 : Sulfate
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate mg			Time
Interval		Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	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

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 (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-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
		Added in 106-AN			Newbox Estimate		
Ao =	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

	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

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

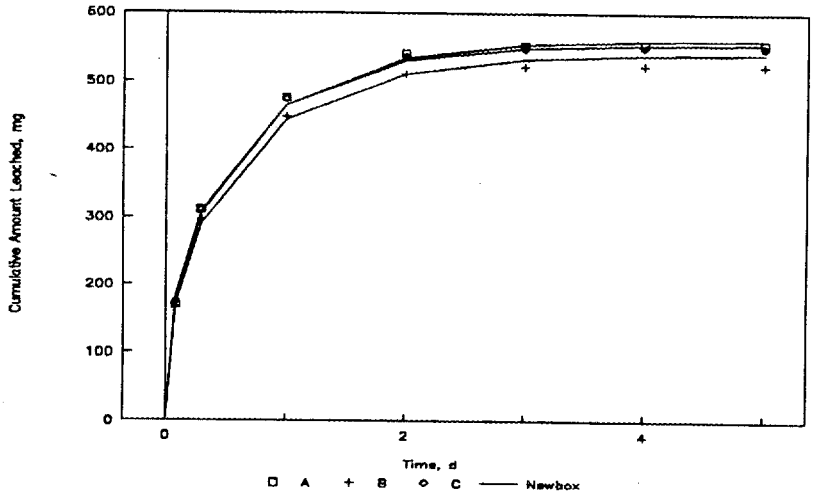
T2-P65 Nitrate + Nitrite

				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

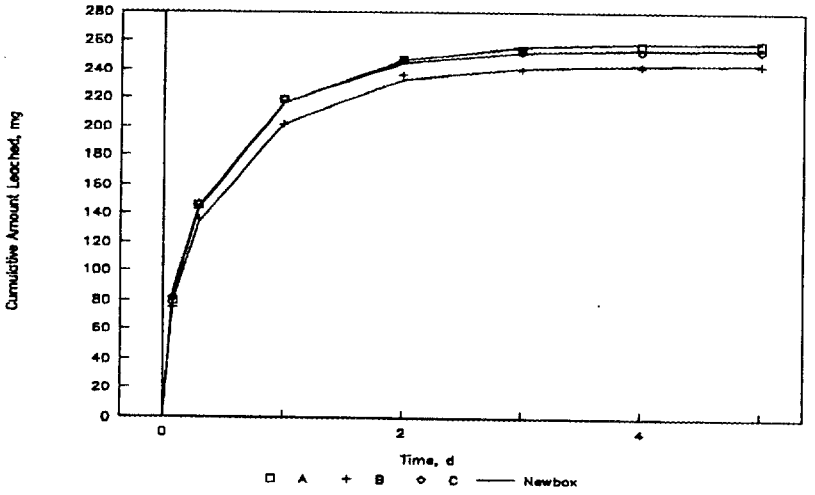
	Added in 106-AN			Newbox Estimate		
Ao =	1607.45	1612.65	1612.65	821	773	811

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

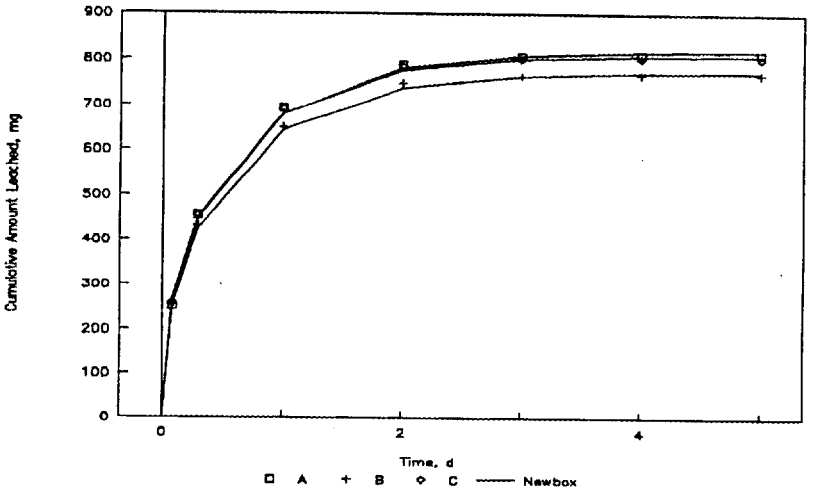
T2/P65 : Nitrate

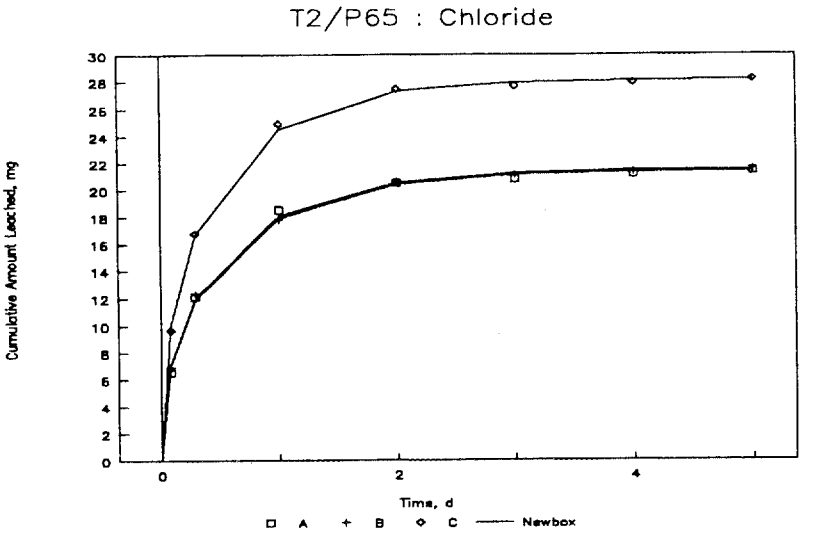


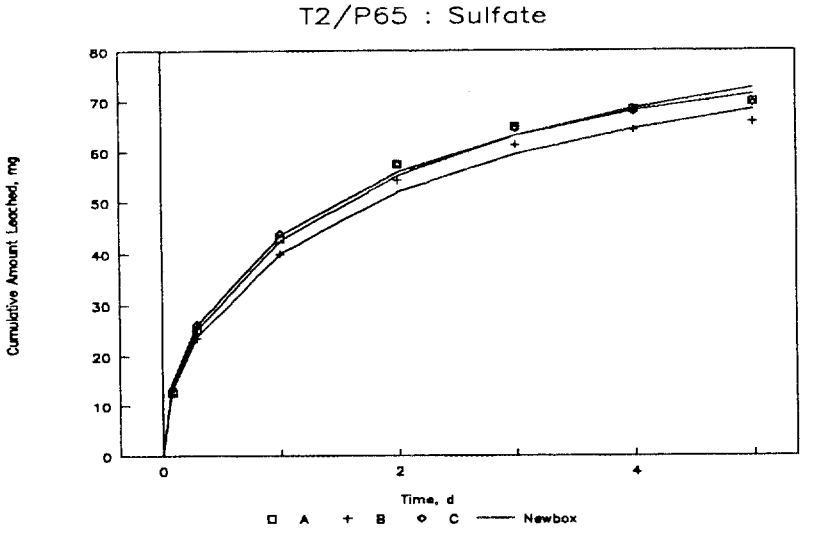
T2/P65 : Nitrite



T2/P65 : Nitrate + Nitrite




T2/P65 : Chloride
Cumulative Amount Leached, mg
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
2
4
Time, d
A
B
C
Newbox


T2/P65 : Sulfate
Cumulative Amount Leached, mg
80
70
60
50
40
30
20
10
0
0
2
4
Time, d
A
B
C
Newbox

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 mg/L			Mass in Leachate mg			Time
Interval		Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	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

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 (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/S24	Chloride						
				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

