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HALLIBURTON NUS
Environmental Corporation

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Pondcrete
Project

November 2, 1992

Mr. Edward M. Lee, Jr.
Program Manager
Solar Ponds Remediation Program
EG&G Rocky Flats, Inc.
Building 080
Golden, Colorado 80402-0464

Subject: Rocky Flats Plant Solar Evaporation Ponds Stabilization Project
[WBS230 TREATABILITY STUDY - HALLIBURTON NUS ROCKY FLATS DENVER]
Dewatering Treatability Study Performed for DOE Oak Ridge K25 Project
RF-HED-92-0755

Dear Mr. Lee:

Enclosed is a preliminary treatability study screening test performed on material contained in the 85,000 barrels located on Pad K-25 at Oak Ridge, Tennessee. The purpose of providing this report is to provide general information useful in evaluating potential A/B Sludge Dewatering Tests for the Rocky Flats facility.

HNUS was successful making a DOT Solid as defined by ASTM D-9096 using a super absorbent material blended with waste with a solids content ranging from 36-65 percent solids. HNUS is anticipating having a material which is approximately 15-25 percent solids to dewater. The Oak Ridge criteria for DOT Solids ASTM D-9096 is significantly more stringent than the D-9095 Paint Filter Test required at Rocky Flats.

For planning purposes, we should schedule about a 4-month period for treatability study work using Superabsorbents as desiccants or reconsider the ability to dewater the sludges to a higher percent solids than the 20 percent solids goal. In addition, the following unknowns need to be considered for detailed study analysis:

1) Long-term degradation of the flocculent used to entrance dewatering in the current rotary screen thickener.
2) Ability to cement and stabilize A/B sludges with super absorbent material homogenized within the matrix.
3) Physical properties of the sludges after introduction of Superabsorbents (viscosity versus time).
4) Effects of long-term degradation of Superabsorbent.

I hope this information is useful in planning various options for the Ponds Sludge Project. If you have any questions, please advise.

Sincerely,

HALLIBURTON NUS ENVIRONMENTAL
CORPORATION

Ted Bittner

Ted A. Bittner
Project Manager

TAB:tw
Enclosure

cc: D. Brenneman
D. Dougherty
S. Heiman
J. Schmidt

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ADMIN RECORD

TREATABILITY STUDY REPORTS

HALLIBURTON NUS
Environmental Corporation

INTERNAL CORRESPONDENCE

February 11, 1992

TO: J. Abshier
V. Kenyen

FROM: J.C. Milbourne
C. Sutton

SUBJECT: Laboratory Test Program For K-25 Samples

INTRODUCTION

A series of experiments were conducted at the HNUS laboratory facility in Pittsburgh, Pennsylvania to test samples of sludges/soils that had been removed from two ponds at the Oak Ridge K-25 site in Tennessee. The objectives of the test program were threefold: 1) to screen different additives with regard to their ability to enhance the filtration rate of the various samples from the two ponds; 2) to determine filtration rates on a Denver Equipment Filtration Press in order to provide scale-up data; and 3) to determine if the filtered solids from the Denver Equipment Press would pass the Liquid Release Test (LRT).

To accomplish the above objectives, the test program consisted of six distinct phases. The first phase involved combining individual samples into composite samples for filtration screening. The second involved characterizing the composites for solids content, viscosity, bulk density, and pH. The third phase consisted of performing screening tests using a Fann filter apparatus to determine the relative effect of the various additives. The fourth phase consisted of performing the filtration tests using the Denver Equipment Company's lab-scale piston filter press. The fifth phase involved subjecting the filter cake generated from the piston press tests to LRT testing. The sixth and last phase was a series of tests to determine settling rates of various samples.

Photographs were taken of the samples, equipment and filter cakes. A Log is provided with this report, as well as one set of photographs. The photographs are numbered on the back to correspond to the photo log.

EXPERIMENTAL AND DATA

Compositing

A total of 76 one quart glass jars were received at the Pittsburgh HNUS laboratory. These jars were inventoried and the percent free standing water estimated by C.Sutton on 1/21/92. These jars contained varying amounts of sludge, rocks, gravel, and free standing water. All samples from the "B" pond were emptied into a 5 gallon bucket and were homogenized using a small motor-driven mixer. Four composites were made from the "C" samples so as to represent various solids content. The sample jars comprising the various composites are shown in Table 1.

Composite Characterization

The five composite samples were analyzed for solids content, pH, viscosity, and slurry density. Solids content was determined by heating at 110°C for 18 hours; pH was measured with a hand-held pH meter and/or by pH paper (both gave similar readings). Slurry density involved weighing a known volume of slurry. The viscosities were measured by NUS geotechnical laboratory personnel using a Brookfield viscometer. Properties of the composites are shown in Table 2.

Screening Tests Using the Fann Filter Apparatus

Screening tests were performed using the 90 mm diameter Fann Filtration apparatus. Composite samples (150 ml) were mixed with various additives and then filtered under pressure. The filtrate volume was recorded as a function of time. The final filter cake thickness, cake moisture, and effluent pH were recorded. Results of these tests are included in Table 3.

The additives that were screened included: anionic, cationic, and nonionic flocculents; sodium silicate; diatomaceous earth; and lime. Composite B was screened using all additives. Only those additives indicating significantly increased filtration rates were tested on the Pond C composites. The filtration rate data are shown in Table 3, and initial filtration rates are presented graphically in Figures 1-7. The initial rates indicate that lime (CaO) had the most significant influence on filtration rate. The addition of 20% diatomaceous earth also provided higher filtration rates than the other additives that were tested. However, due to the relative low cost of lime, lime was used in the subsequent high pressure piston press tests. The polymeric flocculents were added to the solutions such that their concentrations were 100 ppm. At this concentration no significant effects on filtration rate were evident. Given the

high solids loading, perhaps this was not a sufficiently high concentration to show any effect on filtration rate. However, in sedimentation tests an anionic flocculent with lime showed a significant effect on setting rate (Table 5).

Denver Piston Press Tests

High pressure filtration tests were performed on various samples using the Denver Equipment lab-scale piston press test apparatus. The test unit was charged with conditioned sample, sealed, and then pressurized to a set point. The filtrate volume discharged from the test apparatus was recorded as a function of time. These data are presented in Table 4 and are also represented graphically in Figure 8.

Tests conducted on the Pond B composite included:

- no additives, 1500 psig
- 2.5% lime, 1000 psig
- 2.5% lime, 1500 psig

Tests conducted on the Pond C composites included:

- C-3, no additives, 750 psig
- C-4, no additives, 1500 psig
- C-4, 1% lime, 1500 psig

The dewatered filter cake was removed from the test unit at the end of the experiment. The final cake thickness and moisture were recorded. The filter cake was then charged into the LRT apparatus for testing.

The raw data from the test program was forwarded to Denver Equipment Company in Colorado Springs, Colorado for equipment sizing. The data were also sent to Larox and Eimco.

LRT Tests

The moisture content of the solids was the major determinant as to whether or not a sample would pass the LRT. Six of the LRT tests were performed on filter cakes from the Denver Equipment Filter Press. Two of the LRT tests were run on an individual sample (3138-5-1-V3) that had no free-standing water. This sample, first run on the LRT on an "as received" basis, had a moisture content of 29.2% and failed

to pass the test. The same sample air dried overnight had a moisture content of 12.5% and passed. Results of the various LRT tests are shown below:

Sample	Description	% H_2O in Filter Cake	Pass/Fail
B Composite	1500 psig	50.2	Fail
B Composite	2.5% CaO, 1500 psig	25.1	Pass
B Composite	2.5% CaO, 1000 psig	23.8	Pass
Sample 3138-5-1-V3	As received	29.2	Fail
Sample 3138-5-1-V3	Air dried	12.5	Pass
C-3 Composite	750 psig	23.8	Pass
C-4 Composite	1500 psig	27.9	Fail
C-4 Composite	1% CaO, 1500 psig	21.5	Pass

The data indicate that, at least for filter cakes from the Denver Equipment Filter Press, the moisture must be less than 25% to pass the LRT. It should be noted that these tests were not optimized as to final moisture content and that additional test work is necessary to definitively correlate the relationship between cake moisture and passing the LRT.

Settling Tests

A series of settling tests were performed to determine the thickening characteristics of the various materials. The technique involved addition of a known weight of solid sample to a 250 cc graduated cylinder. The graduated cylinder was then filled with water to the 250 cc mark. The cylinder was mixed several times and was then allowed to settle by gravity.

