EMCSF
EMRRR 25724

APPENDIX M

CALCULATIONS

STORMWATER DRAINAGE And GEOTECHNICAL

USEPA SF
1361647

Bechtel National, Inc.

CALCULATION COVER SHEET

PROJECT	JOB NO.	CALC NO.	SHEET
EMF	24230	8E-FC-101	1

SUBJECT	GROUP
Pond 8E - Surface drainage dtiches	Remediation Engineering

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	☐	☒	☐	☐

COMPUTER PROGRAM / TYPE	SCP	MAINFRAME	PC	PROGRAM NO.	VERSION / RELEASE NO.
	☐ YES ☒ NO	☐	☐		

NO.	REASON FOR REVISION	TOTAL NO OF SHEETS	LAST SHEET NO.	BY	CHECKED	APPROVED / ACCEPTED	DATE
0	Final Calculation	4	4	RLN	MK	[illegible]	6/18/01

RECORD OF REVISIONS

Drainage Area	Discharge Rate Q (cfs) 25-year Storm	100-year Storm
A	12.4	20.5
B	2.7	4.5
C	2.9	4.7

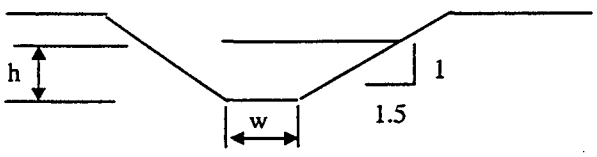
Ditch for Drainage Area A:

Try unlined trapezoidal ditch with 1-1/2 : 1 side slopes,

n= 0.025 ; s = 0.2 % or s = 0.002 ; w = 2 ft.

Manning's Formula:
v= 1.486*(HR)^(2/3)*s^(1/2)/n ; HR= A/WP ; WP= wetted perimeter ; A = area ;

Q= v*A



WP = (1^(2)+1.5^(2))^(1/2)*h*2 + w = 3.606 *h + 2

A = h*(1.5*h) + w*h = (1.5*h + 2)*h

HR = A / WP

Q_{25} = 12.4 cfs ;

Try h = 1.35 ft. WP = 6.878 ft ; A = 5.452 sq. ft.; HR = 0.793 ft.
v = 2.28 fps ; Q = 12.41 cfs

Q_{100} = 20.5 cfs ;

Try h = 1.73 ft. WP = 8.22 ft ; A = 7.913 sq. ft.; HR = 0.963 ft.
v = 2.59 fps ; Q = 20.5 cfs

USE UNLINED OR UNLINED TRAPEZODIAL DITCH W/ 0.2% SLOPE, WIDTH OF 2' AND DEPTH OF 18 INCHES MINIMUM

Ditch for Drainage Area B:

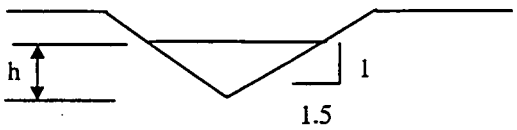
Try unlined "V" ditch with 1-1/2 : 1 side slopes,

n= 0.025 ; minimum slope (due to adjacent roadway)= 0.25 % or s = 0.0025

Manning's Formula:

v= 1.486*(HR)^(2/3)*s^(1/2)/n ; HR= A/WP ; WP= wetted perimeter ; A = area ;

Q= v*A



WP = (1^(2)+1.5^(2))^(1/2)*h*2 = 3.606 *h

A = h*(1.5*h) = 1.5*h^(2)

HR = 1.5*h^(2)/(3.61*h) = 0.416 *h

v= 1.486*(HR)^(2/3)*(s)^(1/2)/n = 1.656 *h^(2/3)

Q = (v*1.5*h^(2) = 2.484 *h^(8/3)

Q_{25} = 2.7 = 2.484*h^(8/3) ; h =(1.3/9.56)^(3/8) = 1.03 ft. ; v = 1.7 fps

Q_{100} = 4.5 = 2.484*h^(8/3) ; h = (2.1/9.56)^(3/8) = 1.25 ft. ; v = 1.9 fps

USE UNLINED "V" DITCH W/ MIN. 0.25% SLOPE AND DEPTH OF 16 INCHES

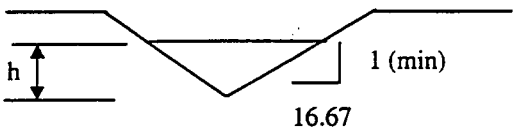
Ditch for Drainage Area C:

Use concrete lined "V" ditch with 6 % side slopes, for flat portion

n= 0.013 ; minimum slope = 0.19 % or s = 0.0019

Manning's Formula:
v= 1.486*(HR)^(2/3)*s^(1/2)/n ; HR= A/WP ; WP= wetted perimeter ; A = area ;

Q= v*A side slope = 16.67 : 1



WP =(16.67 ^(2)+1^(2))^(1/2)*h*2 = 33.39 *h

A = h*(16.67 *h) = 16.67 *h^(2)

HR = 16.67 h^(2)/ 33.39 *h = 0.499 *h

v= 1.486*(HR)^(2/3)*(s)^(1/2)/n = 3.12 *h^(2/3)

Q = (v* A) = 52.07 *h^(8/3)

Q_{25} = 2.9 = 52.07 *h^(8/3) h = (2.9 / 52.07) ^(3/8) = 0.34 ft. ; v = 1.5 fps

Q_{100} = 4.7 = 53.61*h^(8/3) ; h = (4.7 / 52.07) ^(3/8) = 0.41 ft. ; v = 1.7 fps

Maximum width of lined ditch = 0.41/.06' = 13.53 ft.

USE LINED "V" DITCH W/ 6% SIDE SLOPES AND MIN. 0.19% DITCH SLOPE AND 15-FOOT WIDE LINING

Calculation Sheet

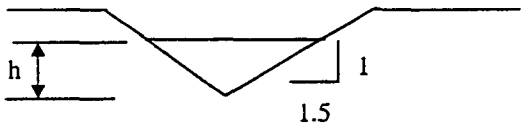
Originator	R. Ng	Date	6/7/2001	Calc. No.	8E-FC-101	Rev. No.	0
Project	EMF	Job No.	24230-025	Checked		Date	
Subject	Pond 8E - Surface drainage dtiches					Sheet No.	4

Use concrete lined "V" ditch with 1-1/2 : 1 side slopes, for steep portion

n= 0.013 ; minimum slope (due to adjacent roadway)= 1.00 % or s = 0.0100

Manning's Formula:
v= 1.486*(HR)^(2/3)*s^(1/2)/n ; HR= A/WP ; WP= wetted perimeter ; A = area ;

Q= v*A



WP = (1^(2)+1.5^(2))^(1/2)*h*2 = 3.606 *h

A = h*(1.5*h) = 1.5*h^(2)

HR = 1.5*h^(2)/(3.61*h) = 0.416 *h

v= 1.486*(HR)^(2/3)*(s)^(1/2)/n = 6.37 *h^(2/3)

Q = (v*1.5*h^(2) = 9.555 *h^(8/3)

Q_{25} = 2.9 = 2.484*h^(8/3) ; h = (1.3/9.56)^(3/8) = 0.64 ft. ; v = 4.7 fps

Q_{100} = 4.7 = 2.484*h^(8/3) ; h = (2.1/9.56)^(3/8) = 0.77 ft. ; v = 5.3 fps

USE LINED "V" DITCH W/ 1% SLOPE AND MIN. DEPTH OF 10 INCHES

Bechtel National, Inc.

CALCULATION COVER SHEET

PROJECT	JOB NO.	CALC NO.	SHEET
EMF	24230	8E-FC-102	1

SUBJECT	GROUP
Pond 8E - Final Cover Subdrain Capacity	Remediation Engineering

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	☐	☒	☐	☐

COMPUTER PROGRAM / TYPE	SCP	MAINFRAME	PC	PROGRAM NO.	VERSION / RELEASE NO.
	☐ YES ☒ NO	☐	☐		

NO.	REASON FOR REVISION	TOTAL NO OF SHEETS	LAST SHEET NO.	BY	CHECKED	APPROVED / ACCEPTED	DATE
0	Final Calculation	2	2	RLN	[illegible]	[illegible]	6/18/01

RECORD OF REVISIONS

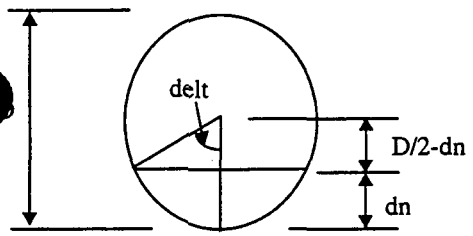
Drainage Area	area (acs)	Discharge Rate Q (cfs)	Length of run (ft.)	Head (ft.)
4 (Maximum)	1.01	0.0098	500	0

Maximum discharge Q_{max} = 0.0098 cfs ; run = 500 ft. ; head = 0 ft.

or Q = 0.0098 cfs ; maximumu run = 500 ft. ; head = 0 ft. or pipe is flat

Try 6" diameter corrugated HDPE pipe : D= 6 in.

n = 0.015



delta = cos-1 (D/2-dn)/(D/2)

WP = 2*delta*(D/2)

A = delta*(D/2)^2 - (D/2)^2*sin(delta)*cos(delta)

HR = A / WP

For Q = 0.0098 cfs ; run = 500 ft. ; head = 0 ft. ; Assuming s= 0.0008
dn= 1.09 in.

delta = 0.881 radian ; WP = 0.44 ft. ; A = 0.024 ft^2

HR = 0.055 ft.

v = 1.486 * HR^(2/3)*s^(1/2)/n = 0.407 fps

Q = v * A = 0.0099 cfs

Assuming an average flow depth of dn or 1.09 inches and an average friction slope of .0008, maximum hydraulic grade line at beginning of pipe, if the pipe is laid flat =
1.09 +500/2*.0008*12 = 3.49 " < 6 " ; therefore flow in pipe is partial and pipe has no surcharge say O.K.

USE 6" PERFORATED CORRUGATED HDPE PIPE AS SUBDRAIN COLLECTION PIPING FOR ALL AREAS

Bechtel National, Inc.

CALCULATION COVER SHEET

PROJECT	JOB NO.	CALC NO.	SHEET
EMF	24230	8E-FC-104	1

SUBJECT	GROUP
Structural Capacity of Corrugated HDPE Subdrain Piping	Remediation Engineering

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	☐	☒	☐	☐

COMPUTER PROGRAM / TYPE	SCP	MAINFRAME	PC	PROGRAM NO.	VERSION / RELEASE NO.
	☐ YES ☒ NO	☐	☐		

NO.	REASON FOR REVISION	TOTAL NO OF SHEETS	LAST SHEET NO.	BY	CHECKED	APPROVED / ACCEPTED	DATE
0	Final Calculation	8	8	RLN	MV	[illegible]	6/18/01

RECORD OF REVISIONS

Reference : Technical Report 4.103 by Advanced Drainage System, Inc.

Given:

H-20 loading
Min. Cover = 2 ft. @ 120 pcf
Soil Cover = 3.5 ft.
bedding angle = 30 °
backfill compaction 85% ASTM D 1557 or equivalent to 90% of standard Proctor
backfill material granular fill

6" Corrugated HDPE manufactured by Advanced Drainage Systems, Inc.

Pipe:	D	= Pipe diameter	=	6	in	
	R	= Pipe radius	=	3	in	
	Ap	= Pipe Wall area	=	0.086	in^2/in	*
	I	= Moment of inertia of the pipe wall	=	0.0034	in^4/in	*
	E	= Modulus of Elasticity (Pipe Material)	=	21,000	psi	**

*Refer to ADS Product Information Sheet
**for 100 yr. - long term value

Wall Crushing:

T = P x D'/2 Where: T = Thrust in lbs/ft
P = Design Load in psf
D' = Diameter in Feet = 0.5 ft.

For 2' of soil cover w/ traffic load, find Design Load P_1

soil load = 2 ft x 120 pcf = 240 psf
traffic load = 5.56 psi = 800.6 psf Refer to Table 5, "Live Load on Flexible Pipes"

P_1 = 240 + 801 = **1041 psf**

For 3.5' of soil cover w/o traffic load, find Design Load P_2

P_2 = 3.5 ft x 120 pcf = **420 psf**

Since $P_1 > P_2$ 3.5' cover is less critical

Determine the Thrust

T = 1041 psf * 0.5 ft /2 = **260.2 lbs/ft**

f_s = T / Ap
= 260 x (1ft/12in) / 0.09 = **252.1 psi** ; where f_s is ring compression stresses

f_a = fu / SF ; where: fa = allowable ring compression stress
f_u = Minimum Tensile Strength = 3000 psi
SF = Safety Factor = 2

f_a = **1,500 psi** >> fs of 252.1 psi **O.K.**

Wall Buckling - Using AASHTO method:

Pcr = 9.24 (R/Ap) x (Cw Ms EI/(0.149xR^3))^(1/2)

Where:

Pcr = Critical Buckling Pressure (psi)

Ms = Soil Modulus (psi)

Refer to Table 3, Design Values of E' (psi)

For 90% standard Proctor, 2 ft. cover, and granular soil Ms = 1,000

Cw = Water Buoyancy Factor

Cw = (1- 0.33 Hw/H) = 1.0

Where Hw = Height of water above top of pipe = 0 ft.

H = Height of ground surface above top of pipe = 3.5 ft.

I = Moment of inertia of the pipe wall (in^4/in)

E = Modulus of Elasticity (Pipe Material) (psi)

R = Pipe radius (in)

Ap = Pipe Wall area in^2/in

Pcr = 42,940.67 psi

T = 260 lb/ft From Thrust calculations above.

P = T / Ap = 260 lb/ft *(1 ft/ 12 in) /0.09 in2/in = 240.741 psi

P = 241 psi << Pcr = 42,940.67 psi **O.K.**

Pipe Deflection using Modified Iowa Formula (Marston-Spangler):

$\Delta x = D_L \{kWr^3/[(D^3PS/53.77) + (0.061E'r^3)]\}$

where : Δx = Horizontal deflection in inches

D_L = Loading factor

k = Bedding constant

W = Total load in pounds/liner inch

r = Pipe radius in inches

D = Pipe diameter in inches

E' = Modulus of soil reactions in lbs/in^2 (psi)

From wall buckling calculation, Ms = E' = 1000 psi ; D_L = 1.0

For bedding angle of 30° k = 0.108 Refer to Table 1, "Values of Bedding Constant, k"

For 2' of soil cover w/ traffic load, find Total Load W_1

soil load = 2 ft x 120 pcf x 0.5 ft x 1 ft/12 in = 10 lb/in.

traffic load = 5.56 psf x 0.5 ft x 12 in/1 ft = 33.36 lb/in.

W_1 = 10 + 33 = 43.36 lb/in.

For 3.5' of soil cover w/o traffic load, find Total Load W_2

W_2 = 3.5 ft x 120 pcf x 0.5 ft x 1 ft/ 12 in = 17.5 lb/in.

W_1 > W_2 therefore the traffic load governs

$\Delta x =$ 0.071 in or 1.18% < 7.5% allowable **O.K.**

PIPE HAVE NO PROBLEM IN SUPPORTING TRAFFIC LOADING AFTER PLACEMENT OF 2 FOOT OF EARTH COVER

8E-FC-104 (5)

Table 3

Design Values of E' (psi)

Type of soil (1)	Depth of Cover (ft) (2)	Standard AASHTO Relative Compaction 85% (3)	90% (4)	95% (5)	100% (6)
Fine-grained soils with less than 25% sand content (CL, ML, DL-ML)	0-5	500	700	1,000	1,500
	5-10	600	1,000	1,400	2,000
	10-15	700	1,200	1,600	2,300
	15-20	800	1,300	1,800	2,600
Coarse-grained soils with fines (SM,SC)	0-5	600	1,000	1,200	1,900
	5-10	900	1,400	1,800	2,700
	10-15	1,000	1,500	2,100	3,200
	15-20	1,100	1,600	2,400	3,700
Coarse-grained soils with little or no fines (SP, SW, GP, GW)	0-5	700	1,000	1,600	2,500
	5-10	1,000	1,500	2,200	3,300
	10-15	1,050	1,600	2,400	3,600
	15-20	1,100	1,700	2,500	3,800

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The design load is generally assumed to be the weight of the soil load above the pipe calculated by multiplying the soil density times the height of cover. Any anticipate live load must be added to this dead load. Live loads are given in Table 5 and shown on Figure 4, 5, and 6.

Table 5

Live Loads on Flexible Pipe
(Live Load Transferred to Pipe, lb/in2)

Height of Cover (FT)	Highway H20	Railway E80	Airports
1	12.50	N.R.	N.R.
2	5.56	26.39	13.14
3	4.17	23.61	12.28
4	2.78	18.40	11.27
5	1.74	16.67	10.09
6	1.39	15.63	8.79
7	1.22	12.15	7.85
8	0.69	11.11	6.93
10	N.S.	7.64	6.08
12	-	5.56	4.76
14	-	4.17	3.06
16	-	3.47	2.29
18	-	2.78	1.91
20	-	2.08	1.53
22	-	1.91	1.14
24	-	1.74	1.05
26	-	1.39	N.S.
28	-	1.04	-
30	-	0.69	-
35	-	N.S.	-
40	-	-	-

Notes: H20 load simulates 20 ton truck traffic and impact.
E80 load simulates 80,000 lb./ft. railway load and impact.
Airport load simulates 180,000 lb. dual tandem gear, 26 inch spacing between tires and 66 inch center-to-center spacing between fore and aft tires under rigid pavement 12" thick plus impact.

N.S. = Not Significant
N.R. = Not Recommended

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Advanced Dr[redacted] Systems, Inc.
Muncy, PA; Wooster, OH; Ludlow, MA; London, OH; Buena Vista, VA
3300 Riverside Drive
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614-457-3051 FAX: 614-459-0169

Types of Pipe		HDPE								
Nominal Sizes		4"	6"	8"	10"	12"	15"	18"	24"	18"
Wall Type - Corrugated of Profile		Type C	Type C	Type C	Type C	Type C	Type C	Type C	Type C	AdvanEDGE
Nominal Pipe Diameter		4"	6"	8"	10"	12"	15"	18"	24"	18"
Inside Diameter (Min)		3.94	5.91	7.88	9.85	11.82	14.78	17.73	23.64	0.75
Outside Diameter		4.71	6.93	9.47	11.89	14.78	17.45	21.05	28.25	1.6
Weight (lb/ft)		0.3	0.7	1.2	1.8	2.8	4.0	6.0	11.2	1.2
Minimum Wall Thickness (In)		.029	.033	.045	.050	.067	.097	.100	.180	.033
Pipe Wall Area (In 2/ft)	(Required)					1.50	1.91	2.34	3.14	
	(Actual)	0.672	1.032	1.224	1.536	1.99	2.31	2.77	4.03	1.04
Pipe Stiffness	(Required)	35	35	35	35	50	42	40	34	
	(Typical)	45.5	49.5	42.9	42.7	62.5	46.4	45.0	40.9	
Tensile Strength	(Minimum)	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
	(Typical)	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600
Tensile Modulus	(Minimum)	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
	(Typical)	125,000	125,000	125,000	125,000	138,000	138,000	138,000	138,000	125,000
50 yr. Tensile Strength	(Minimum)	900	900	900	900	900	900	900	900	900
	(Typical)	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250
100 yr. Tensile Strength	(Minimum)									
	(Typical)	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050
50 yr. Tensile Modulus	(Minimum)	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000
	(Typical)	25,000	25,000	25,000	25,000	27,500	27,500	27,500	27,500	25,000
100 yr. Tensile Modulus	(Minimum)									
	(Typical)	21,000	21,000	21,000	21,000	23,000	23,000	23,000	23,000	21,000
Moment of Inertia	(Required)					0.024	0.053	0.062	0.116	
	(Actual)	0.0011	0.0034	0.010	0.019	0.034	0.070	0.090	0.200	0.035
Years of Use in Transportation		21	21	20	20	16	14	12	12	5

BE-FC-104(7)

A number of factors in the equation are contentious and deserve explanation:

A. The deflection lag factor (D_L) was included in the equation because Dr. Spangler believed that deflections could increase as much as 30% over a period of 40 years. He recommended a D_L of 1.5 to be conservative. We now know virtually all of the deflection occurs during the first year, therefore a D_L of 1.0 may be used.

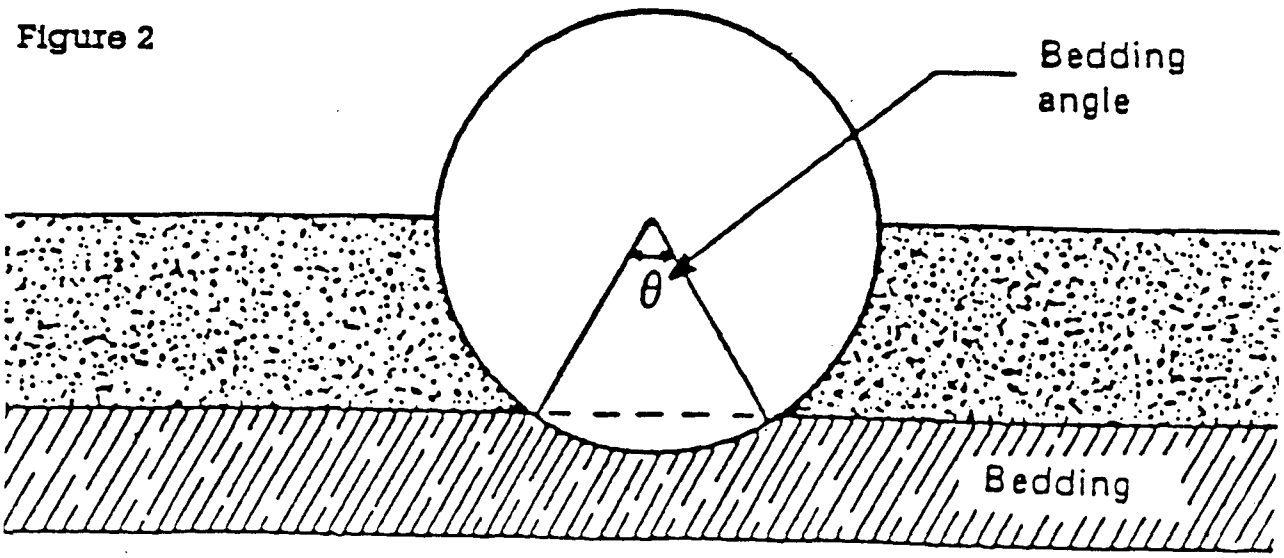
B. The bedding constant (k) is usually assumed to equal 0.1, although, as shown in Table 1, other values may be appropriate for specific installation conditions. A bedding angle (see Figure 2) of 0° would indicate a very firm foundation which would not be recommended for any pipe type.

Table 1

Values of Bedding Constant, K

Bedding angle, degrees	K
0	0.110
30	0.108
45	0.105
60	0.102
90	0.096
120	0.090
180	0.083

Figure 2



"TECHNICAL REPORT 4.103" BY ADVANCED DRAINAGE SYSTEM, INC.

CALCULATION COVER SHEET

PROJECT FMC Corporation Pocatello	JOB NO. 24230-025	CALC NO. 8Ecalc1	SHEET 1
SUBJECT Estimation of Design Surface Runoff Rates for Pond 8E		DISCIPLINE Hydrology/Modeling	

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	X			

COMPUTER PROGRAM/TYPE	SCP	MAINFRAME	PC	PROGRAM NO.	VERSION/RELEASE NO.
	YES [ ] NO [X]	[ ]	[ ]		

Abstract

The purpose of this calculation is to estimate design surface runoff rates for Pond 8E at Pocatello, Idaho. The perimeter drains will collect and convey surface runoff to existing local drainage courses. The design flow rates are computed for 25-year and 100-year storm return periods. Intensity duration-frequency curves for both return periods are determined from the Precipitation-Frequency Atlas for the State of Idaho. Based on the proposed grade of the cap, the cap area is divided into three sub-areas (Areas 1, 2, and 3), each discharging to a different section of the perimeter drain (Figure 1). Part of the runoff collected from Pond 8S discharges also into the Pond 8E drainage system. The design storm durations for each subarea of the pond are estimated using the Kirpich formula. Peak surface runoff is estimated using the Rational Method.

The time of concentration for the southern section (point A, including part of the area of Pond 8S) of the perimeter drain is 6 minutes. For the northern section (Point B) and western section (Point C) of the drain, the time of concentration is 5 minutes.

For Point A, the design flow rates for 25-year and 100-year return periods are 12.4 and 20.5 cfs, respectively. For Point B, the design flow rates for 25-year and 100-year return periods are 2.7 and 4.5 cfs, respectively. For Point C, the design flow rates for 25-year and 100-year return periods are 2.9 and 4.7 cfs, respectively.

Prepared by Jim Q Zhang
Checked by Nadim Copty
Approved by Angelos Findikakis

No.	Reason for Revision	Total No. of Sheets	Last Sheet No.	By	Checked	Approved/ Accepted	Date
				JZ	N.C.	AF	
0	Final Calculation	13	13	J. Zhang	N. Copty	A. Findikakis	June 5, 2001

Record of Revisions

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1. Introduction

A plan view of Pond 8E is shown in Figure 1. Based on the proposed grade of 5% for the cap, the cap surface area can be divided into three sub-areas; with each sub-area discharges to a section of the perimeter drain. As shown in Figure 1, Area 1 drains to the south perimeter drain; area 2 drains to the north perimeter drain; and Area 3 drains to the western perimeter drain located between Pond 8E and the Phase IV ponds., The southern perimeter drain collects runoff from the southern portion of Pond 8S. In addition the western section of the drain also collects drainage water from a small section of the Phase IV ponds, denoted in Figure 1 as sub-area A4. The drainage system of the entire site is under CERCLA remediation of the FMC facility and will be addressed in this calculation.

The purpose of this calculation is to estimate the design flow rates for the three sections of the perimeter drain. Design flow rates will be calculated at the three critical points denoted in Figure 1 as points A, B, and C, at the downstream end of each section of the perimeter drain. The calculations were conducted based on the 25-year and the 100-year return periods. Intensity duration-frequency curves for Pocatello area were determined from the Precipitation-Frequency Atlas of the Western United States, Volume V-Idaho (Miller et al., 1973). The time of concentration and the corresponding surface runoff are estimated using the Kirpich Formula and the Rational Method (described in Chow et al., 1988), respectively. These methods were selected because they are applicable to small undeveloped areas such as Pond 8E.

The rest of the calculation is addressed as follows:

- Section 2 develops intensity duration-frequency curves for the Pocatello region.
- Section 3 estimates the peak surface runoff.

2. Intensity Duration-Frequency Curves

Table 1 lists rainfall intensities for 2-year, 25-year and 100-year return periods and various storm durations determined from the Precipitation-Frequency Atlas of the Western United States, Volume V-Idaho (Miller et al., 1973). The rainfall intensity for the 6-hour and 24-hour duration storms are obtained from precipitation-frequency maps (Figures 19-30) for the town of Pocatello.

Table 1: Rainfall-Duration Intensity for Pocatello, Idaho

Storm Duration	Return Period (Years)	Rainfall (inches)
24 hours	100	2.6 [1]
	25	2.1 [1]
	2	1.1 [1]
6 hours	100	1.7 [1]
	25	1.4 [1]
	2	0.8 [1]
3 hours	100	1.4 [2]
	25	1.1 [2]
	2	0.6 [2]
2 hours	100	1.3 [2]
	25	1.0 [2]
	2	0.5 [2]
1 hour	100	1.1 [3]
	25	0.8 [4]
	2	0.4 [3]
30 minutes	100	0.87 [5]
	25	0.63 [5]
	2	0.32 [5]
15 minutes	100	0.63 [5]
	25	0.46 [5]
	2	0.23 [5]
10 minutes	100	0.50 [5]
	25	0.36 [5]
	2	0.18 [5]
5 minutes	100	0.32 [5]
	25	0.23 [5]
	2	0.12 [5]

[1] Determined from precipitation-duration maps
[2] Interpolated from the 1-hour and 6-hour rainfall values
[3] Estimated using regional regression equations
[4] Interpolated from the 2-year and 100-year rainfall values
[5] Estimated from the one-hour rainfall values and adjustment factors

The 2-year, 1-hour rainfall and the 100-year, 1-hour rainfall are estimated using regression equations defined in Table 12 for Region 2 (Miller et al., 1973):

$$Y_2 = 0.019 + 0.711\frac{X_1^2}{X_2} + 0.001Z \qquad (1)$$

$$Y_{100} = 0.338 + 0.670\frac{X_3^2}{X_4} + 0.001Z \qquad (2)$$

where

Y_2	2-year, 1-hour estimated rainfall value [in]
Y_{100}	100-year, 1-hour estimated rainfall value [in]
X_1	2-year, 6-hour rainfall from precipitation-frequency maps [in]
X_2	2-year, 24-hour rainfall from precipitation-frequency maps [in]
X_3	100-year, 6-hour rainfall from precipitation-frequency maps [in]
X_4	100-year, 24-hour rainfall from precipitation-frequency maps [in]
Z	Point elevation in hundreds of feet. For the FMC Pocatello site, Z=45

The 25-year 1-hour rainfall is estimated by interpolating between the 2-year and 100-year values, as described in Figure 6 (Miller et al., 1973). The 2-hour and 3-hour rainfall values are estimated by interpolating between the 1-hour and 6-hour values. Finally, the rainfall for storm duration shorter than 1 hour is estimated from the Adjustment Factors listed in Table 13 (Miller et al., 1973).

Based on the data shown in Table 1, intensity duration-frequency curves for Pocatello are shown in Figure 2.

3. Surface Runoff

The rational method is a widely used method for the design of storm drains, particularly for small drainage areas. The rational method relates peak surface runoff flow rate to rainfall intensity, surface drainage area and the runoff coefficient C, defined as the fraction of rainfall that appears as surface runoff:

$$Q_R = C\,i\,A \tag{3}$$

where

Q_R	peak runoff flow rate [L^3/T]
C	runoff coefficient which includes the combined effects of ponding, infiltration and evaporation
A	drainage area [L^2]
i	rainfall intensity which depends on the design return period and the storm duration [L/T].

3.1. Runoff Coefficient C

The Runoff Coefficient C is a factor representing the fraction of rainfall that will reach the storm drains. It is influenced by the combination of many factors which include the following:

- storm intensity and duration
- soil properties such as: character and condition of the soil
- soil cover
- ground slope
- ponding character of the surface
- antecedent soil moisture content
- proximity of the water table
- depression storage

The runoff coefficient that is selected must take into account the integrated effects of all of the above factors. Typical values for the runoff coefficient as a function of surface characteristics and storm return period are listed by Chow et al. (Table 15.1.1, page 498, 1988). For a

pasture/range soil cover and an average slope of 2-7 %, Chow et al. (1988) report C values of 0.42 and 0.49 for storm return values of 25 and 100 years, respectively. To provide some measure of conservatism, C values of 0.5 and 0.6 are used in this calculation for the 25-year and 100-year return periods, respectively.

3.2. Time of Concentration

The time of concentration for each subarea of Pond 8E is the sum of the overland travel time from the most remote point and the channel travel time:

$$t_c = t_o + t_{ch} \tag{4}$$

where

- t_c time of concentration
- t_o maximum overland travel time to channel.
- t_{ch} maximum channel travel time

Several empirical equations are found in the literature for the estimation of the time of concentrations for various watershed areas and conditions. The equation selected in this calculation is the Kirpich formula (Kirpich, 1940) which was developed based on Soil Conservation Service data collected from small rural drainage areas:

$$t_o = 0.0078 L_o^{0.77} s^{-0.385} \tag{5}$$

where

- t_o overland travel time in minutes
- L_o maximum overland flow distance in feet
- s surface slope

The travel time through the channel can be estimated using the Manning Equation. Alternatively, because the channel is not designed yet, an average channel velocity is assumed and the travel time is given by:

$$t_{ch} = \frac{L_{ch}}{V_{ch}} \tag{6}$$

where

L_{ch} is the channel length

V_{ch} average channel velocity

Reasonable flow velocities for a self-cleaning channel are 2-5 ft/s. In this calculation, we assume that the velocity is equal to the upper limit of this range, i.e., V_{ch}=5 ft/s.

For each of the perimeter drain section, Table 2 presents the pond sub-areas contributing flow, overland travel-time, channel-travel time, and time of concentration. These values are based on a cap surface slope of 5 %. For the southern section of the perimeter drain, area A1 and parts of Pond 8S contribute surface runoff. The time of concentration for this section was calculated as the time of concentration for the southern perimeter drain of the pond 8S (refer to calculation package P8SCALC1) plus the additional channel travel time along pond 8E.. A design time of concentration equal to 5 minutes was used for all sections with calculated time of concentrations shorter than 5 minutes.

Table 2: Time of Concentration for Pond 8E

Pond Section	Area A (ft^2)	Overland Distance L_o (feet)	Channel Distance L_{ch} (feet)	Estimated Travel Time: Overland (min)	Estimated Travel Time: Channel (min)	Time of Concentration (min)
A1	145,000	250	650	1.7	2.2	3.9 use 5
Pond 8S	270,000	-	-	-	-	3.9 use 5
A1, Pond 8S	415,000	-	-	-	-	6.1 use 6
A2	84,000	200	700	1.5	2.3	3.8 use 5
A3, A5*	89,000	180	650	1.3	2.0	3.3 use 5

Sub-area A5 from the adjacent Phase IV drains to the western perimeter drain.

3.3. Peak Flow Rate

Based on the rational equation (Eq. 1) and the runoff coefficient and time of concentration values estimated in Sections 3.1 and 3.2, the peak surface runoff flow rates at points A, B and C at the

downstream end of each perimeter drain section for the 25-year and 100-year return periods are presented in Table 3.

Table 3: Peak Surface Runoff For Each Section of Perimeter Drain

Point	Surface Area A		Design Time of Concentration t_c	Return Period	Runoff Coefficient	Rainfall Intensity I		Peak Surface Runoff Q_R
	Acres	ft^2	(min)	(year)	C	in.	(in./hr)	(cfs)
A	9.5	415,000	6	25	0.5	0.26	2.6	12.4
				100	0.6	0.36	3.6	20.5
B	1.9	84,000	5	25	0.5	0.23	2.8	2.7
				100	0.6	0.32	3.8	4.4
C	2.0	89,000	5	25	0.5	0.23	2.8	2.9
				100	0.6	0.32	3.8	4.7

4. List of References

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CALCULATION SHEET

PROJECT	*FMC, Pocatello*		
JOB NUMBER	*24230-025*		
CALC NO.	*8Ecalc1*		
SUBJECT	*Estimation of Design Surface Runoff Rates for Pond 8E*	SHEET NO.	*12 of 13*
BY	*Jim Zhang*	DATE *February 6, 2001*	SHEET REV *0*

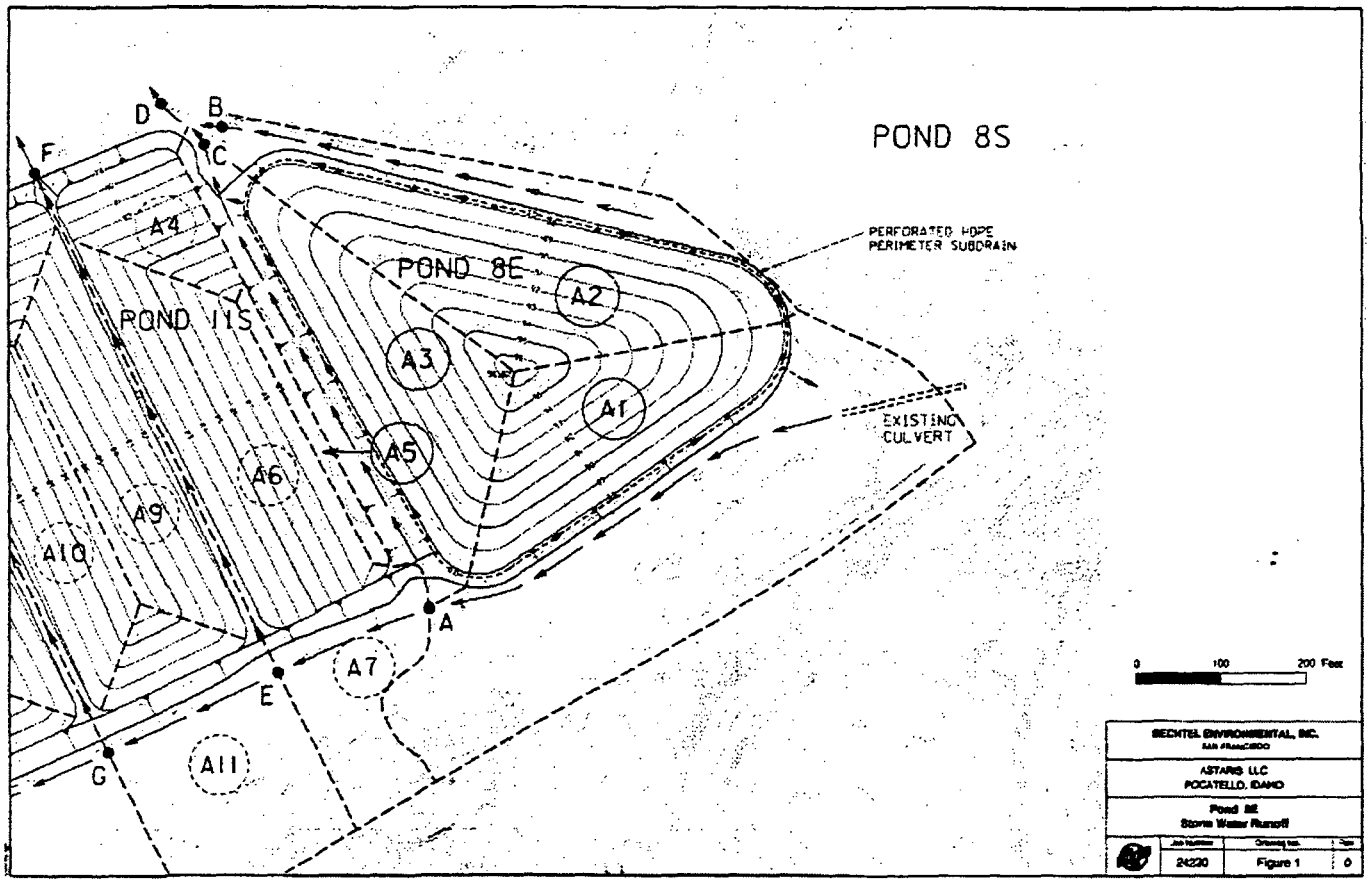

Figure 1: Pond 8E and Storm Water Runoff

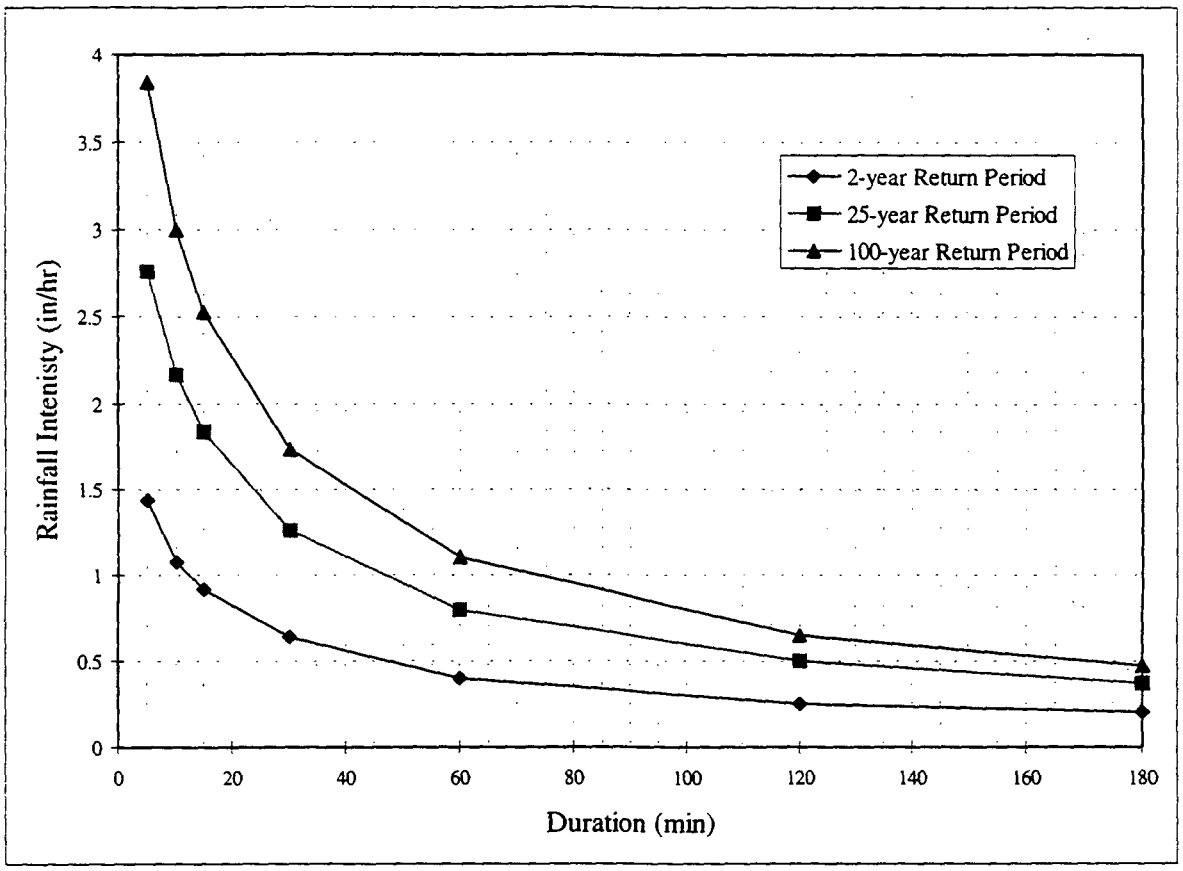

Figure 2: Intensity Duration-Frequency Curves for Pocatello, Idaho

CALCULATION COVER SHEET

PROJECT FMC Corporation Pocatello	JOB NO. 20906-023	CALC NO. 8ECALC2	SHEET 1
SUBJECT Estimation of the Design Flow Rate for the Pond 8E Subdrainage System		DISCIPLINE Hydrology/Modeling	

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	[ ]	[x]	[ ]	[ ]

COMPUTER PROGRAM/TYPE	SCP		MAINFRAME	PC	PROGRAM NO.	VERSION/RELEASE NO.
	[ ] YES	[x] NO	[ ]	[ ]		

Abstract

The proposed subdrainage system for Pond 8E at the FMC facility at Pocatello, Idaho consists of a perimeter subsurface drain for the collection of water from the cap drainage layer. Surface runoff from the pond cover are collected through a separate perimeter ditch. The purpose of this calculation is to estimate the design flow rates of the subdrain. Surface runoff calculations are presented in a separated calculation package (refer to calculation 8Ecalc1).

The peak drainage rate from the cap drainage layer was estimated using the Hydrologic Evaluation of Landfill Performance (HELP) computer program (EPA, 1994a, b). The peak drainage rate is defined as the 100-year 24-hour peak flow rate through the cap drainage layer. A shorter storm duration was not used because of the relatively large travel-times through the various cap layers that tend to dissipate flow rates resulting from shorter-duration, higher-intensity events.

The 100-year 24-hour peak flow rate was estimated by simulating the HELP model for 100 years (based on 100 years of synthetic weather data) and taking the peak flow rate equal to the peak daily drainage from the 100 years of simulation.

Based on the proposed grade of the cap drainage layer, the drainage layer is divided into four sub-areas, each discharging to a section of the subdrain. For a 100-year return period and using the HELP program, the drainage from each of these four sections was found to vary between 0.0093 and 0.0098 cfs.

No.	Reason for Revision	Total No. of Sheets	Last Sheet No.	By	Checked	Approved/Accepted	Date
0	Final Calculation	9	9	N.Copty	I.Kleyn	A.Findikakis	July 3, 2001

Record of Revisions

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Pond 8E Subdrainage System

The drainage system for the proposed Pond 8E closure cap at the FMC facility in Pocatello, Idaho consists of two components:

1. perimeter drain for the collection of surface runoff

2. perimeter subdrain for the collection of water collected by the subdrainage layer of the cap

The purpose of this calculation is to estimate the design flow rates of the cap subdrain. Surface runoff calculations are presented in a separated calculation package (refer to calculation 8Ecalc1). A plan view of the proposed cap is shown in Figure 1. Based on its grade, the proposed cap drainage layer can be divided into four sub-areas, each discharging to a section of the subdrain. A separate flow rate is calculated for each of these four sections of the subdrain.

The peak drainage rate from the cap drainage layer was estimated using the Hydrologic Evaluation of Landfill Performance (HELP) computer program (EPA, 1994a, b). The HELP program, was developed by the US Army Engineer Waterways Experiment Station (WES), Vicksburg, MS for the US Environmental Protection Agency (EPA). HELP is a quasi two-dimensional hydrologic model, which performs water balance analyses to predict water movement through landfills and other solid waste containment facilities.

The peak drainage rate is defined as the 100-year 24-hour peak flow rate through the cap drainage layer. A shorter storm duration was not considered because of the relatively large travel-times through the various cap layers that tend to dissipate flow rates resulting from shorter-duration, higher-intensity events. Consequently, peak lateral drainage flow rates will be significantly lower than surface runoff flow rates.

Climatological Data

Climatological data for the HELP program consist of daily rainfall, temperature, and solar radiation data in addition to general climate data such as average annual wind speed and average quarterly relative humidity. Daily rainfall and minimum and maximum temperature recorded at the Pocatello Municipal Airport (National Weather Service Station No. 24156) for the years 1948 to 1991 were obtained from the National Climatic Center in Asheville, North Carolina. To calculate the 100-year 24-hour peak flow rate through the drainage cap, 100 years of daily rainfall, temperature and solar radiation data were synthetically generate from the 44 years of

record. The 100-year 24-hour peak flow rate was set to the maximum daily drainage reported by the HELP program within the simulated 100-year period.

The routine used to generate the climatological data was developed by the USDA Agricultural Research Service (Richardson and Wright, 1984) and is described in the HELP manual (EPA, 1994a). The generating procedure is designed to preserve the dependence in time, the correlation between variables and the seasonal characteristics of the actual weather data at the specified locations. The daily temperature values used in the model were the average of the daily minimum and maximum temperature readings. The daily solar radiation data were synthetically generated using parameters for the Pocatello area in the HELP database. The general climatological data were set equal to the HELP default values for the Pocatello area. A list of these data is presented in Table 1.

Table 1: General Climatological Data

Maximum Leaf Area (dimensionless)	1.00
Start of Growth Season (Julian Date)	132
End of Growth Season (Julian Date)	275
Average Annual Wind Speed (mph)	10.20
Average First Quarter Relative Humidity	70.00 %
Average Second Quarter Relative Humidity	52.00 %
Average Third Quarter Relative Humidity	43.00 %
Average Fourth Quarter Relative Humidity	65.00 %

Soil Characteristics

The base-case characteristics for the proposed RCRA cap are presented in Table 2 (from BEI, 1995). The porosity, field capacity and wilting point values for each of the layers were set to HELP default values of comparable soil materials (page 30, Table 4, EPA, 1994b). The hydraulic conductivity was assigned conservative values (i.e., leading to higher infiltration rates

through the cap) that are consistent with the HELP default values, and the design and manufacturer's specifications:

- *Top Soil*: The hydraulic conductivity of the top soil was set to 9.35 x 10^{-4} cm/s which is approximately two times the HELP default value for sand-silt mixtures (page 30, Table 4, EPA, 1994b).
- *Slag*: The hydraulic conductivity of the slag was determined from the slag particle size distribution. A commonly accepted relationship between saturated hydraulic conductivity and particle size was reported by Freeze and Cherry (1979):

  $$K = Ad_{10}^2$$

  where K is the hydraulic conductivity

  d_{10} is the grain size diameter at which 10% of the soil particles are finer.

  A is an empirical constant equal to 1 when d_{10} is in units of mm and K is in units of cm/s. For d_{10}=1 mm, the estimated hydraulic conductivity of the slag is 1 cm/s.
- *Liner Foundation Material:* Based on particle size distribution of the liner foundation material, the liner foundation hydraulic conductivity was set equal to the HELP default value for course sand (0.01 cm/s). This value is consistent with the above hydraulic conductivity, particle size relationship.
- *Geonet:* The thickness and transmissivity of the geonet at 10,000 psf compressive are reported in the manufacturer's specifications as 0.2 inches and 0.002 m^2/s, respectively. These values correspond to a saturated hydraulic conductivity of 40 cm/s. To provide some measure of conservatism, the geonet hydraulic conductivity in the HELP model was set to 10 cm/s.
- *Flexible Membrane Liner (FML)*: The hydraulic conductivity of the FML was set equal to 2 x 10^{-12} cm/s, as specified in the manufacturers specifications. This value is also an order of magnitude larger than the HELP default value for HDPE.
- *Geosynthetic Clay Liner (GCL)*: The hydraulic conductivity of the GCL was set equal to the HELP default value for a bentonite mat (3 x 10^{-9} cm/s). This value is also approximately equal to the average of the values reported in the manufacturer's specifications.

Table 2: Soil Characteristics

Layer	Layer Type	Thickness (in)	Total Porosity	Field Capacity	Wilting Point	Saturated Hydraulic Conductivity (cm/s)
Top Soil	Vertical Percolation	12	0.473	0.222	.105	9.35×10^{-4}
Slag	Vertical Percolation	18	.375	.055	.02	1
Liner Foundation	Vertical Percolation	12	0.417	0.045	0.018	0.01
Geonet	Lateral Drainage	0.2	.85	.01	.005	10
FML	Flexible Membrane Liner	0.04	-	-	-	2×10^{-12}
GCL	Barrier Liner	.17	.75	.747	.4	3×10^{-9}

Other assumptions include the following:

- To maximize drainage rates, no surface runoff was allowed.
- The evaporative depth was set to 24 inches
- Initial conditions were set to steady state conditions, as estimated by the HELP program.
- The drainage length of the cap was conservatively set to 200 ft.
- The slope of the drainage layer is 5 %.

Based on the above input parameters and assumptions, the peak daily drainage rate is about 0.23 in/day (2.22×10^{-7} ft/s). The flow rate to each of the four sections of subdrain (Figure 1) are shown in Table 3.

Table 3: Peak Daily Drainage Flow Rates for the Four Subdrain Sections

Subdrain Section	Area (ft^2)	Drainage (cfs)
1	42,000	0.0093
2	44,000	0.0098
3	42,000	0.0093
4	44,000	0.0098
1, 2, 3, 4	172,000	0.0382

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CALCULATION COVER SHEET

PROJECT FMC Corporation Pocatello	JOB NO. 24230-025	CALC NO. 8ECALC3	SHEET 1
SUBJECT Estimation of Rainfall and Wind Erosion from Pond 8E Closure Cap		DISCIPLINE Hydrology/Modeling	

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	[ ]	[x]	[ ]	[ ]

COMPUTER PROGRAM/TYPE	SCP	MAINFRAME	PC	PROGRAM NO.	VERSION/RELEASE NO.
	[ ] YES [x] NO	[ ]	[ ]		

Abstract:

The purpose of this calculation is to estimate long-term rainfall and wind erosion losses from the Pond 8E closure cap at FMC Corporation, Pocatello, Idaho. The average annual and peak daily (100-year return period) rainfall erosion rates are estimated using the Universal Soil Loss Equation (USLE) and Modified Universal Soil Loss Equation (MUSLE), respectively. The average annual wind erosion is estimated using the Wind Erosion Equation.

The annual rainfall erosion rate is estimated to be around 0.0046 in or 0.9 tons/acre. Peak daily rainfall erosion (100-year return period) is estimated to be 0.0015 in. This value will have negligible effect on the performance of the cap. Wind induced erosion is estimated to be about 0.0068 in/yr which corresponds to about 1.3 ton/acre/yr. The combined rainfall and wind induced erosion is 2.2 ton/acre/yr, or about 0.34 in over the 30-year service life of the cap.

prepared by Nadim Copty
checked by Iosif Kleyn
approved by Angelos Findikakis

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				NC	IK	AF	
0	Final Calculation	17	17	N.Copty	I.Kleyn	A.Findikakis	July 2, 2001

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1. Introduction

The purpose of this calculation is to estimate the rainfall and wind erosion losses from Pond 8E closure cap at FMC Corporation, Pocatello, Idaho. The average annual and peak daily (100-year return period) rainfall erosion rates are estimated using the Universal Soil Loss Equation (USLE) and the Modified Universal Soil Loss Equation (MUSLE), respectively. The average annual wind erosion losses are estimated using the wind erosion equation. Where specific data or information are not available, conservative values were used in these equations.

Section 2 of this report describes the rainfall erosion calculation. Section 3 describes the wind erosion calculation. Section 4 presents a brief summary of the rainfall and wind-induced soil erosion estimates.

2. Rainfall Erosion

2.1. Universal Soil Loss Equation

The Universal Soil Loss Equation (USLE) is an empirical equation developed by the National Runoff and Soil Loss Data Center which was established by the Science and Education Administration, in cooperation with Purdue University to estimate long-term soil losses due to rainfall. The equation is based on extensive data collected from numerous locations within the United States. The equation expresses the soil erosion rate as a function of rainfall, soil parameters and management practices (page 4 of Wischmeier and Smith, 1978):

$$A = RKLSCP \tag{1}$$

where

A computed soil loss rate [short tons/acre where 1 short ton = 907.2 kg]

R rainfall erosion index [tons/acre]

K soil erodibility factor [dimensionless]

LS topographic factor [dimensionless] which is the product of the slope-length factor, L, and slope-steepness factor, S.

C cover and management factor [dimensionless]

P soil conservation practice factor [dimensionless]

A description of these factor as well as the numerical values used in this calculation are presented in Sections 2.3 through 2.7.

2.2. Modified Universal Soil Loss Equation

To estimate the rainfall erosion due to a particular event (such as the 100-year, 24-hour storm), the MUSLE is used instead (as described in EPA, 1988):

$$Y = a_1 (V_r q_p)^{0.56} KLSCP \qquad (2)$$

where

Y sediment yield [tons per event, metric tons per event]

V_r storm runoff volume [acre-feet, m^3]

q_p peak flow rate [ft^3/s, m^3/s]

a_1 conversion constant [95 English, 11.8 metric]

The only difference between the USLE and MUSLE is that the rainfall erosion index in the former is replaced by the expression $(V_r q_p)^{0.56}$, function of a particular storm event. This expression is calculated as described below. The storm runoff volume is given by:

$$V_r = a_2 A_r Q_r \qquad (3)$$

where

A_r area [acres, ha]

Q_r depth of runoff [in, cm]

a_2 conversion constant [0.083 English, 100 metric]

The depth of runoff is determined by:

$$Q_r = \frac{(R_t - 0.2S_w)^2}{(R_t + 0.8S_w)} \tag{4}$$

where

R_t total storm rainfall [in, cm]

S_w water retention factor [in, cm]

The water retention factor can be obtained as follows:

$$S_w = \frac{1000}{CN} - 10a_3 \tag{5}$$

where

CN Soil Conservation Service Runoff Curve Number [dimensionless]

a_3 conversion constant [1.0, English, 2.54 metric]

Finally, the peak runoff rate can be calculated as follows:

$$q_p = \frac{a_3 A_r R_t Q_r}{T_r(R_t - 0.2S_w)} \tag{6}$$

where

q_p peak runoff rate [ft^3/s, m^3/s]

T_r storm duration [hour]

a_3 conversion constant [1.01 English, 0.028 metric]

Sections 2.3 through 2.8, discuss the input parameters used in the MUSLE and the resultant rainfall erosion losses due to the 100-year, 24-hour storm event.

2.3. Rainfall Erosion Index

Field data suggest that, with all parameters except rainfall kept constant, the soil loss due to a single storm is directly proportional to the product of the storm energy and the maximum 30-minute intensity EI_{30}:

$$A \propto R = EI_{30} \tag{7}$$

where

E the kinetic energy of a storm [10^2 foot-tons/acre inch]

I_{30} maximum 30-minute intensity [in/hour]

R rainfall index factor [dimensionless]

The storm kinetic energy is given by:

$$E = 9.16 + 3.31 \log_{10} I \tag{8}$$

where

I intensity of the storm [in/hour].

Average annual values of the rainfall erosion index can be determined from isoerodent maps (Figure 1, Wischmeier and Smith., 1978). These values were estimated based on Eqs. (7) and (8) by summing up the contribution of individual events, neglecting rainfalls of less than half an inch. For the area of Pocatello, the annual rainfall erosion index 20.

2.4. Soil Erodibility Factor

The soil erodibility factor K describes the inherent properties of the soil independent of other parameters such as land slope, rainfall and vegetative cover. Values of K can be obtained from the nomograph shown in Figure 3 (Wischmeier and Smith, 1978) as a function of (1) soil particle size distribution, (2) percent organic matter, (3) soil structure and (4) permeability. Based on laboratory testing of top soil samples, the percent of silt and very fine sand is 95% and the

percent of sand (0.1-2.0 mm) is 5%. The percent of organic matter is assumed to be 1 %. The resulting soil erodibility factor *K* is about 0.73 (Table 1).

Table 1: Soil Erodibility Factor

Assumed Soil Characteristics		Soil Erodibility Factor
Percent silt and very fine sand (< 0.1 mm)	95 %	
Percent sand (0.1-2.0 mm)	5 %	
Percent organic matter	1 %	0.73
Soil structure	Fine granular	
Permeability	Slow	

2.5. Topographic Factor

The topographic factor *LS* for a given site is defined as the expected ratio of soil loss from that field to the soil loss from a "reference" plot 72.6 ft long with a uniform slope of 9 %. Values of *LS* can be obtained from Table 3 (page 12) of Wischmeier and Smith (1978) as a function of the slope length and steepness. This table indicates that the soil losses can increase substantially- up to 2-3 orders of magnitude- with increase in slope length and steepness. For the Pond 8E closure cap, the slope length and steepness are approximately 200 ft and 5 % respectively, which corresponds to a *LS* value of 0.758 (Table 2).

Table 2: Topographic Factor

Slope-Length (ft)	Slope Steepness	*LS* Factor
200	5 %	0.758

2.6. Cover and Management Factor

The cover and management factor *C* primarily depends on the type of vegetation present and, if crops are present, the management practices taken in between growing seasons. By definition, *C* is assigned a value of 1 for bare soils. Values of *C* as a function of the type and density of the vegetation can be obtained from various figures and tables (Wischmeier and Smith, 1978; Hydrodynamics, 1991). Assuming that the vegetative cover of closure cap of Pond 8E consists of established native grass with a 50 % areal cover, the corresponding *C* factor is 0.08 (Hydrodynamics, 1991).

2.7. Soil Conservation Factor

The Soil Conservation Factor *P* depends on various agricultural practices other than vegetation effects such as contouring, terracing and maintaining slope-length limits, that can be taken to slow runoff water and, hence, reduce the amount of soil it can carry. For the closure cap of Pond 8E, no such measures are incorporated in the design. Therefore, the P factor is assigned a conservative value of 1.

2.8. Rainfall Erosion Losses

2.8.1. Average Annual Soil Losses

Using the USLE equation and the factors defined in Section 2.3 through 2.7, the average annual rainfall erosion losses were computed. A summary of the USLE factors and the corresponding rainfall erosion losses are presented in Table 3. The annual erosion losses were estimated to be 0.0046 in or 0.9 tons/acre. Over a period of 30 years, the service life of the proposed cap, the projected soil erosion losses due to rainfall are about 0.14 in.

Table 3: Average Annual Rainfall Erosion Losses

Duration	USLE Factors					Soil Loss *A*	
	R	*LS*[1]	*C*[2]	*P*[3]	*K*[4]	(tons/acre/yr)	(in/yr)[5]
Annual	20	0.758	0.08	1	0.73	0.9	0.0046

[1] Corresponds to slope length and steepness of 200 ft and 5 %, respectively.
[2] Corresponds to established native grass, 50 % areal cover.
[3] Assumes no soil conservation measures beyond vegetation.
[4] Based on the soil characteristics defined in Table 1.
[5] Assuming a bulk density of 1.7 g/cc.
In units of tons/(acre-inch):
1.7 g/cc=1.7x(1/907,200 ton/g)x(40,470,000 cm^2/acre)x (2.54 cm/in) =193 tons/acre-inch

2.8.2. Peak Daily Soil Losses

The rainfall erosion losses due to the 100-year, 24-hour storm are calculated based on equations (2)-(6). Assuming that the top soil curve number is 85 (corresponds approximately to fine silty sand with a fair vegetative cover), the water retention factor is

$$S_w = \frac{1000}{85} - 10 = 1.8$$

The 100-year, 24-hour total rainfall for Pocatello is R_t= 2.6 in, estimated by extrapolation from data presented in the Precipitation-Frequency Atlas of the Western United States, Volume V-Idaho (Miller et al., 1973). Therefore, depth of runoff and runoff volumes are (Eqs (3) and (4)):

$$Q_r = \frac{(2.6 - 0.2 \times 1.8)^2}{(2.6 + 0.8 \times 1.8)} = 1.24 \text{ in}$$

$$V_r = 0.083 \times 4 \times 1.24 = 0.41 \text{ acre-ft}$$

where 4 is the area of the cap in acres. The peak runoff rate (Eq. (6)) is:

$$q_p = \frac{1.01 \times 4 \times 1.24 \times 2.6}{24(2.6 - 0.2 \times 1.8)} = 0.24 \text{ cfs}$$

Based on the above values and the erosion parameters listed in Table 3, the erosion loss due to the 100-year 24-hour storm is 0.0015 in (Table 4).

Table 4: Peak Daily Rainfall Erosion Losses

Storm	MUSLE Factors						Sediment Yield Y	
	q_p (cfs)	V_r (acre-ft)	SL[1]	C[2]	P[3]	K[4]	(tons)	(in)[5]
100-year 24-hour storm	0.24	0.41	0.758	0.08	1	0.73	1.15	0.0015

[1] Corresponds to slope length and steepness of 200 ft and 5 %, respectively.
[2] Corresponds to established native grass, 50 % areal cover.
[3] Assumes no soil conservation measures beyond vegetation.
[4] Based on the soil characteristics defined in Table 2.
[5] Assuming a bulk density of 1.7 g/cc (193 tons/acre-inch) and cap area of 4 acres.

3. Wind Erosion

The Wind Erosion Equation is an empirical equation similar to the USLE, designed to estimate wind induced soil losses. The wind erosion equation was initially developed by Chepil (1945), but since then has been continuously modified as new research data became available (e.g., Woodruff and Siddoway, 1965; Cowherd, 1974; Israelsen et al., 1980). The equation expresses the wind soil erosion rate as a function of climatic conditions, soil parameters and management practices:

$$E' = f(I', C', K', V', L')$$

where

E' computed wind soil loss rate [tons/acre/yr]

I' soil wind erodibility factor [tons/acre/yr]

C' local wind erosion climatic factor [dimensionless]

K' soil surface roughness factor [dimensionless]

V' vegetative factor [thousand pounds/acre]

L' length of unshielded distance parallel to wind direction [ft]

Once values for the above factors are defined, the wind soil loss rate is estimated with the nomograph shown in Figure 1 (from Figure 3-3, Israelsen et al., 1980). A description of each factor as well the numerical values used in this calculation are presented in the following sections.

3.1. Soil Wind Erodibility Factor

The soil erodibility factor *I'* is the potential soil loss in tons/acre/yr for a wide, unsheltered, isolated field with bare, smooth, crusted or non-crusted soil surface. Field data suggest that values of *I'* increase as the percentage of soil fractions greater than 0.84 mm (20-mesh which is equivalent to medium-sized sand) in size decreases. For slopes facing the dominant wind direction that are less than 500 feet long, erosion is accelerated. Therefore, the erodibility factor *I'* needs to be adjusted by the knoll erodibility factor I_s. Values of *I'* and I_s can be obtained from tables presented in Woodruff and Siddoway, (1965) or Israelsen et al. (1980).

Laboratory testing of top soil samples indicated that the percent of topsoil greater than 0.84 mm (percent of soil retained on the sieve #20) is about 1%. Furthermore, it is expected that the top soil will form a crusted surface relatively soon after construction, in response to rain and snow. Based on these conditions, the wind erodibility factor *I'* is estimated to be 51.7 ton/acre/yr (Table 3-1, Israelsen et al., 1980). For a surface slope of 5 %, the windward knoll erodibility factor I_s is approximately 3. Therefore, the adjusted erodibility factor *I'* will be approximately 155 tons/acre/year (Table 5).

Table 5: Soil Wind Erodibility Factor

Percent Topsoil Larger than 0.84 mm	Erodibility Factor *I'*	Windward Knoll Erodibility Factor I_s	Adjusted Erodibility Factor *I'*

1 %	51.7	3.0	155

3.2. Climatic Factor

The climatic factor C' represents the relationship between wind erosion and climatic conditions at the field, irrespective of other parameters. Research has indicated that the rate of soil movement by wind is directly proportional to the cube of the velocity and inversely proportional to the square of soil surface moisture. Instead of actually calculating C' from soil moisture and wind velocity, average annual values of C' for various parts of the United States can be obtained from Figure 11 in Cowherd et al. (1974). Based on figure, the climatic factor for Pocatello, Idaho is $C' = 0.3$.

3.3. Soil Surface Roughness Coefficient

The soil surface roughness coefficient K' is a measure of the natural or artificial roughness of the soil surface in the form of ridges or small undulation. It can be determined from the average soil roughness height (Figure 4, Woodruff and Siddoway, 1965). The soil roughness factor varies from 1 for fairly smooth surfaces to 0.5 for average roughness heights of 3-4 in. In this calculation, K' is set to 0.63 which corresponds to soil roughness height of about 1 in.

3.4. Vegetative Factor

The vegetative factor V' represents the reduction in erosion due to the presence of vegetation and/or vegetative residue in the topsoil. The value of V' can be estimated from the amount of organic material in air-dried soil samples from the top 3 in of soil in air-dried soil samples (Figure 3-2, Israelsen et al, 1980). Assuming that its air-dried organic material content is 0.1 % and the soil bulk density is 1.7 g/cc (1.7/454 x 4.047 x10^7 x 2.54 = 3.85 x 10^5 lb/acre-in), the mass of organic material per unit acre is:

$$V' = f_{oc} \times \rho_b \times t = 1.2 \times 10^3 \text{ lb/acre}$$

where

f_{oc} organic material content (0.1 %)

ρ_b bulk density 1.7 g/cc (3.85 x 10^5 lb/acre-in)

t thickness of soil (3 in).

This value is comparable to the air-dried residue of various crops listed in Table A-2 of Cowherd et al. (1974). The resulting vegetative factor, assuming anchored flat straw or grass (Figure 3-2, Israelsen et al., 1980) is 3,800 lb/acre.

3.5. Unsheltered Length of Field

The unsheltered length of field L' is defined as the length (ft) of field in the direction of wind in excess of 10 times the height of any barriers. For the Pond 8E closure cap, we assume that L' = 200 ft which is approximately equal to the maximum distance between the highest point of the cap along its centerline and the edge of the cap.

3.6. Wind Erosion Losses

Table 6 presents the input parameters defined in the Sections 3.1 through 3.5 for the wind erosion equation. Using these input parameters and the nomograph of the wind erosion equation shown in Figure 1, the average annual wind erosion is estimated to be 1.3tons/acre or 0.0068 in. This value corresponds to 0.2 in over a period of 30 years, the service life of the cap. This value is particularly sensitive to the vegetative factor V'.

Table 6: Average Annual Wind Erosion Losses

Wind Erosion Factors					Intermediate Variables[1]		Wind Erosion Losses	
I'	C'	K'	V' (lb/acre)	L' (ft)	$I'K'$	$I'K'C'$	(tons/acre/yr)	(in/yr)[2]
155	0.3	0.63	3,800	200	98	29	1.3	0.0068

[1] Used in wind erosion nomograph (Figure 1)

[2] Assuming bulk density of 1.7 g/cc (193 tons/acre-in)

In units of tons/(acre-inch):

1.7 g/cc=1.7x(1/907,200 ton/g)x(40,470,000 cm^2/acre)x (2.54 cm/in) =193 tons/acre-inch

4. Summary of Results

A summary of the estimated erosion losses due to rainfall and wind are presented in Table 7. The annual rainfall erosion is estimated to be about 0.9 ton/acre or about 0.0046 in. Over a period of 30 years, the service life of the cap, the rainfall erosion is expected to be about 0.14 in. . Rainfall erosion due to extreme short-term events (100-year, 24-hour storm) is about 0.0015 in.. Since the occurrence of such extreme events is rare, their contribution to the long term annual average is minimal.

The annual wind erosion is estimated to be about 1.3 ton/acre or about 0.0068 in.. Over a period of 30 years, this value corresponds to 0.2 in. Therefore, the total erosion due to rainfall and wind is expected to be about 0.34 in.

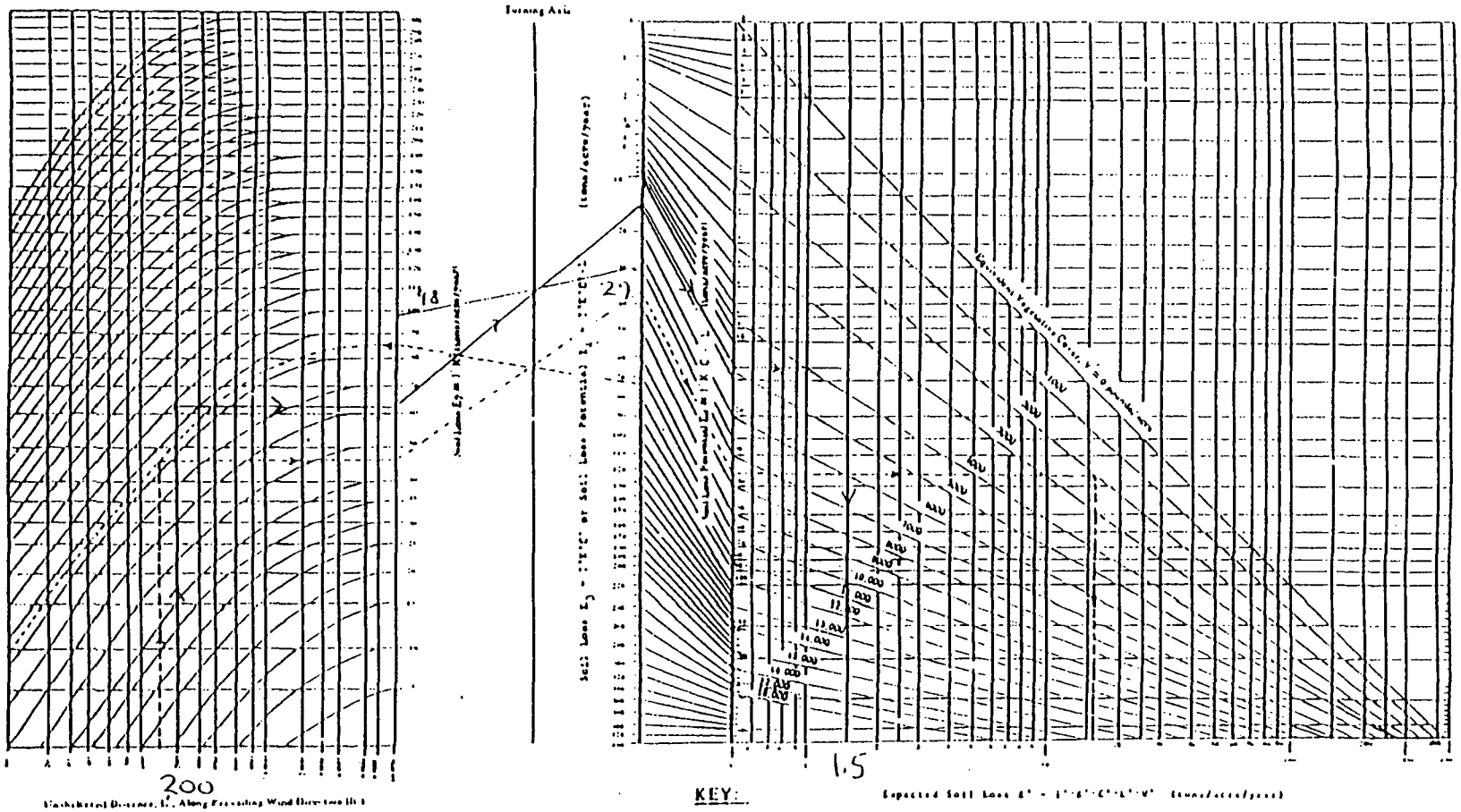
Table 7: Summary of Rainfall and Erosion Losses

	Peak Daily[1] (in)	Average Annual[1] (ton/acre)	Average Annual[1] (in)	Service Life of Cap[2] (in)
Rainfall Erosion	0.0015	0.9	0.0046	0.14
Wind Erosion	NC[3]	1.3	0.0068	0.2
Total Erosion	-	2.2	0.0114	0.34

[1] (100-year return period)
[2] Service life of cap is 30 years
[3] NC- Not calculated

CALCULATION SHEET

SUBJECT	*Estimation of Rainfall and Wind Erosion from Pond 8E Closure Cap*	PROJECT	*FMC, Pocatello*
BY	*Nadim Copty*	JOB NUMBER	*24230-025*
		CALC NO.	*8ECALC3*
	DATE *2 July, 2001*	SHEET NO.	*16 of 17*
		SHEET REV	*1*



Step 1. Locate I'K' value on vertical scale to the left of turning axis and construct curved dotted line as indicated.

Step 2. Move vertically upward from L' value to intercept curved line (Step 1) then horizontally to E_1 scale.

Step 3. Mark I'K'C' value on vertical scale to the right of turning axis.

Step 4. Draw line from I'K' value (Step 1) to I'K'C' value (Step 3) and mark intercept on turning axis.

Step 5. Draw line from value on E_1 scale (Step 2) through point on turning axis (Step 4) to E_4 scale, then diagonally to second E_4 scale, horizontally to intercept with appropriate V' value, and then vertically downward to read expected soil loss on E' scale.

Figure 1: Nomograph for the Wind Soil Loss Equation

5. List of References

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CALCULATION COVER SHEET

PROJECT	FMC - Pond 8E	JOB NO. 24230-025	CALC. NO. 24230-025-1	SHEET 1
SUBJECT	Settlement Evaluation		DISCIPLINE Geotechnical	

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	[ ]	[X]	[ ]	[ ]

COMPUTER PROGRAM/TYPE	SCP	MAINFRAME	PC	PROGRAM NO.	VERSION/RELEASE NO.
	[ ] Yes [ ] No	[ ]	[X]	ACCUMV	--

REV.

Purpose: Evaluate pond settlement of Pond 8E during construction and after final cover is installed. The conclusions in this calculation are based on the laboratory testing results of the samples from Pond 8E. The results of this calculation compare well with ongoing settlement after the initial large-strain settlement has occurred. 1

References:

1. "Field Geotechnical Investigation, Eastern Michaud Flats Project, FMC Ponds 8S and 15S, Pocatello, Idaho," by Bromwell and Carrier, Inc., January 1994, Appendix H of this Closure Plan.
2. "Final Report, Geotechnical Laboratory Test Results, Pond 15S Samples, FMC's Elemental Phosphorus Plant," by Mountain States Analytical, Inc. and Applied Geotechnical Engineering Consultants, Inc., November 18, 1994, Appendix L of Pond 15S Closure Plan, September 1996.
3. Final Report, Geotechnical Laboratory Test Results, Ponds 8E, 11S, 12S, and 13S, FMC's Elemental Phosphorus Plant, Eastern Michaud Flats Project, Pocatello, Idaho, Applied Geotechnical Engineer Consultants, Inc., September 9, 1997, Appendix L of Pond 8E Closure Plan, December 1997.
4. TCON1, Version 4197a from TAGA Engineering Systems and Software.
5. ACCUMV, The One-Dimensional Consolidation of Saturated Clays, A Computer Program for Nonlinear Finite Strain Theory, by Schiffman, R.L., Szavits-Nossan, V., and McArthur, J.M, December 1992.
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7. Pond 8S Settlement Monitoring, Progress Report No. 9, January 30, 1997.
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10. Closure Settlement Report, Pond 8E, Pond 15S, and Phase IV Ponds - Progress Report No. 7, Pond 16S - Progress Report No. 3," Bechtel, July 31, 2001.

1

No.	Reason for Revision	Total No. of Sheets	Last Sheet No.	By	Checked	Approved/ Accepted	Date
1	Incorporated settlement monitoring data	80	App. B-48	JTC	[signature]	[signature]	12/26/01
0	Issued for use	74	App. B-48	JTC	[signature]	[signature]	12/26/01

Record of Revision

CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-1

SUBJECT Pond Settlement Evaluation of Planned Configuration SHEET NO. 2

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	8/6/01								
1	J.T. Cameron	9/28/01								

Purpose of Calculation

This calculation performs an evaluation of the cap settlement for the planned cover design configuration of Pond 8E (see Figures 1 and 2) using the soil parameters developed from laboratory test results of the samples from Pond 8E.

Introduction

Pond 8E has a design capacity of 27 acre-feet and is triangular-shaped in plan with side dimensions varying between about 400 feet and 500 feet. A plan of the pond is shown in Figure 1. The pond is double-lined and is equipped with a leachate collection, detection, and removal system (LCDRS) between the two liners. The pond commenced operation in 1984, primarily for the storage of phossy wastes. It was dredged (as much as possible without damaging the liner) in the Fall of 1994 and began receiving NOSAP slurry in January 1994. December 1996 chemical data indicates that the bottom solids which remained after dredging have phosphorus content ranging from 44 ppm to 445 ppm. The pond is currently at full capacity with a sludge depth of approximately 14 ft. The pond ceased receiving wastes in October/November 1996 and will be permanently closed.

It is currently planned to place a permanent cap over the pond solids. Excess water would be pumped from the pond as fill is placed, an initial fill placed over the pond solids, and after an interval of time provided to allow settlement to occur, a final cap would be placed over the initial fill. The initial fill would be allowed to settle until the rate of settlement had decreased to an acceptable rate. The projected settlement resulting from the existing loads and the additional loads of the final cap construction are estimated for a 30-year design life of the cap.

Special measures and equipment are required to place the fill safely. The principal features of current planning include using a conveyor system to place the initial sand fill over the sludge in thin controlled layers to attain a thickness of approximately 5 feet. Slag fill of about 5 ft to 7 ft. will be placed over the sand. The weight of the fill will cause substantial consolidation of the sediments and

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time dependent settlement of the fill will result. The magnitude and rate of settlement of the fill are important factors in the planning, design and scheduling of the closure process.

Estimating the magnitude and rate of settlement of very soft, fine-grained sediments is an approximate but well-established process. This process normally includes obtaining undisturbed samples of the sediments and measuring strength and consolidation characteristics in the laboratory. This process normally yields reasonable results for the magnitude of settlement, but prediction of time-rates of settlement without the support of field measurements is always a very approximate process.

In the case of the phossy wastes, the accuracy of estimates of both the magnitude and time-rate of settlement are severely degraded because of the impossibility of obtaining undisturbed samples and the difficulty in accurately measuring basic, essential soil properties in the laboratory. Extreme effort, special equipment and special non-standard procedures are required to safely test the materials in the laboratory because of the hazardous nature of the sediments.

Information on the properties of the phossy sediments were first obtained in 1993. Disturbed sampling and insitu vane shear tests were performed at Ponds 8S and 15S. The vane shear strengths indicated the very soft nature of the Pond 8S sediments and the even weaker condition of sediments in Pond 15S. A limited number of laboratory tests were performed at that time. The findings of these investigations are presented in Reference 1.

This information on the sediments and published data were used to initially estimate settlement of Pond 8S. These theoretical analyses predicted large settlements and a long period of consolidation. However, experience with placing the initial fill on Pond 8S and the installation of wick drains to accelerate consolidation suggested that the settlement of the sediments would be less than predicted and consolidation would be faster than anticipated.

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Additional sampling and special laboratory testing were accomplished in 1994 to provide more reliable data on the properties of the sediments and to provide an improved basis for predicting the performance of Pond 15S. The testing primarily included moisture content, gradient ratio/permeability and consolidation tests. The results of the testing are summarized in Reference 2. These early field explorations and field construction and monitoring practice provided valuable insight for the behavior of the phossy waste sludge material.

A field investigation and laboratory test program for Pond 8E was conducted between July 27 and August 25, 1997. The in-situ vane shear tests indicated that the phossy waste inside Pond 8E is essentially of the same nature as those found in Pond 15S, i.e., very soft and weak in shear strength and very sensitive to disturbance. The vane shear tests are summarized in Reference 3.

This current settlement analysis for Pond 8e is based on experience and settlement monitoring data obtained from Pond 8S, the additional laboratory data obtained in the 1994 and 1997 testing programs (References 2 and 3), and the use of analyses methods that account for the major changes in the basic soil properties of void ratio, permeability, and compressibility that take place during consolidation of these very soft sediments.

Background of Analyses

Settlement analyses were performed using two computer codes (TCON1, Reference 4 and ACCUMV, Reference 5) and hand calculations.

TCON1 is a finite difference code based on infinitesimal linear strain theory. Large strains are taken into account by adjusting the thickness of consolidating layer at the end of each time step. The accuracy of the solution is enhanced by increasing the number of layers in the soil model and reducing the time step increment. The program also accommodates non-linear stress dependent relationships of void ratio and permeability by interpolation along a specified curve.
ACCUMV is a finite difference code which implements a non-linear finite strain theory of

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consolidation that accounts for changes in the thickness of the consolidating stratum (i.e. drainage path length) without having to make the adjustments necessary with TCON1. Non-linear stress dependency of void ratio and permeability can be accommodated using either a least squares or a power law relationship.

The required soil design parameters include a relationship between void ratio, e, and effective pressure, γ', and a relationship between void ratio and permeability, k. Laboratory test results presented in Reference 2 indicated that the coefficient of consolidation varied between about 4 and 45 ft2/month. Due to limited laboratory test data, it is assumed that Ch is equal to Cv. Internal checks on comparison of the two computer codes found them to provide solutions within 5 percent of one another. In Reference 6, Section 7, it was concluded that wick drain spacings on the order of 5 to 7 feet could achieve primary consolidation within 1 to 2 months after initial filling of Pond 15S and potentially advance the installation of the permanent cap by about one year.

Laboratory test results on samples taken from Pond 8E and the Phase IV Ponds (Reference 3) indicated that the compressibility characteristics of the sludge were a function of the individual pond material type and the depth below the top of the sludge.

Methodology

The estimated settlement is determined using ACCUMV (Reference 5). A check was performed by comparing measured settlements at Pond 8S with those estimated using ACCUMV. This comparison is provided in Figure 3. The ACCUMV analysis appears to underestimate early settlement and overestimate settlement for later times. However, the results of the model are considered acceptable for estimating purposes. The following methodology was then used to predict settlements for Pond 8e.

Primary Consolidation

ACCUMV requires two constitutive relationships be established for the soft soil layer, i.e., the void ratio versus effective stress, and permeability versus void ratio. These two relationships are provided

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in Reference 5. The relationship between void ratio and effective stress in terms of the natural logarithm is in the general form:

$$e = \frac{A + B * \ln \sigma'}{1 + C * \ln \sigma' + D * (\ln \sigma')^2} \qquad (1)$$

where e = void ratio

A, B, C, D = Curve-fitting parameters,

$\sigma' = \sigma_0' + \Delta\sigma'$ = effective vertical stress,

σ_0' = initial effective vertical stress, and

$\Delta\sigma'$ = change in effective vertical stress

If we let C = D = 0, as in Reference 6, then Eq.(1) degenerates to the conventional formula for settlement analysis:

$$e = A + B * \ln \sigma' \qquad (2)$$

where $A = e_0 + C_c \operatorname{Log} \sigma_0'$, $B = -0.4343\ C_c$, e_0 is the initial void ratio at a particular depth of interest, and C_c is the compression index at the same depth.

As suggested in Reference 5, if we let $\sigma'_0 = 1$ psf and denominate $e_i = e_0$ ($\sigma'_0 = 1$ psf), Eq.(2) can be written as

$$e = e_i - 0.4343\ C_c \ln \sigma' \qquad (3)$$

From Reference 3 it was determined that for the sludge in Pond 8E, the following relationships exist

$$e_i = 9.42 - 0.51*(\text{depth}) \qquad (4)$$

$$C_c = 1.61 - 0.13*(\text{depth}) \qquad (5)$$

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Since e_i and C_c vary with depth while ACCUMV analyzes the entire sediment as one layer, an average depth value should be used to obtain an overall reasonable settlement value. It was found by a hand-calculation that using a depth of 0.55H (where H = thickness of sludge) in the above relationships results in overall settlement values determined from ACCUMV that compare well with the hand calculation. For Pond 8E, H = 13.6 ft. Therefore,

$$e_i = 9.42 - 0.51*(0.55*13.6) = 5.61,\ C_c = 1.61 - 0.13*(0.55*13.6) = 0.638$$

are used in the following calculation. The hand calculation is attached as Attachment A. It should be noted that ACCUMV uses e_i, which is the projected void ratio at a stress of 1 psf, and the hand calculation uses the e_0 reported in the laboratory test results. The average design curve is shown in Figure 4 in comparison with the laboratory test results of Reference 3.

ACCUMV also requires a second constitutive relationship between permeability and void ratio in an equation form. The equation has the general form:

$$k = \frac{G \cdot e^F}{1 + E \cdot e} \qquad (6)$$

where k is permeability, e is the void ratio, and E, F, G are curve-fitting constants. Based on test results reported in Reference 3, the following equation for Pond 8E was determined:

$$k = 0.02\ e \qquad \text{(k in ft./month)} \qquad (7)$$

i.e., G = 0.02 (ft./month), F = 1, and E = 0.

Secondary Consolidation

The secondary compression, C_α, has been inferred from field settlement monitoring results at Pond 8S (Reference 7) to be 0.02 per log cycle. For Pond 8E, the thickness of the sludge H = 13.6 ft., this corresponds to a creep rate, α, of 0.272 ft/log cycle of time. This additional settlement is added to the primary settlement as calculated by ACCUMV.

Wick Drain Design and Analysis

The methodology presented in Reference 8 for wick drain design is used and is summarized below. The wick drain is first converted to an equivalent sand drain diameter, then radial drainage theory is

used to estimate the beneficial effects of the wick drains.

Total area of wick drain, A_w = width * thickness

Void area of wick drain, $A_v = A_w$ * %voids/100

where %voids is typically about 90% to 95%, assume 92%

Equivalent void circle diameter: $d_v = \sqrt{\frac{4 * A_v}{\pi}}$

Equivalent sand drain (or well) diameter: $d_w = \frac{d_v}{n}$, where n = sand porosity (typically about 0.3)

The time to achieve a particular degree of consolidation is determined from the following relationship (Reference 8)

$$t = \frac{d_e^2}{8C_h}\left[\ln\frac{d_e}{d_w} - 0.75\right]\ln\frac{1}{1-U_h} \qquad (8)$$

where

- t = time for consolidation
- C_h = coefficient of consolidation of soil for horizontal flow, assumed to be the same as the vertical coefficient of consolidation, C_v
- d_w = diameter of equivalent sand drain
- d_e = sphere of influence for wick drain (for a triangular pattern use 1.05 spacing; for a square pattern use 1.13 spacing)
- U_h = average degree of consolidation in the horizontal direction

The vertical and horizontal components of degree of consolidation are combined per Reference 9 using the following relationship:

$$U = 1 - (1 - U_h)(1 - U_v) \qquad (9)$$

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0	J.T. Cameron	8/6/01								
1	J.T. Cameron	9/28/01								

where U_v = the average amount of vertical consolidation.

Note that wick drains only effect the primary settlement. Therefore, the amount of settlement that occurs over a given time period after primary settlement is complete should be the same whether wick drains are present or not.

Spacing of the wick drain was assumed to be 7 ft per instruction of the project. It was also assumed that wick drains will be installed one month after the initial fills are placed over the sludge.

Time for Final Cap Placement

Following the practice for Ponds 8S and 15S, the time for final cap placement is defined as when the rate of settlement under the initial fill loading reduces to less than 1 inch per year (Reference 6). The settlement that will occur over the 30-year design life of the final cap is also estimated.

Input Data and Assumptions

Soil properties from Ponds 15S and 8E (References 2 and 3) were used in the current calculation: No additional field testing and sampling, or laboratory testing are planned prior to final closure design. The following assumptions were used in the analyses:

- Pond design life = 30 years after final cap is installed,
- Consider drainage occurs only in the vertically upward direction for the primary consolidation stage,
- Surface water is drawn down to top of sludge prior to loading.
- Pond sludge is normally consolidated, i.e. zero excess pore pressures at start of loading.
- Sludge thickness = 13.6 feet
- Total unit weight of sand backfill = 115 pcf
- Total unit weight of slag backfill = 130 pcf
- Average total unit weight of final cap material = 120 pcf

CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-1

SUBJECT Pond Settlement Evaluation of Planned Configuration SHEET NO. 10

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
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- Specific gravity of solids = 2.79
- Unit weight of solids = 174.1 pcf.
- Void ratio vs. effective stress relationship as defined in Eq.(3) is used. $e_i = 5.61$, $C_c = 0.638$
- Permeability vs. e relationship as defined in Eq.(7) is used.
- Dimensions of the wick drain are assumed to be 110mm by 4mm with 92% void area. In the analyses the wick drains are placed at 7 feet spacing, triangular pattern. And wick drains will be placed after the initial 5 feet of sand is placed.
- By inspection of the Pond 8E laboratory data (Reference 3), the coefficient of vertical consolidation, C_v, is taken as 6 ft^2/month. This value of C_v corresponds to an effective overburden pressure of about 500 - 600 psf, roughly the pressure from the initial sand fill. The coefficient of horizontal consolidation, C_h, is assumed to be the same as C_v.
- Soil porosity for equivalent sand drain is assumed 0.3.
- Secondary compression, C_α, = 0.02 per log cycle. For Pond 8E, this corresponds to a creep rate, α, of 0.272 ft/log cycle of time (in months)

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	8/6/01								
1	J.T. Cameron	9/28/01								

Loading Conditions

Table 1 summarizes the loading sequence anticipated for filling of Pond 8E:

Table 1 -Summary of Loads for Pond 8E

Description	Value		Comments
Elev. Top of Cap	4493	ft	
Elev. Top of Slag	4489.5	ft	
Elev. Top of Sludge	4479.6	ft	
Elev. Pond Bottom [min]	4466	ft	8E slopes 1.9 feet to center
Sludge Thickness	13.6	ft	
Sand Thickness	5.0	ft	
Final Slag Thickness	6.9	ft	= 5.0 ft init. ht. + 1.9 ft settlement
Final Cap Thickness	3.5	ft	
Addtl. Pressure - Sand	575	psf	
Addtl. Pressure - Slag	897	psf	
Addtl. Pressure - Cap	420	psf	
Time to place sand	0.6	months	
Time to place slag	0.4	months	
Begin Cap Construction	24.0	months	After initial filling begins
Time to place cap	1.0	months	

Notes:

Total Unit Weight Sand	*115 pcf*
Total Unit Weight Slag	*130 pcf*
Total Unit Weight Cap	*120 pcf*

For analysis purposes it is assumed that the total unit weights provided in Table 1 above are approximately equal to the saturated unit weights. This loading sequence was used with the soil properties discussed above to perform an ACCUMV run.

Calculations

Primary Consolidation and Secondary Compression

Primary consolidation values are obtained directly from the ACCUMV program results. The printed output is provided as Attachment B.

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0	J.T. Cameron	8/6/01								
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Secondary compression, δ_{sec}, is derived using the following expression (Reference 9):

$$\delta_{sec} = \alpha * \log(t/t_p) \qquad (10)$$

where $\alpha = 0.272$ ft/log cycle, and t_p = time to reach primary consolidation. By inspection of the settlement vs log (time) output from the ACCUMV program results this value is about 10 months.

Wick Drains

Utilizing the assumed wick drain properties, the degree of horizontal consolidation, U_h, can calculated as a function of the time, t, following Eq. (8):

Wick drain spacing, $S = 7$ ft

$d_e = 7 * 1.05 = 7.35$ ft

$A_w = 110 * 4 = 440$ mm^2

$A_v = 440 * 0.92 = 405$ mm^2

$d_v = (4*405/\pi) = 22.7$ mm

$d_w = 22.7/0.3 = 75.7$ mm $= 0.25$ ft

Coefficient of horizontal consolidation $C_h = 6$ ft^2/month

$$t = [7.35^2/(8*6)]\,[\ln(7.35/0.25) - 0.75]\,\ln[1/(1-U_h)] = 2.961 \ln[1/(1-U_h)]$$

Therefore, for this specific case: $U_h = 1 - e^{-t/2.961} = 1 - e^{-0.338\,t}$

The horizontal degree of consolidation, U_h, is combined with the vertical degree of consolidation, U_v, obtained from the ACCUMV output following Eq. (9)

$$U = 1 - (1 - U_h)(1 - U_v)$$

to determine the average degree of consolidation, U. The total amount of settlement including the effects of wick drains, δ_{wick}, is then determined using the following relationship:

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0	J.T. Cameron	8/6/01								
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$$\delta_{wick} = (\delta_{prim}/U_v) * U + \delta_{sec} \quad (11)$$

where δ_{prim} = the amount of primary settlement calculated by ACCUMV.