	Added in 106-AN			Newbox Estimate		
Ao =	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

	Added in 106-AN			Newbox Estimate		
Ao =	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

	Added in 106-AN			Newbox Estimate		
Ao =	44.40	44.71	44.62	93.6	78	76

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

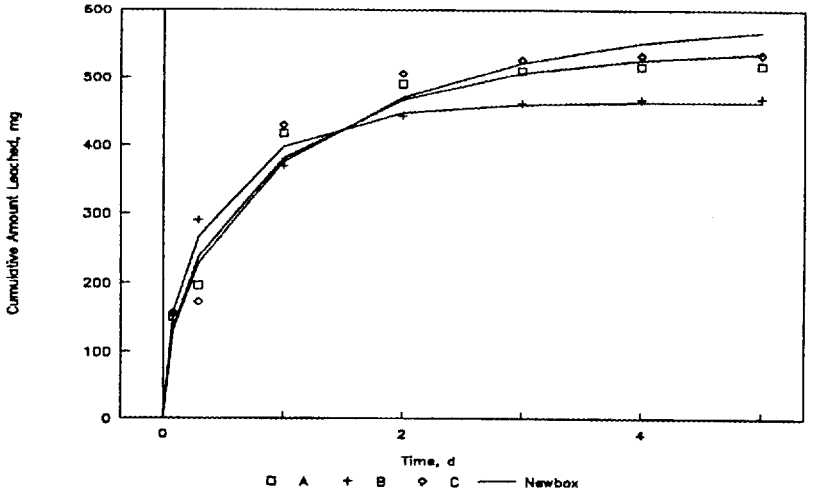
T2/S24 Nitrate + Nitrite

				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

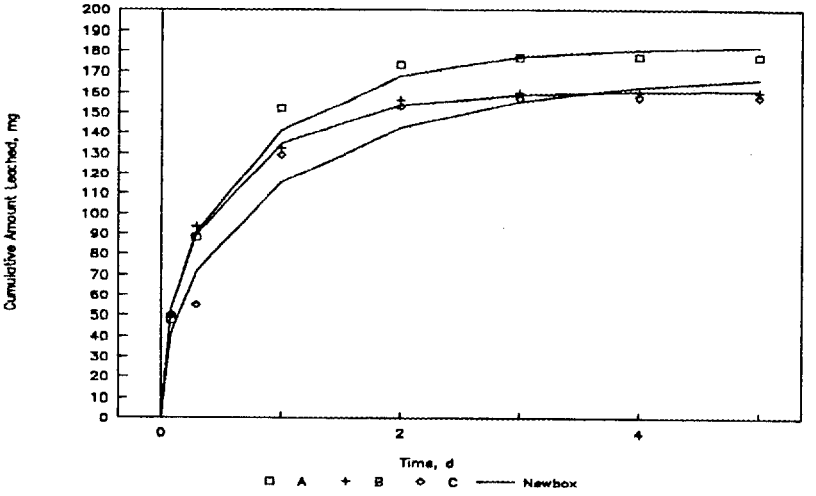
	Added in 106–AN			Newbox Estimate		
Ao =	1712.44	1724.35	1721.10	725	626	754

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

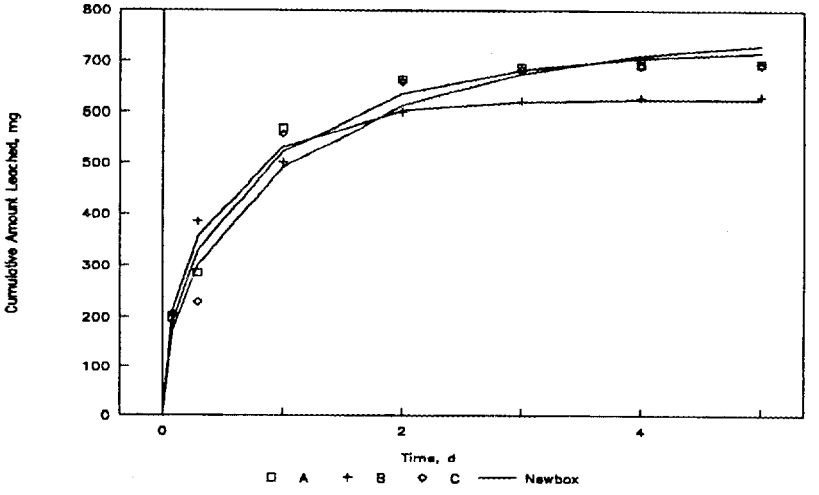
T2/S24 : Nitrate

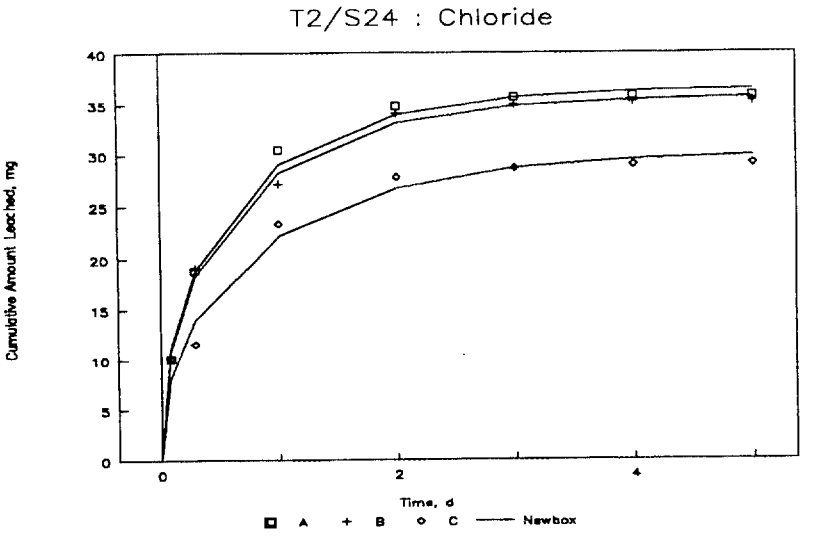


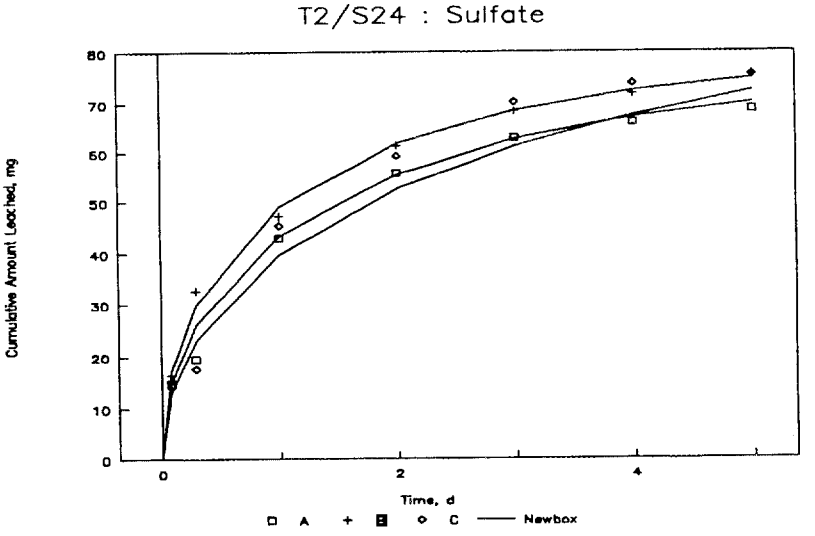
T2/S24 : Nitrite



T2/S24 : Nitrate + Nitrite




T2/S24 : Chloride
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox


T2/S24 : Sulfate
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox

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	4.65	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 mg/L			Mass in Leachate mg			Time
Interval		Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
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
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

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)			
		mg			mg		Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	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

	Added in 106-AN			Newbox Estimate		
Ao =	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

	Added in 106-AN			Newbox Estimate		
Ao =	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