The height of the mudline or interface between the clear solution and the slurry was recorded as a function of time. Various additives including lime and anionic flocculents were also added to enhance settling rates. The data from the settling tests was graphed and sedimentation rates were determined using the Kynch method. The data are included in the appendix and are summarized below.

Sample	Unit Area FT2/TPD	Terminal % Solids
B Composite	20.45	20.3
B Comp + 2% CaO	23.47	16.1
B Comp + 2% CaO + .06% ASP721	6.61	20.3
C Composite	4.76	45.4
C Comp + .5% CaO	3.95	45.4
C Comp + .5% CaO + .02% ASP721	0.15	36.4

The data indicate that lime and anionic flocculent (ASP721) assist settling.

CONCLUSIONS

The following conclusions are the most important ones to be drawn from the data in this report.

1. Lime significantly enhanced filtration rates at concentrations of 1 to 2% for all B and C composites on which it was tested.

2. Diatomaceous earth at loadings of 20% produced filtration rates comparable to those of lime.

3. Polymeric flocculents at 100 ppm did not noticeably improve filtration rates, although perhaps significantly higher concentrations might.

4. A large body of data from both the Fann Filter and Denver Equipment Filter was produced to help in scaling-up for engineering design.

5. Experiments, primarily based upon filter cakes from the Denver Equipment apparatus, indicate that material containing less than 25% moisture will pass the LRT test.

6. Settling tests indicate that lime and an anionic polymeric flocculent increase sedimentation rates.

ENGINEERING CONSIDERATIONS

1. The test program met the objectives as stated earlier, i.e., screen additives to enhance filtration rate and to pass the LRT. However, due to sample and time limitations, the test program did not optimize filtration rates, nor did it evaluate the other types of filtration equipment. The resultant process design is based on less than optimal test data and is therefore perhaps not the best design possible.

2. Other types of dewatering equipment may be more cost effective than the Denver Piston Press for the application. The Larox filter and the Eimco recessed plate pressure filters should be able to produce a cake of acceptable quality that can pass LRT. Further drying would remove the residual moisture to a level that would pass the LRT. Air blowing may also provide a product that will pass LRT. However, this has not been tested in the laboratory. It is anticipated that the maximum moisture allowable in the cake will be 25%. A residual moisture of 10-20% is required to eliminate dust problems.

3. Optimization tests using more inexpensive equipment, with and without air blowing is recomended to improve project economics.

TABLE 1
Composition of Pond B Composite* Sample (I.D. = B)

Bottle Number	Replicate Number	Estimated Amount of Free Standing Water** (%)
938	1	0.5
1238	1	1.2
1338	1	35.4
2238	1	36.8
3238	1	55.8
3538	1	45.4
3738	1	47.0
3738	2	48.6
3838	1	57.6
5838	1	49.4
5838	2	49.3
6038	1	54.6
6038	2	73.2
6238	1	40.4
6238	1	48.6
6638	1	47.5
7038	1	57.1
7038	2	64.4
7438	1	48.4
7438	2	60.4
7738	1	51.1
7738	2	47.6
7938	1	43.2
7938	2	73.7

* All Pond B jars included in composite.
** Data taken on 1/21/92.

TABLE 1 Continued
Composition of One Pond C Composite Sample (I.D. = C1)

Bottle Number	Replicate Number	Estimated Amount of Free Standing Water* (%)
2938	1	59.6
2938	2	60.1
2938	3	54.6
4738	1	51.5
4738	2	57.4
4738	3	62.3

* Data taken on 1/21/92.

TABLE 1 Continued
Composition of a Second Pond C Composite Sample (I.D. = C2)

Bottle Number	Replicate Number	Estimated Amount of Free Standing Water* (%)
2738	1	36.0
2738	2	45.5
2738	3	31.1
2738	4	38.2
4538	1	27.5
4538	2	36.9
4538	3	39.4
4538	4	34.2
5738	1	39.5
5738	2	34.1
5738	3	31.2
5738	4	38.5

* Data taken on 1/21/92.

TABLE 1 Continued
Composition of a Third Pond C Composite Sample
(I.D. = C3)

Bottle Number	Replicate Number	Estimated Amount of Free Standing Water* (%)
1538	1	0
1538	2	0
3938	1	0
4638	1	0
4638	2	0
5438	1	0

* Data taken on 1/21/92.

TABLE 1 Continued
Composition of a Fourth Pond C Composite Sample
(I.D. = C4)

Bottle Number	Replicate Number	Estimated Amount of Free Standing Water* (%)
2338	1	7.0
2338	2	6.7
3038	1	17.4
3038	2	23.8
5538	1	9.7
5538	2	9.7
5638	1	31.2
5638	2	35.6
5638	3	31.2

* Data taken on 1/21/92.

TABLE 2
Properties of Composite Samples

Composite I.D.	% Solids	Viscosity (Centipoise)	Bulk Density (g/cc)	pH
B	31.5	300	1.22	7
C-1	28.2	180	1.18	7
C-2	36.3	1125	1.31	8.5
C-3	66.9	*	1.67**	*
C-4	47.8	>5000***	1.42	10

* Solid sample, viscosity and pH not determinable.
** Estimated from graph of % solids vs density.
*** Estimated from graph of viscosity vs density.

TABLE 3
FANN FILTER SCREEN TESTS

POND	B	C-1	C-2	B	B	B	B	B
TEST	0	1	2	3	4	5	6	7
ADDITIVES	NONE	NONE	NONE	.2% CaO	2% CaO	NONE	NaSiO2	ASP711
PRESSURE	80	80	80	80	80	80	80	80
FEED*								
% SOLID	31.5	28.2	36.3	31.5	31.5	31.5	31.5	31.5
VISCOSITY	300	180	1125	300	HIGH	300	300	300
pH, NAT.	7	7	8.5	7	7	7	7	7
VOLUME,cc	150	150	150	150	150	150	150	150
SG, g/cc	1.22	1.18	1.31	1.22	1.22	1.22	1.22	1.22
EFFLUENT								
CLARITY	CLEAR	CLEAR	CLEAR	PL YELL.	CLEAR	CLEAR	SL.CLDY	CLEAR
pH	7	7	8	7	10	7	7	6
CAKE								
% SOLID	65.2	61.8	61.3	60.6	63.3	63.0	61.7	62.4
THICK.,mm	11	10	13	12		12		11

* Properties prior to additives.

FILTRATE VOLUME (ml)

TIME,min	TEST 0	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	TEST 6	TEST 7
1	14	14	11	17	28	15	16	15
2	21	21	17	25	39	22	22	22
3	27	27	21	30	48	27	28	30
4	31	31	25	35	56	31	32	36
5	35	35	28	39	65	35	36	39
6	38	38	31	43	70	37		
7	43	43	33	47		42	42	46
8	47	47	35	50		45	46	
9	52	52	38	53		48	49	
10	55	55	41	56		51	51	54
15	65	65		69		61	64	65
20	74	74		80		72	74	
25		84		90		80	83	83
27	89	89						
29		92						90
30				98		88	92	
33						94		
35	92						98	
40								
45								
50								
55								
60								

TABLE 3 Cont
FANN FILTER SCREEN TESTS

POND	B	B	B	B	C-2	C-2	C-1	C-1
TEST	8	9	10	11	12	13	14	15
ADDITIVES	ASP713	ASP715	10% DE	20% DE	2% CaO	20%DE	2%CaO	20%DE
PRESSURE	80	80	80	80	80	80	80	80
FEED*								
% SOLID	31.5	31.5	31.5	31.5	36.3	36.3	28.2	28.2
VISCOSITY	300	300	300	300	1125	1125	180	180
pH, NAT.	7	7	7	7	8.5	8.5	7	7
VOLUME,cc	150	150	150	150	150	150	150	150
SG, g/cc	1.22	1.22	1.22	1.22	1.31	1.31	1.18	1.18
EFFLUENT								
CLARITY	CLEAR	CLEAR	CLEAR	CLEAR	VLT.YLW	CLEAR	CLEAR	CLEAR
pH	6	6	7	6.5	+11	8.5	+11	8
CAKE								
% SOLID	61.0	61.0	62.4	61.8	55.8	60.2	56.7	59.9
THICK.,mm	12		11	13		15	11	11/15

* Properties prior to additives.