ACCUMV reports the degree of consolidation, U_v, based on the total final load. Therefore, the ratio of the current settlement over the degree of settlement reported by ACCUMV, (δ_{prim}/U_v), provides a rough approximation of the amount of total settlement that the sludge would experience under the current load. The quantity $(\delta_{prim}/U_v) * U$, therefore represents an approximation of the primary settlement under the current load with wick drains installed.

Determination of time to reach a settlement rate of 1 in/yr

Based on previous studies performed in Reference 6, it was estimated that the final cap could be placed after the settlement rate reduced to less than one inch per year. The rate of settlement can be checked between successive pairs of calculated time-settlement values to determine when this occurs. However, the time, t, can also be explicitly determined based on the value of creep rate, α, as follows.

$$\delta_{sec} = y = \alpha * \log(t)$$

$$\delta y/\delta t = 1 \text{ in/yr} = \alpha / (t * \ln 10)$$

Therefore:

$$t = \alpha / (1 \text{ in/yr} * \ln 10) \quad (13)$$

for $\alpha = 0.272$ ft/log cycle, t = 18 months.

Estimate the amount of settlement that will occur over the 30-year design life of Pond 8E

About 2 inches of primary consolidation is expected under the additional cap loading. The above

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relationship can again be used to estimate the amount of additional secondary settlement that will occur over the 30-year design life of Pond 8E. Assuming that the final cap is completely installed within 24 months, primary consolidation is complete under the cap increment of load at 30 months, and that a secondary compression of 0.272 ft/cycle is acting, the amount of additional settlement that will occur within 30 years after completion of cap is determined as follows:

$$\delta_{30\ yr} = \alpha * \log([t + t_p]/t_p),$$

where $\alpha = 0.272$ ft/cycle, $t_p = 30$ months, $t = 360$ months

$$\delta_{30\ yr} = 0.272 * \log([360+30]/30) = 0.3 \text{ ft} = 4 \text{ in.}$$

Therefore, for the conservative assumptions of α and t_p, the estimated amount of additional settlement that will occur after installation of cap is about 6 inches. Differential settlement will be less.

Results of Calculation

The ACCUMV computer printout is provided in Attachment B. A tabular output of the results is presented in Figure 5 and the plotted results are included in Figures 6, 7, and 8. Figure 6 shows the estimates of primary and secondary compression. Figure 7 presents the same information with the effects of adding wick drains at 7-foot spacing assuming a coefficient of horizontal consolidation of 6 ft^2/month. The effect of the wick drains essentially reduces the time for primary settlement to end by about 4 to 5 months. Table 2 summarizes the calculated results of ultimate primary settlement resulting from each element of the filling operation. These values are plotted in Figure 8. A schematic cross section of Pond 8E showing relative elevations of the fill layers before and after the settlement of the initial fill, is provided in Figure 9.

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Table 2 - Summary of Load/Settlement Analysis Results for Pond 8E

Phase of Construction	Net Pressure, psf	Primary Settlement
	(psf)	(ft)
Begin	0	0
Sand fill, 5-ft thickness	575	1.36
Sand and 2.5 ft of slag (near perimeter dike)	900	1.63
Sand and 6.9 ft of slag	1472	1.94
Permanent, 3.5-ft cap	1892	2.11

Once primary consolidation ends the creep rate controls the time rate of settlement and thereby the time at which the cap may be added. This correlates to 18 months after initial filling begins for a creep rate of 0.272 ft/cycle. The time for placement of the final cap will be controlled by monitoring settlements after the initial fill is placed.

It is estimated that after the final cap is installed the amount of additional settlement that will occur over the 30-year design life of Pond 8E will be about 6 inches.

Figures 10 through 15 show the measured settlements for the 10 settlement monuments installed in Pond 8E (Ref. 10). After the initial large-strain settlement have occurred, the rates of settlement show a good correlation with those predicted. The discrepancy between the plotted and estimated settlements shown in these figures is due primarily to the absence of a well-defined sludge/water interface in the field. The computer program requires input of a definite interface. However, in the field it is likely that the interface is instead a diffuse zone that varies from fluid to solid over a thickness of 2 or more feet. After all the loading has been placed (30-60 days after start of initial filling) the shape, or rate, of the measured settlements are similar to those predicted.

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0	J.T. Cameron	8/6/01								
1	J.T. Cameron	9/28/01								

Conclusions The results of the analyses for Pond 8E are summarized in the following table:

Table 3 - Summary of Settlement Analyses for Pond 8E

Item	Pond 8E
Primary Consolidation of Initial Fill	
Settlement [ft]	1.9
Elapsed Time [months after start of filling]	12
Time to Reach Settlement Rate of 1 in/yr [month]	18
30-yr Secondary Settlement [ft]	0.3
Primary Settlement of Permanent Cap [ft]	0.2
Total Post-Construction 30-yr Settlement [ft]	0.5

For horizontal consolidation coefficient $C_h = 6$ ft^2/yr and 7-foot triangular spacing, the effect of adding wick drains speeds up the time for primary consolidation to occur by about 4 to 5 months.

Field measurements should be made after the initial cap is installed to determine when the final cap may be placed (when settlement rates reduce to 1 in/yr.).

The results of this calculation compare acceptably with ongoing settlement after the initial large-strain settlement has occurred.

Pond 8E: Check the ultimate settlement using the updated lab data

$\Delta e_i = Cc_i * \log *((P_0+\Delta P)/P_0)$

$\Delta H_i = H_{0i} * \Delta e_i /(1+e_{0i})$

$e_0 = 7.18 - 0.33 * (\text{depth})$

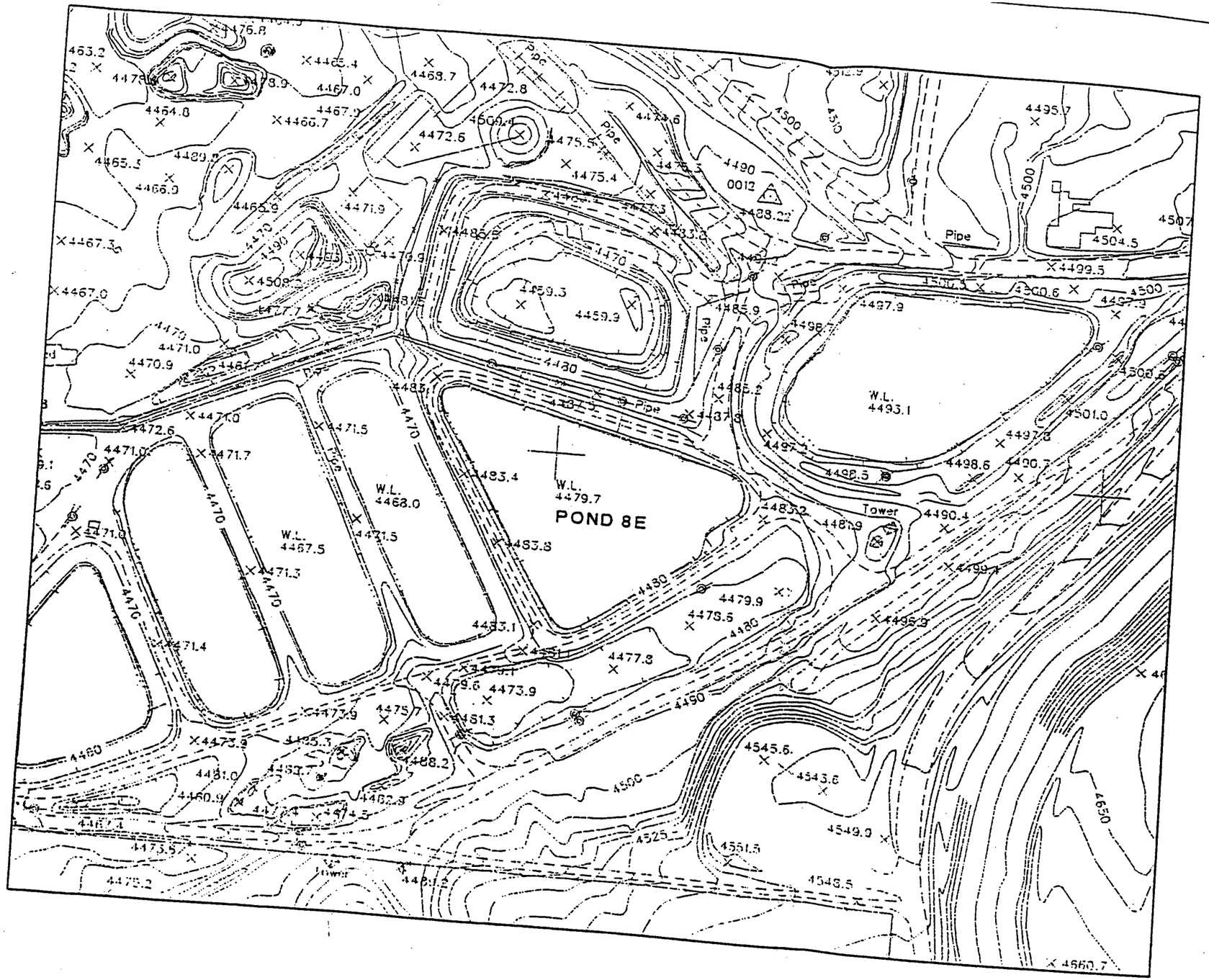
$Cc = 1.61 - 0.13 * (\text{depth})$

$\gamma_{total} = 75.33 + 0.99 *(\text{depth})$

Total Sludge Thickness: 13.6 ft

Layer	Depth (ft)	Mid-Depth (ft)	H_0 (ft)	e_0	Cc	P_0 (psf)	ΔP (psf)	Δe	ΔH (ft.)
	0								
1		1.36	2.72	6.73	1.433	19	1472	2.13	0.75
	2.72								
2		4.08	2.72	5.83	1.080	61	1472	1.51	0.60
	5.44								
3		6.80	2.72	4.94	0.726	111	1472	0.84	0.38
	8.16								
4		9.52	2.72	4.04	0.372	168	1472	0.37	0.20
	10.88								
5		12.24	2.72	3.14	0.019	232	1472	0.02	0.01
	13.60								
								Total:	1.94 ft.

Note: Change of Void Ratio in the P<50 psf range was ignored.
e_0, Cc, γ_{total} relationships ~~per~~ from Reference ~~5~~ 3.



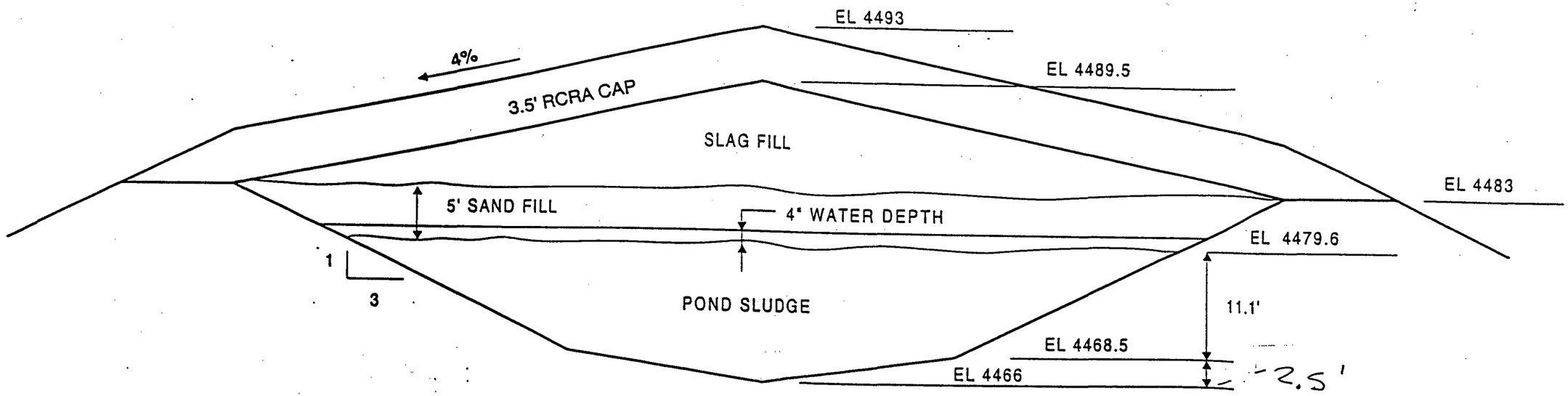
Reference: Vertical Datum is Mean Sea Level.
Horizontal Datum is North American Datum 1983.

Date of Photography: June 1992

Bechtel Environmental, Inc. San Francisco			
FMC CORPORATION POCATELLO, IDAHO			
Pond 8E - Site Topography			
BECHTEL	Job No.	Drawing No.	Rev.
	20906	Figure 1	0

April, 1997

Phase IV Ponds Closure Plan
Pond 8E

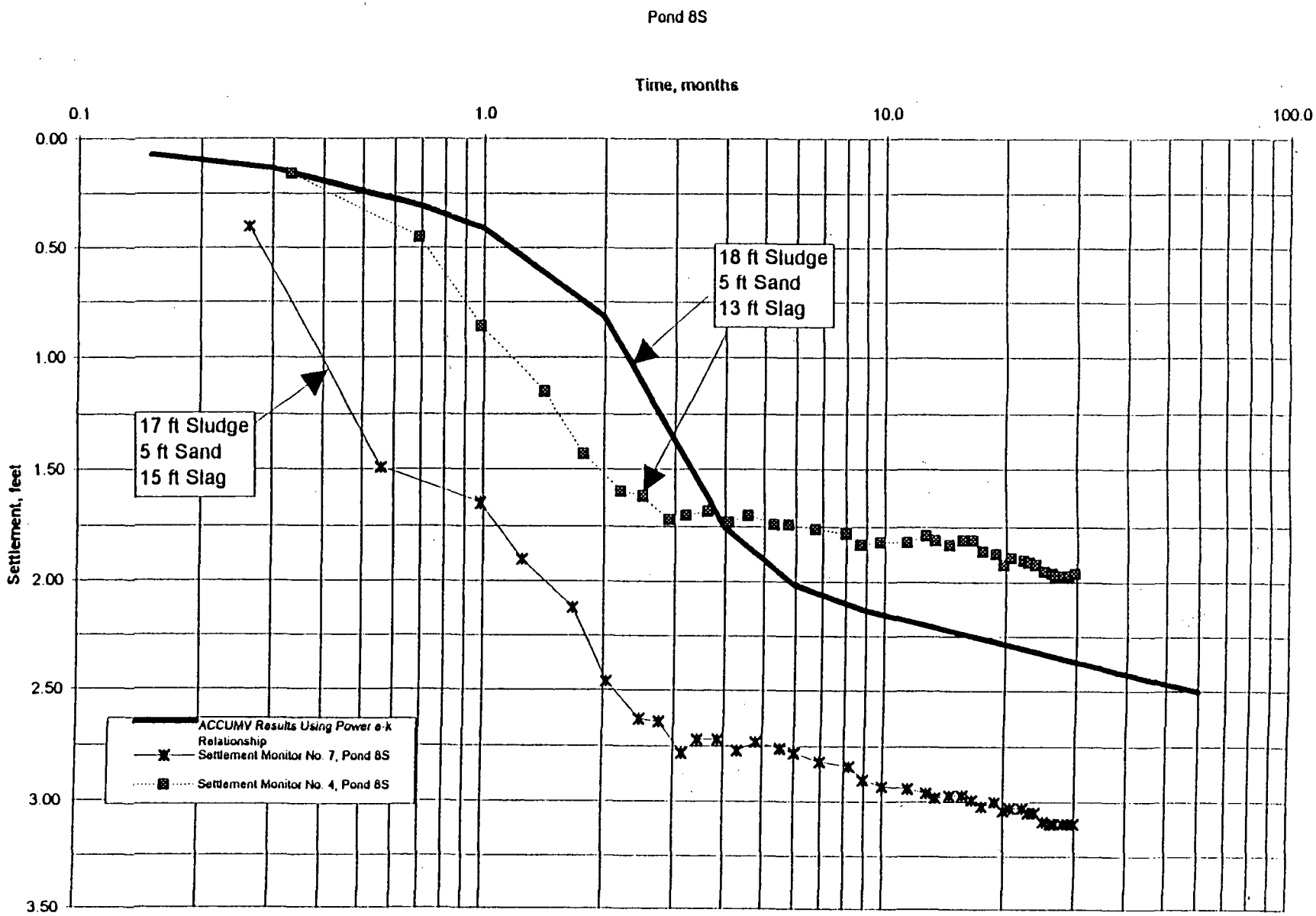


POND 8E

SCHEMATIC CROSS SECTION OF POND 8E

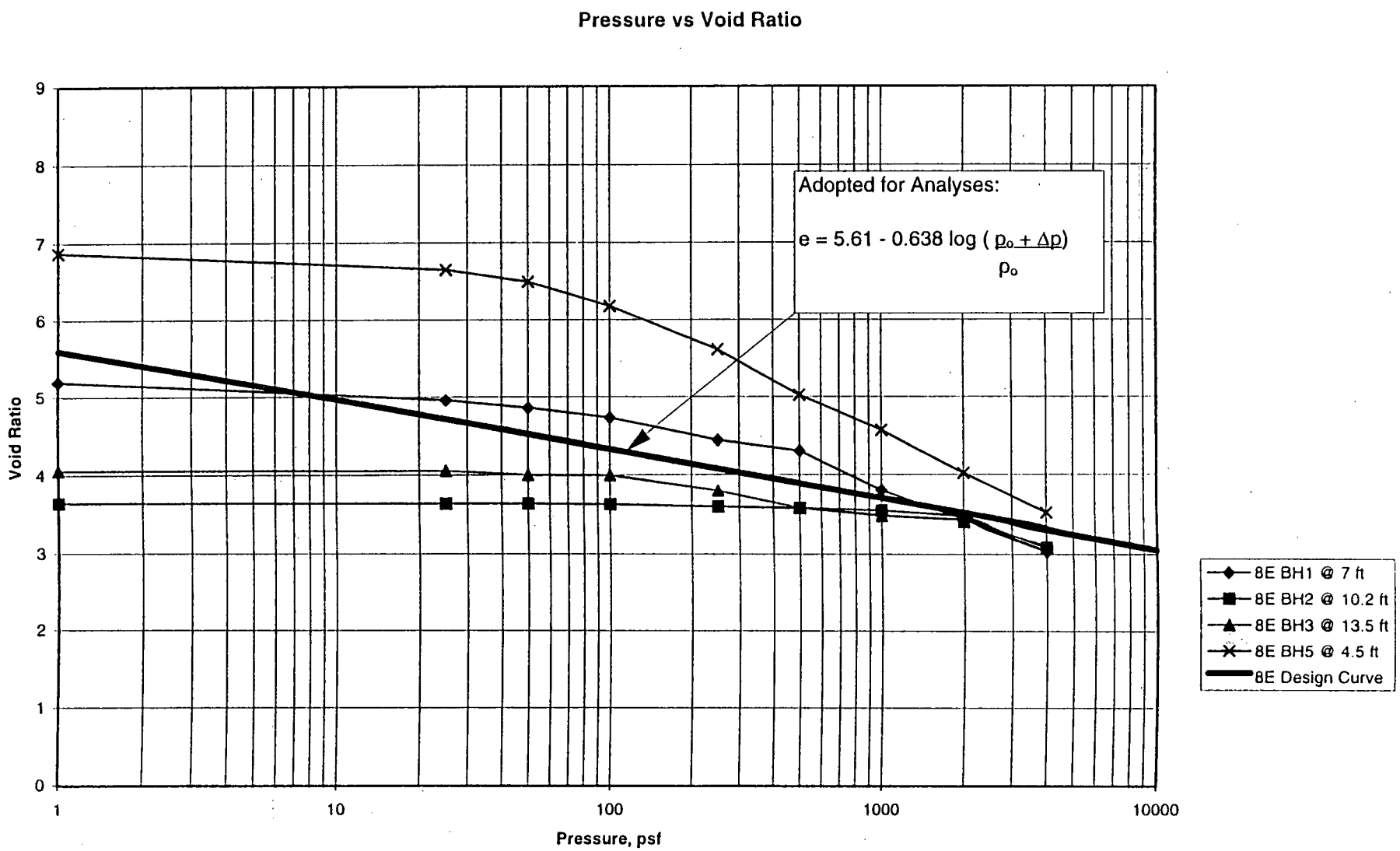
REF: PROVIDED BY PROJECT 3-97

Figure 2



Comparison of ACCUMV Results and Measured Data for Pond 8S

Figure 3



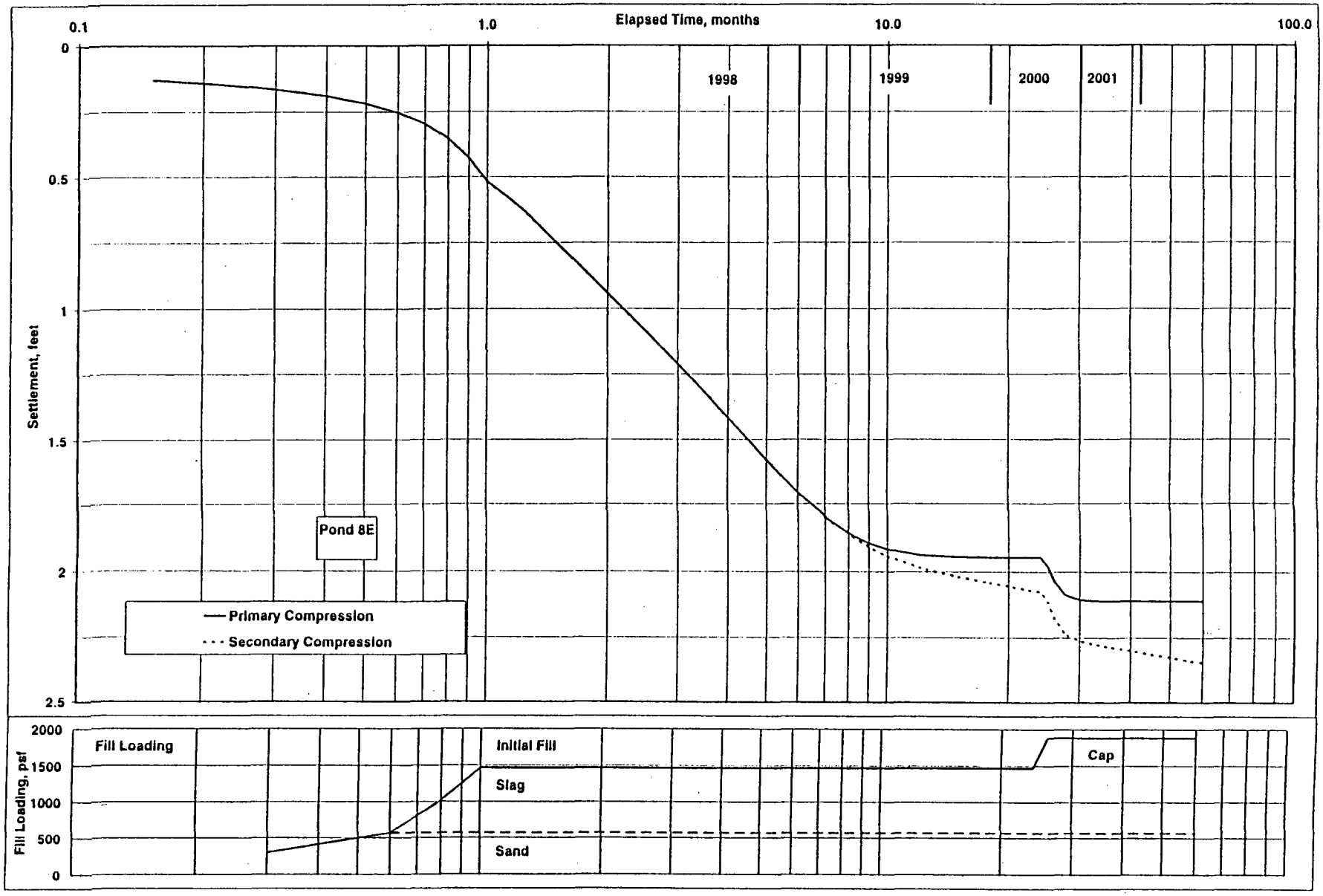
Pond 8E - Consolidation Tests
Void Ratio vs Pressure

Figure 4

Project:	FMC - Pond 8E				Material			Sand	Slag	Cap	Load Sequence						
Computed by:	N. Deng				Thickness, ft			5	6.9	3.5	Time	Load					
Date	10/16/97				Unit Weight, psf			115	130	120	0.3	300					
					Additional Load, psf			575	897	420	0.6	575					
All required inputs are blocked with a bold box.		INPUT			Begin Loading, months			0	0.6	24	0.8	1023.5					
					Time for Loading, months			0.6	0.4	2	1.0	1472					
Sludge Thickness, H		13.6	ft								24.0	1472					
Coef. of Horizontal Consolidation, C_h		6	ft^2/mth		Begin Wick Drain Installation			1	Months		26.0	1892					
Wick Drain Spacing (Triangular), S		7	ft								60.0	1892					
Wick Drain Width, W		110	mm		End of Primary Settlement, t_p						8	months w/o wick drains		2	months with wick drains		
Wick Drain Thickness, b		4	mm		Rate of 2ndary Compr. (ft/log cycle), α						0.272						
Percent Void Area of Wick Drain, A_s		92			Design Life						30	years					
Assumed Equivalent Sand Porosity, por		0.3			ACCUMV OUTPUT (w/o wick drains)									With Wick Drains			
Equivalent Void Diameter, d_v (see Note 6)		22.7	mm				Total	Effective	Prim.	Deg.	Secndry	Total	Deg.	Deg.	Primary	Secondary	Prim+Sec
Equivalent Sand Drain Diameter, d_w (see Note 7)		75.7	mm	Time	Average		Stress	Stress	Sett.	Vert. Cons.	Sett. (ft)	Sett. (ft)	Hor. Cons.	Sett.	Sett.(ft)	Settlement	
Equivalent Sand Drain Diameter, d_s		0.25	ft	t [months]	void ratio		(psf)	(psf)	δ_{prim}	U_v	δ_{sec}[3]	$\delta_{prim} + \delta_{sec}$	U_h[1]	U[4]	δ_{wick}[5]	[ft]	[ft]
Equivalent Drain Diameter = d_e (see Note 1)	1.05 * S =	7.4	ft	0	4.326		579.5	143.6	0.0000	0.0000	0.00	0.00	0.000	0.0000	0.0000	0.00	0.0000
n	d_e / d_w =	30		0.151	4.275		730.6	149.1	0.1282	0.0608	0.00	0.13	0.000	0.0608	0.1282	0.00	0.1282
				0.2	4.271		779.6	151.0	0.1401	0.0664	0.00	0.14	0.000	0.0664	0.1401	0.00	0.1401
NOTES:				0.225	4.268		804.6	152.0	0.1461	0.0693	0.00	0.15	0.000	0.0693	0.1461	0.00	0.1461
[1] Multiply S by 1.05 for triangular pattern and 1.13 for square pattern				0.25	4.266		829.7	153.0	0.1521	0.0721	0.00	0.15	0.000	0.0721	0.1521	0.00	0.1521
[2] $\delta_{sec} = \alpha * \log(t/t_p)$				0.275	4.264		854.7	154.0	0.1581	0.0750	0.00	0.16	0.000	0.0750	0.1581	0.00	0.1581
[3] $U_h = 1 - 1/(e^{A/F_n})$				0.3	4.261		879.7	155.1	0.1643	0.0779	0.00	0.16	0.000	0.0779	0.1643	0.00	0.1643
where $A = d_e^2/(8*C_{h,e}) * (\ln d_e/d_w - 0.75)$				0.35	4.257		925.6	157.2	0.1764	0.0837	0.00	0.18	0.000	0.0837	0.1764	0.00	0.1764
[4] $U = 1 - (1 - U_v) * (1 - U_h)$				0.4	4.251		971.5	159.4	0.1892	0.0898	0.00	0.19	0.000	0.0898	0.1892	0.00	0.1892
[5] $\delta_{wick} = (\delta_{prim}/U_v) * U$				0.5	4.240		1063.4	164.3	0.2177	0.1033	0.00	0.22	0.000	0.1033	0.2177	0.00	0.2177
[6] $d_v = \mathrm{sqrt}(4*A_s/\pi)$				0.6	4.227		1155.2	170.3	0.2515	0.1193	0.00	0.25	0.000	0.1193	0.2515	0.00	0.2515
[7] $d_s = d_v/por$				0.7	4.210		1318.0	180.9	0.2955	0.1401	0.00	0.30	0.000	0.1401	0.2955	0.00	0.2955
		Primary		0.8	4.188		1480.9	196.8	0.3515	0.1667	0.00	0.35	0.000	0.1667	0.3515	0.00	0.3515
Phase of Construction	Net Pressure, psf	Settlement		0.9	4.159		1767.4	229.8	0.4267	0.2023	0.00	0.43	0.000	0.2023	0.4267	0.00	0.4267
	(psf)	(ft)		1	4.123		2054.0	291.8	0.5162	0.2448	0.00	0.52	0.000	0.2448	0.5162	0.00	0.5162
Begin	0	0		1.25	4.077		2055.5	342.7	0.6339	0.3006	0.00	0.63	0.081	0.3618	0.7037	0.00	0.7037
Sand fill, 5-ft thickness	575	1.36		1.5	4.030		2057.7	399.0	0.7559	0.3585	0.00	0.76	0.155	0.4663	0.9069	0.00	0.9069
Sand and 2.5 ft of slag (near perimeter dike)	900	1.63		1.75	3.991		2059.8	450.3	0.8548	0.4054	0.00	0.85	0.223	0.5493	1.0683	0.00	1.0683
Sand and 6.9 ft of slag	1472	1.94		2	3.957		2062.0	497.3	0.9402	0.4459	0.00	0.94	0.286	0.6177	1.2013	0.00	1.2013
Permanent, 3.5-ft cap	1892	2.11		2.25	3.927		2064.2	542.4	1.0176	0.4826	0.00	1.02	0.344	0.6754	1.3135	0.01	1.3274
				2.5	3.900		2066.4	585.4	1.0875	0.5158	0.00	1.09	0.397	0.7240	1.4081	0.03	1.4345
Total Settlement After Final Cap Installed (30 yrs)	5.6	inches		2.75	3.875		2068.6	626.7	1.1516	0.5461	0.00	1.15	0.445	0.7653	1.4883	0.04	1.5259
				3	3.851		2070.8	666.5	1.2110	0.5743	0.00	1.21	0.490	0.8005	1.5569	0.05	1.6048
				3.5	3.809		2075.1	743.5	1.3183	0.6252	0.00	1.32	0.569	0.8565	1.6657	0.07	1.7318
				4	3.772		2079.2	820.4	1.4137	0.6705	0.00	1.41	0.636	0.8977	1.7458	0.08	1.8277
				5	3.708		2086.2	984.8	1.5764	0.7476	0.00	1.58	0.740	0.9501	1.8478	0.11	1.9580
				6	3.659		2091.6	1155.2	1.7030	0.8077	0.00	1.70	0.814	0.9775	1.9010	0.13	
				7	3.623		2095.3	1305.4	1.7938	0.8507	0.00	1.79	0.867	0.9911	1.9275	0.15	
				8	3.600		2097.7	1419.3	1.8540	0.8793	0.00	1.85	0.905	0.9978	1.9405	0.16	
				9	3.585		2099.2	1496.8	1.8916	0.8971	0.01	1.91	0.932	1.0011	1.9470	0.18	
				10	3.576		2100.1	1545.7	1.9141	0.9078	0.03	1.94	0.952	1.0029	1.9505	0.19	
				12	3.568		2100.9	1592.5	1.9348	0.9176	0.05	1.98	0.975	1.0047	1.9540	0.21	
				12.5	3.567		2101.0	1598.2	1.9373	0.9188	0.05	1.99	0.979	1.0050	1.9545	0.22	
				15	3.565		2101.2	1611.4	1.9430	0.9215	0.07	2.02	0.991	1.0058	1.9562	0.24	
				17.5	3.564		2101.3	1614.6	1.9444	0.9221	0.09	2.04	0.996	1.0062	1.9569	0.26	
				18	3.564		2101.3	1614.9	1.9445	0.9222	0.10	2.04	0.997	1.0063	1.9570	0.26	
				20	3.564		2101.3	1615.4	1.9447	0.9223	0.11	2.05	0.998	1.0064	1.9573	0.27	2.0529
				22.5	3.564		2101.3	1615.5	1.9448	0.9223	0.12	2.07	0.999	1.0065	1.9574	0.29	
				24	3.564		2101.3	1615.5	1.9448	0.9223	0.13	2.07	1.000	1.0065	1.9575	0.29	
				25	3.551		2311.9	1690.9	1.9778	0.9380	0.13	2.11	0.000	0.9380	1.9778	0.30	
				26	3.529		2523.4	1832.4	2.0347	0.9650	0.14	2.17	0.286	0.9759	2.0534	0.30	
				27.5	3.510		2525.2	1961.1	2.0826	0.9877	0.15	2.23	0.569	0.9953	2.0943	0.31	
				28	3.507		2525.5	1982.7	2.0903	0.9913	0.15	2.24	0.636	0.9973	2.0985	0.31	
				30	3.502		2526.1	2022.6	2.1042	0.9979	0.16	2.26	0.814	0.9998	2.1042	0.32	
				32	3.500		2526.2	2032.5	2.1075	0.9995	0.16	2.27	0.905	1.0000	2.1075	0.33	
				34	3.500		2526.2	2034.9	2.1084	0.9999	0.17	2.28	0.952	1.0000	2.1084	0.33	
				35	3.500		2526.2	2035.2	2.1085	1.0000	0.17	2.28	0.966	1.0000	2.1085	0.34	
				38	3.500		2526.2	2035.5	2.1086	1.0000	0.18	2.29	0.987	1.0000	2.1086	0.35	
				40	3.500		2526.2	2035.5	2.1086	1.0000	0.19	2.30	0.994	1.0000	2.1086	0.35	
				45	3.500		2526.2	2035.5	2.1086	1.0000	0.20	2.31	0.999	1.0000	2.1086	0.37	
				50	3.500		2526.2	2035.5	2.1086	1.0000	0.22	2.33	1.000	1.0000	2.1086	0.38	
				55	3.500		2526.2	2035.5	2.1086	1.0000	0.23	2.34	1.000	1.0000	2.1086	0.39	
				60	3.500		2526.2	2035.5	2.1086	1.0000	0.24	2.35	1.000	1.0000	2.1086	0.40	

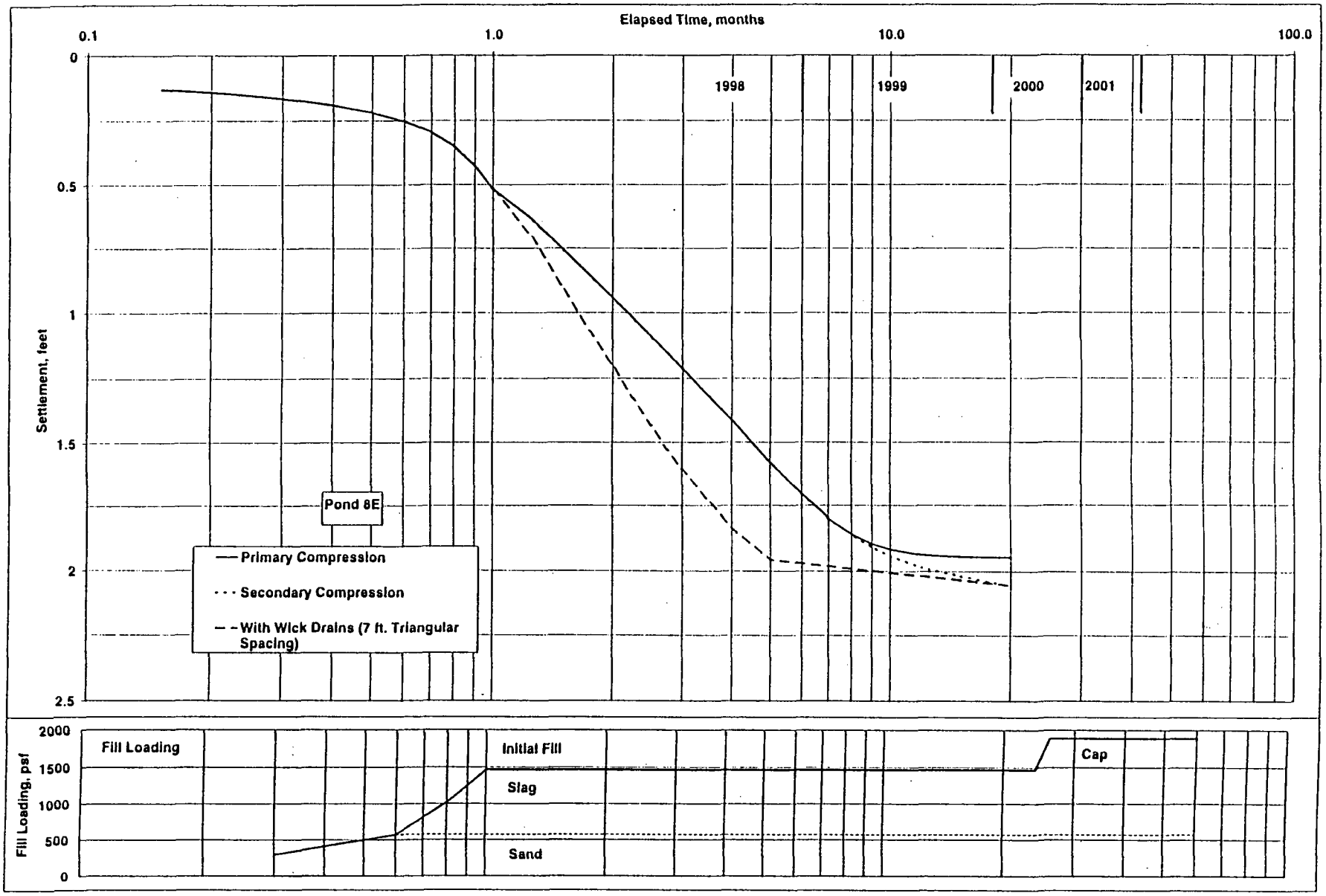
Pond 8E - Settlement Analysis

Figure 5



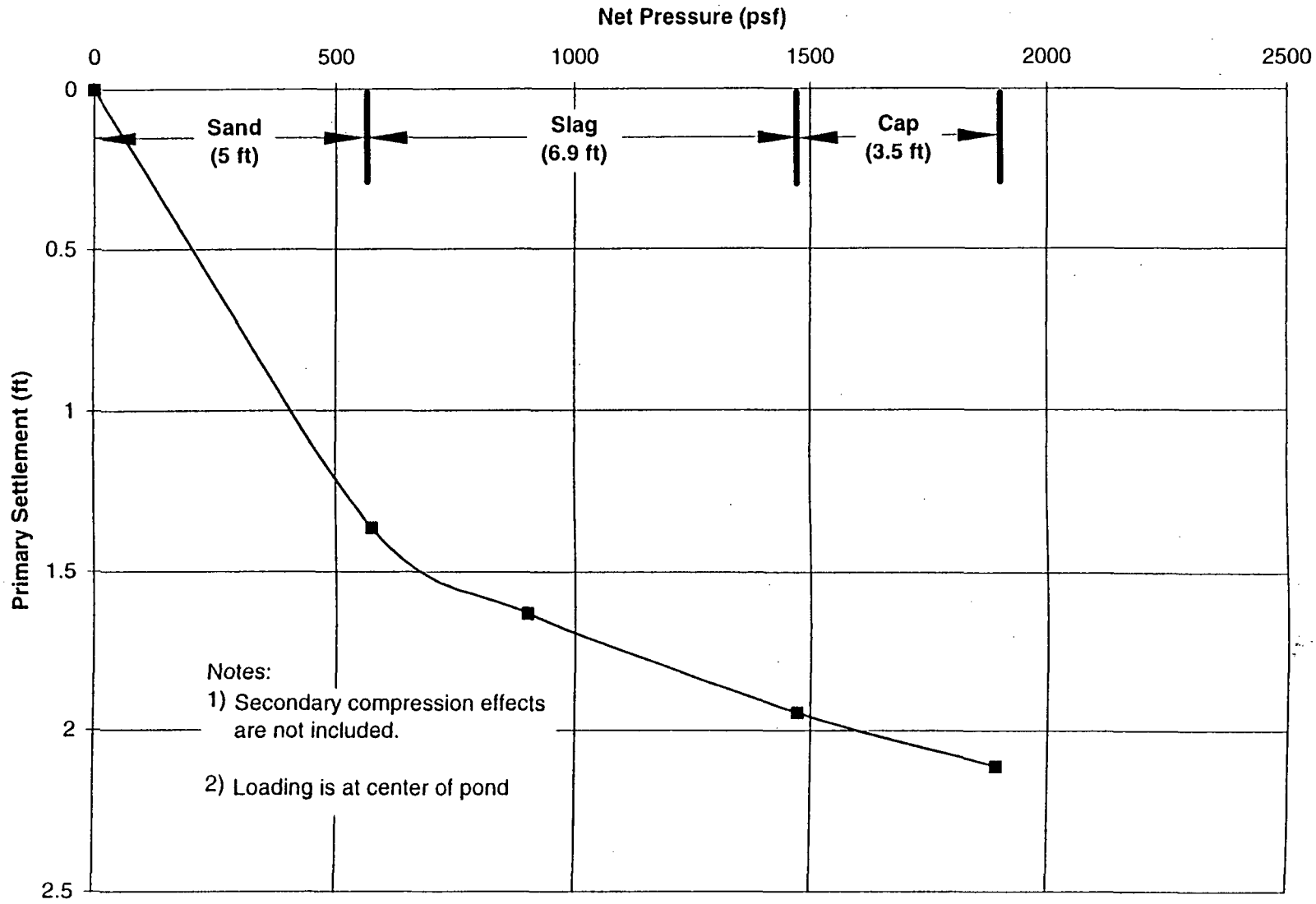
Pond 8E - Loading/Settlement vs Time

Figure 5



Pond 8E - Loading/Settlement vs Time, Wick Drain Alternative

Figure 7



POND 8E - Primary Settlement vs Pressure

Figure 8

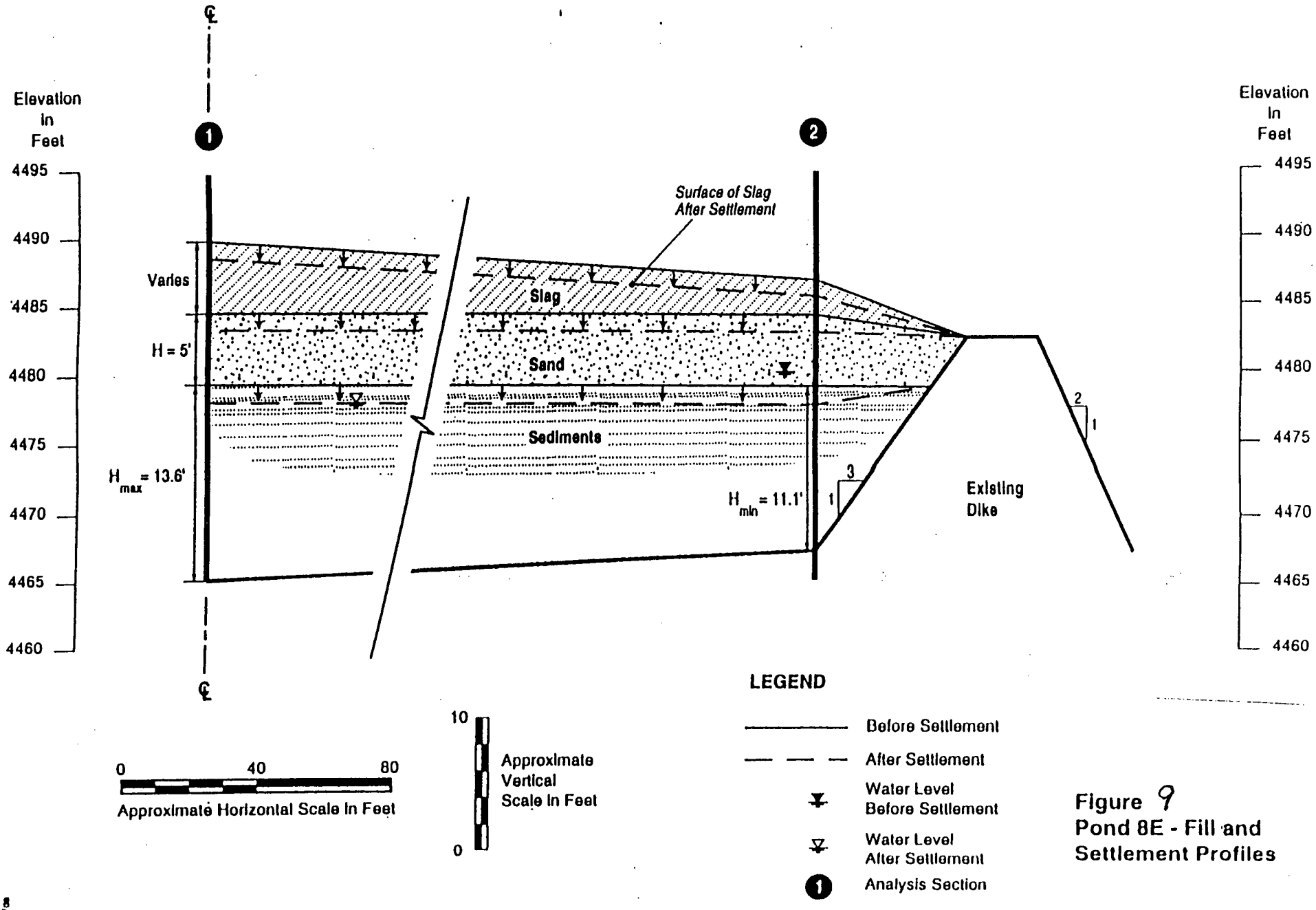


Figure 9
Pond 8E - Fill and Settlement Profiles

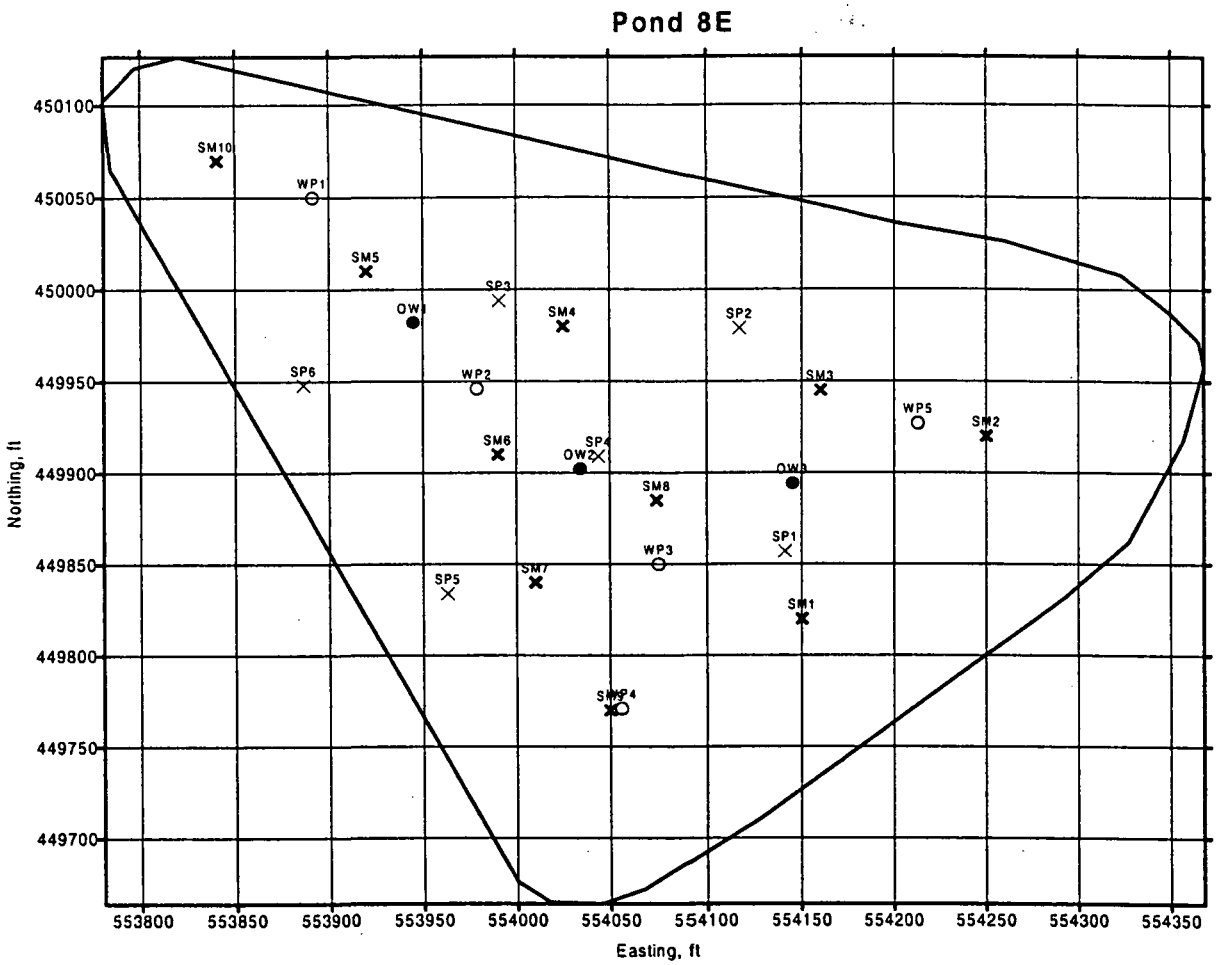
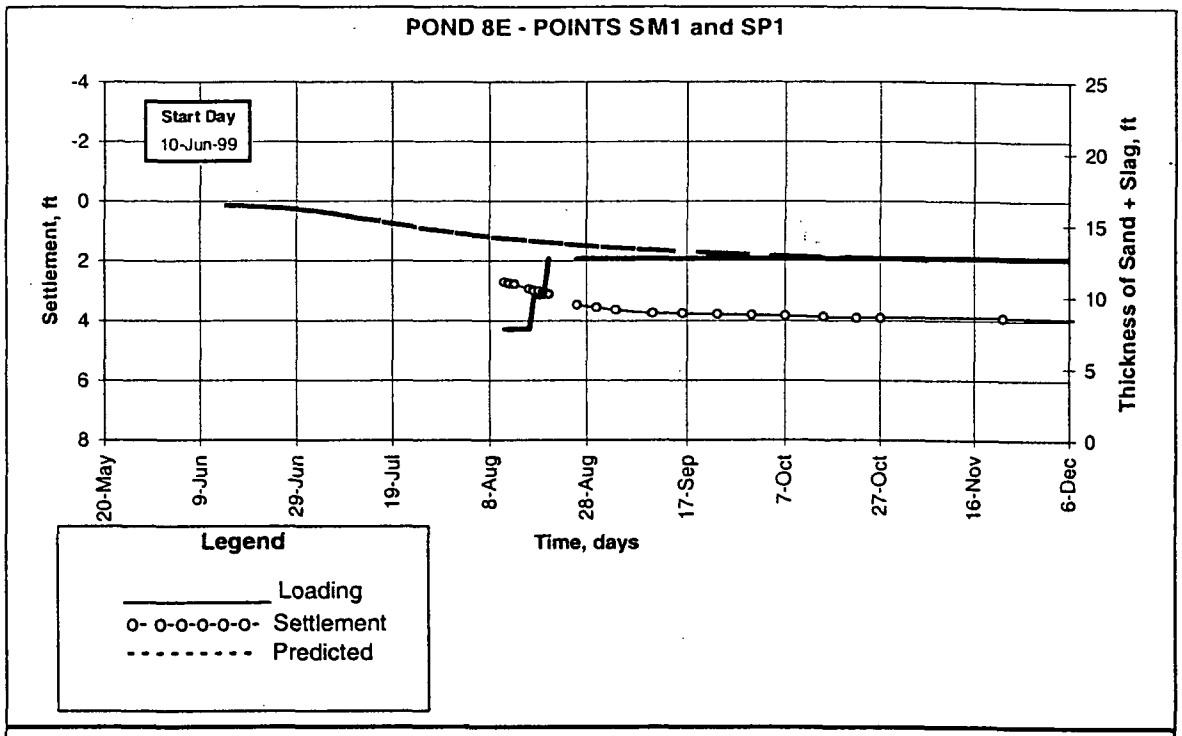


Figure 10 - Pond 8E – Pond Configuration and Location of Monitoring Points

Rev1



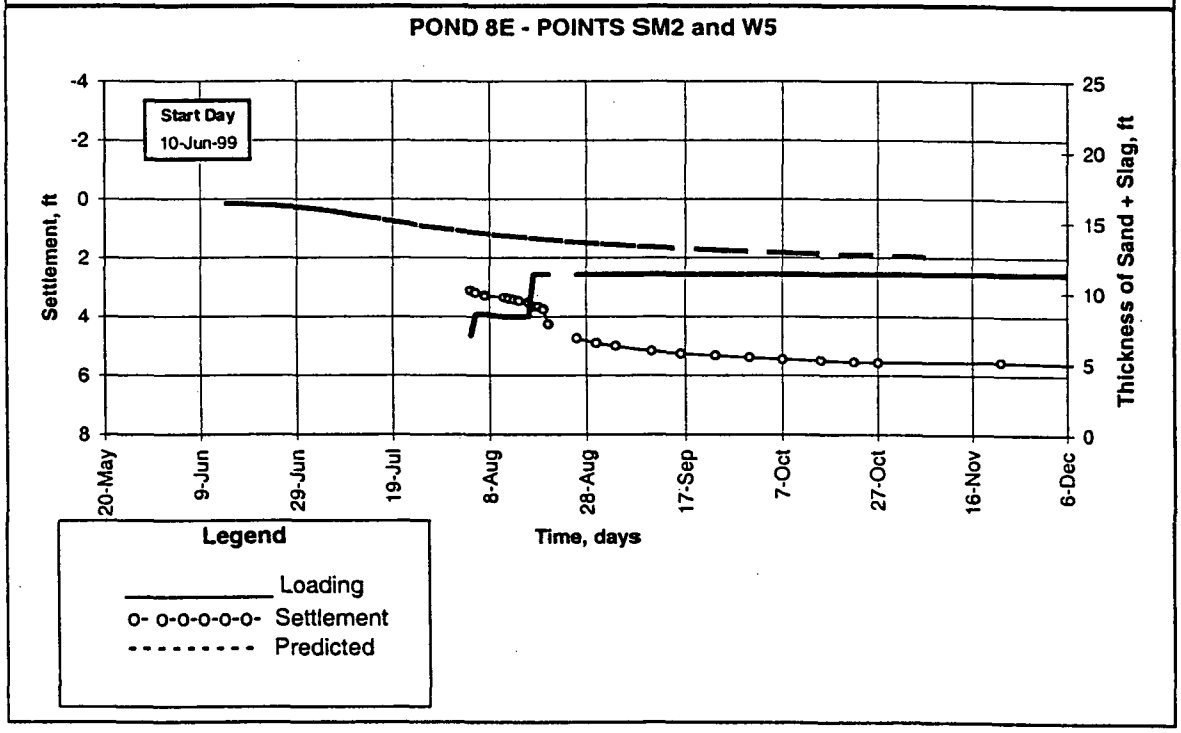


Figure 11 - Pond 8E – Settlement Monitoring Results as of July 2001

Rev 1

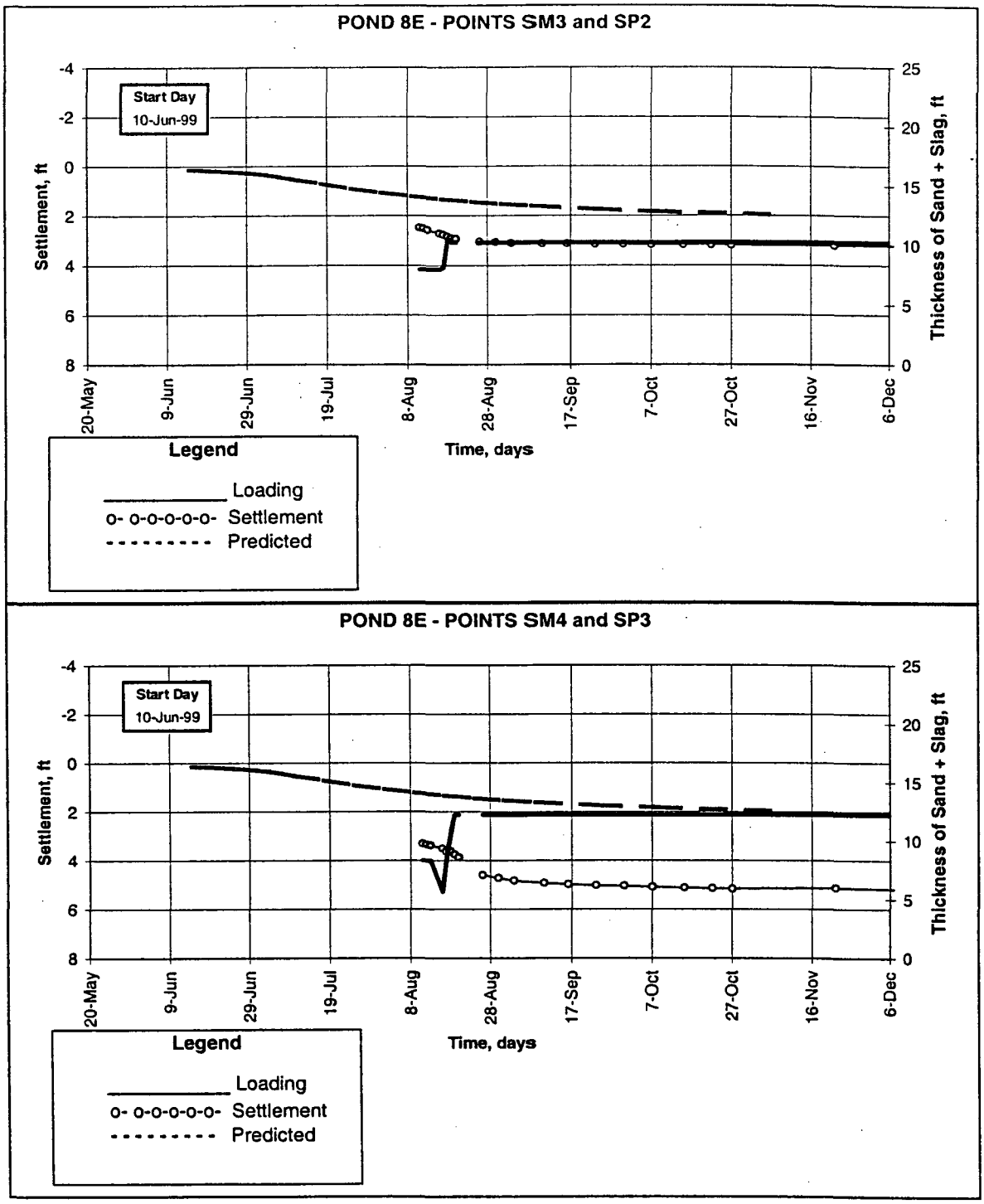


Figure 12 - Pond 8E – Settlement Monitoring Results as of July 2001

Rev 1

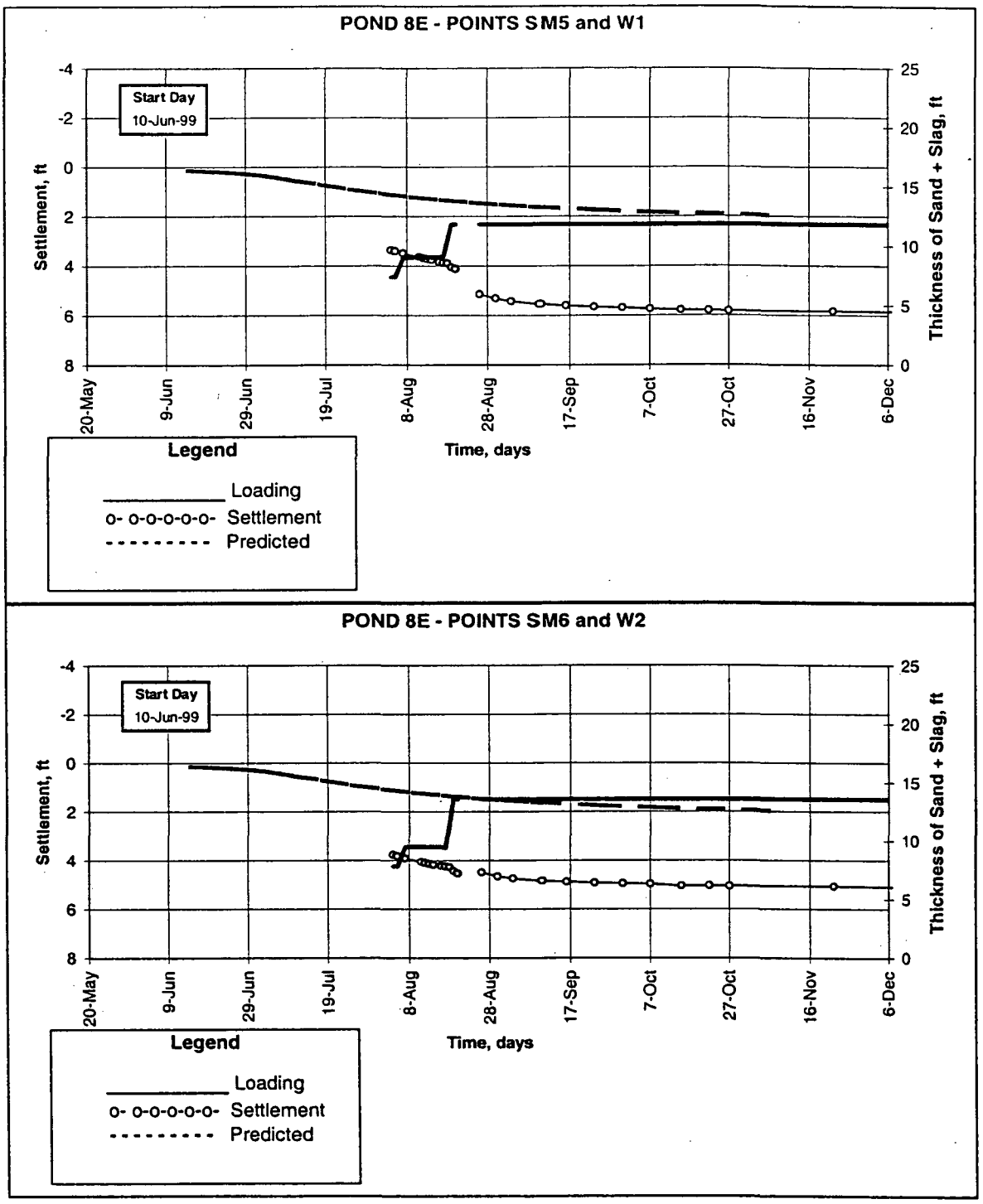


Figure 13 - Pond 8E – Settlement Monitoring Results as of July 2001

Rev 1

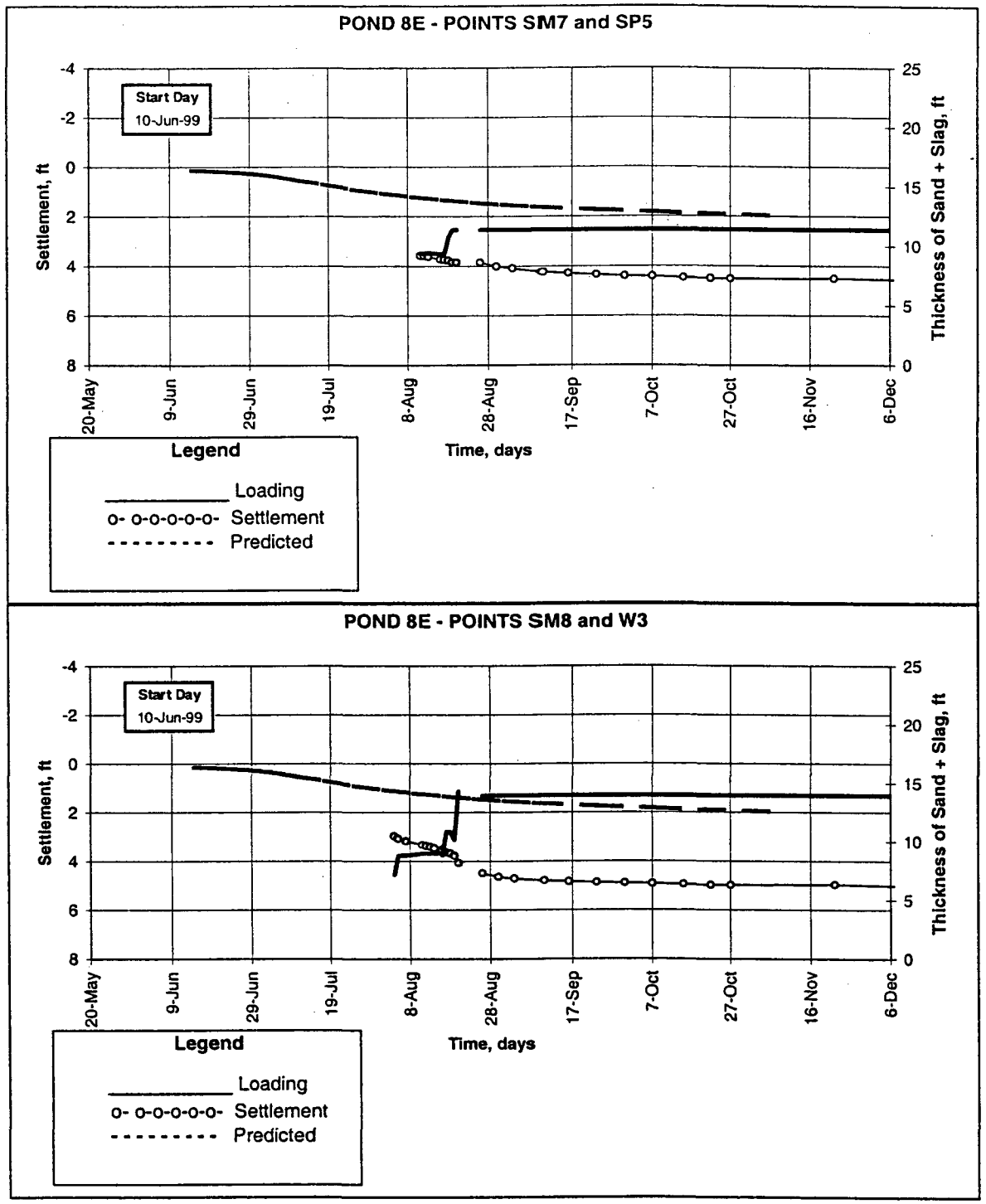


Figure 14 - Pond 8E – Settlement Monitoring Results as of July 2001

Rev 1

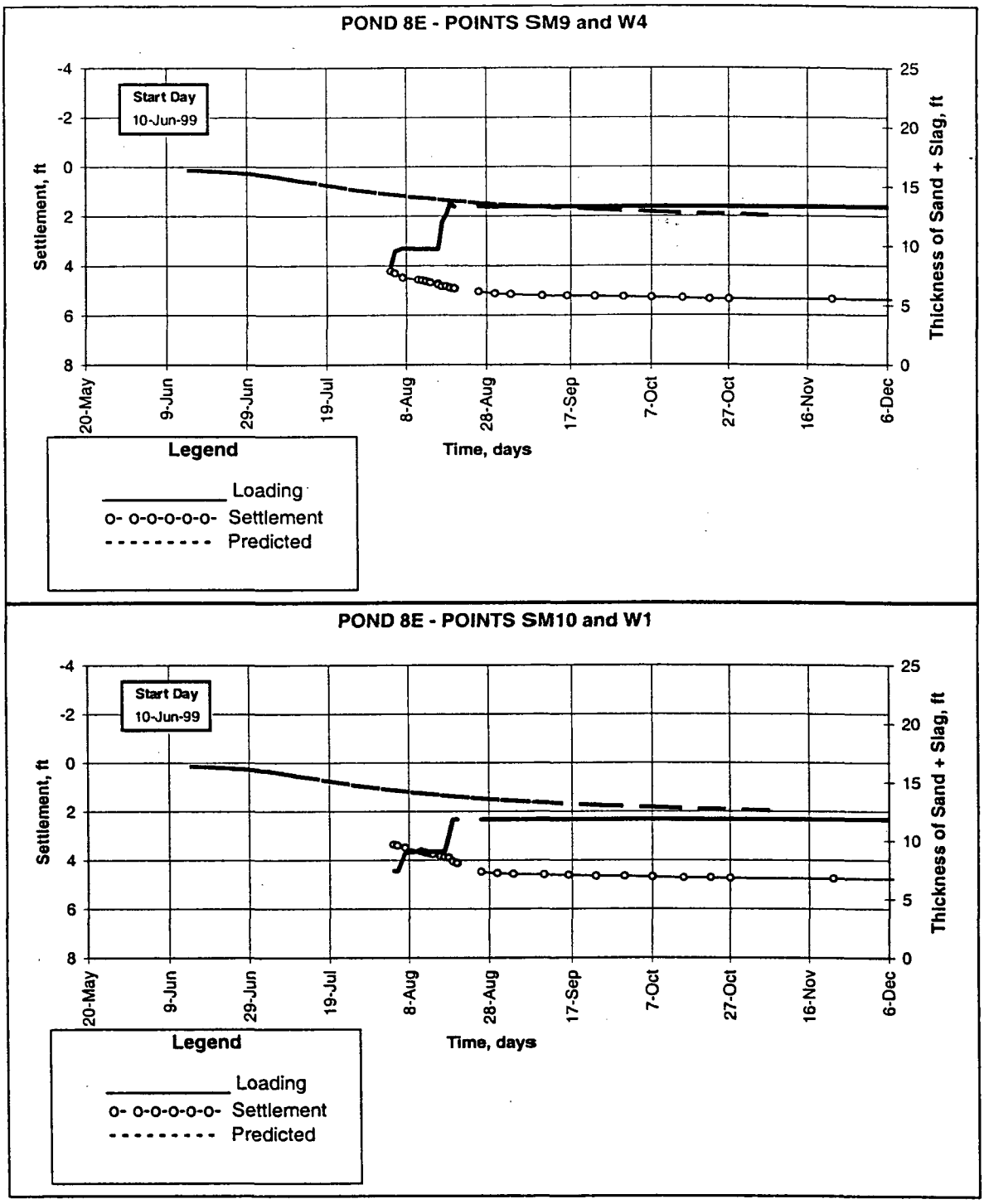


Figure 15 - Pond 8E – Settlement Monitoring Results as of July 2001

Rev 1

Pond 8E: Check the ultimate settlement using the updated lab data

$$\Delta e_i = C_{c_i} * \log((P_0 + \Delta P)/P_0)$$

$$\Delta H_i = H_{0i} * \Delta e_i / (1 + e_{0i})$$

$e_0 =$ 9.42 - 0.51 * depth

$C_c =$ 1.61 - 0.13 * depth

$\gamma_{total} =$ 75.33 + 0.99 * depth

Total Sludge Thickness: 13.6 ft

Layer	Depth	Mid-Depth	H_0	e_0	C_c	P_0	ΔP	Δe	ΔH
	0								
1		1.36	2.72	8.73	1.433	19	1472	2.7	0.756
	2.72								
2		4.08	2.72	7.34	1.080	69	1472	1.45	0.475
	5.44								
3		6.8	2.72	5.95	0.726	134	1472	0.78	0.307
	8.16								
4		9.52	2.72	4.56	0.372	213	1472	0.33	0.164
	10.88								
5		12.24	2.72	3.18	0.019	307	1472	0.01	0.009
	13.6								
								Σ	1.710 ft

Note: Change in voild ratio in the P<50 psf range was ignored.
e_0, C_c, γ_{total} relationships derived from Reference 3.

```
*********************************************************************
*                                                                   *
*          ACCUMV - NONLINEAR LARGE STRAIN CONSOLIDATION            *
*                              by                                   *
*                       ROBERT L. SCHIFFMAN                         *
*                      VLASTA SZAVITS-NOSSAN                        *
*                        JOHN M. McARTHUR                           *
*                                                                   *
*                 DEPARTMENT OF CIVIL ENGINEERING                   *
*                UNIVERSITY OF COLORADO AT BOULDER                  *
*                   BOULDER, CO 80309-0428  USA                     *
*                                                                   *
*                                                                   *
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*                       and John M. McArthur                        *
*                                                                   *
*********************************************************************
```

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

```
                    ****************
                    *              *
                    *  INPUT DATA  *
                    *              *
                    ****************

                 ******    UNITS    ******

          LENGTH              FORCE              TIME
          feet                pounds              months
```

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

```
             *******  UNIT  WEIGHTS  *******
```

```
                          GAMMAS          GAMMAW
                         174.1000         62.4000
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY


                      *******  INITIAL GEOMETRY  *******

                    H(0)                      TOTAL HEADS

                                         TOT HD(L)      HW
                   13.600                     .000    13.600


                  *******  VOID RATIO RANGE  *******

                    EMAX                    EMIN
                    8.000                   1.000
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY


          *******  EFFECTIVE STRESS AT TOP OF LAYER  *******

                                  Q0
                                1.0000
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY


          *******    CONSTITUTIVE RELATIONSHIPS    *******


                    ( .5610E+01) + (-.2770E+00) * LN(EFFSTR)
E = ------------------------------------------------------------------
    1 + ( .0000E+00) * LN(EFFSTR) + ( .0000E+00) * LN(EFFSTR)*LN(EFFSTR)


                        ( .2000E-01) * (E) ** ( .1000E+01)
                  K = ----------------------------------
                              1 + ( .0000E+00) * (E)
1
```

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

********** CALCULATION DATA **********

N	TMAX	ALPHA
10	.6000E+02	.5000E+00

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

******* HEIGHT-TIME FUNCTION *******

TIME	H
.000E+00	13.600
.100E+03	13.600

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

******* TIME - LOAD FUNCTIONS *******

TIME	LOAD
.0000E+00	.0000
.3000E+00	300.0000
.6000E+00	575.0000
.8000E+00	900.0000
.1000E+01	1472.0000
.2400E+02	1472.0000
.2600E+02	1892.0000
.6000E+02	1892.0000

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

**** PRINT TIMES ****
.15100E+00

```
.20000E+00
.22500E+00
.25000E+00
.27500E+00
.30000E+00
.35000E+00
.40000E+00
.50000E+00
.60000E+00
.70000E+00
.80000E+00
.90000E+00
.10000E+01
.12500E+01
.15000E+01
.17500E+01
.20000E+01
.22500E+01
.25000E+01
.27500E+01
.30000E+01
.35000E+01
.40000E+01
.45000E+01
.50000E+01
.60000E+01
.70000E+01
.80000E+01
.90000E+01
.10000E+02
.12000E+02
.12500E+02
.15000E+02
.17500E+02
.18000E+02
.20000E+02
.22500E+02
.24000E+02
.25000E+02
.26000E+02
.27500E+02
.28000E+02
.30000E+02
.32000E+02
.34000E+02
.35000E+02
.38000E+02
.40000E+02
.45000E+02
.50000E+02
.55000E+02
.60000E+02
1
    ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

    ****Pond 8E, 13.6 feet of sludge, Power K
```

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

```
***************
*             *
*  FUNCTIONS  *
*             *
***************
```

E	EFFSTR	K	G	D(G)	D(K/1+E)	AV
1.000	.169E+08	.200E-01	-.978E+04	.304E+05	.500E-02	.164E-07
1.700	.135E+07	.340E-01	-.983E+03	.334E+04	.274E-02	.205E-06
2.400	.108E+06	.480E-01	-.881E+02	.307E+03	.173E-02	.257E-05
3.100	.862E+04	.620E-01	-.754E+01	.266E+02	.119E-02	.321E-04
3.800	.688E+03	.760E-01	-.631E+00	.224E+01	.868E-03	.402E-03
4.500	.550E+02	.900E-01	-.521E-01	.186E+00	.661E-03	.504E-02
5.200	.439E+01	.104E+00	-.426E-02	.153E-01	.520E-03	.630E-01
5.900	.351E+00	.118E+00	-.347E-03	.125E-02	.420E-03	.789E+00
6.600	.280E-01	.132E+00	-.282E-04	.101E-03	.346E-03	.988E+01
7.300	.224E-02	.146E+00	-.228E-05	.819E-05	.290E-03	.124E+03
8.000	.179E-03	.160E+00	-.184E-06	.662E-06	.247E-03	.155E+04

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .00000E+00 LOAD = .000
SET = .0000

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.6000	.0000	5.6100	1.000	1.0000
.1000	12.0549	.2554	4.6723	125.941	29.5248
.2000	10.6390	.5107	4.4850	242.813	58.0498
.3000	9.2469	.7661	4.3743	358.206	86.5746
.4000	7.8915	1.0215	4.2954	471.312	115.0994
.5000	6.5472	1.2769	4.2341	583.718	143.6242
.6000	5.2173	1.5322	4.1839	695.233	172.1494
.7000	3.8990	1.7876	4.1414	806.017	200.6740
.8000	2.5908	2.0430	4.1046	916.171	229.1989
.9000	1.2915	2.2983	4.0721	1025.775	257.7239
1.0000	.0000	2.5537	4.0430	1134.889	286.2484

********** PORE PRESSURES **********

CHI	UW	U0	U
13.6000	.000	.000	.0000
12.0549	96.416	96.416	.0000

10.6390	184.764	184.764	-.0001
9.2469	271.632	271.632	.0000
7.8915	356.213	356.213	.0000
6.5472	440.093	440.093	.0001
5.2173	523.083	523.083	-.0001
3.8990	605.343	605.343	.0000
2.5908	686.972	686.972	.0000
1.2915	768.051	768.051	-.0001
.0000	848.640	848.640	.0003

TIMESTEP SIZE = .00, ITERATIONS BETWEEN PRINT TIMES = 0

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .15100E+00 LOAD = 151.000
SET = .1282

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.4718	.0000	4.2184	159.998	152.0000
.1000	12.0656	.2554	4.6444	276.274	32.6523
.2000	10.6389	.5107	4.4842	393.822	58.2310
.3000	9.2603	.7661	4.3742	508.372	86.6132
.4000	7.8914	1.0215	4.2954	622.313	115.1191
.5000	6.5472	1.2769	4.2341	734.718	143.6364
.6000	5.2172	1.5322	4.1839	846.233	172.1577
.7000	3.8990	1.7876	4.1414	957.018	200.6803
.8000	2.5908	2.0430	4.1046	1067.171	229.2033
.9000	1.2915	2.2983	4.0721	1176.775	257.7274
1.0000	.0000	2.5537	4.0430	1285.889	286.2519

********** PORE PRESSURES **********

CHI	UW	U0	U
13.4718	7.998	7.998	.0000
12.0656	243.622	95.749	147.8725
10.6389	335.591	184.772	150.8187
9.2603	421.759	270.797	150.9614
7.8914	507.194	356.214	150.9804
6.5472	591.082	440.094	150.9880
5.2172	674.075	523.084	150.9915
3.8990	756.337	605.343	150.9938
2.5908	837.968	686.972	150.9957
1.2915	919.047	768.051	150.9964
.0000	999.637	848.640	150.9968

TIMESTEP SIZE = .07, ITERATIONS BETWEEN PRINT TIMES = 3

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .20000E+00 LOAD = 200.000
SET = .1401

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.4599	.0000	4.1410	209.740	201.0001
.1000	12.0641	.2554	4.6293	325.364	34.4865
.2000	10.6388	.5107	4.4835	442.827	58.3673
.3000	9.2604	.7661	4.3741	557.367	86.6321
.4000	7.8914	1.0215	4.2954	671.314	115.1262
.5000	6.5472	1.2769	4.2341	783.718	143.6406
.6000	5.2172	1.5322	4.1839	895.233	172.1603
.7000	3.8990	1.7876	4.1414	1006.018	200.6823
.8000	2.5908	2.0430	4.1046	1116.171	229.2049
.9000	1.2915	2.2983	4.0721	1225.775	257.7288
1.0000	.0000	2.5537	4.0430	1334.889	286.2529

********** PORE PRESSURES **********

CHI	UW	U0	U
13.4599	8.739	8.740	-.0001
12.0641	290.877	95.839	195.0383
10.6388	384.460	184.778	199.6824
9.2604	470.735	270.793	199.9425
7.8914	556.188	356.215	199.9733
6.5472	640.077	440.094	199.9838
5.2172	723.073	523.084	199.9889
3.8990	805.335	605.344	199.9918
2.5908	886.966	686.972	199.9941
1.2915	968.046	768.051	199.9950
.0000	1048.636	848.640	199.9958

TIMESTEP SIZE = .07, ITERATIONS BETWEEN PRINT TIMES = 4
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .22500E+00 LOAD = 225.000
SET = .1461

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.4539	.0000	4.1085	235.115	226.0000
.1000	12.0631	.2554	4.6200	350.430	35.6608
.2000	10.6388	.5107	4.4830	467.831	58.4675

.3000	9.2603	.7661	4.3741	582.374	86.6449
.4000	7.8914	1.0215	4.2953	696.314	115.1302
.5000	6.5472	1.2769	4.2340	808.718	143.6428
.6000	5.2172	1.5322	4.1839	920.233	172.1618
.7000	3.8990	1.7876	4.1414	1031.018	200.6834
.8000	2.5908	2.0430	4.1046	1141.171	229.2056
.9000	1.2915	2.2983	4.0721	1250.775	257.7292
1.0000	.0000	2.5537	4.0430	1359.889	286.2534

********** PORE PRESSURES **********

CHI	UW	U0	U
13.4539	9.115	9.115	.0000
12.0631	314.769	95.905	218.8640
10.6388	409.363	184.781	224.5822
9.2603	495.729	270.799	224.9297
7.8914	581.184	356.215	224.9693
6.5472	665.075	440.094	224.9815
5.2172	748.071	523.084	224.9874
3.8990	830.334	605.344	224.9907
2.5908	911.966	686.972	224.9933
1.2915	993.046	768.051	224.9946
.0000	1073.635	848.640	224.9953

TIMESTEP SIZE = .07, ITERATIONS BETWEEN PRINT TIMES = 5

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .25000E+00 LOAD = 250.000
SET = .1521

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.4479	.0000	4.0794	260.490	251.0000
.1000	12.0618	.2554	4.6099	375.507	36.9771
.2000	10.6387	.5107	4.4825	492.835	58.5869
.3000	9.2601	.7661	4.3740	607.385	86.6603
.4000	7.8914	1.0215	4.2953	721.314	115.1343
.5000	6.5472	1.2769	4.2340	833.718	143.6450
.6000	5.2172	1.5322	4.1839	945.233	172.1633
.7000	3.8990	1.7876	4.1414	1056.018	200.6844
.8000	2.5908	2.0430	4.1046	1166.171	229.2064
.9000	1.2915	2.2983	4.0721	1275.775	257.7297
1.0000	.0000	2.5537	4.0430	1384.889	286.2539

********** PORE PRESSURES **********

CHI	UW	U0	U
13.4479	9.490	9.490	.0000

12.0618	338.530	95.982	242.5478
10.6387	434.248	184.786	249.4628
9.2601	520.725	270.810	249.9143
7.8914	606.180	356.215	249.9651
6.5472	690.073	440.093	249.9793
5.2172	773.070	523.084	249.9859
3.8990	855.333	605.344	249.9897
2.5908	936.965	686.972	249.9925
1.2915	1018.045	768.051	249.9941
.0000	1098.635	848.640	249.9948

TIMESTEP SIZE = .07, ITERATIONS BETWEEN PRINT TIMES = 6

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .27500E+00 LOAD = 275.000
SET = .1581

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.4419	.0000	4.0531	285.868	275.9998
.1000	12.0604	.2554	4.5991	400.593	38.4473
.2000	10.6386	.5107	4.4818	517.840	58.7276
.3000	9.2599	.7661	4.3740	632.400	86.6785
.4000	7.8914	1.0215	4.2953	746.315	115.1389
.5000	6.5472	1.2769	4.2340	858.718	143.6472
.6000	5.2172	1.5322	4.1839	970.233	172.1648
.7000	3.8990	1.7876	4.1414	1081.018	200.6854
.8000	2.5908	2.0430	4.1046	1191.171	229.2072
.9000	1.2915	2.2983	4.0721	1300.775	257.7306
1.0000	.0000	2.5537	4.0430	1409.889	286.2544

********** PORE PRESSURES **********

CHI	UW	U0	U
13.4419	9.868	9.868	.0002
12.0604	362.146	96.068	266.0775
10.6386	459.113	184.791	274.3221
9.2599	545.721	270.825	274.8961
7.8914	631.176	356.215	274.9606
6.5472	715.070	440.093	274.9771
5.2172	798.069	523.084	274.9844
3.8990	880.332	605.344	274.9886
2.5908	961.964	686.972	274.9917
1.2915	1043.044	768.051	274.9933
.0000	1123.634	848.640	274.9943

TIMESTEP SIZE = .07, ITERATIONS BETWEEN PRINT TIMES = 7

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .30000E+00 LOAD = 300.000
SET = .1643

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.4357	.0000	4.0291	311.251	301.0001
.1000	12.0589	.2554	4.5876	425.690	40.0868
.2000	10.6385	.5107	4.4810	542.846	58.8920
.3000	9.2596	.7661	4.3739	657.418	86.7000
.4000	7.8914	1.0215	4.2953	771.315	115.1440
.5000	6.5472	1.2769	4.2340	883.717	143.6497
.6000	5.2172	1.5322	4.1839	995.233	172.1662
.7000	3.8990	1.7876	4.1414	1106.018	200.6865
.8000	2.5908	2.0430	4.1046	1216.171	229.2080
.9000	1.2915	2.2983	4.0721	1325.775	257.7310
1.0000	.0000	2.5537	4.0430	1434.889	286.2549

********** PORE PRESSURES **********

CHI	UW	U0	U
13.4357	10.251	10.251	-.0001
12.0589	385.603	96.165	289.4381
10.6385	483.954	184.796	299.1577
9.2596	570.718	270.843	299.8746
7.8914	656.171	356.215	299.9554
6.5472	740.068	440.093	299.9746
5.2172	823.067	523.084	299.9830
3.8990	905.331	605.344	299.9876
2.5908	986.963	686.972	299.9909
1.2915	1068.044	768.051	299.9928
.0000	1148.634	848.640	299.9938

TIMESTEP SIZE = .07, ITERATIONS BETWEEN PRINT TIMES = 8
1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .35000E+00 LOAD = 345.833
SET = .1764

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.4236	.0000	3.9899	357.841	346.8335
.1000	12.0554	.2554	4.5629	471.739	43.8238

.2000	10.6383	.5107	4.4792	588.693	59.2739
.3000	9.2588	.7661	4.3737	703.297	86.7507
.4000	7.8914	1.0215	4.2953	817.149	115.1553
.5000	6.5472	1.2769	4.2340	929.550	143.6546
.6000	5.2172	1.5322	4.1839	1041.067	172.1695
.7000	3.8990	1.7876	4.1414	1151.851	200.6886
.8000	2.5908	2.0430	4.1046	1262.005	229.2096
.9000	1.2915	2.2983	4.0721	1371.608	257.7323
1.0000	.0000	2.5537	4.0430	1480.722	286.2563

********** PORE PRESSURES **********

CHI	UW	U0	U
13.4236	11.007	11.008	-.0002
12.0554	427.915	96.381	331.5344
10.6383	529.419	184.810	344.6092
9.2588	616.546	270.889	345.6572
7.8914	701.993	356.216	345.7774
6.5472	785.895	440.092	345.8030
5.2172	868.897	523.084	345.8130
3.8990	951.163	605.344	345.8188
2.5908	1032.795	686.972	345.8227
1.2915	1113.876	768.051	345.8248
.0000	1194.466	848.640	345.8257

TIMESTEP SIZE = .07, ITERATIONS BETWEEN PRINT TIMES = 9

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .40000E+00 LOAD = 391.667
SET = .1892

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.4108	.0000	3.9555	404.476	392.6666
.1000	12.0514	.2554	4.5352	517.826	48.4333
.2000	10.6380	.5107	4.4769	634.544	59.7753
.3000	9.2579	.7661	4.3735	749.187	86.8193
.4000	7.8914	1.0215	4.2952	862.983	115.1694
.5000	6.5472	1.2769	4.2340	975.383	143.6601
.6000	5.2172	1.5322	4.1839	1086.900	172.1728
.7000	3.8990	1.7876	4.1414	1197.685	200.6906
.8000	2.5908	2.0430	4.1046	1307.838	229.2112
.9000	1.2915	2.2983	4.0721	1417.442	257.7337
1.0000	.0000	2.5537	4.0430	1526.555	286.2578

********** PORE PRESSURES **********

CHI	UW	U0	U

13.4108	11.809	11.809	.0000
12.0514	469.393	96.635	372.7582
10.6380	574.769	184.828	389.9411
9.2579	662.367	270.945	391.4219
7.8914	747.813	356.217	391.5967
6.5472	831.723	440.092	391.6309
5.2172	914.728	523.085	391.6431
3.8990	996.994	605.344	391.6501
2.5908	1078.627	686.972	391.6544
1.2915	1159.708	768.051	391.6568
.0000	1240.298	848.640	391.6575

TIMESTEP SIZE = .07, ITERATIONS BETWEEN PRINT TIMES = 10

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .50000E+00 LOAD = 483.333
SET = .2177

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.3823	.0000	3.8974	497.921	484.3330
.1000	12.0412	.2554	4.4701	610.125	61.2570
.2000	10.6372	.5107	4.4702	726.263	61.2347
.3000	9.2557	.7661	4.3728	840.994	87.0294
.4000	7.8914	1.0215	4.2951	954.651	115.2097
.5000	6.5473	1.2769	4.2340	1067.047	143.6732
.6000	5.2172	1.5322	4.1839	1178.567	172.1796
.7000	3.8990	1.7876	4.1414	1289.351	200.6955
.8000	2.5908	2.0430	4.1046	1399.505	229.2147
.9000	1.2915	2.2983	4.0721	1509.108	257.7363
1.0000	.0000	2.5537	4.0430	1618.222	286.2603

********** PORE PRESSURES **********

CHI	UW	U0	U
13.3823	13.588	13.587	.0003
12.0412	548.868	97.267	451.6011
10.6372	665.028	184.880	480.1483
9.2557	753.965	271.086	482.8785
7.8914	839.441	356.218	483.2231
6.5473	923.374	440.090	483.2845
5.2172	1006.388	523.085	483.3029
3.8990	1088.656	605.344	483.3119
2.5908	1170.290	686.973	483.3175
1.2915	1251.372	768.051	483.3208
.0000	1331.962	848.640	483.3217

TIMESTEP SIZE = .07, ITERATIONS BETWEEN PRINT TIMES = 12

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .60000E+00 LOAD = 575.000
SET = .2515

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.3485	.0000	3.8494	591.694	575.9999
.1000	12.0278	.2554	4.3895	702.628	81.9541
.2000	10.6359	.5107	4.4597	818.012	63.5984
.3000	9.2528	.7661	4.3717	932.840	87.3877
.4000	7.8913	1.0215	4.2950	1046.319	115.2767
.5000	6.5473	1.2769	4.2340	1158.710	143.6915
.6000	5.2172	1.5322	4.1838	1270.234	172.1876
.7000	3.8990	1.7876	4.1414	1381.018	200.7003
.8000	2.5908	2.0430	4.1046	1491.172	229.2183
.9000	1.2915	2.2983	4.0721	1600.775	257.7394
1.0000	.0000	2.5537	4.0430	1709.889	286.2632

********** PORE PRESSURES **********

CHI	UW	U0	U
13.3485	15.694	15.694	.0001
12.0278	620.674	98.103	522.5707
10.6359	754.414	184.962	569.4513
9.2528	845.453	271.266	574.1868
7.8913	931.043	356.220	574.8228
6.5473	1015.019	440.086	574.9329
5.2172	1098.047	523.085	574.9616
3.8990	1180.318	605.344	574.9738
2.5908	1261.953	686.973	574.9807
1.2915	1343.036	768.051	574.9844
.0000	1423.625	848.640	574.9855

TIMESTEP SIZE = .07, ITERATIONS BETWEEN PRINT TIMES = 14
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .70000E+00 LOAD = 737.500
SET = .2955

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.3045	.0000	3.7805	756.936	738.5002

.1000	12.0102	.2554	4.2879	866.230	118.2778
.2000	10.6338	.5107	4.4435	980.643	67.4469
.3000	9.2495	.7661	4.3698	1095.546	87.9834
.4000	7.8913	1.0215	4.2947	1208.823	115.3889
.5000	6.5474	1.2769	4.2339	1321.205	143.7187
.6000	5.2172	1.5322	4.1838	1432.735	172.1977
.7000	3.8990	1.7876	4.1414	1543.518	200.7058
.8000	2.5908	2.0430	4.1046	1653.672	229.2222
.9000	1.2915	2.2983	4.0721	1763.275	257.7430
1.0000	.0000	2.5537	4.0430	1872.389	286.2662

********** PORE PRESSURES **********

CHI	UW	U0	U
13.3045	18.436	18.436	-.0002
12.0102	747.952	99.205	648.7469
10.6338	913.196	185.093	728.1027
9.2495	1007.563	271.472	736.0912
7.8913	1093.434	356.223	737.2105
6.5474	1177.486	440.081	737.4056
5.2172	1260.537	523.086	737.4515
3.8990	1342.813	605.344	737.4682
2.5908	1424.449	686.973	737.4767
1.2915	1505.532	768.051	737.4808
.0000	1586.122	848.640	737.4824