	Added in 106-AN			Newbox Estimate		
Ao =	42.54	42.62	42.59	137	124	126

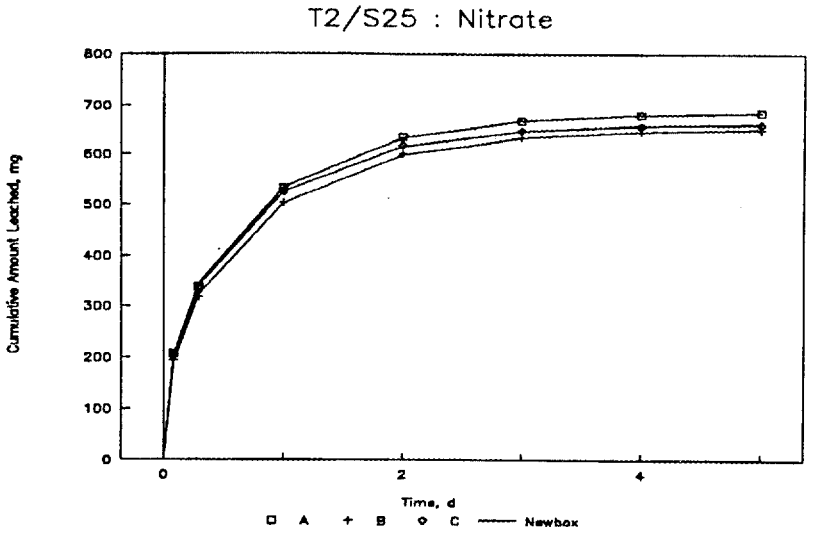
Per cent of 106-AN ion leachable:	322%	291%	296%
Eff. Diffusion Coefficient, sq cm/s:	7.43E-07	9.15E-07	9.74E-07
Std. Deviation, sq cm/s:	3.94E-08	4.35E-08	2.91E-08
Leachability Index:	6.129	6.039	6.012
Upper 95% Confidence Int.:	0.023	0.021	0.013
Lower 95% Confidence Int.:	0.022	0.020	0.012

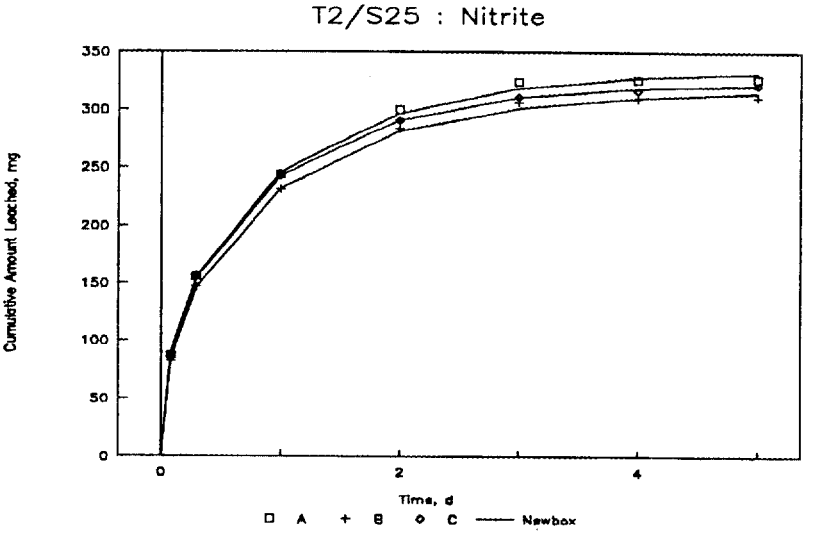
T2-S25 Nitrate + Nitrite

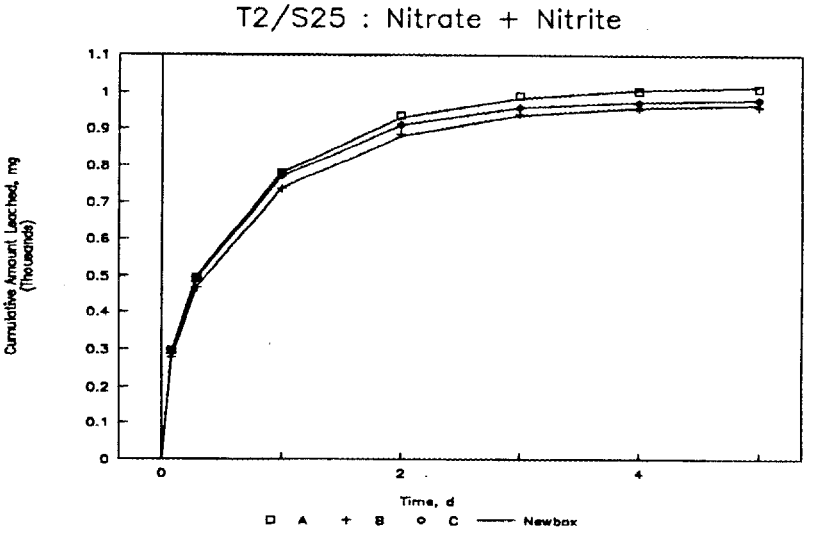
				0.00	0.00	0.00	0
1	294.70	275.82	290.94	290.25	273.13	288.90	0.083333
2	493.47	465.18	493.26	499.76	470.45	495.96	0.291666
3	777.96	736.12	769.29	780.81	737.75	770.07	1
4	934.81	884.50	909.61	929.00	879.66	908.11	2
5	992.08	939.79	958.30	985.21	935.06	957.41	3
6	1005.38	954.83	972.95	1007.69	957.42	975.15	4
7	1011.77	961.05	981.63	1015.87	966.17	982.06	5

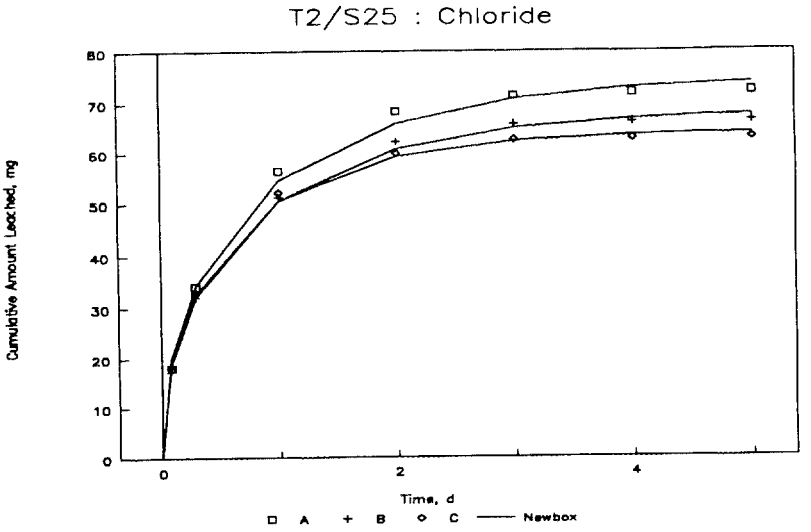
	Added in 106-AN			Newbox Estimate		
Ao =	1640.75	1643.87	1642.83	1022	972	986