FILTRATE VOLUME (ml)

TIME,min	TEST 8	TEST 9	TEST 10	TEST 11	TEST 12	TEST 13	TEST 14	TEST 15
1	14	16	18	20	15	14	22	21
2	21	22	26	30	23	21	32	32
3	26	27	32	38	29	26	40	40
4	30	32	37	44	33	30	46	46
5	34	35	41	50	37	35	52	52
6	38	39	46	54	41	38	58	58
7	41	42	50	59	45	42	62	62
8	44	45	53	63	49	44	67	67
9	47	47	57	68		48	71	71
10	50	50	60	72		50	75	75
15	62	61	74			58	83	90
20	72	71	80					
25	81	80						
27								
29	89							
30		88						
33		90						
35								
40								
45								
50								
55								
60								

TABLE 3 Cont
FANN FILTER SCREEN TESTS

POND	B	C-4	C-4
TEST	16	17	18
ADDITIVES	NONE	NONE	1%CaO
PRESSURE	100	100	100
FEED*			
% SOLID	31.5	47.8	47.8
VISCOSITY	300	>5000	>5000
pH, NAT.	7	10	10
VOLUME,cc	150	150	150
SG, g/cc	1.22	1.42	1.42
EFFLUENT			
CLARITY		CLEAR	CLEAR
pH		10	12+
CAKE			
% SOLID	61.5	66.2	N/A
THICK.,mm	10.0		N/A

* Properties prior to additives.

FILTRATE VOLUME (ml)

TIME,min	TEST 16	TEST 17	TEST 18
1	15	10	too
2	22	14	viscous
3	28	16	to
4	32	19	filter
5	37	21	
6	40	23	
7	44	26	
8	47	27	
9	50	28	
10	53	31	
15	66	36	
20	76		
25	86		
27	91		
29			
30			
33			
35			
40			
45			
50			
55			
60			

TABLE 4
DENVER EQUIPMENT DEWATERING FILTER TESTS

POND	B	B	B	C-3	C-4	C-4
TEST	1	2	3	4	5	6
ADDITIVES	NONE	2.5% CaO	2.5% CaO	NONE	NONE	1.0% CaO
PRESSURE	1500	1000	1500	750	1500	1500
FEED*						
%SOLID	31.5	31.5	31.5	66.9	47.8	47.5
VISCOSITY	300	300	300	—	>5000	>5000
pH, NAT.	7	7	7	—	10	10
VOLUME,cc	600	600	600	600	600	600
SG,g/cc	1.22	1.22	1.22	1.67	1.42	1.42
CAKE						
% SOLID	49.8	76.2	74.9	76.2	72.1	78.5
THICK.,mm	—	35	37	76	65	58

* Properties prior to additive.

FILTRATE VOLUME (ml)

TIME,min	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	TEST 6
2	38		50	12	29	32
3	46	46	66		35	40
5	59	76	88	17	45	51
7	70				54	62
8			118			
10	83	123	133	23	65	74
15		157	168	28	79	
20	117	185	198	32	90	104
30	142	232	244	40	112	128
40	165	272	287		129	148
50		308	323	52	145	174
60	200	332	358	56	159	188
70	219	380	386	61	172	
80	232	398	411	66	283	210
90	246	406	430	70	195	223
100	274	410	440	74	205	236
110	286				215	247
120				80	224	
130				83	233	272
140				86	242	380
150					250	288
160						296
170					269	
180					277	
190						310
200						
210						318
220						320

TABLE 5

SETTLING TEST DATA
K-25 POND
FEB. 2, 1992
NUS LABORATORY, PITTSBURGH, PA.

B COMPOSITE 35 GM DRY SOLID, 250 ml GRADUATED CYLINDER

NO ADDITIVE		2% CaO		2% CaO + .06% ASP721	
TIME, min	HEIGHT,ml	TIME, min	HEIGHT,ml	TIME, min	HEIGHT,ml
0	252	0	250	0	250
10	243.5	10	244	5	237
16	236	22	236	10	200
22	229.5	55	225	17	182
26	224.4	83	219	23	174
36	214	104	215	60	158
46	205	144	208	840	152
61	194	268	205		
76	181	294	201		
81	177	361	193		
		384	190		

C-2 COMPOSITE 28.2 GM DRY SOLID, 250 ml GRADUATED CYLINDER

NO ADDITIVE		0.5% CaO		0.5% CaO + 0.02%ASP721	
TIME, min	HEIGHT,ml	TIME, min	HEIGHT,ml	TIME, min	HEIGHT,ml
0	250	0	250	0	250
2	235	3	216	0.17	80
3	225	5	185	0.5	68
4	214	7	158	1	60
5	204	10	118	2	60
7	182	15	69	3	60
10	154	20	56		
15	106	25	50		
20	66				
30	49				
40	46				
50	44				