TIMESTEP SIZE = .07, ITERATIONS BETWEEN PRINT TIMES = 16

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .80000E+00 LOAD = 900.000
SET = .3515

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.2485	.0000	3.7254	922.935	901.0002
.1000	11.9852	.2554	4.1534	1030.287	192.2204
.2000	10.6304	.5107	4.4175	1143.354	74.0720
.3000	9.2451	.7661	4.3667	1258.321	88.9699
.4000	7.8912	1.0215	4.2943	1371.327	115.5752
.5000	6.5476	1.2769	4.2338	1483.697	143.7618
.6000	5.2172	1.5322	4.1838	1595.235	172.2113
.7000	3.8990	1.7876	4.1414	1706.019	200.7124
.8000	2.5908	2.0430	4.1046	1816.172	229.2266
.9000	1.2915	2.2983	4.0721	1925.775	257.7465
1.0000	.0000	2.5537	4.0430	2034.889	286.2692

********** PORE PRESSURES **********

CHI	UW	U0	U

13.2485	21.935	21.935	-.0002
11.9852	838.066	100.762	737.3044
10.6304	1069.281	185.304	883.9778
9.2451	1169.351	271.746	897.6047
7.8912	1255.752	356.228	899.5243
6.5476	1339.935	440.072	899.8625
5.2172	1423.024	523.086	899.9379
3.8990	1505.306	605.344	899.9617
2.5908	1586.945	686.973	899.9724
1.2915	1668.029	768.051	899.9773
.0000	1748.620	848.640	899.9796

TIMESTEP SIZE = .07, ITERATIONS BETWEEN PRINT TIMES = 18

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .90000E+00 LOAD = 1186.000
SET = .4267

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.1733	.0000	3.6491	1213.624	1187.0000
.1000	11.9503	.2554	3.9794	1318.466	360.2236
.2000	10.6247	.5107	4.3738	1429.708	86.7191
.3000	9.2403	.7661	4.3615	1544.620	90.6648
.4000	7.8911	1.0215	4.2935	1657.335	115.8854
.5000	6.5478	1.2769	4.2337	1769.682	143.8313
.6000	5.2172	1.5322	4.1838	1881.236	172.2315
.7000	3.8990	1.7876	4.1414	1992.018	200.7203
.8000	2.5908	2.0430	4.1046	2102.172	229.2317
.9000	1.2915	2.2983	4.0721	2211.775	257.7501
1.0000	.0000	2.5537	4.0430	2320.889	286.2731

********** PORE PRESSURES **********

CHI	UW	U0	U
13.1733	26.624	26.624	-.0001
11.9503	958.242	102.941	855.3011
10.6247	1342.989	185.658	1157.3310
9.2403	1453.955	272.046	1181.9100
7.8911	1541.449	356.235	1185.2140
6.5478	1625.851	440.058	1185.7930
5.2172	1709.004	523.087	1185.9180
3.8990	1791.298	605.344	1185.9540
2.5908	1872.940	686.973	1185.9670
1.2915	1954.025	768.051	1185.9740
.0000	2034.615	848.640	1185.9750

TIMESTEP SIZE = .06, ITERATIONS BETWEEN PRINT TIMES = 20

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .10000E+01 LOAD = 1472.000
SET = .5162

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.0838	.0000	3.5893	1505.214	1473.0000
.1000	11.9023	.2554	3.7816	1607.461	735.7504
.2000	10.6144	.5107	4.2942	1716.354	115.6166
.3000	9.2371	.7661	4.3519	1830.821	93.8594
.4000	7.8909	1.0215	4.2922	1943.347	116.4232
.5000	6.5482	1.2769	4.2335	2055.656	143.9473
.6000	5.2172	1.5322	4.1837	2167.237	172.2623
.7000	3.8990	1.7876	4.1414	2278.018	200.7317
.8000	2.5908	2.0430	4.1046	2388.172	229.2372
.9000	1.2915	2.2983	4.0721	2497.775	257.7541
1.0000	.0000	2.5537	4.0430	2606.889	286.2766

********** PORE PRESSURES **********

CHI	UW	U0	U
13.0838	32.214	32.214	-.0001
11.9023	871.711	105.936	765.7744
10.6144	1600.738	186.305	1414.4330
9.2371	1736.962	272.247	1464.7150
7.8909	1826.924	356.248	1470.6760
6.5482	1911.709	440.032	1471.6770
5.2172	1994.974	523.087	1471.8870
3.8990	2077.287	605.344	1471.9420
2.5908	2158.935	686.973	1471.9620
1.2915	2240.021	768.051	1471.9700
.0000	2320.612	848.640	1471.9720

TIMESTEP SIZE = .05, ITERATIONS BETWEEN PRINT TIMES = 22

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .12500E+01 LOAD = 1472.000
SET = .6339

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE

.0000	12.9661	.0000	3.5893	1512.558	1473.0000
.1000	11.7798	.2554	3.7179	1615.107	925.7070
.2000	10.5483	.5107	3.9420	1720.476	412.2320
.3000	9.2481	.7661	4.2547	1830.131	133.3167
.4000	7.8890	1.0215	4.2792	1943.464	122.0592
.5000	6.5477	1.2769	4.2315	2055.685	144.9468
.6000	5.2171	1.5322	4.1834	2167.241	172.4843
.7000	3.8990	1.7876	4.1413	2278.015	200.7946
.8000	2.5908	2.0430	4.1045	2388.173	229.2617
.9000	1.2915	2.2983	4.0721	2497.775	257.7678
1.0000	.0000	2.5537	4.0430	2606.889	286.2884

********** PORE PRESSURES **********

CHI	UW	U0	U
12.9661	39.558	39.558	-.0001
11.7798	689.400	113.583	575.8178
10.5483	1308.244	190.427	1117.8180
9.2481	1696.814	271.556	1425.2580
7.8890	1821.405	356.364	1465.0400
6.5477	1910.739	440.061	1470.6770
5.2171	1994.757	523.092	1471.6650
3.8990	2077.221	605.341	1471.8790
2.5908	2158.911	686.974	1471.9370
1.2915	2240.008	768.052	1471.9560
.0000	2320.600	848.640	1471.9600

TIMESTEP SIZE = .03, ITERATIONS BETWEEN PRINT TIMES = 31

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .15000E+01 LOAD = 1472.000
SET = .7559

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	12.8441	.0000	3.5893	1520.170	1473.0000
.1000	11.6605	.2554	3.6829	1622.547	1050.5890
.2000	10.4488	.5107	3.8176	1726.683	645.9172
.3000	9.1926	.7661	4.0393	1833.598	290.1129
.4000	7.8790	1.0215	4.2142	1944.088	154.3294
.5000	6.5418	1.2769	4.2199	2056.053	151.1624
.6000	5.2168	1.5322	4.1813	2167.262	173.7648
.7000	3.8992	1.7876	4.1409	2278.004	201.0900
.8000	2.5908	2.0430	4.1044	2388.174	229.3430
.9000	1.2915	2.2983	4.0720	2497.775	257.7989
1.0000	.0000	2.5537	4.0430	2606.889	286.3091

********** PORE PRESSURES **********

CHI	UW	U0	U
12.8441	47.170	47.170	-.0001
11.6605	571.958	121.022	450.9358
10.4488	1080.766	196.633	884.1325
9.1926	1543.485	275.023	1268.4620
7.8790	1789.759	356.989	1432.7700
6.5418	1904.891	440.429	1464.4620
5.2168	1993.498	523.113	1470.3840
3.8992	2076.914	605.330	1471.5840
2.5908	2158.831	686.975	1471.8560
1.2915	2239.977	768.052	1471.9250
.0000	2320.580	848.640	1471.9400

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 43

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .17500E+01 LOAD = 1472.000
SET = .8548

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	12.7452	.0000	3.5893	1526.339	1473.0000
.1000	11.5638	.2554	3.6662	1628.583	1115.9120
.2000	10.3599	.5107	3.7677	1732.232	773.4838
.3000	9.1256	.7661	3.9062	1837.777	469.1106
.4000	7.8507	1.0215	4.0844	1945.854	246.5752
.5000	6.5374	1.2769	4.1768	2056.333	176.6004
.6000	5.2150	1.5322	4.1714	2167.371	180.1236
.7000	3.8988	1.7876	4.1387	2278.031	202.6877
.8000	2.5907	2.0430	4.1039	2388.180	229.7634
.9000	1.2915	2.2983	4.0719	2497.775	257.9263
1.0000	.0000	2.5537	4.0429	2606.889	286.3801

********** PORE PRESSURES **********

CHI	UW	U0	U
12.7452	53.339	53.339	-.0001
11.5638	512.671	127.058	385.6130
10.3599	958.748	202.182	756.5660
9.1256	1368.666	279.202	1089.4640
7.8507	1699.279	358.755	1340.5240
6.5374	1879.733	440.709	1439.0240
5.2150	1987.247	523.221	1464.0260
3.8988	2075.343	605.356	1469.9860
2.5907	2158.417	686.981	1471.4360
1.2915	2239.848	768.051	1471.7970
.0000	2320.509	848.640	1471.8690

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 56

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .20000E+01 LOAD = 1472.000
SET = .9402

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	12.6598	.0000	3.5893	1531.666	1473.0000
.1000	11.4798	.2554	3.6545	1633.823	1163.7350
.2000	10.2811	.5107	3.7368	1737.147	864.8417
.3000	9.0586	.7661	3.8421	1841.958	591.3593
.4000	7.8059	1.0215	3.9734	1948.653	368.0845
.5000	6.5195	1.2769	4.0973	2057.449	235.3307
.6000	5.2092	1.5322	4.1425	2167.737	199.9196
.7000	3.8965	1.7876	4.1305	2278.174	208.7672
.8000	2.5903	2.0430	4.1017	2388.207	231.6040
.9000	1.2914	2.2983	4.0713	2497.778	258.5273
1.0000	.0000	2.5537	4.0426	2606.889	286.7189

********** PORE PRESSURES **********

CHI	UW	U0	U
12.6598	58.666	58.666	-.0001
11.4798	470.088	132.298	337.7901
10.2811	872.306	207.098	665.2080
9.0586	1250.598	283.383	967.2153
7.8059	1580.569	361.554	1219.0150
6.5195	1822.118	441.825	1380.2940
5.2092	1967.817	523.588	1444.2300
3.8965	2069.406	605.500	1463.9070
2.5903	2156.603	687.008	1469.5950
1.2914	2239.251	768.054	1471.1970
.0000	2320.170	848.640	1471.5300

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 70

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .22500E+01 LOAD = 1472.000
SET = 1.0176

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE

.0000	12.5824	.0000	3.5893	1536.500	1473.0000
.1000	11.4034	.2554	3.6463	1638.595	1199.0650
.2000	10.2083	.5107	3.7157	1741.693	933.0624
.3000	8.9935	.7661	3.8011	1846.021	685.6187
.4000	7.7547	1.0215	3.9042	1951.849	472.5609
.5000	6.4882	1.2769	4.0150	2059.402	316.7223
.6000	5.1961	1.5322	4.0923	2168.551	239.6206
.7000	3.8918	1.7876	4.1107	2278.463	224.2460
.8000	2.5888	2.0430	4.0951	2388.298	237.2270
.9000	1.2910	2.2983	4.0690	2497.804	260.6786
1.0000	.0000	2.5537	4.0413	2606.889	288.0512

********** PORE PRESSURES **********

CHI	UW	U0	U
12.5824	63.499	63.499	-.0001
11.4034	439.530	137.070	302.4603
10.2083	808.631	211.643	596.9874
8.9935	1160.402	287.446	872.9559
7.7547	1479.288	364.750	1114.5390
6.4882	1742.680	443.778	1298.9020
5.1961	1928.930	524.401	1404.5290
3.8918	2054.217	605.789	1448.4280
2.5888	2151.071	687.099	1463.9720
1.2910	2237.125	768.080	1469.0450
.0000	2318.837	848.640	1470.1980

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 85

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .25000E+01 LOAD = 1472.000
SET = 1.0875

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	12.5125	.0000	3.5893	1540.861	1473.0000
.1000	11.3342	.2554	3.6400	1642.909	1226.4690
.2000	10.1418	.5107	3.7004	1745.840	986.1813
.3000	8.9325	.7661	3.7726	1849.825	760.0413
.4000	7.7032	1.0215	3.8576	1955.061	559.1702
.5000	6.4509	1.2769	3.9512	2061.729	398.7248
.6000	5.1753	1.5322	4.0343	2169.852	295.3968
.7000	3.8830	1.7876	4.0779	2279.018	252.4303
.8000	2.5853	2.0430	4.0809	2388.519	249.6654
.9000	1.2898	2.2983	4.0630	2497.882	266.3362
1.0000	.0000	2.5537	4.0376	2606.889	291.9370

********** PORE PRESSURES **********

CHI	UW	U0	U
12.5125	67.861	67.861	-.0001
11.3342	416.441	141.385	275.0562
10.1418	759.659	215.791	543.8684
8.9325	1089.783	291.250	798.5333
7.7032	1395.891	367.961	1027.9290
6.4509	1663.005	446.105	1216.9000
5.1753	1874.455	525.702	1348.7520
3.8830	2026.588	606.344	1420.2440
2.5853	2138.854	687.320	1451.5340
1.2898	2231.545	768.158	1463.3880
.0000	2314.952	848.640	1466.3120

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 100

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .27500E+01 LOAD = 1472.000
SET = 1.1516

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	12.4484	.0000	3.5893	1544.860	1473.0000
.1000	11.2707	.2554	3.6351	1646.871	1248.4130
.2000	10.0804	.5107	3.6887	1749.672	1028.8890
.3000	8.8753	.7661	3.7513	1853.398	820.5528
.4000	7.6529	1.0215	3.8238	1958.200	631.6769
.5000	6.4109	1.2769	3.9039	2064.222	473.0985
.6000	5.1485	1.5322	3.9817	2171.525	357.2437
.7000	3.8685	1.7876	4.0375	2279.921	292.0898
.8000	2.5786	2.0430	4.0582	2388.934	271.0340
.9000	1.2873	2.2983	4.0512	2498.038	277.9054
1.0000	.0000	2.5537	4.0294	2606.889	300.6671

********** PORE PRESSURES **********

CHI	UW	U0	U
12.4484	71.860	71.860	-.0001
11.2707	398.458	145.346	253.1118
10.0804	720.783	219.623	501.1607
8.8753	1032.845	294.823	738.0218
7.6529	1326.523	371.101	955.4226
6.4109	1591.124	448.598	1142.5260
5.1485	1814.282	527.376	1286.9060
3.8685	1987.831	607.247	1380.5840
2.5786	2117.900	687.735	1430.1650
1.2873	2220.133	768.314	1451.8180
.0000	2306.222	848.640	1457.5820

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 116

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .30000E+01 LOAD = 1472.000
SET = 1.2110

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	12.3890	.0000	3.5893	1548.565	1473.0000
.1000	11.2118	.2554	3.6311	1650.546	1266.4530
.2000	10.0232	.5107	3.6793	1753.244	1064.1050
.3000	8.8213	.7661	3.7349	1856.766	870.8630
.4000	7.6042	1.0215	3.7981	1961.235	693.1478
.5000	6.3702	1.2769	3.8677	2066.765	539.1497
.6000	5.1181	1.5322	3.9379	2173.422	418.3759
.7000	3.8492	1.7876	3.9963	2281.123	338.9178
.8000	2.5685	2.0430	4.0287	2389.566	301.4886
.9000	1.2832	2.2983	4.0324	2498.294	297.4240
1.0000	.0000	2.5537	4.0151	2606.889	316.6672

********** PORE PRESSURES **********

CHI	UW	U0	U
12.3890	75.565	75.565	-.0001
11.2118	384.093	149.021	235.0714
10.0232	689.138	223.194	465.9443
8.8213	985.903	298.192	687.7115
7.6042	1268.087	374.136	893.9517
6.3702	1527.615	451.141	1076.4750
5.1181	1755.046	529.273	1225.7730
3.8492	1942.205	608.448	1333.7560
2.5685	2088.078	688.367	1399.7100
1.2832	2200.870	768.570	1432.3000
.0000	2290.221	848.640	1441.5810

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 132

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .35000E+01 LOAD = 1472.000
SET = 1.3183

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	12.2817	.0000	3.5893	1555.264	1473.0000
.1000	11.1052	.2554	3.6250	1657.199	1294.6210
.2000	9.9191	.5107	3.6653	1759.739	1119.3180
.3000	8.7220	.7661	3.7106	1862.960	950.5103
.4000	7.5128	1.0215	3.7610	1966.944	792.5026
.5000	6.2900	1.2769	3.8156	2071.765	650.6199
.6000	5.0531	1.5322	3.8718	2177.477	531.1498
.7000	3.8022	1.7876	3.9235	2284.056	440.6866
.8000	2.5396	2.0430	3.9614	2391.366	384.4051
.9000	1.2701	2.2983	3.9766	2499.109	363.8513
1.0000	.0000	2.5537	3.9668	2606.889	376.9625

********** PORE PRESSURES **********

CHI	UW	U0	U
12.2817	82.264	82.264	-.0001
11.1052	362.578	155.674	206.9040
9.9191	640.421	229.689	410.7316
8.7220	912.450	304.386	608.0643
7.5128	1174.441	379.844	794.5969
6.2900	1421.146	456.141	965.0045
5.0531	1646.327	533.327	1112.9990
3.8022	1843.370	611.382	1231.9870
2.5396	2006.961	690.168	1316.7940
1.2701	2135.257	769.385	1365.8720
.0000	2229.926	848.640	1381.2860

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 165

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .40000E+01 LOAD = 1472.000
SET = 1.4137

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	12.1863	.0000	3.5893	1561.218	1473.0000
.1000	11.0104	.2554	3.6204	1663.117	1316.3700
.2000	9.8261	.5107	3.6549	1765.539	1162.2210
.3000	8.6326	.7661	3.6929	1868.538	1013.2440
.4000	7.4290	1.0215	3.7342	1972.171	872.7683
.5000	6.2144	1.2769	3.7781	2076.483	744.8911
.6000	4.9886	1.5322	3.8225	2181.503	634.5503
.7000	3.7517	1.7876	3.8635	2287.209	547.3895
.8000	2.5054	2.0430	3.8946	2393.501	489.1660
.9000	1.2532	2.2983	3.9089	2500.163	464.5289
1.0000	.0000	2.5537	3.9024	2606.889	475.6160

********** PORE PRESSURES **********

CHI	UW	U0	U
12.1863	88.218	88.218	-.0001
11.0104	346.747	161.592	185.1550
9.8261	603.318	235.489	367.8286
8.6326	855.294	309.964	545.3306
7.4290	1099.402	385.071	714.3312
6.2144	1331.592	460.859	870.7333
4.9886	1546.953	537.354	1009.5990
3.7517	1739.820	614.535	1125.2850
2.5054	1904.335	692.302	1212.0330
1.2532	2035.634	770.439	1265.1950
.0000	2131.273	848.640	1282.6330

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 199

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .45000E+01 LOAD = 1472.000
SET = 1.4995

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	12.1005	.0000	3.5893	1566.569	1473.0000
.1000	10.9251	.2554	3.6165	1668.438	1335.2750
.2000	9.7425	.5107	3.6461	1770.759	1199.7880
.3000	8.5520	.7661	3.6781	1873.572	1068.9520
.4000	7.3530	1.0215	3.7120	1976.911	945.7159
.5000	6.1453	1.2769	3.7469	2080.800	833.6687
.6000	4.9286	1.5322	3.7810	2185.242	737.1190
.7000	3.7037	1.7876	3.8112	2290.201	661.0121
.8000	2.4720	2.0430	3.8332	2395.583	610.5198
.9000	1.2363	2.2983	3.8426	2501.221	590.1313
1.0000	.0000	2.5537	3.8369	2606.889	602.4124

********** PORE PRESSURES **********

CHI	UW	U0	U
12.1005	93.569	93.569	-.0001
10.9251	333.162	166.913	166.2497
9.7425	570.971	240.709	330.2615
8.5520	804.619	314.997	489.6222
7.3530	1031.195	389.811	641.3835
6.1453	1247.131	465.175	781.9556
4.9286	1448.123	541.093	907.0303
3.7037	1629.189	617.527	1011.6620
2.4720	1785.063	694.384	1090.6790
1.2363	1911.089	771.497	1139.5930

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      .0000    2004.476        848.640      1155.8360
 TIMESTEP SIZE =     .01, ITERATIONS BETWEEN PRINT TIMES =    234
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .50000E+01          LOAD =   1472.000
               SET =    1.5764

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y           CHI          Z           E            TOTAL        EFFECTIVE

     .0000      12.0236      .0000      3.5893       1571.365      1473.0000
     .1000      10.8487      .2554      3.6127       1673.204      1353.6720
     .2000       9.6676      .5107      3.6377       1775.430      1236.5200
     .3000       8.4799      .7661      3.6642       1878.067      1123.8840
     .4000       7.2854     1.0215      3.6915       1981.133      1018.5480
     .5000       6.0838     1.2769      3.7185       2084.634       923.7919
     .6000       4.8756     1.5322      3.7437       2188.553       843.3991
     .7000       3.6614     1.7876      3.7648       2292.845       781.5054
     .8000       2.4426     2.0430      3.7791       2397.423       742.2120
     .9000       1.2212     2.2983      3.7841       2502.158       728.9164
    1.0000        .0000     2.5537      3.7786       2606.889       743.5260

                ***********  PORE PRESSURES  ***********

      CHI          UW            U0            U

     12.0236      98.365        98.365        -.0001
     10.8487     319.532       171.679       147.8526
      9.6676     538.910       245.380       293.5295
      8.4799     754.183       319.493       434.6902
      7.2854     962.585       394.034       568.5513
      6.0838    1160.842       469.009       691.8324
      4.8756    1345.154       544.404       800.7501
      3.6614    1511.340       620.171       891.1687
      2.4426    1655.211       696.224       958.9869
      1.2212    1773.241       772.434      1000.8070
       .0000    1863.363       848.640      1014.7230
 TIMESTEP SIZE =     .01, ITERATIONS BETWEEN PRINT TIMES =    270
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .60000E+01          LOAD =   1472.000
               SET =    1.7030

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******
```

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.8970	.0000	3.5893	1579.268	1473.0000
.1000	10.7230	.2554	3.6051	1681.048	1391.2920
.2000	9.5449	.5107	3.6214	1783.085	1311.6150
.3000	8.3627	.7661	3.6378	1885.384	1236.1110
.4000	7.1763	1.0215	3.6537	1987.941	1167.1290
.5000	5.9859	1.2769	3.6683	2090.742	1107.1960
.6000	4.7921	1.5322	3.6807	2193.760	1058.9120
.7000	3.5956	1.7876	3.6898	2296.949	1024.8020
.8000	2.3972	2.0430	3.6946	2400.251	1007.0730
.9000	1.1983	2.2983	3.6945	2503.591	1007.3560
1.0000	.0000	2.5537	3.6893	2606.889	1026.4900

********** PORE PRESSURES **********

CHI	UW	U0	U
11.8970	106.268	106.268	-.0001
10.7230	289.755	179.523	110.2324
9.5449	471.470	253.035	218.4345
8.3627	649.273	326.809	322.4640
7.1763	820.812	400.841	419.9703
5.9859	983.546	475.118	508.4283
4.7921	1134.848	549.611	585.2370
3.5956	1272.147	624.275	647.8718
2.3972	1393.178	699.052	694.1263
1.1983	1496.235	773.867	722.3677
.0000	1580.399	848.640	731.7586

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 343

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .70000E+01 LOAD = 1472.000
SET = 1.7938

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.8062	.0000	3.5893	1584.936	1473.0000
.1000	10.6331	.2554	3.5982	1686.662	1426.1040
.2000	9.4577	.5107	3.6072	1788.532	1380.8360
.3000	8.2800	.7661	3.6157	1890.542	1338.8610
.4000	7.1003	1.0215	3.6235	1992.682	1301.8840
.5000	5.9187	1.2769	3.6300	2094.936	1271.6010
.6000	4.7357	1.5322	3.6348	2197.281	1249.6250
.7000	3.5517	1.7876	3.6375	2299.687	1237.3910
.8000	2.3673	2.0430	3.6378	2402.118	1236.0670
.9000	1.1832	2.2983	3.6355	2504.532	1246.4600
1.0000	.0000	2.5537	3.6306	2606.889	1268.9580

********** PORE PRESSURES **********

CHI	UW	U0	U
11.8062	111.936	111.936	-.0001
10.6331	260.559	185.138	75.4211
9.4577	407.696	258.482	149.2139
8.2800	551.680	331.967	219.7135
7.1003	690.797	405.582	285.2154
5.9187	823.334	479.311	344.0229
4.7357	947.657	553.132	394.5246
3.5517	1062.296	627.013	435.2830
2.3673	1166.051	700.919	465.1320
1.1832	1258.072	774.809	483.2637
.0000	1337.931	848.640	489.2910

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 419

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .80000E+01 LOAD = 1472.000
SET = 1.8540

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.7460	.0000	3.5893	1588.690	1473.0000
.1000	10.5735	.2554	3.5930	1690.375	1453.3640
.2000	9.4002	.5107	3.5965	1792.119	1434.8730
.3000	8.2259	.7661	3.5997	1893.916	1418.6610
.4000	7.0510	1.0215	3.6022	1995.758	1405.8460
.5000	5.8755	1.2769	3.6038	2097.634	1397.4790
.6000	4.6997	1.5322	3.6044	2199.528	1394.5130
.7000	3.5239	1.7876	3.6038	2301.421	1397.7570
.8000	2.3485	2.0430	3.6018	2403.294	1407.8430
.9000	1.1737	2.2983	3.5984	2505.124	1425.1930
1.0000	.0000	2.5537	3.5936	2606.889	1450.0040

********** PORE PRESSURES **********

CHI	UW	U0	U
11.7460	115.690	115.690	-.0001
10.5735	237.011	188.851	48.1607
9.4002	357.246	262.069	95.1772
8.2259	475.254	335.341	139.9132
7.0510	589.912	408.658	181.2535
5.8755	700.154	482.009	218.1450
4.6997	805.015	555.378	249.6365
3.5239	903.664	628.747	274.9169
2.3485	995.451	702.095	293.3563

1.1737	1079.931	775.400	304.5306
.0000	1156.884	848.640	308.2444

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 498

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .90000E+01 LOAD = 1472.000
SET = 1.8916

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.7084	.0000	3.5893	1591.034	1473.0000
.1000	10.5365	.2554	3.5894	1692.690	1472.2130
.2000	9.3644	.5107	3.5894	1794.348	1472.1610
.3000	8.1925	.7661	3.5892	1896.005	1473.5660
.4000	7.0206	1.0215	3.5885	1997.654	1477.1070
.5000	5.8490	1.2769	3.5873	2099.288	1483.4130
.6000	4.6777	1.5322	3.5855	2200.899	1493.0330
.7000	3.5070	1.7876	3.5831	2302.476	1506.4250
.8000	2.3370	2.0430	3.5799	2404.008	1523.9340
.9000	1.1680	2.2983	3.5759	2505.483	1545.7910
1.0000	.0000	2.5537	3.5712	2606.889	1572.0980

********** PORE PRESSURES **********

CHI	UW	U0	U
11.7084	118.034	118.034	-.0001
10.5365	220.477	191.165	29.3119
9.3644	322.187	264.299	57.8886
8.1925	422.439	337.430	85.0088
7.0206	520.546	410.554	109.9922
5.8490	615.875	483.664	132.2116
4.6777	707.866	556.750	151.1166
3.5070	796.051	629.802	166.2490
2.3370	880.074	702.809	177.2648
1.1680	959.691	775.759	183.9327
.0000	1034.791	848.640	186.1507

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 579

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .10000E+02 LOAD = 1472.000
SET = 1.9141

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.6859	.0000	3.5893	1592.439	1473.0000
.1000	10.5142	.2554	3.5872	1694.077	1484.2250
.2000	9.3431	.5107	3.5850	1795.682	1495.9000
.3000	8.1725	.7661	3.5827	1897.251	1508.4560
.4000	7.0025	1.0215	3.5802	1998.781	1522.2980
.5000	5.8332	1.2769	3.5773	2100.270	1537.7890
.6000	4.6647	1.5322	3.5742	2201.711	1555.2440
.7000	3.4970	1.7876	3.5707	2303.099	1574.9220
.8000	2.3303	2.0430	3.5669	2404.429	1597.0140
.9000	1.1646	2.2983	3.5626	2505.694	1621.6470
1.0000	.0000	2.5537	3.5580	2606.889	1648.8790

********** PORE PRESSURES **********

CHI	UW	U0	U
11.6859	119.438	119.439	-.0001
10.5142	209.852	192.552	17.2998
9.3431	299.782	265.632	34.1500
8.1725	388.795	338.676	50.1190
7.0025	476.483	411.682	64.8014
5.8332	562.481	484.645	77.8353
4.6647	646.467	557.561	88.9054
3.4970	728.177	630.425	97.7522
2.3303	807.415	703.230	104.1852
1.1646	884.047	775.970	108.0765
.0000	958.010	848.640	109.3698

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 666

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .12000E+02 LOAD = 1472.000
SET = 1.9348

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.6652	.0000	3.5893	1593.734	1473.0000
.1000	10.4937	.2554	3.5850	1695.355	1495.7860
.2000	9.3234	.5107	3.5808	1796.909	1518.7270
.3000	8.1541	.7661	3.5766	1898.396	1541.9670
.4000	6.9860	1.0215	3.5724	1999.816	1565.6390
.5000	5.8189	1.2769	3.5681	2101.168	1589.8640
.6000	4.6528	1.5322	3.5638	2202.452	1614.7430
.7000	3.4879	1.7876	3.5595	2303.667	1640.3570
.8000	2.3241	2.0430	3.5550	2404.813	1666.7680
.9000	1.1615	2.2983	3.5505	2505.887	1694.0150

1.0000	.0000	2.5537	3.5460	2606.889	1722.1150

********** PORE PRESSURES **********

CHI	UW	U0	U
11.6652	120.733	120.733	-.0001
10.4937	199.568	193.830	5.7384
9.3234	278.182	266.859	11.3232
8.1541	356.429	339.821	16.6079
6.9860	434.176	412.716	21.4602
5.8189	511.304	485.544	25.7602
4.6528	587.709	558.303	29.4060
3.4879	663.310	630.993	32.3168
2.3241	738.044	703.614	34.4309
1.1615	811.872	776.163	35.7088
.0000	884.774	848.640	36.1337

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 848

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .12500E+02 LOAD = 1472.000
SET = 1.9373

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.6627	.0000	3.5893	1593.887	1473.0000
.1000	10.4913	.2554	3.5848	1695.507	1497.1930
.2000	9.3211	.5107	3.5803	1797.055	1521.5020
.3000	8.1520	.7661	3.5759	1898.532	1546.0390
.4000	6.9840	1.0215	3.5714	1999.938	1570.9020
.5000	5.8171	1.2769	3.5670	2101.274	1596.1850
.6000	4.6514	1.5322	3.5626	2202.540	1621.9600
.7000	3.4869	1.7876	3.5581	2303.735	1648.2920
.8000	2.3234	2.0430	3.5536	2404.858	1675.2240
.9000	1.1611	2.2983	3.5491	2505.909	1702.7850
1.0000	.0000	2.5537	3.5446	2606.889	1730.9900

********** PORE PRESSURES **********

CHI	UW	U0	U
11.6627	120.887	120.888	-.0001
10.4913	198.314	193.982	4.3319
9.3211	275.553	267.005	8.5480
8.1520	352.493	339.957	12.5360
6.9840	429.036	412.839	16.1971
5.8171	505.089	485.650	19.4393
4.6514	580.580	558.391	22.1892
3.4869	655.443	631.061	24.3826

2.3234	729.634	703.659	25.9754
1.1611	803.125	776.186	26.9393
.0000	875.899	848.640	27.2588

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 896

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .15000E+02 LOAD = 1472.000
SET = 1.9430

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.6570	.0000	3.5893	1594.244	1473.0000
.1000	10.4857	.2554	3.5842	1695.858	1500.4760
.2000	9.3157	.5107	3.5791	1797.392	1527.9810
.3000	8.1469	.7661	3.5742	1898.846	1555.5420
.4000	6.9795	1.0215	3.5693	2000.222	1583.1800
.5000	5.8132	1.2769	3.5645	2101.520	1610.9220
.6000	4.6482	1.5322	3.5597	2202.743	1638.7820
.7000	3.4844	1.7876	3.5550	2303.890	1666.7780
.8000	2.3217	2.0430	3.5504	2404.963	1694.9160
.9000	1.1603	2.2983	3.5458	2505.962	1723.2090
1.0000	.0000	2.5537	3.5413	2606.889	1751.6580

********** PORE PRESSURES **********

CHI	UW	U0	U
11.6570	121.244	121.244	-.0001
10.4857	195.382	194.334	1.0485
9.3157	269.411	267.342	2.0689
8.1469	343.304	340.271	3.0324
6.9795	417.042	413.122	3.9197
5.8132	490.599	485.896	4.7028
4.6482	563.960	558.594	5.3667
3.4844	637.112	631.216	5.8960
2.3217	710.046	703.764	6.2826
1.1603	782.753	776.238	6.5145
.0000	855.231	848.640	6.5909

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1134

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .17500E+02 LOAD = 1472.000
SET = 1.9444

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********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

     Y            CHI          Z            E            TOTAL        EFFECTIVE

    .0000      11.6556       .0000       3.5893       1594.330       1473.0000
    .1000      10.4843       .2554       3.5840       1695.943       1501.2710
    .2000       9.3144       .5107       3.5788       1797.473       1529.5480
    .3000       8.1457       .7661       3.5738       1898.922       1557.8400
    .4000       6.9784      1.0215       3.5688       2000.290       1586.1520
    .5000       5.8123      1.2769       3.5639       2101.579       1614.4890
    .6000       4.6474      1.5322       3.5590       2202.792       1642.8540
    .7000       3.4838      1.7876       3.5543       2303.927       1671.2500
    .8000       2.3213      2.0430       3.5496       2404.988       1699.6820
    .9000       1.1601      2.2983       3.5450       2505.975       1728.1510
   1.0000        .0000      2.5537       3.5405       2606.889       1756.6570

                ***********  PORE PRESSURES  ***********

     CHI          UW            U0             U

   11.6556     121.330       121.330        -.0001
   10.4843     194.672       194.418         .2541
    9.3144     267.925       267.423         .5018
    8.1457     341.081       340.347         .7344
    6.9784     414.138       413.190         .9476
    5.8123     487.091       485.955        1.1356
    4.6474     559.937       558.642        1.2952
    3.4838     632.677       631.253        1.4241
    2.3213     705.306       703.789        1.5172
    1.1601     777.824       776.251        1.5728
     .0000     850.232       848.640        1.5917
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =   1374
1
    ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

    ****Pond 8E, 13.6 feet of sludge, Power K

    PERVIOUS UPPER BOUNDARY
    IMPERVIOUS LOWER BOUNDARY

              TIME =  .18000E+02          LOAD =   1472.000
              SET =    1.9445

********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

     Y            CHI          Z            E            TOTAL        EFFECTIVE

    .0000      11.6555       .0000       3.5893       1594.336       1473.0000
    .1000      10.4842       .2554       3.5840       1695.950       1501.3340
    .2000       9.3143       .5107       3.5788       1797.479       1529.6740
    .3000       8.1456       .7661       3.5737       1898.927       1558.0230
    .4000       6.9783      1.0215       3.5687       2000.295       1586.3870
    .5000       5.8122      1.2769       3.5638       2101.584       1614.7700
    .6000       4.6473      1.5322       3.5590       2202.795       1643.1720
    .7000       3.4837      1.7876       3.5542       2303.930       1671.6010
    .8000       2.3213      2.0430       3.5496       2404.990       1700.0560
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.9000	1.1601	2.2983	3.5450	2505.976	1728.5390
1.0000	.0000	2.5537	3.5404	2606.889	1757.0500

********** PORE PRESSURES **********

CHI	UW	U0	U
11.6555	121.336	121.336	-.0001
10.4842	194.616	194.425	.1908
9.3143	267.805	267.430	.3754
8.1456	340.905	340.353	.5520
6.9783	413.909	413.196	.7127
5.8122	486.815	485.960	.8548
4.6473	559.623	558.646	.9770
3.4837	632.329	631.256	1.0730
2.3213	704.934	703.791	1.1426
1.1601	777.437	776.252	1.1846
.0000	849.839	848.640	1.1986

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1423

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .20000E+02 LOAD = 1472.000
SET = 1.9447

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.6553	.0000	3.5893	1594.350	1473.0000
.1000	10.4840	.2554	3.5840	1695.963	1501.4620
.2000	9.3141	.5107	3.5788	1797.493	1529.9270
.3000	8.1454	.7661	3.5737	1898.940	1558.3940
.4000	6.9781	1.0215	3.5686	2000.306	1586.8660
.5000	5.8120	1.2769	3.5637	2101.594	1615.3440
.6000	4.6472	1.5322	3.5589	2202.803	1643.8300
.7000	3.4836	1.7876	3.5541	2303.936	1672.3250
.8000	2.3212	2.0430	3.5494	2404.994	1700.8280
.9000	1.1600	2.2983	3.5448	2505.978	1729.3400
1.0000	.0000	2.5537	3.5403	2606.889	1757.8590

********** PORE PRESSURES **********

CHI	UW	U0	U
11.6553	121.350	121.350	-.0001
10.4840	194.501	194.438	.0628
9.3141	267.565	267.443	.1226
8.1454	340.546	340.365	.1806
6.9781	413.440	413.207	.2335
5.8120	486.250	485.969	.2807
4.6472	558.973	558.654	.3193

3.4836	631.611	631.262	.3491
2.3212	704.166	703.795	.3713
1.1600	776.638	776.254	.3840
.0000	849.029	848.640	.3893

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1616

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .22500E+02 LOAD = 1472.000
SET = 1.9448

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.6552	.0000	3.5893	1594.355	1473.0000
.1000	10.4839	.2554	3.5840	1695.968	1501.5020
.2000	9.3140	.5107	3.5788	1797.497	1530.0060
.3000	8.1454	.7661	3.5736	1898.944	1558.5120
.4000	6.9780	1.0215	3.5686	2000.310	1587.0200
.5000	5.8120	1.2769	3.5637	2101.597	1615.5310
.6000	4.6472	1.5322	3.5588	2202.806	1644.0450
.7000	3.4836	1.7876	3.5541	2303.938	1672.5610
.8000	2.3212	2.0430	3.5494	2404.995	1701.0790
.9000	1.1600	2.2983	3.5448	2505.979	1729.6000
1.0000	.0000	2.5537	3.5403	2606.889	1758.1240

********** PORE PRESSURES **********

CHI	UW	U0	U
11.6552	121.355	121.355	-.0001
10.4839	194.466	194.443	.0228
9.3140	267.491	267.447	.0435
8.1454	340.432	340.369	.0625
6.9780	413.290	413.210	.0791
5.8120	486.065	485.972	.0930
4.6472	558.761	558.657	.1042
3.4836	631.377	631.264	.1130
2.3212	703.916	703.796	.1195
1.1600	776.378	776.255	.1235
.0000	848.765	848.640	.1246

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1857

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .24000E+02 LOAD = 1472.000

SET = 1.9448

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.6552	.0000	3.5893	1594.355	1473.0000
.1000	10.4839	.2554	3.5840	1695.968	1501.5020
.2000	9.3140	.5107	3.5788	1797.497	1530.0060
.3000	8.1454	.7661	3.5736	1898.944	1558.5120
.4000	6.9780	1.0215	3.5686	2000.310	1587.0200
.5000	5.8120	1.2769	3.5637	2101.597	1615.5310
.6000	4.6472	1.5322	3.5588	2202.806	1644.0450
.7000	3.4836	1.7876	3.5541	2303.938	1672.5610
.8000	2.3212	2.0430	3.5494	2404.995	1701.0790
.9000	1.1600	2.2983	3.5448	2505.979	1729.6000
1.0000	.0000	2.5537	3.5403	2606.889	1758.1240

********** PORE PRESSURES **********

CHI	UW	U0	U
11.6552	121.355	121.355	-.0001
10.4839	194.466	194.443	.0228
9.3140	267.491	267.447	.0435
8.1454	340.432	340.369	.0625
6.9780	413.290	413.210	.0791
5.8120	486.065	485.972	.0930
4.6472	558.761	558.657	.1042
3.4836	631.377	631.264	.1130
2.3212	703.916	703.796	.1195
1.1600	776.378	776.255	.1235
.0000	848.765	848.640	.1246

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2002

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .25000E+02 LOAD = 1682.000
SET = 1.9778

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.6222	.0000	3.5524	1806.415	1683.0000
.1000	10.4593	.2554	3.5551	1907.505	1666.2990
.2000	9.2958	.5107	3.5565	2008.630	1657.7400
.3000	8.1322	.7661	3.5568	2109.767	1656.3770
.4000	6.9686	1.0215	3.5560	2210.899	1661.2600
.5000	5.8053	1.2769	3.5543	2312.011	1671.4840
.6000	4.6426	1.5322	3.5518	2413.090	1686.2380
.7000	3.4806	1.7876	3.5488	2514.125	1704.8160

.8000	2.3194	2.0430	3.5453	2615.108	1726.6600
.9000	1.1592	2.2983	3.5413	2716.031	1751.3550
1.0000	.0000	2.5537	3.5370	2816.889	1778.6400

********** PORE PRESSURES **********

CHI	UW	U0	U
11.6222	123.414	123.415	-.0004
10.4593	241.207	195.981	45.2259
9.2958	350.890	268.580	82.3096
8.1322	453.390	341.192	112.1980
6.9686	549.639	413.800	135.8398
5.8053	640.527	486.387	154.1398
4.6426	726.852	558.941	167.9110
3.4806	809.309	631.451	177.8584
2.3194	888.448	703.909	184.5393
1.1592	964.676	776.307	188.3690
.0000	1038.249	848.640	189.6087

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2099

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .26000E+02 LOAD = 1892.000
SET = 2.0347

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.5653	.0000	3.5198	2019.967	1892.9990
.1000	10.4104	.2554	3.5246	2120.555	1860.5870
.2000	9.2545	.5107	3.5283	2221.210	1835.9710
.3000	8.0977	.7661	3.5309	2321.916	1818.8360
.4000	6.9405	1.0215	3.5324	2422.653	1808.8290
.5000	5.7830	1.2769	3.5329	2523.408	1805.5820
.6000	4.6254	1.5322	3.5324	2624.162	1808.7370
.7000	3.4682	1.7876	3.5310	2724.901	1817.9590
.8000	2.3114	2.0430	3.5287	2825.610	1832.9550
.9000	1.1552	2.2983	3.5256	2926.277	1853.4900
1.0000	.0000	2.5537	3.5218	3026.889	1879.3890

********** PORE PRESSURES **********

CHI	UW	U0	U
11.5653	126.968	126.967	.0010
10.4104	259.968	199.030	60.9378
9.2545	385.240	271.160	114.0790
8.0977	503.080	343.341	159.7387
6.9405	613.825	415.554	198.2708
5.7830	717.825	487.783	230.0419

4.6254	815.425	560.013	255.4124
3.4682	906.941	632.227	274.7146
2.3114	992.655	704.411	288.2440
1.1552	1072.787	776.553	296.2336
.0000	1147.499	848.640	298.8593

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2197

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .27500E+02 LOAD = 1892.000
SET = 2.0826

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.5174	.0000	3.5198	2022.955	1892.9990
.1000	10.3634	.2554	3.5183	2123.492	1903.1200
.2000	9.2097	.5107	3.5168	2224.004	1913.7130
.3000	8.0565	.7661	3.5151	2324.491	1925.2310
.4000	6.9037	1.0215	3.5133	2424.950	1938.1070
.5000	5.7514	1.2769	3.5112	2525.378	1952.7250
.6000	4.5997	1.5322	3.5088	2625.771	1969.4230
.7000	3.4486	1.7876	3.5062	2726.123	1988.4800
.8000	2.2982	2.0430	3.5032	2826.431	2010.1100
.9000	1.1487	2.2983	3.4998	2926.688	2034.4560
1.0000	.0000	2.5537	3.4961	3026.889	2061.5900

********** PORE PRESSURES **********

CHI	UW	U0	U
11.5174	129.956	129.955	.0010
10.3634	220.372	201.967	18.4051
9.2097	310.291	273.954	36.3368
8.0565	399.260	345.916	53.3432
6.9037	486.843	417.851	68.9928
5.7514	572.654	489.754	82.8997
4.5997	656.347	561.621	94.7260
3.4486	737.643	633.449	104.1943
2.2982	816.320	705.232	111.0886
1.1487	892.232	776.964	115.2679
.0000	965.299	848.640	116.6589

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2353

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .28000E+02 LOAD = 1892.000
SET = 2.0903

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.5097	.0000	3.5198	2023.433	1892.9990
.1000	10.3558	.2554	3.5175	2123.964	1908.4440
.2000	9.2024	.5107	3.5152	2224.458	1924.2280
.3000	8.0497	.7661	3.5129	2324.915	1940.6740
.4000	6.8975	1.0215	3.5104	2425.333	1958.0890
.5000	5.7460	1.2769	3.5078	2525.712	1976.7480
.6000	4.5952	1.5322	3.5050	2626.047	1996.8870
.7000	3.4452	1.7876	3.5020	2726.335	2018.7050
.8000	2.2959	2.0430	3.4987	2826.574	2042.3460
.9000	1.1475	2.2983	3.4953	2926.760	2067.9110
1.0000	.0000	2.5537	3.4916	3026.889	2095.4500

********** PORE PRESSURES **********

CHI	UW	U0	U
11.5097	130.434	130.433	.0010
10.3558	215.519	202.439	13.0807
9.2024	300.230	274.408	25.8222
8.0497	384.241	346.340	37.9005
6.8975	467.245	418.234	49.0110
5.7460	548.964	490.087	58.8765
4.5952	629.159	561.897	67.2619
3.4452	707.630	633.661	73.9691
2.2959	784.228	705.375	78.8530
1.1475	858.849	777.036	81.8127
.0000	931.439	848.640	82.7987

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2410
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .30000E+02 LOAD = 1892.000
SET = 2.1042

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.4958	.0000	3.5198	2024.299	1892.9990
.1000	10.3421	.2554	3.5161	2124.818	1918.2960
.2000	9.1893	.5107	3.5125	2225.279	1943.6760
.3000	8.0374	.7661	3.5088	2325.681	1969.2250
.4000	6.8864	1.0215	3.5052	2426.026	1995.0150
.5000	5.7364	1.2769	3.5016	2526.314	2021.1130
.6000	4.5873	1.5322	3.4980	2626.544	2047.5790

.7000	3.4391	1.7876	3.4944	2726.717	2074.4570
.8000	2.2918	2.0430	3.4908	2826.832	2101.7850
.9000	1.1454	2.2983	3.4872	2926.890	2129.5840
1.0000	.0000	2.5537	3.4835	3026.889	2157.8650

********** PORE PRESSURES **********

CHI	UW	U0	U
11.4958	131.300	131.299	.0010
10.3421	206.522	203.293	3.2291
9.1893	281.602	275.229	6.3735
8.0374	356.456	347.107	9.3497
6.8864	431.012	418.927	12.0847
5.7364	505.201	490.690	14.5115
4.5873	578.966	562.395	16.5705
3.4391	652.260	634.043	18.2168
2.2918	725.048	705.633	19.4143
1.1454	797.306	777.166	20.1401
.0000	869.023	848.640	20.3832

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2640

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .32000E+02 LOAD = 1892.000
SET = 2.1075

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.4925	.0000	3.5198	2024.511	1892.9990
.1000	10.3388	.2554	3.5158	2125.027	1920.7410
.2000	9.1861	.5107	3.5118	2225.479	1948.5040
.3000	8.0344	.7661	3.5079	2325.868	1976.3070
.4000	6.8837	1.0215	3.5040	2426.195	2004.1710
.5000	5.7340	1.2769	3.5001	2526.460	2032.1070
.6000	4.5853	1.5322	3.4963	2626.666	2060.1340
.7000	3.4376	1.7876	3.4926	2726.810	2088.2600
.8000	2.2908	2.0430	3.4889	2826.895	2116.4940
.9000	1.1449	2.2983	3.4852	2926.921	2144.8430
1.0000	.0000	2.5537	3.4815	3026.889	2173.3100

********** PORE PRESSURES **********

CHI	UW	U0	U
11.4925	131.512	131.511	.0010
10.3388	204.286	203.502	.7839
9.1861	276.975	275.429	1.5459
8.0344	349.561	347.293	2.2675
6.8837	422.024	419.096	2.9286

5.7340	494.353	490.836	3.5169
4.5853	566.532	562.516	4.0157
3.4376	638.549	634.136	4.4136
2.2908	710.401	705.696	4.7046
1.1449	782.079	777.197	4.8813
.0000	853.578	848.640	4.9384

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2877

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .34000E+02 LOAD = 1892.000
SET = 2.1084

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.4916	.0000	3.5198	2024.562	1892.9990
.1000	10.3379	.2554	3.5157	2125.077	1921.3330
.2000	9.1853	.5107	3.5116	2225.527	1949.6730
.3000	8.0337	.7661	3.5076	2325.913	1978.0230
.4000	6.8831	1.0215	3.5037	2426.236	2006.3870
.5000	5.7335	1.2769	3.4998	2526.496	2034.7690
.6000	4.5849	1.5322	3.4959	2626.695	2063.1720
.7000	3.4372	1.7876	3.4921	2726.833	2091.6010
.8000	2.2905	2.0430	3.4884	2826.910	2120.0550
.9000	1.1448	2.2983	3.4847	2926.929	2148.5380
1.0000	.0000	2.5537	3.4811	3026.889	2177.0470

********** PORE PRESSURES **********

CHI	UW	U0	U
11.4916	131.563	131.562	.0010
10.3379	203.744	203.552	.1920
9.1853	275.854	275.477	.3766
8.0337	347.890	347.338	.5520
6.8831	419.849	419.136	.7124
5.7335	491.727	490.872	.8549
4.5849	563.523	562.545	.9776
3.4372	635.232	634.158	1.0733
2.2905	706.855	705.711	1.1438
1.1448	778.391	777.205	1.1860
.0000	849.842	848.640	1.2016

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 3115

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .35000E+02 LOAD = 1892.000
SET = 2.1085

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.4915	.0000	3.5198	2024.570	1892.9990
.1000	10.3378	.2554	3.5157	2125.085	1921.4290
.2000	9.1852	.5107	3.5116	2225.535	1949.8590
.3000	8.0336	.7661	3.5076	2325.920	1978.2970
.4000	6.8830	1.0215	3.5036	2426.242	2006.7410
.5000	5.7334	1.2769	3.4997	2526.501	2035.1930
.6000	4.5848	1.5322	3.4959	2626.699	2063.6580
.7000	3.4372	1.7876	3.4921	2726.836	2092.1340
.8000	2.2905	2.0430	3.4883	2826.913	2120.6230
.9000	1.1448	2.2983	3.4846	2926.930	2149.1240
1.0000	.0000	2.5537	3.4810	3026.889	2177.6430

********** PORE PRESSURES **********

CHI	UW	U0	U
11.4915	131.571	131.570	.0010
10.3378	203.656	203.560	.0960
9.1852	275.675	275.485	.1904
8.0336	347.623	347.346	.2778
6.8830	419.501	419.143	.3584
5.7334	491.308	490.877	.4310
4.5848	563.041	562.550	.4910
3.4372	634.702	634.162	.5403
2.2905	706.290	705.714	.5762
1.1448	777.806	777.206	.5996
.0000	849.246	848.640	.6056

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 3234

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .38000E+02 LOAD = 1892.000
SET = 2.1086

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.4914	.0000	3.5198	2024.576	1892.9990
.1000	10.3377	.2554	3.5156	2125.091	1921.5000
.2000	9.1851	.5107	3.5116	2225.541	1950.0020
.3000	8.0335	.7661	3.5075	2325.926	1978.5060
.4000	6.8829	1.0215	3.5036	2426.247	2007.0120
.5000	5.7333	1.2769	3.4997	2526.506	2035.5210

.6000	4.5847	1.5322	3.4958	2626.703	2064.0330
.7000	3.4371	1.7876	3.4920	2726.839	2092.5480
.8000	2.2905	2.0430	3.4883	2826.915	2121.0660
.9000	1.1448	2.2983	3.4846	2926.931	2149.5870
1.0000	.0000	2.5537	3.4809	3026.889	2178.1100

********** PORE PRESSURES **********

CHI	UW	U0	U
11.4914	131.577	131.576	.0010
10.3377	203.591	203.566	.0249
9.1851	275.539	275.491	.0478
8.0335	347.420	347.351	.0685
6.8829	419.235	419.148	.0871
5.7333	490.985	490.882	.1035
4.5847	562.670	562.554	.1162
3.4371	634.291	634.165	.1260
2.2905	705.848	705.716	.1325
1.1448	777.344	777.207	.1372
.0000	848.779	848.640	.1388

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 3592

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .40000E+02 LOAD = 1892.000
SET = 2.1086

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.4914	.0000	3.5198	2024.576	1892.9990
.1000	10.3377	.2554	3.5156	2125.091	1921.5000
.2000	9.1851	.5107	3.5116	2225.541	1950.0020
.3000	8.0335	.7661	3.5075	2325.926	1978.5060
.4000	6.8829	1.0215	3.5036	2426.247	2007.0120
.5000	5.7333	1.2769	3.4997	2526.506	2035.5210
.6000	4.5847	1.5322	3.4958	2626.703	2064.0330
.7000	3.4371	1.7876	3.4920	2726.839	2092.5480
.8000	2.2905	2.0430	3.4883	2826.915	2121.0660
.9000	1.1448	2.2983	3.4846	2926.931	2149.5870
1.0000	.0000	2.5537	3.4809	3026.889	2178.1100

********** PORE PRESSURES **********

CHI	UW	U0	U
11.4914	131.577	131.576	.0010
10.3377	203.591	203.566	.0249
9.1851	275.539	275.491	.0478
8.0335	347.420	347.351	.0685

6.8829	419.235	419.148	.0871
5.7333	490.985	490.882	.1035
4.5847	562.670	562.554	.1162
3.4371	634.291	634.165	.1260
2.2905	705.848	705.716	.1325
1.1448	777.344	777.207	.1372
.0000	848.779	848.640	.1388

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 3831

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .45000E+02 LOAD = 1892.000
SET = 2.1086

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.4914	.0000	3.5198	2024.576	1892.9990
.1000	10.3377	.2554	3.5156	2125.091	1921.5000
.2000	9.1851	.5107	3.5116	2225.541	1950.0020
.3000	8.0335	.7661	3.5075	2325.926	1978.5060
.4000	6.8829	1.0215	3.5036	2426.247	2007.0120
.5000	5.7333	1.2769	3.4997	2526.506	2035.5210
.6000	4.5847	1.5322	3.4958	2626.703	2064.0330
.7000	3.4371	1.7876	3.4920	2726.839	2092.5480
.8000	2.2905	2.0430	3.4883	2826.915	2121.0660
.9000	1.1448	2.2983	3.4846	2926.931	2149.5870
1.0000	.0000	2.5537	3.4809	3026.889	2178.1100

********** PORE PRESSURES **********

CHI	UW	U0	U
11.4914	131.577	131.576	.0010
10.3377	203.591	203.566	.0249
9.1851	275.539	275.491	.0478
8.0335	347.420	347.351	.0685
6.8829	419.235	419.148	.0871
5.7333	490.985	490.882	.1035
4.5847	562.670	562.554	.1162
3.4371	634.291	634.165	.1260
2.2905	705.848	705.716	.1325
1.1448	777.344	777.207	.1372
.0000	848.779	848.640	.1388

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 4427

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY

IMPERVIOUS LOWER BOUNDARY

TIME = .50000E+02 LOAD = 1892.000
SET = 2.1086

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.4914	.0000	3.5198	2024.576	1892.9990
.1000	10.3377	.2554	3.5156	2125.091	1921.5000
.2000	9.1851	.5107	3.5116	2225.541	1950.0020
.3000	8.0335	.7661	3.5075	2325.926	1978.5060
.4000	6.8829	1.0215	3.5036	2426.247	2007.0120
.5000	5.7333	1.2769	3.4997	2526.506	2035.5210
.6000	4.5847	1.5322	3.4958	2626.703	2064.0330
.7000	3.4371	1.7876	3.4920	2726.839	2092.5480
.8000	2.2905	2.0430	3.4883	2826.915	2121.0660
.9000	1.1448	2.2983	3.4846	2926.931	2149.5870
1.0000	.0000	2.5537	3.4809	3026.889	2178.1100

********** PORE PRESSURES **********

CHI	UW	U0	U
11.4914	131.577	131.576	.0010
10.3377	203.591	203.566	.0249
9.1851	275.539	275.491	.0478
8.0335	347.420	347.351	.0685
6.8829	419.235	419.148	.0871
5.7333	490.985	490.882	.1035
4.5847	562.670	562.554	.1162
3.4371	634.291	634.165	.1260
2.2905	705.848	705.716	.1325
1.1448	777.344	777.207	.1372
.0000	848.779	848.640	.1388

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 5023

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .55000E+02 LOAD = 1892.000
SET = 2.1086

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.4914	.0000	3.5198	2024.576	1892.9990
.1000	10.3377	.2554	3.5156	2125.091	1921.5000
.2000	9.1851	.5107	3.5116	2225.541	1950.0020
.3000	8.0335	.7661	3.5075	2325.926	1978.5060
.4000	6.8829	1.0215	3.5036	2426.247	2007.0120

.5000	5.7333	1.2769	3.4997	2526.506	2035.5210
.6000	4.5847	1.5322	3.4958	2626.703	2064.0330
.7000	3.4371	1.7876	3.4920	2726.839	2092.5480
.8000	2.2905	2.0430	3.4883	2826.915	2121.0660
.9000	1.1448	2.2983	3.4846	2926.931	2149.5870
1.0000	.0000	2.5537	3.4809	3026.889	2178.1100

********** PORE PRESSURES **********

CHI	UW	U0	U
11.4914	131.577	131.576	.0010
10.3377	203.591	203.566	.0249
9.1851	275.539	275.491	.0478
8.0335	347.420	347.351	.0685
6.8829	419.235	419.148	.0871
5.7333	490.985	490.882	.1035
4.5847	562.670	562.554	.1162
3.4371	634.291	634.165	.1260
2.2905	705.848	705.716	.1325
1.1448	777.344	777.207	.1372
.0000	848.779	848.640	.1388

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 5619

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .60000E+02 LOAD = 1892.000
SET = 2.1086

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.4914	.0000	3.5198	2024.576	1892.9990
.1000	10.3377	.2554	3.5156	2125.091	1921.5000
.2000	9.1851	.5107	3.5116	2225.541	1950.0020
.3000	8.0335	.7661	3.5075	2325.926	1978.5060
.4000	6.8829	1.0215	3.5036	2426.247	2007.0120
.5000	5.7333	1.2769	3.4997	2526.506	2035.5210
.6000	4.5847	1.5322	3.4958	2626.703	2064.0330
.7000	3.4371	1.7876	3.4920	2726.839	2092.5480
.8000	2.2905	2.0430	3.4883	2826.915	2121.0660
.9000	1.1448	2.2983	3.4846	2926.931	2149.5870
1.0000	.0000	2.5537	3.4809	3026.889	2178.1100

********** PORE PRESSURES **********

CHI	UW	U0	U
11.4914	131.577	131.576	.0010
10.3377	203.591	203.566	.0249
9.1851	275.539	275.491	.0478

8.0335	347.420	347.351	.0685
6.8829	419.235	419.148	.0871
5.7333	490.985	490.882	.1035
4.5847	562.670	562.554	.1162
3.4371	634.291	634.165	.1260
2.2905	705.848	705.716	.1325
1.1448	777.344	777.207	.1372
.0000	848.779	848.640	.1388

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 6215

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

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**********************
*                    *
*  FUNCTIONS OF TIME *
*                    *
**********************
```

TIME	EAV	TOTAV	EFFAV	SET	DEG
.0000E+00	.4326E+01	579.519	143.6243	.0000	.0000
.1510E+00	.4275E+01	730.586	149.0971	.1282	.0608
.2000E+00	.4271E+01	779.623	150.9884	.1401	.0664
.2250E+00	.4268E+01	804.646	151.9876	.1461	.0693
.2500E+00	.4266E+01	829.670	153.0074	.1521	.0721
.2750E+00	.4264E+01	854.696	154.0496	.1581	.0750
.3000E+00	.4261E+01	879.725	155.1164	.1643	.0779
.3500E+00	.4257E+01	925.619	157.1769	.1764	.0837
.4000E+00	.4251E+01	971.522	159.3643	.1892	.0898
.5000E+00	.4240E+01	1063.354	164.2612	.2177	.1033
.6000E+00	.4227E+01	1155.232	170.2906	.2515	.1193
.7000E+00	.4210E+01	1318.006	180.8997	.2955	.1401
.8000E+00	.4188E+01	1480.880	196.7695	.3515	.1667
.9000E+00	.4159E+01	1767.389	229.8056	.4267	.2023
.1000E+01	.4123E+01	2054.042	291.8176	.5162	.2448
.1250E+01	.4077E+01	2055.500	342.7165	.6339	.3006
.1500E+01	.4030E+01	2057.713	398.9677	.7559	.3585
.1750E+01	.3991E+01	2059.816	450.2740	.8548	.4054
.2000E+01	.3957E+01	2061.959	497.3165	.9402	.4459
.2250E+01	.3927E+01	2064.177	542.3771	1.0176	.4826
.2500E+01	.3900E+01	2066.392	585.3924	1.0875	.5158
.2750E+01	.3875E+01	2068.607	626.6531	1.1516	.5461
.3000E+01	.3851E+01	2070.812	666.5045	1.2110	.5743
.3500E+01	.3809E+01	2075.119	743.5290	1.3183	.6252
.4000E+01	.3772E+01	2079.186	820.3907	1.4137	.6705
.4500E+01	.3738E+01	2082.912	900.5953	1.4995	.7111
.5000E+01	.3708E+01	2086.232	984.8323	1.5764	.7476
.6000E+01	.3659E+01	2091.570	1155.1990	1.7030	.8077
.7000E+01	.3623E+01	2095.283	1305.3480	1.7938	.8507
.8000E+01	.3600E+01	2097.695	1419.2990	1.8540	.8793
.9000E+01	.3585E+01	2099.184	1496.7730	1.8916	.8971
.1000E+02	.3576E+01	2100.070	1545.6980	1.9141	.9078

.1200E+02	.3568E+01	2100.883	1592.4940	1.9348	.9176
.1250E+02	.3567E+01	2100.979	1598.1710	1.9373	.9188
.1500E+02	.3565E+01	2101.203	1611.4030	1.9430	.9215
.1750E+02	.3564E+01	2101.256	1614.6040	1.9444	.9221
.1800E+02	.3564E+01	2101.260	1614.8570	1.9445	.9222
.2000E+02	.3564E+01	2101.269	1615.3740	1.9447	.9223
.2250E+02	.3564E+01	2101.272	1615.5420	1.9448	.9223
.2400E+02	.3564E+01	2101.272	1615.5420	1.9448	.9223
.2500E+02	.3551E+01	2311.884	1690.8920	1.9778	.9380
.2600E+02	.3529E+01	2523.412	1832.3730	2.0347	.9650
.2750E+02	.3510E+01	2525.228	1961.1110	2.0826	.9877
.2800E+02	.3507E+01	2525.530	1982.7160	2.0903	.9913
.3000E+02	.3502E+01	2526.074	2022.5890	2.1042	.9979
.3200E+02	.3500E+01	2526.207	2032.4650	2.1075	.9995
.3400E+02	.3500E+01	2526.239	2034.8560	2.1084	.9999
.3500E+02	.3500E+01	2526.244	2035.2370	2.1085	1.0000
.3800E+02	.3500E+01	2526.248	2035.5330	2.1086	1.0000
.4000E+02	.3500E+01	2526.248	2035.5330	2.1086	1.0000
.4500E+02	.3500E+01	2526.248	2035.5330	2.1086	1.0000
.5000E+02	.3500E+01	2526.248	2035.5330	2.1086	1.0000
.5500E+02	.3500E+01	2526.248	2035.5330	2.1086	1.0000
.6000E+02	.3500E+01	2526.248	2035.5330	2.1086	1.0000

TIME	UWAV	U0AV	UAV
.0000E+00	435.8949	435.8949	.0000
.1510E+00	581.4893	435.9620	145.5273
.2000E+00	628.6346	435.9986	192.6360
.2250E+00	652.6578	436.0211	216.6367
.2500E+00	676.6625	436.0456	240.6169
.2750E+00	700.6467	436.0720	264.5748
.3000E+00	724.6083	436.1004	288.5080
.3500E+00	768.4422	436.1614	332.2808
.4000E+00	812.1573	436.2307	375.9267
.5000E+00	899.0927	436.3963	462.6964
.6000E+00	984.9410	436.6072	548.3337
.7000E+00	1137.1060	436.8813	700.2245
.8000E+00	1284.1100	437.2555	846.8549
.9000E+00	1537.5830	437.7644	1099.8190
.1000E+01	1762.2240	438.4175	1323.8070
.1250E+01	1712.7840	439.8761	1272.9080
.1500E+01	1658.7450	442.0886	1216.6570
.1750E+01	1609.5420	444.1921	1165.3500
.2000E+01	1564.6430	446.3347	1118.3080
.2250E+01	1521.8000	448.5526	1073.2470
.2500E+01	1480.9990	450.7672	1030.2320
.2750E+01	1441.9540	452.9828	988.9713
.3000E+01	1404.3080	455.1878	949.1199
.3500E+01	1331.5900	459.4944	872.0954
.4000E+01	1258.7950	463.5616	795.2336
.4500E+01	1182.3170	467.2880	715.0291
.5000E+01	1101.4000	470.6078	630.7921
.6000E+01	936.3703	475.9452	460.4251
.7000E+01	789.9346	479.6586	310.2760
.8000E+01	678.3961	482.0709	196.3252
.9000E+01	602.4102	483.5592	118.8510
.1000E+02	554.3718	484.4456	69.9262
.1200E+02	508.3888	485.2588	23.1301

.1250E+02	502.8084	485.3552	17.4531
.1500E+02	489.7997	485.5783	4.2214
.1750E+02	486.6519	485.6319	1.0200
.1800E+02	486.4040	485.6361	.7678
.2000E+02	485.8952	485.6447	.2504
.2250E+02	485.7302	485.6476	.0825
.2400E+02	485.7302	485.6476	.0825
.2500E+02	620.9919	486.2595	134.7324
.2600E+02	691.0388	487.7874	203.2513
.2750E+02	564.1168	489.6038	74.5130
.2800E+02	542.8137	489.9052	52.9085
.3000E+02	503.4854	490.4501	13.0353
.3200E+02	493.7422	490.5828	3.1594
.3400E+02	491.3834	490.6148	.7685
.3500E+02	491.0071	490.6199	.3872
.3800E+02	490.7155	490.6239	.0916
.4000E+02	490.7155	490.6239	.0916
.4500E+02	490.7155	490.6239	.0916
.5000E+02	490.7155	490.6239	.0916
.5500E+02	490.7155	490.6239	.0916
.6000E+02	490.7155	490.6239	.0916

CALCULATION COVER SHEET

PROJECT	JOB NO.	CALC. NO.	SHEET
FMC - Pond 8E	24230-025	24230-025-2	1
SUBJECT: Slope Stability Analysis		DISCIPLINE: Geotechnical Engineering	

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	[ ]	[X]	[ ]	[ ]

COMPUTER PROGRAM/TYPE	SCP		MAINFRAME	PC	PROGRAM NO.	VERSION/RELEASE NO.
	Yes [ ]	No [X]	[ ]	[X]	SLOPE/W	3.0

Purpose -

The stability of the permanent external slopes of the dike and cover system were evaluated by stability analyses calculations. The analyses were performed for the critical dike sections identified from the design drawings. Also evaluated in the calculation is the slope stability of the internal slope during construction.

The interior stability of the sand fill during construction is not covered in this calculation.

References -

1. FMC Pond 8E Final Cover Design Drawings (Draft).
2. FMC Drawing No. 392025, dated Feb. 20, 1997.
3. UBC Code, 1997, Section 1629, Figure 16-2 and Table 16-I.
4. SLOPE/W for Slope Stability Analyses, Version 3, Geo-Slope International, Ltd., Calgary, Alberta, Canada, 1995.

Rev. No.	Reason for Revision	Total No. of Sheets	Last Sheet No.	By	Checked	Approved/ Accepted	Date
0	ORIGINAL ISSUE	12	Fig. 8	JTC	[illegible]	[illegible]	8/6/01

Record of Revision

Selection of Critical Dike Sections

The dikes designed around the perimeters of Pond 8E are all of similar shape with an external slope of 2:1 (H:V), an internal slope of 3:1 and a top width of 20 ft.. Figure 1 shows a typical section of the dike and cover design which was taken from Ref. 1. The dikes vary around the perimeter in terms of ground elevation inside and outside the ponds. It was determined from Ref. 1 and 2 that the critical section for slope stability was a slope with an external height of about 10 ft and a slope of 2:1, and an internal height of about 16 ft and a slope of 3:1.

When the pond is filled with sludge and the designed cover layers (sand, slag, and RCRA cap), the fill materials tend to stabilize the internal slope. During construction of the initial fill, a crane will be resting on top of the dike, adding a surcharge to the dike top. The critical case for the internal slope was therefore selected as an empty pond with a crane surcharge.

Soil Properties and Design Criteria

Soil conditions of the foundation materials are represented in boring logs adjacent to the pond. The boring logs are summarized in Figure 2. Locations of the borings are shown in Figure 3. The foundation material is a silt with SPT N-value that increases with depth (Minimum of 18 blows/ft. at shallow depth and can be as high as 50 blows/ft at 50-foot depth). Based on the data, it can be inferred that the silt is dense to very dense. The body of the dike appears to consist of a medium dense silt fill with N-values between 13 and 25 blows/ft., i.e., medium dense.

For this after-cap completion (long-term) stability analyses, the conservative geotechnical soil parameters presented in Table 1 were used. These long-term soil strength parameters used in the current analysis were similar to the values used in the previous slope stability analyses of other adjacent ponds, e.g., Pond 8S and Pond 9E.

Table 1 - Summary of Soil Properties

Soil Type	Total Density (pcf)	Cohesion (psf)	Internal Friction Angle (deg)
Cap (Slag+ Sand)	120	--	35
Slag	130	--	35
Sand	115	--	30
Sludge	100	50	--
Dike	115	--	28
Foundation	120	--	30

The water table beneath Pond 8E, as measured in nearby ground water monitoring wells, was about elevation 4398 feet, or over 50 feet below the pond bottom (See summary in Figure 2). The existence of the liner along the internal boundary of the dike effectively blocks the seepage of water from inside the pond toward outside. The effects of groundwater were therefore excluded from the analyses since no critical failure planes would intersect the phreatic surface.

Based on the UBC code (Ref. 3) the site is in seismic zone 2B with a seismic zone factor of Z=0.2. This value of acceleration was used as a pseudo-static coefficient to evaluate slope stability under seismic loading. In addition, the critical pseudo-static seismic coefficient required to yield a factor of safety of 1.0 was also determined.

The effect of a crane operating along the top of the dike was also evaluated assuming a uniform 500 psf load acting over a 20-foot width the top of the dike. The crane would not be expected to be present after the dike was completed, but was included in the slope stability analysis for the construction phase. The value of crane load was determined from the weight of actual cranes which were used in the constructions of the final cover for Pond 8S

Methodology and Calculations

The slope stability analyses were performed using the computer program, SLOPE/W (Ref.4), and circular failure surfaces. The Spencer method, which satisfies both force and moment equilibrium, was utilized in calculating the factors of safety for all the cases Each program run was made using an automatic search for the minimum failure surface on specified depth tangents. The sections analyzed and the five different cases considered herein are shown in Figures 4 through 8.

Results of Analysis

Table 2 summarizes the results of the stability analyses.

Table 2 - Summary of Results for Slope Stability Analyses

Case	Minimum Factor of Safety	Corresponding Figure No.
Static, External Slope	1.7	Figure 4
Seismic, External Slope, Z=0.2	1.1	Figure 5
Seismic, External Slope, Yield Accel. = 0.25g	1.0	Figure 6
Static, External Slope with 500 psf Crane Load	1.3	Figure 7
Static, Internal Slope with 500 psf Crane Load	1.6	Figure 8

Plots of the analysis outputs are shown in Figures 4 through 8.

Stability of Cover

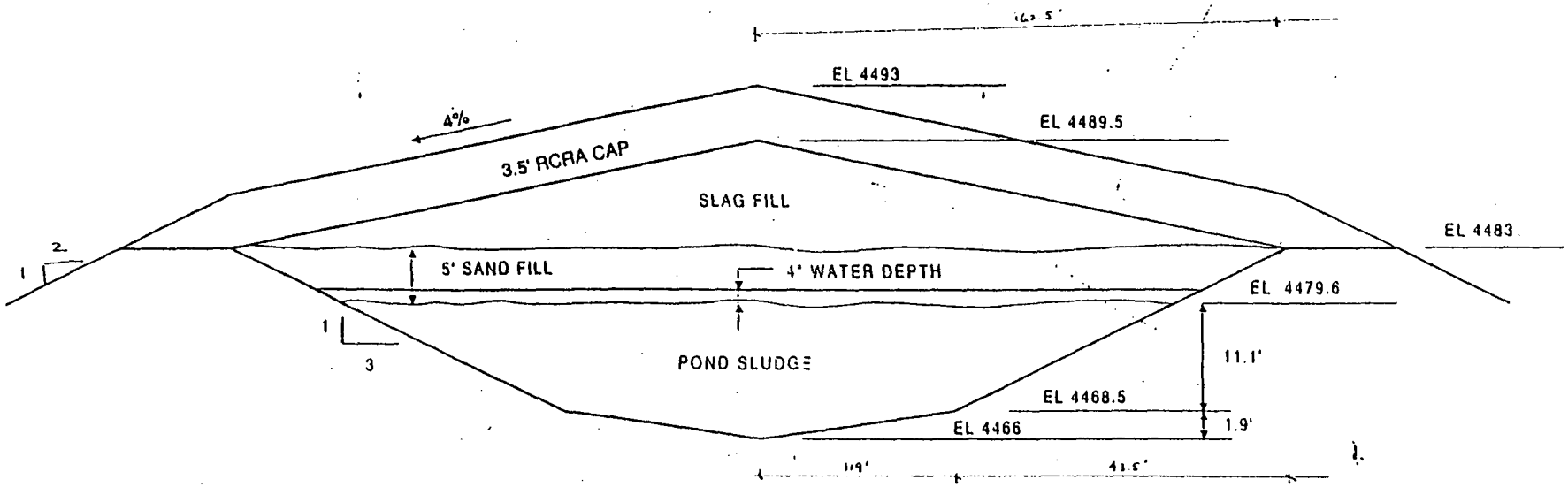
The final cap consists of top soil, slag, geotextile, geonet, HDPE membrane, geocomposite clay liner and a bedding layer of sand. The internal stability of the cap will be controlled by the interface friction between the HDPE and the geonet. The cap will be initially constructed to a maximum surface gradient of 5 percent (3 degrees) and a final grade of 4% gradient after the initial fill settles for approximately 2 years. The effective coefficient of friction of the HDPE-geonet interface is approximately 12 degrees. Thus, the cap will have a factor of safety against internal sliding of approximately four (sin 12°/sin 3°).

Conclusion

The stability analyses results indicate that the dike slopes are stable for both static and seismic conditions.

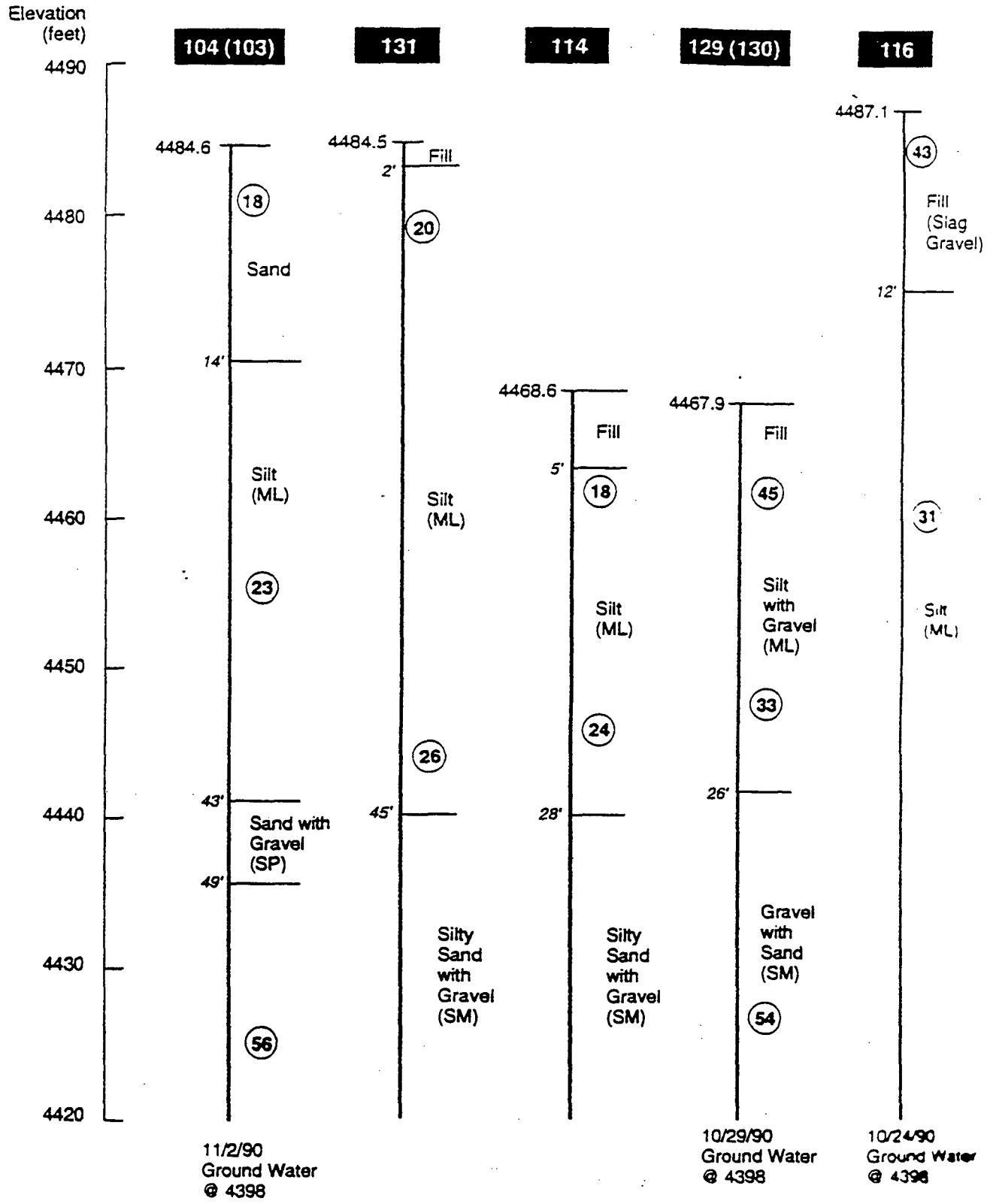
Figures:

Figure 1	Typical Design Section
Figure 2	Summary of Soil Boring Logs
Figure 3	Location map for Borings
Figure 4	Analysis Result for Static, External Slope
Figure 5	Analysis Result for Seismic, External Slope, Z = 0.2
Figure 6	Analysis Result for Seismic, External Slope, Yield Acce. = 0.25 g
Figure 7	Analysis Result for Static, External Slope, 500 psf Crane Load
Figure 8	Analysis Result for Static, Internal Slope, 500 psf Crane Load



POND 8E

Figure 1 Pond 8E Final Cover Design
(Not in Scale)



Blowcount (SPT-N)

Bechtel Environmental, Inc. San Francisco			
FMC Corporation Pocatello, Idaho			
Summary of Boring Logs			
	Job No.	Figure No.	Rev
	20906	2	0

97-05930b.010

April 1997

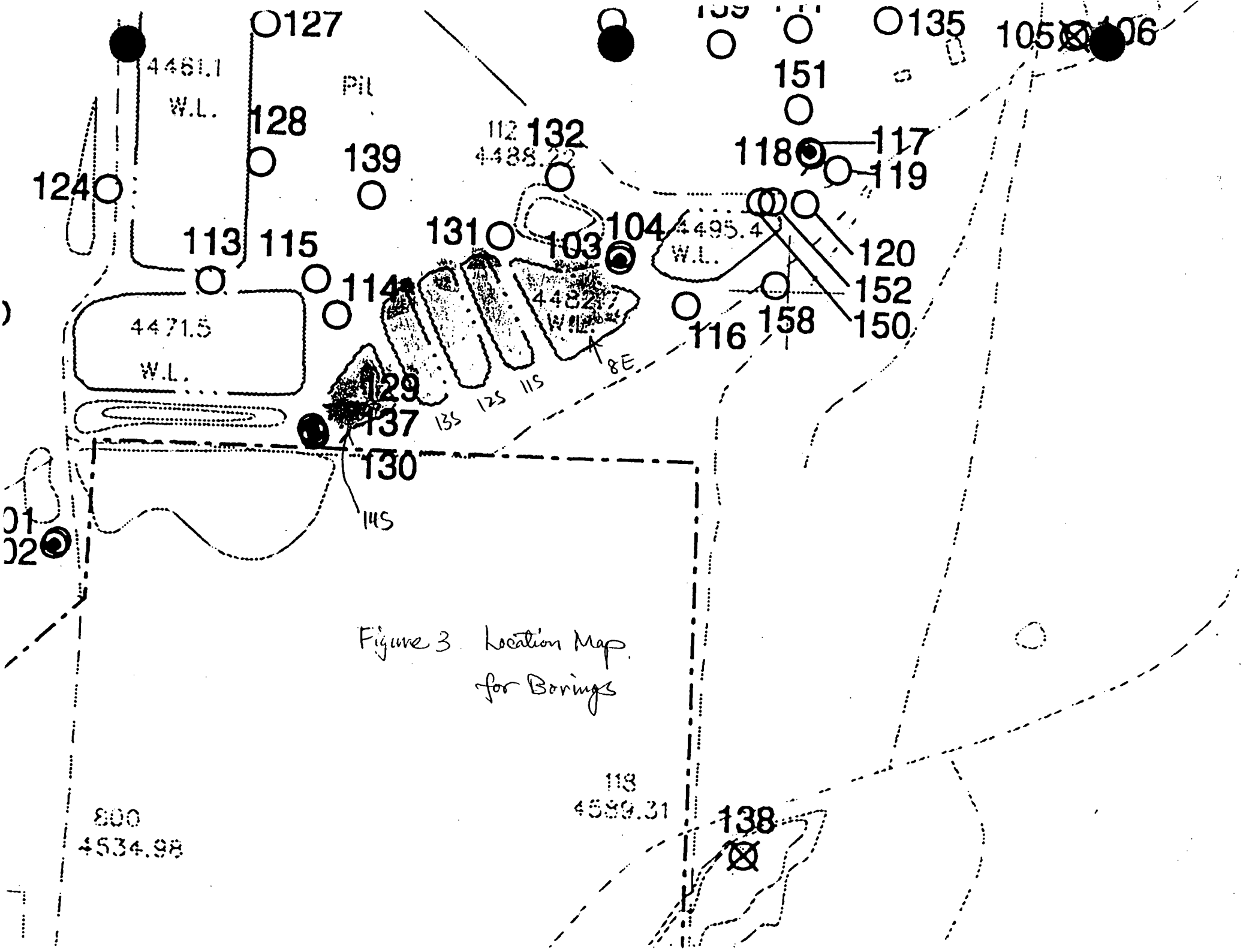


Figure 3 Location Map for Borings

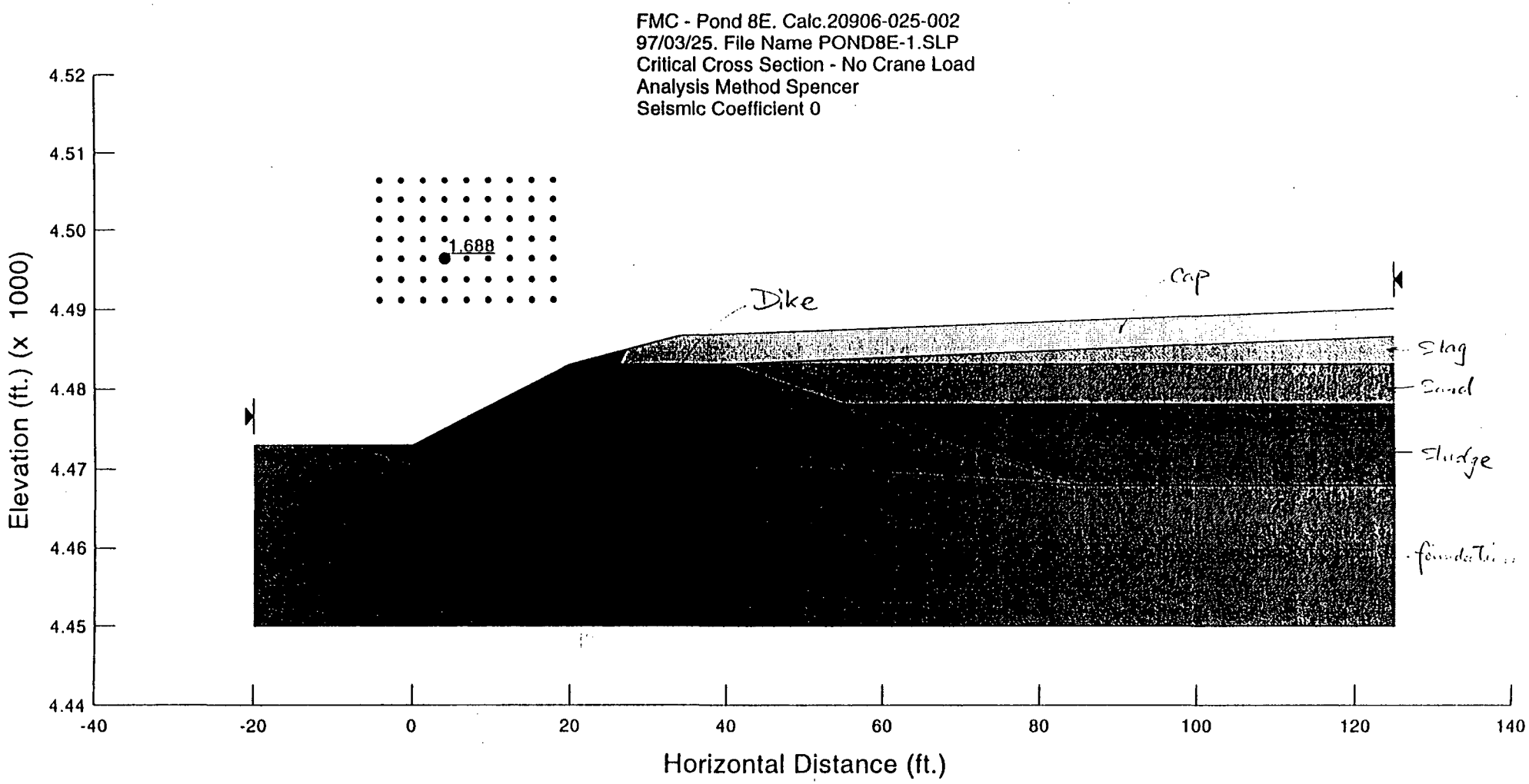

FMC - Pond 8E. Calc.20906-025-002
97/03/25. File Name POND8E-1.SLP
Critical Cross Section - No Crane Load
Analysis Method Spencer
Seismic Coefficient 0
1.688
Dike
Cap
Slag
Sand
Sludge
Elevation (ft.) (x 1000)
4.52
4.51
4.50
4.49
4.48
4.47
4.46
4.45
4.44
-40
-20
0
20
40
60
80
100
120
140
Horizontal Distance (ft.)

Figure 4

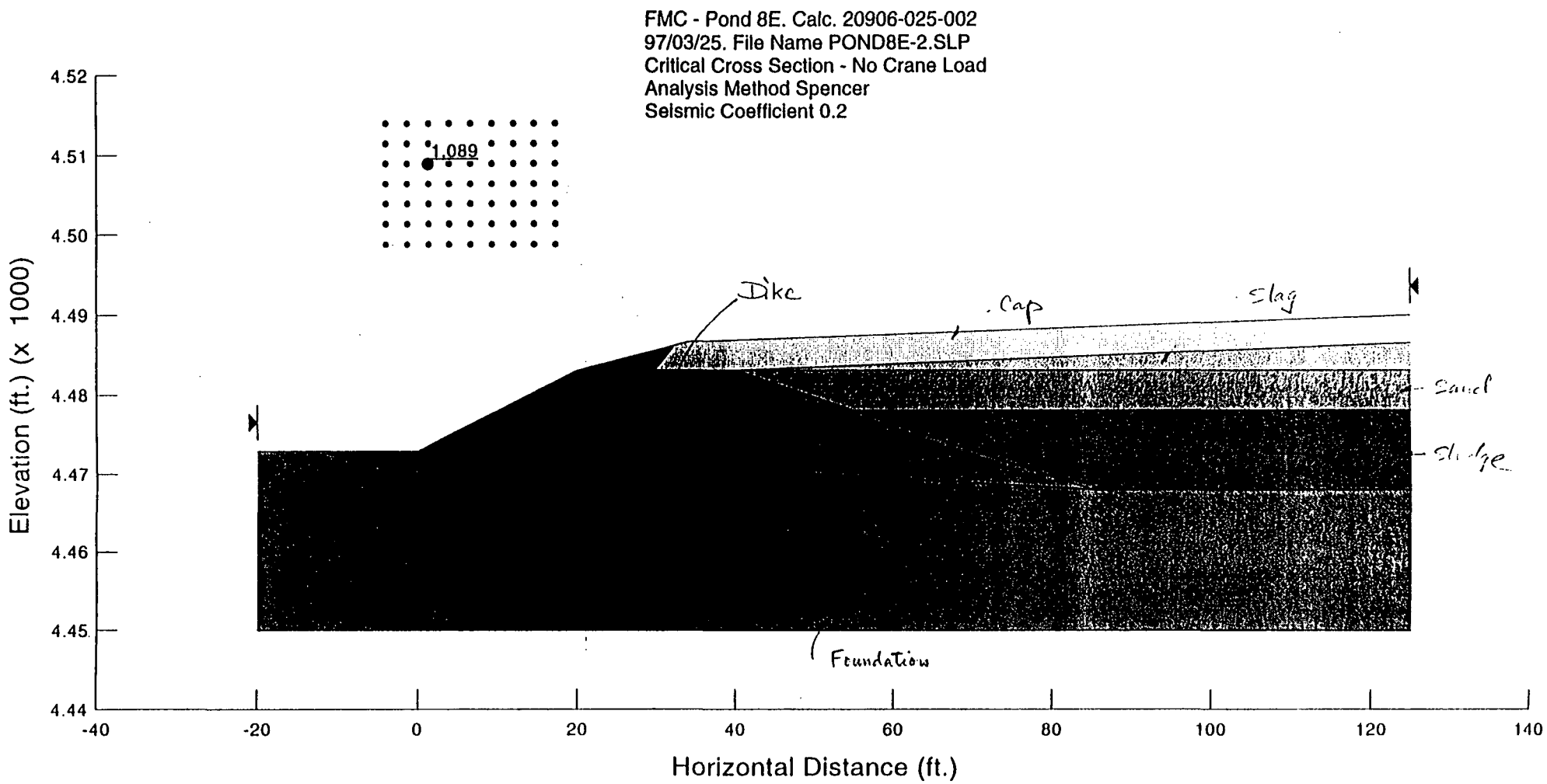

FMC - Pond 8E. Calc. 20906-025-002
97/03/25. File Name POND8E-2.SLP
Critical Cross Section - No Crane Load
Analysis Method Spencer
Seismic Coefficient 0.2
1.089
Dike
Cap
Slag
Sand
Sludge
Foundation
Elevation (ft.) (x 1000)
4.52
4.51
4.50
4.49
4.48
4.47
4.46
4.45
4.44
-40
-20
0
20
40
60
80
100
120
140
Horizontal Distance (ft.)