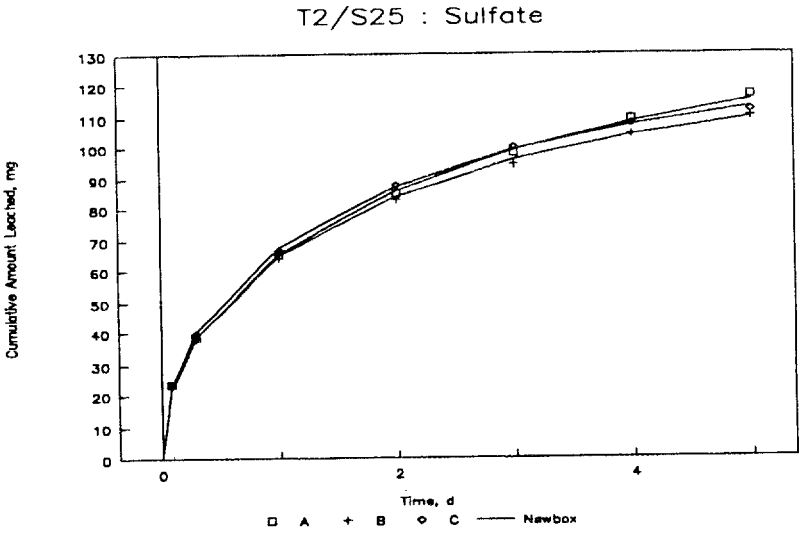
Per cent of 106-AN ion leachable:	62%	59%	60%
Eff. Diffusion Coefficient, sq cm/s:	2.66E-06	2.58E-06	2.83E-06
Std. Deviation, sq cm/s:	7.49E-08	6.07E-08	3.14E-08
Leachability Index:	5.575	5.589	5.548
Upper 95% Confidence Int.:	0.012	0.010	0.005
Lower 95% Confidence Int.:	0.012	0.010	0.005


T2/S25 : Nitrate
Cumulative Amount Leached, mg
800
700
600
500
400
300
200
100
0
0
2
4
Time, d
A
B
C
Newbox


T2/S25 : Nitrite
Cumulative Amount Leached, mg
350
300
250
200
150
100
50
0
0
2
4
Time, d
A
B
C
Newbox


T2/S25 : Nitrate + Nitrite
Cumulative Amount Leached, mg (Thousands)
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
Time, d
A
B
C
Newbox


T2/S25 : Chloride
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
70
80
0
2
4
Time, d
A
B
C
Newbox


T2/S25 : Sulfate
Cumulative Amount Leached, mg
0
10
20
30
40
50
60
70
80
90
100
110
120
130
0
2
4
Time, d
A
B
C
Newbox

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	Length,cm	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 mg/L			Mass in Leachate mg			
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
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
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

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 (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-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

		Added in 106-AN			Newbox Estimate	
Ao =	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

		Added in 106-AN			Newbox Estimate	
Ao =	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

		Added in 106-AN			Newbox Estimate	
Ao =	36.74	41.81	41.81	129	111	123

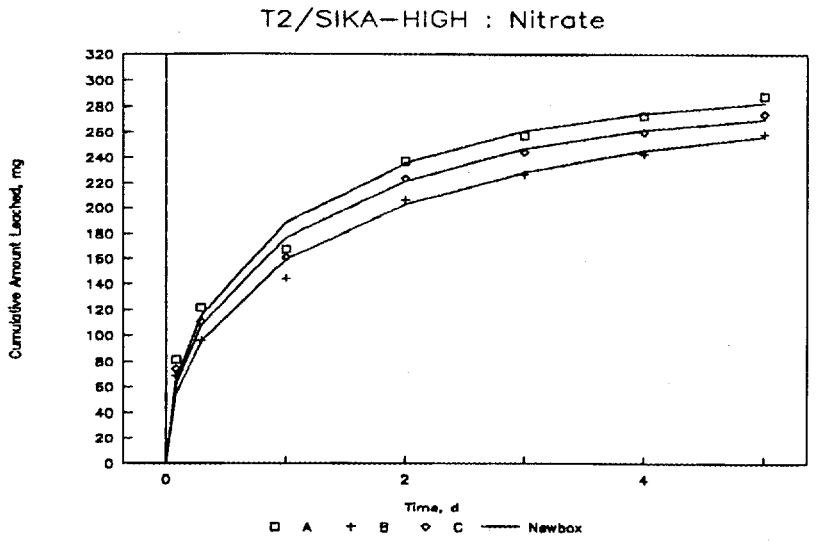
Per cent of 106-AN ion leachable:	351%	265%	294%
Eff. Diffusion Coefficient, sq cm/s:	2.09E-06	1.54E-06	1.89E-06
Std. Deviation, sq cm/s:	4.98E-07	5.13E-07	5.32E-07
Leachability Index:	5.679	5.813	5.723
Upper 95% Confidence Int.:	0.114	0.170	0.139
Lower 95% Confidence Int.:	0.090	0.122	0.105

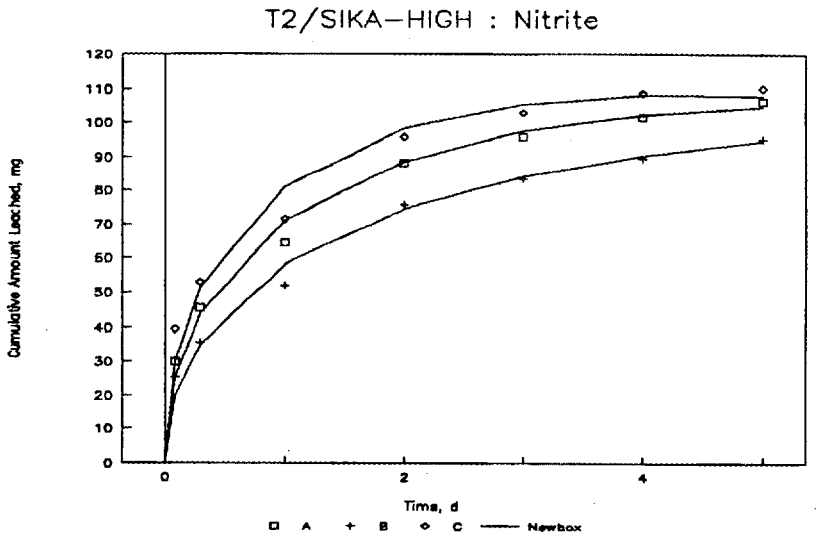
T2-SIKA (Nitrate + Nitrite

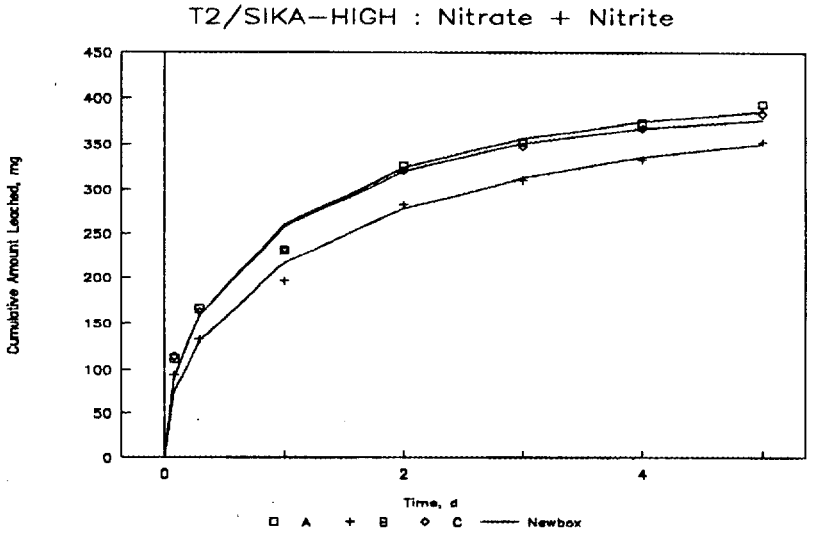
				0.00	0.00	0.00	0
1	111.21	94.02	113.74	90.80	73.53	91.24	0.083333
2	167.31	131.87	164.18	159.20	130.68	159.39	0.291666
3	231.94	196.40	232.79	259.60	217.55	257.95	1
4	325.69	282.46	320.25	324.00	277.75	319.94	2
5	352.85	310.65	347.31	357.20	313.18	351.89	3
6	374.09	332.90	368.77	376.00	335.66	369.22	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