FIGURE 1
FANN FILTRATION DATA, B COMPOSITE

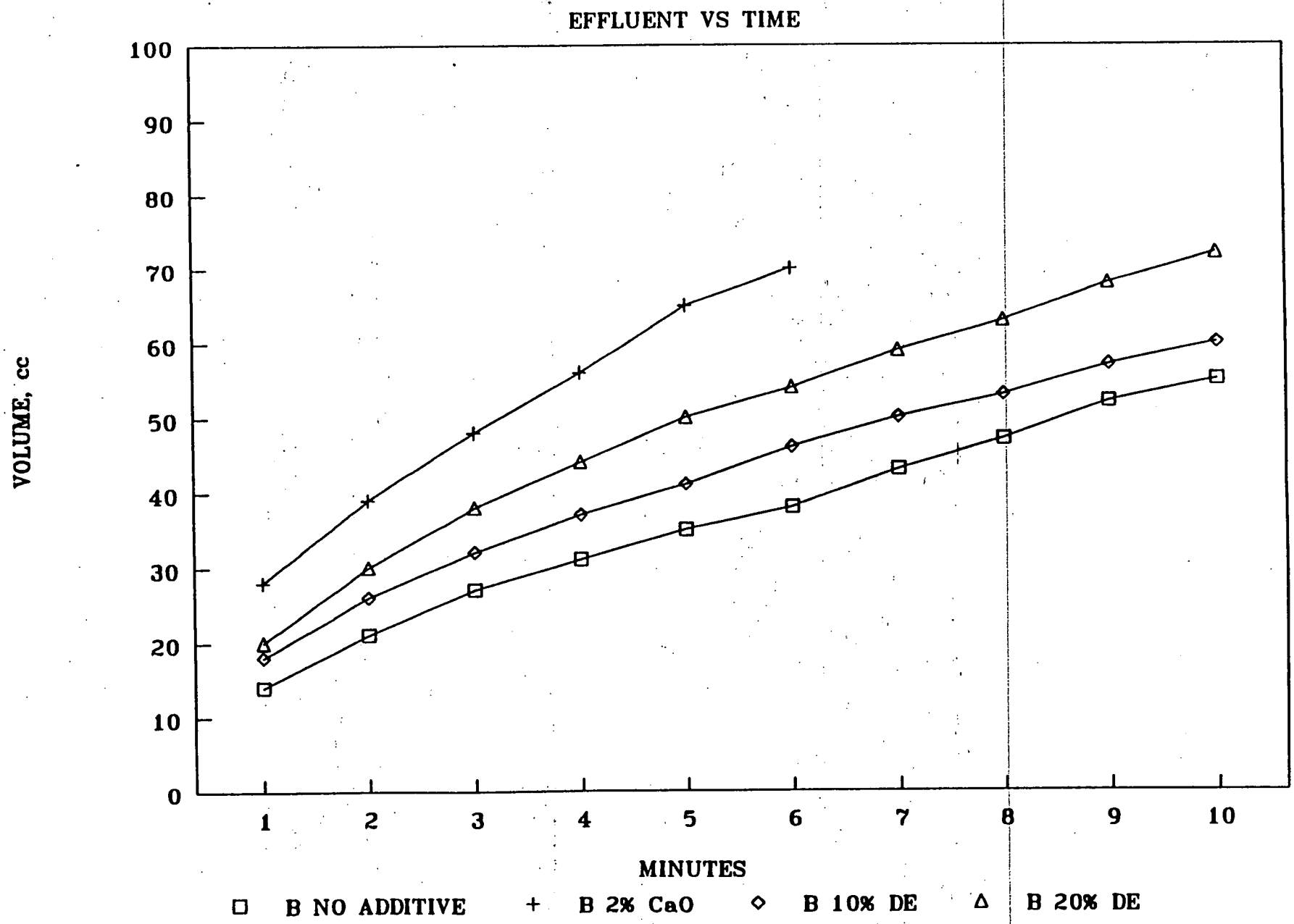

FIGURE 2
FANN FILTRATION DATA, B COMPOSITE

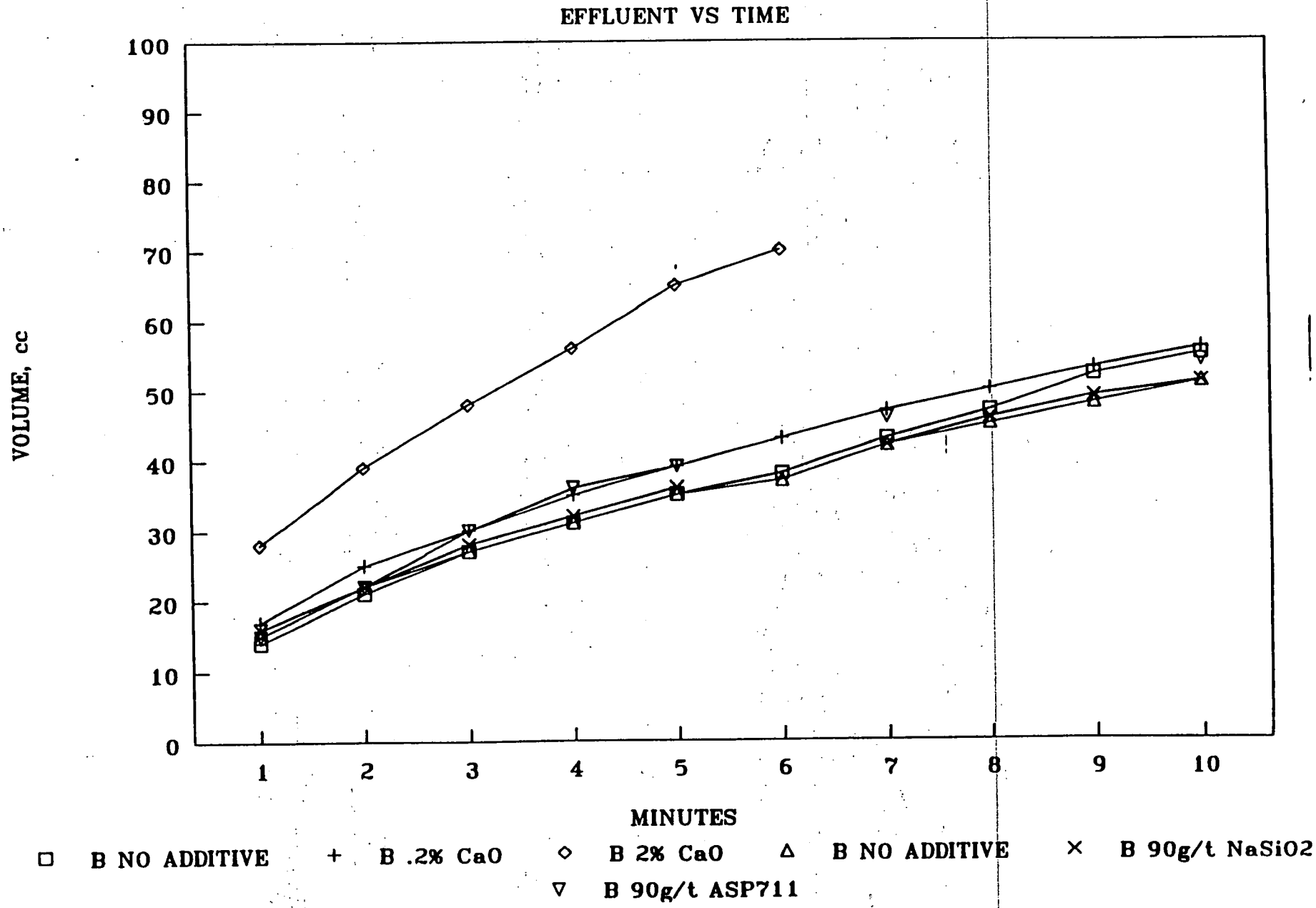

FIGURE 3
FANN FILTRATION DATA, B COMPOSITE

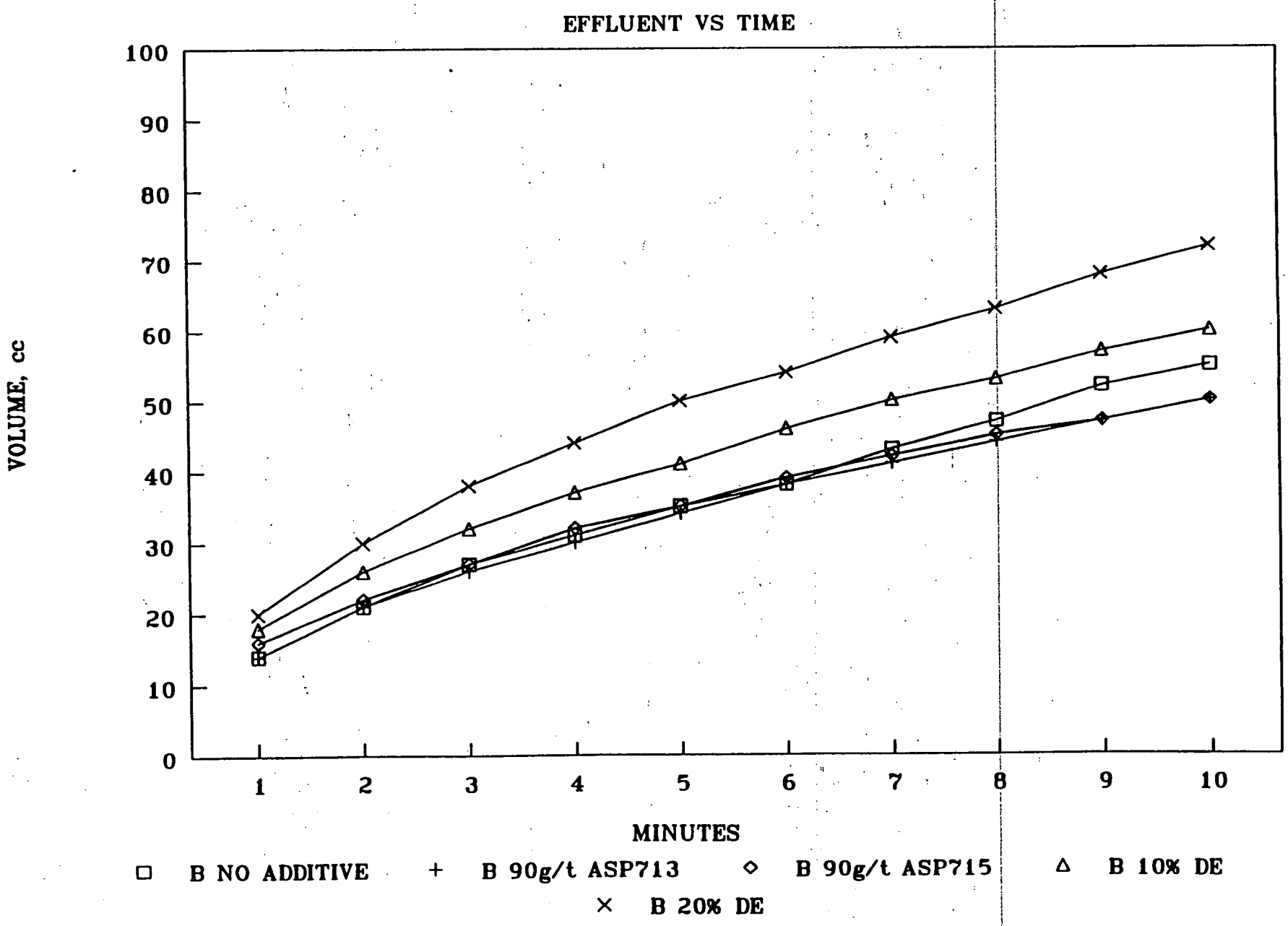

FIGURE 4
FANN FILTRATION DATA, B COMPOSITE REPLICATES

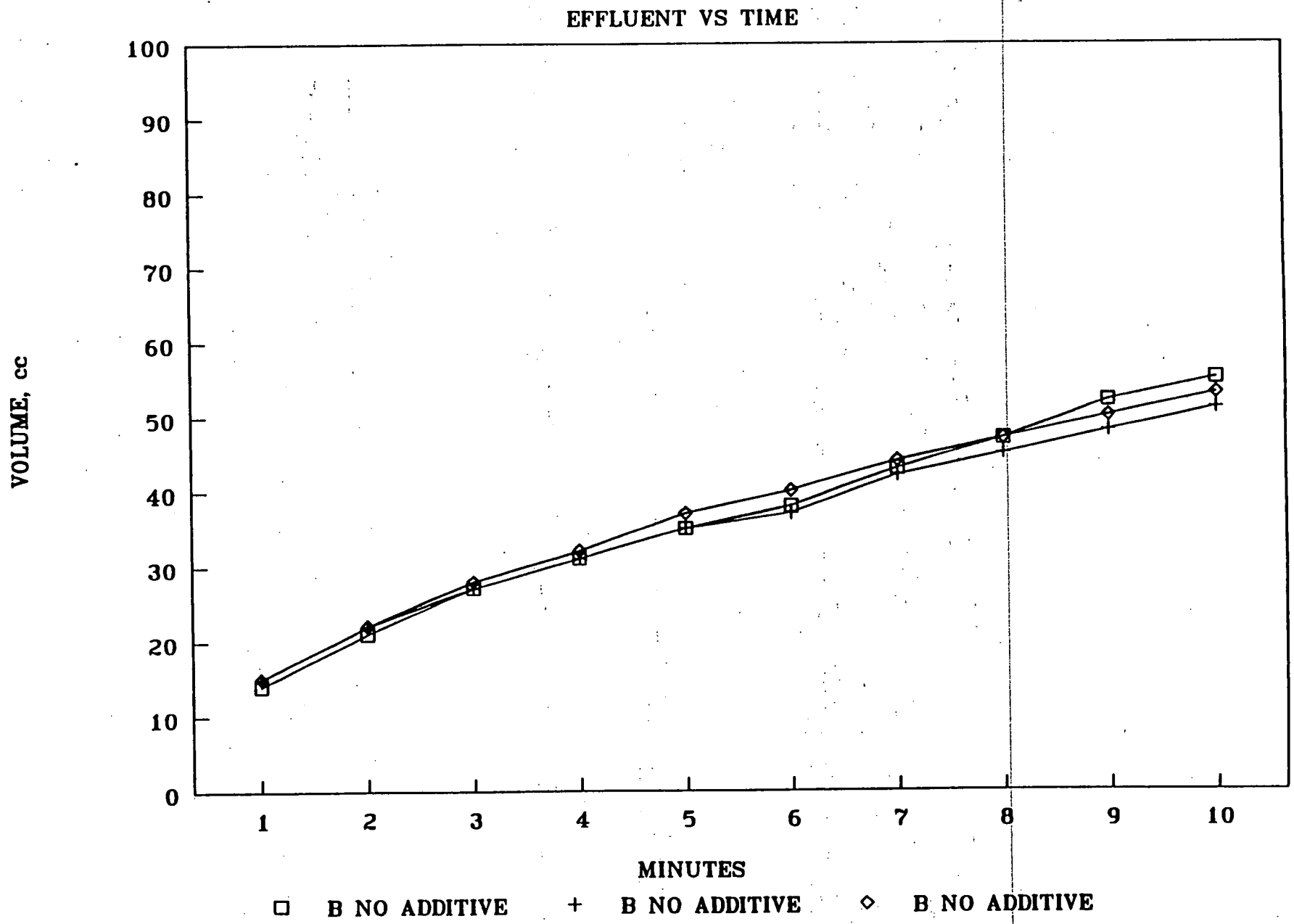

FIGURE 5
FANN FILTRATION DATA, C-2 COMPOSITE

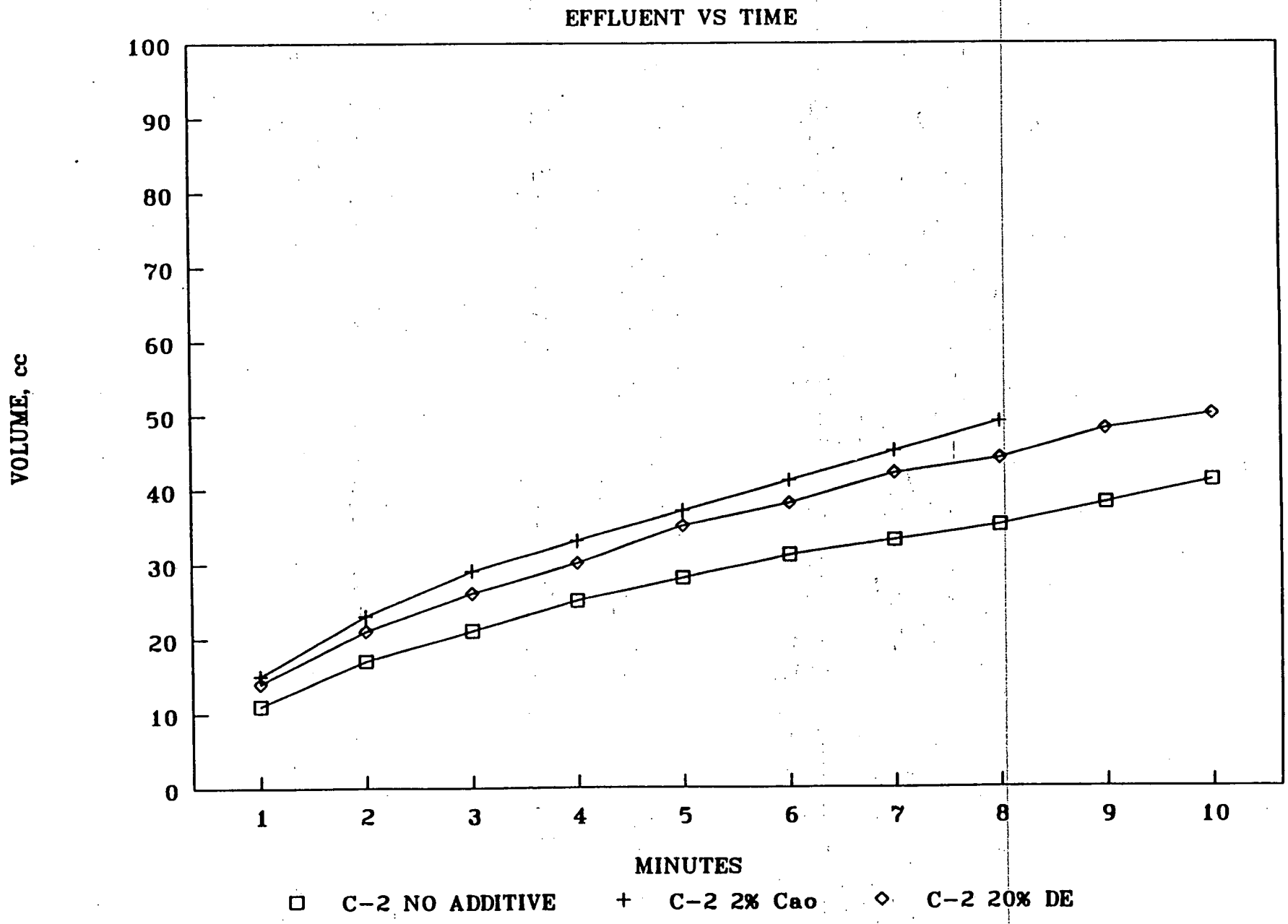

FIGURE 6
FANN FILTRATION DATA

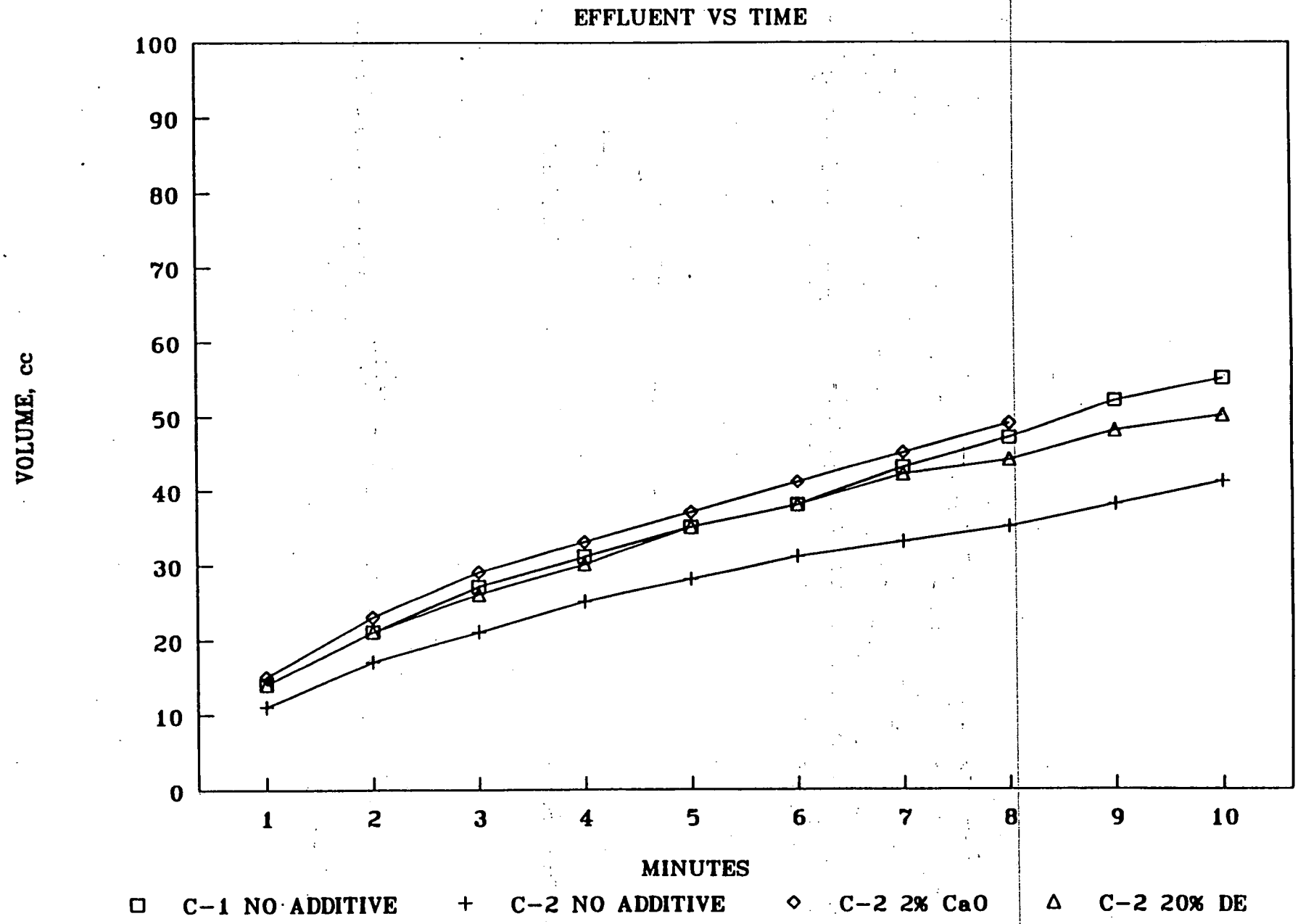

FIGURE 7
FANN FILTRATION DATA

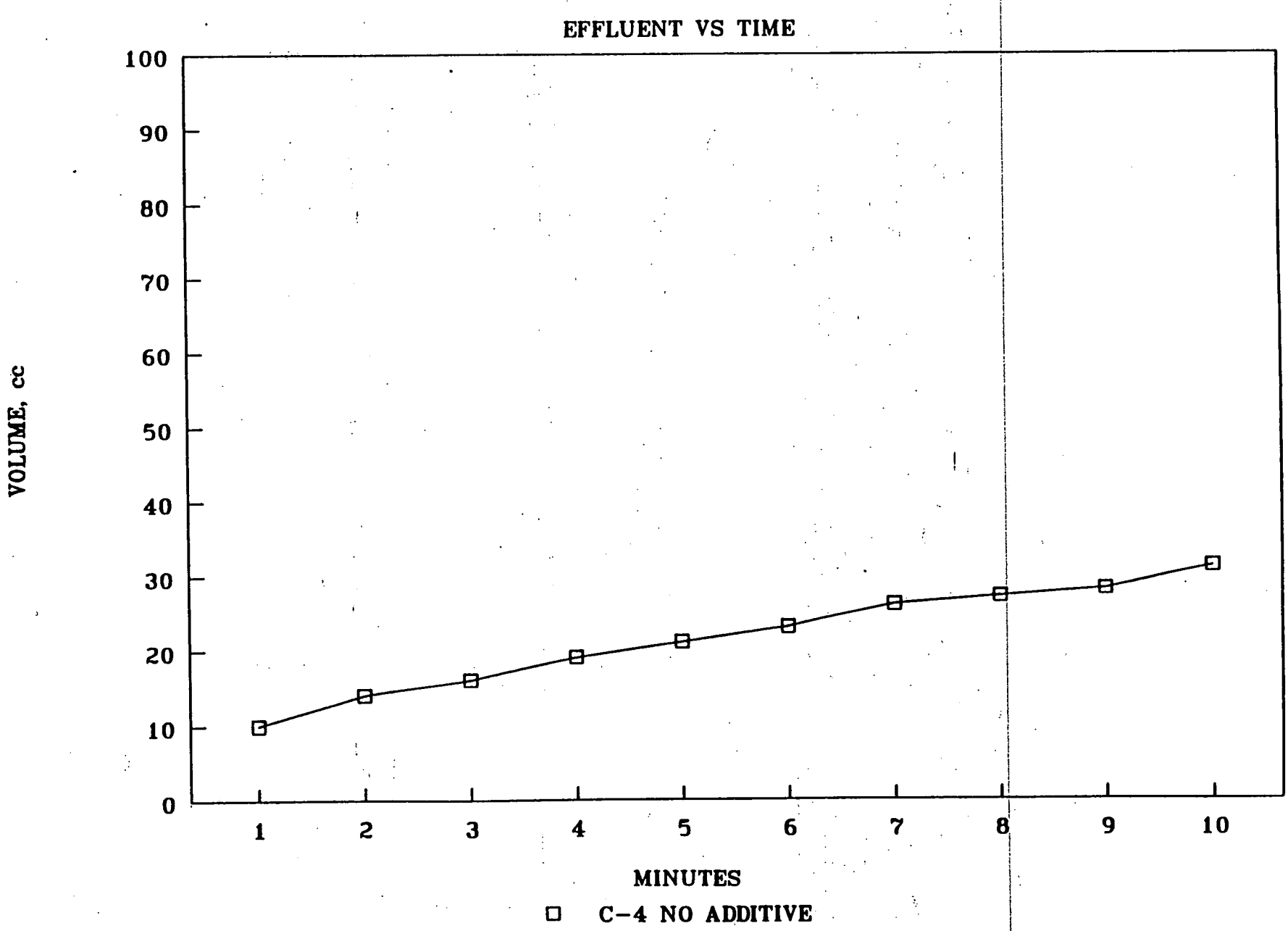

FIGURE 8
DENVER PISTON PRESS FILTRATION DATA

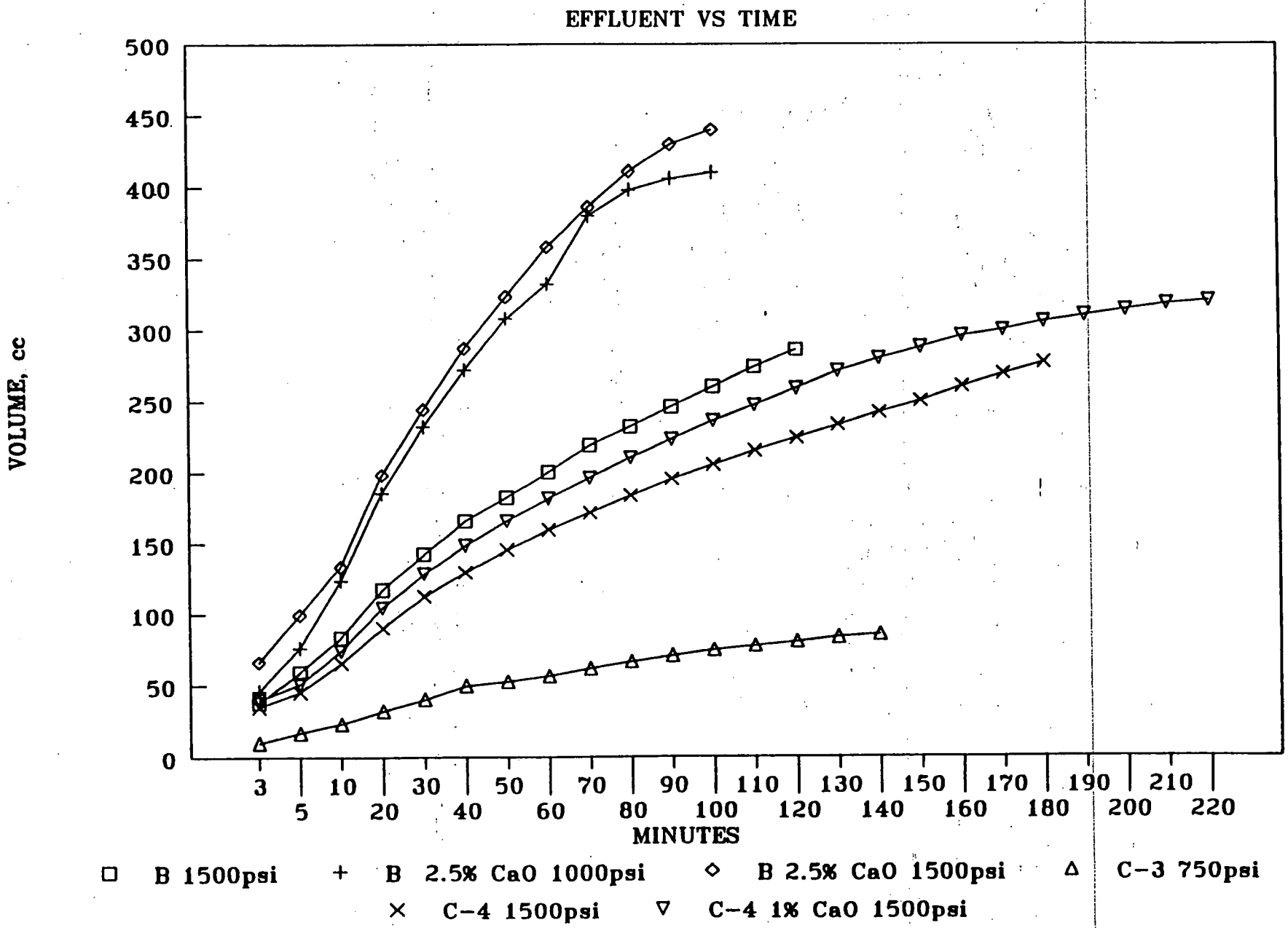

PHOTO LOG

Photo #	Description
24	Atypical samples from Pond B: 1338-5-1-V3 (right), 2238-5-1-V3 (left), These samples are brownish and have standing water
23	Typical samples from Pond B. Black standing water and black solids. Sample 7738-5-2-V3 (left), Sample 7438-5-1-V3 (right)
22	Very little free standing water, Sample 938-5-1-V3, Pond B
21	Granular clumped clay. Dry material from Pond C. 1538-5-2-V3 (left), 3138-5-1-V3 (right)
20	Sticky clay from Pond C. No free standing water. 3338-5-2-V3 (left), 1038-5-2-V3 (right)
19	Typical sample from Pond C. Two sediment layers--one brown above and one black. Free standing water. 4738-5-2-V3 (left), 2938-5-3-V3 (right)
17	LRT test rig
16	Assembled LRT and running test on 3138-5-1
15	Failed LRT test of 3138-5-1 Filter cake + wet filter and dry filter for comparison
14	Pond C samples to be composited containing 50 to 65% free standing water.
13	Passed LRT of 3138-5-1-V3. LRT run after this sample had been air dried overnight.
12	Denver Equipment test rig running on "dry C" composite (C-3).
11	Filter cake of "dry C" composite that passed LRT (550-750 psi).
10	Filter cake of composite C-4 after Denver Filter Press. Note clear filtrate.

BENCH SCALE TREATABILITY STUDY USING SUPERABSORBENT COMPOSITIONS ON K-25 SAMPLES

INTRODUCTION

The physical properties of sludges as in K-25 are largely controlled by two factors:

(1) Sludge, general texture
(2) Sludge, structure

The general texture is determined by the relative amounts of different particle sizes occurring in the sand, silt, loam and clay. The sludge structure is determined by the stable arrangement of these primary particles as they stabilize themselves into primary aggregates. A good sludge structure is therefore an arrangement of the sludge particles. The most satisfactory sludge is apparently stable aggregates that range in size from a pinhead to the size of a pea.

It is known that certain hydrocolloids, occurring naturally in adequate quantities in good soil are responsible for cementing together primary particles to form water stable aggregates of optimum size; thus creating good soil structure by their binding action. These naturally occurring materials are formed in small quantities and are rapidly consumed by soil bacteria. The structure characteristics of different types of soil vary widely and when the soil has depleted its organic matter, it no longer has proper pore space; its moisture absorption and holding capacity is low and cracks or fissures may develop which hastens water loss. Superabsorbents with proper functionality are a synthetic replacement for these natural hydrocolloids. A broad definition of a super absorbent is based on the concept of adding a colloidal material with power or in dispersed form which will swell in a liquid vehicle to form its own particles which exhibit thixotropic behavior.

The resultant structures are strong enough to resist low stresses and boost the liquids viscosity, therein eliminating phase separations, conditions. The proposed super absorbents can be tailor made for each type of sludge and formulated so that they retain their aggregating power as well as be inert to soil bacteria. The primary effect of the superabsorbents in sludges of the K-25 type is to stabilize the clay and sand aggregates against the dispersing or slaking action of the water. The proposed superabsorbent