Figure 4

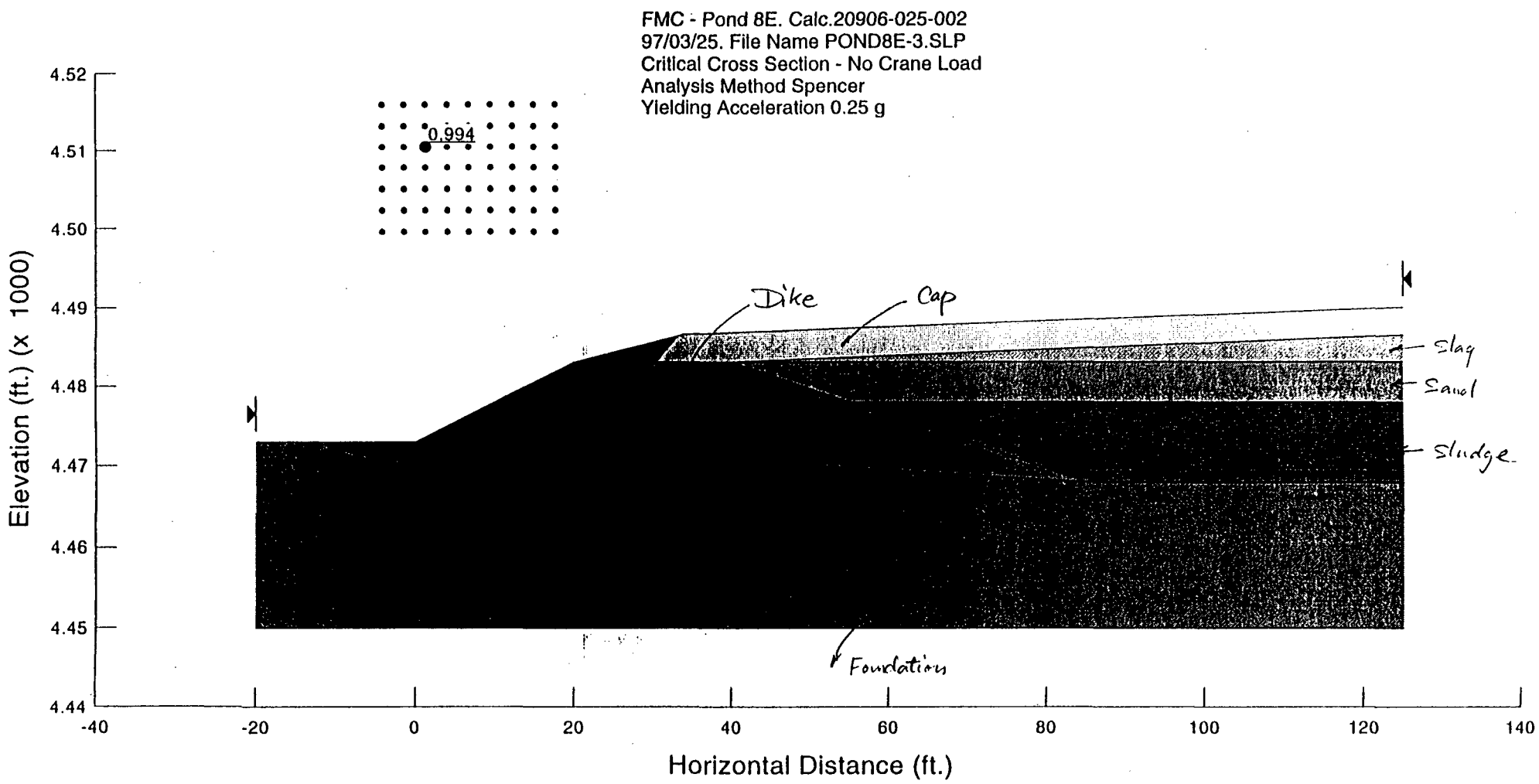

FMC - Pond 8E. Calc.20906-025-002
97/03/25. File Name POND8E-3.SLP
Critical Cross Section - No Crane Load
Analysis Method Spencer
Yielding Acceleration 0.25 g
0.994
Dike
Cap
Slag
Sand
Sludge
Foundation
Elevation (ft.) (x 1000)
4.52
4.51
4.50
4.49
4.48
4.47
4.46
4.45
4.44
-40
-20
0
20
40
60
80
100
120
140
Horizontal Distance (ft.)

Figure 6

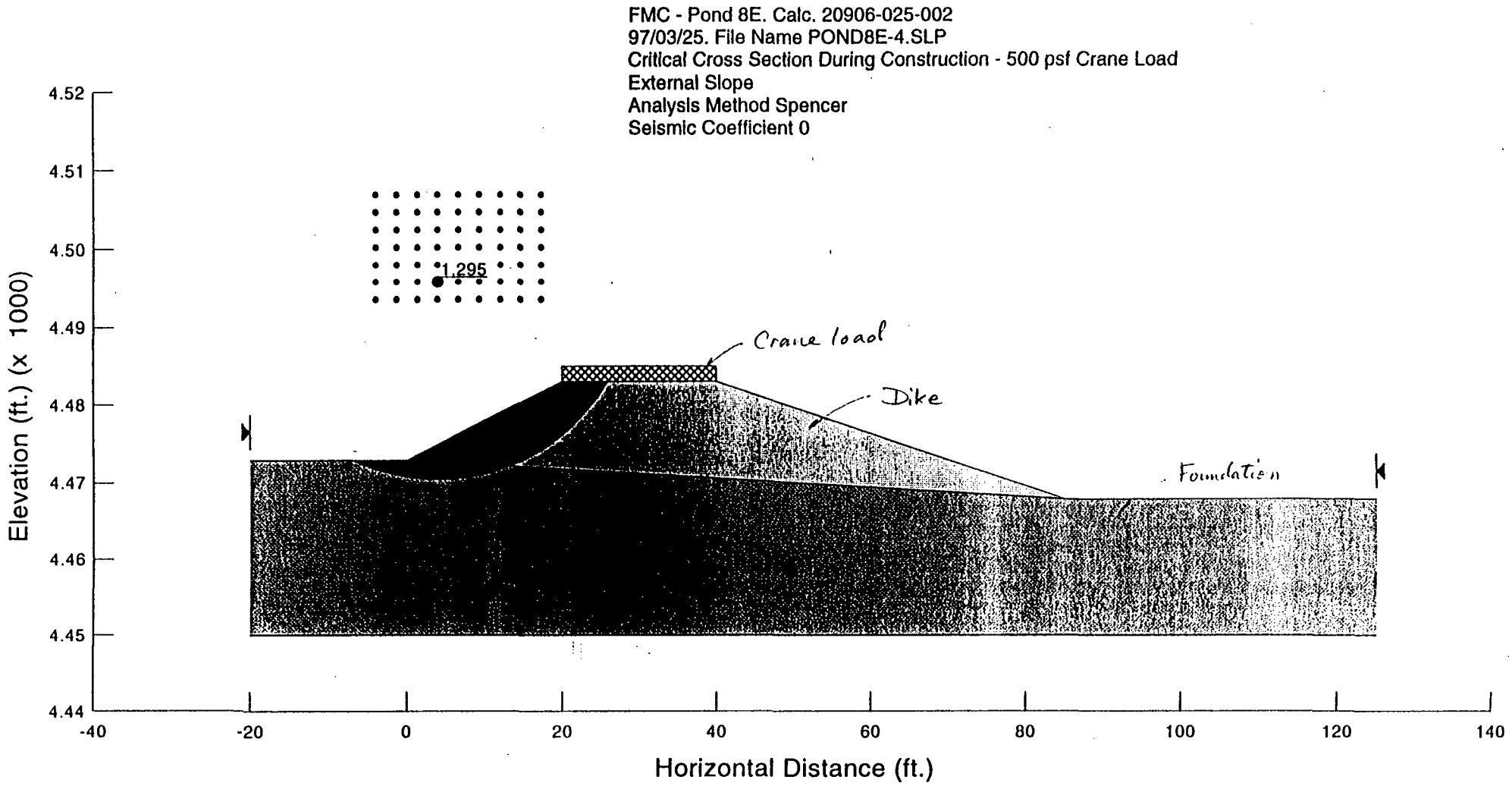

FMC - Pond 8E. Calc. 20906-025-002
97/03/25. File Name POND8E-4.SLP
Critical Cross Section During Construction - 500 psf Crane Load
External Slope
Analysis Method Spencer
Seismic Coefficient 0
1.295
Crane load
Dike
Foundation
Elevation (ft.) (x 1000)
4.52
4.51
4.50
4.49
4.48
4.47
4.46
4.45
4.44
-40
-20
0
20
40
60
80
100
120
140
Horizontal Distance (ft.)

Figure 7

FMC - Pond 8E. Calc. 20906-025-002
97/03/25. File Name POND8E-5.SLP
Critical Cross Section During Construction - 500 psf Crane Load
Internal Slope
Analysis Method Spencer
Seismic Coefficient 0

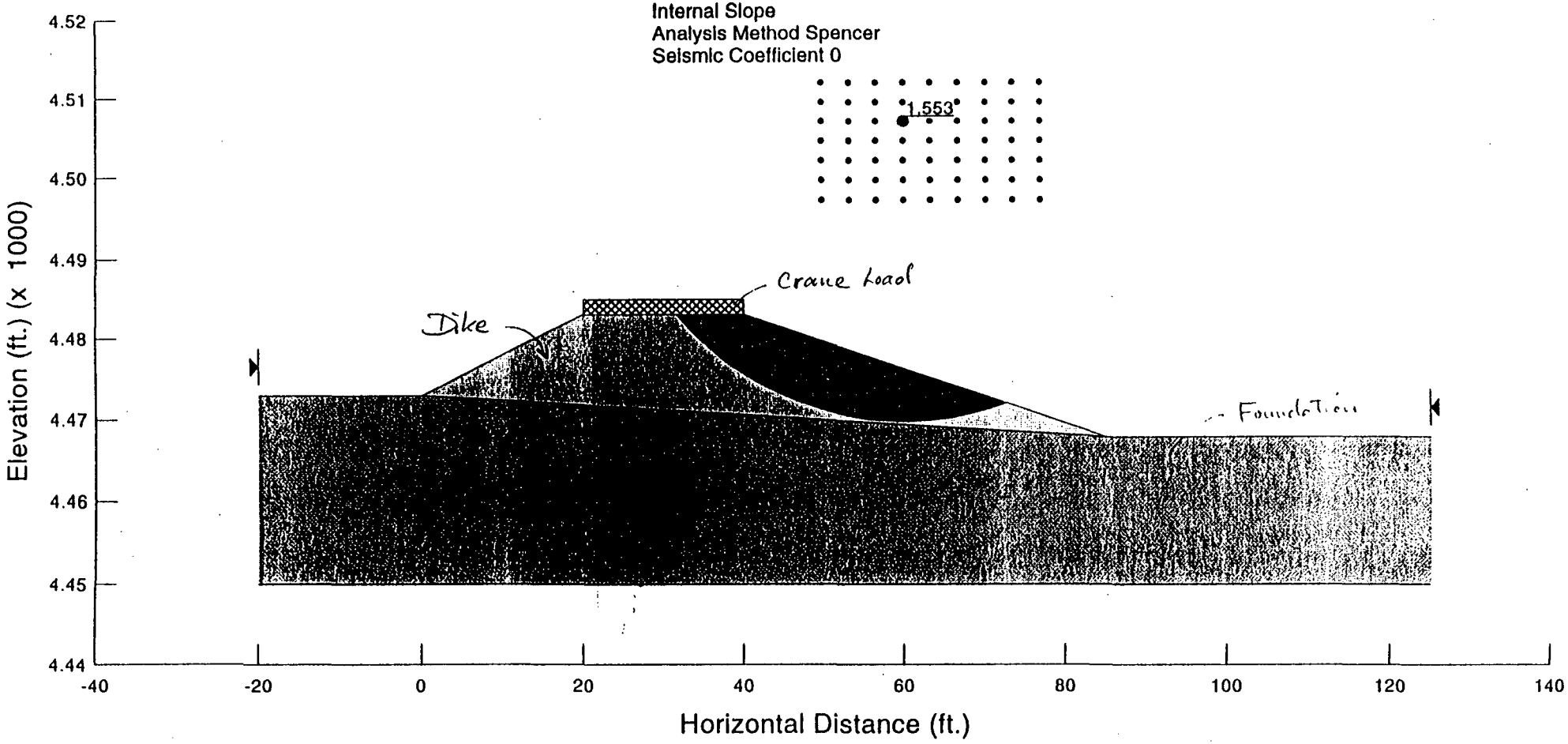


Figure 8

CALCULATION COVER SHEET

PROJECT	JOB NO.	CALC. NO.	SHEET
FMC - Pond 8E	24230-025	24230-025-3	1
SUBJECT Evaluation of Strains in Final Pond Configuration		DISCIPLINE Geotechnical Engineering	

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
		X		

COMPUTER PROGRAM/TYPE	SCP		MAINFRAME	PC	PROGRAM NO.	VERSION/RELEASE NO.
	Yes	No				

Purpose: Evaluate the effect of settlement for Pond 8E after final cover is installed. In particular, address the potential strains of the membrane elements caused by the settlement.

References: 1. Calculation, 24230-025-4, Pond 8E - Settlement Evaluation, Rev. 0, May 8, 2002.

Conclusions: Estimated cap settlement will only result in minor depressions that will not produce ponding on the 5 percent slope of the final cap. The possibility that the synthetic elements of the final cover, particularly the HDPE membrane and the GCL, could be breached due to post-cap total and differential settlement, was also considered. The elongation properties of each are as follows:

Property	HDPE/Bentonite Composite liner (15mil HDPE)	Geotextile/ Bentonite Composite Liner	60 mil HDPE
Elongation at yield (%)	10	NA	12
Elongation at break (%)	500	100	500

Assuming the maximum calculated settlement (8 in.) occurs near the edge of the dike, a maximum membrane elongation of 2.2 percent was calculated. As the above properties readily demonstrate, both liner types can tolerate the strains imposed by differential settlement of the permanent cap and the estimated strains are well below the respective elongation yield limits. Other elements of the cap have similar or better elongation properties and will be even more tolerant of settlement-induced strains. Therefore, settlement of the final cap is not expected to have any significant detrimental effect on the cap system.

Rev. No.	Reason for Revision	Total No. of Sheets	Last Sheet No.	By	Checked	Approved/ Accepted	Date
2	Incorporate initial fill settlement & final grading	7	7	JTC	[illegible]	[illegible]	7/8/02
1	Incorporated settlement monitoring data	7	7	JTC	ND	IA	9/28/01
0	ORIGINAL ISSUE	7	7	JTC	ND	IA	8/6/01

Record of Revision

Purpose: Evaluate the effect of settlement on the permanent cap elements.

1) Assumptions

The cap is expected to settle at a slow rate over time.

Little differential settlement is expected over the central pond.

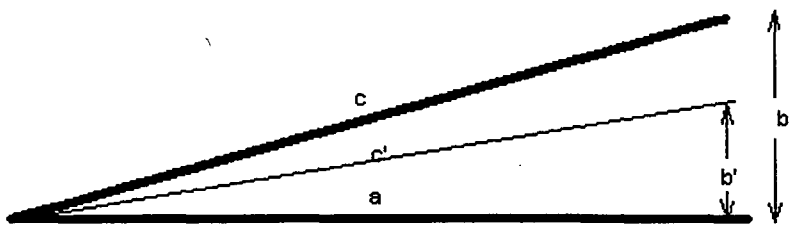
A maximum long-term settlement about 8 inches is estimated for the cap at Pond 8E (see Reference 1).

Measured settlement will be less because measured points will be set a few months after grading commences.

Maximum differential settlement will occur around the pond perimeter.

2) The effect of settlement around the perimeter will be to place the cap elements into a small amount of compression.

For example, assume 8-inch differential in 30 feet. (Note that 30 feet is the approximate horizontal distance of the sludge-covered 3:1 interior slope of Pond 8E.)



$slope := 5 \cdot \%$

$a := 30 \cdot ft$

$b := a \cdot slope$ $\quad b = 1.5\,ft$

$c := \left(a^2 + b^2\right)^{.5}$ $\quad c = 30.0375\,ft$

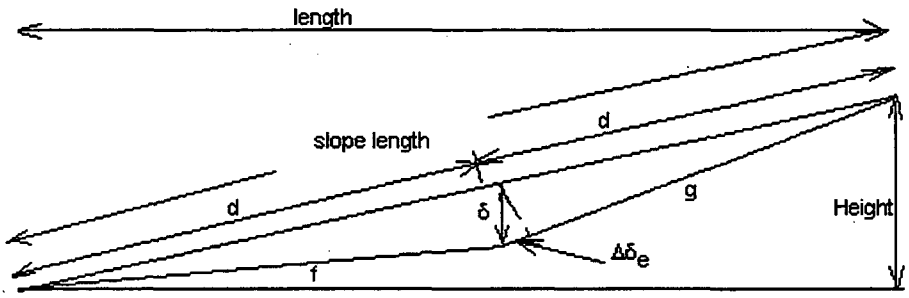
$b_1 := b - 8 \cdot in$ $\quad b_1 = 0.8333\,ft$

$c_1 := \left(a^2 + b_1^2\right)^{.5}$ $\quad c_1 = 30.0116\,ft$

$c - c_1 = 0.0259\,ft$

$\varepsilon := \frac{c - c_1}{c}$ $\quad \varepsilon = 0.0862\,\%$ strain compression

3) Consider a localized settlement depression superimposed on a plane surface of the cap.



Assume $\delta := 2 \cdot in$ within a 100 ft diameter circle

$length := 100 \cdot ft$

$height := 4 \cdot ft$

$slope\_length := \left(length^2 + height^2\right)^{.5}$

$slope\_length = 100.08\,ft$

$d := \frac{slope\_length}{2}$ $\quad d = 50.04\,ft$

$f := \left[\left(\frac{length}{2}\right)^2 + \left(\frac{height}{2} - \delta\right)^2\right]^{.5}$ $\quad f = 50.0336\,ft$

$\Delta\delta_c := d - f$ $\quad \Delta\delta_c = 6.3842 \times 10^{-3}\,ft$ compression

$\varepsilon_c := \frac{\Delta\delta_c}{\left(\frac{length}{2}\right)}$ $\quad \varepsilon_c = 0.0128\,\%$

$g := \left[\left(\frac{length}{2}\right)^2 + \left(\frac{height}{2} + \delta\right)^2\right]^{.5}$ $\quad g = 50.0469\,ft$

$\Delta\delta_e := d - g$ $\quad \Delta\delta_e = -6.9384 \times 10^{-3}\,ft$ elongation

$\varepsilon_e := \frac{\Delta\delta_e}{\left(\frac{length}{2}\right)}$ $\quad \varepsilon_e = -0.0139\,\%$

Assume $\delta := 4 \cdot in$ within a 100 ft diameter circle

$length := 100 \cdot ft$

$slope\_length := \left(length^2 + height^2\right)^{.5}$

$slope\_length = 100.08\,ft$ compression

$d := \frac{slope\_length}{2}$ $d = 50.04\,ft$

$f := \left[\left(\frac{length}{2}\right)^2 + \left(\frac{height}{2} - \delta\right)^2\right]^{.5}$ $f = 50.0278\,ft$

$\Delta\delta_c := d - f$ $\Delta\delta_c = 0.0122\,ft$

elongation

$\varepsilon_c := \frac{\Delta\delta_c}{\left(\frac{length}{2}\right)}$ $\varepsilon_c = 0.0244\,\%$

$g := \left[\left(\frac{length}{2}\right)^2 + \left(\frac{height}{2} + \delta\right)^2\right]^{.5}$ $g = 50.0544\,ft$

$\Delta\delta_e := d - g$ $\Delta\delta_e = -0.0144\,ft$

$\varepsilon_e := \frac{\Delta\delta_e}{\left(\frac{length}{2}\right)}$ $\varepsilon_e = -0.0289\,\%$

Assume $\delta := 8 \cdot in$ within a 100 ft diameter circle

$length := 100 \cdot ft$ $height := 4 \cdot ft$

$slope\_length := \left(length^2 + height^2\right)^{.5}$

$slope\_length = 100.08\,ft$

$d := \frac{slope\_length}{2}$ $d = 50.04\,ft$

$f := \left[\left(\frac{length}{2}\right)^2 + \left(\frac{height}{2} - \delta\right)^2\right]^{.5}$ $f = 50.0178\,ft$ compression

$\Delta\delta_c := d - f$ $\qquad \Delta\delta_c = 0.0222\,\text{ft}$

$$\varepsilon_c := \frac{\Delta\delta_c}{\left(\frac{\text{length}}{2}\right)} \qquad \varepsilon_c = 0.0444\,\%$$

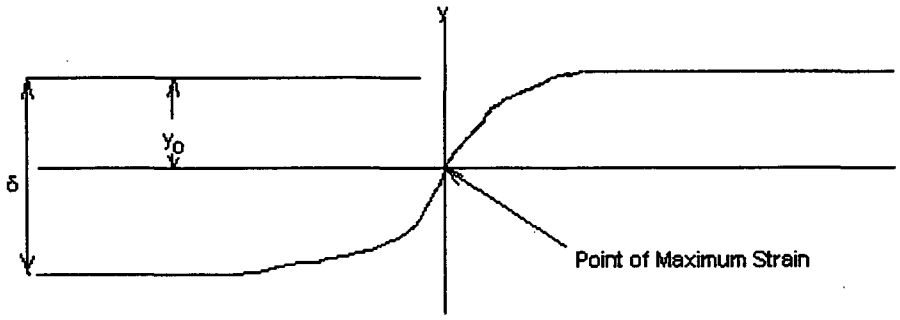
$$g := \left[\left(\frac{\text{length}}{2}\right)^2 + \left(\frac{\text{height}}{2} + \delta\right)^2\right]^{.5} \qquad g = 50.0711\,\text{ft}$$

elongation

$\Delta\delta_e := d - g$ $\qquad \Delta\delta_e = -0.0311\,\text{ft}$

$$\varepsilon_e := \frac{\Delta\delta_e}{\left(\frac{\text{length}}{2}\right)} \qquad \varepsilon_e = -0.0622\,\%$$

4) Consider a tangent shape of deformation.
The above analyses assume that strain is equally distributed along the membrane. In fact, it is more appropriate to assume a tangent shape to the deformed membrane where the maximum strain occurs at the maximum slope as depicted below:



The general formula describing the tangent deformation shape is

y = A atan(x)

'A' can be determined for a maximum vertical deformation, δ, of say 8 inches (y_0 = 4 inches for the half amplitude deformation), which occurs when atan(x)=π/2.

Assume $\delta := 8 \cdot \text{in}$

$$y_0 := \frac{\delta}{2} \qquad y_0 = 0.3333\,\text{ft}$$

$A := \frac{y_0}{\left(\frac{\pi}{2}\right)}$ $\quad A = 0.2122\,ft$

Hence, maximum strain occurs at $\quad x := 0\ ft$

$y := A \cdot atan(x)$

$dy_x := \frac{A}{1 + x^2}$ $\quad dy_x = 0.2122\,ft\ /ft$

$\theta := atan\left(\frac{dy_x}{1 \cdot ft}\right)$ $\quad \theta = 11.9808\,deg$

$\varepsilon := \frac{1}{\cos(\theta)} - 1$ $\quad \varepsilon = 2.2268\,\%$

Assume $\quad \delta := 2 \cdot in$

$y_0 := \frac{\delta}{2}$ $\quad y_0 = 0.0833\,ft$

$A := \frac{y_0}{\left(\frac{\pi}{2}\right)}$ $\quad A = 0.0531\,ft$

Hence, maximum strain occurs at $\quad x := 0\ ft$

$y := A \cdot atan(x)$

$dy_x := \frac{A}{1 + x^2}$ $\quad dy_x = 0.0531\,ft\ /ft$

$\theta := atan\left(\frac{dy_x}{1 \cdot ft}\right)$ $\quad \theta = 3.0368\,deg$

$\varepsilon := \frac{1}{\cos(\theta)} - 1$ $\quad \varepsilon = 0.1406\,\%$

Assume $\quad \delta := 4 \cdot in$

$y_0 := \frac{\delta}{2}$ $\quad y_0 = 0.1667\,ft$

$A := \frac{y_0}{\left(\frac{\pi}{2}\right)}$ $\quad A = 0.1061\,ft$

Hence, maximum strain occurs at $x := 0\ ft$

$y := A \cdot atan(x)$

$dy_x := \frac{A}{1 + x^2}$ $\quad dy_x = 0.1061\ ft\ /ft$

$\theta := atan\left(\frac{dy_x}{1 \cdot ft}\right)$ $\quad \theta = 6.0566\ deg$

$\varepsilon := \frac{1}{cos(\theta)} - 1$ $\quad \varepsilon = 0.5613\ \%$

Conclusions:

The maximum elongation is estimated to be on the order of 0.14% assuming a 2-inch depression in the pond surface near the perimeter, increasing to 2.2% for an assumed 8-inch depression.

CALCULATION COVER SHEET

PROJECT	FMC - Pond 8E	JOB NO. 24230-025	CALC. NO. 24230-025-4	SHEET 1
SUBJECT	Settlement Evaluation Final Cap		DISCIPLINE Geotechnical	

CALCULATION STATUS DESIGNATION	PRELIMINARY	CONFIRMED	SUPERSEDED	VOIDED
	[ ]	[X]	[ ]	[ ]

COMPUTER PROGRAM/TYPE	SCP	MAINFRAME	PC	PROGRAM NO.	VERSION/RELEASE NO.
	[ ] Yes [ ] No	[ ]	[X]	ACCUMV	--

Purpose:
Evaluate pond settlement of Pond 8E after final cap is installed. This analysis augments the earlier analysis performed for estimating initial and final cap settlement by accounting for average settlements that were measured during initial fill settlement, as-built grades, and the planned final grading required to complete the cap.

References:
1. FMC-Pond 8E, Settlement Evaluation, Calculation No. 24230-025-1, Bechtel Geotechnical, dated 12/26/01.
2. Pond 8E, Final Grading Plan, Drawing No. 250-C-213, Rev. 0.
3. Closure Settlement Report, Pond 8E, Pond 15S, and Phase IV Ponds - Progress Report No. 10, Pond 16S - Progress Report No. 6, Bechtel, April 30, 2002.
4. ACCUMV, The One-Dimensional Consolidation of Saturated Clays, A Computer Program for Nonlinear Finite Strain Theory, by Schiffman, R.L., Szavits-Nossan, V., and McArthur, J.M, December 1992.

Summary of Conclusions:
Estimated permanent cap settlement is about 8 inches over its 30-year design life. This is about 2 inches greater than the value estimated in Reference 1.

No.	Reason for Revision	Total No. of Sheets	Last Sheet No.	By	Checked	Approved/ Accepted	Date
0	Issued for use	42	A-39	JTC	[signature]	FO by RC	5/8/02

Record of Revision

g:\geotech\jtc analysis\8e\8efinal.doc

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

Purpose of Calculation

This calculation performs an evaluation of the final cap settlement for the planned cap design configuration of Pond 8E using the same soil parameters as reported in Reference 1. The general description of Pond 8E construction and the description of methodology used in this analysis are also included in Reference 1.

Input Data and Assumptions

All input parameters used for the initial fill calculation (Ref. 1) are the same except that the thickness of slag has been modified to reflect measurements made during the construction, the current grade, and the final grading plan (see Refs. 2 and 3). Based on this information, the following estimate was made for the total slag thickness added during initial filling:

Current top of slag elevation	4491.9	ft
- Elevation of top of sludge (initial)	-4479.6	ft
- Sand thickness (initial)	- 5	ft
+ Measured settlement (From Ref. 3)	+ 4.75	ft
Current slag thickness	12.0 ft	
Current slag load @ 130 pcf	1560 psf	

Prior to constructing the final cap some regrading will be required. Based on the grading plans it is estimated that in addition to the 3.5-foot thick final cap, it will be necessary to add an average of 1.4 feet of additional fill over portions of Pond 8E. The final load required for the cap installation is therefore

Final cap thickness	3.5 ft
Regrading fill	1.4 ft
Total thickness	4.9 ft
Final cap load @ 120 pcf	588 psf

Results As for the calculations in Reference 1, the analyses were performed using ACCUMV (Reference 4). The summary of the analysis results and computer output for the analysis is attached as Appendix A. The results of the analyses for Pond 8E are summarized in the following table:

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

Table 1 - Summary of Settlement Analyses for Pond 8E

Item	Pond 8E
Primary Settlement of Permanent Cap [ft]	0.2
30-yr Secondary Settlement [ft]	0.5
Total Post-Construction 30-yr Settlement [ft]	0.7

Conclusions

It is estimated that the permanent cap will settle about 8 inches over its 30-year design life. This is about 2 inches greater than the value estimated in Reference 1.

![Bechtel logo]

CALCULATION SHEET

PROJECT FMC - Pond 8E | JOB NO. 24230-025 | CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap | SHEET NO. A-1

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								↓

Analysis Results

Project	FMC - Pond 8E
Computed by:	J.T. Cameron
Date	5/8/2002

All required inputs are blocked with a bold box.

		INPUT	
Sludge Thickness, H		20.5	ft
Coef. of Horizontal Consolidation, C_h		25	ft²/mth
Wick Drain Spacing (Triangular), S		10	ft
Wick Drain Width, W		110	mm
Wick Drain Thickness, b		4	mm
Percent Void Area of Wick Drain, A_v		92	
Assumed Equivalent Sand Porosity, por		0.3	
Equivalent Void Diameter, d_v (see Note 6)		22.7	mm
Equivalent Sand Drain Diameter, d_w (see Note 7)		75.7	mm
Equivalent Sand Drain Diameter, d_w		0.25	ft
Equivalent Drain Diameter – d_e (see Note 1)	1.05 * S =	10.5	
n	d_e / d_w =	42	

NOTES:

[1] Multiply S by 1.05 for triangular pattern and 1.13 for square pattern

[2] $\delta_{sec} = \alpha * \log(t/t_p)$

[3] $U_h = 1 - 1/(e^{t/A})$

where $A = d_e^2/(8*C_{h,v}) * (\ln d_e/d_w - 0.75)$

[4] $U = 1 - (1 - U_v) * (1 - U_h)$

[5] $\delta_{prim} = (\delta_{prim}/U_v) * U$

[6] $d_v = \text{sqrt}(4*A_v/\pi)$

[7] $d_w = d_v/\text{por}$

Phase of Construction	Net Pressure, psf (psf)	Primary Settlement (ft)
Begin	0	0
Sand fill, 5-ft thickness	575	1.27
Sand and 2.5 ft of slag (near perimeter dike)	900	1.56
Sand and 17. ft of slag	2135	2.18
Permanent, 4.9-ft cap	2723	2.35

Secondary Settlement of Final Cap, ft		0.53
Total Additional Settlement After Final Cap Installed (30 -year)	8.4	inches

Material	Sand	Slag	Cap
Thickness, ft	5	12	4.9
Unit Weight, pcf	115	130	120
Additional Load, psf	575	1560	588
Begin Loading, months	0	2.7	24
Time for Loading, months	2	1	1

Load Sequence Time	Load
0.5	300
1.0	575
2.0	1095
2.5	1615
3.0	2135
27.0	2135
29.0	2723
60.0	2723

Begin Wick Drain Installation	3	Months		
End of Primary Settlement, t_p	8	months w/o wick drains	4	months with wick drains
Rate of 2ndary Compr. (ft/log cycle), α	0.272			
Design Life	30	years		

ACCUMV OUTPUT (w/o wick drains)								With Wick Drains				
Time t (months)	Average void ratio	Total Stress (psf)	Effective Stress (psf)	Prim. Sett. δ_{prim}	Deg. Vert. Cons. U_v	Secndry Sett. (ft) δ_{sec}[2]	Total Sett. (ft) $\delta_{prim}+\delta_{sec}$	Deg. Hor. Cons. U_h[3]	Deg. Sett. U[4]	Primary Sett.(ft) δ_{prim}[5]	Secondary Settlement (ft)	Prim+Sec (ft)
0.00E+00	4.33E+00	579.519	143.6243	0	0	0.00	0.00	0.000	0.00	0.0000	0.00	0.0000
1.50E-01	4.28E+00	729.586	149.059	0.1279	0.0544	0.00	0.13	0.000	0.05	0.1279	0.00	0.1279
2.00E-01	4.27E+00	779.623	150.9875	0.14	0.0596	0.00	0.14	0.000	0.06	0.1400	0.00	0.1400
2.25E-01	4.27E+00	804.645	151.9867	0.1461	0.0621	0.00	0.15	0.000	0.06	0.1461	0.00	0.1461
2.50E-01	4.27E+00	829.67	153.0064	0.1521	0.0647	0.00	0.15	0.000	0.06	0.1521	0.00	0.1521
2.75E-01	4.26E+00	854.696	154.0486	0.1581	0.0673	0.00	0.16	0.000	0.07	0.1581	0.00	0.1581
3.00E-01	4.26E+00	879.725	155.1153	0.1643	0.0699	0.00	0.16	0.000	0.07	0.1643	0.00	0.1643
3.50E-01	4.26E+00	925.619	157.1757	0.1764	0.075	0.00	0.18	0.000	0.08	0.1764	0.00	0.1764
4.00E-01	4.25E+00	971.522	159.3629	0.1892	0.0805	0.00	0.19	0.000	0.08	0.1892	0.00	0.1892
5.00E-01	4.24E+00	1063.354	164.2593	0.2177	0.0926	0.00	0.22	0.000	0.09	0.2177	0.00	0.2177
6.00E-01	4.23E+00	1155.231	170.2877	0.2515	0.107	0.00	0.25	0.000	0.11	0.2515	0.00	0.2515
7.00E-01	4.21E+00	1415.512	184.3016	0.2993	0.1273	0.00	0.30	0.000	0.13	0.2993	0.00	0.2993
8.00E-01	4.18E+00	1675.928	205.2679	0.3633	0.1545	0.00	0.36	0.000	0.15	0.3633	0.00	0.3633
9.00E-01	4.15E+00	1936.531	246.6538	0.4504	0.1916	0.00	0.45	0.000	0.19	0.4504	0.00	0.4504
1.00E+00	4.11E+00	2197.22	318.9612	0.5421	0.2306	0.00	0.54	0.000	0.23	0.5421	0.00	0.5421
1.25E+00	4.07E+00	2204.505	370.2946	0.6663	0.283	0.00	0.67	0.000	0.28	0.6663	0.00	0.6663
1.50E+00	4.01E+00	2212.619	434.7551	0.7964	0.3387	0.00	0.80	0.000	0.34	0.7964	0.00	0.7964
1.75E+00	3.97E+00	2220.551	494.2851	0.901	0.3832	0.00	0.90	0.000	0.38	0.9010	0.00	0.9010
2.00E+00	3.94E+00	2228.607	549.3635	0.9936	0.4226	0.00	0.99	0.000	0.42	0.9936	0.00	0.9935
2.25E+00	3.90E+00	2236.726	602.5072	1.0772	0.4582	0.00	1.08	0.000	0.46	1.0772	0.00	1.0772
2.50E+00	3.87E+00	2244.847	653.4822	1.153	0.4904	0.00	1.15	0.000	0.49	1.1530	0.00	1.1530
2.75E+00	3.85E+00	2252.98	702.7453	1.2229	0.5201	0.00	1.22	0.000	0.52	1.2229	0.00	1.2229
3.00E+00	3.82E+00	2261.103	750.7077	1.2879	0.5478	0.00	1.29	0.000	0.56	1.2879	0.00	1.2879
3.50E+00	3.78E+00	2277.231	845.005	1.4061	0.5981	0.00	1.41	0.261	0.70	1.5336	0.00	1.5336
4.00E+00	3.73E+00	2293.076	942.1892	1.512	0.6431	0.00	1.51	0.454	0.81	1.7563	0.00	1.7563
5.00E+00	3.66E+00	2323.452	1158.491	1.6931	0.7201	0.00	1.69	0.702	0.92	1.9992	0.03	2.0256
6.00E+00	3.61E+00	2351.779	1383.88	1.8318	0.7791	0.00	1.83	0.838	0.96	2.1027	0.05	2.1506
7.00E+00	3.57E+00	2378.222	1577.615	1.9281	0.8201	0.00	1.93	0.911	0.98	2.1462	0.07	2.2123
8.00E+00	3.55E+00	2403.239	1720.985	1.9904	0.8466	0.00	1.99	0.952	0.99	2.1648	0.08	2.2467
9.00E+00	3.53E+00	2427.319	1818.856	2.0296	0.8632	0.01	2.04	0.974	1.00	2.1731	0.10	2.2689
1.00E+01	3.52E+00	2450.841	1884.807	2.0545	0.8739	0.03	2.08	0.986	1.00	2.1770	0.11	2.2853
1.20E+01	3.51E+00	2497.091	1956.61	2.0844	0.8866	0.05	2.13	0.996	1.00	2.1799	0.13	2.3097
1.25E+01	3.51E+00	2508.573	1981.833	2.0899	0.8889	0.05	2.14	0.997	1.00	2.1802	0.13	2.3148
1.50E+01	3.50E+00	2565.817	2046.793	2.1127	0.8986	0.07	2.19	0.999	1.00	2.1808	0.16	2.3370
1.75E+01	3.49E+00	2622.956	2105.415	2.1326	0.9071	0.09	2.23	1.000	1.00	2.1810	0.17	2.3563
1.80E+01	3.49E+00	2634.379	2116.942	2.1365	0.9088	0.10	2.23	1.000	1.00	2.1810	0.18	2.3587
2.00E+01	3.48E+00	2680.064	2162.858	2.1517	0.9152	0.11	2.26	1.000	1.00	2.1810	0.19	2.3711
2.25E+01	3.48E+00	2737.153	2220.069	2.1702	0.9231	0.12	2.29	1.000	1.00	2.1810	0.20	2.3850
2.40E+01	3.47E+00	2771.399	2254.356	2.181	0.9277	0.13	2.31	1.000	1.00	2.1810	0.21	2.3927
2.50E+01	3.46E+00	3066.368	2392.743	2.2236	0.9458	0.13	2.36	1.000	1.00	2.2235	0.22	2.4400
2.60E+01	3.43E+00	3362.289	2627.616	2.2897	0.9739	0.14	2.43	1.000	1.00	2.2897	0.22	2.5108
2.75E+01	3.41E+00	3364.101	2808.657	2.3368	0.9939	0.15	2.48	1.000	1.00	2.3368	0.23	2.5645
2.80E+01	3.41E+00	3364.319	2830.932	2.3423	0.9963	0.15	2.49	1.000	1.00	2.3423	0.23	2.5722
3.00E+01	3.41E+00	3364.616	2861.625	2.3499	0.9995	0.16	2.51	1.000	1.00	2.3499	0.24	2.5879
3.20E+01	3.41E+00	3364.657	2866.921	2.3509	0.9999	0.16	2.51	1.000	1.00	2.3509	0.25	2.5965
3.40E+01	3.41E+00	3364.663	2866.504	2.351	1	0.17	2.52	1.000	1.00	2.3510	0.25	2.6038
3.50E+01	3.41E+00	3364.663	2866.504	2.351	1	0.17	2.53	1.000	1.00	2.3510	0.26	2.6072
3.80E+01	3.41E+00	3364.663	2866.504	2.351	1	0.18	2.54	1.000	1.00	2.3510	0.27	2.6169
4.00E+01	3.41E+00	3364.663	2866.504	2.351	1	0.19	2.54	1.000	1.00	2.3510	0.27	2.6230
4.50E+01	3.41E+00	3364.663	2866.504	2.351	1	0.20	2.56	1.000	1.00	2.3510	0.29	2.6369
5.00E+01	3.41E+00	3364.663	2866.504	2.351	1	0.22	2.57	1.000	1.00	2.3510	0.30	2.6494
5.50E+01	3.41E+00	3364.663	2866.504	2.351	1	0.23	2.58	1.000	1.00	2.3510	0.31	2.6606
6.00E+01	3.41E+00	3364.663	2866.504	2.351	1	0.24	2.59	1.000	1.00	2.3510	0.32	2.6709

CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-2

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
*********************************************************************
*                                                                   *
*          ACCUMV - NONLINEAR LARGE STRAIN CONSOLIDATION            *
*                              by                                   *
*                       ROBERT L. SCHIFFMAN                         *
*                      VLASTA SZAVITS-NOSSAN                        *
*                        JOHN M. McARTHUR                           *
*                                                                   *
*                 DEPARTMENT OF CIVIL ENGINEERING                   *
*                UNIVERSITY OF COLORADO AT BOULDER                  *
*                   BOULDER, CO 80309-0428  USA                     *
*                                                                   *
*                                                                   *
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*                       and John M. McArthur                        *
*                                                                   *
*********************************************************************
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

                              ****************
                              *              *
                              *  INPUT DATA  *
                              *              *
                              ****************

                            ******    UNITS    ******

                     LENGTH              FORCE              TIME
                     feet                pounds              months
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY


                       *******  UNIT  WEIGHTS  *******

                           GAMMAS          GAMMAW
                          174.1000         62.4000
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY


                         *******  INITIAL GEOMETRY  *******
```

CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-3

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
                    H(0)                    TOTAL HEADS

                                        TOT HD(L)      HW
                   13.600                    .000    13.600

                 *******  VOID RATIO RANGE  *******

                   EMAX                    EMIN
                   8.000                   1.000
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY


          *******  EFFECTIVE STRESS AT TOP OF LAYER  *******

                                  Q0
                                1.0000
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY


         *******    CONSTITUTIVE RELATIONSHIPS    *******


                   ( .5610E+01) + (-.2770E+00) * LN(EFFSTR)
     E = ------------------------------------------------------------------
         1 + ( .0000E+00) * LN(EFFSTR) + ( .0000E+00) * LN(EFFSTR)*LN(EFFSTR)


                       ( .2000E-01) * (E) ** ( .1000E+01)
                 K = ----------------------------------
                            1 + ( .0000E+00) * (E)
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY


              **********    CALCULATION DATA    **********

                 N          TMAX              ALPHA
                 10       .6000E+02         .5000E+00
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY


                 *******  HEIGHT-TIME  FUNCTION  *******

                   TIME                H
                 .000E+00            13.600
                 .100E+03            13.600
```

CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-4

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
1
      ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

      ****Pond 8E, 13.6 feet of sludge, Power K

      PERVIOUS UPPER BOUNDARY
      IMPERVIOUS LOWER BOUNDARY


                    *******  TIME - LOAD FUNCTIONS  *******

                          TIME           LOAD
                       .0000E+00          .0000
                       .3000E+00       300.0000
                       .6000E+00       575.0000
                       .8000E+00      1095.0000
                       .1000E+01      1615.0000
                       .2400E+02      2135.0000
                       .2600E+02      2723.0000
                       .6000E+02      2723.0000
1
      ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

      ****Pond 8E, 13.6 feet of sludge, Power K

      PERVIOUS UPPER BOUNDARY
      IMPERVIOUS LOWER BOUNDARY


                              **** PRINT TIMES ****
                                   .15000E+00
                                   .20000E+00
                                   .22500E+00
                                   .25000E+00
                                   .27500E+00
                                   .30000E+00
                                   .35000E+00
                                   .40000E+00
                                   .50000E+00
                                   .60000E+00
                                   .70000E+00
                                   .80000E+00
                                   .90000E+00
                                   .10000E+01
                                   .12500E+01
                                   .15000E+01
                                   .17500E+01
                                   .20000E+01
                                   .22500E+01
                                   .25000E+01
                                   .27500E+01
                                   .30000E+01
                                   .35000E+01
                                   .40000E+01
                                   .50000E+01
                                   .60000E+01
                                   .70000E+01
                                   .80000E+01
                                   .90000E+01
                                   .10000E+02
                                   .12000E+02
                                   .12500E+02
                                   .15000E+02
                                   .17500E+02
                                   .18000E+02
                                   .20000E+02
                                   .22500E+02
                                   .24000E+02
                                   .25000E+02
                                   .26000E+02
```

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                                  .27500E+02
                                  .28000E+02
                                  .30000E+02
                                  .32000E+02
                                  .34000E+02
                                  .35000E+02
                                  .38000E+02
                                  .40000E+02
                                  .45000E+02
                                  .50000E+02
                                  .55000E+02
                                  .60000E+02
1
    ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

    ****Pond 8E, 13.6 feet of sludge, Power K

    PERVIOUS UPPER BOUNDARY
    IMPERVIOUS LOWER BOUNDARY

                                 ***************
                                 *             *
                                 *  FUNCTIONS  *
                                 *             *
                                 ***************

  E       EFFSTR        K          G         D(G)      D(K/1+E)       AV

 1.000   .169E+08   .200E-01  -.978E+04   .304E+05   .500E-02   .164E-07
 1.700   .135E+07   .340E-01  -.983E+03   .334E+04   .274E-02   .205E-06
 2.400   .108E+06   .480E-01  -.881E+02   .307E+03   .173E-02   .257E-05
 3.100   .862E+04   .620E-01  -.754E+01   .266E+02   .119E-02   .321E-04
 3.800   .688E+03   .760E-01  -.631E+00   .224E+01   .868E-03   .402E-03
 4.500   .550E+02   .900E-01  -.521E-01   .186E+00   .661E-03   .504E-02
 5.200   .439E+01   .104E+00  -.426E-02   .153E-01   .520E-03   .630E-01
 5.900   .351E+00   .118E+00  -.347E-03   .125E-02   .420E-03   .789E+00
 6.600   .280E-01   .132E+00  -.282E-04   .101E-03   .346E-03   .988E+01
 7.300   .224E-02   .146E+00  -.228E-05   .819E-05   .290E-03   .124E+03
 8.000   .179E-03   .160E+00  -.184E-06   .662E-06   .247E-03   .155E+04
1
    ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

    ****Pond 8E, 13.6 feet of sludge, Power K

    PERVIOUS UPPER BOUNDARY
    IMPERVIOUS LOWER BOUNDARY

            TIME =  .00000E+00          LOAD =       .000
            SET =      .0000

 ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

     Y          CHI         Z          E            TOTAL        EFFECTIVE

   .0000      13.6000      .0000      5.6100         1.000         1.0000
   .1000      12.0549      .2554      4.6723       125.941        29.5248
   .2000      10.6390      .5107      4.4850       242.813        58.0498
   .3000       9.2469      .7661      4.3743       358.206        86.5746
   .4000       7.8915     1.0215      4.2954       471.312       115.0994
   .5000       6.5472     1.2769      4.2341       583.718       143.6242
   .6000       5.2173     1.5322      4.1839       695.233       172.1494
   .7000       3.8990     1.7876      4.1414       806.017       200.6740
   .8000       2.5908     2.0430      4.1046       916.171       229.1989
   .9000       1.2915     2.2983      4.0721      1025.775       257.7239
  1.0000        .0000     2.5537      4.0430      1134.889       286.2484

            ***********  PORE PRESSURES  ***********
```

CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-6

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
        CHI          UW            U0            U

     13.6000        .000          .000         .0000
     12.0549      96.416        96.416         .0000
     10.6390     184.764       184.764        -.0001
      9.2469     271.632       271.632         .0000
      7.8915     356.213       356.213         .0000
      6.5472     440.093       440.093         .0001
      5.2173     523.083       523.083        -.0001
      3.8990     605.343       605.343         .0000
      2.5908     686.972       686.972         .0000
      1.2915     768.051       768.051        -.0001
       .0000     848.640       848.640         .0003
 TIMESTEP SIZE =      .00, ITERATIONS BETWEEN PRINT TIMES =      0
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .15000E+00          LOAD =    150.000
               SET =      .1279

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y           CHI          Z           E            TOTAL        EFFECTIVE

     .0000      13.4721      .0000       4.2202        158.982       151.0001
     .1000      12.0656      .2554       4.6447        275.272        32.6181
     .2000      10.6389      .5107       4.4842        392.822        58.2285
     .3000       9.2603      .7661       4.3742        507.372        86.6129
     .4000       7.8914     1.0215       4.2954        621.313       115.1189
     .5000       6.5472     1.2769       4.2341        733.718       143.6364
     .6000       5.2172     1.5322       4.1839        845.233       172.1573
     .7000       3.8990     1.7876       4.1414        956.018       200.6803
     .8000       2.5908     2.0430       4.1046       1066.171       229.2033
     .9000       1.2915     2.2983       4.0721       1175.775       257.7274
    1.0000        .0000     2.5537       4.0430       1284.889       286.2519

                ***********  PORE PRESSURES  ***********

      CHI          UW            U0            U

     13.4721       7.982         7.982        -.0001
     12.0656     242.654        95.748       146.9067
     10.6389     334.593       184.772       149.8212
      9.2603     420.759       270.798       149.9617
      7.8914     506.195       356.214       149.9806
      6.5472     590.082       440.094       149.9880
      5.2172     673.076       523.084       149.9919
      3.8990     755.337       605.343       149.9938
      2.5908     836.968       686.972       149.9957
      1.2915     918.047       768.051       149.9964
       .0000     998.637       848.640       149.9968
 TIMESTEP SIZE =      .07, ITERATIONS BETWEEN PRINT TIMES =      3
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .20000E+00          LOAD =    200.000
               SET =      .1400

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******
```

CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-7

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.4600	.0000	4.1410	209.738	201.0001
.1000	12.0641	.2554	4.6293	325.363	34.4807
.2000	10.6388	.5107	4.4835	442.827	58.3664
.3000	9.2604	.7661	4.3741	557.367	86.6321
.4000	7.8914	1.0215	4.2954	671.314	115.1260
.5000	6.5472	1.2769	4.2341	783.718	143.6406
.6000	5.2172	1.5322	4.1839	895.233	172.1603
.7000	3.8990	1.7876	4.1414	1006.018	200.6823
.8000	2.5908	2.0430	4.1046	1116.171	229.2049
.9000	1.2915	2.2983	4.0721	1225.775	257.7288
1.0000	.0000	2.5537	4.0430	1334.889	286.2529

********** PORE PRESSURES **********

CHI	UW	U0	U
13.4600	8.738	8.738	-.0001
12.0641	290.883	95.839	195.0442
10.6388	384.461	184.777	199.6833
9.2604	470.735	270.793	199.9425
7.8914	556.188	356.215	199.9735
6.5472	640.077	440.094	199.9838
5.2172	723.073	523.084	199.9889
3.8990	805.335	605.344	199.9918
2.5908	886.966	686.972	199.9941
1.2915	968.046	768.051	199.9950
.0000	1048.636	848.640	199.9958

TIMESTEP SIZE = .07, ITERATIONS BETWEEN PRINT TIMES = 4

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .22500E+00 LOAD = 225.000
SET = .1461

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.4539	.0000	4.1085	235.114	226.0000
.1000	12.0631	.2554	4.6200	350.430	35.6547
.2000	10.6388	.5107	4.4830	467.831	58.4665
.3000	9.2603	.7661	4.3741	582.374	86.6449
.4000	7.8914	1.0215	4.2953	696.314	115.1300
.5000	6.5472	1.2769	4.2340	808.718	143.6428
.6000	5.2172	1.5322	4.1839	920.233	172.1618
.7000	3.8990	1.7876	4.1414	1031.018	200.6834
.8000	2.5908	2.0430	4.1046	1141.171	229.2056
.9000	1.2915	2.2983	4.0721	1250.775	257.7292
1.0000	.0000	2.5537	4.0430	1359.889	286.2534

********** PORE PRESSURES **********

CHI	UW	U0	U
13.4539	9.114	9.114	.0000
12.0631	314.775	95.905	218.8702
10.6388	409.364	184.781	224.5832
9.2603	495.729	270.799	224.9297
7.8914	581.184	356.215	224.9695
6.5472	665.075	440.094	224.9815
5.2172	748.071	523.084	224.9874
3.8990	830.334	605.344	224.9907
2.5908	911.966	686.972	224.9933

```
      1.2915     993.046        768.051        224.9946
       .0000    1073.635        848.640        224.9953
 TIMESTEP SIZE =     .07, ITERATIONS BETWEEN PRINT TIMES =      5
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

              TIME =  .25000E+00          LOAD =    250.000
              SET =     .1521

   ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y           CHI         Z           E            TOTAL        EFFECTIVE

     .0000      13.4479      .0000       4.0794       260.489       251.0000
     .1000      12.0618      .2554       4.6100       375.506        36.9706
     .2000      10.6387      .5107       4.4825       492.835        58.5858
     .3000       9.2601      .7661       4.3740       607.385        86.6601
     .4000       7.8914     1.0215       4.2953       721.314       115.1343
     .5000       6.5472     1.2769       4.2340       833.718       143.6450
     .6000       5.2172     1.5322       4.1839       945.233       172.1633
     .7000       3.8990     1.7876       4.1414      1056.018       200.6844
     .8000       2.5908     2.0430       4.1046      1166.171       229.2064
     .9000       1.2915     2.2983       4.0721      1275.775       257.7297
    1.0000        .0000     2.5537       4.0430      1384.889       286.2539

              ***********  PORE PRESSURES  ***********

      CHI          UW            U0            U

     13.4479       9.489         9.489         .0000
     12.0618     338.536        95.981       242.5542
     10.6387     434.249       184.786       249.4639
      9.2601     520.725       270.810       249.9144
      7.8914     606.180       356.215       249.9651
      6.5472     690.073       440.093       249.9793
      5.2172     773.070       523.084       249.9859
      3.8990     855.333       605.344       249.9897
      2.5908     936.965       686.972       249.9925
      1.2915    1018.045       768.051       249.9941
       .0000    1098.635       848.640       249.9948
 TIMESTEP SIZE =     .07, ITERATIONS BETWEEN PRINT TIMES =      6
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K.

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

              TIME =  .27500E+00          LOAD =    275.000
              SET =     .1581

   ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y           CHI         Z           E            TOTAL        EFFECTIVE

     .0000      13.4419      .0000       4.0531       285.867       275.9998
     .1000      12.0605      .2554       4.5992       400.593        38.4405
     .2000      10.6386      .5107       4.4818       517.840        58.7264
     .3000       9.2599      .7661       4.3740       632.400        86.6782
     .4000       7.8914     1.0215       4.2953       746.315       115.1389
     .5000       6.5472     1.2769       4.2340       858.718       143.6472
     .6000       5.2172     1.5322       4.1839       970.233       172.1648
     .7000       3.8990     1.7876       4.1414      1081.018       200.6854
     .8000       2.5908     2.0430       4.1046      1191.171       229.2072
```

.9000	1.2915	2.2983	4.0721	1300.775	257.7306
1.0000	.0000	2.5537	4.0430	1409.889	286.2544

********** PORE PRESSURES **********

CHI	UW	U0	U
13.4419	9.867	9.867	.0002
12.0605	362.152	96.068	266.0843
10.6386	459.114	184.790	274.3233
9.2599	545.721	270.825	274.8964
7.8914	631.176	356.215	274.9606
6.5472	715.070	440.093	274.9771
5.2172	798.069	523.084	274.9844
3.8990	880.332	605.344	274.9886
2.5908	961.964	686.972	274.9917
1.2915	1043.044	768.051	274.9933
.0000	1123.634	848.640	274.9943

TIMESTEP SIZE = .07, ITERATIONS BETWEEN PRINT TIMES = 7

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .30000E+00 LOAD = 300.000
SET = .1643

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.4357	.0000	4.0291	311.250	301.0001
.1000	12.0589	.2554	4.5876	425.689	40.0795
.2000	10.6385	.5107	4.4810	542.846	58.8907
.3000	9.2596	.7661	4.3739	657.418	86.6997
.4000	7.8914	1.0215	4.2953	771.315	115.1440
.5000	6.5472	1.2769	4.2340	883.717	143.6497
.6000	5.2172	1.5322	4.1839	995.233	172.1662
.7000	3.8990	1.7876	4.1414	1106.018	200.6865
.8000	2.5908	2.0430	4.1046	1216.171	229.2080
.9000	1.2915	2.2983	4.0721	1325.775	257.7310
1.0000	.0000	2.5537	4.0430	1434.889	286.2549

********** PORE PRESSURES **********

CHI	UW	U0	U
13.4357	10.250	10.250	-.0001
12.0589	385.610	96.164	289.4453
10.6385	483.955	184.796	299.1590
9.2596	570.718	270.843	299.8749
7.8914	656.171	356.215	299.9554
6.5472	740.068	440.093	299.9746
5.2172	823.067	523.084	299.9830
3.8990	905.331	605.344	299.9876
2.5908	986.963	686.972	299.9909
1.2915	1068.044	768.051	299.9928
.0000	1148.634	848.640	299.9938

TIMESTEP SIZE = .07, ITERATIONS BETWEEN PRINT TIMES = 8

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-10

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

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                TIME =  .35000E+00          LOAD =     345.833
                SET =      .1764

 ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

     Y            CHI          Z           E            TOTAL        EFFECTIVE

    .0000       13.4236      .0000       3.9899        357.840       346.8335
    .1000       12.0554      .2554       4.5629        471.738        43.8157
    .2000       10.6383      .5107       4.4792        588.693        59.2723
    .3000        9.2588      .7661       4.3737        703.297        86.7503
    .4000        7.8914     1.0215       4.2953        817.149       115.1553
    .5000        6.5472     1.2769       4.2340        929.550       143.6546
    .6000        5.2172     1.5322       4.1839       1041.067       172.1695
    .7000        3.8990     1.7876       4.1414       1151.851       200.6886
    .8000        2.5908     2.0430       4.1046       1262.005       229.2096
    .9000        1.2915     2.2983       4.0721       1371.608       257.7323
   1.0000         .0000     2.5537       4.0430       1480.722       286.2563

                ***********  PORE PRESSURES  ***********

     CHI           UW            U0             U

   13.4236       11.006        11.006         -.0002
   12.0554      427.923        96.380       331.5425
   10.6383      529.421       184.810       344.6107
    9.2588      616.547       270.889       345.6576
    7.8914      701.993       356.216       345.7774
    6.5472      785.895       440.092       345.8030
    5.2172      868.897       523.084       345.8130
    3.8990      951.163       605.344       345.8188
    2.5908     1032.795       686.972       345.8227
    1.2915     1113.876       768.051       345.8248
     .0000     1194.466       848.640       345.8257
 TIMESTEP SIZE =     .07, ITERATIONS BETWEEN PRINT TIMES =      9
1
    ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

    ****Pond 8E, 13.6 feet of sludge, Power K

    PERVIOUS UPPER BOUNDARY
    IMPERVIOUS LOWER BOUNDARY

                TIME =  .40000E+00          LOAD =     391.667
                SET =      .1892

 ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

     Y            CHI          Z           E            TOTAL        EFFECTIVE

    .0000       13.4108      .0000       3.9555        404.474       392.6666
    .1000       12.0514      .2554       4.5352        517.826        48.4240
    .2000       10.6380      .5107       4.4769        634.544        59.7736
    .3000        9.2579      .7661       4.3735        749.187        86.8189
    .4000        7.8914     1.0215       4.2952        862.983       115.1694
    .5000        6.5472     1.2769       4.2340        975.383       143.6601
    .6000        5.2172     1.5322       4.1839       1086.900       172.1728
    .7000        3.8990     1.7876       4.1414       1197.685       200.6906
    .8000        2.5908     2.0430       4.1046       1307.838       229.2112
    .9000        1.2915     2.2983       4.0721       1417.442       257.7337
   1.0000         .0000     2.5537       4.0430       1526.555       286.2578

                ***********  PORE PRESSURES  ***********

     CHI           UW            U0             U

   13.4108       11.808        11.808          .0000
   12.0514      469.402        96.634       372.7676
   10.6380      574.771       184.828       389.9428
    9.2579      662.368       270.945       391.4224
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CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-11

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
        7.8914     747.813        356.216       391.5967
        6.5472     831.723        440.092       391.6309
        5.2172     914.728        523.085       391.6431
        3.8990     996.994        605.344       391.6501
        2.5908    1078.627        686.972       391.6544
        1.2915    1159.708        768.051       391.6568
         .0000    1240.298        848.640       391.6575
 TIMESTEP SIZE =     .07, ITERATIONS BETWEEN PRINT TIMES =     10
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

                TIME =  .50000E+00          LOAD =    483.333
                SET =      .2177

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y            CHI          Z           E            TOTAL        EFFECTIVE

     .0000      13.3823      .0000       3.8974        497.919       484.3330
     .1000      12.0412      .2554       4.4702        610.124        61.2442
     .2000      10.6372      .5107       4.4702        726.263        61.2324
     .3000       9.2557      .7661       4.3729        840.994        87.0288
     .4000       7.8914     1.0215       4.2951        954.651       115.2095
     .5000       6.5473     1.2769       4.2340       1067.047       143.6732
     .6000       5.2172     1.5322       4.1839       1178.568       172.1796
     .7000       3.8990     1.7876       4.1414       1289.351       200.6955
     .8000       2.5908     2.0430       4.1046       1399.505       229.2147
     .9000       1.2915     2.2983       4.0721       1509.108       257.7363
    1.0000        .0000     2.5537       4.0430       1618.222       286.2603

                ***********  PORE PRESSURES  ***********

      CHI          UW           U0              U

     13.3823      13.586       13.586          .0003
     12.0412     548.880       97.266       451.6140
     10.6372     665.030      184.879       480.1507
      9.2557     753.965      271.086       482.8791
      7.8914     839.441      356.218       483.2233
      6.5473     923.374      440.090       483.2845
      5.2172    1006.388      523.085       483.3029
      3.8990    1088.656      605.344       483.3119
      2.5908    1170.290      686.973       483.3175
      1.2915    1251.372      768.051       483.3208
       .0000    1331.962      848.640       483.3217
 TIMESTEP SIZE =     .07, ITERATIONS BETWEEN PRINT TIMES =     12
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

                TIME =  .60000E+00          LOAD =    575.000
                SET =      .2515

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y            CHI          Z           E            TOTAL        EFFECTIVE

     .0000      13.3485      .0000       3.8494        591.692       575.9999
     .1000      12.0278      .2554       4.3896        702.627        81.9352
     .2000      10.6359      .5107       4.4597        818.012        63.5953
     .3000       9.2528      .7661       4.3717        932.840        87.3870
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REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

.4000	7.8913	1.0215	4.2950	1046.319	115.2765
.5000	6.5473	1.2769	4.2340	1158.710	143.6913
.6000	5.2172	1.5322	4.1838	1270.234	172.1876
.7000	3.8990	1.7876	4.1414	1381.018	200.7003
.8000	2.5908	2.0430	4.1046	1491.172	229.2183
.9000	1.2915	2.2983	4.0721	1600.775	257.7394
1.0000	.0000	2.5537	4.0430	1709.889	286.2632

********** PORE PRESSURES **********

CHI	UW	U0	U
13.3485	15.692	15.692	.0001
12.0278	620.692	98.103	522.5897
10.6359	754.417	184.962	569.4545
9.2528	845.453	271.265	574.1876
7.8913	931.043	356.220	574.8229
6.5473	1015.019	440.086	574.9331
5.2172	1098.047	523.085	574.9616
3.8990	1180.318	605.344	574.9738
2.5908	1261.953	686.973	574.9807
1.2915	1343.036	768.051	574.9844
.0000	1423.625	848.640	574.9855

TIMESTEP SIZE = .07, ITERATIONS BETWEEN PRINT TIMES = 14

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .70000E+00 LOAD = 835.000
SET = .2993

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	13.3007	.0000	3.7462	854.675	835.9997
.1000	12.0102	.2554	4.2852	963.730	119.4199
.2000	10.6338	.5107	4.4435	1078.143	67.4424
.3000	9.2497	.7661	4.3698	1193.032	87.9823
.4000	7.8913	1.0215	4.2947	1306.322	115.3887
.5000	6.5474	1.2769	4.2339	1418.705	143.7187
.6000	5.2172	1.5322	4.1838	1530.235	172.1977
.7000	3.8990	1.7876	4.1414	1641.018	200.7058
.8000	2.5908	2.0430	4.1046	1751.172	229.2222
.9000	1.2915	2.2983	4.0721	1860.775	257.7430
1.0000	.0000	2.5537	4.0430	1969.889	286.2662

********** PORE PRESSURES **********

CHI	UW	U0	U
13.3007	18.675	18.675	.0002
12.0102	844.310	99.205	745.1049
10.6338	1010.700	185.093	825.6072
9.2497	1105.050	271.458	833.5922
7.8913	1190.934	356.223	834.7107
6.5474	1274.986	440.081	834.9056
5.2172	1358.037	523.086	834.9515
3.8990	1440.313	605.344	834.9682
2.5908	1521.949	686.973	834.9767
1.2915	1603.032	768.051	834.9808
.0000	1683.622	848.640	834.9824

TIMESTEP SIZE = .07, ITERATIONS BETWEEN PRINT TIMES = 16

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-13

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

          TIME =  .80000E+00          LOAD =   1095.000
          SET =      .3633

********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

   Y            CHI          Z           E            TOTAL        EFFECTIVE

  .0000       13.2367      .0000       3.6712       1118.670      1096.0000
  .1000       11.9828      .2554       4.1327       1225.439       207.1142
  .2000       10.6303      .5107       4.4168       1338.357        74.2594
  .3000        9.2446      .7661       4.3667       1453.349        88.9706
  .4000        7.8912     1.0215       4.2943       1566.327       115.5750
  .5000        6.5476     1.2769       4.2338       1678.696       143.7618
  .6000        5.2172     1.5322       4.1838       1790.235       172.2113
  .7000        3.8990     1.7876       4.1414       1901.019       200.7124
  .8000        2.5908     2.0430       4.1046       2011.172       229.2266
  .9000        1.2915     2.2983       4.0721       2120.775       257.7465
 1.0000         .0000     2.5537       4.0430       2229.889       286.2692

            ***********  PORE PRESSURES  ***********

   CHI          UW            U0            U

 13.2367      22.670        22.670        -.0002
 11.9828    1018.325       100.914       917.4107
 10.6303    1264.098       185.308      1078.7900
  9.2446    1364.378       271.774      1092.6040
  7.8912    1450.752       356.228      1094.5250
  6.5476    1534.935       440.072      1094.8630
  5.2172    1618.024       523.086      1094.9380
  3.8990    1700.306       605.344      1094.9620
  2.5908    1781.945       686.973      1094.9720
  1.2915    1863.029       768.051      1094.9770
   .0000    1943.620       848.640      1094.9790
TIMESTEP SIZE =     .07, ITERATIONS BETWEEN PRINT TIMES =     18
1
ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

          TIME =  .90000E+00          LOAD =   1355.000
          SET =      .4504

********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

   Y            CHI          Z           E            TOTAL        EFFECTIVE

  .0000       13.1496      .0000       3.6122       1384.105      1356.0000
  .1000       11.9414      .2554       3.9218       1488.019       443.4009
  .2000       10.6242      .5107       4.3682       1598.741        88.4902
  .3000        9.2382      .7661       4.3614       1713.748        90.7125
  .4000        7.8911     1.0215       4.2935       1826.334       115.8861
  .5000        6.5478     1.2769       4.2337       1938.679       143.8316
  .6000        5.2172     1.5322       4.1838       2050.236       172.2312
  .7000        3.8990     1.7876       4.1414       2161.019       200.7203
  .8000        2.5908     2.0430       4.1046       2271.172       229.2317
  .9000        1.2915     2.2983       4.0721       2380.775       257.7501
 1.0000         .0000     2.5537       4.0430       2489.889       286.2731

            ***********  PORE PRESSURES  ***********

   CHI          UW            U0            U
```

```
      13.1496      28.105        28.105          .0001
      11.9414    1044.618       103.494       941.1238
      10.6242    1510.250       185.691      1324.5590
       9.2382    1623.036       272.174      1350.8620
       7.8911    1710.448       356.235      1354.2130
       6.5478    1794.848       440.055      1354.7930
       5.2172    1878.005       523.087      1354.9180
       3.8990    1960.298       605.344      1354.9540
       2.5908    2041.940       686.973      1354.9670
       1.2915    2123.025       768.051      1354.9740
        .0000    2203.615       848.640      1354.9750
 TIMESTEP SIZE =      .06, ITERATIONS BETWEEN PRINT TIMES =      20
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .10000E+01          LOAD =   1615.000
               SET =      .5421

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

       Y            CHI          Z           E            TOTAL        EFFECTIVE

      .0000      13.0579      .0000      3.5636       1649.829      1616.0000
      .1000      11.8887      .2554      3.7265       1751.313       897.3665
      .2000      10.6116      .5107      4.2686       1859.528       126.8151
      .3000       9.2370      .7661      4.3502       1973.827        94.4453
      .4000       7.8909     1.0215      4.2921       2086.348       116.4643
      .5000       6.5484     1.2769      4.2335       2198.645       143.9522
      .6000       5.2172     1.5322      4.1837       2310.237       172.2629
      .7000       3.8990     1.7876      4.1414       2421.018       200.7317
      .8000       2.5908     2.0430      4.1046       2531.172       229.2372
      .9000       1.2915     2.2983      4.0721       2640.775       257.7541
     1.0000        .0000     2.5537      4.0430       2749.889       286.2766

                 ***********  PORE PRESSURES  ***********

       CHI          UW            U0             U

      13.0579      33.829        33.829          .0000
      11.8887     853.946       106.788       747.1583
      10.6116    1732.713       186.479      1546.2350
       9.2370    1879.382       272.253      1607.1290
       7.8909    1969.884       356.249      1613.6350
       6.5484    2054.692       440.020      1614.6720
       5.2172    2137.974       523.087      1614.8860
       3.8990    2220.287       605.344      1614.9420
       2.5908    2301.935       686.973      1614.9620
       1.2915    2383.021       768.051      1614.9700
        .0000    2463.612       848.640      1614.9720
 TIMESTEP SIZE =      .04, ITERATIONS BETWEEN PRINT TIMES =      23
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .12500E+01          LOAD =   1620.652
               SET =      .6653

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

       Y            CHI          Z           E            TOTAL        EFFECTIVE
```

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

.0000	12.9347	.0000	3.5626	1663.165	1621.6530
.1000	11.7549	.2554	3.6861	1765.311	1038.6220
.2000	10.5346	.5107	3.8893	1869.984	498.6145
.3000	9.2461	.7661	4.2296	1978.913	145.9453
.4000	7.8886	1.0215	4.2758	2092.142	123.5270
.5000	6.5473	1.2769	4.2312	2204.368	145.1333
.6000	5.2171	1.5322	4.1833	2315.894	172.5104
.7000	3.8990	1.7876	4.1413	2426.667	200.7984
.8000	2.5908	2.0430	4.1045	2536.825	229.2621
.9000	1.2915	2.2983	4.0721	2646.428	257.7678
1.0000	.0000	2.5537	4.0430	2755.541	286.2879

********** PORE PRESSURES **********

CHI	UW	U0	U
12.9347	41.512	41.513	-.0006
11.7549	726.689	115.134	611.5549
10.5346	1371.370	191.283	1180.0880
9.2461	1832.967	271.686	1561.2810
7.8886	1968.615	356.390	1612.2250
6.5473	2059.234	440.091	1619.1430
5.2171	2143.383	523.092	1620.2910
3.8990	2225.868	605.340	1620.5280
2.5908	2307.563	686.974	1620.5890
1.2915	2388.660	768.052	1620.6080
.0000	2469.253	848.640	1620.6130

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 34

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .15000E+01 LOAD = 1626.304
SET = .7964

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	12.8036	.0000	3.5617	1676.998	1627.3040
.1000	11.6275	.2554	3.6527	1778.914	1171.3840
.2000	10.4240	.5107	3.7823	1882.536	733.8152
.3000	9.1783	.7661	3.9899	1988.791	346.8416
.4000	7.8758	1.0215	4.1934	2098.592	166.3503
.5000	6.5410	1.2769	4.2161	2210.413	153.2472
.6000	5.2167	1.5322	4.1807	2321.572	174.1347
.7000	3.8993	1.7876	4.1408	2432.305	201.1579
.8000	2.5908	2.0430	4.1044	2542.479	229.3552
.9000	1.2915	2.2983	4.0720	2652.079	257.8011
1.0000	.0000	2.5537	4.0430	2761.193	286.3091

********** PORE PRESSURES **********

CHI	UW	U0	U
12.8036	49.694	49.694	-.0001
11.6275	607.530	123.085	484.4449
10.4240	1148.721	198.182	950.5389
9.1783	1641.949	275.912	1366.0370
7.8758	1932.242	357.188	1575.0540
6.5410	2057.166	440.484	1616.6820
5.2167	2147.438	523.119	1624.3190
3.8993	2231.147	605.326	1625.8210
2.5908	2313.123	686.975	1626.1480
1.2915	2394.278	768.051	1626.2270

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
      .0000    2474.884        848.640      1626.2440
 TIMESTEP SIZE =     .02, ITERATIONS BETWEEN PRINT TIMES =     47
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .17500E+01          LOAD =   1631.957
               SET =     .9010

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y            CHI          Z           E            TOTAL        EFFECTIVE

     .0000      12.6990      .0000       3.5607       1689.178      1632.9560
     .1000      11.5252      .2554       3.6353       1790.950      1247.5610
     .2000      10.3296      .5107       3.7328       1894.078       877.2215
     .3000       9.1049      .7661       3.8654       1999.023       543.5627
     .4000       7.8408     1.0215       4.0436       2106.431       285.7050
     .5000       6.5354     1.2769       4.1606       2216.411       187.2528
     .6000       5.2144     1.5322       4.1676       2327.366       182.5980
     .7000       3.8986     1.7876       4.1379       2438.000       203.2547
     .8000       2.5907     2.0430       4.1038       2548.138       229.8952
     .9000       1.2915     2.2983       4.0719       2657.731       257.9587
    1.0000        .0000     2.5537       4.0429       2766.845       286.3948

               ***********  PORE PRESSURES  ***********

      CHI          UW            U0            U

     12.6990      56.222        56.222         .0005
     11.5252     543.389       129.469       413.9201
     10.3296    1016.856       204.071       812.7848
      9.1049    1455.460       280.491      1174.9690
      7.8408    1820.726       359.375      1461.3510
      6.5354    2029.158       440.830      1588.3280
      5.2144    2144.768       523.260      1621.5080
      3.8986    2234.746       605.370      1629.3760
      2.5907    2318.243       686.983      1631.2600
      1.2915    2399.772       768.050      1631.7220
       .0000    2480.450       848.640      1631.8100
 TIMESTEP SIZE =     .02, ITERATIONS BETWEEN PRINT TIMES =     62
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .20000E+01          LOAD =   1637.609
               SET =     .9935

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y            CHI          Z           E            TOTAL        EFFECTIVE

     .0000      12.6065      .0000       3.5598       1700.603      1638.6090
     .1000      11.4342      .2554       3.6233       1802.277      1302.7240
     .2000      10.2438      .5107       3.7027       1905.082       977.9408
     .3000       9.0305      .7661       3.8040       2009.320       678.5795
     .4000       7.7880     1.0215       3.9317       2115.376       427.8489
     .5000       6.5114     1.2769       4.0657       2223.562       263.7534
     .6000       5.2067     1.5322       4.1300       2333.501       209.1323
     .7000       3.8956     1.7876       4.1270       2443.837       211.4211
     .8000       2.5901     2.0430       4.1008       2553.826       232.3520
     .9000       1.2914     2.2983       4.0710       2663.388       258.7503
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REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

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      1.0000        .0000      2.5537       4.0425       2772.498       286.8344

                 ***********  PORE PRESSURES  ***********

        CHI          UW              U0              U

      12.6065      61.994          61.994         -.0002
      11.4342     499.553         135.143        364.4099
      10.2438     927.142         209.424        717.7176
       9.0305    1330.740         285.136       1045.6040
       7.7880    1687.527         362.668       1324.8590
       6.5114    1959.808         442.329       1517.4800
       5.2067    2124.369         523.743       1600.6260
       3.8956    2232.416         605.554       1626.8620
       2.5901    2321.474         687.019       1634.4560
       1.2914    2404.637         768.055       1636.5820
        .0000    2485.663         848.640       1637.0230
  TIMESTEP SIZE =      .02, ITERATIONS BETWEEN PRINT TIMES =      78
 1
      ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

      ****Pond 8E, 13.6 feet of sludge, Power K

      PERVIOUS UPPER BOUNDARY
      IMPERVIOUS LOWER BOUNDARY

                 TIME =  .22500E+01          LOAD =   1643.261
                 SET =    1.0772

   ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

       Y           CHI          Z           E            TOTAL        EFFECTIVE

      .0000      12.5228      .0000       3.5588       1711.479       1644.2620
      .1000      11.3517      .2554       3.6144       1813.079       1345.1850
      .2000      10.1650      .5107       3.6818       1915.654       1054.7930
      .3000       8.9593      .7661       3.7643       2019.418        783.1646
      .4000       7.7302     1.0215       3.8646       2124.636        545.2299
      .5000       6.4737     1.2769       3.9773       2231.564        362.9008
      .6000       5.1899     1.5322       4.0685       2340.200        261.0864
      .7000       3.8898     1.7876       4.1010       2449.854        232.1709
      .8000       2.5881     2.0430       4.0919       2559.600        239.9285
      .9000       1.2908     2.2983       4.0679       2669.076        261.6429
     1.0000        .0000     2.5537       4.0408       2778.150        288.6210

                 ***********  PORE PRESSURES  ***********

        CHI          UW              U0              U

      12.5228      67.218          67.219         -.0007
      11.3517     467.894         140.293        327.6004
      10.1650     860.861         214.343        646.5173
       8.9593    1236.254         289.583        946.6709
       7.7302    1579.406         366.276       1213.1300
       6.4737    1868.663         444.679       1423.9840
       5.1899    2079.114         524.790       1554.3240
       3.8898    2217.683         605.919       1611.7640
       2.5881    2319.672         687.140       1632.5310
       1.2908    2407.434         768.092       1639.3420
        .0000    2489.529         848.640       1640.8890
  TIMESTEP SIZE =      .02, ITERATIONS BETWEEN PRINT TIMES =      94
 1
      ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

      ****Pond 8E, 13.6 feet of sludge, Power K

      PERVIOUS UPPER BOUNDARY
      IMPERVIOUS LOWER BOUNDARY

                 TIME =  .25000E+01          LOAD =   1648.913
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CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-18

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

SET = 1.1530

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	12.4470	.0000	3.5579	1721.860	1649.9120
.1000	11.2769	.2554	3.6075	1823.400	1379.2280
.2000	10.0930	.5107	3.6663	1925.800	1115.5930
.3000	8.8927	.7661	3.7362	2029.223	866.5204
.4000	7.6729	1.0215	3.8191	2133.863	642.5437
.5000	6.4305	1.2769	3.9128	2239.914	458.1759
.6000	5.1641	1.5322	4.0030	2347.465	330.8097
.7000	3.8781	1.7876	4.0601	2456.231	269.1899
.8000	2.5834	2.0430	4.0733	2565.547	256.5995
.9000	1.2892	2.2983	4.0600	2674.834	269.2821
1.0000	.0000	2.5537	4.0358	2783.802	293.8767

********** PORE PRESSURES **********

CHI	UW	U0	U
12.4470	71.948	71.947	.0006
11.2769	444.172	144.962	299.2104
10.0930	810.207	218.837	591.3698
8.8927	1162.703	293.736	868.9672
7.6729	1491.319	369.850	1121.4690
6.4305	1781.738	447.376	1334.3620
5.1641	2016.655	526.402	1490.2530
3.8781	2187.041	606.644	1580.3970
2.5834	2308.948	687.435	1621.5130
1.2892	2405.552	768.197	1637.3550
.0000	2489.925	848.640	1641.2850

TIMESTEP SIZE = .02, ITERATIONS BETWEEN PRINT TIMES = 111

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .27500E+01 LOAD = 1654.565
SET = 1.2229

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	12.3771	.0000	3.5569	1731.872	1655.5660
.1000	11.2078	.2554	3.6019	1833.361	1407.5530
.2000	10.0262	.5107	3.6541	1935.623	1165.4430
.3000	8.8300	.7661	3.7152	2038.786	935.0562
.4000	7.6171	1.0215	3.7859	2142.998	724.2480
.5000	6.3849	1.2769	3.8655	2248.409	543.4036
.6000	5.1319	1.5322	3.9469	2355.121	405.0741
.7000	3.8598	1.7876	4.0125	2463.031	319.6510
.8000	2.5747	2.0430	4.0445	2571.741	284.7956
.9000	1.2859	2.2983	4.0444	2680.691	284.8318
1.0000	.0000	2.5537	4.0249	2789.454	305.6871

********** PORE PRESSURES **********

CHI	UW	U0	U
12.3771	76.306	76.307	-.0005
11.2078	425.808	149.271	276.5370
10.0262	770.180	223.008	547.1722
8.8300	1103.729	297.646	806.0836
7.6171	1418.750	373.333	1045.4170

CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-19

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

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        6.3849    1705.006        450.220       1254.7860
        5.1319    1950.047        528.407       1421.6400
        3.8598    2143.379        607.791       1535.5880
        2.5747    2286.946        687.977       1598.9690
        1.2859    2395.859        768.402       1627.4570
         .0000    2483.767        848.640       1635.1270
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =    129
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .30000E+01          LOAD =   1660.217
               SET =    1.2879

   ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

       Y           CHI          Z           E            TOTAL        EFFECTIVE

      .0000      12.3121      .0000       3.5560       1741.580      1661.2180
      .1000      11.1435      .2554       3.5971       1843.025      1431.7880
      .2000       9.9637      .5107       3.6443       1945.173      1207.4230
      .3000       8.7709      .7661       3.6986       2048.128       992.7886
      .4000       7.5633     1.0215       3.7605       2152.008       793.9931
      .5000       6.3389     1.2769       3.8295       2256.932       618.8989
      .6000       5.0964     1.5322       3.9016       2362.990       476.9890
      .7000       3.8362     1.7876       3.9664       2470.155       377.5161
      .8000       2.5618     2.0430       4.0085       2578.199       324.2225
      .9000       1.2806     2.2983       4.0202       2686.675       310.8777
     1.0000        .0000     2.5537       4.0059       2795.106       327.2775

                 ***********  PORE PRESSURES  ***********

       CHI          UW            U0             U

      12.3121      80.362        80.362        -.0007
      11.1435     411.237       153.283       257.9539
       9.9637     737.750       226.906       510.8438
       8.7709    1055.339       301.336       754.0034
       7.5633    1358.015       376.691       981.3238
       6.3389    1638.033       453.090      1184.9430
       5.0964    1886.001       530.623      1355.3780
       3.8362    2092.639       609.264      1483.3750
       2.5618    2253.977       688.783      1565.1940
       1.2806    2375.797       768.733      1607.0640
        .0000    2467.829       848.640      1619.1890
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =    147
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .35000E+01          LOAD =   1671.522
               SET =    1.4061

   ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

       Y           CHI          Z           E            TOTAL        EFFECTIVE

      .0000      12.1939      .0000       3.5541       1760.261      1672.5220
      .1000      11.0265      .2554       3.5894       1861.632      1472.0840
      .2000       9.8495      .5107       3.6291       1963.600      1275.6380
      .3000       8.6618      .7661       3.6736       2066.238      1086.4620
      .4000       7.4621     1.0215       3.7231       2169.624       908.7034
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      .5000      6.2492     1.2769      3.7771      2273.837      747.5507
      .6000      5.0220     1.5322      3.8338      2378.936      609.3182
      .7000      3.7806     1.7876      3.8879      2484.926      501.1094
      .8000      2.5265     2.0430      3.9306      2591.705      429.5577
      .9000      1.2642     2.2983      3.9514      2699.001      398.5738
     1.0000       .0000     2.5537      3.9448      2806.410      408.0688

                 ***********  PORE PRESSURES  ***********

       CHI          UW            U0            U

     12.1939      87.739        87.739        -.0004
     11.0265     389.548       160.585       228.9627
      9.8495     687.962       234.028       453.9338
      8.6618     979.776       308.141       671.6340
      7.4621    1260.921       383.003       877.9178
      6.2492    1526.286       458.691      1067.5950
      5.0220    1769.618       535.265      1234.3530
      3.7806    1983.817       612.730      1371.0860
      2.5265    2162.147       690.984      1471.1630
      1.2642    2300.427       769.755      1530.6720
       .0000    2398.342       848.640      1549.7020
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =    184
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .40000E+01          LOAD =   1682.826
               SET =    1.5120

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

       Y            CHI          Z           E            TOTAL        EFFECTIVE

      .0000      12.0880       .0000      3.5522       1778.173      1683.8260
      .1000      10.9217       .2554      3.5831       1879.480      1506.1750
      .2000       9.7470       .5107      3.6171       1981.304      1331.9950
      .3000       8.5632       .7661      3.6545       2083.696      1163.9560
      .4000       7.3695      1.0215      3.6951       2186.710      1005.3850
      .5000       6.1650      1.2769      3.7382       2290.392       860.4291
      .6000       4.9494      1.5322      3.7821       2394.771       734.2050
      .7000       3.7228      1.7876      3.8233       2499.834       632.7968
      .8000       2.4867      2.0430      3.8558       2605.495       562.8298
      .9000       1.2442      2.2983      3.8723       2711.554       530.2632
     1.0000        .0000      2.5537      3.8680       2817.715       538.5397

                 ***********  PORE PRESSURES  ***********

       CHI          UW            U0            U

     12.0880      94.347        94.347        -.0001
     10.9217     373.305       167.129       206.1761
      9.7470     649.309       240.428       408.8813
      8.5632     919.740       314.296       605.4446
      7.3695    1181.326       388.785       792.5409
      6.1650    1429.963       463.942       966.0212
      4.9494    1660.567       539.796      1120.7700
      3.7228    1867.038       616.334      1250.7030
      2.4867    2042.665       693.470      1349.1950
      1.2442    2181.291       771.005      1410.2870
       .0000    2279.175       848.640      1430.5350
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =    222
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K
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CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-21

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .50000E+01 LOAD = 1705.435
SET = 1.6931

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.9069	.0000	3.5485	1812.084	1706.4350
.1000	10.7425	.2554	3.5714	1913.270	1571.1860
.2000	9.5720	.5107	3.5957	2014.832	1439.2330
.3000	8.3952	.7661	3.6211	2116.791	1313.0690
.4000	7.2118	1.0215	3.6471	2219.161	1195.6370
.5000	6.0218	1.2769	3.6726	2321.941	1090.3780
.6000	4.8254	1.5322	3.6962	2425.117	1001.2150
.7000	3.6235	1.7876	3.7159	2528.640	932.3848
.8000	2.4173	2.0430	3.7294	2632.431	888.0577
.9000	1.2087	2.2983	3.7346	2736.374	871.6767
1.0000	.0000	2.5537	3.7303	2840.323	885.2219

********** PORE PRESSURES **********

CHI	UW	U0	U
11.9069	105.649	105.649	-.0001
10.7425	342.084	178.310	163.7734
9.5720	575.600	251.348	324.2519
8.3952	803.722	324.782	478.9404
7.2118	1023.524	398.626	624.8975
6.0218	1231.563	472.882	758.6810
4.8254	1423.902	547.533	876.3695
3.6235	1596.255	622.531	973.7241
2.4173	1744.374	697.798	1046.5760
1.2087	1864.697	773.215	1091.4820
.0000	1955.102	848.640	1106.4620

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 301
1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .60000E+01 LOAD = 1728.043
SET = 1.8318

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.7682	.0000	3.5449	1843.347	1729.0440
.1000	10.6057	.2554	3.5597	1944.413	1638.9600
.2000	9.4394	.5107	3.5748	2045.717	1551.9260
.3000	8.2692	.7661	3.5898	2147.262	1470.1380
.4000	7.0952	1.0215	3.6041	2249.042	1395.9650
.5000	5.9178	1.2769	3.6172	2351.040	1331.9100
.6000	4.7372	1.5322	3.6281	2453.230	1280.4980
.7000	3.5543	1.7876	3.6360	2555.572	1244.1330
.8000	2.3697	2.0430	3.6404	2658.012	1224.8870
.9000	1.1846	2.2983	3.6405	2760.489	1224.2820
1.0000	.0000	2.5537	3.6363	2862.932	1243.1070

********** PORE PRESSURES **********

CHI	UW	U0	U

11.7682	114.304	114.304	-.0002
10.6057	305.452	186.844	118.6081
9.4394	493.791	259.624	234.1670
8.2692	677.124	332.644	344.4803
7.0952	853.077	405.899	447.1783
5.9178	1019.130	479.372	539.7581
4.7372	1172.732	553.037	619.6950
3.5543	1311.438	626.854	684.5845
2.3697	1433.125	700.770	732.3552
1.1846	1536.206	774.721	761.4850
.0000	1619.826	848.640	771.1856

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 385

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .70000E+01 LOAD = 1750.652
SET = 1.9281

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.6719	.0000	3.5413	1871.969	1751.6520
.1000	10.5111	.2554	3.5493	1972.923	1701.7180
.2000	9.3484	.5107	3.5571	2074.004	1654.2650
.3000	8.1837	.7661	3.5645	2175.207	1610.8590
.4000	7.0172	1.0215	3.5711	2276.521	1573.0850
.5000	5.8491	1.2769	3.5765	2377.931	1542.4910
.6000	4.6799	1.5322	3.5805	2479.417	1520.5300
.7000	3.5098	1.7876	3.5827	2580.952	1508.4800
.8000	2.3395	2.0430	3.5829	2682.507	1507.3700
.9000	1.1694	2.2983	3.5810	2784.048	1517.9110
1.0000	.0000	2.5537	3.5769	2885.541	1540.4520

********** PORE PRESSURES **********

CHI	UW	U0	U
11.6719	120.317	120.316	.0004
10.5111	271.205	192.746	78.4591
9.3484	419.739	265.302	154.4368
8.1837	564.348	337.980	226.3678
7.0172	703.436	410.769	292.6670
5.8491	835.440	483.655	351.7855
4.6799	958.887	556.615	402.2711
3.5098	1072.472	629.626	442.8461
2.3395	1175.136	702.656	472.4807
1.1694	1266.137	775.672	490.4649
.0000	1345.089	848.640	496.4491

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 474

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .80000E+01 LOAD = 1773.261
SET = 1.9904

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE

.0000	11.6096	.0000	3.5377	1898.460	1774.2610
.1000	10.4504	.2554	3.5410	1999.321	1753.4500
.2000	9.2904	.5107	3.5440	2100.231	1734.5390
.3000	8.1296	.7661	3.5466	2201.186	1718.5010
.4000	6.9683	1.0215	3.5485	2302.178	1706.2720
.5000	5.8066	1.2769	3.5498	2403.195	1698.7340
.6000	4.6446	1.5322	3.5501	2504.225	1696.6770
.7000	3.4827	1.7876	3.5494	2605.253	1700.7690
.8000	2.3211	2.0430	3.5477	2706.261	1711.5270
.9000	1.1601	2.2983	3.5448	2807.232	1729.2980
1.0000	.0000	2.5537	3.5409	2908.149	1754.2450

********** PORE PRESSURES **********

CHI	UW	U0	U
11.6096	124.199	124.199	.0000
10.4504	245.871	196.535	49.3358
9.2904	365.692	268.921	96.7712
8.1296	482.686	341.351	141.3349
6.9683	595.906	413.818	182.0883
5.8066	704.461	486.310	218.1511
4.6446	807.549	558.815	248.7334
3.4827	904.483	631.318	273.1658
2.3211	994.734	703.801	290.9325
1.1601	1077.934	776.248	301.6865
.0000	1153.904	848.640	305.2641

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 568

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .90000E+01 LOAD = 1795.870
SET = 2.0295

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.5705	.0000	3.5342	1923.508	1796.8690
.1000	10.4126	.2554	3.5346	2024.290	1794.4610
.2000	9.2546	.5107	3.5347	2125.075	1793.5260
.3000	8.0965	.7661	3.5346	2225.861	1794.6140
.4000	6.9386	1.0215	3.5340	2326.640	1798.2460
.5000	5.7809	1.2769	3.5330	2427.408	1804.8960
.6000	4.6235	1.5322	3.5314	2528.154	1814.9780
.7000	3.4665	1.7876	3.5293	2628.872	1828.8390
.8000	2.3102	2.0430	3.5266	2729.552	1846.7370
.9000	1.1546	2.2983	3.5233	2830.184	1868.8430
1.0000	.0000	2.5537	3.5195	2930.758	1895.2330

********** PORE PRESSURES **********

CHI	UW	U0	U
11.5705	126.639	126.639	.0001
10.4126	229.828	198.895	30.9329
9.2546	331.549	271.156	60.3935
8.0965	431.246	343.416	87.8297
6.9386	528.394	415.671	112.7225
5.7809	622.512	487.914	134.5982
4.6235	713.177	560.136	153.0408
3.4665	800.034	632.329	167.7048
2.3102	882.815	704.483	178.3316
1.1546	961.341	776.590	184.7502
.0000	1035.526	848.640	186.8857

CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-24

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

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 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =    665
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .10000E+02          LOAD =   1818.478
               SET =    2.0545

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y            CHI          Z           E            TOTAL        EFFECTIVE

     .0000      11.5455      .0000       3.5308       1947.681      1819.4780
     .1000      10.3886      .2554       3.5295       2048.394      1827.7470
     .2000       9.2321      .5107       3.5281       2149.086      1837.2180
     .3000       8.0760      .7661       3.5264       2249.753      1848.1890
     .4000       6.9203     1.0215       3.5245       2350.392      1860.9300
     .5000       5.7651     1.2769       3.5223       2450.999      1875.6920
     .6000       4.6106     1.5322       3.5198       2551.567      1892.6880
     .7000       3.4567     1.7876       3.5170       2652.094      1912.0910
     .8000       2.3036     2.0430       3.5138       2752.573      1934.0270
     .9000       1.1513     2.2983       3.5103       2852.999      1958.5820
    1.0000        .0000     2.5537       3.5065       2953.367      1985.7880

                **********  PORE PRESSURES  **********

      CHI          UW            U0            U

     11.5455     128.203       128.202        .0004
     10.3886     220.647       200.391      20.2566
      9.2321     311.868       272.558      39.3101
      8.0760     401.564       344.700      56.8643
      6.9203     489.462       416.814      72.6479
      5.7651     575.306       488.896      86.4106
      4.6106     658.880       560.940      97.9396
      3.4567     740.003       632.942     107.0613
      2.3036     818.546       704.896     113.6499
      1.1513     894.417       776.797     117.6197
       .0000     967.579       848.640     118.9394
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =    770
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .12000E+02          LOAD =   1863.696
               SET =    2.0844

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y            CHI          Z           E            TOTAL        EFFECTIVE

     .0000      11.5156      .0000       3.5240       1994.764      1864.6960
     .1000      10.3606      .2554       3.5214       2095.358      1882.0280
     .2000       9.2063      .5107       3.5187       2195.911      1900.3160
     .3000       8.0527      .7661       3.5159       2296.420      1919.6350
     .4000       6.8999     1.0215       3.5130       2396.883      1940.0530
     .5000       5.7478     1.2769       3.5099       2497.298      1961.6280
     .6000       4.5965     1.5322       3.5067       2597.664      1984.4110
     .7000       3.4460     1.7876       3.5034       2697.978      2008.4430
     .8000       2.2964     2.0430       3.4999       2798.237      2033.7490
     .9000       1.1478     2.2983       3.4963       2898.440      2060.3430
    1.0000        .0000     2.5537       3.4926       2998.584      2088.2280
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CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-25