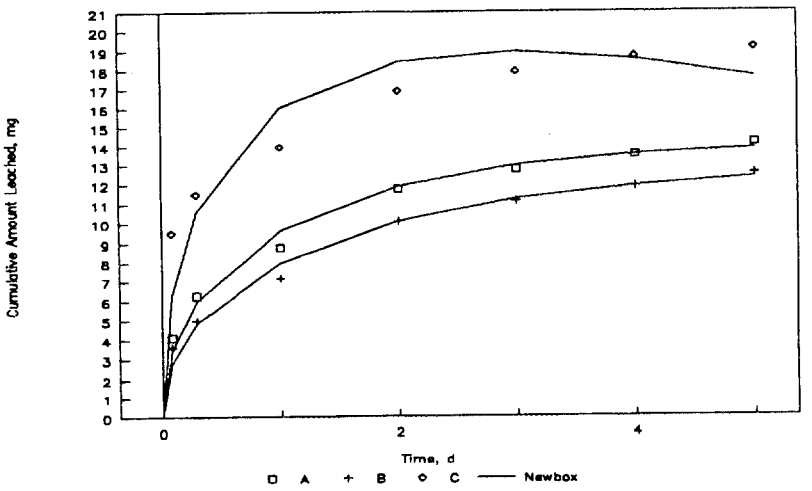
Per cent of 106-AN ion leachable:	28%	24%	24%
Eff. Diffusion Coefficient, sq cm/s:	1.58E-06	1.09E-06	1.70E-06
Std. Deviation, sq cm/s:	3.40E-07	2.08E-07	3.76E-07
Leachability Index:	5.802	5.963	5.771
Upper 95% Confidence Int.:	0.102	0.089	0.105
Lower 95% Confidence Int.:	0.083	0.074	0.085


T2/SIKA–HIGH : Nitrate
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox

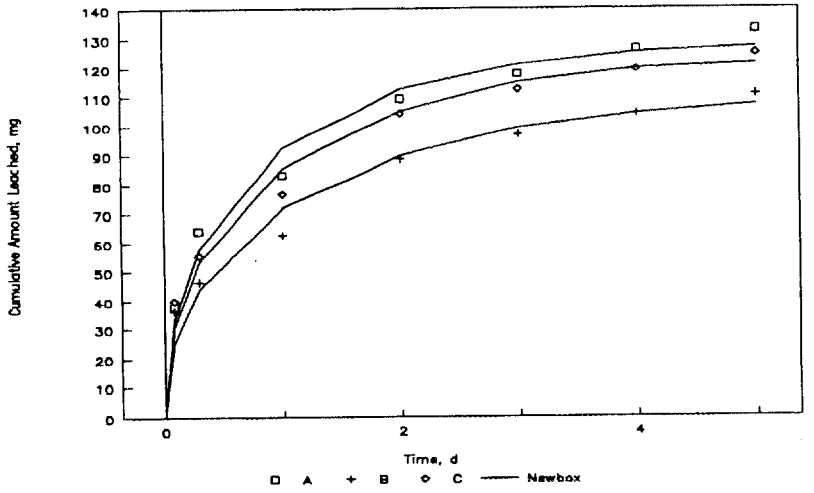

T2/SIKA–HIGH : Nitrite
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox


T2/SIKA–HIGH : Nitrate + Nitrite
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox

T2/SIKA–HIGH : Chloride



T2/SIKA–HIGH : Sulfate



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 mg/L			Mass in Leachate mg			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time 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

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)

	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/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

	Added in 106-AN			Newbox Estimate		
Ao =	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

	Added in 106-AN			Newbox Estimate		
Ao =	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

	Added in 106-AN			Newbox Estimate		
Ao =	64.58	64.75	65.09	50.3	53.3	62.4

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

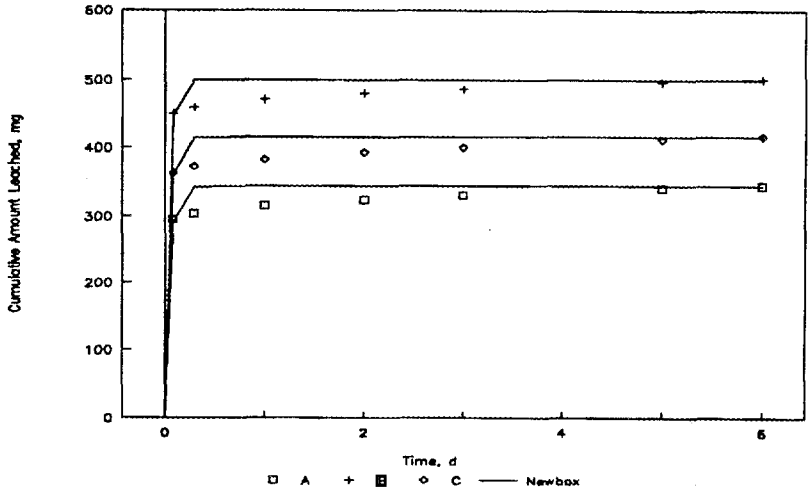
T2/SIKAL Nitrate + Nitrite

				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

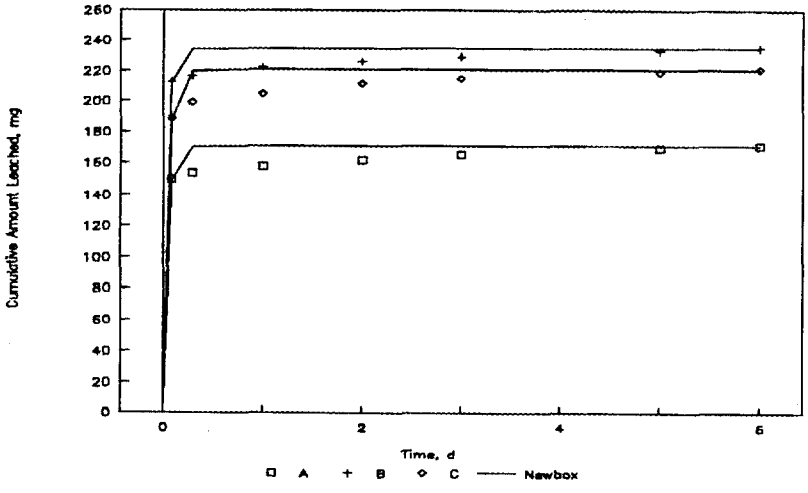
	Added in 106-AN			Newbox Estimate		
Ao =	2490.71	2497.37	2510.68	517	736	638