are water soluble resins and when dispersed in the K-25 sludge, become solubilized. They are readily absorbed to the colloidal clay particles binding them through the carbon linkage bridge between the reactive groups on the polymer. As a general rule the ultimate level of absorption is about equal to the anion exchange capacity of the clay in the sludge. The mechanism of aggregations is postulated as follows:

(1) Although the proposed superabsorbents are water soluble polymers (a necessity for adequate dispersion) when dispersed in the sludgetreactive

groups and absorbed in the clay particles by exceeding powerful forces of attraction and they cannot be leached out by water.

(2) The maximum aggregation effect at the lowest concentration of superabsorbent is obtained by the presence of Ca, Mg, Na and other indications which are present in most ponds and sludges.

From the foregoing it becomes apparent that the sludge with superabsorbent basically requires sufficient mechanical dispersion (high shear) of the material throughout to permit subsequent solubilizing of the polymer in the moisture to complete the activation. The hydrogel created by the high shear modiolus exhibit thixotropic behavior, give much improved gel strength and excellent filter cake characteristics.

The effects of the superabsorbent treatment are dramatically apparent in the formulation of aggregates which are readily observable in mixing. The integrated sludge mass becomes quite porous and friable giving numerous round spongy balls of various sizes. The treated swollen sludge is easy to work and has a dry feel to the touch. The most spectacular effect produced by the superabsorbent treatment is the water holding capacity and its workability at high moisture content. The evaporation from a treated sludge is also greatly reduced because of the much-like character of the surface.

BENCH SCALE TREATABILITY STUDIES USING SEVERAL SUPERABSORBENT COMPOSITIONS ON K-25 B POND