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

********** PORE PRESSURES **********

CHI	UW	U0	U
11.5156	130.068	130.068	-.0004
10.3606	213.330	202.138	11.1925
9.2063	295.595	274.165	21.4296
8.0527	376.784	346.149	30.6349
6.8999	456.830	418.088	38.7424
5.7478	535.671	489.978	45.6925
4.5965	613.253	561.819	51.4344
3.4460	689.534	633.608	55.9266
2.2964	764.488	705.342	59.1460
1.1478	838.097	777.020	61.0767
.0000	910.356	848.640	61.7164

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 988

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .12500E+02 LOAD = 1875.000
SET = 2.0899

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.5101	.0000	3.5223	2006.408	1876.0000
.1000	10.3556	.2554	3.5196	2106.974	1894.3090
.2000	9.2018	.5107	3.5168	2207.497	1913.5450
.3000	8.0487	.7661	3.5139	2307.975	1933.7580
.4000	6.8964	1.0215	3.5109	2408.405	1954.9950
.5000	5.7449	1.2769	3.5077	2508.786	1977.2960
.6000	4.5941	1.5322	3.5045	2609.115	2000.6950
.7000	3.4443	1.7876	3.5011	2709.393	2025.2190
.8000	2.2953	2.0430	3.4976	2809.615	2050.8820
.9000	1.1472	2.2983	3.4940	2909.781	2077.6930
1.0000	.0000	2.5537	3.4903	3009.889	2105.6500

********** PORE PRESSURES **********

CHI	UW	U0	U
11.5101	130.407	130.408	-.0004
10.3556	212.665	202.449	10.2154
9.2018	293.952	274.447	19.5049
8.0487	374.217	346.400	27.8169
6.8964	453.410	418.305	35.1046
5.7449	531.490	490.161	41.3286
4.5941	608.421	561.966	46.4546
3.4443	684.174	633.719	50.4551
2.2953	758.733	705.416	53.3166
1.1472	832.088	777.057	55.0305
.0000	904.238	848.640	55.5983

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1046

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .15000E+02 LOAD = 1931.522
SET = 2.1127

CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-26

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

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********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

     Y            CHI          Z           E            TOTAL        EFFECTIVE

    .0000      11.4873      .0000      3.5141       2064.352      1932.5210
    .1000      10.3350      .2554      3.5111       2164.785      1952.9520
    .2000       9.1833      .5107      3.5081       2265.172      1974.2330
    .3000       8.0325      .7661      3.5051       2365.510      1996.3720
    .4000       6.8824     1.0215      3.5019       2465.798      2019.3670
    .5000       5.7332     1.2769      3.4986       2566.035      2043.2220
    .6000       4.5848     1.5322      3.4953       2666.220      2067.9360
    .7000       3.4373     1.7876      3.4919       2766.351      2093.5080
    .8000       2.2906     2.0430      3.4884       2866.427      2119.9310
    .9000       1.1448     2.2983      3.4849       2966.447      2147.2030
   1.0000        .0000     2.5537      3.4813       3066.410      2175.3110

                ***********  PORE PRESSURES  ***********

     CHI          UW             U0             U

   11.4873     131.830        131.830          .0004
   10.3350     211.834        203.739         8.0951
    9.1833     290.939        275.601        15.3384
    8.0325     369.139        347.414        21.7246
    6.8824     446.431        419.177        27.2541
    5.7332     522.814        490.889        31.9245
    4.5848     598.284        562.549        35.7347
    3.4373     672.843        634.155        38.6875
    2.2906     746.496        705.706        40.7895
    1.1448     819.244        777.202        42.0424
     .0000     891.100        848.640        42.4596
 TIMESTEP SIZE =     .01, ITERATIONS BETWEEN PRINT TIMES =   1335
1
    ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

    ****Pond 8E, 13.6 feet of sludge, Power K

    PERVIOUS UPPER BOUNDARY
    IMPERVIOUS LOWER BOUNDARY

              TIME =  .17500E+02          LOAD =   1988.043
              SET =    2.1326

********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

     Y            CHI          Z           E            TOTAL        EFFECTIVE

    .0000      11.4674      .0000      3.5061       2122.121      1989.0430
    .1000      10.3170      .2554      3.5032       2222.427      2010.0260
    .2000       9.1674      .5107      3.5002       2322.687      2031.8260
    .3000       8.0186      .7661      3.4971       2422.898      2054.4390
    .4000       6.8706     1.0215      3.4940       2523.060      2077.8630
    .5000       5.7233     1.2769      3.4908       2623.171      2102.0920
    .6000       4.5770     1.5322      3.4875       2723.231      2127.1200
    .7000       3.4314     1.7876      3.4841       2823.238      2152.9380
    .8000       2.2867     2.0430      3.4807       2923.191      2179.5390
    .9000       1.1429     2.2983      3.4773       3023.089      2206.9150
   1.0000        .0000     2.5537      3.4738       3122.932      2235.0590

                ***********  PORE PRESSURES  ***********

     CHI          UW             U0             U

   11.4674     133.078        133.077          .0006
   10.3170     212.402        204.859         7.5428
    9.1674     290.861        276.594        14.2674
    8.0186     368.459        348.280        20.1791
    6.8706     445.197        419.917        25.2796
    5.7233     521.079        491.504        29.5758
```

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

```
        4.5770      596.111        563.038        33.0730
        3.4314      670.300        634.520        35.7793
        2.2867      743.652        705.948        37.7036
        1.1429      816.175        777.322        38.8527
         .0000      887.873        848.640        39.2328
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =   1633
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .18000E+02          LOAD =   1999.348
               SET =    2.1365

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y            CHI          Z           E            TOTAL        EFFECTIVE

     .0000      11.4635       .0000       3.5045       2133.666      2000.3470
     .1000      10.3135       .2554       3.5016       2233.948      2021.3910
     .2000       9.1643       .5107       3.4986       2334.183      2043.2460
     .3000       8.0159       .7661       3.4956       2434.369      2065.9120
     .4000       6.8683      1.0215       3.4924       2534.507      2089.3810
     .5000       5.7214      1.2769       3.4892       2634.594      2113.6460
     .6000       4.5754      1.5322       3.4860       2734.629      2138.7020
     .7000       3.4303      1.7876       3.4826       2834.612      2164.5450
     .8000       2.2860      2.0430       3.4793       2934.542      2191.1670
     .9000       1.1425      2.2983       3.4758       3034.417      2218.5570
    1.0000        .0000      2.5537       3.4723       3134.237      2246.7070

                **********  PORE PRESSURES  **********

      CHI          UW            U0             U

     11.4635     133.320       133.318         .0011
     10.3135     212.557       205.075        7.4814
      9.1643     290.937       276.785       14.1514
      8.0159     368.458       348.447       20.0108
      6.8683     445.126       420.059       25.0666
      5.7214     520.948       491.622       29.3266
      4.5754     595.927       563.132       32.7951
      3.4303     670.067       634.590       35.4764
      2.2860     743.375       705.995       37.3797
      1.1425     815.860       777.345       38.5145
       .0000     887.529       848.640       38.8892
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =   1695
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .20000E+02          LOAD =   2044.565
               SET =    2.1517

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y            CHI          Z           E            TOTAL        EFFECTIVE

     .0000      11.4483       .0000       3.4983       2179.832      2045.5650
     .1000      10.2999       .2554       3.4954       2280.015      2066.8040
     .2000       9.1523       .5107       3.4925       2380.152      2088.8380
     .3000       8.0054       .7661       3.4895       2480.241      2111.6600
     .4000       6.8593      1.0215       3.4864       2580.283      2135.2660
     .5000       5.7140      1.2769       3.4833       2680.274      2159.6490
```

.6000	4.5695	1.5322	3.4801	2780.215	2184.8040
.7000	3.4259	1.7876	3.4768	2880.104	2210.7210
.8000	2.2831	2.0430	3.4735	2979.941	2237.3920
.9000	1.1411	2.2983	3.4701	3079.725	2264.8120
1.0000	.0000	2.5537	3.4667	3179.454	2292.9730

********** PORE PRESSURES **********

CHI	UW	U0	U
11.4483	134.266	134.266	-.0001
10.2999	213.210	205.925	7.2856
9.1523	291.314	277.537	13.7773
8.0054	368.582	349.102	19.4801
6.8593	445.017	420.618	24.3985
5.7140	520.625	492.085	28.5401
4.5695	595.411	563.501	31.9107
3.4259	669.384	634.865	34.5186
2.2831	742.549	706.177	36.3720
1.1411	814.912	777.436	37.4768
.0000	886.481	848.640	37.8410

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 1941

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .22500E+02 LOAD = 2101.087
SET = 2.1702

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.4298	.0000	3.4908	2237.507	2102.0870
.1000	10.2834	.2554	3.4879	2337.570	2123.5230
.2000	9.1376	.5107	3.4851	2437.588	2145.7340
.3000	7.9927	.7661	3.4821	2537.560	2168.7120
.4000	6.8484	1.0215	3.4791	2637.483	2192.4540
.5000	5.7050	1.2769	3.4760	2737.359	2216.9480
.6000	4.5624	1.5322	3.4729	2837.185	2242.1940
.7000	3.4205	1.7876	3.4697	2936.960	2268.1810
.8000	2.2795	2.0430	3.4665	3036.684	2294.9040
.9000	1.1393	2.2983	3.4632	3136.356	2322.3530
1.0000	.0000	2.5537	3.4598	3235.976	2350.5230

********** PORE PRESSURES **********

CHI	UW	U0	U
11.4298	135.420	135.420	.0002
10.2834	214.047	206.958	7.0883
9.1376	291.854	278.451	13.4023
7.9927	368.848	349.898	18.9498
6.8484	445.030	421.297	23.7328
5.7050	520.411	492.648	27.7633
4.5624	594.990	563.949	31.0418
3.4205	668.779	635.199	33.5798
2.2795	741.781	706.398	35.3821
1.1393	814.003	777.546	36.4577
.0000	885.453	848.640	36.8127

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2255

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-29

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .24000E+02 LOAD = 2135.000
SET = 2.1810

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.4190	.0000	3.4863	2272.097	2136.0000
.1000	10.2736	.2554	3.4835	2372.090	2157.5460
.2000	9.1290	.5107	3.4807	2472.038	2179.8520
.3000	7.9852	.7661	3.4778	2571.940	2202.9160
.4000	6.8421	1.0215	3.4748	2671.795	2226.7300
.5000	5.6997	1.2769	3.4718	2771.603	2251.2850
.6000	4.5581	1.5322	3.4687	2871.361	2276.5780
.7000	3.4174	1.7876	3.4655	2971.070	2302.6010
.8000	2.2774	2.0430	3.4623	3070.728	2329.3500
.9000	1.1383	2.2983	3.4591	3170.334	2356.8170
1.0000	.0000	2.5537	3.4558	3269.889	2384.9920

********** PORE PRESSURES **********

CHI	UW	U0	U
11.4190	136.097	136.097	.0005
10.2736	214.544	207.565	6.9787
9.1290	292.186	278.988	13.1974
7.9852	369.024	350.366	18.6586
6.8421	445.065	421.696	23.3697
5.6997	520.317	492.978	27.3392
4.5581	594.783	564.212	30.5713
3.4174	668.469	635.395	33.0735
2.2774	741.378	706.529	34.8493
1.1383	813.517	777.610	35.9067
.0000	884.896	848.640	36.2563

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2448
1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .25000E+02 LOAD = 2429.000
SET = 2.2235

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.3765	.0000	3.4506	2568.747	2430.0010
.1000	10.2395	.2554	3.4538	2668.219	2402.4480
.2000	9.1019	.5107	3.4560	2767.734	2383.1290
.3000	7.9637	.7661	3.4574	2867.278	2371.4250
.4000	6.8254	1.0215	3.4579	2966.837	2366.6970
.5000	5.6870	1.2769	3.4577	3066.398	2368.3270
.6000	4.5487	1.5322	3.4569	3165.952	2375.7380
.7000	3.4107	1.7876	3.4554	3265.486	2388.4270
.8000	2.2732	2.0430	3.4534	3364.993	2405.9740
.9000	1.1362	2.2983	3.4508	3464.463	2428.0590
1.0000	.0000	2.5537	3.4478	3563.889	2454.4690

********** PORE PRESSURES **********

CHI	UW	U0	U
11.3765	138.746	138.747	-.0007

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

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      10.2395     265.772        209.694        56.0774
       9.1019     384.605        280.685       103.9206
       7.9637     495.853        351.703       144.1493
       6.8254     600.140        422.737       177.4029
       5.6870     698.072        493.774       204.2974
       4.5487     790.214        564.802       225.4112
       3.4107     877.059        635.812       241.2468
       2.2732     959.019        706.794       252.2253
       1.1362    1036.404        777.739       258.6652
        .0000    1109.420        848.640       260.7799
 TIMESTEP SIZE =     .01, ITERATIONS BETWEEN PRINT TIMES =   2579
1
    ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

    ****Pond 8E, 13.6 feet of sludge, Power K

    PERVIOUS UPPER BOUNDARY
    IMPERVIOUS LOWER BOUNDARY

              TIME =  .26000E+02          LOAD =   2723.000
              SET =    2.2897

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

     Y           CHI          Z           E            TOTAL        EFFECTIVE

    .0000      11.3103      .0000       3.4190       2866.879      2724.0010
    .1000      10.1813      .2554       3.4232       2965.855      2683.1510
    .2000       9.0513      .5107       3.4266       3064.891      2650.1350
    .3000       7.9205      .7661       3.4292       3163.977      2624.8620
    .4000       6.7891     1.0215       3.4311       3263.098      2607.2130
    .5000       5.6574     1.2769       3.4322       3362.242      2597.0470
    .6000       4.5255     1.5322       3.4325       3461.398      2594.2210
    .7000       3.3936     1.7876       3.4320       3560.552      2598.5810
    .8000       2.2619     2.0430       3.4308       3659.693      2609.9930
    .9000       1.1307     2.2983       3.4289       3758.810      2628.3270
   1.0000        .0000     2.5537       3.4262       3857.889      2653.4830

              ***********  PORE PRESSURES  ***********

     CHI          UW            U0            U

    11.3103     142.877       142.879        -.0012
    10.1813     282.703       213.330       69.3735
     9.0513     414.756       283.842      130.9147
     7.9205     539.115       354.402      184.7130
     6.7891     655.885       424.998      230.8863
     5.6574     765.195       495.618      269.5772
     4.5255     867.177       566.249      300.9283
     3.3936     961.971       636.878      325.0930
     2.2619    1049.701       707.495      342.2063
     1.1307    1130.482       778.086      352.3964
      .0000    1204.406       848.640      355.7655
 TIMESTEP SIZE =     .01, ITERATIONS BETWEEN PRINT TIMES =   2714
1
    ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

    ****Pond 8E, 13.6 feet of sludge, Power K

    PERVIOUS UPPER BOUNDARY
    IMPERVIOUS LOWER BOUNDARY

              TIME =  .27500E+02          LOAD =   2723.000
              SET =    2.3368

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

     Y           CHI          Z           E            TOTAL        EFFECTIVE

    .0000      11.2632      .0000       3.4190       2869.815      2724.0010
```

.1000	10.1349	.2554	3.4175	2968.745	2738.2230
.2000	9.0070	.5107	3.4161	3067.652	2752.8080
.3000	7.8795	.7661	3.4145	3166.535	2768.1120
.4000	6.7523	1.0215	3.4129	3265.393	2784.4610
.5000	5.6256	1.2769	3.4111	3364.224	2802.1560
.6000	4.4994	1.5322	3.4092	3463.026	2821.4650
.7000	3.3737	1.7876	3.4072	3561.796	2842.6010
.8000	2.2485	2.0430	3.4049	3660.532	2865.7370
.9000	1.1239	2.2983	3.4025	3759.230	2890.9900
1.0000	.0000	2.5537	3.3999	3857.889	2918.4230

********** PORE PRESSURES **********

CHI	UW	U0	U
11.2632	145.814	145.815	-.0012
10.1349	230.522	216.220	14.3017
9.0070	314.844	286.602	28.2416
7.8795	398.423	356.960	41.4628
6.7523	480.931	427.293	53.6380
5.6256	562.067	497.599	64.4678
4.4994	641.561	567.876	73.6846
3.3737	719.195	638.122	81.0732
2.2485	794.795	708.333	86.4619
1.1239	868.241	778.507	89.7341
.0000	939.465	848.640	90.8254

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 2935

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .28000E+02 LOAD = 2723.000
SET = 2.3423

******** COORDINATES ********* VOID RATIO ****** STRESSES *******

Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.2577	.0000	3.4190	2870.160	2724.0010
.1000	10.1295	.2554	3.4170	2969.086	2743.7100
.2000	9.0018	.5107	3.4150	3067.980	2763.6480
.3000	7.8746	.7661	3.4129	3166.841	2784.0300
.4000	6.7479	1.0215	3.4108	3265.670	2805.0600
.5000	5.6218	1.2769	3.4087	3364.465	2826.9220
.6000	4.4962	1.5322	3.4065	3463.226	2849.7790
.7000	3.3712	1.7876	3.4041	3561.950	2873.7620
.8000	2.2468	2.0430	3.4017	3660.636	2898.9760
.9000	1.1231	2.2983	3.3992	3759.283	2925.4930
1.0000	.0000	2.5537	3.3966	3857.889	2953.3480

********** PORE PRESSURES **********

CHI	UW	U0	U
11.2577	146.159	146.160	-.0012
10.1295	225.375	216.561	8.8144
9.0018	304.332	286.930	17.4018
7.8746	382.811	357.267	25.5446
6.7479	460.611	427.571	33.0399
5.6218	537.544	497.841	39.7025
4.4962	613.447	568.077	45.3706
3.3712	688.188	638.276	49.9119
2.2468	761.660	708.437	53.2231
1.1231	833.790	778.559	55.2309
.0000	904.541	848.640	55.9006

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 3015

CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-32

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

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1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

              TIME =  .30000E+02          LOAD =   2723.000
              SET =    2.3499

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

     Y          CHI         Z          E            TOTAL        EFFECTIVE

    .0000     11.2501      .0000      3.4190       2870.631      2724.0010
    .1000     10.1220      .2554      3.4162       2969.550      2751.2870
    .2000      8.9946      .5107      3.4135       3068.426      2778.6100
    .3000      7.8679      .7661      3.4108       3167.259      2805.9940
    .4000      6.7419     1.0215      3.4081       3266.048      2833.4720
    .5000      5.6165     1.2769      3.4054       3364.794      2861.0620
    .6000      4.4919     1.5322      3.4027       3463.498      2888.7930
    .7000      3.3679     1.7876      3.4000       3562.159      2916.6830
    .8000      2.2446     2.0430      3.3974       3660.778      2944.7490
    .9000      1.1220     2.2983      3.3947       3759.354      2972.9940
   1.0000       .0000     2.5537      3.3921       3857.889      3001.4280

              ***********  PORE PRESSURES  ***********

     CHI          UW            U0            U

    11.2501     146.630       146.631       -.0012
    10.1220     218.263       217.025       1.2375
     8.9946     289.816       287.376       2.4396
     7.8679     361.265       357.684       3.5807
     6.7419     432.575       427.948       4.6273
     5.6165     503.732       498.170       5.5626
     4.4919     574.704       568.348       6.3558
     3.3679     645.476       638.485       6.9910
     2.2446     716.029       708.579       7.4504
     1.1220     786.360       778.630       7.7297
      .0000     856.461       848.640       7.8205
 TIMESTEP SIZE =     .01, ITERATIONS BETWEEN PRINT TIMES =   3338
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

              TIME =  .32000E+02          LOAD =   2723.000
              SET =    2.3509

  ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

     Y          CHI         Z          E            TOTAL        EFFECTIVE

    .0000     11.2491      .0000      3.4190       2870.696      2724.0010
    .1000     10.1210      .2554      3.4161       2969.615      2752.3530
    .2000      8.9936      .5107      3.4133       3068.488      2780.7080
    .3000      7.8670      .7661      3.4105       3167.316      2809.0700
    .4000      6.7410     1.0215      3.4077       3266.100      2837.4450
    .5000      5.6158     1.2769      3.4049       3364.840      2865.8380
    .6000      4.4912     1.5322      3.4022       3463.535      2894.2510
    .7000      3.3674     1.7876      3.3995       3562.188      2922.6890
    .8000      2.2443     2.0430      3.3968       3660.797      2951.1530
    .9000      1.1218     2.2983      3.3941       3759.364      2979.6370
   1.0000       .0000     2.5537      3.3915       3857.889      3008.1500
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CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-33

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

********** PORE PRESSURES **********

CHI	UW	U0	U
11.2491	146.695	146.696	-.0012
10.1210	217.262	217.090	.1716
8.9936	287.780	287.438	.3415
7.8670	358.246	357.742	.5043
6.7410	428.655	428.001	.6542
5.6158	499.001	498.215	.7860
4.4912	569.284	568.386	.8980
3.3674	639.499	638.514	.9849
2.2443	709.644	708.598	1.0461
1.1218	779.727	778.640	1.0869
.0000	849.739	848.640	1.0986

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 3666

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .34000E+02 LOAD = 2723.000
SET = 2.3510

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.2490	.0000	3.4190	2870.705	2724.0010
.1000	10.1209	.2554	3.4161	2969.624	2752.4910
.2000	8.9935	.5107	3.4132	3068.497	2780.9840
.3000	7.8668	.7661	3.4104	3167.324	2809.4810
.4000	6.7409	1.0215	3.4076	3266.107	2837.9830
.5000	5.6157	1.2769	3.4048	3364.846	2866.4870
.6000	4.4912	1.5322	3.4021	3463.541	2894.9960
.7000	3.3673	1.7876	3.3994	3562.192	2923.5100
.8000	2.2442	2.0430	3.3967	3660.800	2952.0270
.9000	1.1218	2.2983	3.3940	3759.365	2980.5480
1.0000	.0000	2.5537	3.3914	3857.889	3009.0690

********** PORE PRESSURES **********

CHI	UW	U0	U
11.2490	146.704	146.705	-.0012
10.1209	217.133	217.099	.0341
8.9935	287.513	287.447	.0661
7.8668	357.843	357.750	.0934
6.7409	428.125	428.008	.1168
5.6157	498.359	498.221	.1373
4.4912	568.544	568.391	.1531
3.3673	638.682	638.518	.1646
2.2442	708.773	708.601	.1723
1.1218	778.818	778.642	.1762
.0000	848.819	848.640	.1794

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 3994

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .35000E+02 LOAD = 2723.000
SET = 2.3510

CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-34

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

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********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y          CHI         Z          E          TOTAL        EFFECTIVE

    .0000     11.2490      .0000     3.4190     2870.705      2724.0010
    .1000     10.1209      .2554     3.4161     2969.624      2752.4910
    .2000      8.9935      .5107     3.4132     3068.497      2780.9840
    .3000      7.8668      .7661     3.4104     3167.324      2809.4810
    .4000      6.7409     1.0215     3.4076     3266.107      2837.9830
    .5000      5.6157     1.2769     3.4048     3364.846      2866.4870
    .6000      4.4912     1.5322     3.4021     3463.541      2894.9960
    .7000      3.3673     1.7876     3.3994     3562.192      2923.5100
    .8000      2.2442     2.0430     3.3967     3660.800      2952.0270
    .9000      1.1218     2.2983     3.3940     3759.365      2980.5480
   1.0000       .0000     2.5537     3.3914     3857.889      3009.0690

                ***********  PORE PRESSURES  ***********

      CHI          UW           U0           U

    11.2490     146.704      146.705      -.0012
    10.1209     217.133      217.099       .0341
     8.9935     287.513      287.447       .0661
     7.8668     357.843      357.750       .0934
     6.7409     428.125      428.008       .1168
     5.6157     498.359      498.221       .1373
     4.4912     568.544      568.391       .1531
     3.3673     638.682      638.518       .1646
     2.2442     708.773      708.601       .1723
     1.1218     778.818      778.642       .1762
      .0000     848.819      848.640       .1794
 TIMESTEP SIZE =     .01, ITERATIONS BETWEEN PRINT TIMES =   4158
1
    ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

    ****Pond 8E, 13.6 feet of sludge, Power K

    PERVIOUS UPPER BOUNDARY
    IMPERVIOUS LOWER BOUNDARY

              TIME =  .38000E+02          LOAD =   2723.000
              SET =    2.3510

********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y          CHI         Z          E          TOTAL        EFFECTIVE

    .0000     11.2490      .0000     3.4190     2870.705      2724.0010
    .1000     10.1209      .2554     3.4161     2969.624      2752.4910
    .2000      8.9935      .5107     3.4132     3068.497      2780.9840
    .3000      7.8668      .7661     3.4104     3167.324      2809.4810
    .4000      6.7409     1.0215     3.4076     3266.107      2837.9830
    .5000      5.6157     1.2769     3.4048     3364.846      2866.4870
    .6000      4.4912     1.5322     3.4021     3463.541      2894.9960
    .7000      3.3673     1.7876     3.3994     3562.192      2923.5100
    .8000      2.2442     2.0430     3.3967     3660.800      2952.0270
    .9000      1.1218     2.2983     3.3940     3759.365      2980.5480
   1.0000       .0000     2.5537     3.3914     3857.889      3009.0690