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

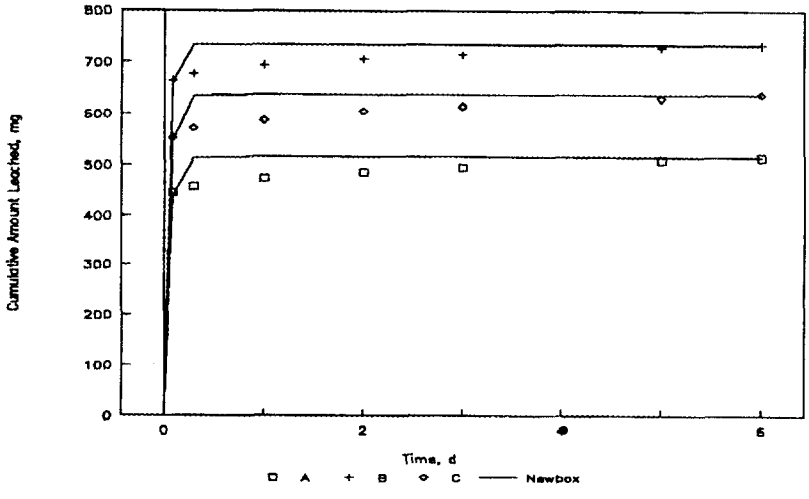
T2/SIKA–LOW : Nitrate

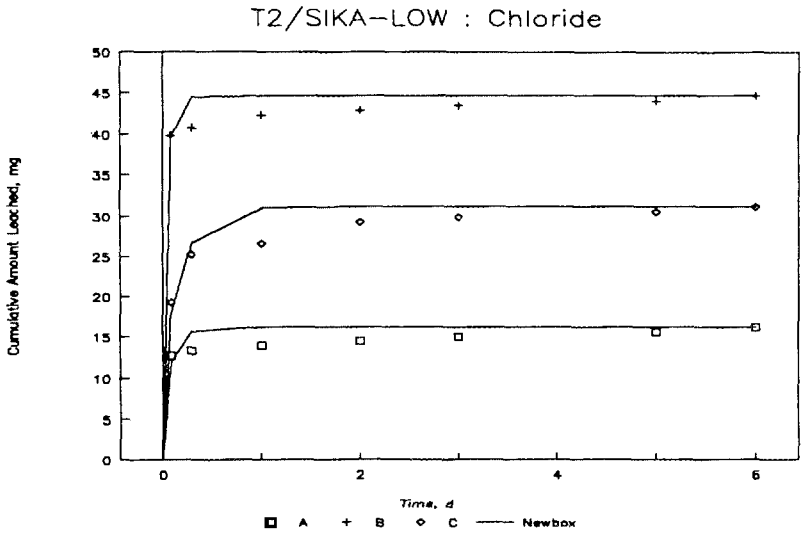


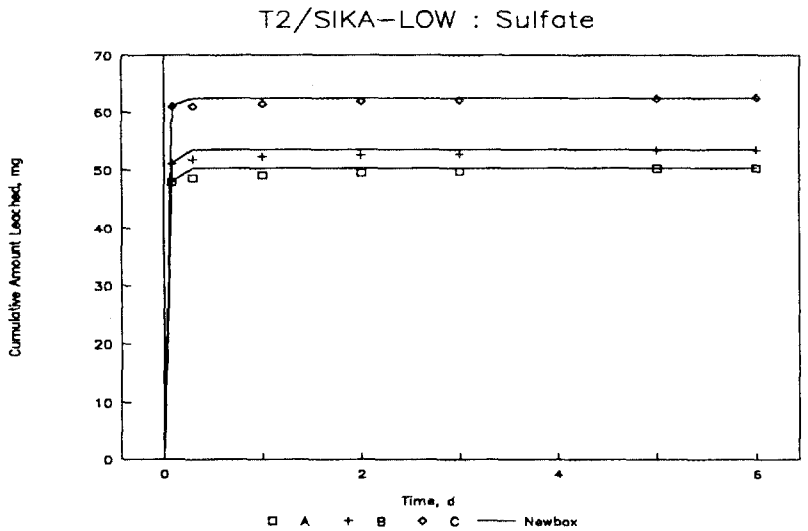
T2/SIKA–LOW : Nitrite



T2/SIKA–LOW : Nitrate + Nitrite




T2/SIKA-LOW : Chloride
Cumulative Amount Leached, mg
50
45
40
35
30
25
20
15
10
5
0
0
2
4
6
Time, d
A
B
C
Newbox


T2/SIKA-LOW : Sulfate
Cumulative Amount Leached, mg
70
60
50
40
30
20
10
0
0
2
4
6
Time, d
A
B
C
Newbox

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	Length,cm	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 mg/L			Mass in Leachate mg			Time
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	d
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

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			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

	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

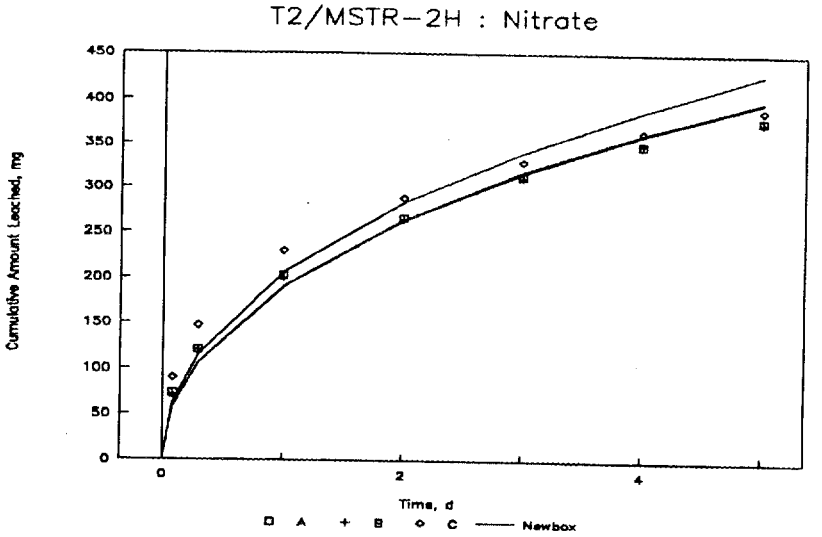
Per cent of 106-AN ion leachable:	312%	318%	286%
Eff. Diffusion Coefficient, sq cm/s:	9.38E-07	1.10E-06	1.38E-06
Std. Deviation, sq cm/s:	1.67E-07	2.52E-07	2.39E-07
Leachability Index:	6.028	5.958	5.859
Upper 95% Confidence Int.:	0.082	0.109	0.080
Lower 95% Confidence Int.:	0.069	0.087	0.067

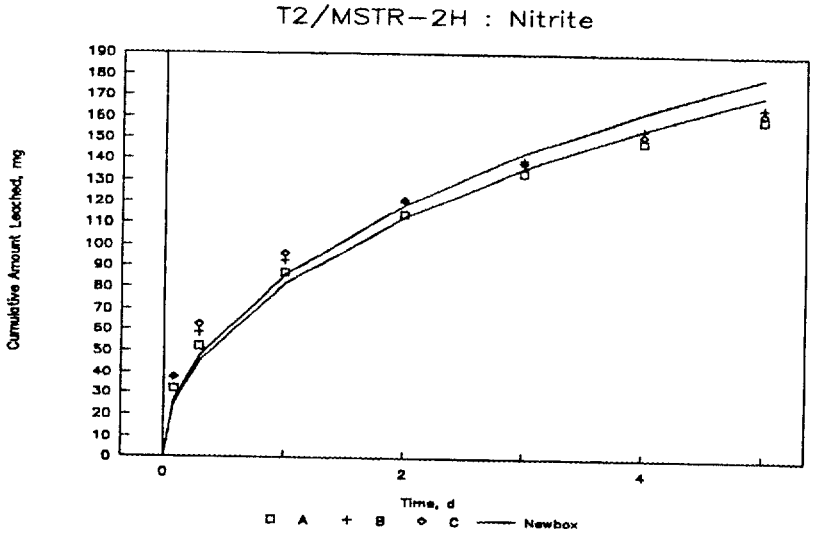
T2/MSTR- Nitrate + Nitrite

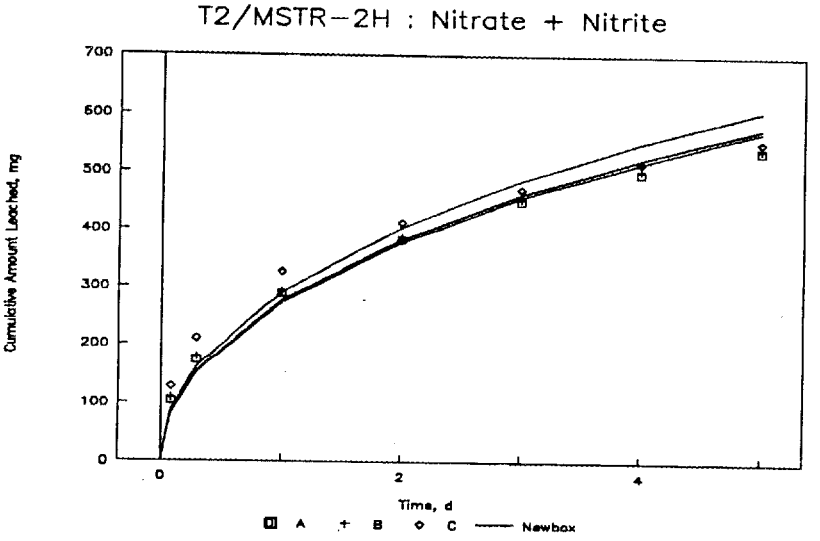
				0.00	0.00	0.00	0
1	104.83	108.94	127.22	81.57	82.77	87.45	0.083333
2	172.51	178.83	209.90	151.07	153.35	161.76	0.291666
3	289.51	293.08	326.23	272.44	276.45	290.96	1
4	381.72	385.96	410.87	376.85	382.15	402.75	2
5	447.76	452.08	469.20	455.16	460.21	484.94	3
6	498.44	505.16	516.42	517.15	523.63	550.70	4
7	538.28	542.06	552.60	570.98	577.29	606.59	5