The purpose of this bench scale study was to demonstrate the effectiveness of several superabsorbent compositions on sludge from the K-25 B-pond. The filtration properties of the sludge composites were evaluated by the standard API filters loss test. This static filtration test which takes place when the mixture is not stirred and the filter cake grows undisturbed (swelling and expansion). It was demonstrated that a stable hydrogel containing about fifty percent pond water could be formed using a 1.5% superabsorbent preparation. A crumbly, easily worked mass of small aggregates was formed. When the treated sludge was placed in the API filter loss apparatus and 100 psi of air pressure imposed on the aggregated swollen mass, immediate break-through of air occurred and no moisture was collected in the filtrate. The filter cake was removed and a thick spongy mass observed. This crumbly solid material cannot be pumped but can be handled by mechanical means including shovels, scoops, front end loaders, conveyors, etc. The spongy mass had a dry feel with no evidence of any free moisture on the surface. There is no upper limit to the amount of absorbent which can be combined with the K-25 sludge. However, for economic reasons, the preferred range of addition is from 1 to 2.5 parts absorbent to one hundred parts of water. Additionally the crumbly composite of the B pond sludge may also be readily encapsulated (stabilized) in cement therein permitting safe disposal of the entire mass of sludge without any radioactive leakage.

SUMMARY OF PROJECTED SUPERABSORBENTS EFFECTS
OF
K - 25 SLUDGE

- STABILIZATION OF AGGREGATES
- EASIER WORKABILITY
- BETTER DRAINAGE
- INCREASED AERATION
- MUCH IMPROVED WATER HOLDING CAPACITY
- RETARDED MOISTURE LOSS THROUGH EVAPORATION
- GREATER DIMENSIONAL STABILITY ON WETTING AND DRYING
- PREVENTION OF SLAKING AND CRUSTING
- TOTAL CONSOLIDATION OF SLUDGE (WATER/SAND/SILT/CLAYS)
- EASE OF ENCAPSULATING WITH CEMENT

K-25 DEWATERING TREATABILITY STUDY

Additional Results for D-25 Filtration
Tests Using Larox Lab Test Unit.