                ***********  PORE PRESSURES  ***********

      CHI          UW           U0           U

    11.2490     146.704      146.705      -.0012
    10.1209     217.133      217.099       .0341
     8.9935     287.513      287.447       .0661
     7.8668     357.843      357.750       .0934
     6.7409     428.125      428.008       .1168
     5.6157     498.359      498.221       .1373
     4.4912     568.544      568.391       .1531
```

3.3673	638.682	638.518	.1646
2.2442	708.773	708.601	.1723
1.1218	778.818	778.642	.1762
.0000	848.819	848.640	.1794

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 4650

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .40000E+02 LOAD = 2723.000
SET = 2.3510

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.2490	.0000	3.4190	2870.705	2724.0010
.1000	10.1209	.2554	3.4161	2969.624	2752.4910
.2000	8.9935	.5107	3.4132	3068.497	2780.9840
.3000	7.8668	.7661	3.4104	3167.324	2809.4810
.4000	6.7409	1.0215	3.4076	3266.107	2837.9830
.5000	5.6157	1.2769	3.4048	3364.846	2866.4870
.6000	4.4912	1.5322	3.4021	3463.541	2894.9960
.7000	3.3673	1.7876	3.3994	3562.192	2923.5100
.8000	2.2442	2.0430	3.3967	3660.800	2952.0270
.9000	1.1218	2.2983	3.3940	3759.365	2980.5480
1.0000	.0000	2.5537	3.3914	3857.889	3009.0690

********** PORE PRESSURES **********

CHI	UW	U0	U
11.2490	146.704	146.705	-.0012
10.1209	217.133	217.099	.0341
8.9935	287.513	287.447	.0661
7.8668	357.843	357.750	.0934
6.7409	428.125	428.008	.1168
5.6157	498.359	498.221	.1373
4.4912	568.544	568.391	.1531
3.3673	638.682	638.518	.1646
2.2442	708.773	708.601	.1723
1.1218	778.818	778.642	.1762
.0000	848.819	848.640	.1794

TIMESTEP SIZE = .01, ITERATIONS BETWEEN PRINT TIMES = 4978

1

ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

****Pond 8E, 13.6 feet of sludge, Power K

PERVIOUS UPPER BOUNDARY
IMPERVIOUS LOWER BOUNDARY

TIME = .45000E+02 LOAD = 2723.000
SET = 2.3510

******** COORDINATES *********			VOID RATIO	****** STRESSES *******	
Y	CHI	Z	E	TOTAL	EFFECTIVE
.0000	11.2490	.0000	3.4190	2870.705	2724.0010
.1000	10.1209	.2554	3.4161	2969.624	2752.4910
.2000	8.9935	.5107	3.4132	3068.497	2780.9840
.3000	7.8668	.7661	3.4104	3167.324	2809.4810
.4000	6.7409	1.0215	3.4076	3266.107	2837.9830
.5000	5.6157	1.2769	3.4048	3364.846	2866.4870
.6000	4.4912	1.5322	3.4021	3463.541	2894.9960

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

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      .7000      3.3673     1.7876      3.3994      3562.192      2923.5100
      .8000      2.2442     2.0430      3.3967      3660.800      2952.0270
      .9000      1.1218     2.2983      3.3940      3759.365      2980.5480
     1.0000       .0000     2.5537      3.3914      3857.889      3009.0690

                 ***********  PORE PRESSURES  ***********

      CHI          UW            U0            U

     11.2490     146.704       146.705       -.0012
     10.1209     217.133       217.099        .0341
      8.9935     287.513       287.447        .0661
      7.8668     357.843       357.750        .0934
      6.7409     428.125       428.008        .1168
      5.6157     498.359       498.221        .1373
      4.4912     568.544       568.391        .1531
      3.3673     638.682       638.518        .1646
      2.2442     708.773       708.601        .1723
      1.1218     778.818       778.642        .1762
       .0000     848.819       848.640        .1794
 TIMESTEP SIZE =     .01, ITERATIONS BETWEEN PRINT TIMES =   5798
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

               TIME =  .50000E+02          LOAD =   2723.000
               SET =    2.3510

   ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

      Y            CHI          Z           E            TOTAL        EFFECTIVE

      .0000      11.2490       .0000      3.4190       2870.705      2724.0010
      .1000      10.1209       .2554      3.4161       2969.624      2752.4910
      .2000       8.9935       .5107      3.4132       3068.497      2780.9840
      .3000       7.8668       .7661      3.4104       3167.324      2809.4810
      .4000       6.7409      1.0215      3.4076       3266.107      2837.9830
      .5000       5.6157      1.2769      3.4048       3364.846      2866.4870
      .6000       4.4912      1.5322      3.4021       3463.541      2894.9960
      .7000       3.3673      1.7876      3.3994       3562.192      2923.5100
      .8000       2.2442      2.0430      3.3967       3660.800      2952.0270
      .9000       1.1218      2.2983      3.3940       3759.365      2980.5480
     1.0000        .0000      2.5537      3.3914       3857.889      3009.0690

                 ***********  PORE PRESSURES  ***********

      CHI          UW            U0            U

     11.2490     146.704       146.705       -.0012
     10.1209     217.133       217.099        .0341
      8.9935     287.513       287.447        .0661
      7.8668     357.843       357.750        .0934
      6.7409     428.125       428.008        .1168
      5.6157     498.359       498.221        .1373
      4.4912     568.544       568.391        .1531
      3.3673     638.682       638.518        .1646
      2.2442     708.773       708.601        .1723
      1.1218     778.818       778.642        .1762
       .0000     848.819       848.640        .1794
 TIMESTEP SIZE =     .01, ITERATIONS BETWEEN PRINT TIMES =   6618
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
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REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

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     IMPERVIOUS LOWER BOUNDARY

                TIME =   .55000E+02          LOAD =   2723.000
                SET =     2.3510

 ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

     Y          CHI          Z          E            TOTAL        EFFECTIVE

    .0000     11.2490      .0000      3.4190       2870.705      2724.0010
    .1000     10.1209      .2554      3.4161       2969.624      2752.4910
    .2000      8.9935      .5107      3.4132       3068.497      2780.9840
    .3000      7.8668      .7661      3.4104       3167.324      2809.4810
    .4000      6.7409     1.0215      3.4076       3266.107      2837.9830
    .5000      5.6157     1.2769      3.4048       3364.846      2866.4870
    .6000      4.4912     1.5322      3.4021       3463.541      2894.9960
    .7000      3.3673     1.7876      3.3994       3562.192      2923.5100
    .8000      2.2442     2.0430      3.3967       3660.800      2952.0270
    .9000      1.1218     2.2983      3.3940       3759.365      2980.5480
   1.0000       .0000     2.5537      3.3914       3857.889      3009.0690

              ***********  PORE PRESSURES  ***********

     CHI          UW            U0            U

   11.2490     146.704       146.705       -.0012
   10.1209     217.133       217.099        .0341
    8.9935     287.513       287.447        .0661
    7.8668     357.843       357.750        .0934
    6.7409     428.125       428.008        .1168
    5.6157     498.359       498.221        .1373
    4.4912     568.544       568.391        .1531
    3.3673     638.682       638.518        .1646
    2.2442     708.773       708.601        .1723
    1.1218     778.818       778.642        .1762
     .0000     848.819       848.640        .1794
 TIMESTEP SIZE =     .01, ITERATIONS BETWEEN PRINT TIMES =   7438
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

                TIME =   .60000E+02          LOAD =   2723.000
                SET =     2.3510

 ********  COORDINATES  *********     VOID RATIO     ******  STRESSES  *******

     Y          CHI          Z          E            TOTAL        EFFECTIVE

    .0000     11.2490      .0000      3.4190       2870.705      2724.0010
    .1000     10.1209      .2554      3.4161       2969.624      2752.4910
    .2000      8.9935      .5107      3.4132       3068.497      2780.9840
    .3000      7.8668      .7661      3.4104       3167.324      2809.4810
    .4000      6.7409     1.0215      3.4076       3266.107      2837.9830
    .5000      5.6157     1.2769      3.4048       3364.846      2866.4870
    .6000      4.4912     1.5322      3.4021       3463.541      2894.9960
    .7000      3.3673     1.7876      3.3994       3562.192      2923.5100
    .8000      2.2442     2.0430      3.3967       3660.800      2952.0270
    .9000      1.1218     2.2983      3.3940       3759.365      2980.5480
   1.0000       .0000     2.5537      3.3914       3857.889      3009.0690

              ***********  PORE PRESSURES  ***********

     CHI          UW            U0            U

   11.2490     146.704       146.705       -.0012
   10.1209     217.133       217.099        .0341
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REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

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        8.9935      287.513        287.447          .0661
        7.8668      357.843        357.750          .0934
        6.7409      428.125        428.008          .1168
        5.6157      498.359        498.221          .1373
        4.4912      568.544        568.391          .1531
        3.3673      638.682        638.518          .1646
        2.2442      708.773        708.601          .1723
        1.1218      778.818        778.642          .1762
         .0000      848.819        848.640          .1794
 TIMESTEP SIZE =      .01, ITERATIONS BETWEEN PRINT TIMES =    8258
1
     ACCUMV-FINITE STRAIN CONSOLIDATION OF A THICK LAYER

     ****Pond 8E, 13.6 feet of sludge, Power K

     PERVIOUS UPPER BOUNDARY
     IMPERVIOUS LOWER BOUNDARY

                              ***********************
                              *                     *
                              *  FUNCTIONS OF TIME  *
                              *                     *
                              ***********************
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TIME	EAV	TOTAV	EFFAV	SET	DEG
.0000E+00	.4326E+01	579.519	143.6243	.0000	.0000
.1500E+00	.4276E+01	729.586	149.0590	.1279	.0544
.2000E+00	.4271E+01	779.623	150.9875	.1400	.0596
.2250E+00	.4268E+01	804.645	151.9867	.1461	.0621
.2500E+00	.4266E+01	829.670	153.0064	.1521	.0647
.2750E+00	.4264E+01	854.696	154.0486	.1581	.0673
.3000E+00	.4261E+01	879.725	155.1153	.1643	.0699
.3500E+00	.4257E+01	925.619	157.1757	.1764	.0750
.4000E+00	.4252E+01	971.522	159.3629	.1892	.0805
.5000E+00	.4240E+01	1063.354	164.2593	.2177	.0926
.6000E+00	.4227E+01	1155.231	170.2877	.2515	.1070
.7000E+00	.4208E+01	1415.512	184.3016	.2993	.1273
.8000E+00	.4183E+01	1675.928	205.2679	.3633	.1545
.9000E+00	.4149E+01	1936.531	246.6538	.4504	.1916
.1000E+01	.4113E+01	2197.220	318.9612	.5421	.2306
.1250E+01	.4065E+01	2204.505	370.2946	.6653	.2830
.1500E+01	.4014E+01	2212.619	434.7551	.7964	.3387
.1750E+01	.3973E+01	2220.551	494.2851	.9010	.3832
.2000E+01	.3937E+01	2228.607	549.3635	.9935	.4226
.2250E+01	.3904E+01	2236.726	602.5072	1.0772	.4582
.2500E+01	.3874E+01	2244.847	653.4822	1.1530	.4904
.2750E+01	.3847E+01	2252.980	702.7453	1.2229	.5201
.3000E+01	.3821E+01	2261.103	750.7077	1.2879	.5478
.3500E+01	.3775E+01	2277.231	845.0050	1.4061	.5981
.4000E+01	.3734E+01	2293.076	942.1892	1.5120	.6431
.5000E+01	.3663E+01	2323.452	1158.4910	1.6931	.7201
.6000E+01	.3608E+01	2351.779	1383.8800	1.8318	.7791
.7000E+01	.3571E+01	2378.222	1577.6150	1.9281	.8201
.8000E+01	.3546E+01	2403.239	1720.9850	1.9904	.8466
.9000E+01	.3531E+01	2427.319	1818.8560	2.0295	.8632
.1000E+02	.3521E+01	2450.841	1884.8070	2.0545	.8739
.1200E+02	.3509E+01	2497.091	1966.6100	2.0844	.8866
.1250E+02	.3507E+01	2508.573	1981.8330	2.0899	.8889
.1500E+02	.3498E+01	2565.817	2046.7930	2.1127	.8986
.1750E+02	.3490E+01	2622.956	2105.4150	2.1326	.9071
.1800E+02	.3489E+01	2634.379	2116.9420	2.1365	.9088
.2000E+02	.3483E+01	2680.064	2162.8580	2.1517	.9152
.2250E+02	.3476E+01	2737.153	2220.0690	2.1702	.9231
.2400E+02	.3472E+01	2771.399	2254.3560	2.1810	.9277
.2500E+02	.3455E+01	3066.368	2392.7430	2.2235	.9458
.2600E+02	.3429E+01	3362.289	2627.6160	2.2897	.9739
.2750E+02	.3411E+01	3364.101	2808.6570	2.3368	.9939
.2800E+02	.3408E+01	3364.319	2830.9320	2.3423	.9963
.3000E+02	.3405E+01	3364.616	2861.6250	2.3499	.9995

CALCULATION SHEET

PROJECT FMC - Pond 8E JOB NO. 24230-025 CALC. NO. 24230-025-4

SUBJECT Settlement Evaluation of Final Cap SHEET NO. A-39

REV	ORIGINATOR	DATE	CHECKER	DATE	REV	ORIGINATOR	DATE	CHECKER	DATE	REV
0	J.T. Cameron	5/6/02								

.3200E+02	.3405E+01	3364.657	2865.9210	2.3509	.9999
.3400E+02	.3405E+01	3364.663	2866.5040	2.3510	1.0000
.3500E+02	.3405E+01	3364.663	2866.5040	2.3510	1.0000
.3800E+02	.3405E+01	3364.663	2866.5040	2.3510	1.0000
.4000E+02	.3405E+01	3364.663	2866.5040	2.3510	1.0000
.4500E+02	.3405E+01	3364.663	2866.5040	2.3510	1.0000
.5000E+02	.3405E+01	3364.663	2866.5040	2.3510	1.0000
.5500E+02	.3405E+01	3364.663	2866.5040	2.3510	1.0000
.6000E+02	.3405E+01	3364.663	2866.5040	2.3510	1.0000

TIME	UWAV	U0AV	UAV
.0000E+00	435.8949	435.8949	.0000
.1500E+00	580.5267	435.9613	144.5654
.2000E+00	628.6353	435.9985	192.6368
.2250E+00	652.6586	436.0209	216.6376
.2500E+00	676.6634	436.0455	240.6179
.2750E+00	700.6476	436.0718	264.5758
.3000E+00	724.6093	436.1003	288.5091
.3500E+00	768.4433	436.1613	332.2820
.4000E+00	812.1586	436.2306	375.9281
.5000E+00	899.0947	436.3962	462.6984
.6000E+00	984.9437	436.6070	548.3366
.7000E+00	1231.2100	436.8874	794.3228
.8000E+00	1470.6610	437.3041	1033.3570
.9000E+00	1689.8770	437.9064	1251.9700
.1000E+01	1878.2590	438.5958	1439.6630
.1250E+01	1834.2100	440.2281	1393.9820
.1500E+01	1777.8640	442.6899	1335.1740
.1750E+01	1726.2650	444.9695	1281.2960
.2000E+01	1679.2430	447.3738	1231.8700
.2250E+01	1634.2190	449.8407	1184.3780
.2500E+01	1591.3650	452.3098	1139.0550
.2750E+01	1550.2350	454.7906	1095.4440
.3000E+01	1510.3950	457.2611	1053.1340
.3500E+01	1432.2260	462.0851	970.1412
.4000E+01	1350.8870	466.6256	884.2614
.5000E+01	1164.9610	474.3927	690.5685
.6000E+01	967.8995	480.1115	487.7881
.7000E+01	800.6069	483.9451	316.6618
.8000E+01	682.2535	486.3531	195.9004
.9000E+01	608.4626	487.8250	120.6376
.1000E+02	566.0349	488.7387	77.2961
.1200E+02	530.4808	489.7704	40.7105
.1250E+02	526.7402	489.9487	36.7915
.1500E+02	519.0241	490.6711	28.3530
.1750E+02	517.5418	491.2885	26.2533
.1800E+02	517.4378	491.4073	26.0305
.2000E+02	517.2061	491.8740	25.3321
.2250E+02	517.0845	492.4416	24.6429
.2400E+02	517.0435	492.7748	24.2686
.2500E+02	673.6253	493.7438	179.8815
.2600E+02	734.6730	495.6647	239.0083
.2750E+02	555.4445	497.4766	57.9678
.2800E+02	533.3878	497.6948	35.6929
.3000E+02	502.9908	497.9917	4.9990
.3200E+02	498.7366	498.0329	.7037
.3400E+02	498.1591	498.0385	.1206
.3500E+02	498.1591	498.0385	.1206
.3800E+02	498.1591	498.0385	.1206
.4000E+02	498.1591	498.0385	.1206
.4500E+02	498.1591	498.0385	.1206
.5000E+02	498.1591	498.0385	.1206
.5500E+02	498.1591	498.0385	.1206
.6000E+02	498.1591	498.0385	.1206

Appendix N

APPENDIX N

VENDOR INFORMATION AND DATA RESULTS ON LINER COMPATIBILITY

GSE™

GSE Lining Technology, Inc.

19103 Gundle Road
Houston, Texas 77073
800-435-2008
713-443-8564
Fax: 713-875-6010

10 September, 1997

Bechtel Corporation
50 Beale Street
San Franscico, CA 94105

Attn: Michael Kostanian

Re: Chemical Resistance of Polyethylene Geomembranes

GSE geomembranes are made of high quality, virgin polyethylene resin which demonstrates excellent chemical resistance. GSE polyethylene geomembranes are resistant to a great number and combinations of chemicals. It is this property of HDPE geomembranes that makes it the lining material of choice.

The chemical resistance of polyethylene has been investigated by many people over the past several decades. We are able to draw from that work when making statements about the chemical resistance of today's polyethylene geomembranes. In addition to that, many tests have been performed that specifically use geomembranes and certain chemical mixtures. Naturally, however, every mixture of chemicals cannot be tested for. Please refer to the attached chemical resistance data sheet for polyethylene.

Polyethylene is, for practical purposes, considered impermeable. Be aware, however, that all materials are permeable to some extent that varies with concentration, temperature, pressure and type of permeant. The rates of permeation are so low, however, that they are usually insignificant. In general, oxidizing chemicals are the only substances that can degrade polyethylene. For example, long term containment of concentrated sulphuric acid is not recommended.

In the case of containment of phosphene and elemental phosphorous in the project you described, GSE recommends HDPE liner. HDPE can withstand exposure to phosphene and elemental phosphorous for many years without any permanent damage (provided the temperature is less than 30 °C); we cannot make any guarantee of *maximum* exposure time.

If you have any questions, please feel free to call or fax.

Regards,

Matt Adams

Matthew W. Adams
Technical Support
Chemist

Chemical Resistance

For environmental lining solutions...the world comes to GSE.

GSE is the world's leading supplier of high quality, polyethylene geomembranes. GSE polyethylene geomembranes are resistant to a great number and combinations of chemicals. Note that the effect of chemicals on any material is influenced by a number of variable factors such as temperature, concentration, exposed area and duration. Many tests have been performed that use geomembranes and certain specific chemical mixtures. Naturally, however, every mixture of chemicals cannot be tested for, and various criteria may be used to judge performance. Reported performance ratings may not apply to all applications of a given material in the same chemical. Therefore, these ratings are offered as a guide only.

Abbreviations

S = Satisfactory
L = Limited application possible
U = Unsatisfactory
— = Not tested

Concentration

sat. sol. = Saturated aqueous solution, prepared at 20°C (68°F)
sol. = aqueous solution with concentration above 10% but below saturation level
dil. sol. = diluted aqueous solution with concentration below 10%
cust. conc. = customary service concentration

Medium	Concentration	Resistance at: 20 °C (68 °F)	60 °C (140 °F)
A			
Acetic acid	100%	S	L
Acetic acid	10%	S	S
Acetic acid anhydride	100%	S	L
Acetone	100%	L	L
Adipic acid	sat. sol.	S	S
Allyl alcohol	96%	S	S
Aluminum chloride	sat. sol.	S	S
Aluminum fluoride	sat. sol.	S	S
Aluminum sulfate	sat. sol.	S	S
Alum	sol.	S	S
Ammonia, aqueous	dil. sol.	S	S
Ammonia, gaseous dry	100%	S	S
Ammonia, liquid	100%	S	S
Ammonium chloride	sat. sol.	S	S
Ammonium fluoride	sol.	S	S
Ammonium nitrate	sat. sol.	S	S
Ammonium sulfate	sat. sol.	S	S
Ammonium sulfide	sol.	S	S
Amyl acetate	100%	S	L
Amyl alcohol	100%	S	L
Aniline	100%	S	L
Antimony trichloride	90%	S	S
Arsenic acid	sat. sol.	S	S
Aqua regia	HCl-HNO33/1	U	U
B			
Barium carbonate	sat. sol.	S	S
Barium chloride	sat. sol.	S	S
Barium hydroxide	sat. sol	S	S
Barium sulfate	sat. sol	S	S
Barium sulfide	sol.	S	S
Benzaldehyde	100%	S	L
Benzene	—	L	L
Benzoic acid	sat. sol.	S	S
Beer	—	S	S
Borax (sodium tetraborate)	sat. sol.	S	S
Boric acid	sat. sol	S	S
Bromine, gaseous dry	100%	U	U
Bromine, liquid	100%	U	U
Butane, gaseous	100%	S	S
1-Butanol	100%	S	S
Butyric acid	100%	S	L
C			
Calcium carbonate	sat. sol.	S	S
Calcium chlorate	sat. sol.	S	S
Calcium chloride	sat. sol.	S	S
Calcium nitrate	sat. sol.	S	S
Calcium sulfate	sat. sol	S	S
Calcium sulfide	dil. sol.	L	L
Carbon dioxide, gaseous dry	100%	S	S
Carbon disulfide	100%	L	U
Carbon monoxide	100%	S	S
Chloracetic acid	sol.	S	S
Carbon tetrachloride	100%	L	U
Chlorine, aqueous solution	sat. sol.	L	U
Chlorine, gaseous dry	100%	L	U
Chloroform	100%	U	U
Chromic acid	20%	S	L
Chromic acid	50%	S	L
Citric acid	sat. sol.	S	S
Copper chloride	sat. sol.	S	S
Copper nitrate	sat. sol.	S	S
Copper sulfate	sat. sol.	S	S
Cresylic acid	sat. sol.	L	—
Cyclohexanol	100%	S	S
Cyclohexanone	100%	S	L
D			
Decahydronaphthalene	100%	S	L
Dextrine	sol.	S	S
Diethyl ether	100%	L	—
Dioctylphthalate	100%	S	L
Dioxane	100%	S	S
E			
Ethanediol	100%	S	S
Ethanol	40%	S	L
Ethyl acetate	100%	S	U
Ethylene trichloride	100%	U	U
F			
Ferric chloride	sat. sol.	S	S
Ferric nitrate	sol.	S	S
Ferric sulfate	sat. sol.	S	S
Ferrous chloride	sat. sol.	S	S
Ferrous sulfate	sat. sol.	S	S
Fluorine, gaseous	100%	U	U
Fluorosilicic acid	40%	S	S
Formaldehyde	40%	S	S
Formic acid	50%	S	S
Formic acid	98-100%	S	S
Furfuryl alcohol	100%	S	L
G			
Gasoline	—	S	L
Glacial acetic acid	96%	S	L
Glucose	sat. sol.	S	S
Glycerine	100%	S	S
Glycol	sol.	S	S
H			
Heptane	100%	S	U
Hydrobromic acid	50%	S	S

(CONTINUED ON OTHER SIDE)

(S) Satisfactory: *Liner material is resistant to the given reagent at the given concentration and temperature. No mechanical or chemical degradation is observed.*
(L) Limited Application Possible: *Liner material may reflect some attack. Factors such as concentration, pressure and temperature directly affect liner performance against the given media. Application, however, is possible under less severe conditions, e.g. lower concentration, secondary containment, additional liner protections, etc.*
(U) Unsatisfactory: *Liner material is not resistant to the given reagent at the given concentration and temperature. Mechanical and/or chemical degradation is observed.*
(–) Not tested

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information.

Medium	Concentration	Resistance at: 20 °C (68 °F)	60 °C (140 °F)
Hydrobromic acid	100%	S	S
Hydrochloric acid	10%	S	S
Hydrochloric acid	35%	S	S
Hydrocyanic acid	10%	S	S
Hydrofluoric acid	4%	S	S
Hydrofluoric acid	60%	S	L
Hydrogen	100%	S	S
Hydrogen peroxide	30%	S	L
Hydrogen peroxide	90%	S	U
Hydrogen sulfide, gaseous	100%	S	S
L			
Lactic acid	100%	S	S
Lead acetate	sat. sol.	S	—
M			
Magnesium carbonate	sat. sol.	S	S
Magnesium chloride	sat. sol.	S	S
Magnesium hydroxide	sat. sol.	S	S
Magnesium nitrate	sat. sol.	S	S
Maleic acid	sat. sol.	S	S
Mercuric chloride	sat. sol.	S	S
Mercuric cyanide	sat. sol.	S	S
Mercuric nitrate	sol.	S	S
Mercury	100%	S	S
Methanol	100%	S	S
Methylene chloride	100%	L	—
Milk	—	S	S
Molasses	—	S	S
N			
Nickel chloride	sat. sol.	S	S
Nickel nitrate	sat. sol.	S	S
Nickel sulfate	sat. sol.	S	S
Nicotinic acid	dil. sol.	S	—
Nitric acid	25%	S	S
Nitric acid	50%	S	U
Nitric acid	75%	U	U
Nitric acid	100%	U	U
O			
Oils and Grease	—	S	L
Oleic acid	100%	S	L
Orthophosphoric acid	50%	S	S
Orthophosphoric acid	95%	S	L
Oxalic acid	sat. sol.	S	S
Oxygen	100%	S	L
Ozone	100%	L	U
P			
Petroleum (kerosene)	—	S	L
Phenol	sol.	S	S
Phosphorus trichloride	100%	S	L
Photographic developer	cust. conc.	S	S
Picric acid	sat. sol.	S	—
Potassium bicarbonate	sat. sol	S	S
Potassium bisulfide	sol.	S	S
Potassium bromate	sat. sol.	S	S
Potassium bromide	sat. sol.	S	S
Potassium carbonate	sat. sol.	S	S
Potassium chlorate	sat. sol.	S	S
Potassium chloride	sat. sol.	S	S
Potassium chromate	sat. sol.	S	S
Potassium cyanide	sol.	S	S
Potassium dichromate	sat. sol.	S	S
Potassium ferricyanide	sat. sol.	S	S
Potassium ferrocyanide	sat. sol.	S	S
Potassium fluoride	sat. sol.	S	S
Potassium hydroxide	10%	S	S
Potassium hydroxide	sol.	S	S
Potassium hypochlorite	sol.	S	L
Potassium nitrate	sat. sol.	S	S
Potassium orthophosphate	sat. sol.	S	S
Potassium perchlorate	sat. sol.	S	S
Potassium permanganate	20%	S	S
Potassium persulfate	sat. sol.	S	S
Potassium sulfate	sat. sol.	S	S
Potassium sulfite	sol.	S	S
Propionic acid	50%	S	S
Propionic acid	100%	S	L
Pyridine	100%	S	L
Q			
Quinol (Hydroquinone)	sat. sol.	S	S
S			
Salicylic acid	sat. sol.	S	S
Silver acetate	sat. sol.	S	S
Silver cyanide	sat. sol.	S	S
Silver nitrate	sat. sol.	S	S
Sodium benzoate	sat. sol.	S	S
Sodium bicarbonate	sat. sol.	S	S
Sodium biphosphate	sat. sol.	S	S
Sodium bisulfite	sol.	S	S
Sodium bromide	sat. sol.	S	S
Sodium carbonate	sat. sol.	S	S
Sodium chlorate	sat. sol.	S	S
Sodium chloride	sat. sol.	S	S
Sodium cyanide	sat. sol.	S	S
Sodium ferricyanide	sat. sol.	S	S
Sodium ferrocyanide	sat. sol.	S	S
Sodium fluoride	sat. sol.	S	S
Sodium hydroxide	40%	S	S
Sodium hydroxide	sat. sol.	S	S
Sodium hypochlorite	15% active chlorine	S	S
Sodium nitrate	sat. sol.	S	S
Sodium nitrite	sat. sol.	S	S
Sodium orthophosphate	sat. sol.	S	S
Sodium sulfate	sat. sol.	S	S
Sodium sulfide	sat. sol.	S	S
Sulfur dioxide, dry	100%	S	S
Sulfur trioxide	100%	U	U
Sulfuric acid	10%	S	S
Sulfuric acid	50%	S	S
Sulfuric acid	98%	S	U
Sulfuric acid	fuming	U	U
Sulfurous acid	30%	S	S
T			
Tannic acid	sol.	S	S
Tartaric acid	sol.	S	S
Thionyl chloride	100%	L	U
Toluene	100%	L	U
Triethylamine	sol.	S	L
U			
Urea	sol.	S	S
Urine	—	S	S
W			
Water	—	S	S
Wine vinegar	—	S	S
Wines and liquors	—	S	S
X			
Xylenes	100%	L	U
Y			
Yeast	sol.	S	S
Z			
Zinc carbonate	sat. sol.	S	S
Zinc chloride	sat. sol.	S	S
Zinc (II) chloride	sat. sol.	S	S
Zinc (IV) chloride	sat. sol.	S	S
Zinc oxide	sat. sol.	S	S
Zinc sulfate	sat. sol.	S	S

Specific immersion testing should be undertaken to ascertain the suitability of chemicals not listed above with reference to special requirements.

GSE is a registered trademark of GSE Lining Technology, Inc.

GSE Lining Technology, Inc.
Corporate Headquarters
19103 Gundle Road
Houston, Texas 77073
USA
800-435-2008, 281-443-8564
FAX: 281-875-6010

GSE Lining Technology GmbH
European Headquarters
Buxtehuder Straße 112
D-21073 Hamburg
Germany
49-40-767-420
FAX: 49-40-767-42-33

Sales/Installation Offices
Australia
Egypt
Singapore
United Kingdom

Distributed by:

A Gundle/SLT Environmental, Inc. Company

STAFF

TECH FACTS

METHANE GAS TRANSMISSION RATES

UC 4000 has the best methane gas transmission rates or commercially available Geomembranes in today's market.

TEST RESULTS

Sample		Det.	CC/M² 24 Hours ATM	Thickness, mil	
Avg.	Min.	Max.			
36 MIL	1	48.5	36.8	36.4	37.3
UC 4000	2	47.9	36.9	36.5	37.7
	3	49.2	36.4	36.1	36.8
		Avg. 48.5			
36 MIL	1	52.8	37.9	37.6	38.1
HYPALON	2	53.6	37.5	37.2	38.0
	3	53.2	37.7	37.5	38.0
		Avg. 53.2			
40 MIL	1	63.5	39.4	39.9	38.9
HDPE	2	65.3	39.3	39.9	38.8
	3	63.0	39.7	40.0	39.3
		Avg. 63.9			
40 MIL	1	89.8	39.9	36.9	40.2
O.R. PVC	2	93.0	37.0	36.9	37.2
	3	90.9	39.0	38.0	39.4
		Avg. 91.2			
40 MIL	1	359	40.3	40.1	40.5
PVC	2	342	40.5	40.0	40.8
	3	339	40.9	40.0	41.0
		Avg. 347			

TEST PERFORMED: The submitted samples were tested for Methane Gas Permeability in accordance with the procedures outlined in ASTM D1434, Procedure V.

Staff Industries, Inc. 240 Chene, Detroit, MI 48207 (313) 259-1818 Fax (313) 259-0631

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

001604

October 23, 1997

Ms. Susan E. Lackey
FMC Corporation
PO Box 4111
Pocatello, Idaho 83205

Dear Ms. Lackey:

This letter is written to forward a revised TRI 9090A report, generated under a 1995 work agreement for FMC Corporation. We understand from your office that the original leachate designation as "Calcium Chloride" was in error and that you are assured that new barrels had been used for leachate transportation to our laboratory for material exposure.

Per your request, we have changed the title on the applicable report pages to reflect the correct leachate designation of "NOSAP Precipitator Slurry".

TRI/Environmental, Inc. (TRI) is pleased to be of service to FMC. If you have any questions or if I may provide any additional assistance, please call me (1-800-880-8378).

Sincerely,

Sam R. Allen

Sam R. Allen
Vice President and Program Manager
Geosynthetics Testing Program

9063 Bee Caves Road • Austin, TX 78733-6201 • (512) 263-2101 • FAX 263-2558 • 1-800-880-T-E-S-T

Sample locations for samples collected for 9090 waste compatibility testing.

NOSAP sample: Collected in August 1994, shipped December 1994.
Location: Pilot circulation loop, 2nd pass #4 furnace.
Amount collected: Two 55 gallon drums.

Dock Sample: Collected February 1997. Comprised of approximately 40% NE sump effluent and 60% North Solids Tank.
Location: Sample Port Pump discharges next to NE Sump and North Solids Tank.
Amount collected: 5 Ten gallon carboys (50 gallons)

V3600: Collected February 1997
Location: Sample taken at P3601 discharge pump bleed valve.
Amount collected: 5 Ten gallon carboys (50 gallons)

FMC Corporation

Phosphorus Chemicals Division
P. O. Box 4111 Highway 30 West of City
Pocatello, Idaho 83202

TRANSFER REPORT 6925

QUESTER'S NAME	PURCHASE ORDER NO.	RELEASE NO.	DATE
STEVE WILF	9411137A	3	12/29/94

VENDOR'S NAME	VENDOR'S ORDER NO.	O.S. & D. NO.
TFI		

Please forward to the Shipping Department, the following material:

Material Located:

QUANTITY	UNIT OF MEASURE	DESCRIPTION	FMC STORES NO.	VALUE
5		Metal - 55 gallon - Drums		
		Contains: "NOSAP" Slurry		
		(Lime Slurry & PPT Acid)		
		MSDS Attach with each drum		
		Corrosive Liquids Poisonous, N.O.S.		
		8 (6.1) UN 2922 PG II		
		(RQ 12 Cadmium Contamination)		

REASON FOR SHIPMENT: [illegible] Testing

RETURN SHIPMENT EXPECTED: YES est June 1995

SPECIAL INSTRUCTIONS TO ACCOUNTING:

SPECIAL INSTRUCTIONS TO SHIPPING:

Ship To: TFI [illegible]
[illegible] Mr. [illegible]
9663 Bee Caves Road
Austin TX 78733-6[illegible]

Ship Via: ☑ Prepaid ☐ Collect
UPS: Air: Vendor:
Mail: Truck: [illegible] Other:

CHARGE SHIPMENT COSTS TO: C94020005

AUTHORIZED SIGNATURE: [illegible]

SHIPPED BY:

HOW SHIPPED:

PREPAID CHARGES: DATE SHIPPED:

NO. OF CONTAINERS: APPROX. WEIGHT:

CARRIER'S AGENT SIGNATURE:

BILL OF LADING NO.: 6925

1st WHITE - Accounting Copy 2nd WHITE - Packing Slip 3rd YELLOW - Receiver 4th GOLD - Purchasing 5th PINK - Requestor 6th BLUE - Log Book

FMC Corporation
Phosphorus Chemicals Division
P. O. Box 4111 - Highway 30 West of City
Pocatello, Idaho 83202

TRANSFER REPORT 1257

REQUESTER'S NAME	PURCHASE ORDER NO.	RELEASE NO.	DATE
S.D.W.	97347PIC		3/6/97
VENDOR'S NAME	**VENDOR'S ORDER NO.**		**O.S. & D. NO.**
TRI Environmental			

Please forward to the Shipping Department, the following material:

Material Located:

QUANTITY	UNIT OF MEASURE	DESCRIPTION	FMC STORES NO.	VALUE
4	DR	30 Gallon Drums, Waste		
		Phosphorus, White Fired		
		Water		

REASON FOR SHIPMENT: Analysis / Lab Testing

RETURN SHIPMENT EXPECTED: YES

SPECIAL INSTRUCTIONS TO ACCOUNTING:

SPECIAL INSTRUCTIONS TO SHIPPING:

Ship To: TRI Environmental
7703 Zoe Ruiz Rd
Austin TX 78733

Ship Via: ☒ Prepaid ☐ Collect
UPS: Air: Vendor:
Mail: Truck: Other:

CHARGE SHIPMENT COSTS TO: C9706001

AUTHORIZED SIGNATURE:

SHIPPED BY: Express

HOW SHIPPED:

PREPAID CHARGES:

DATE SHIPPED:

NO. OF CONTAINERS:

APPROX. WEIGHT:

CARRIER'S AGENT SIGNATURE:

BILL OF LADING NO.:

1257

1st WHITE - Accounting Copy 2nd WHITE - Packing Slip 3rd YELLOW - Receiver 4th GOLD - Purchasing 5th PINK - Requestor 6th BLUE - Log Book

FMC Corporation

Phosphorus Chemicals Division
P. O. Box 4111 Highway 30 West of City
Pocatello, Idaho 83202

TRANSFER REPORT 12727

REQUESTER'S NAME	PURCHASE ORDER NO.	RELEASE NO.	DATE
[illegible]	77-4781C		2/12/97
VENDOR'S NAME	**VENDOR'S ORDER NO.**		**O. S. & D. NO.**
TAT [illegible]			

Please forward to the Shipping Department, the following material:

Material Located:

QUANTITY	UNIT OF MEASURE	DESCRIPTION	FMC STORES NO.	VALUE
5	EA	30 Gallon Drums - Solid		
		Phosphorus in Water.		

REASON FOR SHIPMENT: [illegible] Testing

RETURN SHIPMENT EXPECTED: 1/05

SPECIAL INSTRUCTIONS TO ACCOUNTING:

SPECIAL INSTRUCTIONS TO SHIPPING: [illegible] Department

Ship To: [illegible]

Ship Via: ☐ Prepaid ☐ Collect
UPS: ____ Air: ____ Vendor: ____
Mail: ____ Truck: X Other: [illegible]

CHARGE SHIPMENT COSTS TO: [illegible]

AUTHORIZED SIGNATURE: [illegible]

SHIPPED BY: TAEL

HOW SHIPPED: X CF Bob Hardesty

PREPAID CHARGES: [illegible]

DATE SHIPPED: 2-13-97

NO. OF CONTAINERS: [illegible]

APPROX. WEIGHT: [illegible]

CARRIER'S AGENT SIGNATURE:

BILL OF LADING NO.: [illegible]

12727

1st WHITE - Accounting Copy 2nd WHITE - Packing Slip 3rd YELLOW - Receiver 4th GOLD - Purchasing 5th PINK - Requestor 6th BLUE - Log Book

MSDS ENCLOSED

Notice Concerning MSDS's Included in Shipment

MSDS's have been included for the following materials:

1. *Hydrated Lime Slurry*
2. *Treated Precipitator Dust (Co-Product)*

These materials are the constituents of the slurry comprising this shipment.

Note: The *treated precipitator dust* has fully reacted with water in forming the slurry comprising this shipment. **MSDS Fire, Explosion and Reactivity Data for *treated precipitator dust* listing water as a condition to avoid does not apply to the slurry comprising this shipment.**

Due to the high pH of the slurry comprising this shipment and the cadmium content of this slurry, it is being shipped with the following classification:

Corrosive liquids, poisonous, n.o.s.
8 (6.1) , UN2922, PG II,
(pH12, Cadmium Contamination).

MSDS FOR LIME SLURRY
01/31/90 10.48.09
REPORT NO. PSH4010

SECTION I

SOURCE: FMC CORPORATION
ADDRESS: P.O. BOX 4111
POCATELLO ID 83202
CHEM. NAME: CALCIUM HYDROXIDE SLURRY
TRADE NAME: HYDRATED LIME SLURRY

CAS NO: UNKNOWN
PHONE: (208)236-8343
FMC FILE NO: 294
STORES NO: NO
LAST CHANGE: 01/25/88

SECTION II - HAZARDOUS INGREDIENTS

INGREDIENT	PERCENT	CAS NO	TLV
CALCIUM HYDROXIDE	30	1305-62-0	5.0 MG/M3

SECTION III - PHYSICAL DATA

BOILING POINT: 212 F
VAPOR PRESSURE: N.A.
VAPOR DENSITY: N.A.
SOLUBILITY: SOLUBLE
ROUTE OF ENTRY: SKIN
APPEARANCE: SMOOTH WHITE SLURRY
ODOR: EARTHY ODOR

SPECIFIC GRAVITY: 1.0-1.3
PERCENT VOLATILE: N.A.
EVAPORATION RATE: N.A.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: N.A. N.A.
FLAMMABLE LIMITS: N.A. N.A.
EXTINGUISHING MEDIA: NON COMBUSTIBLE
FIRE FIGHTING PROCEDURES: N.A. LIME SLURRY MAY BE HOT (185 F) WHEN FORMED. IT SHOULD NOT CAUSE FIRE DANGER.
FIRE & EXPLOSION HAZARDS: NONE

SECTION V - HEALTH HAZARD DATA

THRESHOLDS: OSHA PEL - 005.00 MG/M3
ACGIH TLV - 000.00
OTHER MAC - 000.00
CARCINOGEN: NTP? U IARC? U OSHA? U
EXPOSURE EFFECTS: IRRITATING TO GASTROINTESTINAL TRACT IF INGESTED IN LARGE QUANTITIES.SKIN & EYE CONTACT MAY CAUSE REDDENING AND IRRIT. INHALATION, THOUGH UNLIKELY, MAY CAUSE IRRITATION.
FIRST AID PROCEDURES: FLUSH EYES IMMEDIATELY WITH PLENTY OF WATER FOLLOWED WITH BORIC ACID SOLUTION. IF IRRITATION DEVELOPS FOLLOWING SKIN CONTACT, CONTACT PHYSICIAN. IF SWALLOWED, GIVE LARGE QUANT. OF WATER. DO NOT INDUCE VOMITING. GET MEDICAL ATTENTION.

FMC

MATERIAL SAFETY DATA 69012 62 0

NFPA.....704

TREATED PRECIPITATOR COPRODUCT

RATINGS:
FIRE - 0
HEALTH - 2
REACTIVITY - 0
SPECIFIC HAZARD -

EMERGENCY TELEPHONE NOS:
CHEMTREC (800) 424-9300
MEDICAL (303) 595-9048
PLANT (208) 236-8200 POCATELLO, ID

REVISION: 01 EFFECTIVE: 11/15/88 PRINTED: 02/11/93

PREPARED FOR USE BY..... ERNEST SELDERS

========== IDENTIFICATION ==========

INFORMATION PROVIDED BY..: FMC CORPORATION
1735 MARKET STREET
PHILADELPHIA, PA 19103

========== PRODUCT INFORMATION ==========

SYNONYMS.....: TREATED PRECIPITATOR DUST
SHIPPING NAME - DOT.....: NONE: NOT REGULATED
IATA.....: NONE: NOT REGULATED
IMDG.....: NONE: NOT REGULATED
FORMULA.....: UNKNOWN
CHEMICAL FAMILY.....: MIXTURE
PRODUCT USES.....: RAW MATERIAL FOR FERTILIZERS AND FOR MINERAL RECOVERY.

========== PRECAUTIONARY INFORMATION ==========

PRECAUTIONARY STATEMENT..: CAUTION. THIS PRODUCT CONTAINS REDUCED PHOSPHORUS COMPOUNDS. INGESTION OR INHALATION OF LARGE QUANTITIES MAY BE HARMFUL. PRODUCT MAY RELEASE PHOSPHINE GAS, PARTICULARLY IF HEATED. REPEATED OR PROLONGED SKIN CONTACT MAY CAUSE IRRITATION.
(PLEASE USE THIS STATEMENT TO SATISFY THE IN-PLANT LABELING REQUIREMENTS OF THE OSHA HAZARD COMMUNICATIONS STANDARD 29CFR 1910.1200)

FMC

MATERIAL SAFETY DATA 69012 62 0

NFPA.....704

TREATED PRECIPITATOR COPRODUCT

RATINGS:
FIRE - 0
HEALTH - 2
REACTIVITY - 0
SPECIFIC HAZARD -

EMERGENCY TELEPHONE NOS:
CHEMTREC (800) 424-9300
MEDICAL (303) 595-9048
PLANT (208) 236-8200 POCATELLO, ID

REVISION: 01 EFFECTIVE: 11/15/88 PRINTED: 02/11/93

========== FIRE, EXPLOSION AND REACTIVITY DATA ==========

FLASH POINT.....: NOT APPLICABLE
AUTOIGNITION TEMPERATURE.: NOT APPLICABLE
FLAMMABLE LIMITS UPPER..: NOT APPLICABLE
(AIR) LOWER..: NOT APPLICABLE
EXTINGUISHING MEDIA... : WATER
SPECIAL FIREFIGHTING.....: PHOSPHINE (FLAMMABLE, POISONOUS) GAS MAY BE
PROCEDURES LIBERATED IF MATERIAL IS HEATED OR COMES IN CONTACT WITH MOISTURE.
DEGREE OF FIRE AND .....: SLIGHT DUE TO BUILDUP OF FLAMMABLE PHOSPHINE
EXPLOSION HAZARD GAS.
STABILITY.....: YES. STABLE
HAZARDOUS POLYMERIZATION.: NO. WILL NOT OCCUR
CONDITIONS TO AVOID.....: HEAT, WATER
MAJOR CONTAMINANTS THAT..: NONE
CONTRIBUTE TO INSTABILITY
INCOMPATIBILITY.....: STRONG OXIDIZING AGENTS
HAZARDOUS DECOMPOSITION..: PHOSPHINE
PRODUCTS
SENSITIVITY TO MECH.....: NONE
IMPACT
SENSITIVITY TO STATIC....: NONE
DISCHARGE

========== ROUTES OF EXPOSURE ==========

EYE CONTACT.....: YES
SKIN CONTACT.....: YES
SKIN ABSORPTION.....: UNLIKELY
INHALATION.....: YES
INGESTION.....: UNLIKELY

FMC

MATERIAL SAFETY DATA 69012 62 0

NFPA.....704

TREATED PRECIPITATOR COPRODUCT

RATINGS:
FIRE - 0
HEALTH - 2
REACTIVITY - 0
SPECIFIC HAZARD -

EMERGENCY TELEPHONE NOS:
CHEMTREC (800) 424-9300
MEDICAL (303) 595-9048
PLANT (208) 236-8200 POCATELLO, ID

REVISION: 01 EFFECTIVE: 11/15/88 PRINTED: 02/11/93

SPECIAL PROTECTION

VENTILATION REQUIREMENTS.: LOCAL OR GENERAL VENTILATION SUFFICIENT TO REDUCE CADMIUM, ZINC AND PHOSPHINE CONCENTRATIONS BELOW PEL.

RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY.....: SELF CONTAINED BREATHING APPARATUS IF VENTILATION IS INADEQUATE.

EYES.....: SAFETY GLASSES OR GOGGLES

GLOVES.....: RECOMMENDED TO REDUCE IRRITATION.

SPECIAL CLOTHING AND EQUIPMENT..: NO SPECIAL REQUIREMENT

FOOTWEAR.....: NO SPECIAL REQUIREMENT

STORAGE AND HANDLING

(PLEASE USE THIS STATEMENT TO SATISFY THE IN-PLANT LABELING REQUIREMENTS OF THE OSHA HAZARD COMMUNICATIONS STANDARD 29CFR 1910.1200)

THIS MATERIAL SHOULD BE STORED IN A COOL, DRY WELL VENTILATED AREA. EXPOSURE TO HEAT AND/OR WATER MAY RELEASE PHOSPHINE GAS.

DISPOSAL, SPILL OR LEAK PROCEDURES

PROCEDURE FOR RELEASE OR SPILL....: CONTAIN SPILL. VACUUM OR SHOVEL UP MATERIAL. USE RESPIRATOR TO MINIMIZE DUST EXPOSURE.

WASTE DISPOSAL METHOD....: DISPOSE OF IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS.

TRANSPORTATION DATA

DOT PROPER SHIPPING NAME..: NONE, NOT REGULATED

DOT CLASSIFICATION.....: NOT REGULATED

DOT LABELS.....: NOT REQUIRED

DOT MARKING.....: NONE

DOT PLACARD.....: NOT REQUIRED

MSDS ENCLOSED

Notice Concerning MSDS's Included in Shipment

MSDS's have been included for the following materials:

1. *Hydrated Lime Slurry*
2. *Treated Precipitator Dust (Co-Product)*

These materials are the constituents of the slurry comprising this shipment.

Note: The *treated precipitator dust* has fully reacted with water in forming the slurry comprising this shipment. **MSDS Fire, Explosion and Reactivity Data for *treated precipitator dust* listing water as a condition to avoid does not apply to the slurry comprising this shipment.**

Due to the high pH of the slurry comprising this shipment and the cadmium content of this slurry, it is being shipped with the following classification:

Corrosive liquids, poisonous, n.o.s.
8 (6.1) , UN2922, PG II,
(pH12, Cadmium Contamination).

MSDS FOR LIME SLURRY
01/31/90 10.48.09
REPORT NO. PSH4010

SECTION I

SOURCE: FMC CORPORATION
ADDRESS: P.O. BOX 4111
POCATELLO ID 83202
CHEM. NAME: CALCIUM HYDROXIDE SLURRY
TRADE NAME: HYDRATED LIME SLURRY

CAS NO: UNKNOWN
PHONE: (208)236-8343
FMC FILE NO: 294
STORES NO: NO
LAST CHANGE: 01/25/88

SECTION II - HAZARDOUS INGREDIENTS

INGREDIENT	PERCENT	CAS NO	TLV
CALCIUM HYDROXIDE	30	1305-62-0	5.0 MG/M3

SECTION III - PHYSICAL DATA

BOILING POINT: 212 F
SPECIFIC GRAVITY: 1.0-1.3
VAPOR PRESSURE: N.A.
PERCENT VOLATILE: N.A.
VAPOR DENSITY: N.A.
EVAPORATION RATE: N.A.
SOLUBILITY: SOLUBLE
ROUTE OF ENTRY: SKIN
APPEARANCE: SMOOTH WHITE SLURRY
ODOR: EARTHY ODOR

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: N.A. N.A.
FLAMMABLE LIMITS: N.A. N.A.
EXTINGUISHING MEDIA: NON COMBUSTIBLE
FIRE FIGHTING PROCEDURES: N.A. LIME SLURRY MAY BE HOT (185 F) WHEN FORMED. IT SHOULD NOT CAUSE FIRE DANGER.
FIRE & EXPLOSION HAZARDS: NONE

SECTION V - HEALTH HAZARD DATA

THRESHOLDS: OSHA PEL - 005.00 MG/M3
ACGIH TLV - 000.00
OTHER MAC - 000.00
CARCINOGEN: NTP? U IARC? U OSHA? U
EXPOSURE EFFECTS: IRRITATING TO GASTROINTESTINAL TRACT IF INGESTED IN LARGE QUANTITIES.SKIN & EYE CONTACT MAY CAUSE REDDENING AND IRRIT. INHALATION, THOUGH UNLIKELY, MAY CAUSE IRRITATION.
FIRST AID PROCEDURES: FLUSH EYES IMMEDIATELY WITH PLENTY OF WATER FOLLOWED WITH BORIC ACID SOLUTION. IF IRRITATION DEVELOPS FOLLOWING SKIN CONTACT, CONTACT PHYSICIAN. IF SWALLOWED, GIVE LARGE QUANT. OF WATER. DO NOT INDUCE VOMITING. GET MEDICAL ATTENTION.

FMC

MATERIAL SAFETY DATA 69012 62 0

TREATED PRECIPITATOR COPRODUCT

NFPA.....704

RATINGS:
FIRE - 0
HEALTH - 2
REACTIVITY - 0
SPECIFIC HAZARD -

EMERGENCY TELEPHONE NOS:
CHEMTREC (800) 424-9300
MEDICAL (303) 595-9048
PLANT (208) 236-8200 POCATELLO, ID

REVISION: 01 EFFECTIVE: 11/15/88 PRINTED: 02/11/93

PREPARED FOR USE BY..... ERNEST SELDERS

========== IDENTIFICATION ==========

INFORMATION PROVIDED BY..: FMC CORPORATION
1735 MARKET STREET
PHILADELPHIA, PA 19103

========== PRODUCT INFORMATION ==========

SYNONYMS.....: TREATED PRECIPITATOR DUST
SHIPPING NAME - DOT.....: NONE: NOT REGULATED
IATA.....: NONE: NOT REGULATED
IMDG.....: NONE: NOT REGULATED
FORMULA.....: UNKNOWN
CHEMICAL FAMILY.....: MIXTURE
PRODUCT USES.....: RAW MATERIAL FOR FERTILIZERS AND FOR MINERAL RECOVERY.

========== PRECAUTIONARY INFORMATION ==========

PRECAUTIONARY STATEMENT..: CAUTION. THIS PRODUCT CONTAINS REDUCED PHOS-
(PLEASE USE THIS STATEMENT PHORUS COMPOUNDS. INGESTION OR INHALATION
TO SATISFY THE IN-PLANT OF LARGE QUANTITIES MAY BE HARMFUL. PRODUCT
LABELING REQUIREMENTS MAY RELEASE PHOSPHINE GAS, PARTICULARLY IF
OF THE OSHA HAZARD HEATED. REPEATED OR PROLONGED SKIN CONTACT
COMMUNICATIONS STANDARD MAY CAUSE IRRITATION.
29CFR 1910.1200)

FMC

MATERIAL SAFETY DATA 69012 62 0

NFPA.....704

TREATED PRECIPITATOR COPRODUCT

RATINGS:
FIRE - 0
HEALTH - 2
REACTIVITY - 0
SPECIFIC HAZARD -

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MEDICAL (303) 595-9048
PLANT (208) 236-8200 POCATELLO, ID

REVISION: 01 EFFECTIVE: 11/15/88 PRINTED: 02/11/93

========== FIRE, EXPLOSION AND REACTIVITY DATA ==========

FLASH POINT.....: NOT APPLICABLE
AUTOIGNITION TEMPERATURE.: NOT APPLICABLE
FLAMMABLE LIMITS UPPER..: NOT APPLICABLE
(AIR) LOWER..: NOT APPLICABLE
EXTINGUISHING MEDIA... -: WATER
SPECIAL FIREFIGHTING.....: PHOSPHINE (FLAMMABLE, POISONOUS) GAS MAY BE
PROCEDURES LIBERATED IF MATERIAL IS HEATED OR COMES IN CONTACT WITH MOISTURE.
DEGREE OF FIRE AND .....: SLIGHT DUE TO BUILDUP OF FLAMMABLE PHOSPHINE
EXPLOSION HAZARD GAS.
STABILITY.....: YES. STABLE
HAZARDOUS POLYMERIZATION.: NO. WILL NOT OCCUR
CONDITIONS TO AVOID.....: HEAT, WATER
MAJOR CONTAMINANTS THAT..: NONE
CONTRIBUTE TO INSTABILITY
INCOMPATIBILITY.....: STRONG OXIDIZING AGENTS
HAZARDOUS DECOMPOSITION..: PHOSPHINE
PRODUCTS
SENSITIVITY TO MECH.....: NONE
IMPACT
SENSITIVITY TO STATIC....: NONE
DISCHARGE

========== ROUTES OF EXPOSURE ==========

EYE CONTACT.....: YES
SKIN CONTACT.....: YES
SKIN ABSORPTION.....: UNLIKELY
INHALATION.....: YES
INGESTION.....: UNLIKELY

FMC

MATERIAL SAFETY DATA 69012 62 0

TREATED PRECIPITATOR COPRODUCT

NFPA.....704

RATINGS:
FIRE - 0
HEALTH - 2
REACTIVITY - 0
SPECIFIC HAZARD -

EMERGENCY TELEPHONE NOS:
CHEMTREC (800) 424-9300
MEDICAL (303) 595-9048
PLANT (208) 236-8200 POCATELLO, ID

REVISION: 01 EFFECTIVE: 11/15/88 PRINTED: 02/11/93

SPECIAL PROTECTION

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EYES.....: SAFETY GLASSES OR GOGGLES

GLOVES.....: RECOMMENDED TO REDUCE IRRITATION.

SPECIAL CLOTHING..: NO SPECIAL REQUIREMENT AND EQUIPMENT

FOOTWEAR.....: NO SPECIAL REQUIREMENT

STORAGE AND HANDLING

(PLEASE USE THIS STATEMENT TO SATISFY THE IN-PLANT LABELING REQUIREMENTS OF THE OSHA HAZARD COMMUNICATIONS STANDARD 29CFR 1910.1200)

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WASTE DISPOSAL METHOD....: DISPOSE OF IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS.

TRANSPORTATION DATA

DOT PROPER SHIPPING NAME.: NONE, NOT REGULATED
DOT CLASSIFICATION.....: NOT REGULATED
DOT LABELS.....: NOT REQUIRED
DOT MARKING.....: NONE
DOT PLACARD.....: NOT REQUIRED

001604

A 120 Day Final Report:

Laboratory Testing of Geosynthetics
for Waste Containment
EPA Method 9090

June 1995
(Reissued: October 1997)

Submitted to:
FMC Corporation
P.O. Box 4111
Pocatello, Idaho 83205

Attn: Mr. Larry Plooster

Submitted by:

TRI/Environmental, Inc.
9063 Bee Caves Rd.
Austin, Texas 78733

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

October 23, 1997

Ms. Susan E. Lackey
FMC Corporation
PO Box 4111
Pocatello, Idaho 83205

Dear Ms. Lackey:

This letter is written to forward a revised TRI 9090A report, generated under a 1995 work agreement for FMC Corporation. We understand from your office that the original leachate designation as "Calcium Chloride" was in error and that you are assured that new barrels had been used for leachate transportation to our laboratory for material exposure.

Per your request, we have changed the title on the applicable report pages to reflect the correct leachate designation of "NOSAP Precipitator Slurry".

TRI/Environmental, Inc. (TRI) is pleased to be of service to FMC. If you have any questions or if I may provide any additional assistance, please call me (1-800-880-8378).

Sincerely,

Sam R. Allen

Sam R. Allen
Vice President and Program Manager
Geosynthetics Testing Program

9063 Bee Caves Road • Austin, TX 78733-6201 • (512) 263-2101 • FAX 263-2558 • 1-800-880-T·E·S·T

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

June 13, 1995

Mr. Larry Plooster
FMC Corporation
P.O. Box 4111
Pocatello, Idaho 83205

Dear Mr Plooster:

TRI/Environmental, Inc. (TRI) is pleased to present this 120 Day Final Report for geosynthetic chemical compatibility studies via EPA Method 9090.

TRI thanks FMC Corporation for the opportunity to participate in this project and looks forward to working with you in the future. Please call me if you have any questions or require any additional information.

Respectfully submitted,

Martin D. Nelson

Martin D. Nelson
Laboratory Administrator: Geosynthetic Technologies

cc: Sam R. Allen
Program Manager

9063 Bee Caves Road • Austin, TX 78733-6201 • (512) 263-2101 • FAX (512) 263-2558