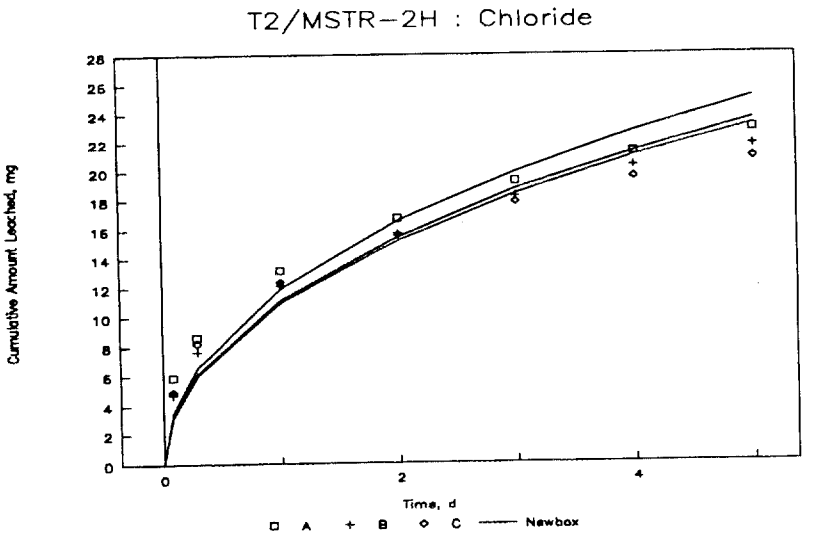
	Added in 106-AN			Newbox Estimate		
Ao =	1631.38	1626.18	1643.87	1631.38	1626.18	1643.87

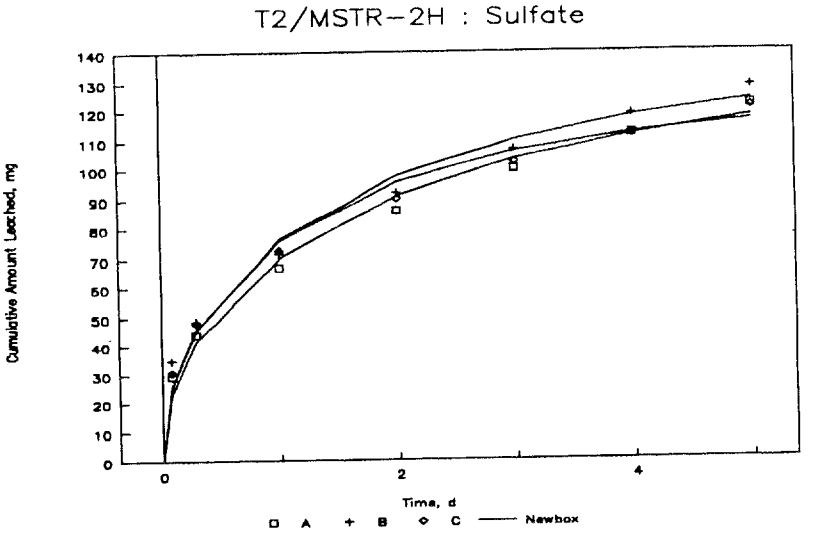
Per cent of 106-AN ion leachable:	100%	100%	100%
Eff. Diffusion Coefficient, sq cm/s:	6.93E-08	7.05E-08	7.68E-08
Std. Deviation, sq cm/s:	8.61E-09	9.61E-09	1.63E-08
Leachability Index:	7.159	7.152	7.114
Upper 95% Confidence Int.:	0.056	0.062	0.100
Lower 95% Confidence Int.:	0.050	0.054	0.081


T2/MSTR-2H : Nitrate
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox


T2/MSTR-2H : Nitrite
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox


T2/MSTR-2H : Nitrate + Nitrite
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox


T2/MSTR-2H : Chloride
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox


T2/MSTR-2H : Sulfate
Cumulative Amount Leached, mg
Time, d
A
B
C
Newbox

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	Dia., cm	2.53	2.51	2.50
23.38	4.65	Length,cm	0.74	0.71	0.75
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 mg/L			Mass in Leachate mg			
Interval	Batch 1	Batch 2	Batch 3	Batch 1	Batch 2	Batch 3	Time d
T2/MSTR- Chloride		Initially:		115.63	115.84	115.84	
0	157.53	177.86	182.22	25.36	27.87	28.94	0
1	6.88	12.05	5.12	1.11	1.89	0.81	0.083333
2	5.08	6.05	3.6	0.82	0.95	0.57	0.291666
3	5.96	7.78	0	0.96	1.22	0.00	1
4	3.64	3.25	4.47	0.59	0.51	0.71	2
5	2.01	1.63	3.06	0.32	0.26	0.49	3
6	1.37	0	2.26	0.22	0.00	0.36	4
7	0.99	0.53	1.66	0.16	0.08	0.26	5
T2/MSTR- Nitrite		Initially:		758.23	759.57	759.57	
0	1125.67	1232.42	1238.65	181.23	193.12	196.70	0
1	51.43	58.76	36.42	8.28	9.21	5.78	0.083333
2	32.39	41.69	24.57	5.21	6.53	3.90	0.291666
3	44.88	56.89	21.9	7.23	8.91	3.48	1
4	27.38	32.4	33.95	4.41	5.08	5.39	2
5	13.87	10.71	22.36	2.23	1.68	3.55	3
6	8.35	4.95	16.98	1.34	0.78	2.70	4
7	5.46	2.21	12.13	0.88	0.35	1.93	5
T2/MSTR- Nitrate		Initially:		1739.14	1742.23	1742.23	
0	2763.46	2998.54	3013.82	444.92	469.87	478.59	0
1	119.84	129.54	86.7	19.29	20.30	13.77	0.083333
2	71.2	90.74	51.21	11.46	14.22	8.13	0.291666
3	105.85	130.93	97.01	17.04	20.52	15.41	1
4	57.77	63.69	80.13	9.30	9.98	12.72	2
5	26.99	25.75	47.93	4.35	4.04	7.61	3
6	18.37	10.21	35.2	2.96	1.60	5.59	4
7	9.48	4.04	24.13	1.53	0.63	3.83	5

T2/MSTR- Sulfate		Initially:		64.75	64.86	64.86	
0	345.89	371.73	369.57	55.69	58.25	58.69	0
1	10.93	12.45	7.31	1.76	1.95	1.16	0.083333
2	6.59	7.64	3.04	1.06	1.20	0.48	0.291666
3	7.22	9.15	10.61	1.16	1.43	1.68	1
4	4.56	3.64	4.14	0.73	0.57	0.66	2
5	2.43	0	2.95	0.39	0.00	0.47	3
6	1.91	0	1.9	0.31	0.00	0.30	4
7	1.07	1.26	1.72	0.17	0.20	0.27	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
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
		Added in 106-AN			Newbox Estimate		
Ao =	115.63	115.84	115.84	29.5	32.8	32.1	