BACKGROUND

Joe Milbourne visited the HALLIBURTON NUS laboratory in Pittsburgh, Pennsylvania last week to conduct a series of lab scale filtration tests with the Larox test unit. These tests were deemed necessary due to the relatively low unit throughput observed in the Denver Equipment piston press tested earlier this month.

Joe was joined by Kurt Polins, Sales Engineer from the regional Larox office in Maryland. Kurt brought on older lab test unit that was used for all of the filtration tests.

The data generated by the lab unit was used by the engineers at Larox to calculate the requisite filtration area and cycle times for a given dry solids feed rate and for a final cake moisture. The lab data was also given to Eimco to assist their design engineers in the selection of a recessed plate filter press. Joe is am also sending the data to Andritz to allow them to size a Hyperbaric filter.

TEST WORK

The Larox test apparatus used in the recent round of tests operated in a batch mode. The test unit simulates all cycles of operation found in Larox's commercial units including: loading, pressing, air blowing, and cake discharge. The loading of the test unit was to be accomplished by creating a vacuum in the filtration chamber of the unit that would then draw the sample into the filtration chamber. This procedure was ineffective due to the high viscosity of the test samples. Loading was accomplished by removing the filter media support plate at the base of the unit and ladling the sample into the filtration chamber.

The only parameters that were varied during the tests were the amount of sample introduced to the unit (which ultimately dictates cake thickness) and the press cycle time.

The tests were conducted on the same samples that were used in the Denver Piston press tests with the exception that the high % solids sample 3138-5-1-V3 was not tested due to difficulty in loading the test unit. The sample designations for the Larox tests are as follow:

SAMPLE	DESCRIPTION
B COMPOSITE	Same as in HNUS report (Milbourne, Sutton to Abshier, 2/11/92
C-1 COMPOSITE	Same as C-2 " " " " " " "
C-2 COMPOSITE	Same as C-1 " " " " " " "
C-3 COMPOSITE	Same as C-4 " " " " " " "

TEST RESULTS

The data from the Larox tests is presented in the appendix. This data has been distributed to other filter vendors including Eimco, Andritz and Filtra Systems to assist their engineers in specifying a filtration system.

The test procedure consisted of: charging the test unit with a predetermined volume of sample slurry; pressurizing the unit to 16 bar (235 psig) and pressing for a predetermined amount of time; air blowing the filter cake for 2 minutes; and discharging the filter cake. The wet cake weight and thickness were recorded. A sample of wet cake was fired in a 105 degree C oven for 18 hours to determine the cake moisture.

The test conditions included: as received, 1% CaO, 2% CaO for the B Composite; 1% CaO and 2% CaO for the C-1 and C-2 Composites; and 1% CaO for the C-3 Composite sample. The reagent addition levels were determined in previous Fann Filter tests performed earlier in late January and early February. Although not optimized, these additions provided a significant improvement in filtration heat over untreated material.

The data indicates that the Larox test unit was only able to achieve cake moistures in the range of 30.8% to 34.6% moisture. The filtration cycle time necessary to achieve these moisture level varied from a low of 10 minutes to a high of 45 minutes. A 2 minute air blow was used for all tests.

The test engineer from Larox will forward his recommendation for equipment size based on the optimum cycle time and cake thickness. The relatively high cake moistures indicate that a cake drying step will be required to achieve the 25% moisture target previously identified as the upper limit required to pass the LRT.

It is anticipated that the other filter vendors will be able to provide the same dewatering capacity as the Larox equipment, i.e., ultimate cake moisture at or near 30%

SUMMARY

1) The Larox test unit was able to dewater the B Composite to approximately 30.8% moisture. The C Composites had slightly higher moisture contents in the filter cake ranging from 32.4% moisture to 35.1% moisture. These moisture levels are higher than the expected 25% threshold moisture level necessary to pass the LRT. As a result, a dryer will be required to lower the filter cake moisture to 25%.

2) The filtration performance of the Larox test unit is thought to be typical of the performance expected from other pressure filters including the Eimco - Shriver, Verti-Press, and Andritz Hyperbaric.

3) Test data is only as good as the sample.

APPENDIX

LAROX FILTER TEST DATA

LAROX FILTER TEST DATA
HALLIBURTON NUS LABORATORY, PITTSBURGH, PA.

FEED CONDITIONS

TEST	1	2	3	4	5	6	7	8	9	10
SAMPLE	B	B	B	B	B	C-1	C-1	C-2	C-2	C-3
VOLUME,cc	100	300	200	200	200	100	200	200	200	200
SLURRY SG,	1.22	1.22	1.22	1.22	1.22	1.31	1.31	1.18	1.18	1.42
% SOLIDS	31.5	31.5	31.5	31.5	31.5	36.3	36.3	28.2	28.2	47.5
TEMP, F	AMB	AMB	AMB	AMB	AMB	AMB	AMB	AMB	AMB	AMB
CaO,%	NONE	NONE	1%	2%	1%	1%	2%	1%	2%	1%
PRESS,psig	235	235	235	235	235	235	235	235	235	235

TEST DATA

EFFLUENT VOLUME, cc

TIME/TEST	1	2	3	4	5	6	7	8	9	10
0	0	0	0	0	0	0	0	0	0	0
1	15		15		19	14	15	20	24	9
2	22	28	25	25	30	22	25	28	32	14
3	29	31	32	36	36		32	36	40	18
4	33		38	46	42	35	36	42	46	22
5		36	44	61	48	39	43	48	50	25
6			50	66	53	44	46	53	56	28
7			54	73	58	48	50	58	60	30
8			57	78	63	50	54	62	64	34
9			59	84	68	52	58	66	68	36
10		54	61	90	72	54	61	70	72	38
15				102	89	56	76	86	89	46
20		74			106		88	100	107	54
25		96			120		97	116	115	62
30		104			127		110	126	118	68
35		112			128			130		73
40		120								
45		128								
AIR BLOW	42	138	64	106	132	59	110	133	123	82

FILTER CAKE DATA

TEST	1	2	3	4	5	6	7	8	9	10
THICK,mm	7	15	7	11	15	9	17	13	13	25
% H2O	32.7	41.3	30.8	31.7	31.2	33.3	35.1	33.9	34.6	32.4
% SOLID	67.3	58.7	69.2	68.3	68.8	66.7	64.9	66.1	65.4	67.6
WET WT,g	NA	NA	55.5	88.3	122.2	72.6	142.2	95.8	101.3	202.9
DRY WT,g	NA	NA	38.4	60.3	84.1	48.4	92.3	63.3	66.3	137.2
CALC FEED	NA	NA	32.1	31.0	33.1	36.8	36.6	27.7	29.5	48.1
ACT. FEED %	31.5	31.5	31.5	31.5	31.5	36.4	36.4	28	28	47.5

% SOLIDS VS TIME DURING PRESS

TIME/TEST	1	2	3	4	5	6	7	8	9	10
0	NA	NA	32.1	31.0	33.1	36.8	36.6	27.7	29.5	48.1
1	NA	NA	36.8	31.0	35.7	41.2	38.9	30.3	33.1	49.7
2	NA	NA	40.6	35.6	37.5	44.2	40.6	31.5	34.5	50.6
3	NA	NA	43.9	38.1	38.5	36.8	41.9	32.8	35.9	51.4
4	NA	NA	47.1	40.7	39.6	50.1	42.7	33.9	37.2	52.2
5	NA	NA	50.9	45.2	40.8	52.3	44.1	35.0	38.0	52.8
6	NA	NA	55.3	47.0	41.8	55.3	44.8	36.0	39.4	53.4
7	NA	NA	58.6	49.7	42.9	57.9	45.6	37.1	40.3	53.8
8	NA	NA	61.4	51.9	44.0	59.3	46.6	38.0	41.3	54.7
9	NA	NA	63.5	54.7	45.2	60.8	47.5	38.9	42.4	55.1
10	NA	NA	65.7	57.8	46.1	62.4	48.3	39.9	43.5	55.6
15	NA	NA		65.3	50.9	64.1	52.4	44.3	49.0	57.4
20	NA	NA			56.7		56.2	49.2	56.5	59.4
25	NA	NA			62.6		59.5	56.1	60.6	61.5
30	NA	NA			66.1		64.9	61.6	62.3	63.2
35	NA	NA			66.6			64.1		64.7
40	NA	NA								
45	NA	NA								
AIR BLOW	NA	NA	69.2	68.3	68.8	66.7	64.9	66.1	65.4	67.6