FOREWORD

The testing reported herein is based upon accepted industry practice as well as the test method listed. TRI/Environmental Inc. (TRI) neither accepts responsibility for nor makes claim as to the final use and purpose of the materials tested.

Tests were performed under laboratory conditions and not under actual usage conditions. TRI can give no conclusions as to the serviceability, life expectancy or general durability of the products tested when used in a lining and/or leachate collection system.

1.0 INTRODUCTION

This report describes the work performed by TRI/Environmental, Inc. (TRI) to determine the chemical compatibility of various geosynthetic products with one waste leachate. The study included one textured high density polyethylene (HDPE) geomembrane, one polyvinyl chloride (PVC) geomembrane, one nonwoven polypropylene geotextile, one HDPE geonet, and one HDPE geopipe. The objective was to determine the resistance of each geosynthetic to changes caused by exposure to leachate. Changes in physical, mechanical and hydraulic properties were measured after exposure to leachate provided by FMC Corporation at 23°C and 50°C for 30, 60, 90 and 120 days following the exposure regimen specified in United States Environmental Protection Agency (EPA) Method 9090.

Methods, results and discussion are provided in the sections which follow. Test results are provided in the Tables and Graphs of Results which accompany this report.

2.0 METHODS

2.1 Materials

Table 1 lists products selected for evaluation in this chemical compatibility study.

Table 1. List of geomembranes evaluated in chemical compatibility study

Geosynthetic	Source
60 mil textured HDPE geomembrane	Serrot Corporation
30 mil PVC geomembrane	Staff Industries
Trevira 1120 nonwoven polypropylene geotextile	Hoechst Celanese Corporation
Polynet 3000 HDPE geonet	National Seal Company
Plexco 6" IPS 17.0 PE3408 HDPE geopipe	Chevron

2.2 Leachate

The waste leachate used during the testing was provided by FMC Corporation. The leachate provided was NOSAP precipitator slurry.

2.3 Exposure Conditions

Geosynthetic test specimens were exposed to the waste leachate following the specifications of EPA Method 9090A as they relate to exposure to waste fluids. The tanks used for these exposures were maintained at 23 $\pm$ 2°C and 50 $\pm$ 2°C throughout the 120-day exposure period. Tanks were constructed from chemically resistant stainless steel, fitted with stirrers and heated with a circulating hot water heat exchanger system. The 50°C tanks were sealed with a lid, and a reflux condenser was installed to minimize loss of volatile leachate components.

2.4 Testing Procedures

The following sections list tests performed on the various geosynthetic products.

2.4.1 HDPE Geomembrane

Table 2 lists tests performed on HDPE geomembrane. The number of test replicates was doubled for baseline determinations on unexposed material. Where required, testing was performed in both the machine and transverse directions

Table 2. Tests performed on HDPE geomembrane

Test or Physical Property	Method
Dimensions and weight	EPA 9090A
Hardness	ASTM D 2240 D scale
Volatiles and Extractables	EPA SW 870 Appendix III
Environmental Stress Crack Resistance	ASTM D 1693, Condition B
Specific Gravity	ASTM D 792
Tensile Properties	ASTM D 638
Modulus of Elasticity	ASTM D 882, 2% secant method
Hydrostatic Resistance	ASTM D 751 Method A
Tear Strength	ASTM D 1004
Puncture Resistance	FTMS 101C Method 2065
Seam Peel & Shear Strength	ASTM D 4437

2.4.2 *PVC Geomembrane*

Table 3 lists tests performed on PVC geomembrane. The number of test replicates was doubled for baseline determinations on unexposed material. Where required, testing was performed in both the machine and transverse directions

Table 3. Tests performed on PVC geomembrane

Test or Physical Property	Method
Dimensions and weight	EPA 9090A
Hardness	ASTM D 2240 D scale
Volatiles and Extractables	EPA SW 870 Appendix III
Specific Gravity	ASTM D 792
Tensile Properties	ASTM D 882
Hydrostatic Resistance	ASTM D 751 Method A
Tear Strength	ASTM D 1004
Puncture Resistance	FTMS 101C Method 2065
Seam Peel & Shear Strength	ASTM D 4437

2.4.3 Geotextile

Table 4 lists tests performed on the geotextile. The number of test replicates was doubled for baseline determinations on unexposed material.

Table 4. Tests performed on geotextile

Test or Physical Property	Method
Dimensions and weight	EPA 9090A
Grab Tensile Properties	ASTM D 4632
Trapezoidal Tear Resistance	ASTM D 4533
Puncture Resistance	ASTM D 4833
Mullen Burst Strength	ASTM D 3786
Permittivity (flow rate: gal/min/ft^2)	ASTM D 4491

At each testing period, exposed geotextile specimens dedicated to dimension analysis were rinsed, blotted dry with absorbent towels and dried in an air oven at 45°C for eight hours. Test specimens dedicated to mechanical testing were rinsed, blotted dry with absorbent towels and stored in polyethylene bags until tested. Test specimens were tested in a moist condition.

2.4.4 *HDPE Geonet*

Table 5 lists tests performed on the drainage geonet. The number of test replicates was doubled for baseline determinations on unexposed material.

Table 5. Tests performed on geonet

Test or Physical Property	Method
Dimensions and weight	EPA 9090A
Tensile Properties	ASTM D 1682
Transmissivity - machine direction Grad. 1.0 Normal Load:10000 psf	ASTM D 4716

At each testing period, exposed geonet specimens dedicated to mechanical property testing were rinsed, blotted dry with absorbent towels and stored in polyethylene bags until tested.

2.4.5 *HDPE Geopipe*

Table 6 lists tests performed on the HDPE geopipe. The number of test replicates was doubled for baseline determinations on unexposed material.

Table 6. Tests performed on geonet

Test or Physical Property	Method
Dimensions and weight	EPA 9090A
Compressive Strength @ 5% & 10% deflection	ASTM D 2412

At each testing period, exposed geopipe specimens dedicated to mechanical property testing were rinsed, blotted dry with absorbent towels and stored in polyethylene bags until tested.

3.0 DISCUSSION/RESULTS

Test results are presented in the Tables of Test Results (raw data) and graphical presentations are presented in Appendix A.

In considering these results, it must be determined through engineering judgment whether observed differences in the value of test results measured before and after immersion are due to product variability, unidentified factors relating to the test procedure, or leachate interaction with the products. Any significant chemical interaction with leachate would be expected to result in degradation trends which are consistent across the various properties being evaluated, and not isolated to one set of test results only. However, with each type of material there may be specific properties which are highly sensitive to leachate-induced effects. These factors must be considered in evaluating the various test results for a given product. These issues are addressed in the following sections for each class of geosynthetic

Also of critical importance is the issue of product variability. With geotextiles, a range of physical and mechanical index test values covering 25% or more of the average is not uncommon. This can be traced to variability inherent in the product, and the randomness associated with the onset of failure under the specified testing conditions. However, in chemical compatibility testing the statistical sampling of a broad range of manufactured product is not possible. Therefore, the small size of the sample population tested at each time point must be taken into consideration. The criteria to be applied in evaluating data measured before and after leachate immersion should be that property changes, if observed, are consistent and so great that product variability and experimental factors can be ruled out.

In this report, standard deviations (STD) are reported for most measurements involving three or more replicate specimens. In statistics, the standard deviation is defined as root of the mean squared deviations of individual test results about the mean value. The standard deviation is a quantitative measure of variability within a group of measurements.

One related measure of variability observed within a sample set, relative to the magnitude of the mean value itself, is the *coefficient of variation or variance* (COV). The coefficient of variance is defined as the standard deviation divided by the mean associated with a group of specimens, and may be expressed as a percentage. The COV provides an indication of what proportion of the mean value may be attributable to random experimental factors or product variability. It is useful to consider apparent changes in property values against the criterion of COV since observed changes which fall below the COV may not be significant. This approach was used in preparing the tables in the next sections.

The term *range* refers to the difference between the extreme highest and lowest points within a group of measured values. Considering range as a percentage of the mean values provides another measure of variability within a dataset.

In the tables, the high and low extremes for percentage change in mean values are listed for comparison against COV and range as a percentage of mean from the baseline sample group. The high and low percentage changes are the extremes from data measured at 30, 60, 90 and 120 days.

3.1 Serrot HDPE Geomembrane

Table 7 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for Serrot HDPE geomembrane.

Table 7. Baseline coefficients of variation and range of percentage change results for Serrot HDPE Geomembrane

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Stress at yield (MD)	1	5	9	-7
Stress at break (MD)	6	16	-1	-24
Elongation at yield (MD)	9	24	21	-9
Elongation at break (MD)	9	25	-7	-23
Modulus (MD)	16	41	1	-16
Tear strength (MD)	2	6	9	0
Puncture Resistance	3	8	22	5
Hydrostatic Resistance	2	6	11	1
Seam Shear Strength	3	9	14	5
Seam Peel Strength	3	9	15	2

3.2 Staff PVC Geomembrane

Table 8 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for Staff PVC geomembrane.

Table 8. Baseline coefficients of variation and range of percentage change results for Staff PVC Geomembrane

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Stress at break (MD)	4	11	14	-20
Elongation at break (MD)	8	23	13	-24
Tear strength (MD)	3	9	11	-2
Puncture Resistance	5	10	22	0
Hydrostatic Resistance	3	9	10	-9
Seam Shear Strength	6	17	17	4
Seam Peel Strength	10	26	42	8

3.3 Polypropylene Hoechst Celanese Trevira Geotextile

Table 9 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for Trevira 1120 geotextile.

Table 9. Baseline coefficients of variation and range of percentage change results for Polypropylene Hoechst Celanese Geotextile

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Grab Strength (MD)	13	32	-5	-23
Grab Elongation (MD)	5	19	14	-18
Tear Strength (MD)	15	49	-13	-26
Puncture Resistance	13	44	-5	-23
Burst Strength	10	34	1	-11
Permittivity	6	24	3	-24

3.4 National Seal Polynet 3000 HDPE Geonet

Table 10 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for Polynet 3000 HDPE geonet.

Table 10. Baseline coefficients of variation and range of percentage change results for Polynet 3000 HDPE Geonet

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Tensile Strength (MD)	7	24	6	-6
Transmissivity (MD)	3	8	-12	-17

3.5 Chevron Plexco HDPE Geopipe

Table 11 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for Chevron Plexco HDPE geopipe.

Table 11. Baseline coefficients of variation and range of percentage change results for Plexco HDPE Geopipe

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Compressive Strength @ 5% deflection	22	57	21	-14
Compressive Strength @ 10% deflection	16	49	8	-17

4.0 CONCLUSION

While changes in certain measured physical and mechanical properties were noted for some products, the effects of product variability and experimental factors could not be ruled out as causes. In the opinion of the authors, the data, considered together, do not support the conclusion that observed changes were consistently and uniformly caused by the test exposures.

TRI/Environmental, Inc. is pleased to have been selected to participate in this project. We trust that the information provided in this report meets your requirements for technical documentation of this chemical compatibility study. Please do not hesitate to call me if I may provide any further information.

Respectfully submitted,

Sam R. Allen
Program Manager: Geosynthetics Testing Technologies

APPENDIX A - TEST RESULTS

This section includes generated test data provided in both tabular and graphical form. Each graph is represented by a series of "I" beam plots. Each "I" beam represents a single test population and illustrates the high and low value as the end points, and the mean as a central box on the beam.

At each testing period, two "I" beams are shown. The left beam represents the 23°C exposed specimens while the right beam represents the 50°C specimens. The initial "I" beam represents the baseline or unexposed test specimens. Graphical representations are

EPA METHOD 9090 TEST RESULTS

SERROT 60 mil TEXTURED HDPE GEOMEMBRANE

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

SRA
Quality Review

Report Date: June 13, 1995
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Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							

GEOMEMBRANE: SERROT 60 mil TEXTURED HDPE GEOMEMBRANE

Tensile Properties:									
Tensile Stress @ Yield (psi)	2569	2811	3007	2829	2878	2683	2587	2412	2488
ASTM D638	2694	2827	2595	2788	2899	2755	2847	2638	2350
Machine Direction	2640	2904	2811	2740	2622	2729	2571	2420	2447
	2623								
	2592								
	2619								
Average	2623	2847	2804	2786	2800	2722	2668	2490	2428
STD	39	41	168	36	126	30	127	105	58
Coefficient of Variation	1	1	6	1	4	1	5	4	2
% Change		9	7	6	7	4	2	-5	-7
Tensile Strength @ Break (psi)	3465	3342	2429	3254	3608	1688	1337	2830	1349
ASTM D638	3216	3226	2490	3285	3391	3117	3261	3115	2885
Machine Direction	2965	1864	3191	3111	1490	3191	3070	2842	3151
	3271								
	3148								
	3490								
Average	3259	2811	2703	3217	2830	2665	2556	2929	2462
STD	181	671	346	76	951	692	865	132	794
Coefficient of Variation	6	24	13	2	34	26	34	4	32
% Change		-14	-17	-1	-13	-18	-22	-10	-24
Tensile Properties:									
Elongation @ Yield (%)	16	15	18	15	16	16	17	18	22
ASTM D638	16	15	19	17	17	17	15	17	19
Machine Direction	17	17	16	16	19	15	14	16	20
	20								
	16								
	16								
Average	17	16	18	16	17	16	15	17	20
STD	1	1	1	1	1	1	1	1	1
Coefficient of Variation	9	6	7	5	7	5	8	5	6
% Change		-7	5	-5	3	-5	-9	1	21

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
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Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Elongation @ Break (%)	454	398	242	383	420	308	256	370	301
ASTM D638	390	394	330	391	389	372	380	379	397
Machine Direction	356	354	374	356	241	392	411	370	394
	419								
	377								
	457								
Average	409	382	315	377	350	357	349	373	364
STD	38	20	55	15	78	36	67	4	45
Coefficient of Variation	9	5	17	4	22	10	19	1	12
% Change		-7	-23	-8	-14	-13	-15	-9	-11
Set after Break (%)	361	332	214	322	362	278	242	342	338
ASTM D638	314	294	250	300	331	276	274	387	367
Machine Direction	279	274	271	294	247	303	350	381	421
	345								
	307								
	354								
Average	327	300	245	305	313	286	289	370	375
STD	29	24	24	12	49	12	45	20	34
Coefficient of Variation	9	8	10	4	16	4	16	5	9
% Change		-8	-25	-7	-4	-13	-12	13	15
Stress @ 100% Elongation (psi)	2091	2333	2550	2399	2394	2252	2180	2055	2093
ASTM D638	2110	2338	2160	2400	2481	2249	2337	2292	2017
Machine Direction	2034	2305	2272	2355	2233	2247	2091	2079	2020
	2063								
	2103								
	2041								
Average	2074	2325	2327	2385	2369	2249	2203	2142	2043
STD	30	15	164	21	103	2	102	107	35
Coefficient of Variation	1	1	7	1	4	0	5	5	2
% Change		12	12	15	14	8	6	3	-1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
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Reissued (October 21, 1997)

~~SPA~~
Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Stress @ 200% Elongation (psi)	2174	2454	2456	2371	2523	2204	2111	2017	2101
ASTM D638	2249	2303	2217	2462	2387	2231	2385	2271	2133
Machine Direction	2137	2368	2361	2396	2177	2220	2161	2058	2065
	2186								
	2223								
	2205								
Average	2196	2375	2345	2410	2362	2218	2219	2115	2100
STD	36	62	98	38	142	11	119	111	28
Coefficient of Variation	2	3	4	2	6	0	5	5	1
% Change		8	7	10	8	1	1	-4	-4
Tensile Properties:									
Tensile Stress @ Yield (psi)	2651	3051	2552	2784	2758	2829	2727	2406	2472
ASTM D638	2624	3011	3064	2600	2749	2835	2839	2511	2726
Transverse Direction	2551	2992	2886	2763	2709	2865	2719	2638	2444
	2755								
	2826								
	2691								
Average	2683	3018	2834	2716	2739	2843	2762	2518	2547
STD	89	25	212	82	21	16	55	95	127
Coefficient of Variation	3	1	7	3	1	1	2	4	5
% Change		12	6	1	2	6	3	-6	-5
Tensile Strength @ Break (psi)	2807	1837	3199	2603	2937	2694	1997	1233	2586
ASTM D638	2850	2137	3561	2643	3090	1010	1223	2633	2910
Transverse Direction	2984	3249	2466	2512	3314	1579	1402	1482	2872
	3302								
	3114								
	2203								
Average	2877	2408	3075	2586	3114	1761	1541	1783	2789
STD	344	607	456	55	155	699	331	610	145
Coefficient of Variation	12	25	15	2	5	40	21	34	5
% Change		-16	7	-10	8	-39	-46	-38	-3

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Test Parameters	Baseline	Exposure Time and Temperature: 30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Tensile Properties:									
Elongation @ Yield (%)	16	15	18	15	15	15	15	17	16
ASTM D638	16	15	16	16	16	16	16	16	16
Transverse Direction	19	15	18	15	14	16	17	18	18
	16								
	16								
	14								
Average	16	15	17	15	15	16	16	17	17
STD	1	0	1	0	1	0	1	1	1
Coefficient of Variation	9	0	5	3	5	3	5	5	6
% Change		-7	7	-5	-7	-3	-1	5	3
Elongation @ Break (%)	354	334	450	324	382	347	220	233	347
ASTM D638	368	360	423	358	409	177	241	358	342
Transverse Direction	393	415	217	325	440	280	342	324	386
	441								
	415								
	295								
Average	378	370	363	336	410	268	268	305	358
STD	47	34	104	16	24	70	53	53	20
Coefficient of Variation	12	9	29	5	6	26	20	17	5
% Change		-2	-4	-11	9	-29	-29	-19	-5
Set after Break (%)	286	275	372	274	388	282	213	352	362
ASTM D638	310	256	342	286	337	126	246	390	338
Transverse Direction	317	310	174	254	358	254	306	384	381
	359								
	355								
	265								
Average	315	280	296	271	361	221	255	375	360
STD	34	22	87	13	21	68	38	17	18
Coefficient of Variation	11	8	29	5	6	31	15	4	5
% Change		-11	-6	-14	14	-30	-19	19	14

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Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Stress @ 100% Elongation (psi)	1863	2133	1937	2022	2011	2118	1975	1808	1846
ASTM D638	1768	2145	2466	1992	2042	2076	2060	1966	2113
Transverse Direction	1831	2162	2213	2112	2099	2160	2003	1947	1834
	1970								
	1900								
	1954								
Average	1881	2147	2205	2042	2051	2118	2013	1907	1931
STD	70	12	216	51	36	34	35	70	129
Coefficient of Variation	4	1	10	2	2	2	2	4	7
% Change		14	17	9	9	13	7	1	3
Stress @ 200% Elongation (psi)	2060	2139	2075	2153	2094	2084	2034	1912	1962
ASTM D638	1938	2185	2325	1977	2085	2134	2111	2030	2117
Transverse Direction	1982	2178	2266	2089	2165	2102	2079	2076	1965
	2019								
	2004								
	1991								
Average	1999	2167	2222	2073	2115	2107	2075	2006	2015
STD	37	20	107	73	36	21	32	69	72
Coefficient of Variation	2	1	5	4	2	1	2	3	4
% Change		8	11	4	6	5	4	0	1
Modulus of Elasticity:									
ASTM D882 (psi)	77075	76389	68798	66892	65426	68554	64572	56211	67738
Machine Direction	80440	75964	65662	61443	68106	72186	76701	65329	69742
2% Secant	70599	71787	76096	70891	57168	73012	69998	65265	67716
	60724								
	62466								
	91264								
Average	73761	74713	70185	66409	63567	71251	70424	62268	68399
STD	11571	2543	5354	4743	5701	2372	6076	5246	1163
Coefficient of Variation	16	3	8	7	9	3	9	8	2
% Change		1	-5	-10	-14	-3	-5	-16	-7

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Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Modulus of Elasticity:									
ASTM D882 (psi)	66153	80634	59948	73617	66166	75450	75843	60607	73688
Transverse Direction	62397	76929	73594	68372	70382	71559	68234	60674	75371
2% Secant	50823	76892	69820	71828	68419	75683	61710	48320	63182
	57759								
	62697								
	75615								
Average	62574	78152	67787	71272	68322	74231	68596	56534	70747
STD	8297	2150	7046	2666	2110	2317	7073	7113	6605
Coefficient of Variation	13	3	10	4	3	3	10	13	9
% Change		25	8	14	9	19	10	-10	13
Indentation Hardness:									
Reading	53	46	54	48	51	49	49	43	46
ASTM D2240	56	53	55	49	51	50	48	38	43
(with TYPE D DUROMETER)	53	53	53	51	48	45	48	45	44
	53	52	51	50	53	49	48	48	50
	53	46	48	49	54	48	48	43	44
	52								
	52								
	48								
	48								
	53								
Average	52	50	52	49	51	48	48	43	45
STD	2	4	3	1	2	2	0	4	3
Coefficient of Variation	5	7	5	2	4	4	1	8	6
% Change		-4	0	-5	-1	-7	-7	-17	-13
Specific Gravity:									
ASTM D792, Method A	0 942	0 941	0 941	0.936	0.949	0.939	0.933	0.931	0.934
	0 947	0 940	0 938	0.936	0.947	0.933	0.933	0.934	0.942
	0 944	0 936	0 940	0.941	0.948	0.937	0.939	0.945	0.940
	0 940								
	0 944								
	0 939								
Average	0 943	0 939	0 940	0.938	0.948	0.936	0.935	0.937	0.939
STD	0 003	0 003	0 002	0.003	0.001	0.003	0.003	0.007	0.004
Coefficient of Variation	0	0	0	0	0	0	0	1	0
% Change		-0.39	-0.32	-0.53	0.57	-0.67	-0.81	-0.64	-0.42
Environmental Stress Crack Resistance:									
ASTM D1693, Condition B									
Machine Direction (% Failed)	N/A	0	0	0	0	0	0	0	0
Transverse Direction (% Failed)	N/A	0	0	0	0	0	0	0	0

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Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Puncture Resistance:									
Load @ Rupture (lbs)	85	98	92	95	98	102	106	95	94
FTMS 101C Method 2065	86	95	98	96	99	103	105	95	91
	84	95	97	93	99	104	109	92	91
	89								
	91								
	91								
Average	88	96	96	95	99	103	107	94	92
STD	3	1	3	1	0	1	2	1	1
Coefficient of Variation	3	1	3	1	0	1	2	2	2
% Change		10	9	8	13	17	22	7	5
Volatiles and Extractables:									
Machine Diameter Change (%)	-0.18	-0.27	-0.10	0.00	-0.12	0.70	-0.35	-0.08	0.08
SW 870 - Appendix III-D	-0.16	-0.17	-0.03	-0.13	-0.75	-0.60	-0.23	-0.23	0.05
	-0.15								
	-0.16								
Average	-0.16	-0.22	-0.07	-0.07	-0.44	-0.29	-0.29	-0.16	0.07
STD	0.01	0.05	0.04	0.07	0.32	0.06	0.06	0.08	0.02
Transverse Diameter Change (%)	0.25	-0.58	-0.20	-0.22	-0.35	-0.95	-0.38	-0.30	-0.56
SW 870 - Appendix III-D	0.07	-0.40	-0.38	-0.25	-0.47	0.73	-0.12	-0.25	-0.58
	-0.29								
	-0.33								
Average	-0.08	-0.49	-0.29	-0.24	-0.41	-0.11	-0.25	-0.28	-0.57
STD	0.24	0.09	0.09	0.02	0.06	0.84	0.13	0.02	0.01
% Volatiles	0.03	0.04	0.10	0.05	0.05	0.08	0.08	0.10	0.18
SW 870 - Appendix III-D	0.04	0.04	0.06	0.04	0.05	0.07	0.08	0.09	0.19
	0.04								
	0.04								
Average	0.04	0.04	0.08	0.05	0.05	0.08	0.08	0.10	0.19
STD	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.01	0.01
% Extractables	0.08	0.06	0.10	0.49	0.43	0.35	0.26	0.50	0.48
SW 870 - Appendix III-D	0.09	0.24	0.17	0.46	0.38	0.35	0.25	0.31	0.29
	0.10								
	0.10								
Average	0.09	0.15	0.14	0.48	0.41	0.35	0.26	0.41	0.39
STD	0.01	0.09	0.04	0.01	0.02	0.00	0.01	0.10	0.10

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
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Test Parameters	Baseline	Exposure Time and Temperature: 30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Tear Resistance:									
ASTM D1004	53	54	56	57	56	53	54	51	50
(lbs)	51	55	57	52	53	53	52	51	50
Machine Direction	52	54	56	53	55	51	56	51	51
	53								
	52								
	50								
Average	52	54	56	54	55	52	54	51	50
STD	1	1	1	3	2	1	2	0	1
Coefficient of Variation	2	1	1	5	3	2	4	0	1
% Change		5	9	4	5	1	4	-2	-3
Tear Resistance:									
ASTM D1004	51	54	55	51	54	54	55	52	51
(lbs)	51	52	56	52	53	53	54	54	48
Transverse Direction	50	52	53	54	51	52	56	51	52
	51								
	50								
	50								
Average	51	53	55	52	53	53	55	52	50
STD	1	1	2	2	2	1	1	2	2
Coefficient of Variation	1	2	3	3	3	2	2	3	4
% Change		4	8	4	4	5	9	4	-0
Hydrostatic Resistance:									
ASTM D751	420	450	430	460	470	450	450	450	460
(psi)	420	440	410	470	480	450	475	425	480
	415	440	440	470	470	455	480	440	460
	425								
	420								
	440								
Average	423	443	427	467	473	452	468	438	467
STD	9	6	15	6	6	3	16	13	12
Coefficient of Variation	2	1	4	1	1	1	3	3	2
% Change		5	1	10	12	7	11	4	10

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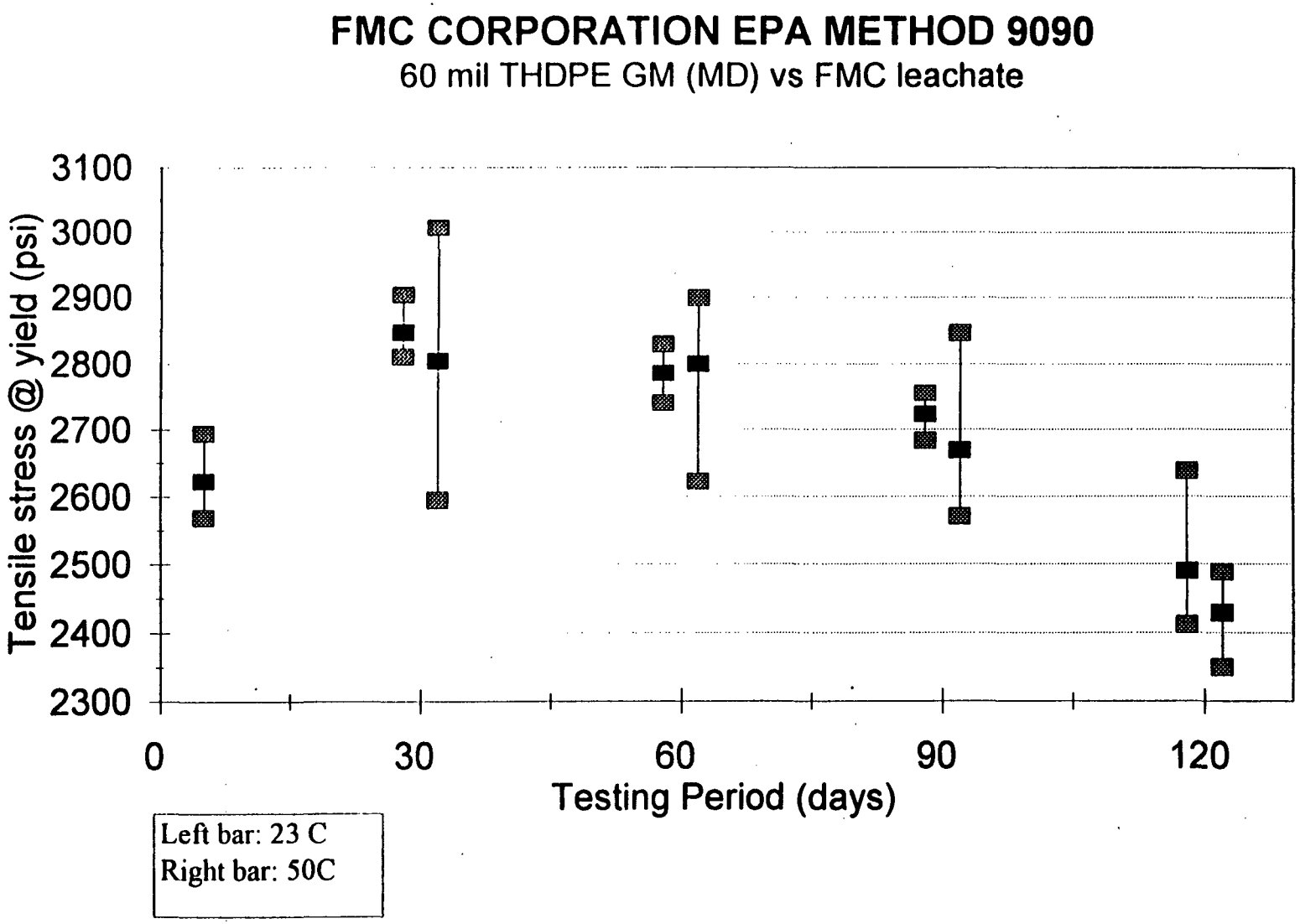
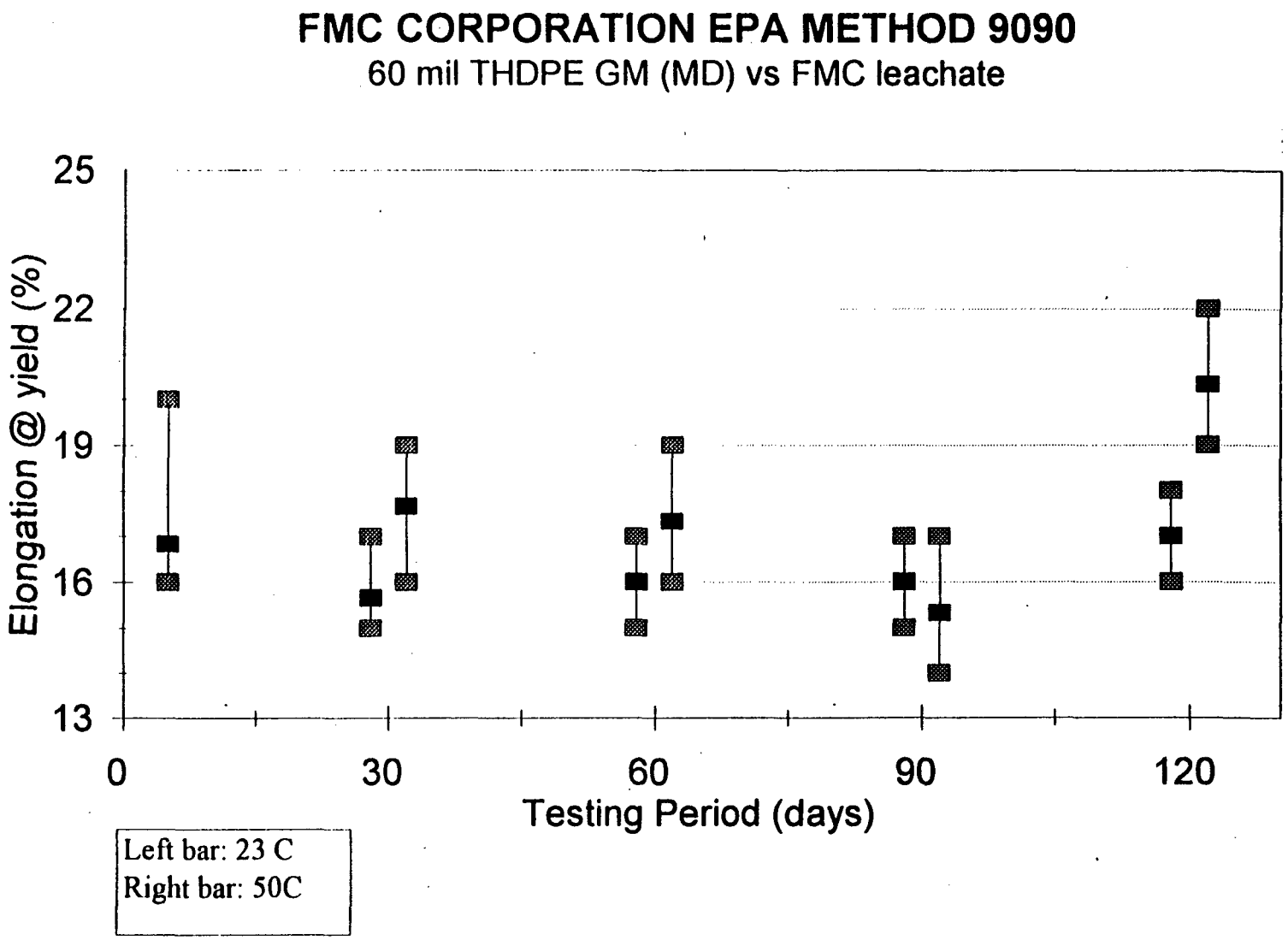
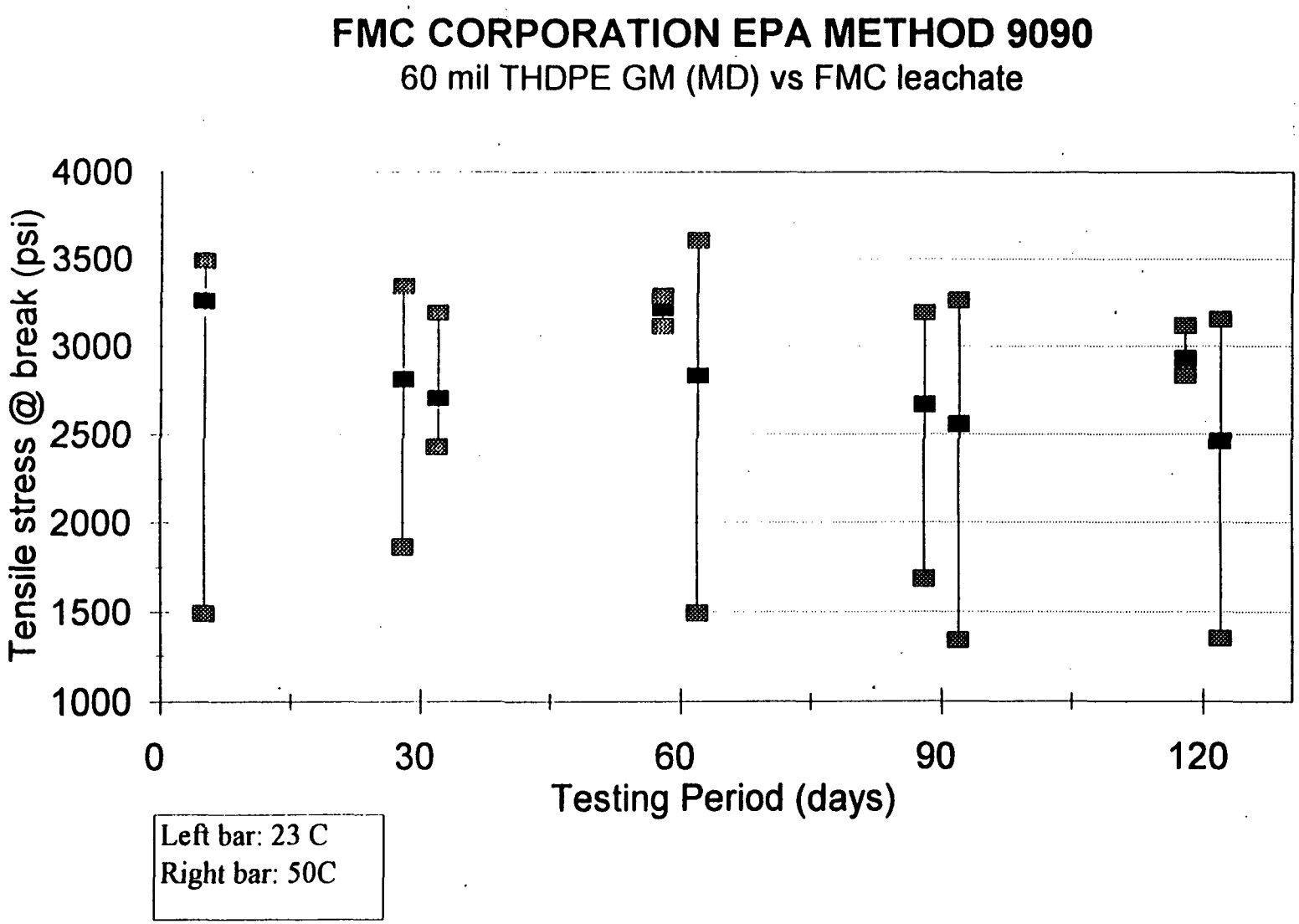
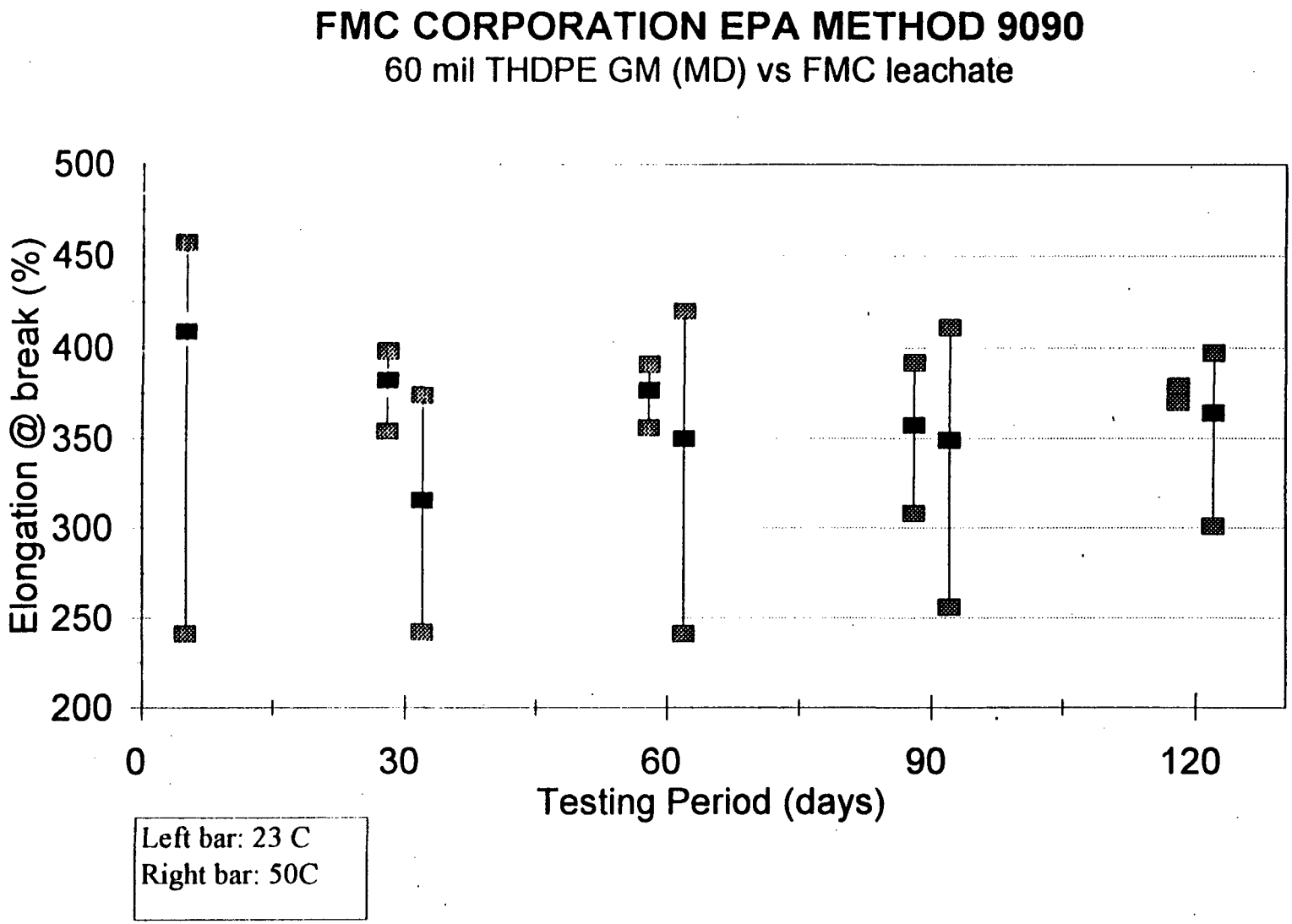
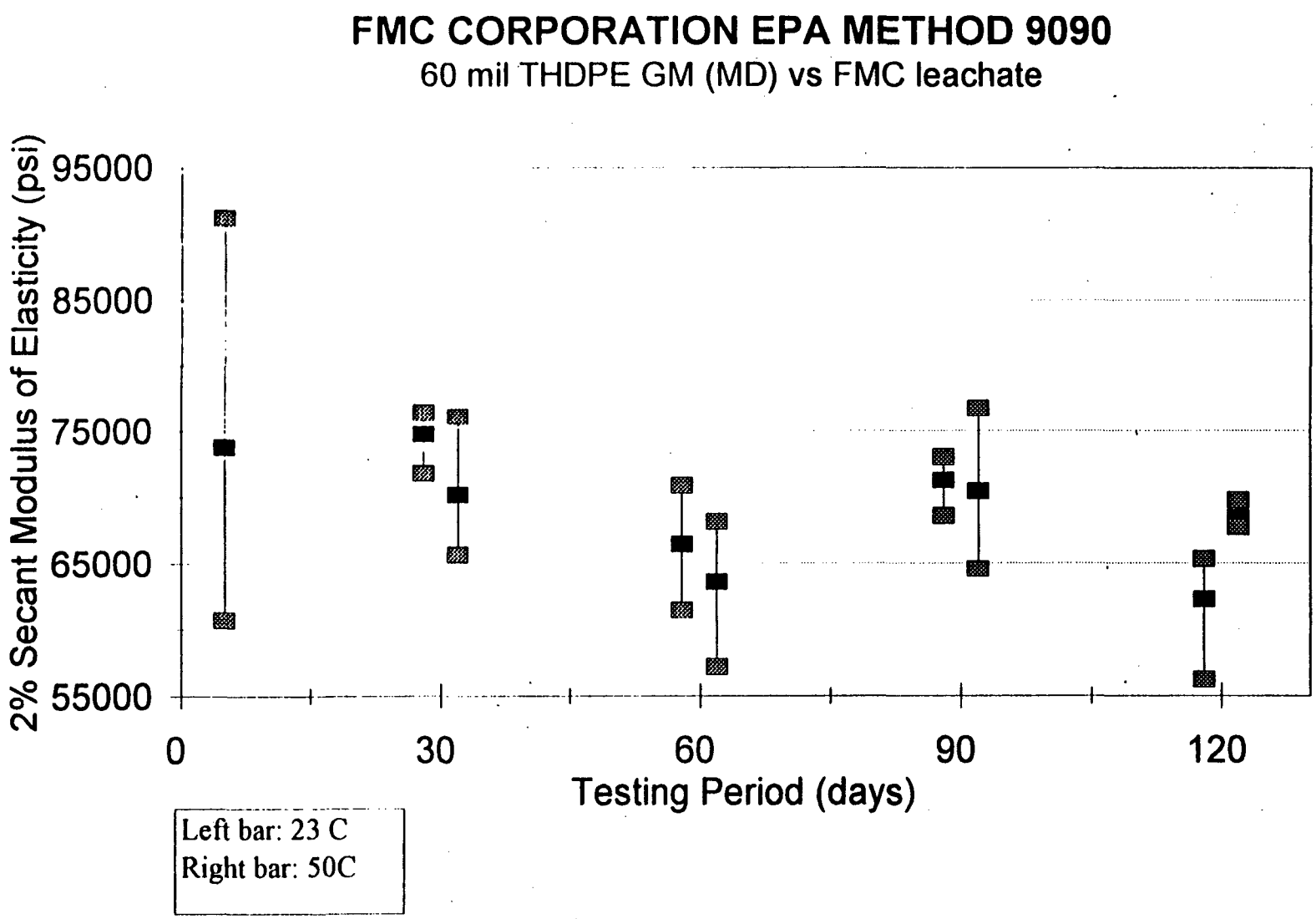
Test Parameters	Baseline	Exposure Time and Temperature: 30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Seam Peel Adhesion:									
ASTM D4437 (lbs)	118	137	142	121	134	135	128	142	143
	128	142	148	132	121	122	124	138	130
	126	139	142	128	128	131	130	145	138
	119	128	136	131	137	122	130	133	140
	126	133	147	124	128	138	126	134	138
	124	145	136	133	117	126	119	139	136
	122								
	121								
	129								
	123								
	122								
	125								
Average	124	137	142	128	128	129	126	139	138
STD	3	6	5	4	7	6	4	4	4
Coefficient of Variation	3	4	3	3	5	5	3	3	3
% Change		11	15	4	3	4	2	12	11
Failure Mode (FTB = All Film Tear Bond)	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB
Shear Seam Strength:									
Shear Seam Strength (lbs)	144	168	169	160	165	156	160	167	168
ASTM D4437	156	164	161	160	165	154	160	170	168
	145	169	163	162	163	154	160	166	166
	149								
	142								
	149								
Average	148	167	164	161	164	155	160	168	167
STD	5	2	3	1	1	1	0	2	1
Coefficient of Variation	3	1	2	1	1	1	0	1	1
% Change		13	11	9	11	5	8	14	13

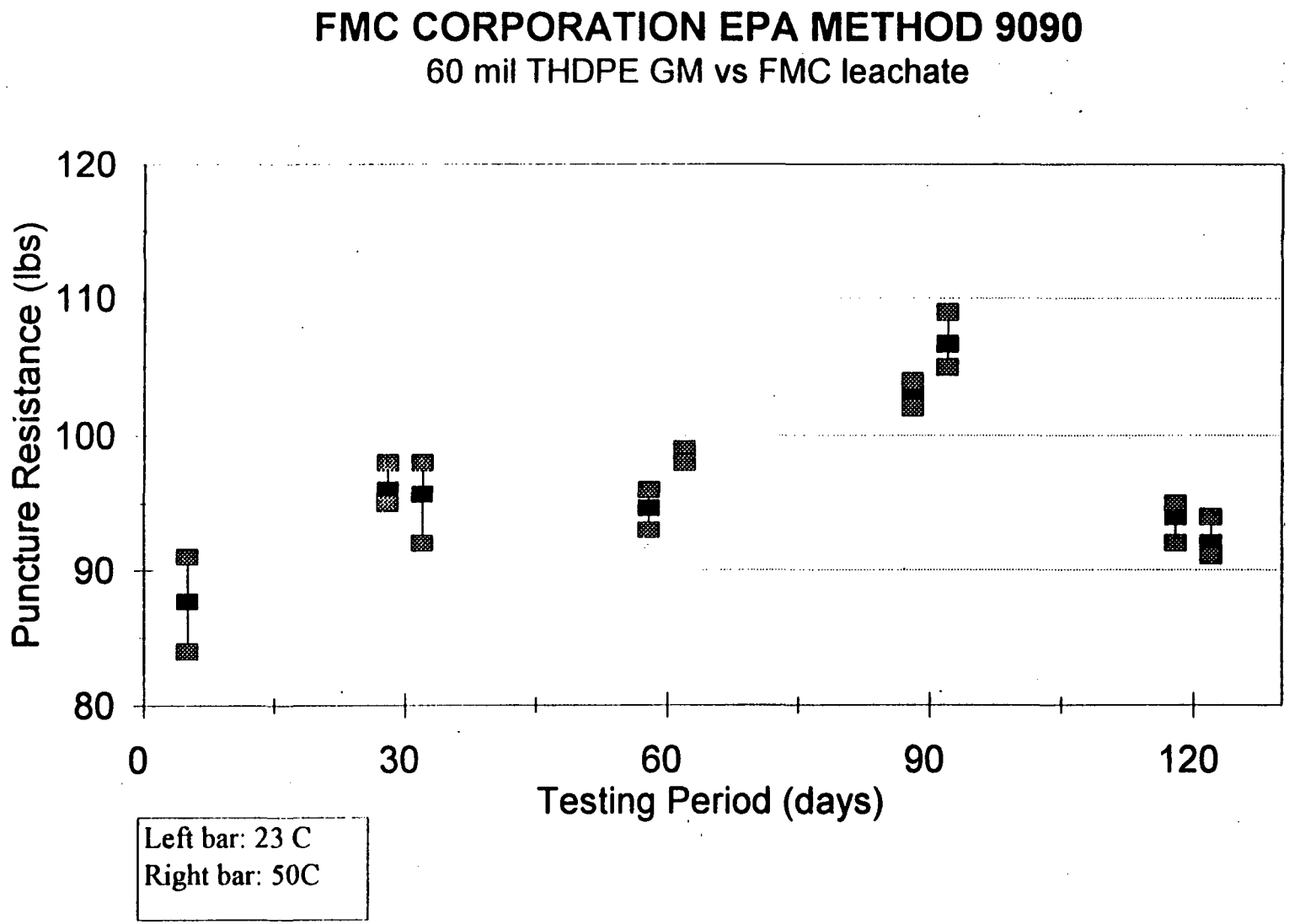

FMC CORPORATION EPA METHOD 9090
60 mil THDPE GM (MD) vs FMC leachate
Tensile stress @ yield (psi)
3100
3000
2900
2800
2700
2600
2500
2400
2300
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

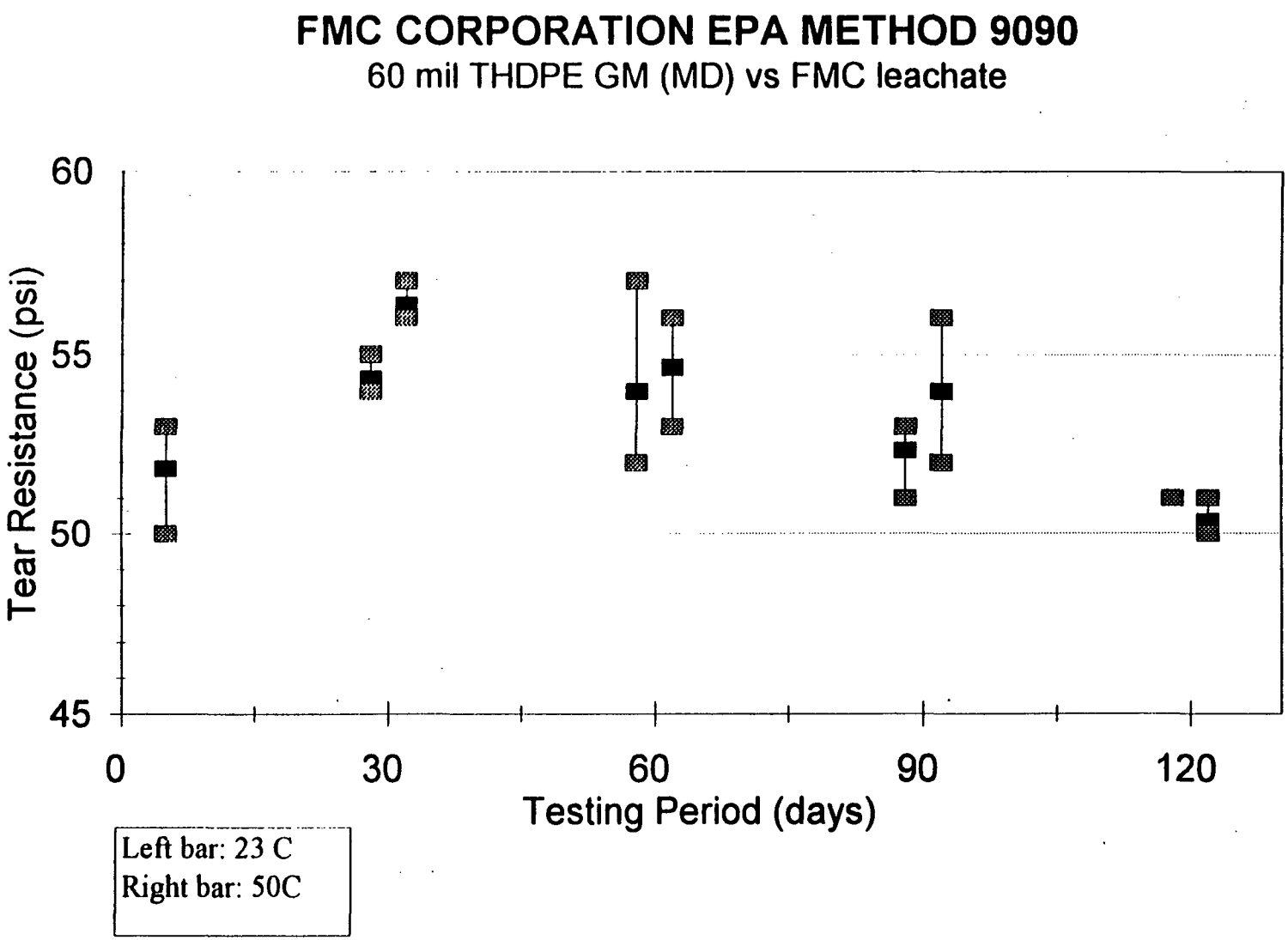

FMC CORPORATION EPA METHOD 9090
60 mil THDPE GM (MD) vs FMC leachate
Elongation @ yield (%)
25
22
19
16
13
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

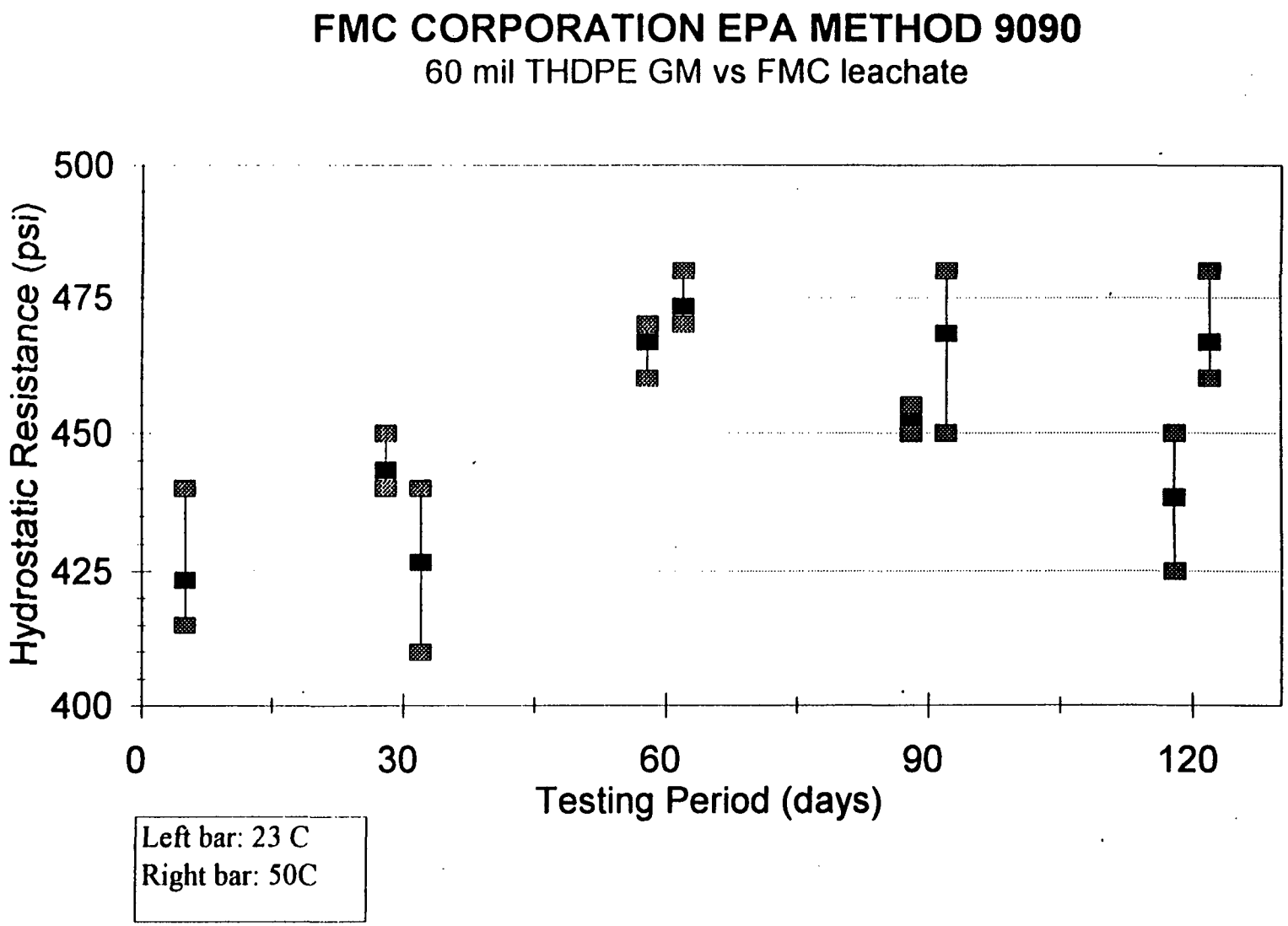

FMC CORPORATION EPA METHOD 9090
60 mil THDPE GM (MD) vs FMC leachate
Tensile stress @ break (psi)
4000
3500
3000
2500
2000
1500
1000
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

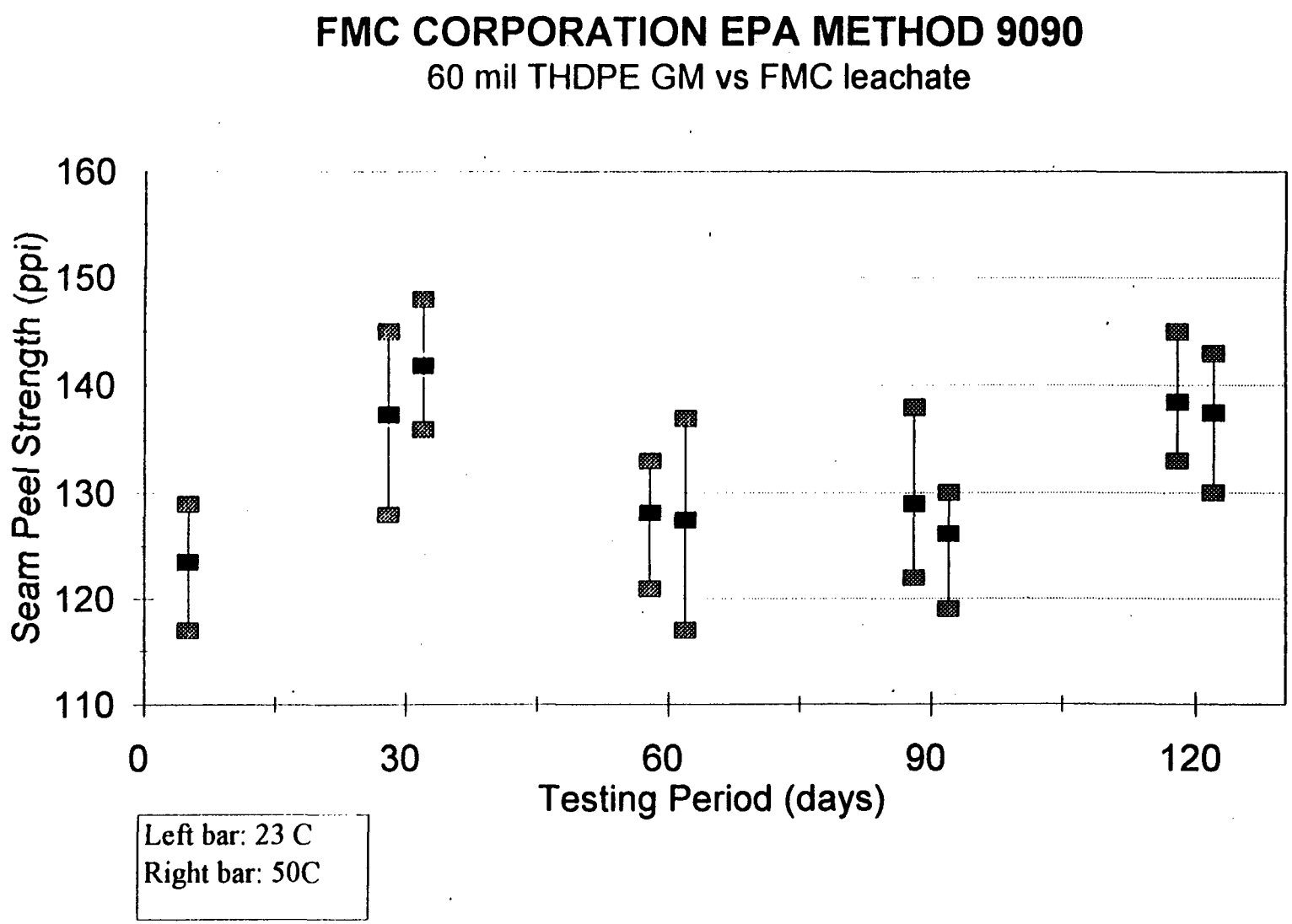

FMC CORPORATION EPA METHOD 9090
60 mil THDPE GM (MD) vs FMC leachate
Elongation @ break (%)
500
450
400
350
300
250
200
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

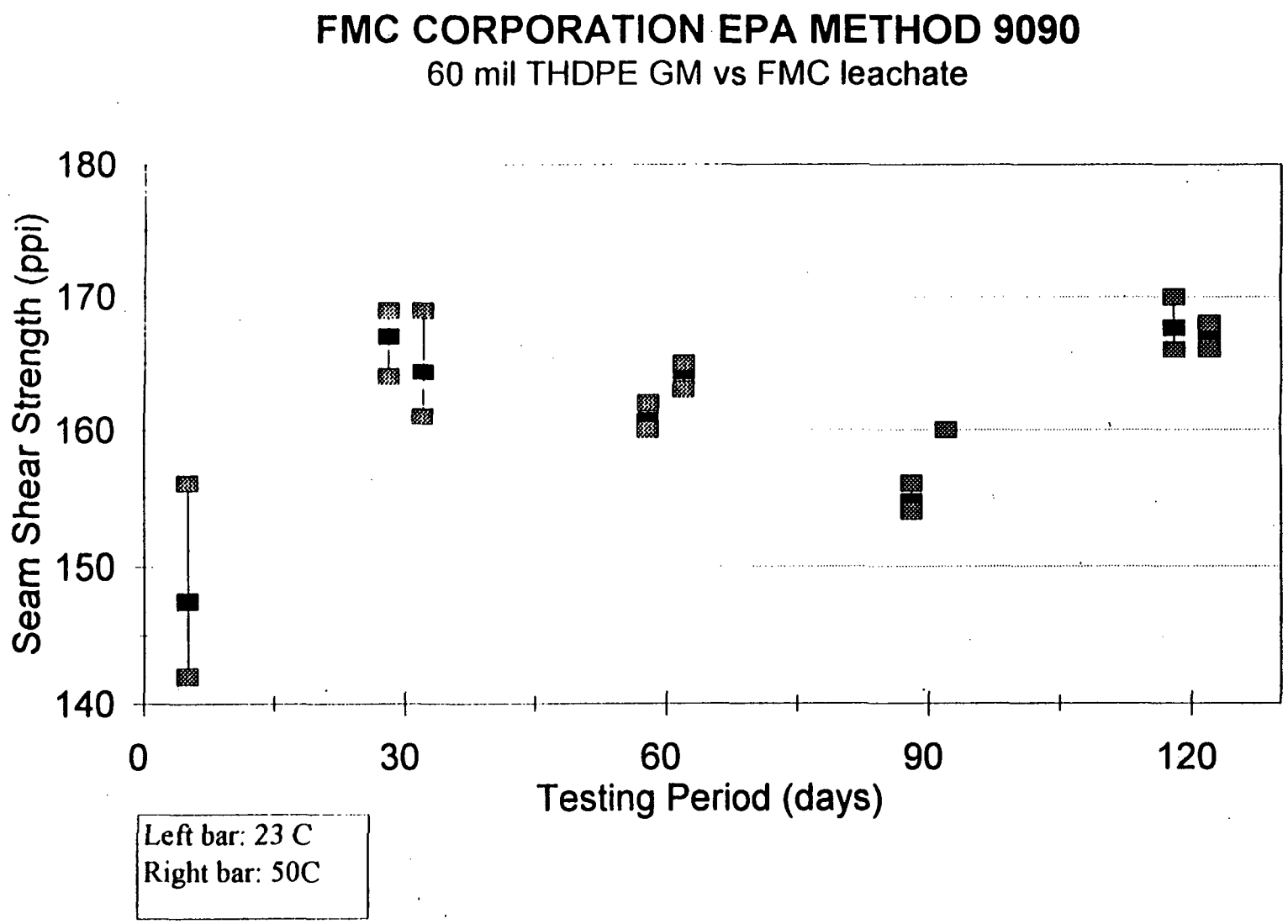

FMC CORPORATION EPA METHOD 9090
60 mil THDPE GM (MD) vs FMC leachate
2% Secant Modulus of Elasticity (psi)
95000
85000
75000
65000
55000
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C


FMC CORPORATION EPA METHOD 9090
60 mil THDPE GM vs FMC leachate
Puncture Resistance (lbs)
120
110
100
90
80
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C


FMC CORPORATION EPA METHOD 9090
60 mil THDPE GM (MD) vs FMC leachate
Tear Resistance (psi)
60
55
50
45
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C


FMC CORPORATION EPA METHOD 9090
60 mil THDPE GM vs FMC leachate
Hydrostatic Resistance (psi)
500
475
450
425
400
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C


FMC CORPORATION EPA METHOD 9090
60 mil THDPE GM vs FMC leachate
Seam Peel Strength (ppi)
160
150
140
130
120
110
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C


FMC CORPORATION EPA METHOD 9090
60 mil THDPE GM vs FMC leachate
Seam Shear Strength (ppi)
180
170
160
150
140
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

EPA METHOD 9090 TEST RESULTS

STAFF 30 mil PVC GEOMEMBRANE

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

Report Date: June 12, 1995
Reissued (October 21, 1997)

Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
GEOMEMBRANE: STAFF INDUSTRIES 30 MIL PVC GEOMEMBRANE									
Tensile Properties:									
Tensile Stress @ Break (psi)	2593	2715	2602	2068	2158	2676	2947	2479	2514
ASTM D882	2875	2769	2791	2225	2099	2327	3094	2603	2712
Machine Direction	2561	2721	2593	2105	2250	2501	3030	2530	2715
	2851								
	2680								
	2612								
Average	2662	2735	2662	2133	2169	2501	3024	2537	2647
STD	95	24	91	67	62	142	60	51	94
Coefficient of Variation	4	1	3	3	3	6	2	2	4
% Change		3	0	-20	-19	-6	14	-5	-1
Tensile Properties:									
Elongation @ Break (%)	397	475	312	418	478	372	475	382	435
ASTM D882	403	389	344	468	427	305	480	417	472
Machine Direction	380	405	309	447	488	347	467	407	488
	477								
	460								
	410								
Average	421	423	322	444	464	341	474	402	465
STD	35	37	16	20	27	28	5	15	22
Coefficient of Variation	8	9	5	5	6	8	1	4	5
% Change		0	-24	6	10	-19	13	-5	10
Set after Break (%)	69	98	79	75	95	57	95	56	72
ASTM D882	69	98	73	100	82	42	100	68	78
Machine Direction	62	98	99	85	100	51	82	68	85
	95								
	76								
	68								
Average	73	98	84	87	92	50	92	64	78
STD	11	0	11	10	8	6	8	6	5
Coefficient of Variation	14	0	13	12	8	12	8	9	7
% Change		34	14	18	26	-32	26	-13	7
Stress @ 100% Elongation (psi)	1209	788	1137	1102	1128	1558	1604	1363	1378
ASTM D882	1257	1006	1170	1087	1140	1537	1653	1392	1390
Machine Direction	1304	933	1117	1062	1130	1537	1642	1345	1367
	1159								
	1180								
	1235								
Average	1224	909	1141	1084	1133	1544	1633	1367	1378
STD	48	91	22	16	5	10	21	19	9
Coefficient of Variation	4	10	2	2	0	1	1	1	1
% Change		-26	-7	-11	-7	26	33	12	13
Stress @ 200% Elongation (psi)	2049	1231	1467	1589	1572	2204	2168	1972	1917
ASTM D882	2092	1311	1516	1595	1590	2163	2241	1983	1938
Machine Direction	2092	1284	1440	1558	1576	2167	2253	1944	1897
	1981								
	1961								
	2014								
Average	2032	1275	1474	1581	1579	2178	2221	1966	1917
STD	51	33	31	16	8	18	38	16	17
Coefficient of Variation	2	3	2	1	0	1	2	1	1
% Change		-37	-27	-22	-22	7	9	-3	-6

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

SRA
Quality Review

Report Date: June 12, 1995
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Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Tensile Properties:									
Tensile Stress @ Break (psi)	2462	2711	2771	1853	1932	2794	2884	2546	2513
ASTM D882	2391	2844	2775	1996	2156	2780	2979	2496	2654
Transverse Direction	2434	2749	2859	2062	1958	2801	2688	2568	2524
	2495								
	2536								
	2514								
Average	2472	2701	2802	1970	2015	2792	2844	2537	2564
STD	49	43	41	87	100	9	120	30	64
Coefficient of Variation	2	2	1	4	5	0	4	1	2
% Change		9	13	-20	-18	13	15	3	4
Tensile Properties:									
Elongation @ Break (%)	440	328	360	400	422	482	462	487	462
ASTM D882	413	389	357	447	490	485	507	475	502
Transverse Direction	407	389	349	472	430	475	445	498	465
	453								
	457								
	447								
Average	436	369	355	440	447	481	471	487	476
STD	19	29	5	30	30	4	26	9	18
Coefficient of Variation	4	8	1	7	7	1	6	2	4
% Change		-15	-19	1	3	10	8	12	9
Set after Break (%)	83	79	99	75	89	109	104	96	78
ASTM D882	71	97	89	110	110	111	119	138	93
Transverse Direction	66	64	89	100	91	105	86	103	85
	85								
	78								
	80								
Average	77	80	92	95	97	108	103	112	85
STD	7	13	5	15	9	2	13	18	6
Coefficient of Variation	9	17	5	15	10	2	13	16	7
% Change		4	20	23	25	40	33	46	11
Stress @ 100% Elongation (psi)	1126	1107	1074	998	1080	1409	1554	1228	1341
ASTM D882	1132	932	1205	1010	1088	1404	1552	1237	1330
Transverse Direction	1147	1024	1219	1030	1058	1411	1527	1211	1327
	1130								
	1092								
	1147								
Average	1129	1021	1166	1013	1075	1408	1544	1225	1333
STD	18	71	65	13	13	3	12	11	6
Coefficient of Variation	2	7	6	1	1	0	1	1	0
% Change		-10	3	-10	-5	25	37	9	18
Stress @ 200% Elongation (psi)	1856	1434	1381	1437	1482	1996	2086	1747	1825
ASTM D882	1848	1251	1512	1470	1511	1984	2081	1753	1813
Transverse Direction	1898	1306	1504	1477	1477	1996	2030	1713	1809
	1832								
	1833								
	1878								
Average	1858	1330	1466	1461	1490	1992	2066	1738	1816
STD	24	77	60	17	15	6	25	18	7
Coefficient of Variation	1	6	4	1	1	0	1	1	0
% Change		-28	-21	-21	-20	7	11	-6	-2

Property: FMC Corporation File: 317 pvc.wb1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Exposed to NOSAP Precipitator Slurry

SRA

Report Date: June 12, 1995
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Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Puncture Resistance:									
Load @ Rupture (lbs)	47	49	51	56	49	55	62	55	57
FTMS 101C Method 2065	48	51	51	45	50	58	62	56	54
	46	50	46	50	53	64	56	54	56
	50								
	52								
	52								
Average	49	50	49	50	51	59	60	55	56
STD	2	1	2	4	2	4	3	1	1
Coefficient of Variation	5	2	5	9	3	6	5	1	2
% Change		2	0	2	3	20	22	12	13
Tear Resistance:									
Maximum Load (ppi)	11	11	12	11	12	11	12	14	11
ASTM D1004	11	11	11	11	12	11	12	11	11
Machine Direction	11	12	12	10	12	11	11	11	12
	11								
	10								
	11								
Average	11	11	12	11	12	11	12	12	11
STD	0	0	0	0	0	0	0	1	0
Coefficient of Variation	3	4	4	4	0	0	4	12	4
% Change		5	8	-2	11	2	8	11	5
Maximum Load (ppi)	10	11	11	11	11	10	12	9	10
ASTM D1004	11	10	11	11	12	11	11	10	10
Transverse Direction	11	10	10	10	11	11	12	11	11
	12								
	11								
	11								
Average	11	10	11	11	11	11	12	10	10
STD	1	0	0	0	0	0	0	1	0
Coefficient of Variation	5	5	4	4	4	4	4	8	5
% Change		-6	-3	-3	3	-3	6	-9	-6

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Exposed to NOSAP Precipitator Slurry

SRA
Quality Review

Report Date: June 12, 1995
Reissued (October 21, 1997)

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Indentation Hardness:									
Reading	86	84	83	89	89	92	90	90	88
ASTM D2240	87	90	85	89	89	92	90	87	88
(with TYPE D DUROMETER)	88	89	85	90	88	88	89	89	91
	88								
	86								
	87								
Average	87	88	84	89	89	91	90	89	89
STD	1	3	1	1	1	2	1	2	2
Coefficient of Variation	1	4	1	1	1	3	1	2	2
% Change		1	-3	3	2	4	3	2	2
Hydrostatic Resistance									
ASTM D751, Method A	107	98	110	105	110	108	104	97	94
	98	100	115	107	110	110	108	90	92
	108	110	118	107	110	107	107	99	98
	105								
	103								
	103								
Average	104	103	114	106	110	108	108	95	95
STD	3	6	4	1	0	2	2	5	3
Coefficient of Variation	3	6	4	1	0	1	2	5	3
% Change		-1	10	3	6	5	3	-8	-9
Specific Gravity:									
ASTM D792, Method A	1.205	1.244	1.252	1.284	1.281	1.221	1.231	1.237	1.233
	1.240	1.250	1.266	1.284	1.283	1.224	1.235	1.236	1.232
	1.232	1.243	1.255	1.284	1.284	1.232	1.238	1.232	1.236
	1.245								
	1.221								
	1.214								
Average	1.226	1.246	1.258	1.284	1.283	1.226	1.235	1.235	1.234
STD	0.016	0.004	0.007	0.000	0.002	0.006	0.004	0.003	0.002
Coefficient of Variation	1	0	1	0	0	0	0	0	0
% Change		1.59	2.57	4.72	4.61	-0.04	0.69	0.72	0.61

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Exposed to NOSAP Precipitator Slurry

SRA

Report Date: June 12, 1995
Reissued (October 21, 1997)

Quality Review

Test Parameters	Baseline	Exposure Time and Temperature: 30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Volatiles and Extractables:									
Machine Diameter Change (%)	1.41	1.04	-2.33	-3.42	-5.66	-4.14	-0.96	-4.02	-2.52
SW 870 - Appendix III-D	-2.90	0.57	-3.28	-3.05	0.48	-3.45	0.50	-3.75	-2.98
	1.20								
	1.35								
Average	0.27	0.81	-2.81	-3.24	-2.59	-3.80	-0.23	-3.89	-2.75
STD	1.83	0.24	0.47	0.19	3.07	0.34	0.73	0.13	0.23
Transverse Diameter Change (%)	-4.46	-4.39	-0.10	0.58	1.15	1.31	0.18	0.58	-0.03
SW 870 - Appendix III-D	0.25	-4.34	0.15	0.93	-4.28	1.24	-1.42	0.28	1.47
	-3.65								
	-2.64								
Average	-2.63	-4.37	0.02	0.76	-1.57	1.28	-0.62	0.43	0.72
STD	1.78	0.02	0.13	0.18	2.72	0.04	0.80	0.15	0.75
% Volatiles	0.25	0.48	0.65	0.31	0.27	0.52	0.78	0.25	0.19
SW 870 - Appendix III-D	0.24	0.41	0.69	0.30	0.28	0.54	0.71	0.21	0.15
	0.18								
	0.13								
Average	0.20	0.45	0.67	0.31	0.28	0.53	0.75	0.23	0.17
STD	0.05	0.04	0.02	0.01	0.01	0.01	0.04	0.02	0.02
% Extractables	24.32	21.58	22.91	24.50	22.92	27.82	25.87	22.16	24.34
SW 870 - Appendix III-D	24.98	27.05	23.05	23.92	22.61	28.46	25.85	23.91	24.24
	24.43								
	23.41								
Average	24.29	24.32	22.98	24.21	22.77	28.14	25.86	23.04	24.29
STD	0.56	2.74	0.07	0.29	0.16	0.32	0.01	0.88	0.05

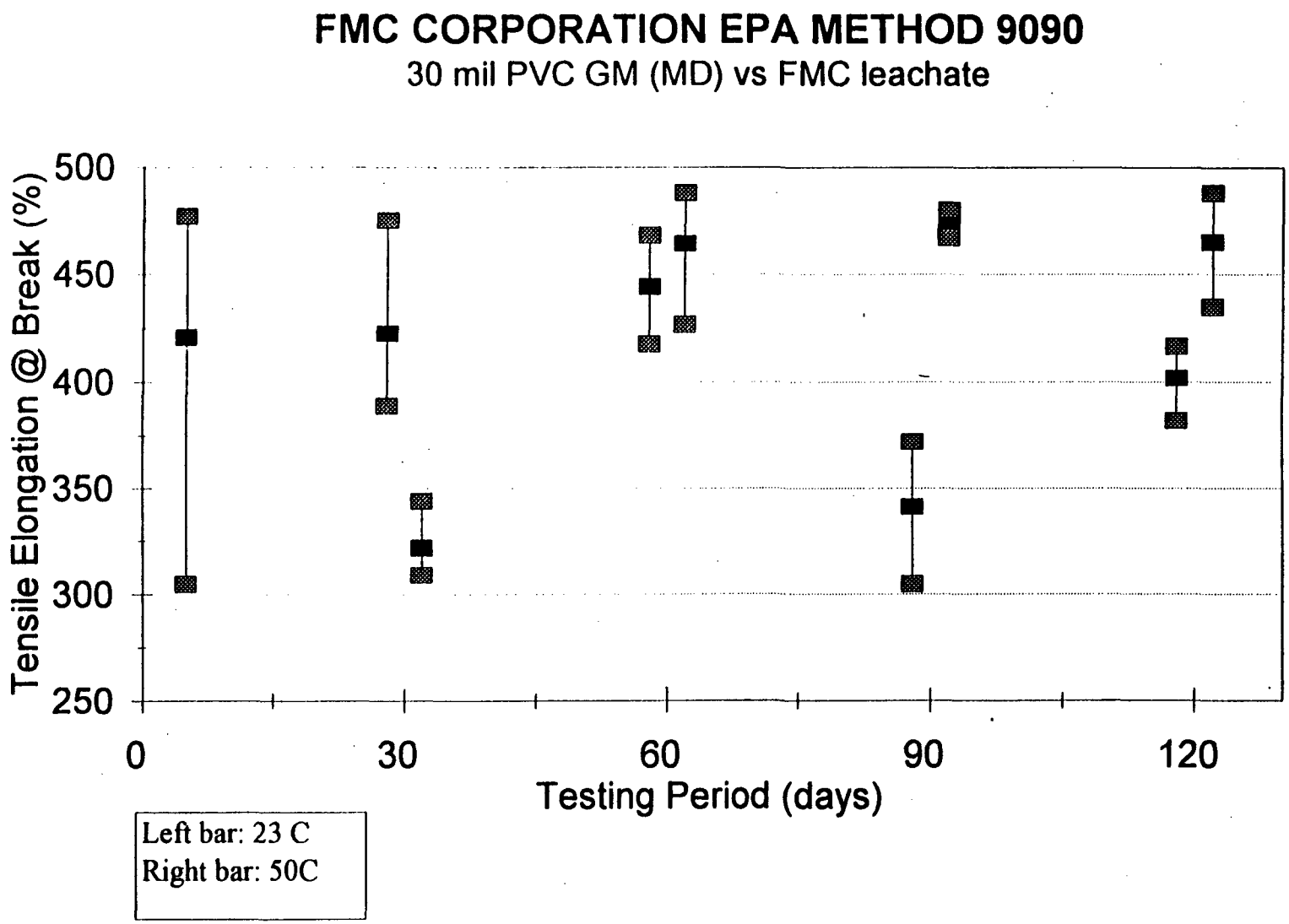
TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

MDN
Quality Review

Report Date: June 12, 1995

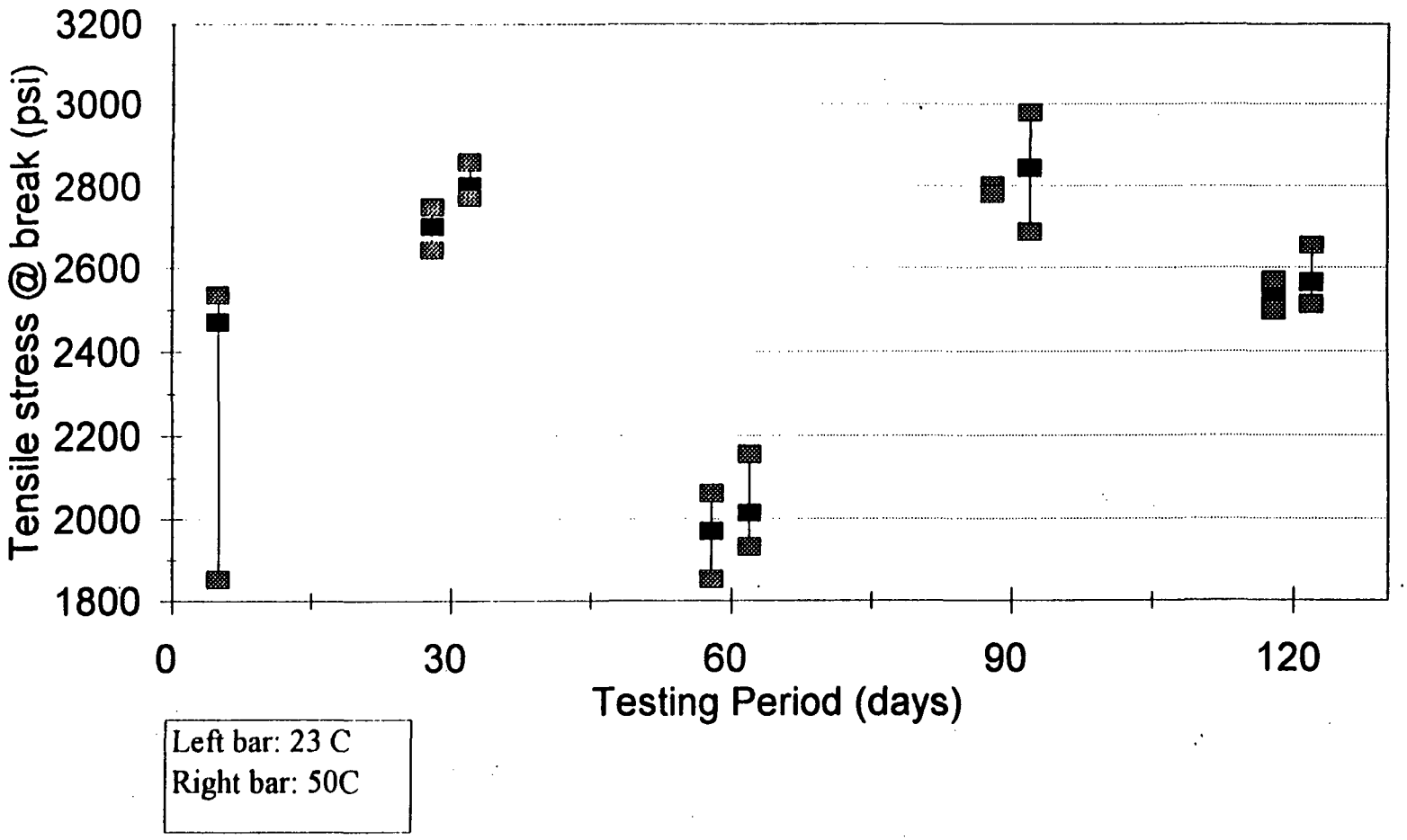
Exposure Time and Temperature

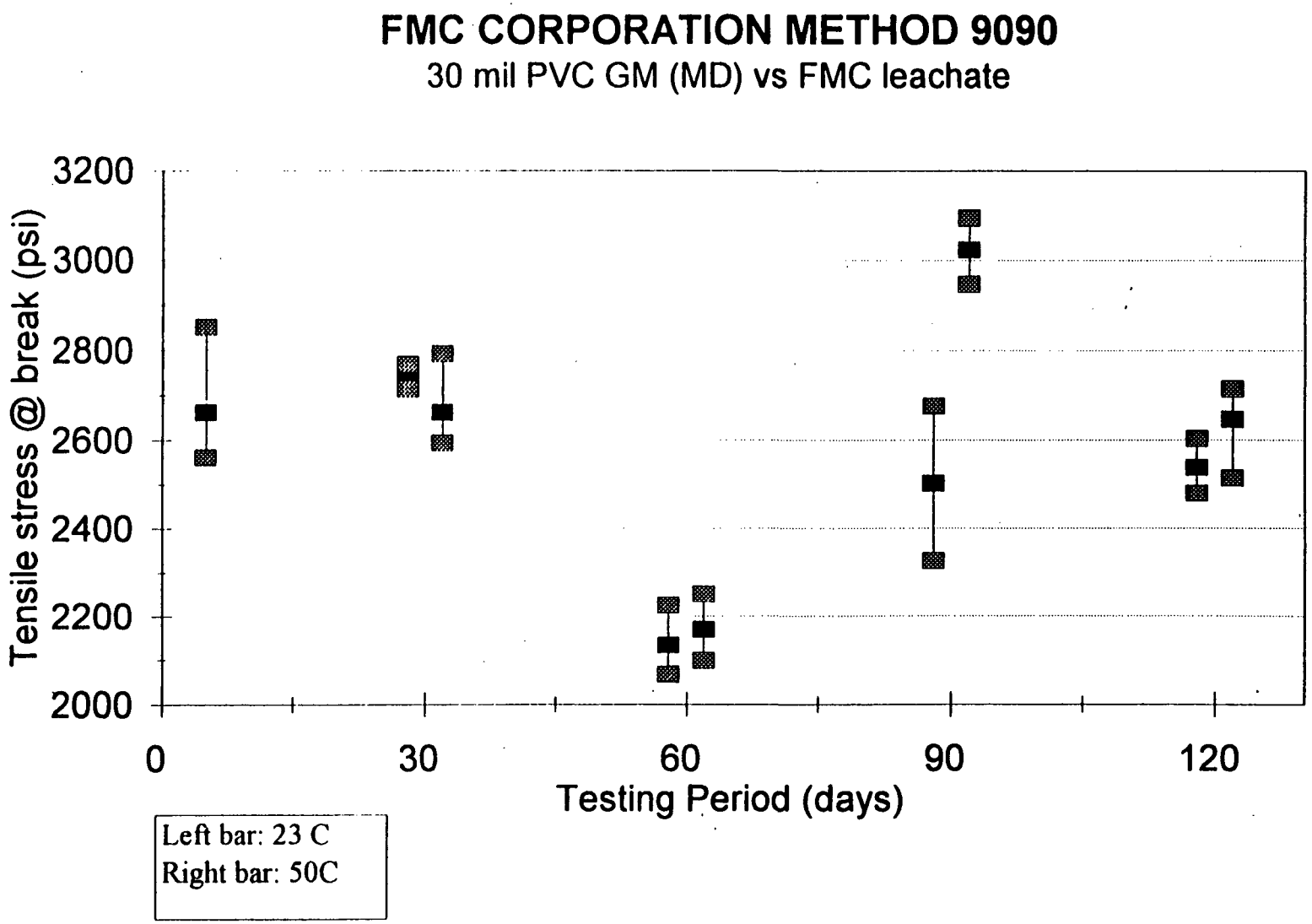
Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Seam Peel Adhesion:									
ASTM D4437 (lbs)	23	35	34	26	17	34	32	27	27
	24	19	28	30	30	31	31	27	34
	20	26	22	24	26	31	29	21	34
	25								
	19								
	24								
Average	23	27	28	27	24	32	31	25	32
STD	2	7	5	2	5	1	1	3	3
Coefficient of Variation	10	25	17	9	22	4	4	11	10
% Change		19	24	19	8	42	36	11	41
Failure Mode (SF: 100% Peel)	SF	SF	SF	SF	SF	SF	SF	SF	SF
Shear Seam Strength:									
Shear Seam Strength (lbs)	53	60	60	62	65	57	58	55	66
ASTM D4437	46	49	59	60	63	60	56	58	62
	54	57	62	49	58	58	55	70	55
	54								
	55								
	57								
Average	53	55	60	57	62	58	56	61	61
STD	3	5	1	6	3	1	1	6	5
Coefficient of Variation	6	8	2	10	5	2	2	11	7
% Change		4	13	7	17	10	6	15	15

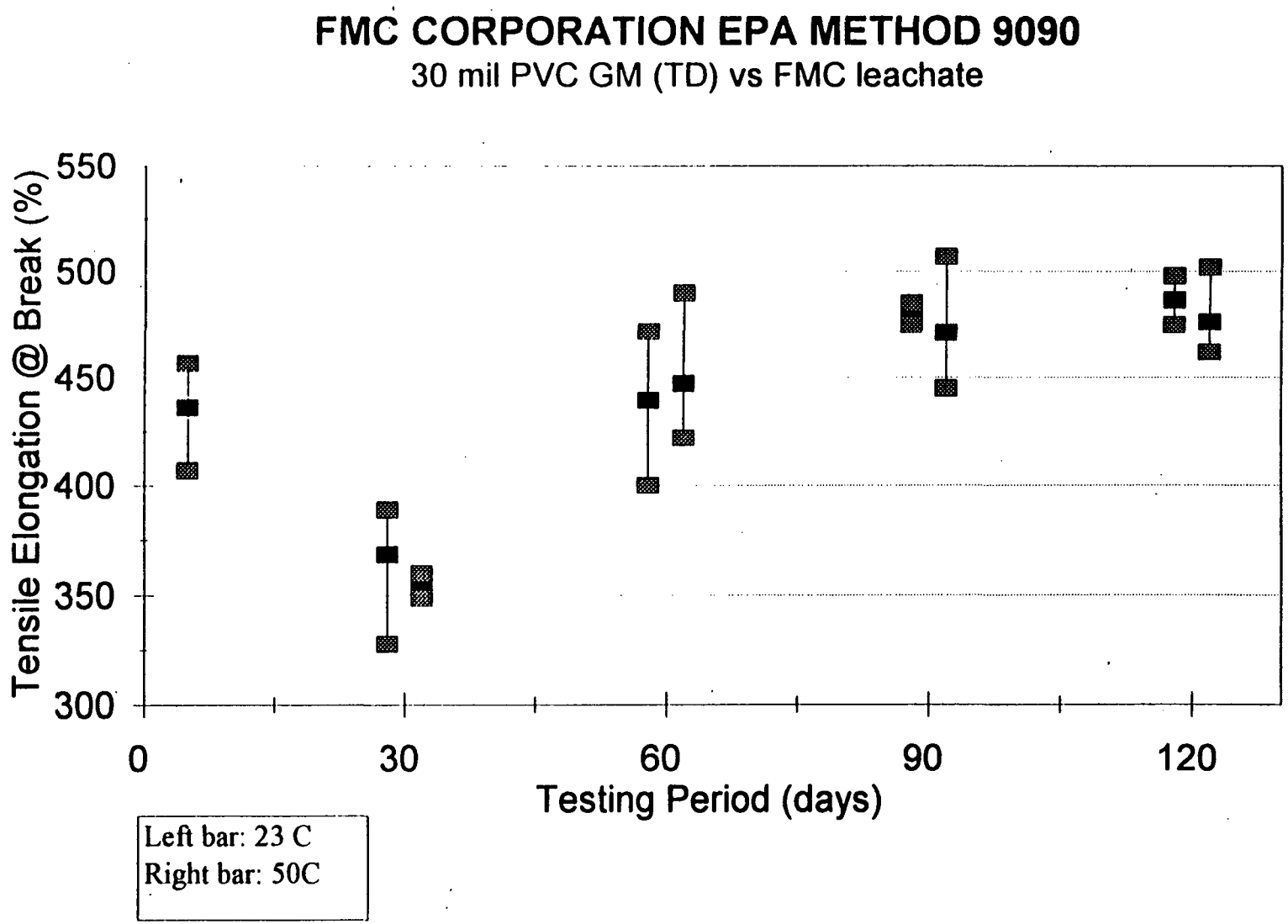

FMC CORPORATION EPA METHOD 9090
30 mil PVC GM (MD) vs FMC leachate
Tensile Elongation @ Break (%)
500
450
400
350
300
250
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

FMC CORPORATION EPA METHOD 9090

30 mil PVC GM (TD) vs FMC leachate

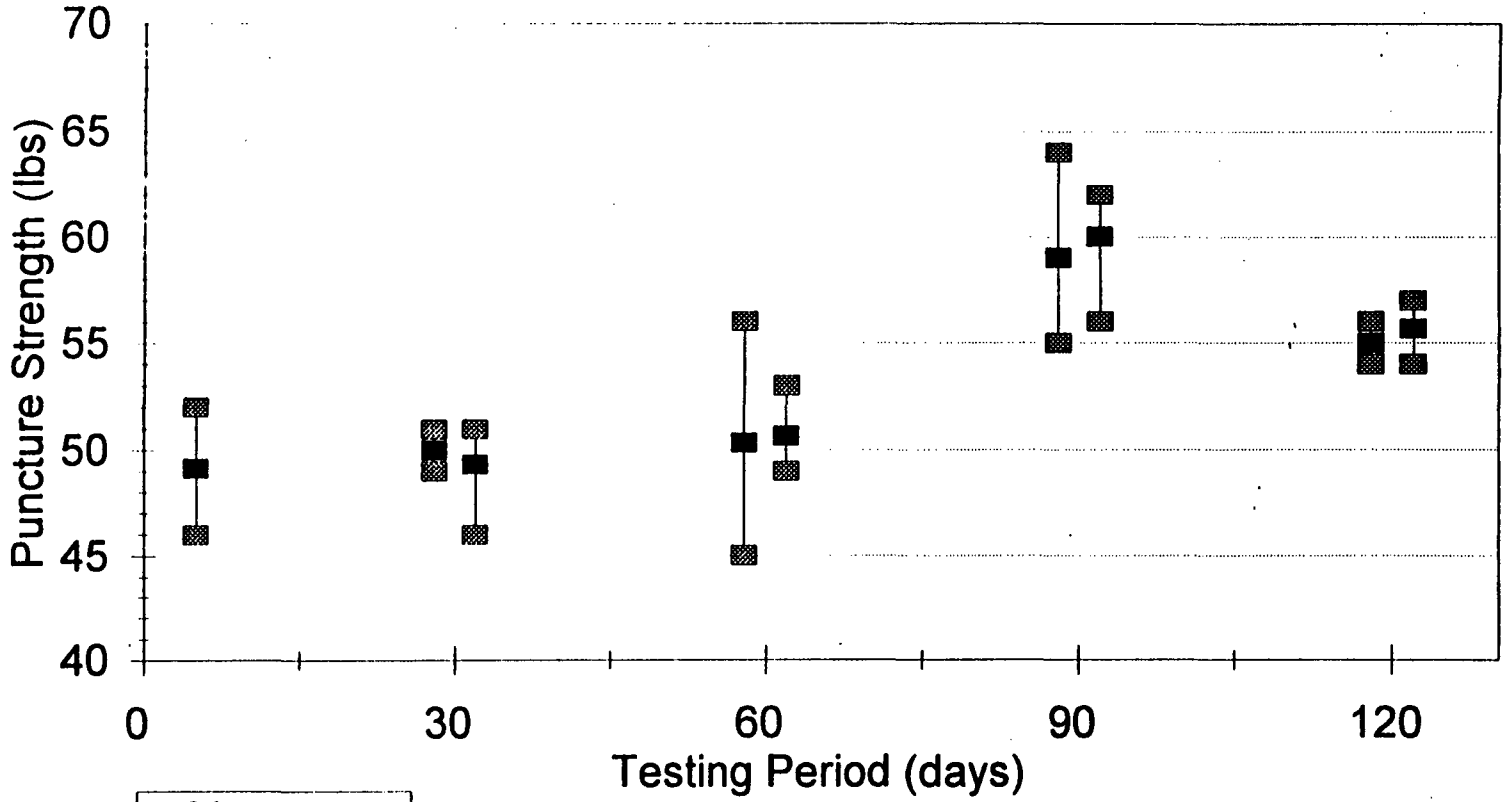



FMC CORPORATION METHOD 9090
30 mil PVC GM (MD) vs FMC leachate
Tensile stress @ break (psi)
3200
3000
2800
2600
2400
2200
2000
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

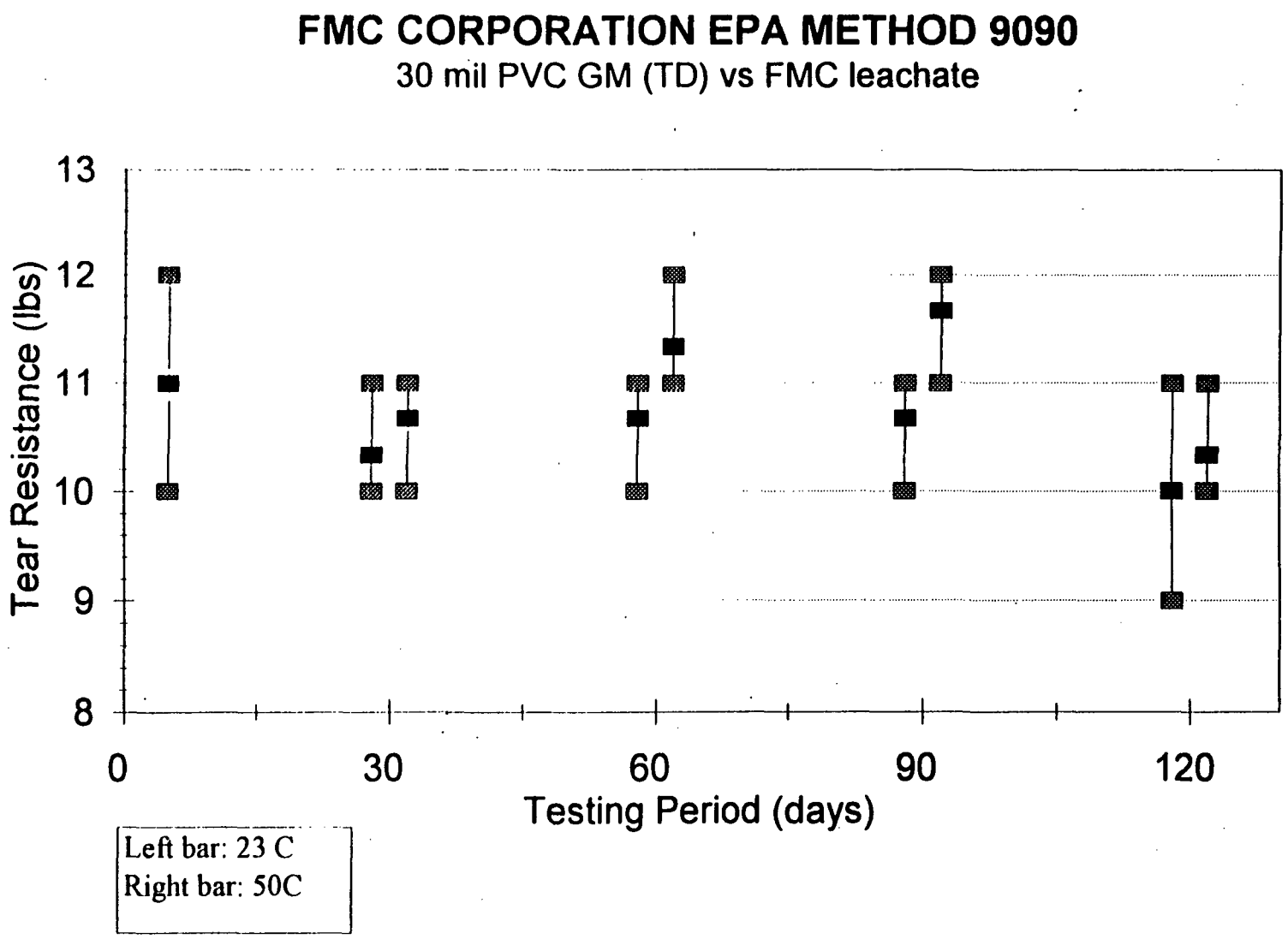

FMC CORPORATION EPA METHOD 9090
30 mil PVC GM (TD) vs FMC leachate
Tensile Elongation @ Break (%)
550
500
450
400
350
300
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

FMC CORPORATION EPA METHOD 9090

30 mil PVC GM vs FMC leachate

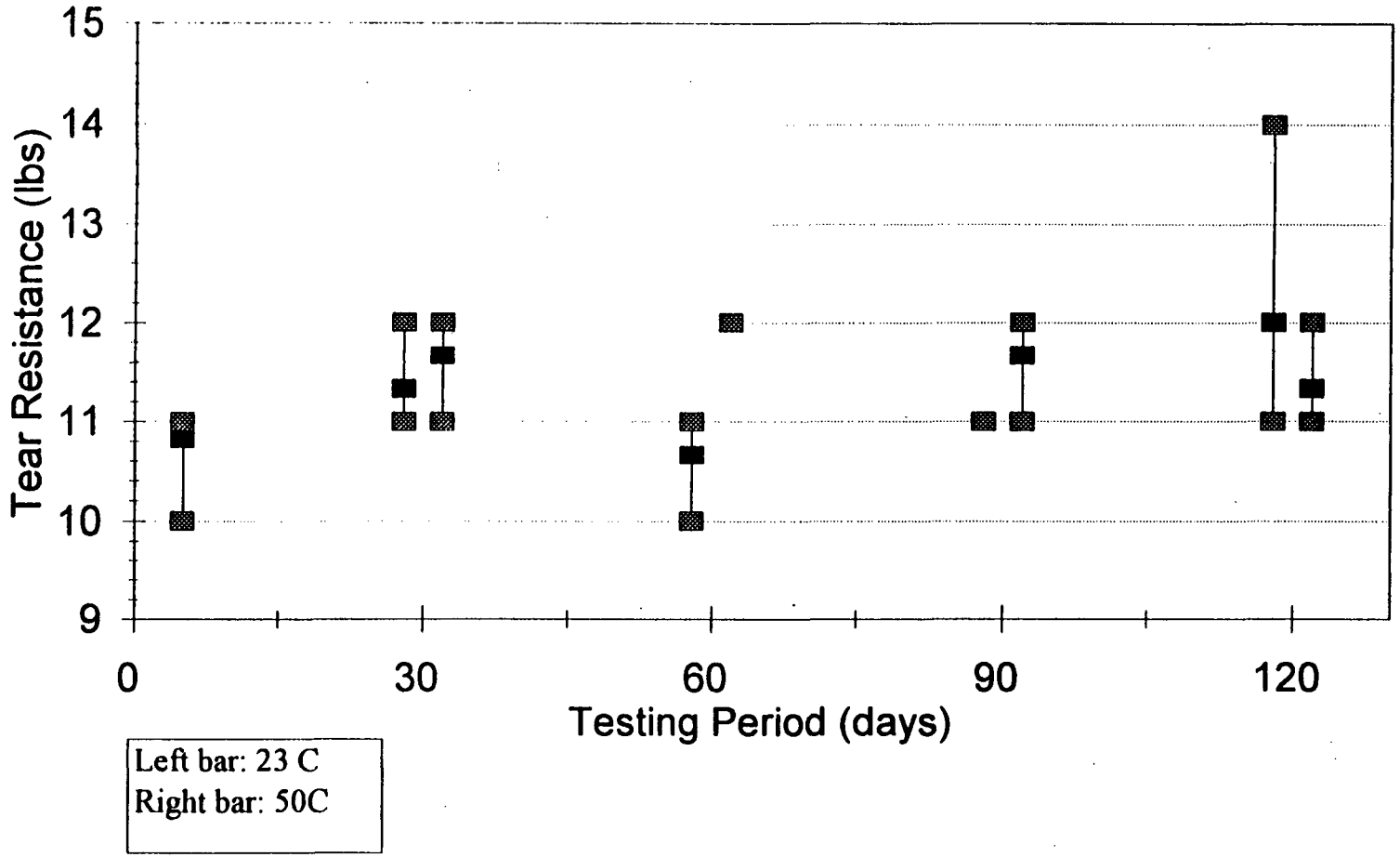


Left bar: 23 C
Right bar: 50C


FMC CORPORATION EPA METHOD 9090
30 mil PVC GM (TD) vs FMC leachate
Tear Resistance (lbs)
13
12
11
10
9
8
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

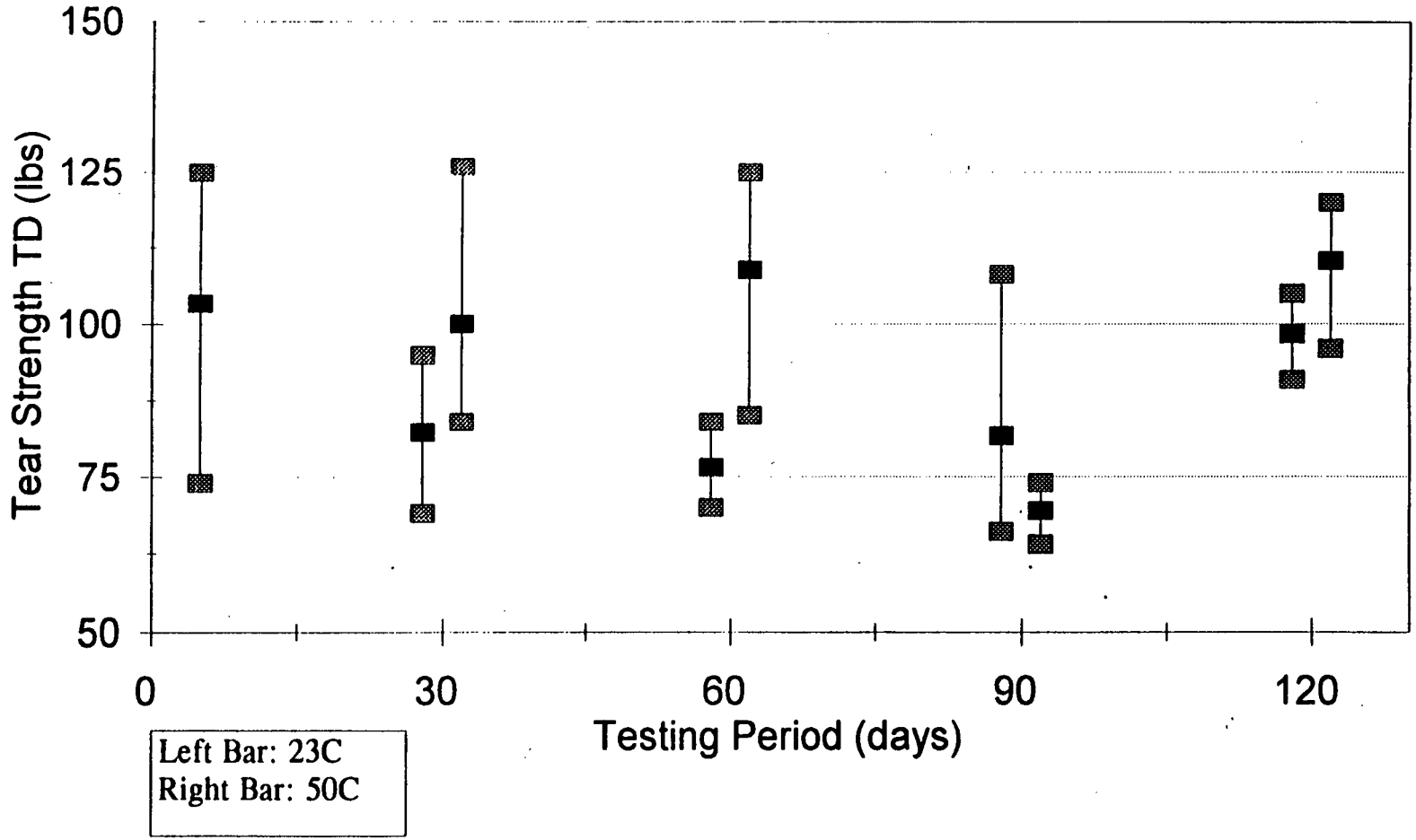
FMC CORPORATION EPA METHOD 9090

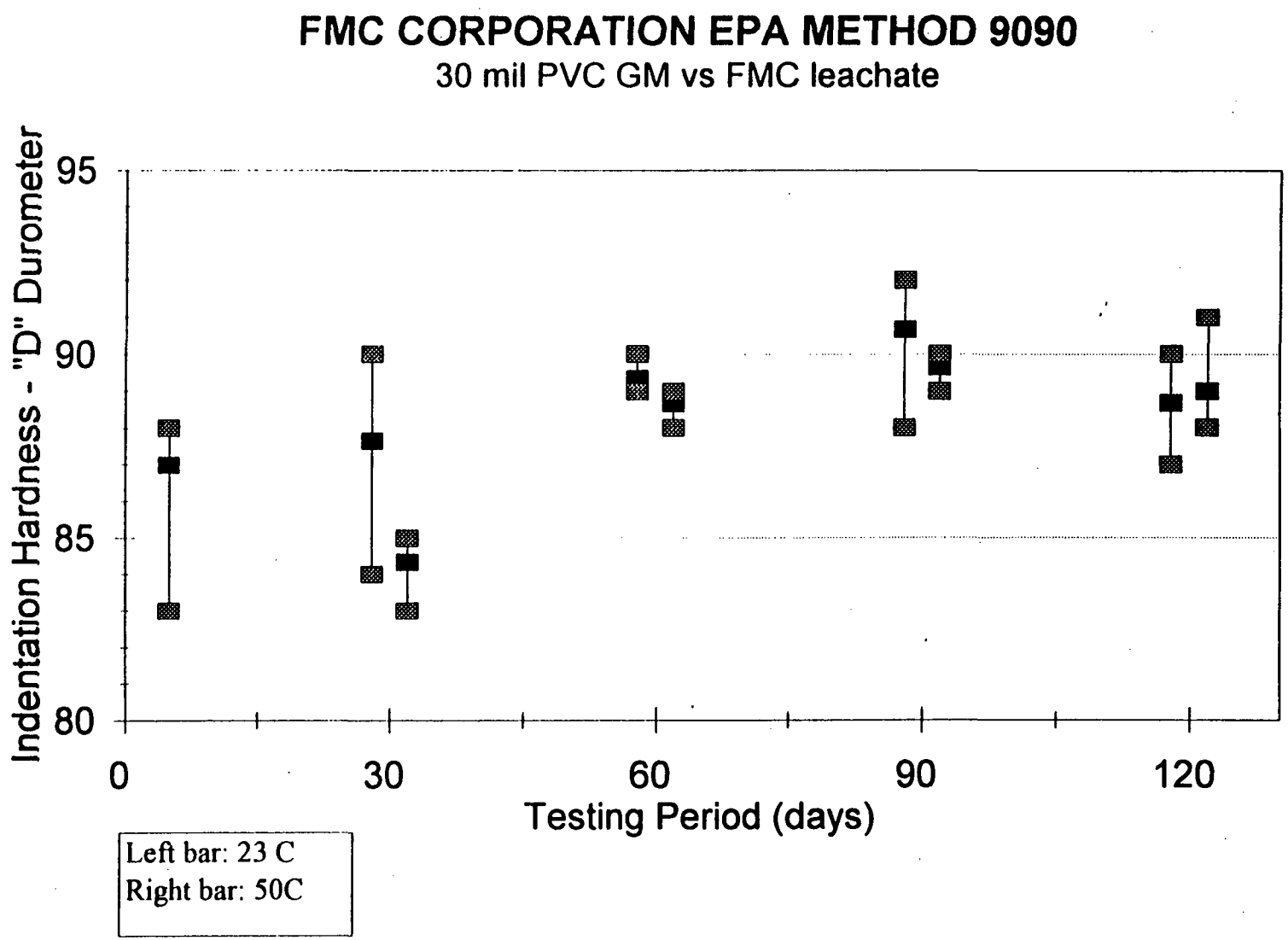
30 mil PVC GM (MD) vs FMC leachate

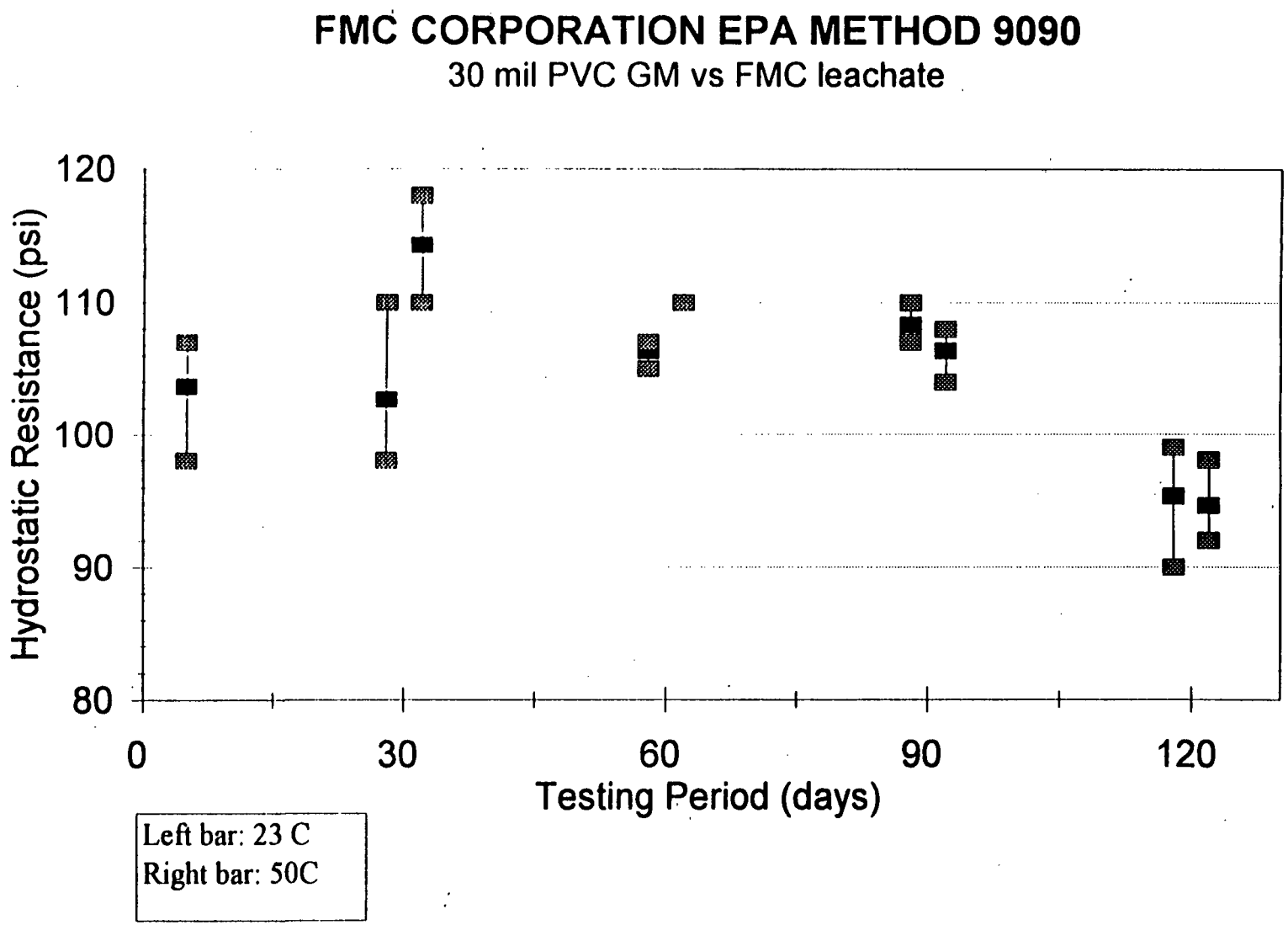


FMC CORPORATION EPA METHOD 9090

Trevira 1120 GT vs FMC Leachate

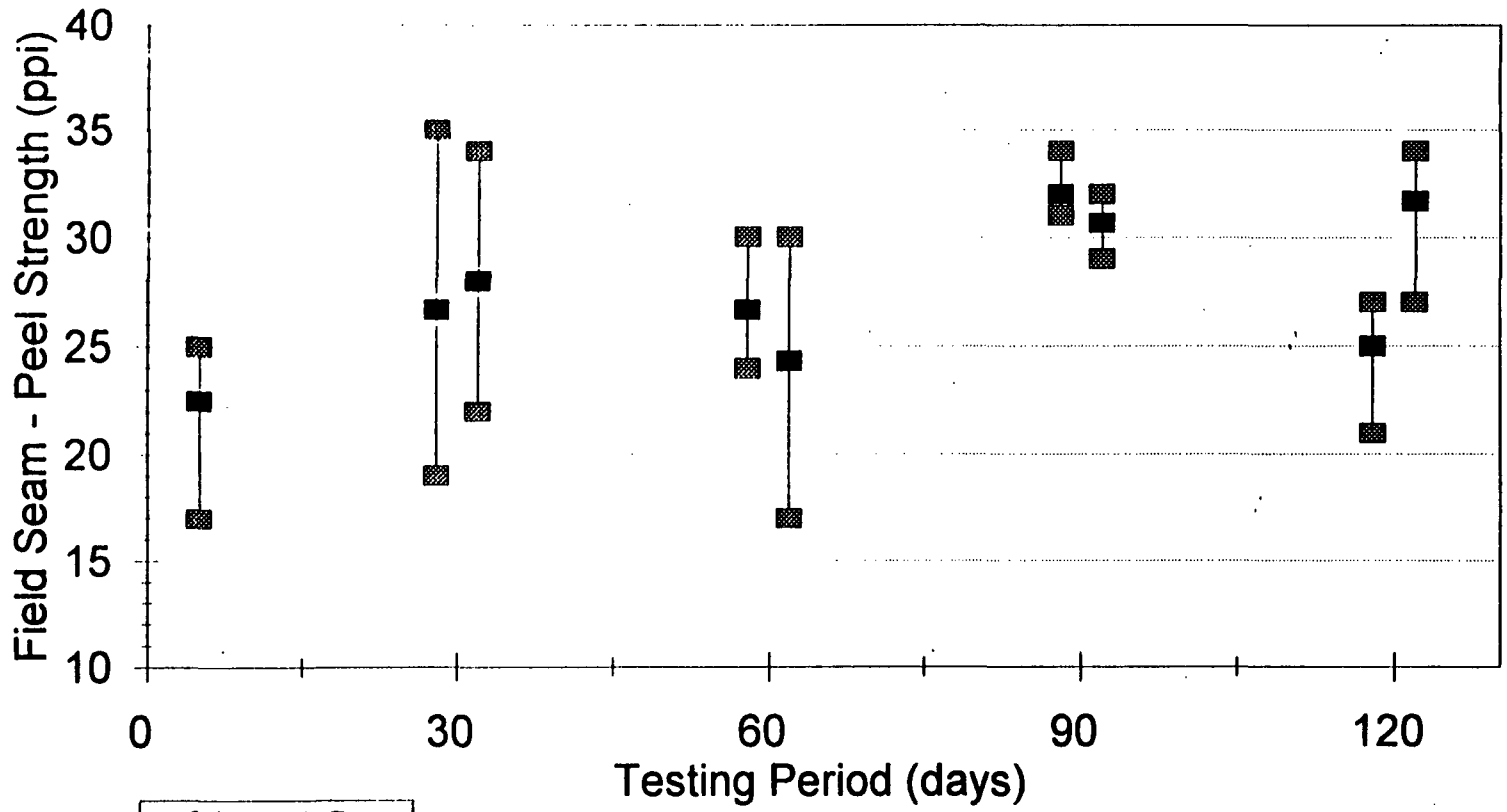



FMC CORPORATION EPA METHOD 9090
30 mil PVC GM vs FMC leachate
Indentation Hardness - "D" Durometer
95
90
85
80
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

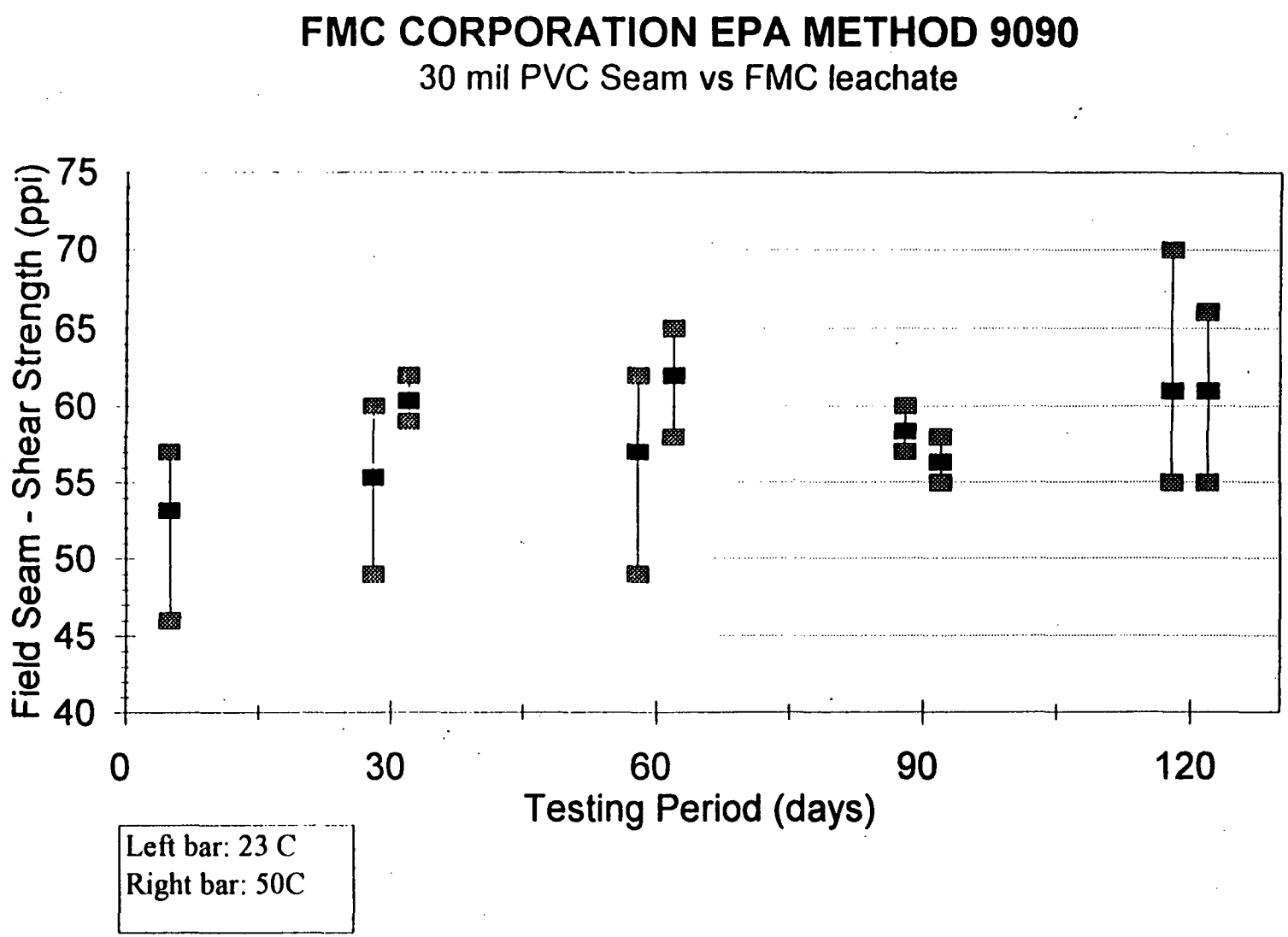

FMC CORPORATION EPA METHOD 9090
30 mil PVC GM vs FMC leachate
Hydrostatic Resistance (psi)
120
110
100
90
80
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

FMC CORPORATION EPA METHOD 9090

30 mil PVC Seam vs FMC leachate



Left bar: 23 C
Right bar: 50C


FMC CORPORATION EPA METHOD 9090
30 mil PVC Seam vs FMC leachate
Field Seam - Shear Strength (ppi)
75
70
65
60
55
50
45
40
0
30
60
90
120
Testing Period (days)
Left bar: 23 C
Right bar: 50C

EPA METHOD 9090 TEST RESULTS

HOECHST CELANESE TREVIRA 1120 6 oz. GEOTEXTILE

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

Report Date: June 12, 1995
Reissued (October 22, 1997)

Test Parameters	Baseline	Exposure Time and Temperature: 30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Grab:									
Grab Strength (lb)	191	176	162	205	186	224	193	199	166
ASTM D4632	213	204	182	202	180	206	143	214	174
Machine Direction	187	242	173	237	214	158	166	186	160
	204	204	174	201	216	174	172	193	173
	187	227	169	203	185	146	188	181	185
	230								
	257								
	256								
	258								
	237								
Average	222	211	172	210	196	182	172	195	172
STD	28	23	7	14	15	29	18	11	8
Coefficient of Variation	13	11	4	7	8	16	10	6	5
% Change		-5	-23	-6	-12	-18	-22	-12	-23
Grab Elongation (%)	75	65	68	63	63	93	84	78	80
ASTM D4632	88	65	81	60	67	69	63	96	83
Machine Direction	75	79	65	67	67	136	68	87	80
	79	75	77	64	75	73	68	92	93
	73	73	72	63	68	69	73	85	89
	75								
	80								
	76								
	79								
	75								
Average	78	71	73	63	68	88	71	88	85
STD	4	6	6	2	4	26	7	6	5
Coefficient of Variation	5	8	8	4	6	29	10	7	6
% Change		-8	-6	-18	-12	14	-8	13	10

SRA
Quality Review

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

Report Date: June 12, 1995
Reissued (October 22, 1997)

Test Parameters	Baseline	Exposure Time and Temperature: 30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Grab:									
Grab Strength (lb)	167	165	135	138	155	150	139	215	187
ASTM D4632	160	152	157	148	152	145	151	158	200
Transverse Direction	175	147	138	143	179	138	134	225	187
	189	165	139	141	151	148	130	177	215
	177	140	154	145	158	146	129	188	192
	157								
	158								
	160								
	147								
	175								
Average	167	154	145	143	159	145	137	193	196
STD	12	10	9	3	10	4	8	25	11
Coefficient of Variation	7	6	6	2	6	3	6	13	5
% Change		-8	-13	-14	-5	-13	-18	16	18
Grab Elongation (%)	99	92	76	79	92	96	85	79	79
ASTM D4632	97	84	89	81	81	92	83	107	76
Transverse Direction	97	89	93	77	109	97	84	100	73
	99	99	91	67	80	97	75	75	75
	92	83	99	81	99	92	92	63	72
	85								
	95								
	87								
	83								
	91								
Average	93	89	90	77	92	95	84	85	75
STD	6	6	8	5	11	2	5	16	2
Coefficient of Variation	6	7	8	7	12	2	6	19	3
% Change		-3	-3	-17	-0	2	-9	-8	-19

SRA
Quality Review

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

Report Date: June 12, 1995
Reissued (October 22, 1997)

Test Parameters	Baseline	Exposure Time and Temperature: 30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Tear Resistance:									
Trapezoidal Tear Strength (lb)	93	67	74	74	77	68	82	74	82
ASTM D4533	89	71	67	77	75	57	74	65	90
Machine Direction	76	80	74	75	75	70	82	63	69
	80	63	78	72	80	71	62	65	74
	115	64	66	77	81	67	82	63	74
	94								
	71								
	110								
	79								
	86								
Average	89	69	72	75	78	67	76	66	78
STD	14	6	5	2	2	5	8	4	7
Coefficient of Variation	15	9	6	3	3	8	10	6	9
% Change		-23	-20	-16	-13	-25	-14	-26	-13
Tear Resistance:									
Trapezoidal Tear Strength (lb)	87	89	112	82	85	108	66	91	116
ASTM D4533	123	81	91	70	111	77	70	105	120
Transverse Direction	99	77	84	84	125	66	73	104	96
	99	95	126	74	112	88	64	94	106
	114	69	87	73	111	69	74	98	114
	120								
	74								
	96								
	97								
	125								
Average	103	82	100	77	109	82	69	98	110
STD	16	9	16	5	13	15	4	5	9
Coefficient of Variation	15	11	16	7	12	19	6	6	8
% Change		-21	-3	-26	5	-21	-33	-5	7
Puncture:									
Load @ Rupture (lb)	105	79	84	73	97	78	86	94	83
ASTM D4833	90	79	74	83	110	89	96	82	104
	111	91	98	88	92	83	107	84	91
	96	56	96	92	86	84	81	77	83
	103	85	80	80	92	88	99	93	68
	79								
	117								
	123								
	102								
	83								
Average	101	78	86	83	95	84	94	86	86
STD	13	12	9	7	8	4	9	7	12
Coefficient of Variation	13	15	11	8	8	5	10	8	14
% Change		-23	-14	-18	-5	-16	-7	-15	-15

SRA

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

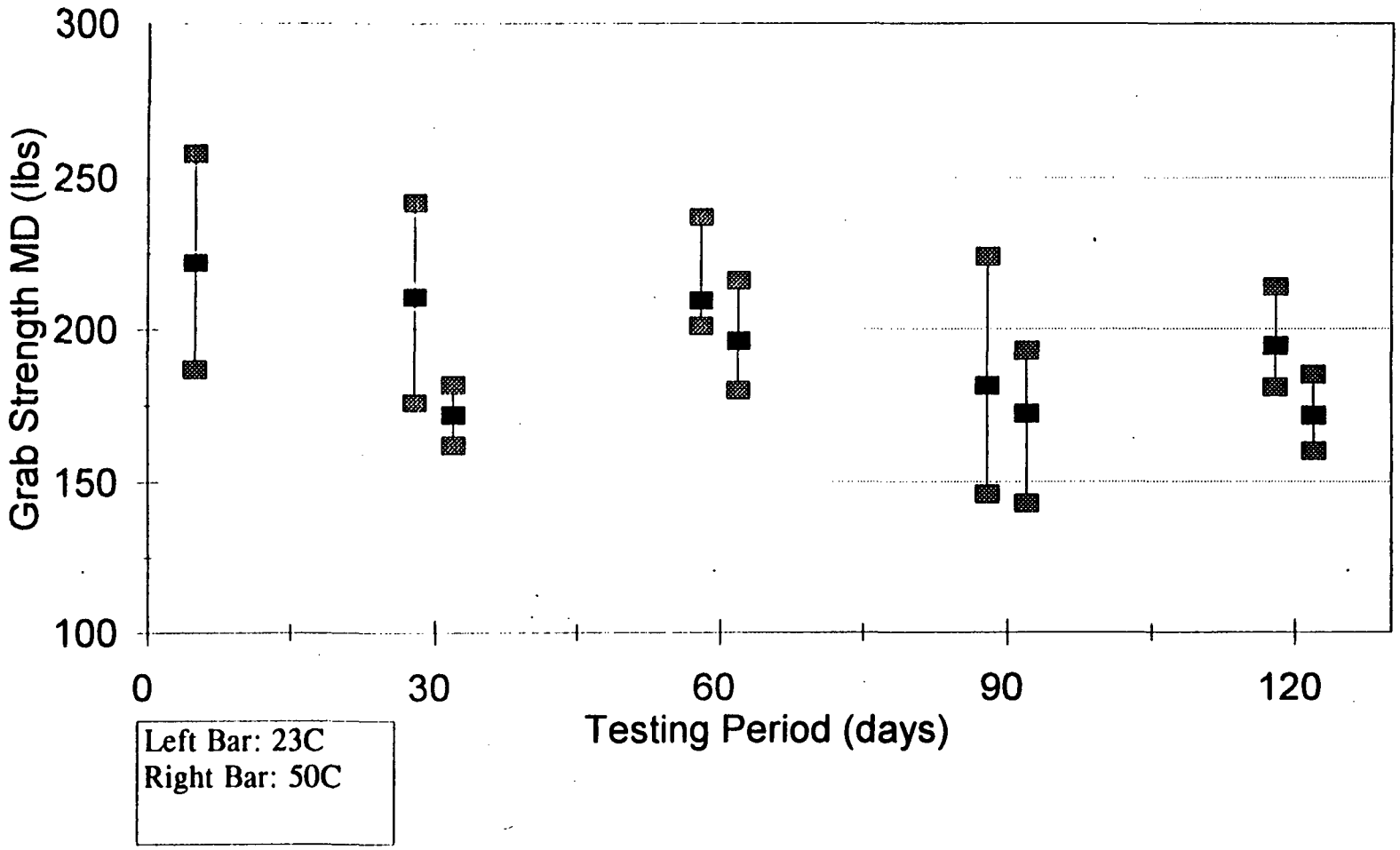
Report Date: June 12, 1995
Reissued (October 22,. 1997)

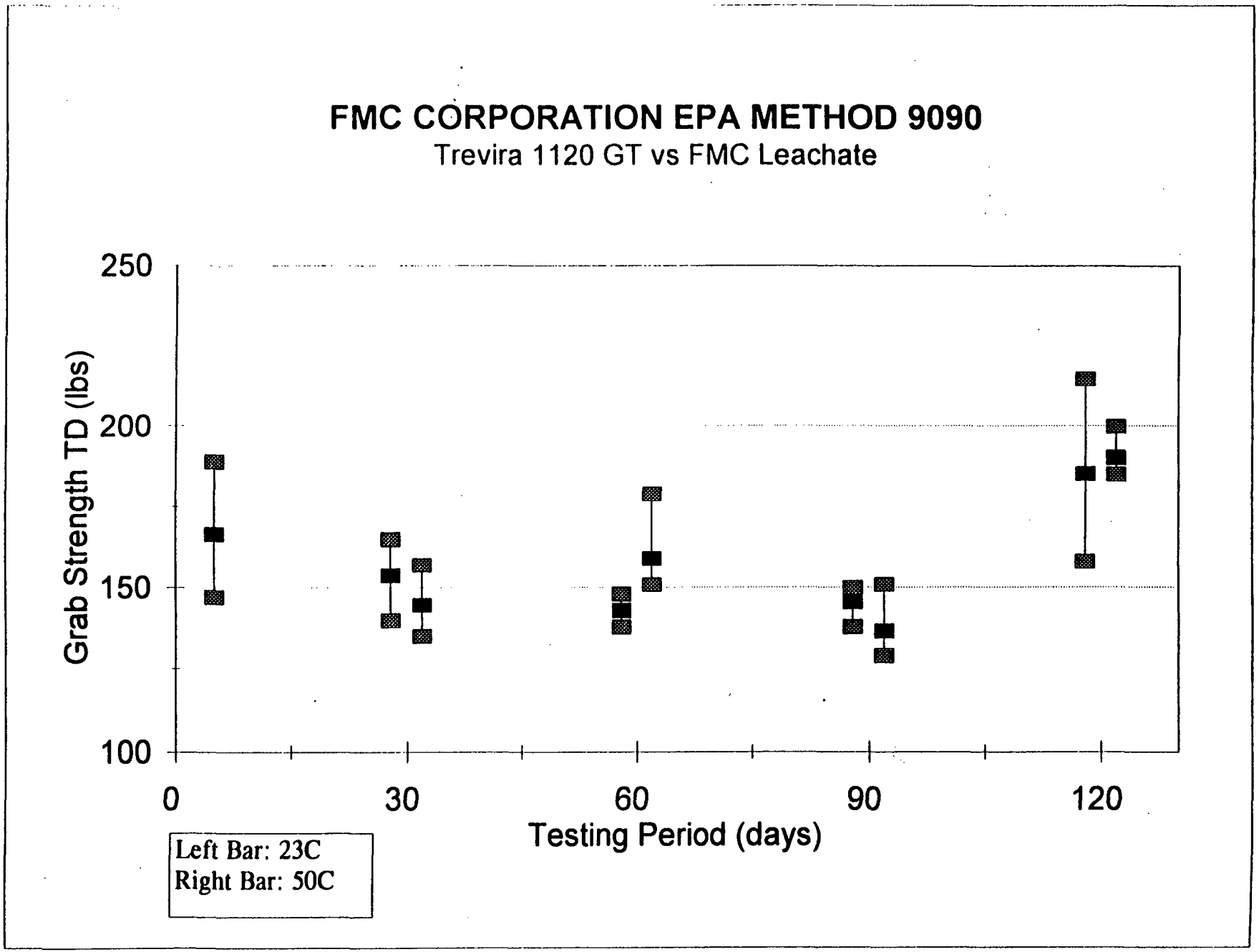
Test Parameters	Baseline	Exposure Time and Temperature: 30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Permittivity:									
(gal/min/ft2)	129	143	160	127	141	133	127	150	140
ASTM D4491	158	143	151	135	153	123	128	147	149
	150	162	153	132	142	95	134	157	161
	144	163	149	132	132	125	122	150	156
	147	160	155	125	145	136	132	151	163
	165								
	156								
	145								
	149								
	159								
Average	150	154	154	130	143	122	129	151	154
STD	10	9	4	4	7	15	4	3	8
Coefficient of Variation	6	6	2	3	5	12	3	2	5
% Change		3	2	-13	-5	-19	-14	1	2
Mullen Burst:									
Burst Strength (psi)	310	280	280	280	280	250	290	290	260
ASTM D3786	270	280	285	240	250	280	275	250	255
	290	280	295	260	220	270	330	300	265
	280	285	295	240	280	270	280	300	300
	320	265	305	275	280	250	280	230	330
	250								
	260								
	265								
	310								
	350								
Average	291	278	292	259	262	264	291	274	282
STD	30	7	9	17	24	12	20	29	29
Coefficient of Variation	10	2	3	7	9	5	7	10	10
% Change		-4	1	-11	-10	-9	0	-6	-3

SRA
Quality Review

FMC CORPORATION EPA METHOD 9090

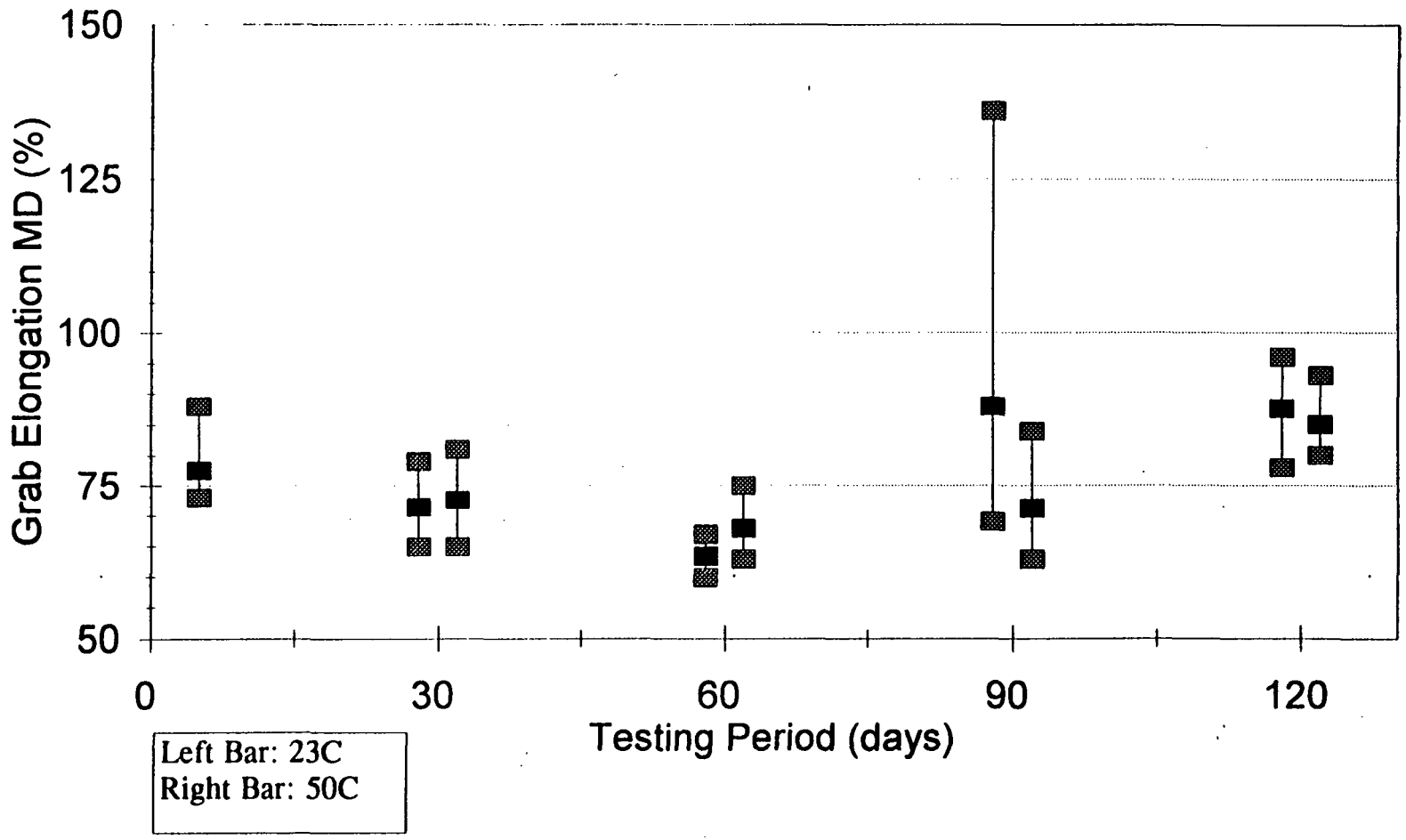
Trevira 1120 GT vs FMC Leachate




FMC CORPORATION EPA METHOD 9090
Trevira 1120 GT vs FMC Leachate
Grab Strength TD (lbs)
250
200
150
100
0
30
60
90
120
Testing Period (days)
Left Bar: 23C
Right Bar: 50C

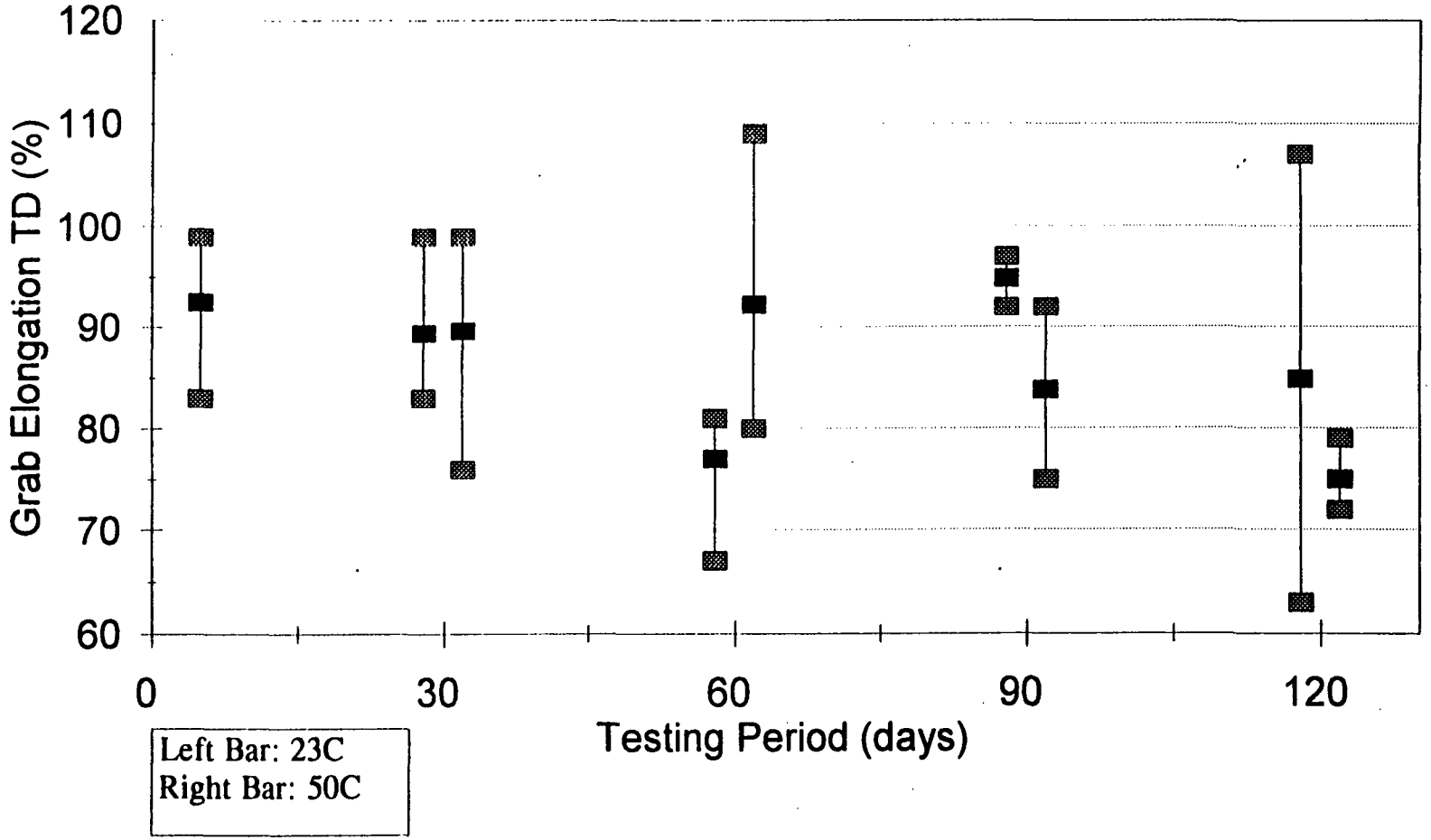
FMC CORPORATION EPA METHOD 9090

Trevira 1120 GT vs FMC Leachate



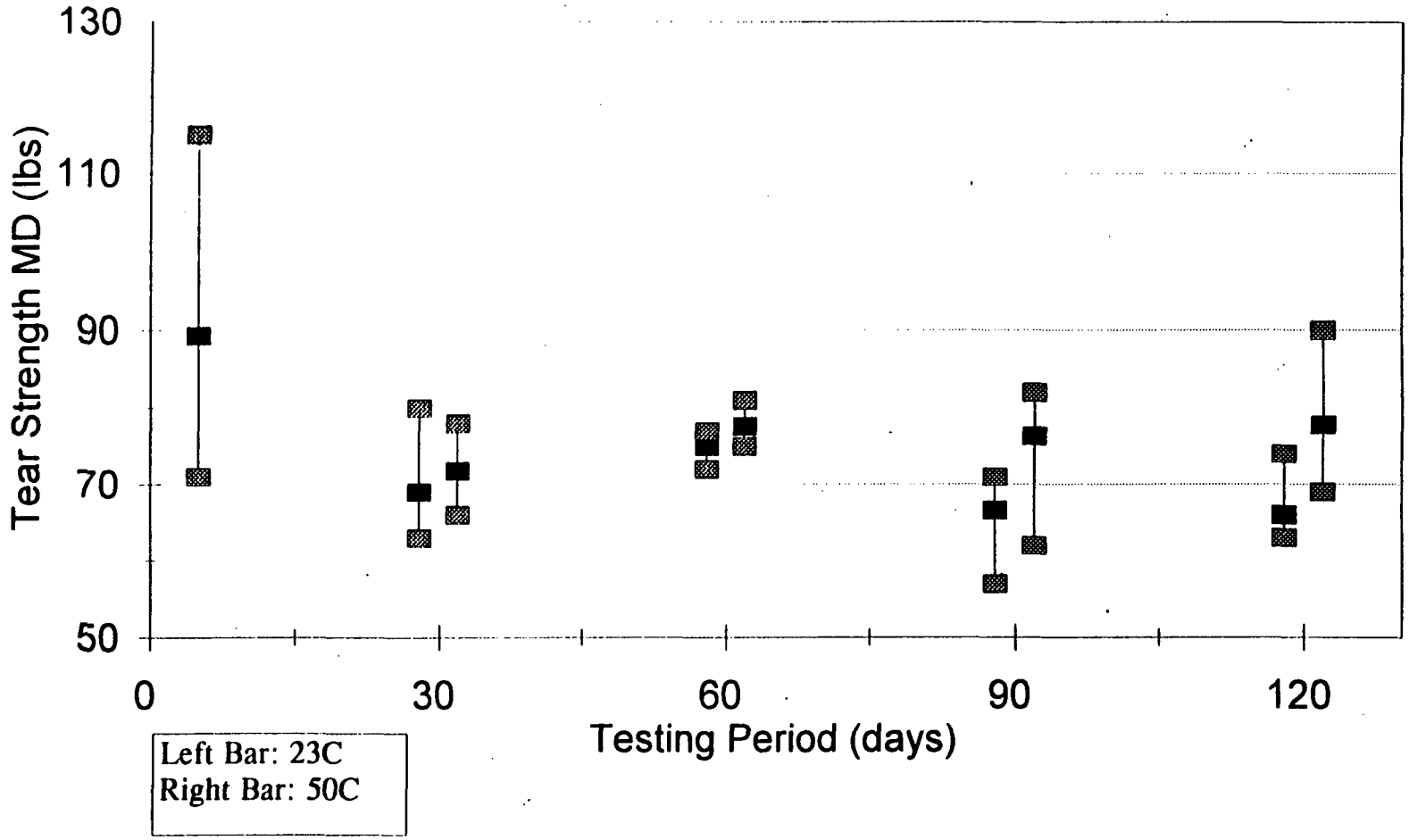
FMC CORPORATION EPA METHOD 9090

Trevira 1120 GT vs FMC Leachate



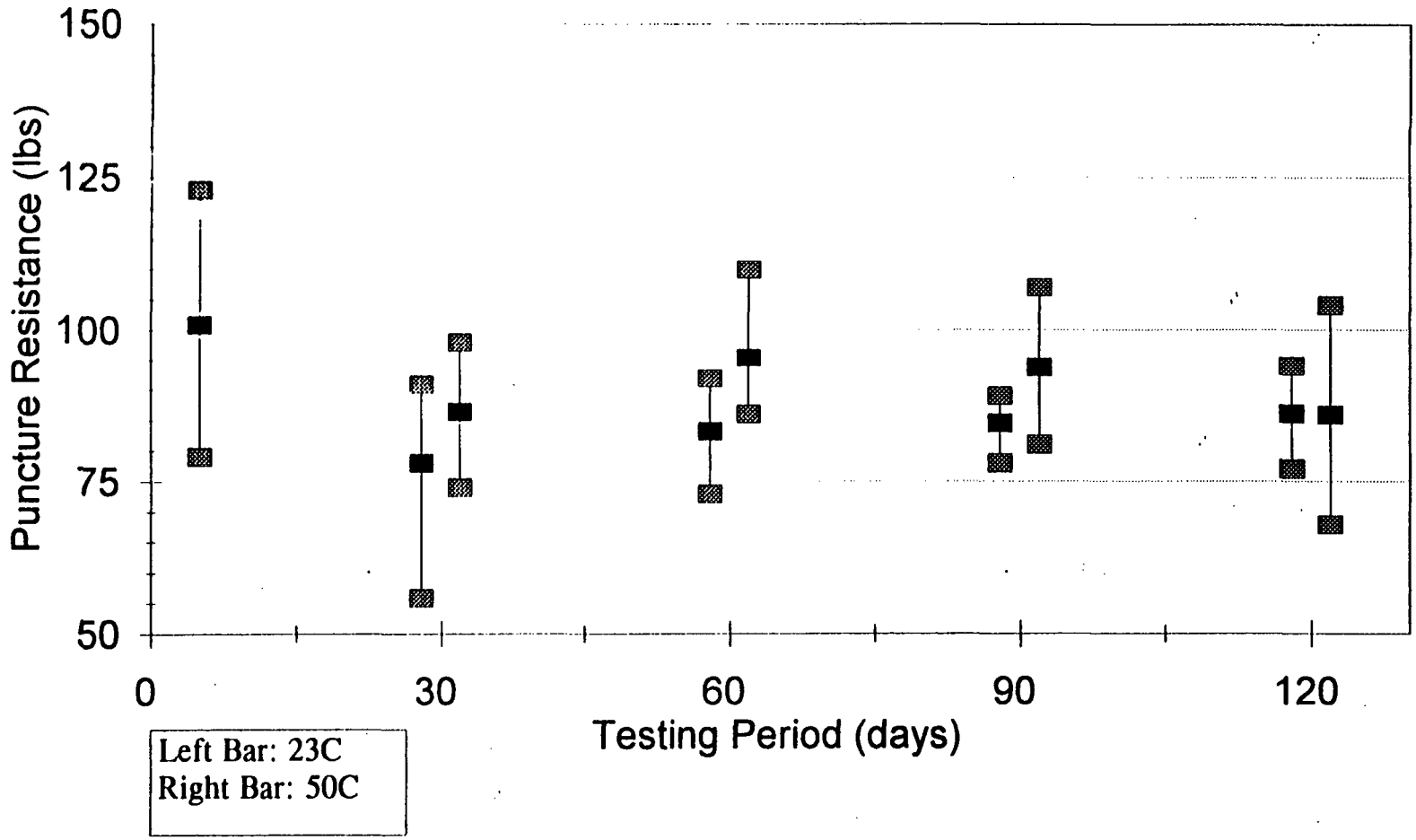
FMC CORPORATION EPA METHOD 9090

Trevira 1120 GT vs FMC Leachate



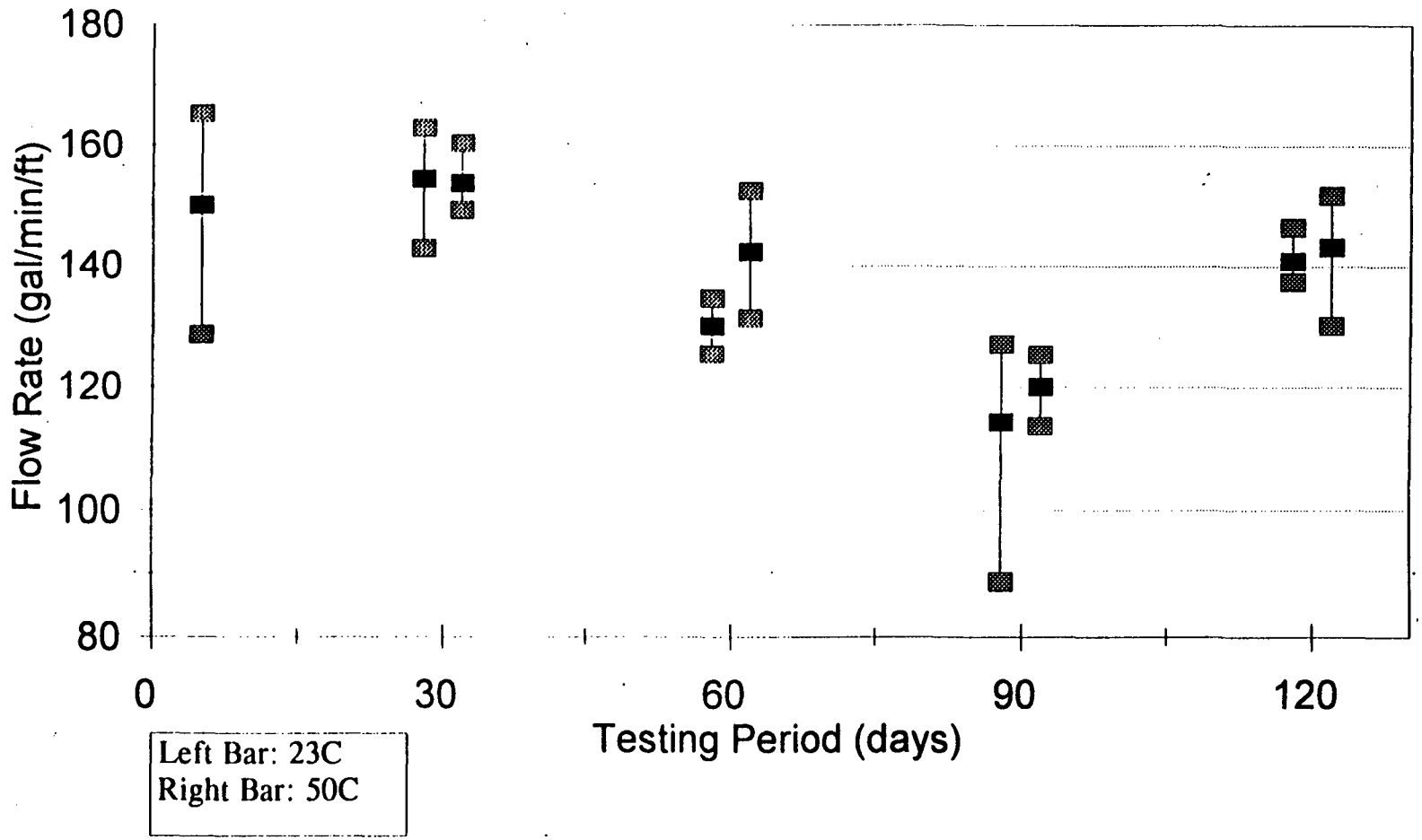
FMC CORPORATION EPA METHOD 9090

Trevira 1120 GT vs FMC Leachate



FMC CORPORATION EPA METHOD 9090

Trevira 1120 GT vs FMC Leachate



EPA METHOD 9090 TEST RESULTS

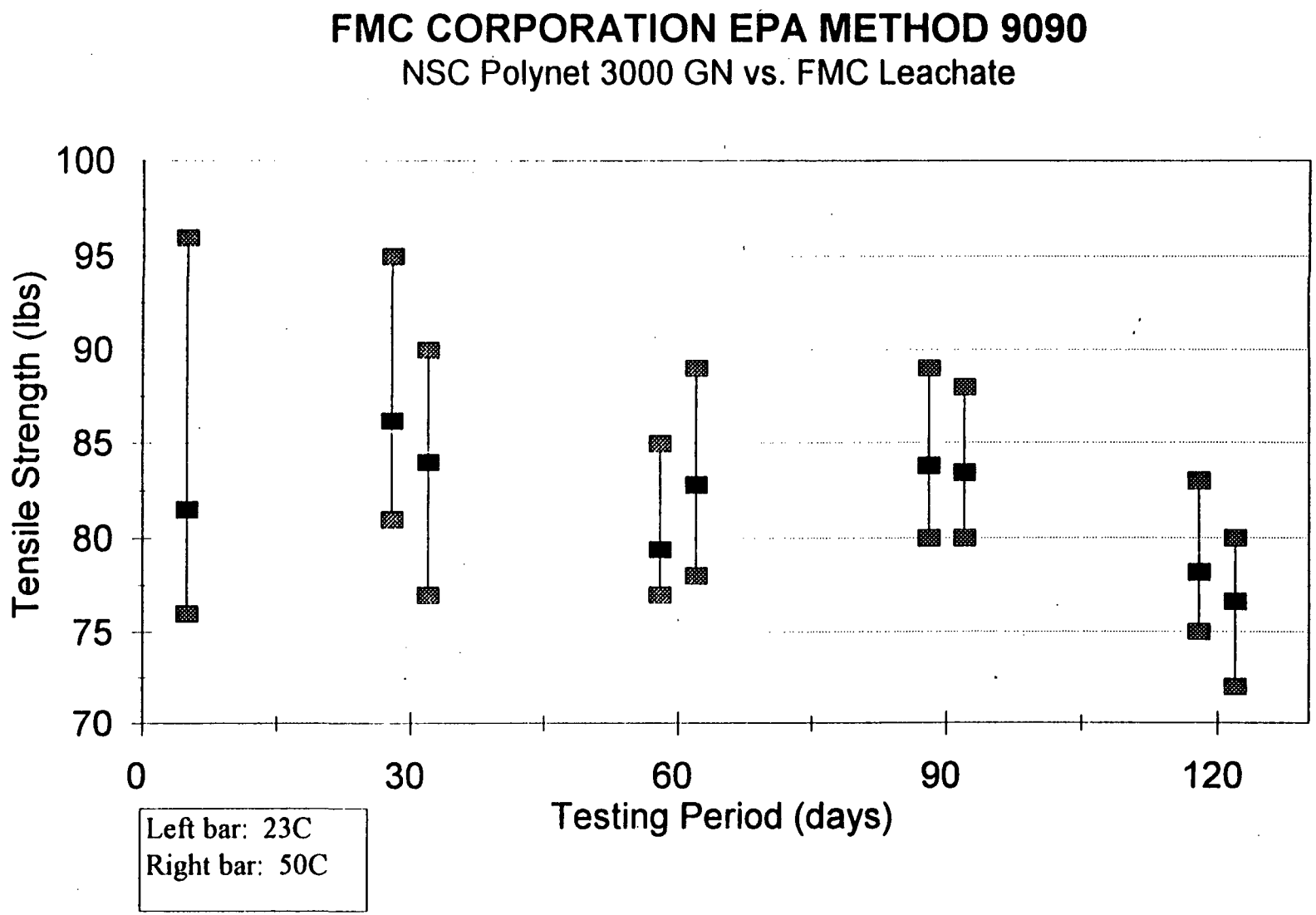
NATIONAL SEAL POLYNET 3000 HDPE GEONET

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

SRA
Quality Review

Report Date: June 12, 1995
Reissued (October 21, 1997)

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
GEONET: NATIONAL SEAL POLYNET 3000 HDPE GEONET									
Tensile Properties:									
Load at Break (lbs/in)	96	84	84	85	81	80	83	77	74
Machine Direction	82	89	77	77	89	81	88	80	78
ASTM D1682	79	95	86	78	78	88	81	76	80
	84	82	90	77	79	81	85	83	72
	77	81	83	80	87	89	80	75	79
	84								
	81								
	78								
	78								
	76								
Average	82	86	84	79	83	84	83	78	77
STD	6	5	4	3	4	4	3	3	3
Coefficient of Variation	7	6	5	4	5	5	3	4	4
% Change		6	3	-3	2	3	2	-4	-6
Load at Break (lbs/in)	53	50	55	54	54	55	53	51	55
Transverse Direction	54	54	54	54	52	54	55	49	54
ASTM D1682	55	51	56	54	53	52	53	52	54
	57	55	59	55	53	56	55	54	54
	55	55	56	54	53	55	52	53	53
	52								
	55								
	53								
	51								
	53								
Average	54	53	56	54	53	54	54	52	54
STD	2	2	2	0	1	1	1	2	1
Coefficient of Variation	3	4	3	1	1	2	2	3	1
% Change		-1	4	1	-1	1	-0	-4	0
Transmissivity:	1.71E-03	N/A	N/A	1.38E-03	1.39E-03	N/A	N/A	1.51E-03	1.41E-03
ASTM D4716 (m2/sec)	1.64E-03	N/A	N/A	1.50E-03	1.36E-03	N/A	N/A	1.42E-03	1.48E-03