Per cent of 106-AN ion leachable:	26%	28%	28%
Eff. Diffusion Coefficient, sq cm/s:	1.12E-05	1.11E-05	1.37E-05
Std. Deviation, sq cm/s:	4.15E-06	3.47E-06	6.26E-06
Leachability Index:	4.951	4.955	4.864
Upper 95% Confidence Int.:	0.194	0.158	0.255
Lower 95% Confidence Int.:	0.134	0.115	0.160

T2/MSTR- Nitrite							
				0.00	0.00	0.00	0
1	189.51	202.33	202.48	189.48	201.32	201.37	0.083333
2	194.73	208.86	206.38	210.79	225.47	222.78	0.291666
3	201.95	217.78	209.86	211.00	225.70	223.00	1
4	206.36	222.85	215.25	211.00	225.70	223.00	2
5	208.59	224.53	218.80	211.00	225.70	223.00	3
6	209.94	225.31	221.50	211.00	225.70	223.00	4
7	210.82	225.65	223.43	211.00	225.70	223.00	5

	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

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

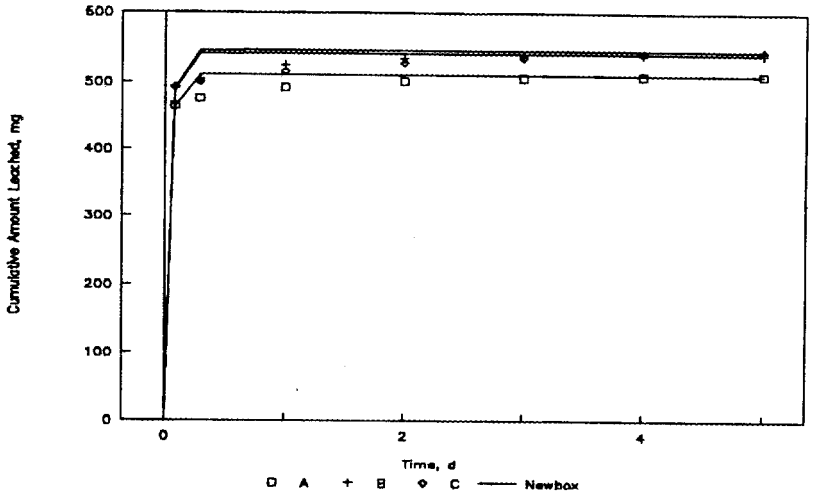
T2/MSTR- Nitrate + Nitrite

				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

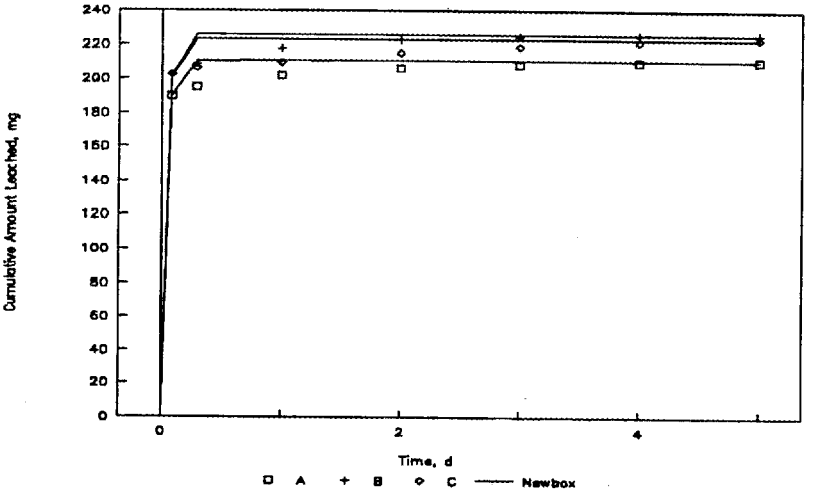
	Added in 106-AN			Newbox Estimate		
Ao =	2497.37	2501.80	2501.80	722	767	769

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

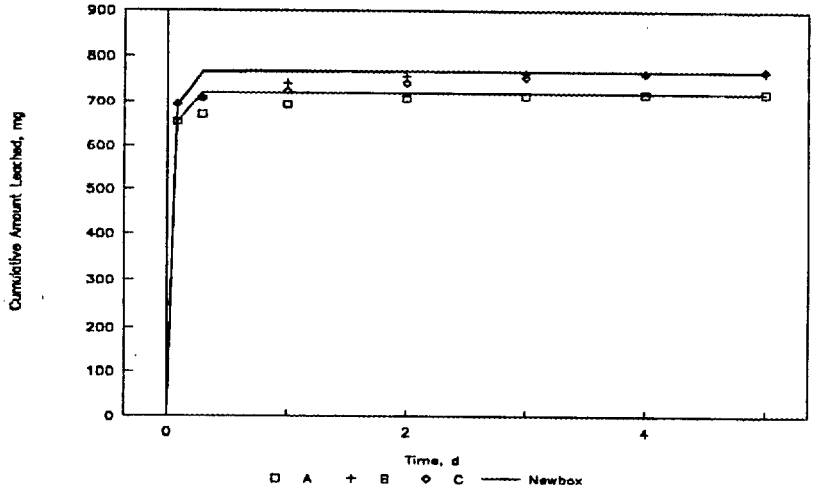
T2/MSTR–LOW : Nitrate



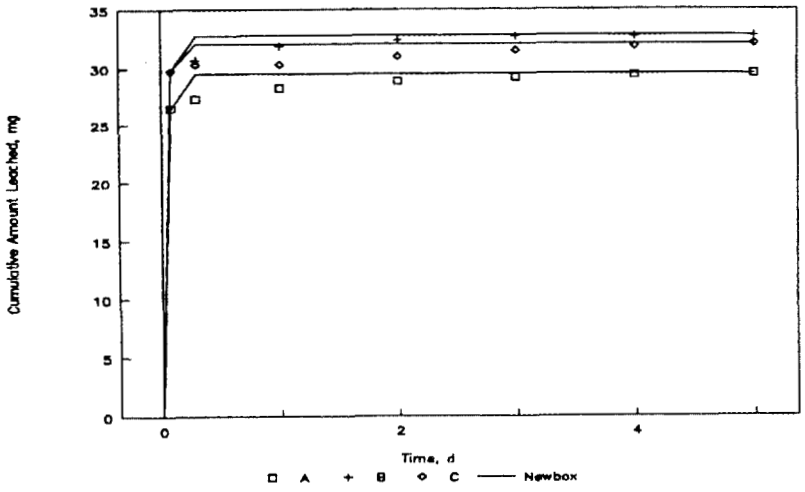
T2/MSTR–LOW : Nitrite



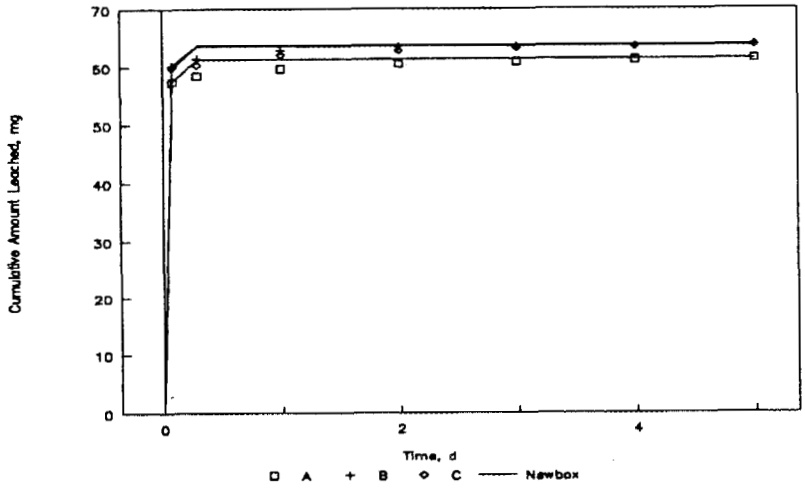
T2/MSTR–LOW : Nitrate + Nitrite



T2/MSTR–LOW : Chloride



T2/MSTR–LOW : Sulfate



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