Machine Direction	1.57E-03	N/A	N/A	1.52E-03	1.39E-03	N/A	N/A	1.34E-03	1.41E-03
Hydraulic Grad 1.0	1.67E-03								
Compressive Load 10000 psf	1.71E-03								
	1.69E-03								
Average	1.67E-03			1.47E-03	1.38E-03			1.42E-03	1.43E-03
STD	4.89E-05			6.18E-05	1.41E-05			6.94E-05	3.30E-05
Coefficient of Variation	2.94E+00			4.22E+00	1.02E+00			4.88E+00	2.30E+00
% Change				-12	-17			-15	-14


FMC CORPORATION EPA METHOD 9090
NSC Polynet 3000 GN vs. FMC Leachate
Tensile Strength (lbs)
100
95
90
85
80
75
70
0
30
60
90
120
Testing Period (days)
Left bar: 23C
Right bar: 50C

EPA METHOD 9090 TEST RESULTS

PLEXCO 6" IPS 17.0 PE3408 OIL & GAS GATHER HDPE GEOPIPE

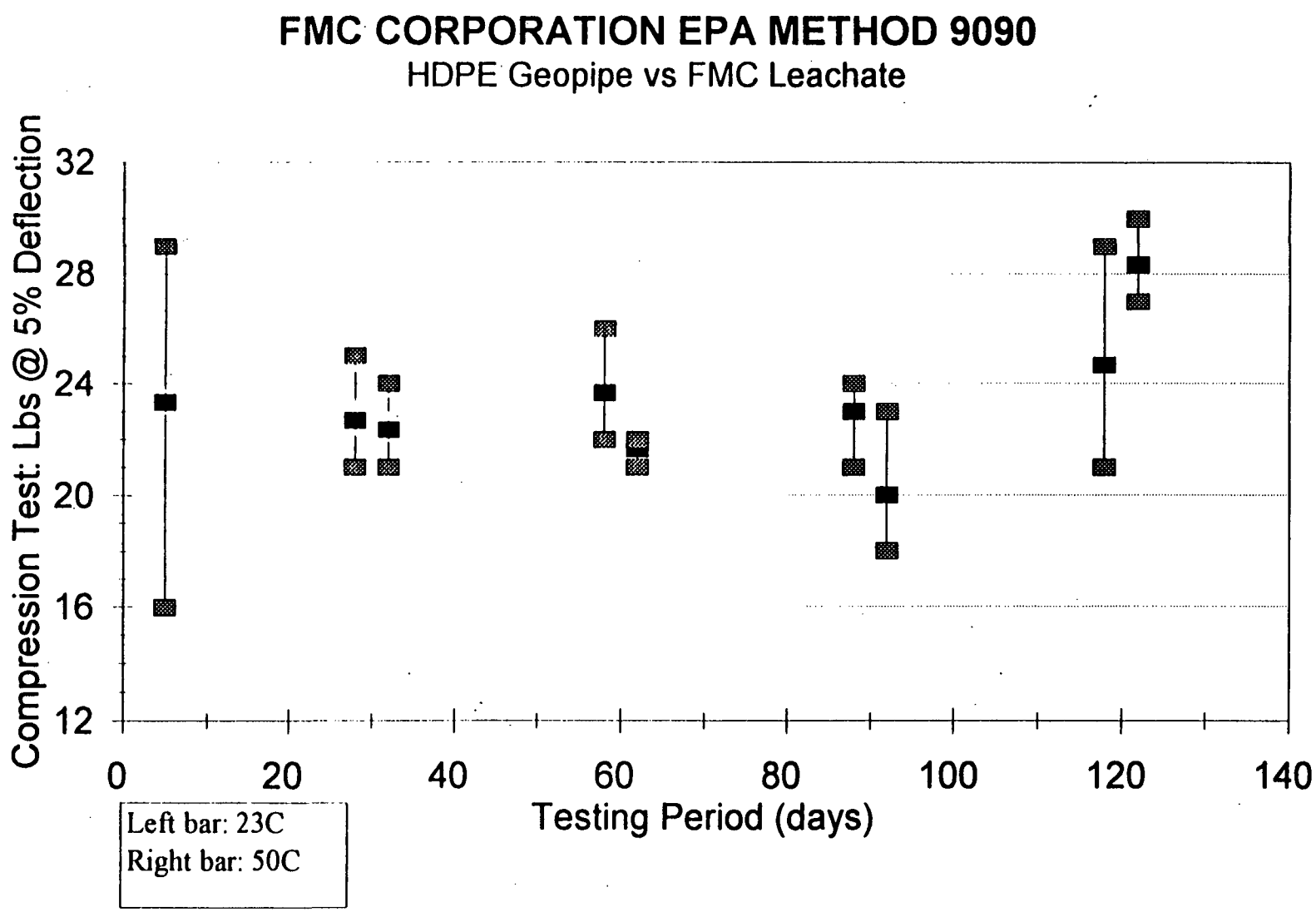
TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to NOSAP Precipitator Slurry

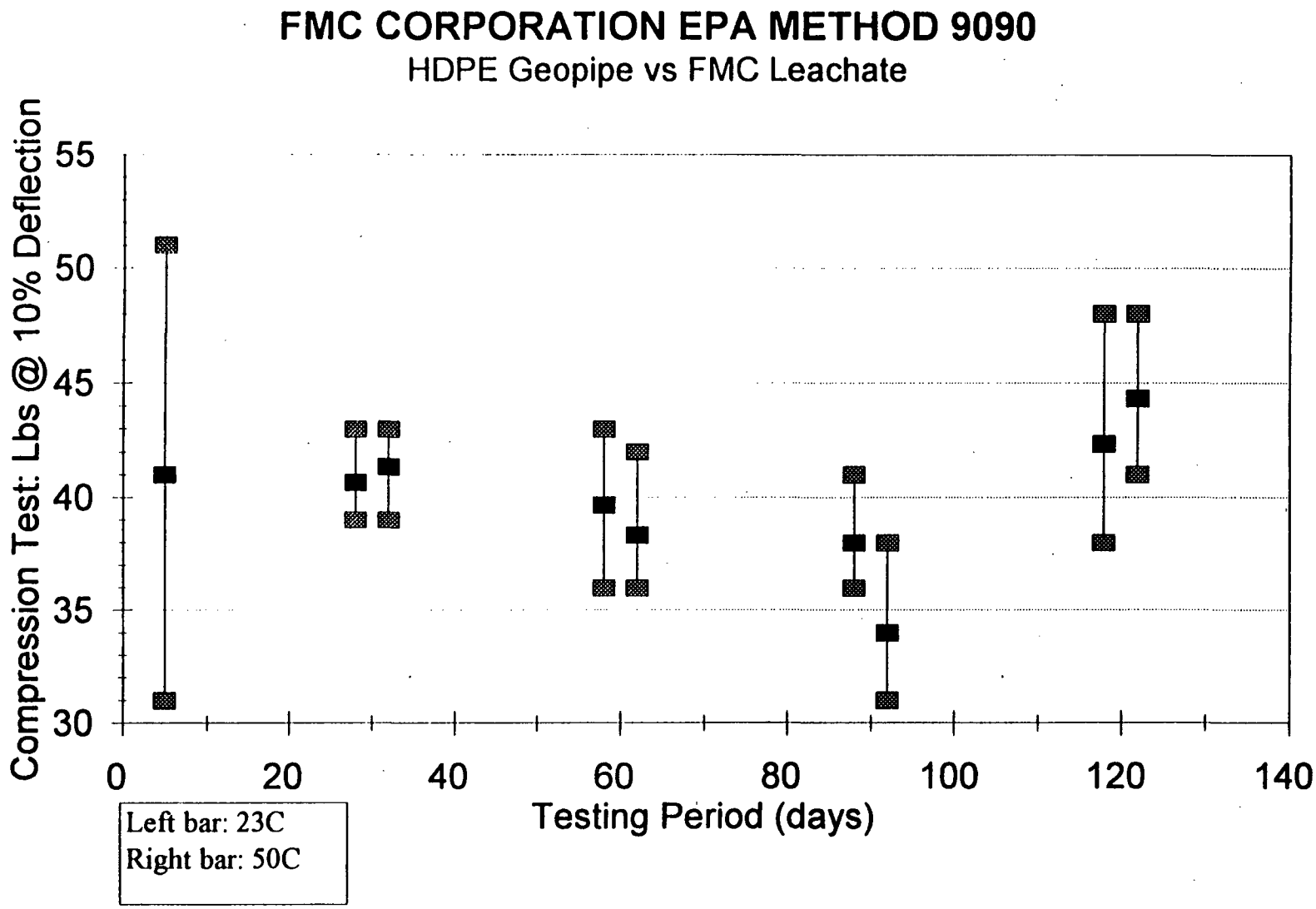
Report Date: June 12, 1995
Reissued (October 21, 1997)

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature						Quality Review	

GEOPIPE: PLEXCO 6" IPS 17.0 PE3408 OIL & GAS GATHER HDPE GEOPIPE

Compression Test:	29	21	22	23	22	24	23	29	30
Load @ 5% deflection (lb)	20	25	24	26	22	21	18	21	27
ASTM D2412	28	22	21	22	21	24	19	24	28
	19								
	28								
	16								
Average	23	23	22	24	22	23	20	25	28
STD	5	2	1	2	0	1	2	3	1
Coefficient of Variation	22	7	6	7	2	6	11	13	4
% Change		-3	-4	1	-7	-1	-14	6	21
Compression Test:	51	40	39	36	42	36	38	48	48
Load @ 10% deflection (lb)	38	43	43	40	36	37	33	38	41
ASTM D 2412	46	39	42	43	37	41	31	41	44
	36								
	44								
	31								
Average	41	41	41	40	38	38	34	42	44
STD	7	2	2	3	3	2	3	4	3
Coefficient of Variation	16	4	4	7	7	6	9	10	6
% Change		-1	1	-3	-7	-7	-17	3	8


FMC CORPORATION EPA METHOD 9090
HDPE Geopipe vs FMC Leachate
Compression Test: Lbs @ 5% Deflection
32
28
24
20
16
12
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23C
Right bar: 50C


FMC CORPORATION EPA METHOD 9090
HDPE Geopipe vs FMC Leachate
Compression Test: Lbs @ 10% Deflection
55
50
45
40
35
30
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23C
Right bar: 50C

EPA METHOD 9090 TEST RESULTS

GEOSYNTHETIC DIMENSIONS

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Dimensional Stability Data — Exposed to NOSAP Precipitator Slurry

Report Date: June 13, 1995
Reissued (October 21, 1997)

Exposure Time and Temperature

SRA
Quality Review

Test Parameters	Temp.	Baseline	30 Day Exposed	% Change	Baseline	60 Day Exposed	% Change	Baseline	90 Day Exposed	% Change	Baseline	120 Day Exposed	% Change
GEOMEMBRANE: SERROT 60 mil TEXTURED HDPE GEOMEMBRANE													
Thickness (mils)	23C	60	58	-3.3	57	57	0.0	59	57	-3.4	59	62	5.1
	50C	61	61	0.0	58	59	1.7	62	60	-3.2	60	59	-1.7
Length (inches)	23C	10.04	10.03	-0.1	10.00	10.00	0.0	10.00	9.99	-0.1	9.98	10.00	0.2
	50C	10.00	9.99	-0.1	10.01	9.99	-0.2	10.03	10.04	0.1	10.00	10.01	0.1
Width (inches)	23C	8.13	8.11	-0.2	8.22	8.22	0.0	8.15	8.16	0.1	8.20	8.18	-0.2
	50C	8.22	8.22	0.0	8.26	8.26	0.0	8.09	8.10	0.1	8.14	8.13	-0.1
Mass (g)	23C	85.04	85.09	0.1	82.02	82.01	-0.0	85.22	85.18	-0.0	81.76	82.38	0.8
	50C	85.75	86.20	0.5	86.37	86.35	-0.0	85.37	85.45	0.1	85.69	86.64	1.1
GEOMEMBRANE: STAFF INDUSTRIES 30 Mil PVC GEOMEMBRANE													
Thickness (mils)	23C	28	29	3.6	29	29	0.0	28	30	7.1	28	29	3.6
	50C	29	29	0.0	28	29	3.6	28	29	3.6	28	29	3.6
Length (inches)	23C	9.98	9.99	0.1	10.02	9.96	-0.6	10.02	9.98	-0.4	9.99	9.94	-0.5
	50C	10.01	9.90	-1.1	10.03	10.00	-0.3	10.01	9.87	-1.4	10.01	9.86	-1.5
Width (inches)	23C	7.98	8.00	0.3	8.02	8.02	0.0	7.98	8.00	0.3	8.01	8.03	0.2
	50C	7.99	8.03	0.5	8.00	7.99	-0.1	7.99	8.04	0.6	8.01	8.02	0.1
Mass (g)	23C	46.70	46.71	0.0	47.52	47.35	-0.4	47.80	47.52	-0.6	46.53	46.62	0.2
	50C	46.95	47.39	0.9	47.36	47.22	-0.3	47.52	46.59	-2.0	47.13	47.02	-0.2

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Dimensional Stability Data — Exposed to NOSAP Precipitator Slurry

SRA
Quality Review

Report Date: June 13, 1995
Reissued (October 21, 1997)

Exposure Time and Temperature

Test Parameters	Temp.	30 Day Baseline	30 Day Exposed	30 Day % Change	60 Day Baseline	60 Day Exposed	60 Day % Change	90 Day Baseline	90 Day Exposed	90 Day % Change	120 Day Baseline	120 Day Exposed	120 Day % Change
GEOTEXTILE: HOECHST CELANESE TREVIRA 1120 6oz. GEOTEXTILE													
Thickness (mils)	23C	73	81	11.0	83	89	7.2	83	93	12.0	81	99	22.2
	50C	85	89	4.7	74	85	14.9	83	94	13.3	77	82	6.5
Length (inches)	23C	8.04	8.06	0.2	8.00	7.98	-0.2	8.03	8.12	1.1	8.00	8.17	2.1
	50C	8.03	8.04	0.1	8.02	7.90	-1.5	7.99	8.04	0.6	8.02	7.95	-0.9
Width (inches)	23C	4.02	4.02	0.0	4.03	4.02	-0.2	4.01	3.98	-0.7	4.04	4.03	-0.2
	50C	4.02	3.98	-1.0	4.01	3.90	-2.7	4.05	3.98	-1.7	4.03	3.94	-2.2
Mass (g)	23C	4.24	4.34	2.4	4.27	4.50	5.4	4.30	4.49	4.4	4.39	4.78	8.9
	50C	4.27	4.31	0.9	4.16	4.40	5.8	4.48	4.44	-0.9	4.22	4.24	0.5
GEONET: NATIONAL SEAL POLYNET 3000 HDPE GEONET													
Thickness (mils)	23C	226	225	-0.4	225	228	1.3	228	229	0.4	224	225	0.4
	50C	226	228	0.9	223	224	0.4	223	225	0.9	228	223	-2.2
Length (inches)	23C	5.45	5.45	0.0	5.62	5.62	0.0	5.68	5.67	-0.2	5.82	5.82	0.0
	50C	5.44	5.43	-0.2	5.40	5.41	0.2	5.72	5.74	0.3	5.60	5.55	-0.9
Width (inches)	23C	1.93	1.92	-0.5	1.95	1.94	-0.5	2.00	2.01	0.5	1.99	2.00	0.5
	50C	2.00	1.98	-1.0	1.99	1.99	0.0	1.98	1.98	0.0	1.93	1.96	1.6
Mass (g)	23C	8.56	8.55	-0.1	8.85	8.85	0.0	9.49	9.48	-0.1	9.66	9.67	0.1
	50C	8.87	8.89	0.2	8.67	8.77	1.2	9.35	9.34	-0.1	8.77	8.82	0.6

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Dimensional Stability Data — Exposed to NOSAP Precipitator Slurry

Report Date: June 13, 1995
Reissued (October 21, 1997)

Exposure Time and Temperature

SRA
Quality Review

Test Parameters	Temp.	30 Day Baseline	30 Day Exposed	30 Day % Change	60 Day Baseline	60 Day Exposed	60 Day % Change	90 Day Baseline	90 Day Exposed	90 Day % Change	120 Day Baseline	120 Day Exposed	120 Day % Change
GEOPIPE: PLEXCO 6" IPS 17.0 PE3408 OIL & GAS GATHER HDPE GEOPIPE													
Thickness (inches)	23C	0.417	0.415	-0.5	0.417	0.420	0.7	0.415	0.413	-0.5	0.423	0.429	1.3
	50C	0.418	0.417	-0.2	0.420	0.422	0.5	0.416	0.417	0.2	0.419	0.421	0.5
Width (inches)	23C	1.017	1.028	1.1	1.018	1.018	0.0	1.015	1.016	0.1	1.015	1.015	0.0
	50C	1.019	1.029	1.0	1.023	1.030	0.7	1.019	1.019	0.0	1.013	1.013	-0.1
Mass (g)	23C	129.19	129.23	0.0	129.38	130.79	1.1	129.34	129.28	-0.0	129.49	129.57	0.1
	50C	129.63	129.66	0.0	130.77	129.45	-1.0	130.24	130.21	-0.0	129.93	130.02	0.1

File C97-06 6.2.1.4

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

A 120 Day Final Report:

Laboratory Testing of Geosynthetics for Waste Containment EPA Method 9090A

Leachate: phosphorus bearing mixture of phos dock effluent from the north solids tank and northest sump

June 1997

TRI

A 120 Day Final Report:

Laboratory Testing of Geosynthetics for Waste Containment EPA Method 9090A

Leachate: phosphorus bearing mixture of phos dock effluent from the north solids tank and northest sump

June 1997
(Reissued October 1997)

Submitted to:
FMC Corporation
P.O. Box 4111
Pocatello, Idaho 83205

Attn: **Mr. Larry Plooster**

Submitted by:

TRI/Environmental, Inc.
9063 Bee Caves Rd.
Austin, Texas 78733

FOREWORD

The testing reported herein is based upon accepted industry practice as well as the test method listed. TRI/Environmental Inc. (TRI) neither accepts responsibility for nor makes claim as to the final use and purpose of the materials tested.

Tests were performed under laboratory conditions and not under actual usage conditions. TRI can give no conclusions as to the serviceability, life expectancy or general durability of the products tested when used in a lining and/or leachate collection system.

1.0 INTRODUCTION

This report describes the work performed by TRI/Environmental, Inc. (TRI) to determine the chemical compatibility of two geomembranes, one geonet, one geopipe and two component geotextiles (one woven and one nonwoven) of a geosynthetic clay liner product with one waste leachate. The products selected represented possible liner system materials for the proposed waste facility construction project. The objective was to determine the resistance of each product to changes caused by exposure to leachate. Changes in physical, mechanical properties and dimensional stability were measured after exposure to the leachate at 23°C and 50°C for 30, 60, 90 and 120 days following the exposure regime specified in United States Environmental Protection Agency (EPA) Method 9090A

Methods, results and discussion are provided in the sections which follow. Test results are provided in the Tables of Results which accompany this report.

2.0 METHODS

2.1 Materials

Table 1 lists products selected for evaluation in this chemical compatibility study.

Table 1. List of geosynthetics evaluated in chemical compatibility study
60 mil high density polyethylene (HDPE) geomembrane
30 mil poly-vinyl chloride (PVC) geomembrane
HDPE geonet
HDPE geopipe
geosynthetic clay liner (GCL) component woven geotextile
GCL component non-woven geotextile

2.2 Leachate

The waste leachate was received from FMC Corporation and used directly from the shipping tanks. The leachate represented a phosphorus bearing mixture of phos dock effluent from the north solids tank and the northeast sump.

2.3 Exposure Conditions

Geosynthetic test coupons and specimens were exposed to the exposure leachate following the specifications of EPA Method 9090A as they relate to exposure to waste fluids. The tanks used for these exposures were maintained at 23 ±2°C and 50 ±2°C throughout the 120-day exposure period. Tanks were constructed from chemically resistant stainless steel, fitted with stirrers and heated with a circulating hot water heat exchanger system. The 50°C tanks were sealed with a lid, and a reflux condenser was installed to minimize loss of volatile leachate components.

2.4 Testing Procedures

Testing coupons and specimens were cut from provided sample material for subsequent exposure in the leachate baths. Upon removal from the exposure baths, sample materials were rinsed with deionized water and wiped or patted with absorbent towels to remove excess water and stored in polyethylene baggies until tested.

At each testing session, samples of unexposed and exposed specimens were tested. This "baseline" testing at each testing interval served to minimize variation in observed changes caused by testing machine variability.

The following sections list tests performed on the various geosynthetic products.

2.4.1 HDPE Geomembrane

Table 2 lists tests performed on HDPE geomembrane. The number of test replicates was doubled for baseline determinations on unexposed material.

Table 2. Tests performed on HDPE geomembrane

Test or Physical Property	Method	Number of specimens
Dimensions and weight	EPA 9090A	3
Hardness	ASTM D 2240, D scale	3
Volatiles and Extractables	EPA SW 870, App..III	2
Specific Gravity	ASTM D 792	3
Tensile Properties	ASTM D 638	3
Modulus of Elasticity	ASTM D 882	3
Hydrostatic Resistance	ASTM D 751 Method A	3

Table 2. Tests performed on HDPE geomembrane		
Test or Physical Property	**Method**	**Number of specimens**
Tear Strength	ASTM D 1004	3
Puncture Resistance	FTMS 101C Method 2065	3
Seam Peel and Shear	ASTM D 4437	3

2.4.2 *PVC Geomembrane*

Table 3 lists tests performed on PVC geomembrane. The number of test replicates was doubled for baseline determinations on unexposed material.

Table 3. Tests performed on PVC geomembrane		
Test or Physical Property	**Method**	**Number of specimens**
Dimensions and weight	EPA 9090A	3
Hardness	ASTM D 2240, A scale	3
Volatiles and Extractables	EPA SW 870 Appendix III	2
Specific Gravity	ASTM D 792	3
Tensile Properties	ASTM D 882	3
Hydrostatic Resistance	ASTM D 751 Method A	3
Tear Strength	ASTM D 1004	3
Puncture Resistance	FTMS 101C Method 2065	3
Seam Shear Resistance	ASTM D 4437	3

2.4.3 *HDPE Geonet*

Table 4 lists tests performed on HDPE geonet. The number of test replicates was doubled for baseline determinations on unexposed material.

Table 4. Tests performed on HDPE geonet

Test or Physical Property	Method	Number of specimens
Dimensions and weight	EPA 9090A	3
Transmissivity	ASTM D 4716, grad. 0.5, load: 1000 psf	3
Tensile Properties	ASTM D 5035	3

Tensile properties were measures using strip test specimens cut in the machine direction only. Transmissivity testing was performed using a hydraulic gradient of 0.5 and a normal compressive stress of 1000 psf. Transmissivity testing was performed at 60 and 120 days only.

2.4.4 *Geopipe*

Table 5 lists tests performed on HDPE geopipe. The number of test replicates was doubled for baseline determinations on unexposed material.

Table 5. Tests performed on HDPE geopipe

Test or Physical Property	Method	Number of specimens
Dimensions and weight	EPA 9090A	3
Arc bend strength	ASTM D 2412, modified using arc shaped test specimens	3

2.4.5 *Woven Geotextile*

Table 6 lists tests performed on the GCL woven geotextile component material. The number of test replicates was doubled for baseline determinations on unexposed material.

Table 6. Tests performed on woven geotextile		
Test or Physical Property	**Method**	**Number of specimens**
Dimensions and weight	EPA 9090A	3
Grab Tensile Properties (MD)	ASTM D 4632	5
Tear Resistance (MD)	ASTM D 4533	5
Puncture Resistance	ASTM D 4833	5
Mullen Burst Strength	ASTM D 3786	5
Permittivity (falling head)	ASTM D 4491	5

Grab tensile properties and tear resistance strength were measured in the machine direction only. Permittivity was measured using a falling head test procedure.

2.4.6 Non Woven Geotextile

Table 7 lists tests performed on the GCL non woven geotextile component material. The number of test replicates was doubled for baseline determinations on unexposed material.

Table 7. Tests performed on non woven geotextile		
Test or Physical Property	**Method**	**Number of specimens**
Dimensions and weight	EPA 9090A	3
Grab Tensile Properties (MD)	ASTM D 4632	5
Tear Resistance (MD)	ASTM D 4533	5
Puncture Resistance	ASTM D 4833	5
Mullen Burst Strength	ASTM D 3786	5
Permittivity (constant head)	ASTM D 4491	5

Grab tensile properties and tear resistance strength were measured in the machine direction only. Permittivity was measured using a constant head testing apparatus and a 2 inch head.

3.0 Results and Discussion

Test results are presented in the Tables of Results which are included in the Appendix of this report.

In considering these results, it must be determined through engineering judgment whether observed differences in the value of test results measured before and after immersion are due to product variability, unidentified factors relating to the test procedure, or leachate interaction with the products. Any significant chemical interaction with leachate would be expected to result in degradation trends which are consistent across the various properties being evaluated, and not isolated to one set of test results only. However, with each type of material there may be specific properties which are highly sensitive to leachate-induced effects. These factors must be considered in evaluating the various test results for a given product. .

Also of critical importance is the issue of product variability. With most geosynthetics, a range of physical and mechanical index test values covering 15% or more of the average is not uncommon. This can be traced to variability inherent in the product, and the randomness associated with the onset of failure under the specified testing conditions. Due to this variability, TRI employed in this testing program baseline testing at each testing period rather than just at the beginning of the study. However, in chemical compatibility testing the statistical sampling of a broad range of manufactured product is not possible. Therefore, the small size of the sample population tested at each time point must be taken into consideration. The criteria to be applied in evaluating data measured before and after leachate immersion should be that property changes, if observed, are consistent and so great that product variability and experimental factors can be ruled out.

In this report, standard deviations (STD) are reported for most measurements involving three or more replicate specimens. In statistics, the standard deviation is defined as root of the mean squared deviations of individual test results about the mean value. The standard deviation is a quantitative measure of variability within a group of measurements.

One related measure of variability observed within a sample set, relative to the magnitude of the mean value itself, is the *coefficient of variation or variance* (COV). The coefficient of variance is defined as the standard deviation divided by the mean associated with a group of specimens, and may be expressed as a percentage. The COV provides an indication of what proportion of the mean value may be attributable to random experimental factors or product variability. It is useful to consider apparent changes in property values against the criterion of COV since observed changes which fall below the COV may not be significant. This approach was used in preparing the tables in the next sections.

The term *range* refers to the difference between the extreme highest and lowest points within a group of measured values. Considering range as a percentage of the mean values provides another measure of variability within a dataset.

In the tables, the high and low extremes for percentage change in selected mean values are listed for comparison against the largest COV and range-as-a-percentage-of-mean from all of the baseline sample groups. The high and low percentage changes are the extremes from data measured at 30, 60, 90 and 120 days.

3.1 HDPE Geomembrane

Table 8 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for HDPE geomembrane.

Table 8. Baseline coefficients of variation and range of percentage change results for HDPE Geomembrane

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Stress at break (MD)	7	21	3	-7
Elongation at break (MD)	7	18	7	-5
Modulus (MD)	14	43	3	-7
Tear strength (MD)	2	6	3	-6
Puncture Resistance	4	13	5	-5
Hydrostatic resistance	4	14	5	-3
Seam Peel Adhesion	8	30	6	-4
Shear Seam Strength	2	7	11	-2

3.2 PVC Geomembrane

Table 9 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for PVC geomembrane.

Table 9. Baseline coefficients of variation and range of percentage change results for PVC geomembrane

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Stress at break (MD)	4	11	1	-13
Elongation at break (MD)	7	18	6	-11
Tear strength (MD)	6	18	15	-4
Puncture resistance	6	20	12	-12
Hydrostatic resistance	7	20	10	-2
Shear Seam Strength	4	12	9	-2

3.2 HDPE Geonet

Table 10 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for HDPE geonet.

Table 10. Baseline coefficients of variation and range of percentage change results for HDPE geonet

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Tensile strength (MD)	6	17	7	-13
Transmissivity (MD)	7	21	11	0

3.2 HDPE Geopipe

Table 11 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for HDPE geonet.

Table 11. Baseline coefficients of variation and range of percentage change results for HDPE geopipe

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Arc Bend strength (@5% strain)	5	13	9	-5

Table 11. Baseline coefficients of variation and range of percentage change results for HDPE geopipe

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Arc Bend strength (@10% strain)	5	14	10	-6

3.4 Woven Component Geotextile of GCL

Table 12 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for the woven component geotextile of GCL.

Table 12. Baseline coefficients of variation and range of percentage change results for woven geotextile

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Grab tensile strength (MD)	19	62	29	-13
Elongation @ break (MD)	14	43	8	-10
Tear strength (MD)	18	54	22	-17
Puncture resistance	19	73	48	-1
Mullen burst	17	54	7	-4
Permittivity	14	42	3	-8

3.5 Non Woven Component Geotextile of GCL

Table 13 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for the non woven component geotextile of GCL.

Table 13. Baseline coefficients of variation and range of percentage change results for non woven geotextile

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Grab tensile strength (MD)	6	21	10	-1
Elongation @ break (MD)	20	65	11	-6
Tear strength (MD)	10	36	14	-9
Puncture resistance	9	30	39	-4
Mullen burst	11	29	9	0
Permittivity	19	67	42	-11

4.0 CONCLUSION

Because of random variability inherent in the geotextiles studied, results for most index mechanical property tests were observed to vary greatly. This was related to their construction as "component" geotextiles. In addition, certain measurements were subject to greater random variability. These included geomembrane modulus of elasticity (because of the visco-elastic properties of HDPE which cause uncertainty in the determination of the best linear fit), and tensile elongation at break and tensile set after break (attributed to the element of randomness associated with the initiation of tear upon failure). As a general rule, individual sample means showing changes within this range after exposure should not be considered significant, unless there is a pattern or trend which would suggest a time-dependent degradation process. Any loss of performance attributed to chemical interaction should be consistent across measurements of several physical and mechanical index properties, and would be expected to show changes outside the range of expected variability.

While changes in certain measured physical and mechanical properties were noted for some products, the effects of product variability and experimental factors could not be ruled out as causes. In the opinion of the authors, the data, considered together, do not support the conclusion that observed changes were caused by the test exposures.

TRI/Environmental, Inc. is pleased to have been selected to participate in this project. We trust that the information provided in this report meets your requirements for technical documentation of this chemical compatibility study. Please do not hesitate to call if we can provide any further information.

Respectfully submitted,

Sam R. Allen

Sam R. Allen
Vice President and Program Manager
Geosynthetics Technology

TEST RESULTS

This section includes generated test data provided in both tabular and graphical form. Each graph is represented by a series of "I" beam plots. Each "I" beam represents a single test population and illustrates the high and low value as the end-points, and the mean as a central box on the beam.

At each testing period, three "I" beams are shown. The left beam represents the 23°C exposed specimens, the center beam represents unexposed baseline specimens, and the right beam represents the 50°C specimens.

EPA METHOD 9090 TEST RESULTS

GEOSYNTHETIC DIMENSIONS

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure T Exposure Time and Temperature

Test Parameters	Temp.	30 Day Baseline	30 Day Exposed	30 Day % Change	60 Day Baseline	60 Day Exposed	60 Day % Change	90 Day Baseline	90 Day Exposed	90 Day % Change	120 Day Baseline	120 Day Exposed	120 Day % Change
GEOMEMBRANE: 60 mil SMOOTH HDPE													
Thickness (mils)	23C	60	61	1.7	63	62	-1.6	60	61	1.7	62	61	-1.6
	50C	63	63	0.0	61	61	0.0	60	61	1.7	61	61	0.0
Length (inches)	23C	10.00	10.00	0.0	10.00	9.99	-0.1	10.00	10.00	0.0	10.00	10.00	0.0
	50C	10.01	10.00	-0.1	10.01	10.00	-0.1	10.00	9.99	-0.1	10.00	9.99	-0.1
Width (inches)	23C	8.01	8.01	0.0	8.01	7.99	-0.2	7.99	8.00	0.1	8.01	8.01	0.0
	50C	8.00	8.00	0.0	8.01	8.00	-0.1	7.97	7.98	0.3	8.01	7.99	-0.2
Mass (g)	23C	74.85	74.86	0.0	76.19	76.01	-0.2	75.17	75.31	0.2	76.32	76.11	-0.3
	50C	76.26	76.10	-0.2	74.80	74.76	-0.1	75.90	75.95	0.1	75.79	74.87	-1.2
GEOMEMBRANE: 30 mil PVC													
Thickness (mils)	23C	31	32	3.2	31	31	0.0	31	30	-3.2	31	31	0.0
	50C	31	32	3.2	31	31	0.0	30	30	0.0	31	31	0.0
Length (inches)	23C	9.96	9.98	0.0	9.99	9.98	0.0	9.80	9.84	0.4	10.00	9.94	-0.6
	50C	9.99	9.88	-1.1	9.98	9.85	-1.3	9.81	9.84	0.3	9.99	9.83	-1.6
Width (inches)	23C	8.00	8.01	0.1	7.98	8.02	0.4	7.98	8.01	0.4	8.01	7.99	-0.2
	50C	7.99	8.06	0.9	7.99	8.03	0.5	7.99	8.04	0.6	8.02	8.02	0.0
Mass (g)	23C	50.24	50.55	0.6	50.49	50.75	0.5	49.96	50.14	0.4	50.31	50.10	-0.4
	50C	48.51	50.85	4.8	50.25	50.50	0.5	51.95	52.04	0.2	50.48	50.07	-0.8
GEONET: HDPE GEONET													
Thickness (mils)	23C	231	230	-0.4	230	228	-0.9	224	227	1.3	225	227	0.9
	50C	225	224	-0.4	222	228	2.7	222	225	1.4	225	227	0.9
Mass (g)	23C	50.50	50.60	0.2	54.90	55.08	0.3	53.47	53.61	0.3	51.41	51.39	-0.0
	50C	52.64	52.73	0.2	51.39	51.96	1.1	52.28	52.41	0.2	51.90	51.95	0.1
GEOPIPE: HDPE GEOPIPE													
Thickness (mils)	23C	63	63	0.0	63	63	0.0	62	62	0.0	63	62	-1.6
	50C	63	64	1.6	62	63	1.6	64	64	0.0	61	61	0.0
Width (mils)	23C	1.00	1.00	0.0	1.00	1.01	1.0	1.00	1.00	0.0	1.00	1.00	0.0
	50C	1.00	1.01	1.0	1.00	1.01	1.0	1.00	1.00	0.0	1.00	1.00	-0.1
Mass (g)	23C	186.90	185.74	-0.1	183.52	183.89	0.2	184.23	184.56	0.2	183.78	185.11	0.7
	50C	188.32	188.51	0.1	185.28	185.29	0.0	184.86	185.07	0.1	186.31	186.69	0.2

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TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: June 18, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	Temp.	30 Day Baseline	30 Day Exposed	30 Day % Change	60 Day Baseline	60 Day Exposed	60 Day % Change	90 Day Baseline	90 Day Exposed	90 Day % Change	120 Day Baseline	120 Day Exposed	120 Day % Change
GEOTEXTILE: BENTOFIX GCL - woven textile component													
Thickness (mils)	23C	80	85	6.3	85	92	8.2	81	86	6.2	72	77	6.9
	50C	73	80	9.6	74	85	14.9	79	86	8.9	74	83	12.2
Length (inches)	23C	7.97	7.87	-1.3	7.96	7.95	-0.1	8.00	7.95	-0.6	7.97	7.96	-0.1
	50C	7.96	7.87	-1.1	7.98	7.91	-0.9	8.00	7.93	-0.9	8.01	7.97	-0.5
Width (inches)	23C	4.01	4.02	0.2	4.03	4.03	0.0	4.01	4.02	0.2	4.02	4.02	0.0
	50C	4.04	4.04	0.0	4.06	4.06	0.0	3.99	4.04	1.3	4.07	4.06	-0.2
Mass (g)	23C	5.98	5.94	-0.7	5.98	6.39	7.2	6.67	6.90	3.4	5.06	5.19	2.6
	50C	5.55	5.53	-0.4	5.83	5.93	1.7	6.09	6.18	1.5	5.83	5.93	1.7
GEOTEXTILE: BENTOFIX GCL - nonwoven textile component													
Thickness (mils)	23C	137	140	2.2	128	136	7.8	135	144	6.7	149	147	-1.3
	50C	133	135	1.5	128	134	4.7	138	140	1.4	143	143	0.0
Length (inches)	23C	7.95	7.86	-1.1	7.84	7.83	-0.1	7.86	7.85	-0.4	8.10	8.08	-0.2
	50C	7.98	7.95	-0.4	7.86	7.83	-1.9	7.89	7.84	-0.6	7.83	7.83	0.0
Width (inches)	23C	4.05	3.98	-1.7	4.01	4.00	-0.2	4.05	4.08	0.7	4.07	4.06	-0.2
	50C	4.06	3.97	-2.2	4.06	4.00	-1.5	4.01	4.07	1.5	4.05	4.05	0.0
Mass (g)	23C	5.15	5.09	-1.2	4.85	4.88	0.7	5.18	5.33	3.3	5.38	5.54	2.8
	50C	5.11	5.06	-1.0	4.77	4.83	1.3	5.27	5.28	0.2	5.32	5.48	3.0

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EPA METHOD 9090 TEST RESULTS

FMC CORPORATION - POCATELLO

60 mil SMOOTH HDPE GEOMEMBRANE

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 60 mil SMOOTH HDPE												
Tensile Properties:	2505	2538	2537	2485	2385	2234	2502	2466	2601	2527	2583	2648
Tensile Stress @ Yield (psi)	2630	2484	2593	2485	2306	2466	2523	2420	2599	2543	2478	2633
ASTM D638	2404	2612	2489	2495	2388	2667	2487	2506	2602	2567	2531	2684
Machine Direction	2523			2456			2463			2528		
	2516			2548			2494			2547		
	2490			2494			2462			2528		
Average	2528	2545	2540	2494	2360	2456	2489	2464	2601	2540	2531	2655
STD	75	52	42	27	38	177	21	35	1	14	43	21
Coefficient of Variation	3	2	2	1	2	7	1	1	0	1	2	1
Range as % of Baseline	9			4			2			2		
% Change		1	0		-5	-2		-1	5		-0	5
Tensile Properties:	4285	3848	4377	3919	3929	3622	4383	4144	4030	4017	4415	4256
Tensile Strength @ Break (psi)	4771	4740	3795	4254	3896	4212	4178	4664	4210	3985	4516	4510
ASTM D638	3957	4882	4666	3917	3811	4828	5007	4410	4831	4158	3136	3538
Machine Direction	4699			4147			4774			4231		
	4382			4664			4083			4366		
	4098			4117			4537			4631		
Average	4365	4490	4279	4170	3879	4220	4494	4408	4357	4231	4022	4101
STD	295	458	362	252	50	492	323	212	343	220	628	412
Coefficient of Variation	7	10	8	6	1	12	7	5	8	5	16	10
Range as % of Baseline	19			18			21			15		
% Change		3	-2		-7	1		-2	-3		-5	-3
Tensile Properties:	17	18	18	17	18	18	17	17	17	16	16	15
Elongation @ Yield (%)	18	17	18	17	17	18	17	19	18	16	16	16
ASTM D638	18	17	17	17	17	19	18	16	18	15	15	15
Machine Direction	17			17			17			16		
	18			17			17			16		
	18			17			17			16		
Average	18	17	18	17	17	18	17	17	18	16	16	15
STD	0	0	0	0	0	0	0	1	0	0	0	0
Coefficient of Variation	3	3	3	0	3	3	2	7	3	2	3	3
% Change		-2	0		2	8		1	3		-1	-3

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TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
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Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 60 mil SMOOTH HDPE												
Tensile Properties:	729	663	740	680	786	737	823	841	694	719	839	732
Elongation @ Break (%)	792	800	650	735	768	763	715	799	715	694	575	779
ASTM D638	694	813	804	708	786	814	840	778	807	722	757	677
Machine Direction	779			737			811			734		
	766			750			703			760		
	719			751			777			799		
Average	747	759	731	727	780	771	778	806	739	738	724	729
STD	35	68	63	25	8	32	53	26	49	34	110	42
Coefficient of Variation	5	9	9	3	1	4	7	3	7	5	15	6
Range as % of Baseline	13			10			18			14		
% Change		2	-2		7	6		4	-5		-2	-1
Tensile Properties:	647	618	660	625	686	667	715	707	602	660	695	638
Set after Break (%)	740	726	615	663	690	680	653	686	655	640	572	700
ASTM D638	615	710	734	685	685	731	665	672	689	688	640	590
Machine Direction	681			613			729			662		
	688			660			667			666		
	660			732			646			670		
Average	672	685	670	663	687	693	679	688	649	664	636	643
STD	39	48	49	39	2	28	31	14	36	14	50	45
Coefficient of Variation	6	7	7	6	0	4	5	2	6	2	8	7
Range as % of Baseline	19			18			12			7		
% Change		2	-0		4	4		1	-4		-4	-3
Tensile Properties:	1976	1984	2064	1953	1862	1680	1992	1948	2076	1984	2032	2024
Tensile Stress @ 100% Elongation (psi)	2018	1992	2078	1998	1823	1885	1988	2011	2076	2015	1969	2082
ASTM D638	1965	2025	2011	1968	1853	2071	1982	1946	2075	2034	2036	2099
Machine Direction	2028			1948			1942			2034		
	1949			1993			1988			2026		
	1933			1980			1956			2025		
Average	1978	2000	2051	1973	1846	1879	1975	1968	2076	2020	2012	2068
STD	34	18	29	19	17	160	19	30	0	17	31	32
Coefficient of Variation	2	1	1	1	1	9	1	2	0	1	2	2
Range as % of Baseline	5			3			3			2		
% Change		1	4		-6	-5		-0	5		-0	2
Tensile Properties:	2015	2025	2175	1992	1701	1672	2038	1933	2081	2007	2068	2029
Tensile Stress @ 200% Elongation (psi)	2081	2024	2093	1993	1726	1859	2002	2014	2093	2097	2014	2163
ASTM D638	2004	2054	2067	2004	1775	2063	2041	2009	2139	2021	2086	2119
Machine Direction	2058			1966			1995			2090		
	1982			1989			2024			2045		
	1988			1986			1988			2076		
Average	2018	2034	2118	1992	1734	1865	2015	1985	2104	2056	2056	2104
STD	31	14	40	6	31	160	21	37	25	34	31	56
Coefficient of Variation	2	1	2	0	2	9	1	2	1	2	1	3
Range as % of Baseline	4			1			3			4		
% Change		1	5		-13	-6		-1	4		0	2

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Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
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Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 60 mil SMOOTH HDPE												
Tensile Properties:	2568	2599	2567	2682	2270	2721	2642	2555	2752	2606	2568	2607
Tensile Stress @ Yield (psi)	2593	2625	2696	2546	2322	2705	2656	2587	2604	2576	2552	2739
ASTM D638	2581	2675	2601	2619	2264	2765	2623	2526	2626	2576	2559	2710
Transverse Direction	2606			2561			2420			2621		
	2676			2597			2553			2610		
	2615			2173			2608			2648		
Average	2607	2633	2621	2528	2285	2730	2584	2556	2661	2607	2560	2685
STD	35	32	55	162	26	25	80	25	65	25	7	57
Coefficient of Variation	1	1	2	6	1	1	3	1	2	1	0	2
Range as % of Baseline	4			19			9			3		
% Change		1	1		-10	8		-1	3		-2	3
Tensile Properties:	4360	4629	3660	3630	3439	3016	4195	4523	4582	3086	4415	4556
Tensile Strength @ Break (psi)	3537	4990	4369	3763	3619	3744	4059	3950	4280	4333	4516	4510
ASTM D638	4074	4518	4841	4428	2981	3756	3554	4282	4037	4159	3136	3538
Transverse Direction	4524			4148			3641			3077		
	4745			3791			3897			2680		
	4635			3565			3904			3484		
Average	4313	4712	4290	3888	3346	3505	3875	4252	4300	3470	4022	4201
STD	407	202	485	304	269	346	222	235	223	598	628	489
Coefficient of Variation	9	4	11	8	8	10	6	6	5	17	16	11
Range as % of Baseline	28			22			17			48		
% Change		9	-1		-14	-10		10	11		16	21
Tensile Properties:	15	16	19	15	16	16	15	16	16	16	15	15
Elongation @ Yield (%)	16	15	17	15	16	16	16	16	16	15	14	15
ASTM D638	16	16	16	15	14	16	15	16	16	15	15	16
Transverse Direction	16			16			19			15		
	16			15			16			15		
	16			15			16			15		
Average	16	16	17	15	15	16	16	16	16	15	15	15
STD	0	0	1	0	1	0	1	0	0	0	0	0
Coefficient of Variation	2	3	7	2	6	0	8	0	0	2	3	3
Range as % of Baseline	6			7			25			7		
% Change		-1	9		1	5		-1	-1		-3	1
Tensile Properties:	766	798	669	639	740	737	697	812	768	564	794	778
Elongation @ Break (%)	635	851	765	673	745	793	744	718	756	782	822	780
ASTM D638	718	770	846	770	725	781	615	765	715	752	579	766
Transverse Direction	765			743			649			561		
	793			725			606			667		
	787			730			619			627		
Average	744	806	760	713	737	770	655	765	746	659	732	775
STD	54	34	72	44	8	24	50	38	23	85	109	6
Coefficient of Variation	7	4	10	6	1	3	8	5	3	13	15	1
Range as % of Baseline	21			18			21			34		
% Change		8	2		3	8		17	14		11	18

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Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	Baseline	60 Day 23C	60 Day 50C	Baseline	90 Day 23C	90 Day 50C	Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 60 mil SMOOTH HDPE												
Tensile Properties:	664	741	614	600	648	674	641	692	684	550	720	658
Set after Break (%)	615	725	682	654	663	683	650	653	673	672	715	780
ASTM D638	654	750	682	684	650	685	600	668	651	710	545	666
Transverse Direction	711			681			598			665		
	655			654			576			540		
	650			662			575			561		
Average	658	739	659	653	654	681	607	671	669	616	660	701
STD	28	10	32	26	7	5	29	16	14	68	81	56
Coefficient of Variation	4	1	5	4	1	1	5	2	2	11	12	8
Range as % of Baseline	15			13			12			28		
% Change		12	0		0	4		11	10		7	14
Tensile Properties:	1857	1896	1896	1897	1784	1978	1937	1856	1908	1895	1861	1836
Tensile Stress @ 100% Elongation (psi)	1862	1919	1876	1851	1854	1959	1887	1920	1862	1857	1876	1960
ASTM D638	1864	1965	1927	1868	1552	1994	1966	1859	1919	1862	1921	1910
Transverse Direction	1908			1842			1969			1910		
	1932			1835			1908			1861		
	1896			1592			1919			1934		
Average	1887	1927	1900	1814	1730	1977	1931	1878	1896	1887	1888	1902
STD	28	29	21	101	129	14	30	29	25	29	25	51
Coefficient of Variation	1	-1	1	6	7	1	2	2	1	2	1	3
Range as % of Baseline	4			17			4			4		
% Change		2	1		-5	9		-3	-2		-0	1
Tensile Properties:	1950	1924	2016	1930	1926	2036	1961	1882	2027	1997	1932	1908
Tensile Stress @ 200% Elongation (psi)	1907	2018	1988	1907	1947	2051	1925	1884	1928	2006	2014	1960
ASTM D638	1923	1971	2007	1901	1912	2060	1959	1873	1949	1950	2062	1910
Transverse Direction	1962			1869			2004			1990		
	1987			1859			1926			2034		
	1960			1929			1923			2010		
Average	1952	1971	2004	1899	1928	2049	1953	1880	1968	1998	2003	1926
STD	29	38	12	27	14	10	31	5	43	25	54	24
Coefficient of Variation	1	2	1	1	1	0	2	0	2	1	3	1
Range as % of Baseline	4			4			4			4		
% Change		1	3		2	8		-4	1		0	-4
Modulus of Elasticity:	116722	85335	101415	67805	69213	79320	77511	78639	82095	66929	75555	66855
Tangential (psi)	75578	76904	90054	78409	82340	76408	80303	74854	83621	75202	73929	74911
ASTM D882	97419	104116	101954	84530	81997	61548	82092	82601	83099	78866	69958	80190
Machine Direction	92820			75034			76709			68145		
	96378			84972			84367			69951		
	95350			74804			83850			81159		
Average	95711	88785	97808	77592	77850	72425	80805	78698	82938	73375	73147	73985
STD	13105	13930	6720	5963	6109	7783	2930	3163	633	5396	2351	5483
Coefficient of Variation	14	16	7	8	8	11	4	4	1	7	3	7
Range as % of Baseline	43			22			9			19		
% Change		-7	2		0	-7		-3	3		-0	1

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TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

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Test Parameters	Baseline	30 Day 23C	30 Day 50C	Baseline	60 Day 23C	60 Day 50C	Baseline	90 Day 23C	90 Day 50C	Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 60 mil SMOOTH HDPE												
Modulus of Elasticity:	82872	75123	99583	83154	78609	73002	78929	77514	79862	75543	70109	67697
Tangential (psi)	91734	79360	95825	82909	76596	76612	81224	84358	81114	64657	79578	68921
ASTM D882	92860	115752	84933	65632	81622	79304	83570	76983	75832	72258	81452	84381
Transverse Direction	93412			76115			79391			56864		
	93013			82675			83440			74903		
	105500			72003			77667			81930		
Average	93232	90078	93447	77081	78942	76306	80704	79618	78936	71026	77046	73666
STD	7215	22335	7609	6582	2065	2582	2239	3358	2254	8134	4965	7593
Coefficient of Variation	8	25	8	9	3	3	3	4	3	11	6	10
Range as % of Baseline	24			23			7			35		
% Change		-3	0		2	-1		-1	-2		8	4
Indentation Hardness:	63	62	62	62	62	63	62	62	62	62	62	62
Reading	62	62	62	62	62	62	63	62	62	61	61	62
ASTM D2240	63	62	63	62	63	62	62	60	61	62	62	61
(with TYPE D DUROMETER)	61			62			62			62		
	63			62			62			62		
	62			62			63			61		
Average	62	62	62	62	62	62	62	61	62	62	62	62
STD	1	0	1	0	0	0	0	1	0	0	0	0
Coefficient of Variation	1	0	1	0	1	1	1	2	1	1	1	1
Range as % of Baseline	3			0			2			2		
% Change		-1	0		1	1		-2	-1		0	0
Specific Gravity:	0.951	0.950	0.950	0.952	0.949	0.952	0.949	0.957	0.949	0.946	0.948	0.949
Specific Gravity (grams/cu.cm)	0.951	0.950	0.950	0.953	0.958	0.951	0.953	0.947	0.949	0.948	0.949	0.946
ASTM D792, Method A	0.951	0.951	0.950	0.951	0.952	0.956	0.951	0.948	0.952	0.948	0.948	0.948
	0.951			0.949			0.951			0.944		
	0.951			0.953			0.949			0.946		
	0.951			0.950			0.952			0.947		
Average	0.951	0.950	0.950	0.951	0.953	0.953	0.951	0.951	0.950	0.947	0.948	0.948
STD	0.000	0.001	0.000	0.001	0.004	0.002	0.001	0.004	0.001	0.001	0.000	0.001
Coefficient of Variation	0.000	0.061	0.000	0.157	0.393	0.227	0.154	0.473	0.149	0.146	0.050	0.132
Range as % of Baseline	0.00			0.42			0.42			0.42		
% Change		-0.07	-0.11		0.18	0.18		-0.02	-0.09		0.19	0.12
Environmental Stress Crack Resistance:												
ASTM D1693, Condition B												
Machine Direction (% Failed)	N/A	0	0	N/A	0	0	N/A	0	0	N/A	0	0
Transverse Direction (% Failed)	N/A	0	0	N/A	0	0	N/A	0	0	N/A	0	0

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Test Parameters	Baseline	30 Day 23C	30 Day 50C	Baseline	60 Day 23C	60 Day 50C	Baseline	90 Day 23C	90 Day 50C	Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 60 mil SMOOTH HDPE												
Puncture Resistance:	88	85	91	86	93	93	90	88	93	89	90	97
Load @ Rupture (lbs)	91	85	91	94	94	89	87	88	93	92	93	97
FTMS 101C Method 2065	90	87	90	98	91	91	90	89	95	92	91	95
	90			98			87			92		
	90			94			88			93		
	91			96			92			93		
Average	90	86	91	94	93	91	89	88	94	92	91	96
STD	1	1	0	4	1	2	2	0	1	1	1	1
Coefficient of Variation	1	1	1	4	1	2	2	1	1	1	1	1
Range as % of Baseline	3			13			6			4		
% Change		-5	1		-2	-4		-1	5		-1	5
Volatiles and Extractables:	-0.48	-0.55	-0.32	0.05	-0.08	0.00	-0.28	-0.13	-0.20	-0.21	-0.18	-0.21
Diameter Change (%)	-0.43	-0.57	-0.20	-0.57	-0.28	-0.08	-0.23	-0.07	-0.15	-0.17	-0.23	-0.24
SW 870 - Appendix III-D	-0.48			-0.05			-0.17			-0.17		
Machine Direction	-0.28			-0.15			-0.22			-0.20		
Average	-0.42	-0.56	-0.26	-0.18	-0.18	-0.04	-0.23	-0.10	-0.18		-0.21	-0.23
STD	0.08	0.01	0.06	0.24	0.10	0.04	0.04	0.03	0.03		0.03	-100
Volatiles and Extractables:	-0.03	-0.10	0.18	-0.03	-0.15	-0.13	-0.05	-0.23	-0.02	-0.11	-0.15	-0.07
Diameter Change (%)	0.20	0.15	-0.08	-0.18	-0.18	-0.08	-0.18	-0.12	-0.04	-0.15	-0.19	-0.13
SW 870 - Appendix III-D	-0.10			0.30			-0.11			-0.06		
Transverse Direction	0.20			-0.23			-0.08			-0.14		
Average	0.07	0.02	0.05	-0.04	-0.17	-0.11	-0.11	-0.18	-0.03		-0.17	-0.10
STD	0.13	0.13	0.13	0.21	0.02	0.03	0.05	0.08	0.01		0.02	0.03
Volatiles and Extractables:	0.03	0.09	0.08	0.08	0.08	0.05	0.05	0.06	0.08	0.08	0.05	0.09
% Volatiles	0.02	0.08	0.05	0.07	0.09	0.07	0.05	0.07	0.06	0.07	0.08	0.09
SW 870 - Appendix III-D	0.04			0.04			0.06			0.09		
	0.02			0.03			0.07			0.07		
Average	0.03	0.09	0.07	0.06	0.09	0.06	0.06	0.07	0.07		0.07	0.09
STD	0.01	0.00	0.02	0.02	0.00	0.01	0.01	0.01	0.01		0.02	0.00
Volatiles and Extractables:	0.24	0.24	0.26	0.19	0.23	0.23	0.20	0.22	0.25	0.21	0.27	0.24
% Extractables	0.27	0.26	0.20	0.22	0.22	0.22	0.22	0.22	0.21	0.24	0.24	0.22
SW 870 - Appendix III-D	0.28			0.23			0.18			0.23		
	0.24			0.17			0.24			0.17		
Average	0.26	0.25	0.23	0.20	0.23	0.23	0.21	0.22	0.23		0.26	0.23
STD	0.02	0.01	0.03	0.02	0.01	0.01	0.02	0.00	0.02		0.02	0.01

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TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 60 mil SMOOTH HDPE												
Tear Resistance:	53	48	48	51	51	51	49	51	48	49	50	51
Tear Resistance (lbs)	50	47	49	51	51	51	52	51	52	51	49	53
ASTM D1004	51	48	50	50	51	52	50	47	50	50	51	50
Machine Direction	50			51			51			51		
	50			49			49			49		
	50			50			52			49		
Average	51	48	49	50	51	51	51	50	50	50	50	51
STD	1	1	1	1	0	0	1	2	2	1	1	1
Coefficient of Variation	2	1	2	1	0	1	2	4	3	2	2	2
Range as % of Baseline	6			4			6			4		
% Change		-6	-3		1	2		-2	-1		0	3
Tear Resistance:	50	49	52	46	49	47	48	49	49	49	46	50
Tear Resistance (lbs)	49	49	49	47	50	47	48	48	52	49	44	53
ASTM D1004	51	47	49	49	49	48	48	48	49	49	48	51
Transverse Direction	53			46			48			51		
	50			46			49			49		
	49			46			50					
Average	50	48	50	47	49	47	49	48	50	49	46	51
STD	2	1	2	1	0	0	1	0	1	1	2	1
Coefficient of Variation	3	2	3	2	1	1	2	1	3	2	4	2
Range as % of Baseline	8			6			4			4		
% Change		-4	-1		6	1		-0	3		-7	4
Hydrostatic Resistance:	450	430	440	470	460	485	510	510	525	458	453	454
Load @ Rupture (psi)	470	450	450	475	470	460	490	510	510	456	455	454
ASTM D751	440	440	455	470	450	455	480	520	520	458	454	453
	450			495			480			505		
	460			475			500			465		
	450			485			510			442		
Average	453	440	448	478	460	467	495	513	518	464	454	454
STD	10	10	8	9	8	13	13	5	6	20	1	0
Coefficient of Variation	2	2	2	2	2	3	3	1	1	4	0	0
Range as % of Baseline	7			5			6			14		
% Change		-3	-1		-4	-2		4	5		-2	-2

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TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
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Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 60 mil SMOOTH HDPE												
Seam Shear Strength:	150	152	149	149	151	159	150	147	144	148	148	161
Seam Shear Strength (ppi)	151	156	150	149	150	158	150	148	142	146	152	163
ASTM D4437	150	155	144	153	152	160	151	149	147	148	153	167
	150			143			145			148		
	151			149			143			140		
	155			152			147			151		
Average	151	154	148	149	151	159	148	148	144	147	151	164
STD	2	2	3	3	1	1	3	1	2	3	2	2
Coefficient of Variation	1	1	2	2	1	1	2	1	1	2	1	2
Range as % of Baseline	3			7			5			7		
% Change		2	-2		1	7		0	-2		3	11
Seam Peel Adhesion:	127	131	121	120	130	128	125	131	120	120	112	120
Seam Peel Strength (ppi)	129	121	119	121	97	123	122	130	120	115	120	120
ASTM D4437	130	131	124	119	128	125	115	123	115	127	121	118
	126	118	121	131	114	121	118	121	121	117	127	133
	123	127	116	122	112	123	115	118	119	128	129	133
	116	119	119	120	112	124	120	120	117	120	130	127
	121			118			118			121		
	119			118			119			106		
	130			116			119			136		
	118			118			112			123		
	118			117			105			121		
	94			123			112			102		
Average	121	125	120	120	116	124	117	124	119	120	123	125
STD	9	5	2	4	11	2	5	5	2	9	6	6
Coefficient of Variation	8	4	2	3	10	2	4	4	2	7	5	5
Range as % of Baseline	30			6			12			28		
% Change		3	-1		-4	3		6	2		3	5
Failure Mode (FTB = All Film Tear Bond)	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB

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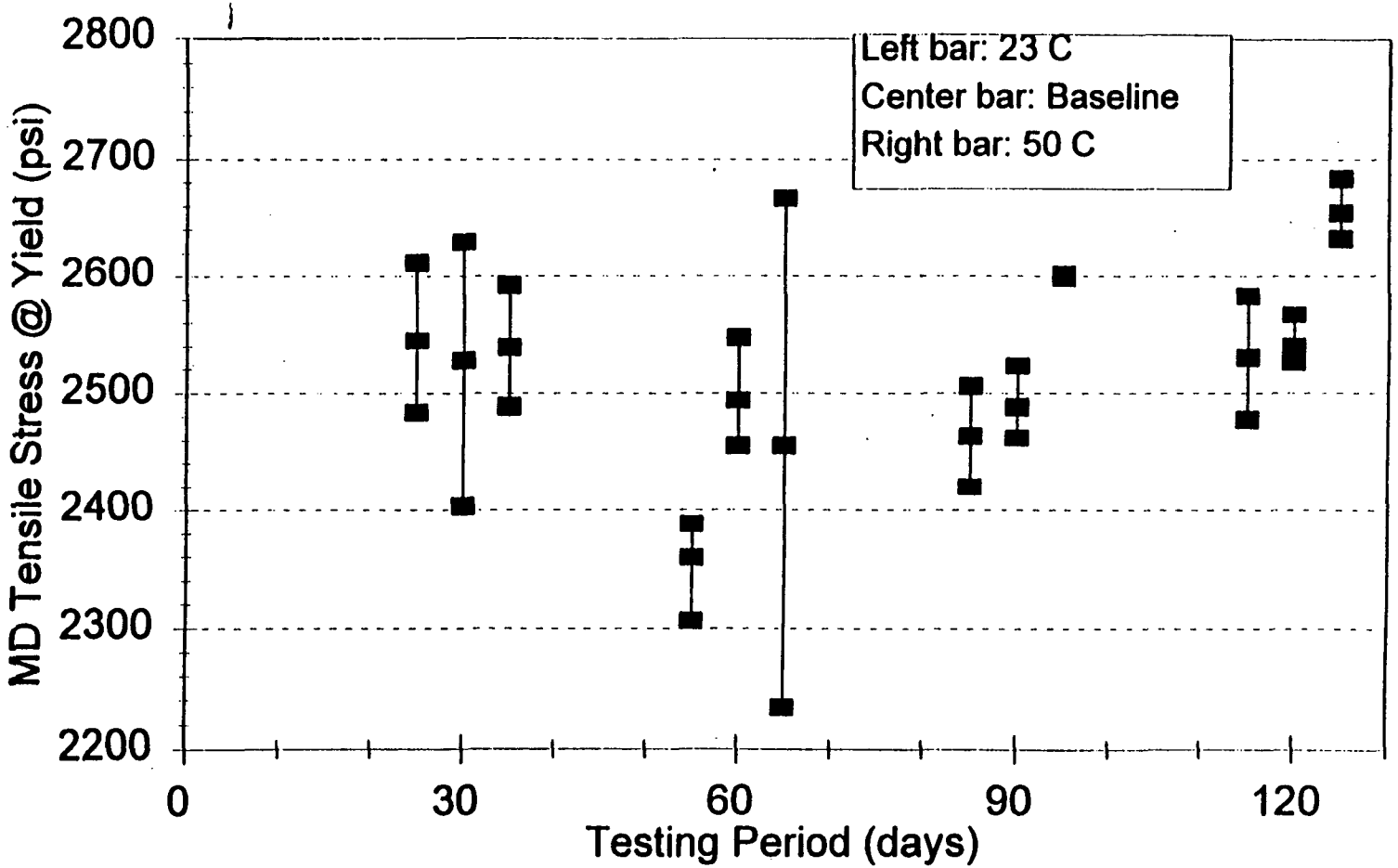
FMC CORPORATION EPA METHOD 9090

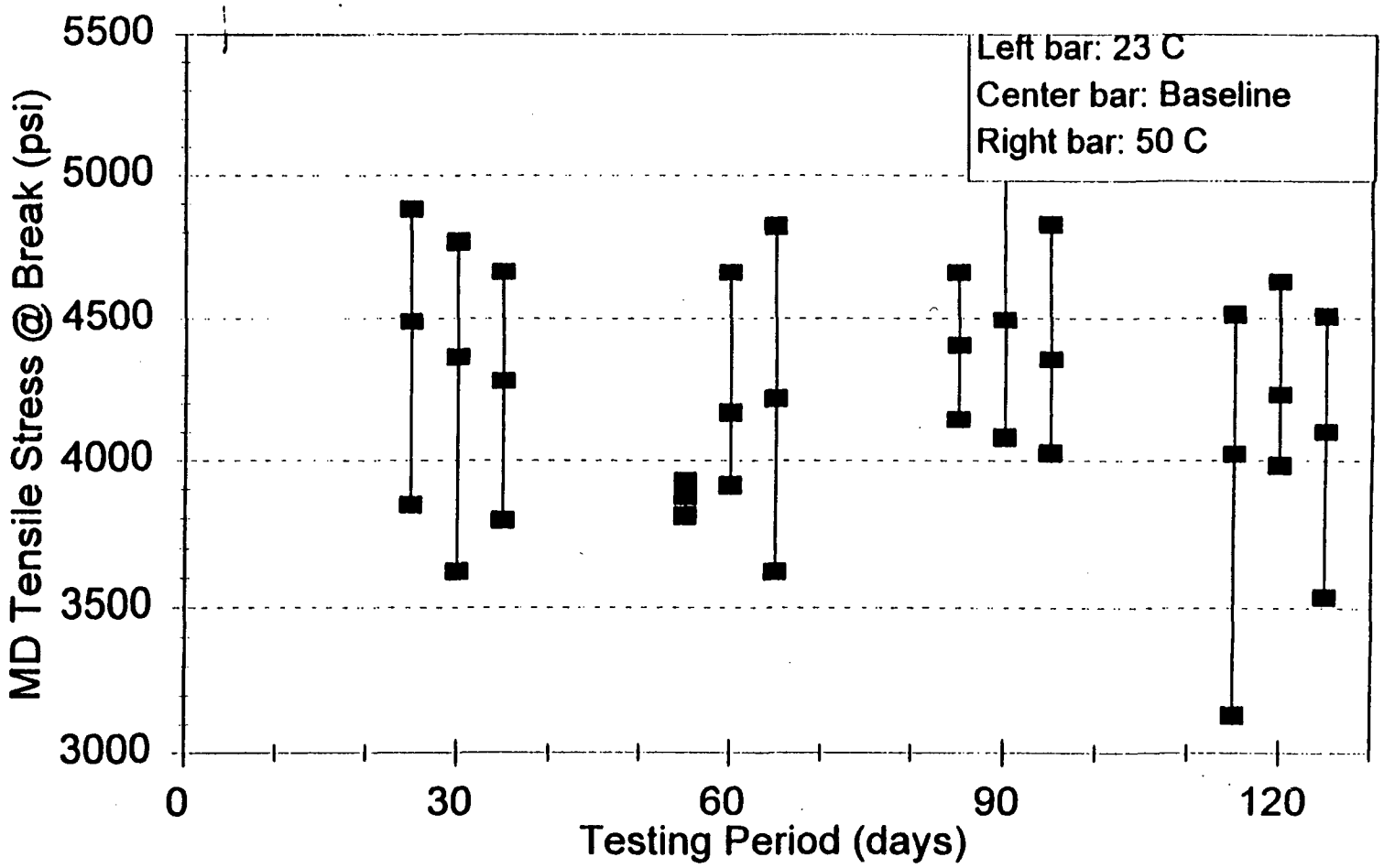
60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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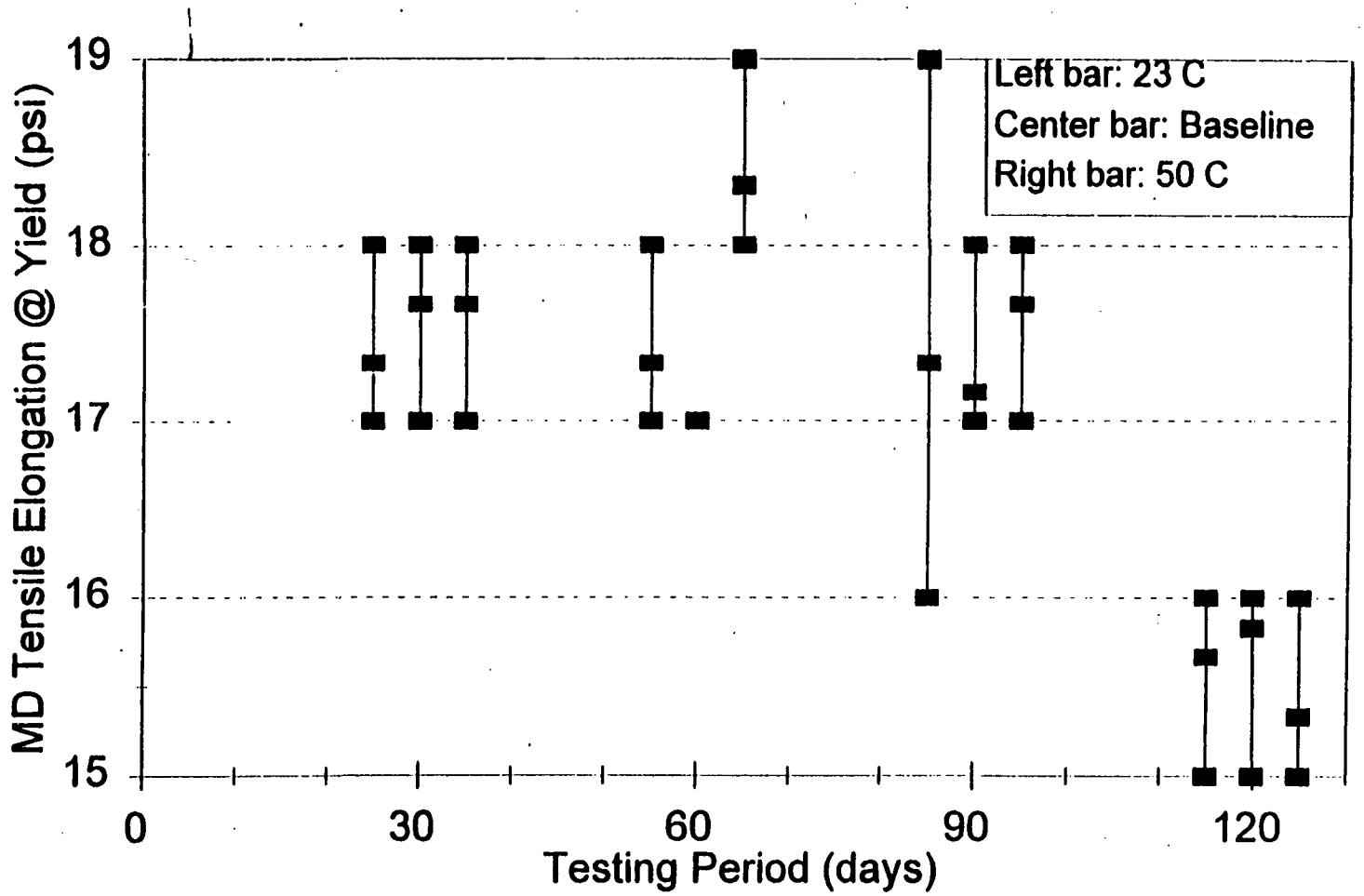
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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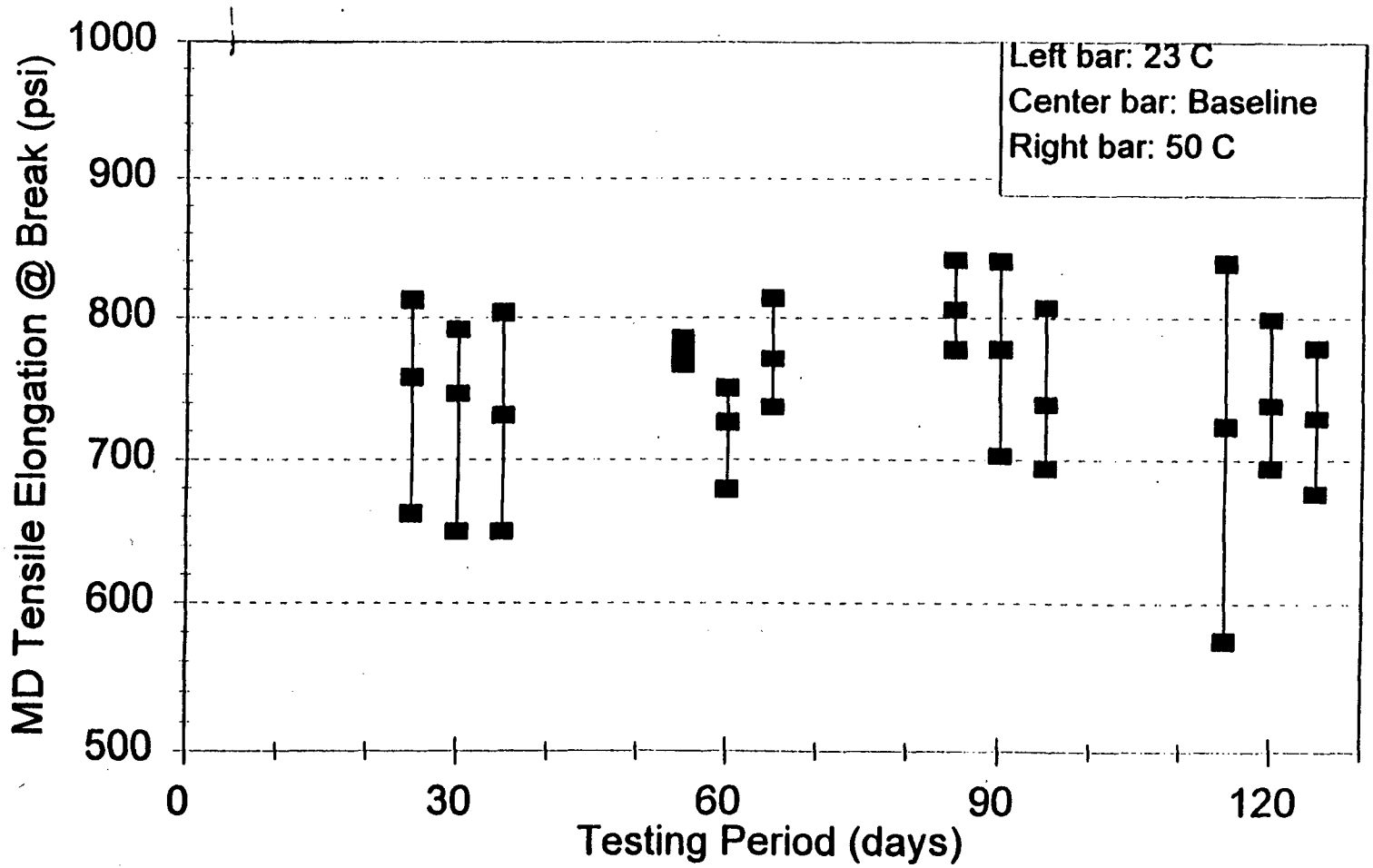
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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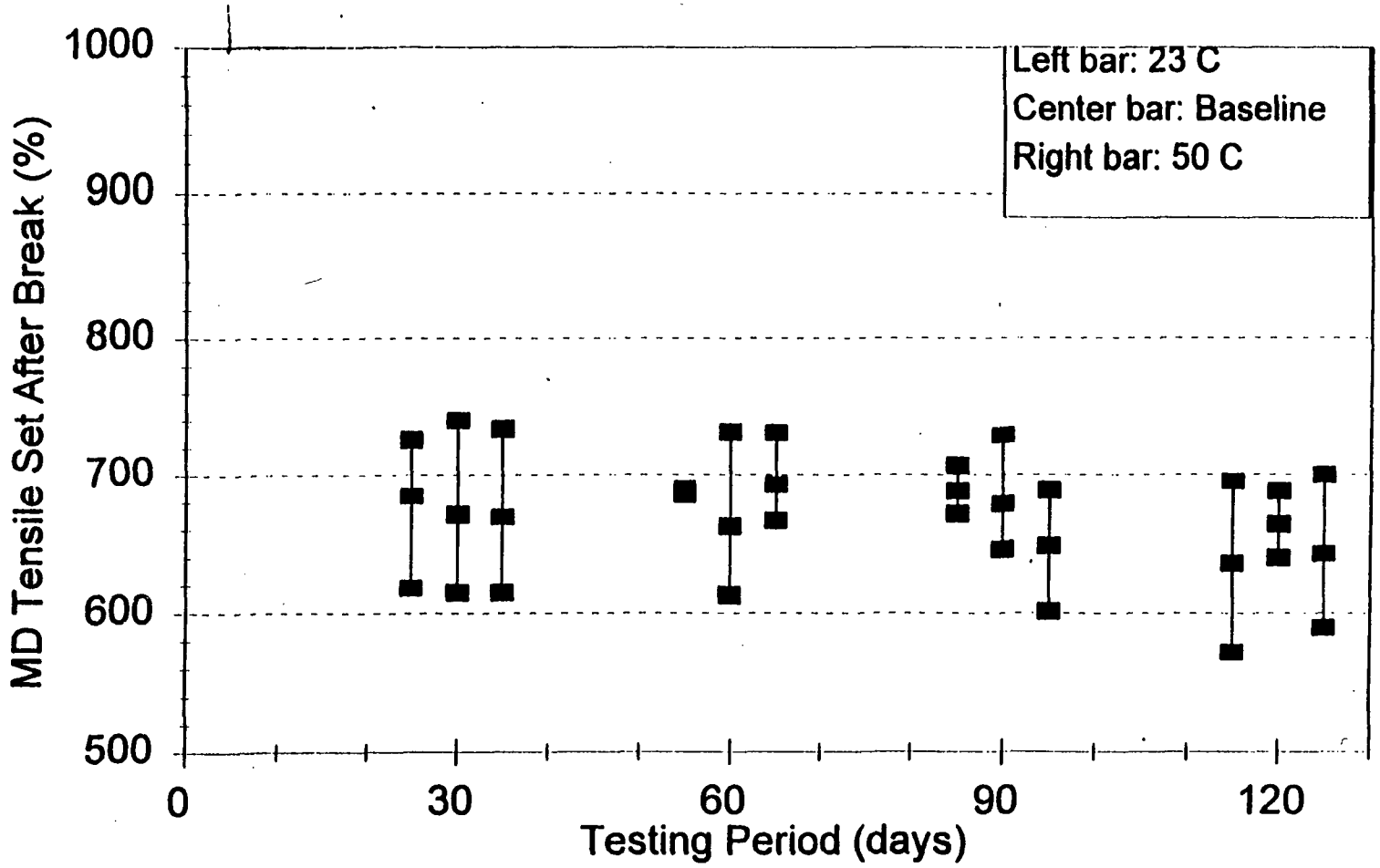
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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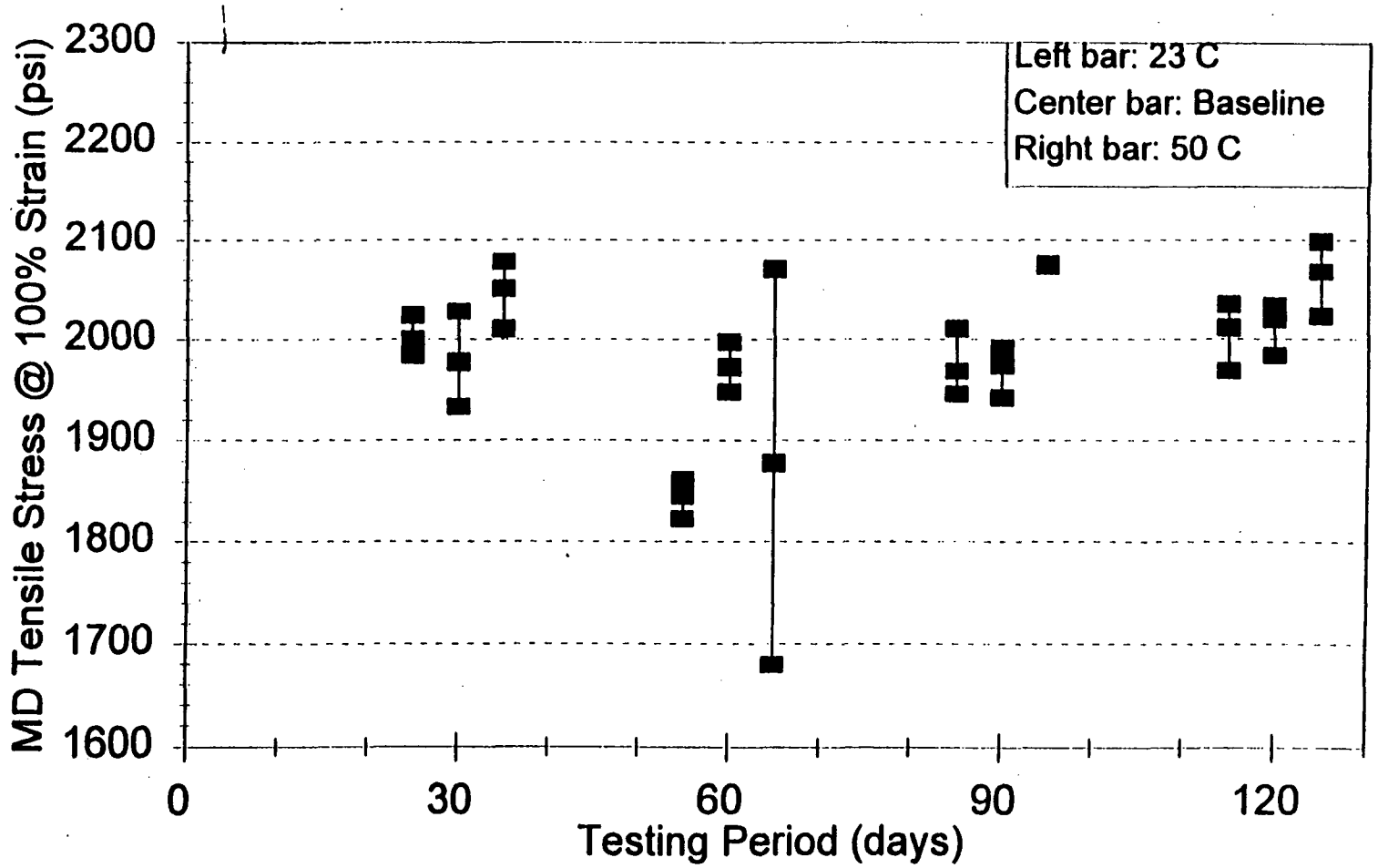
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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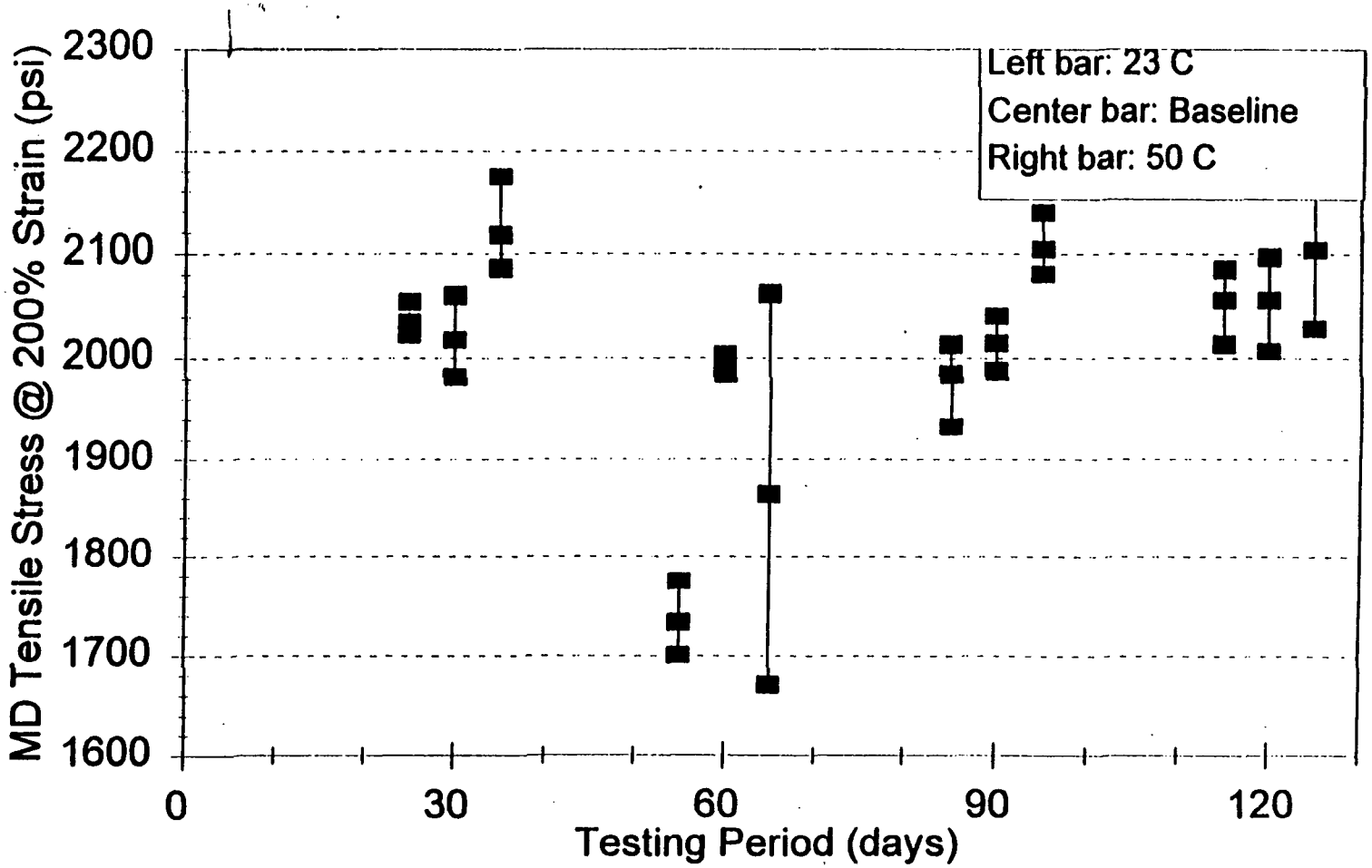
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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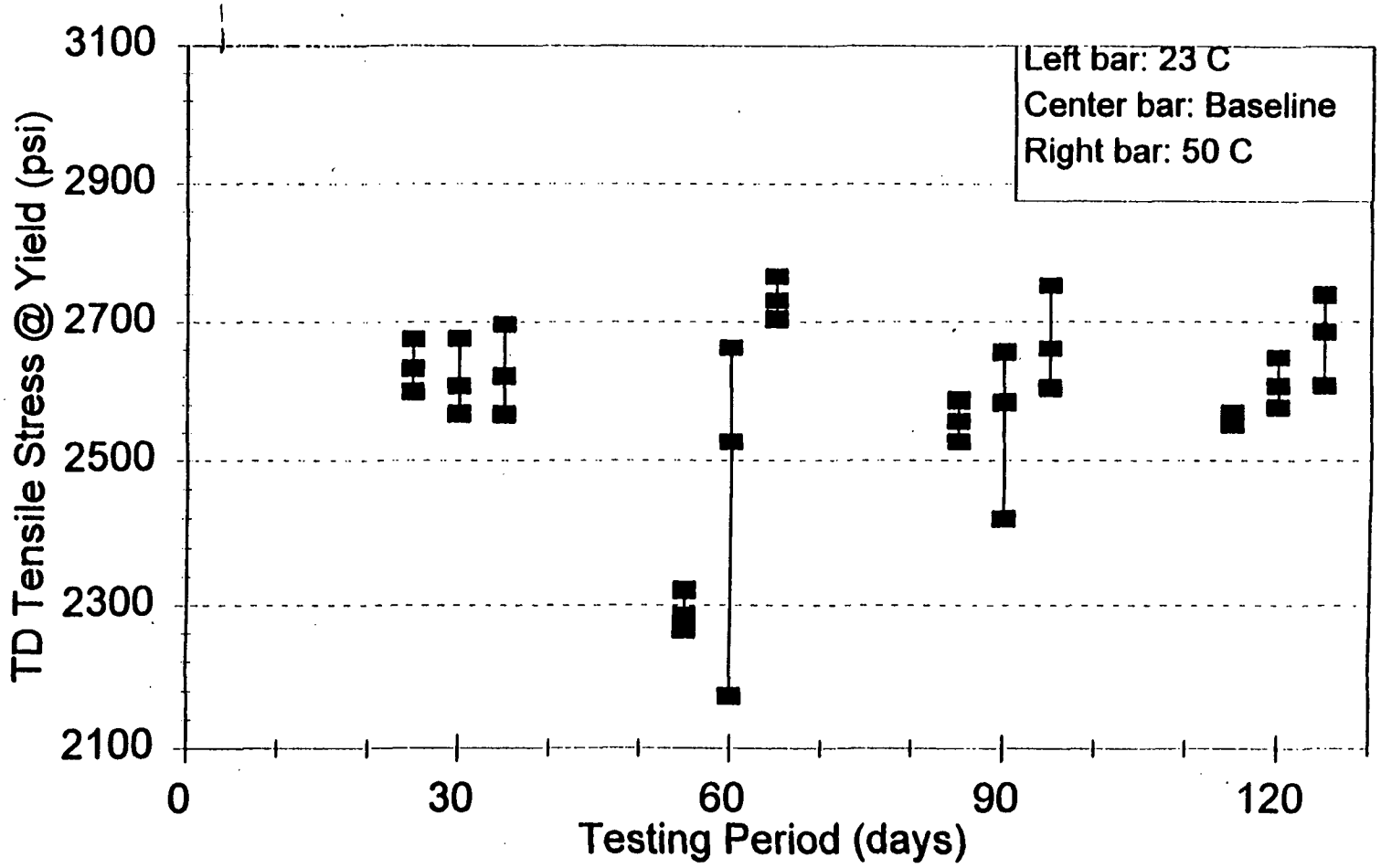
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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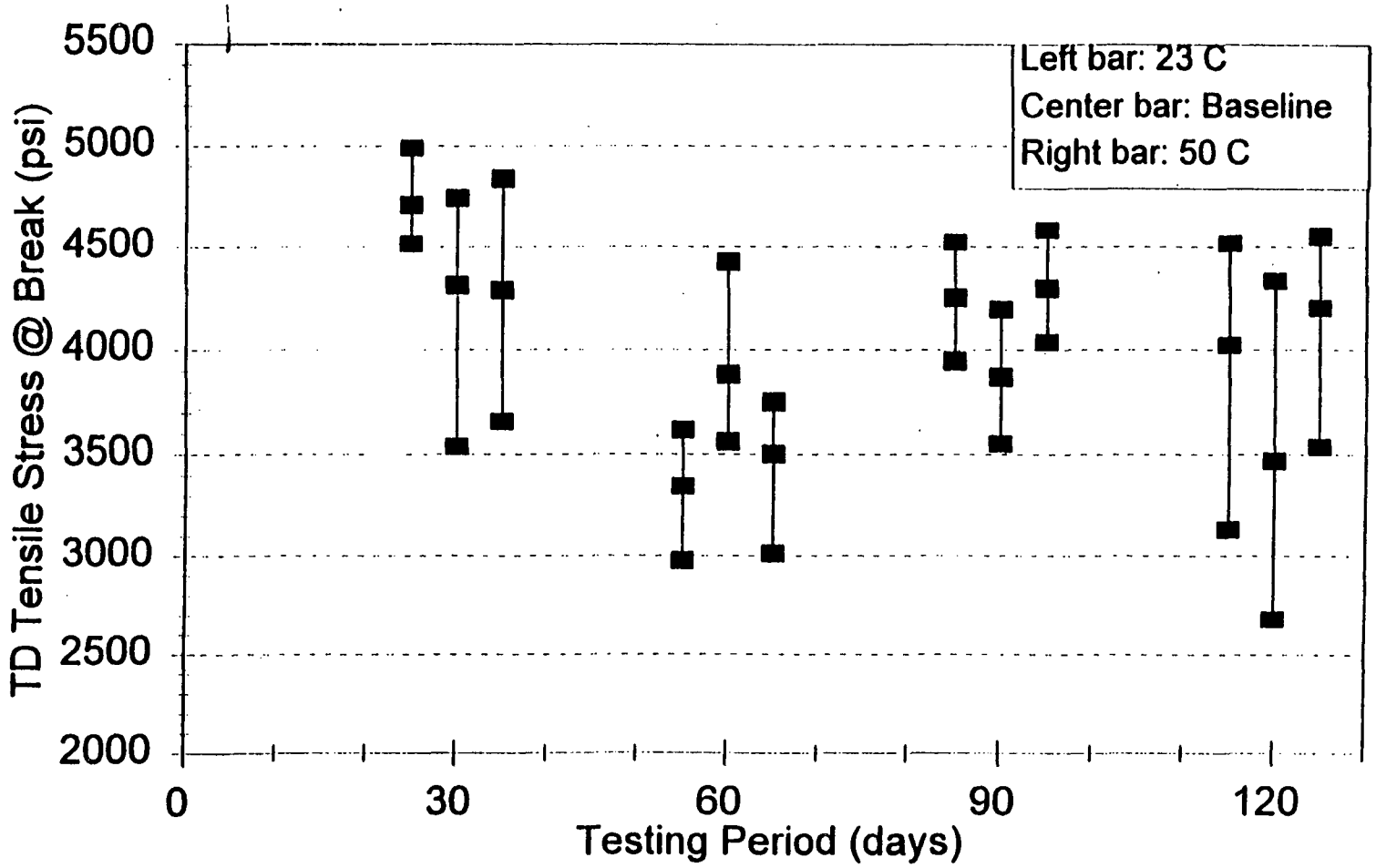
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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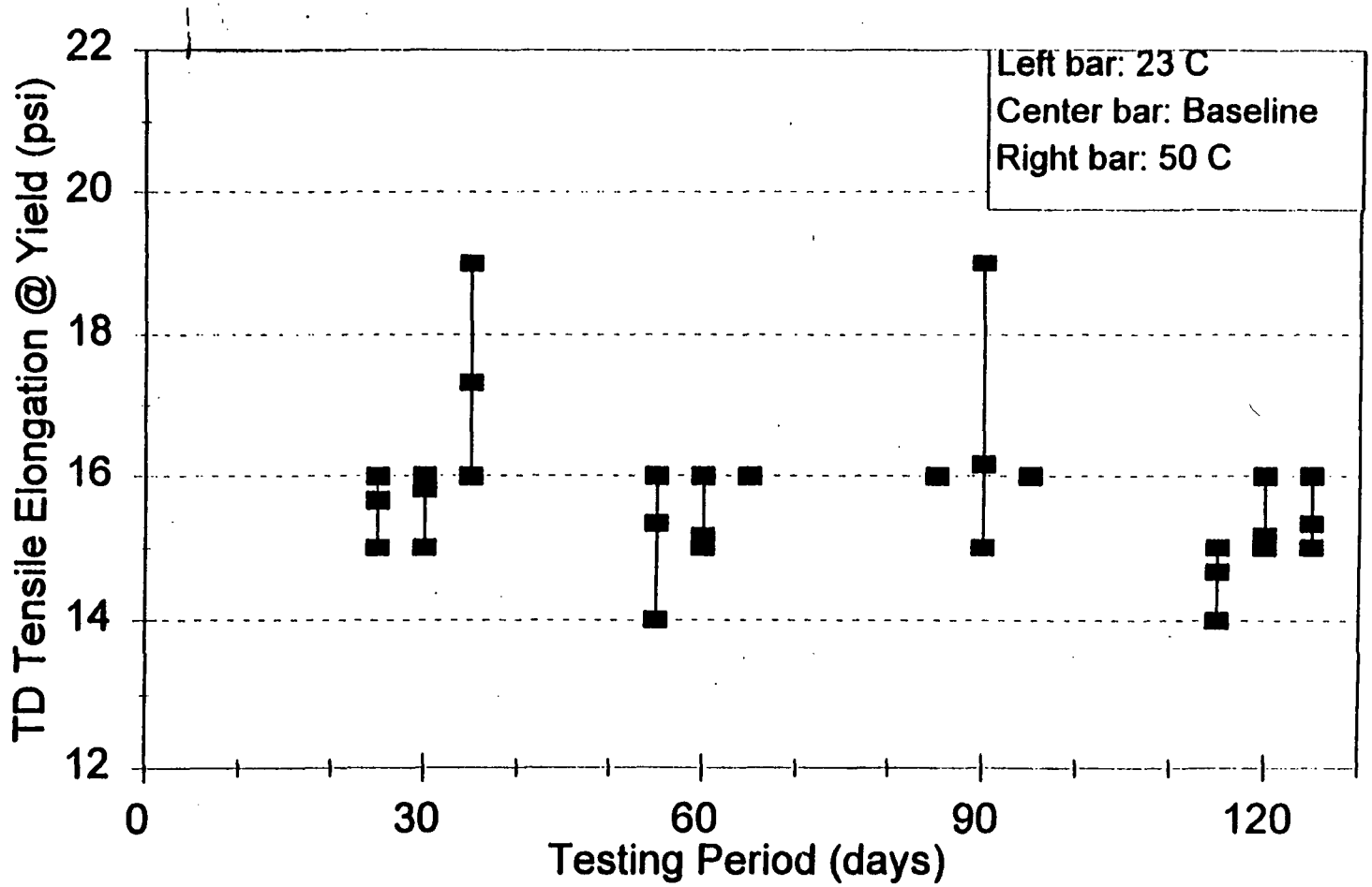
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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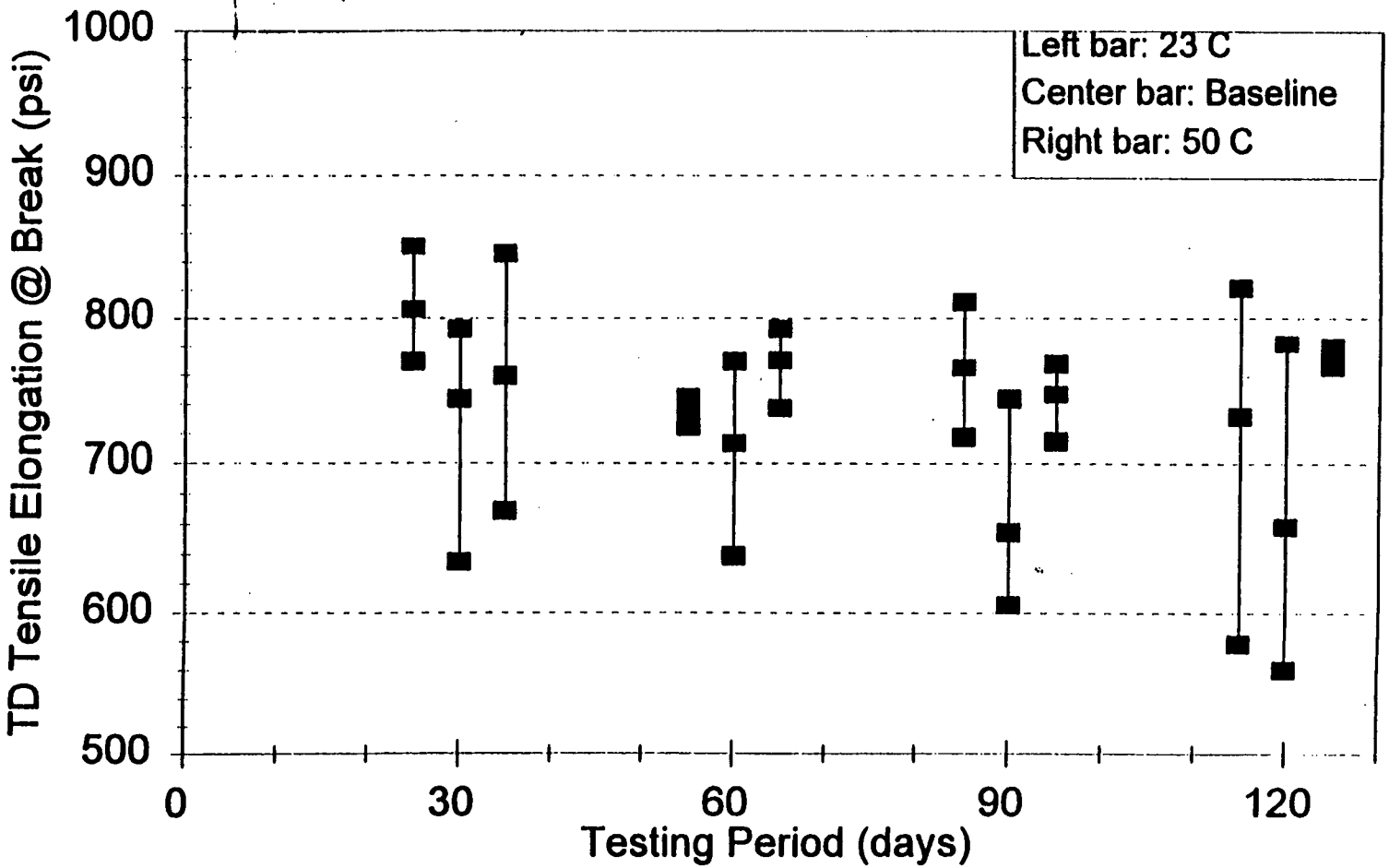
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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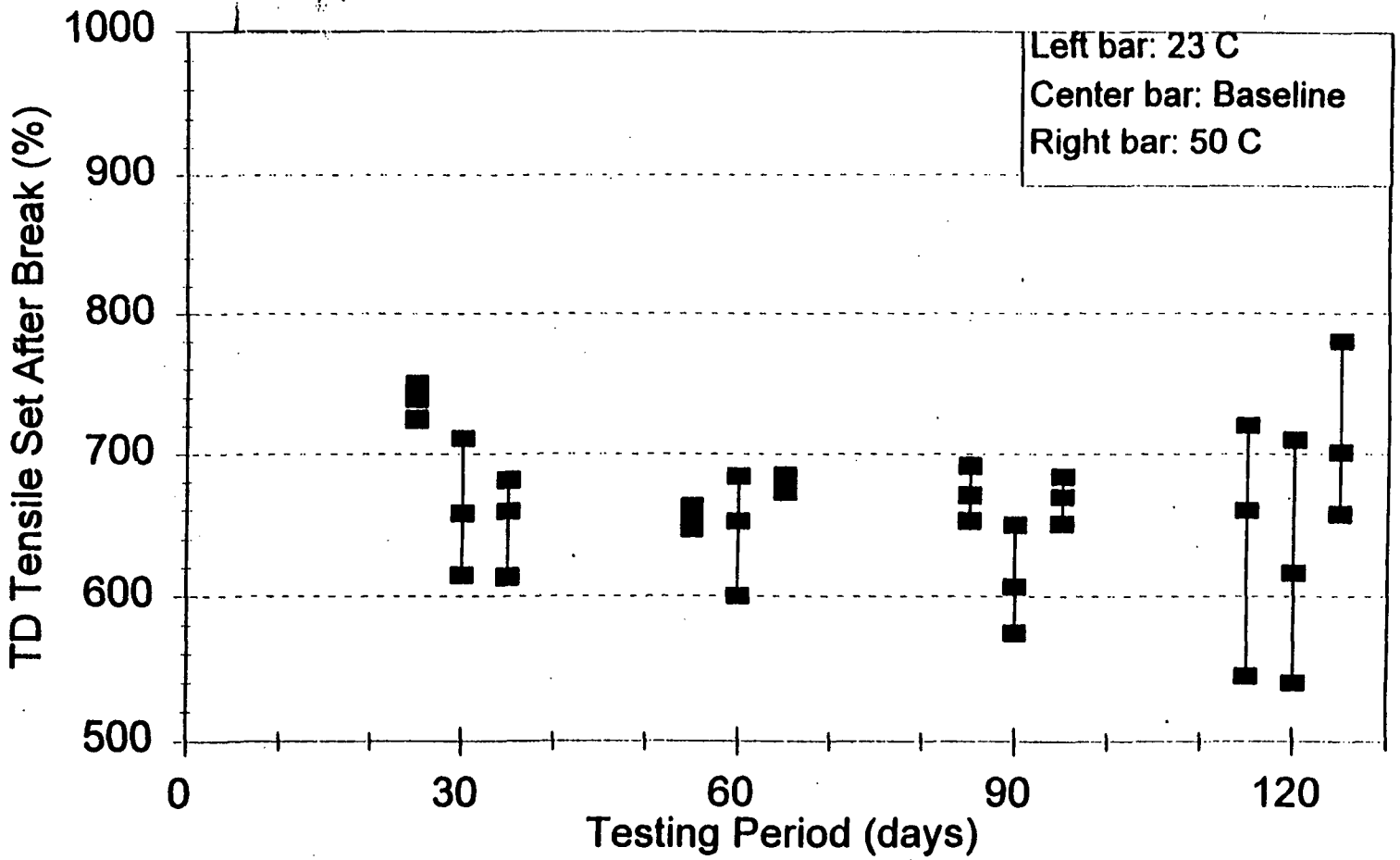
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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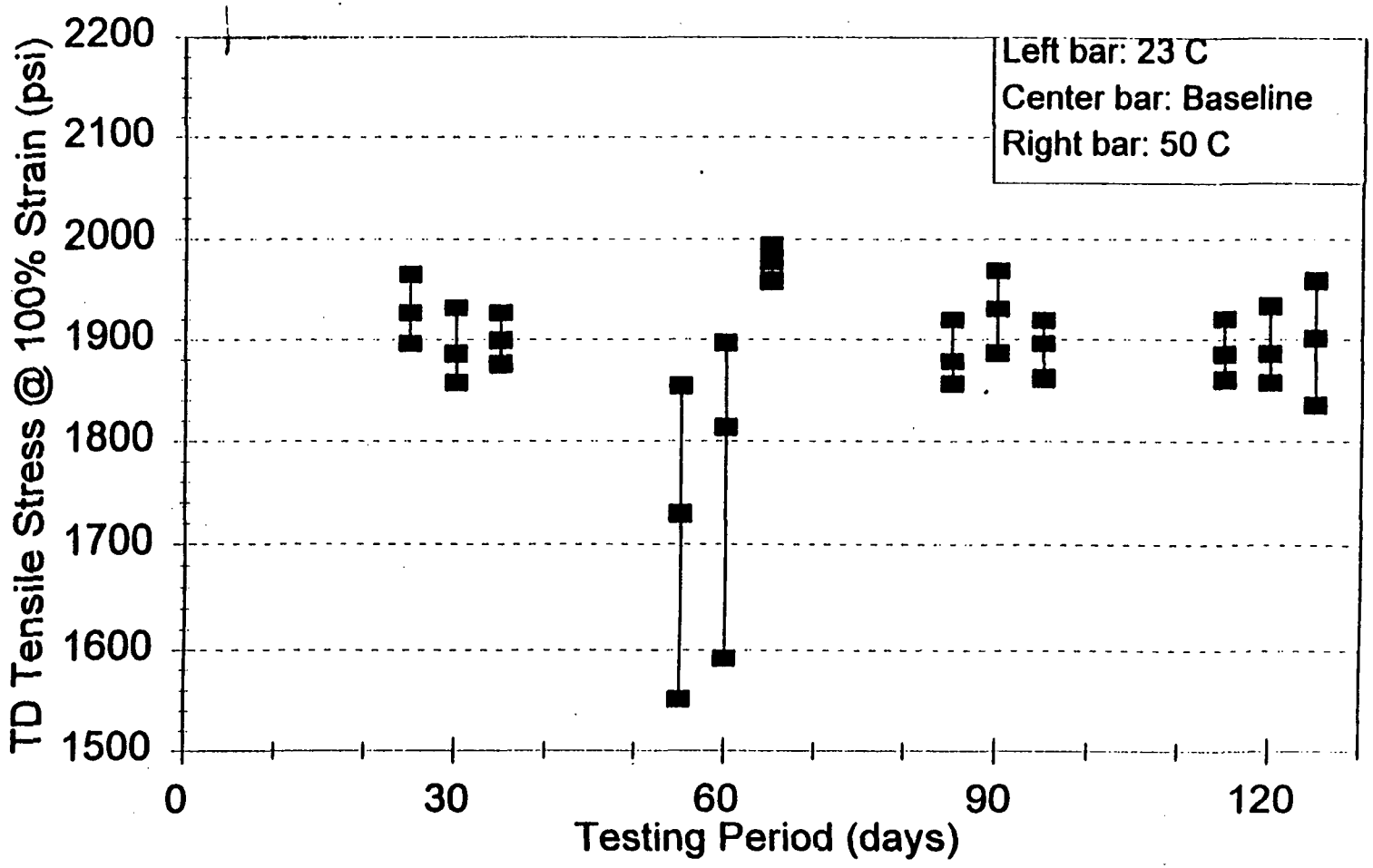
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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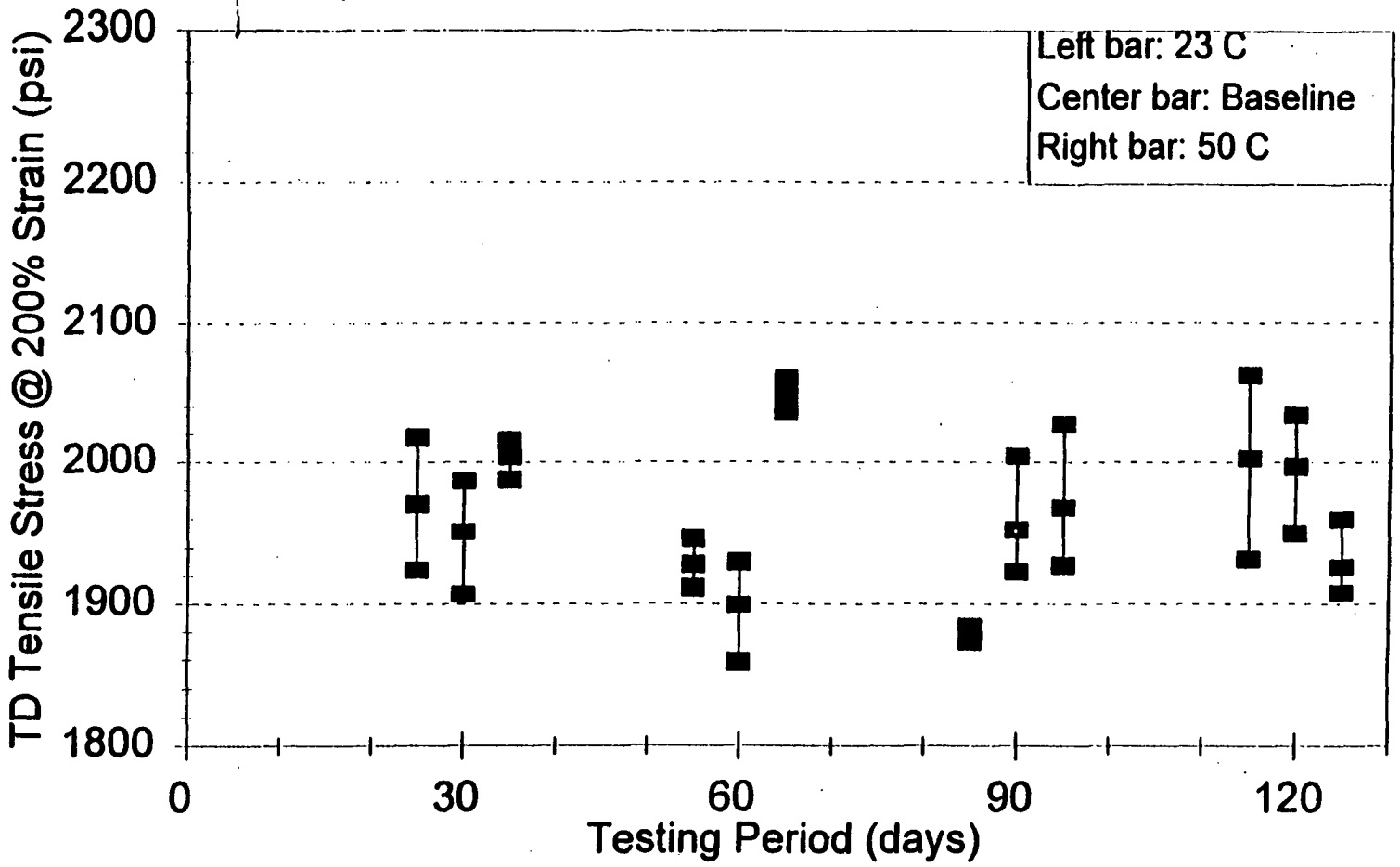
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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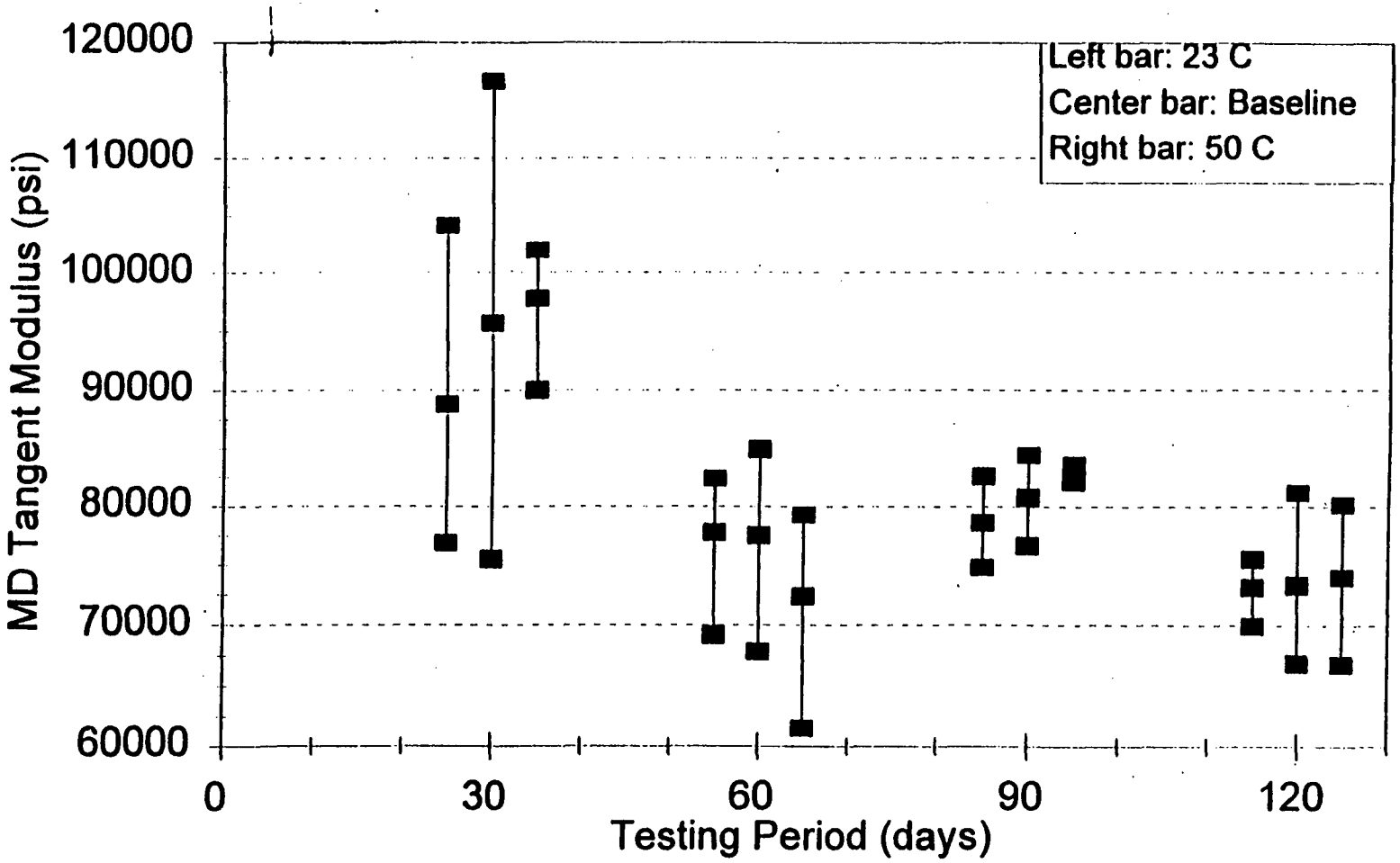
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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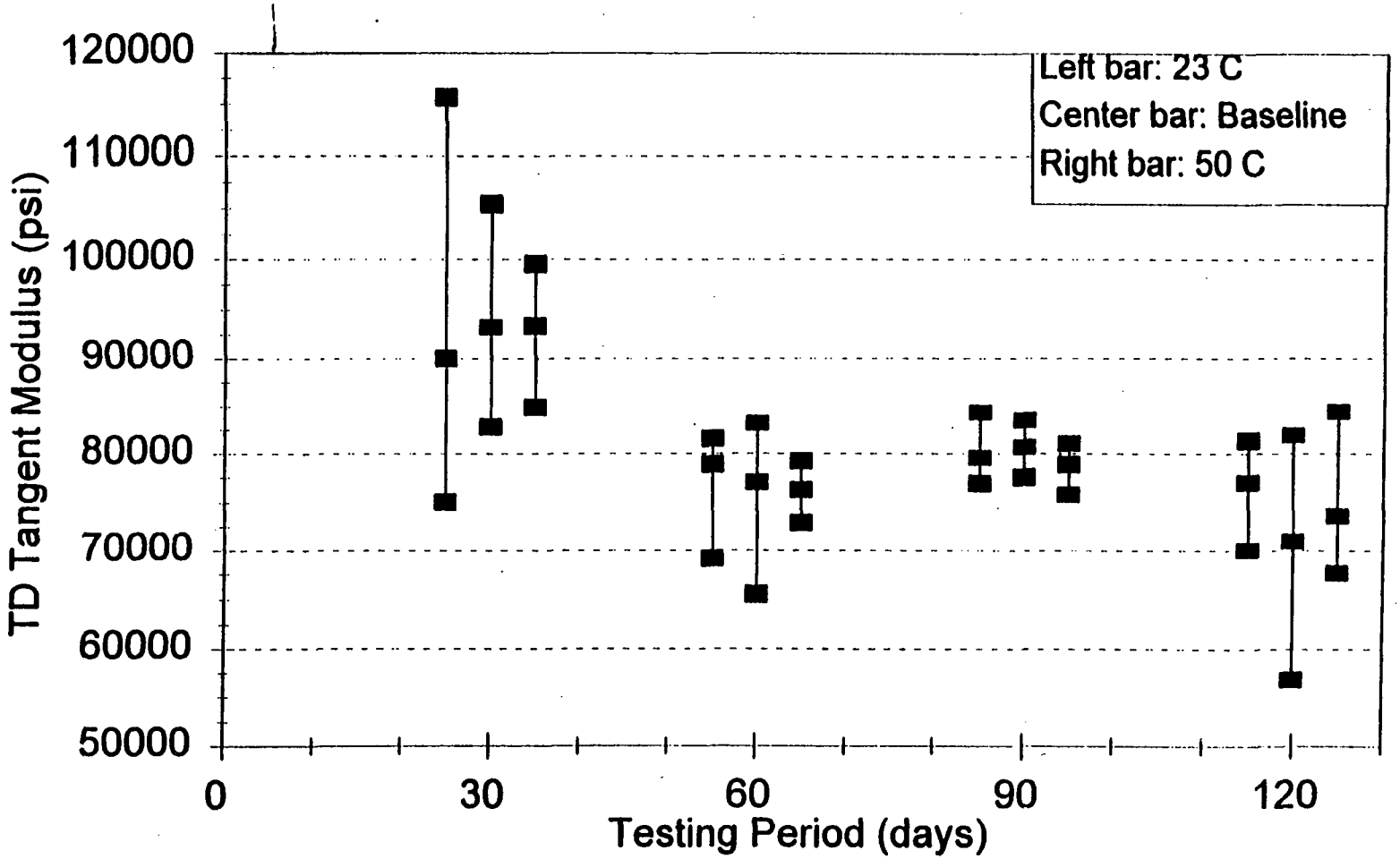
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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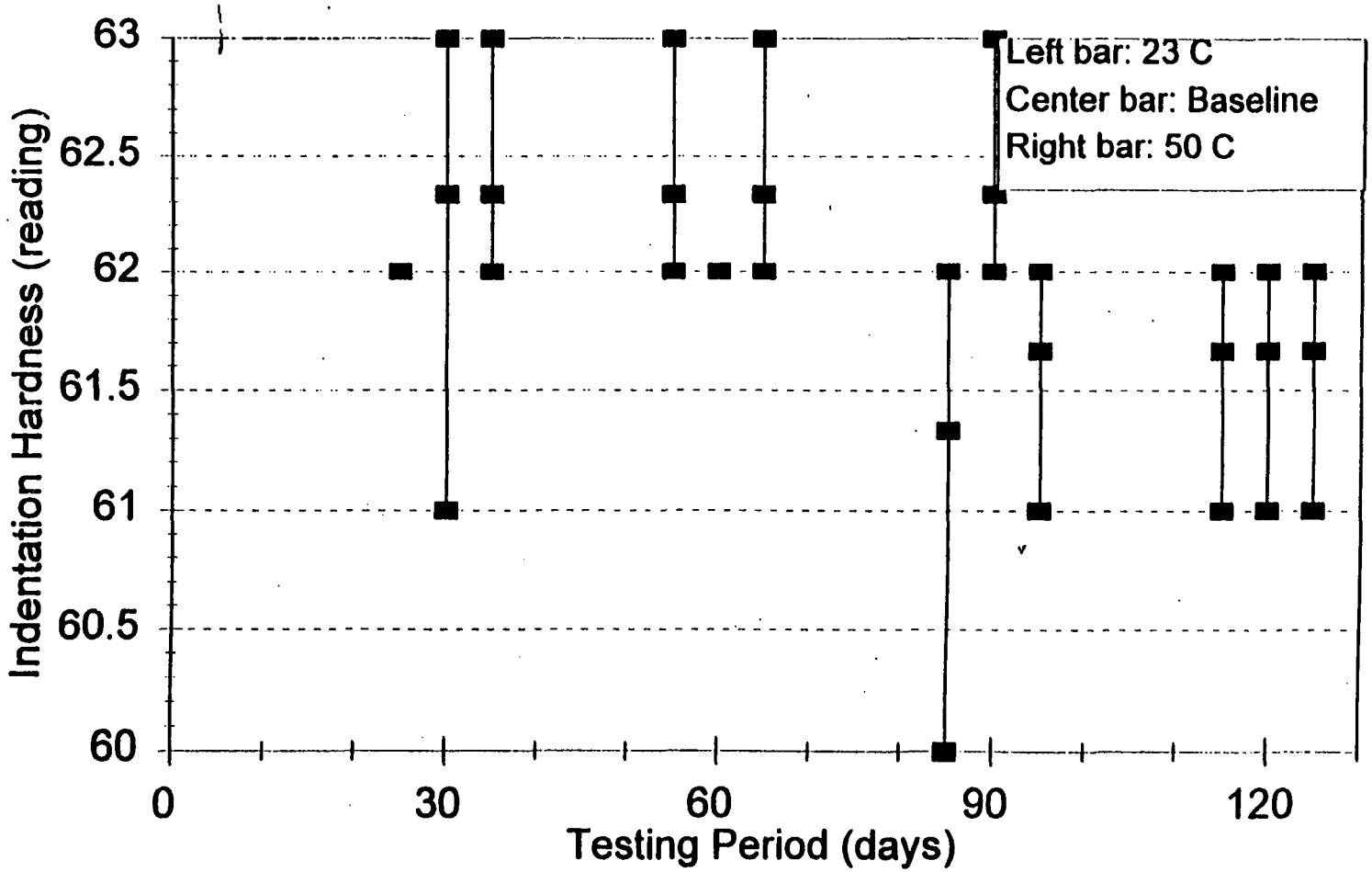
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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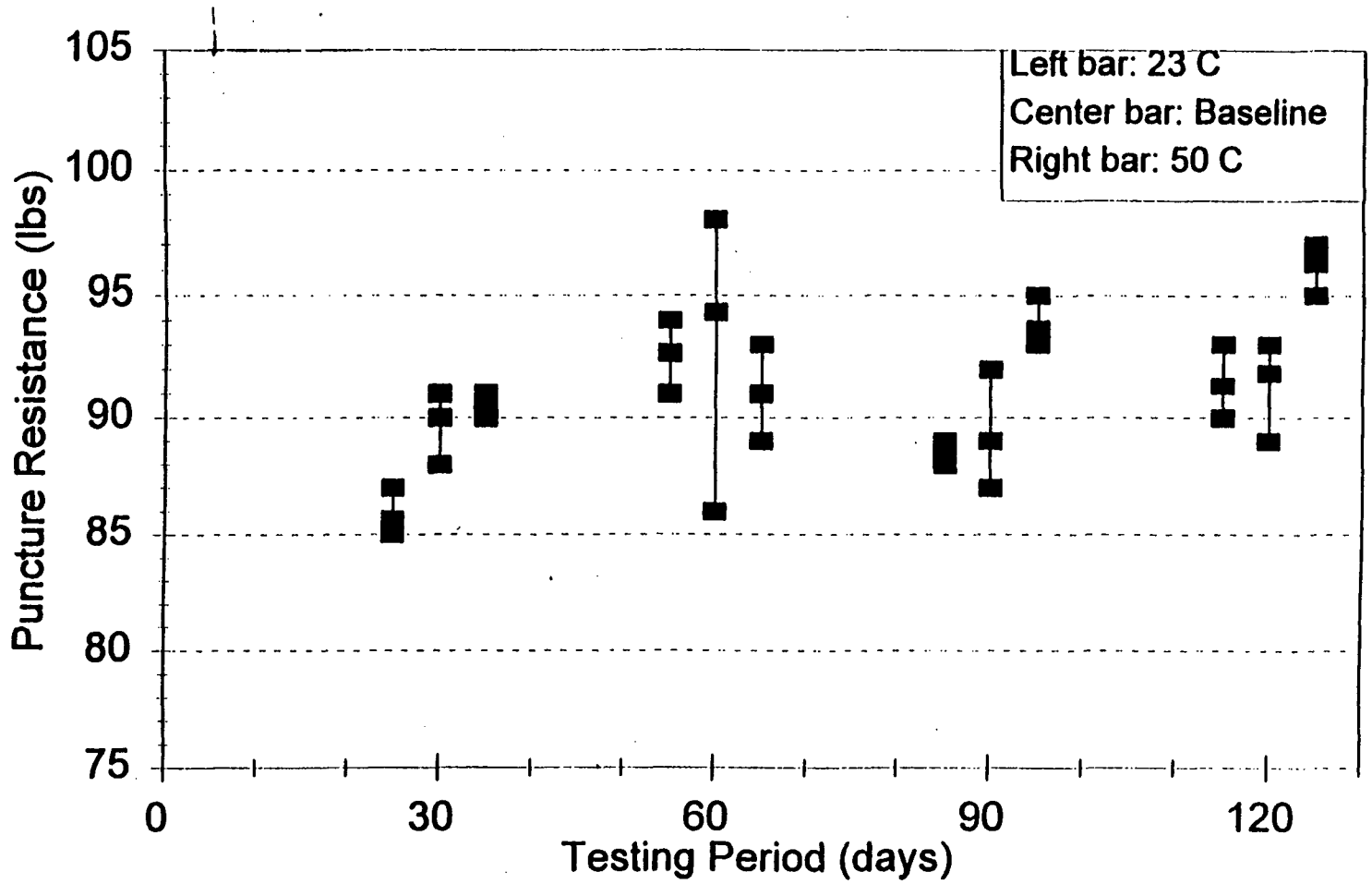
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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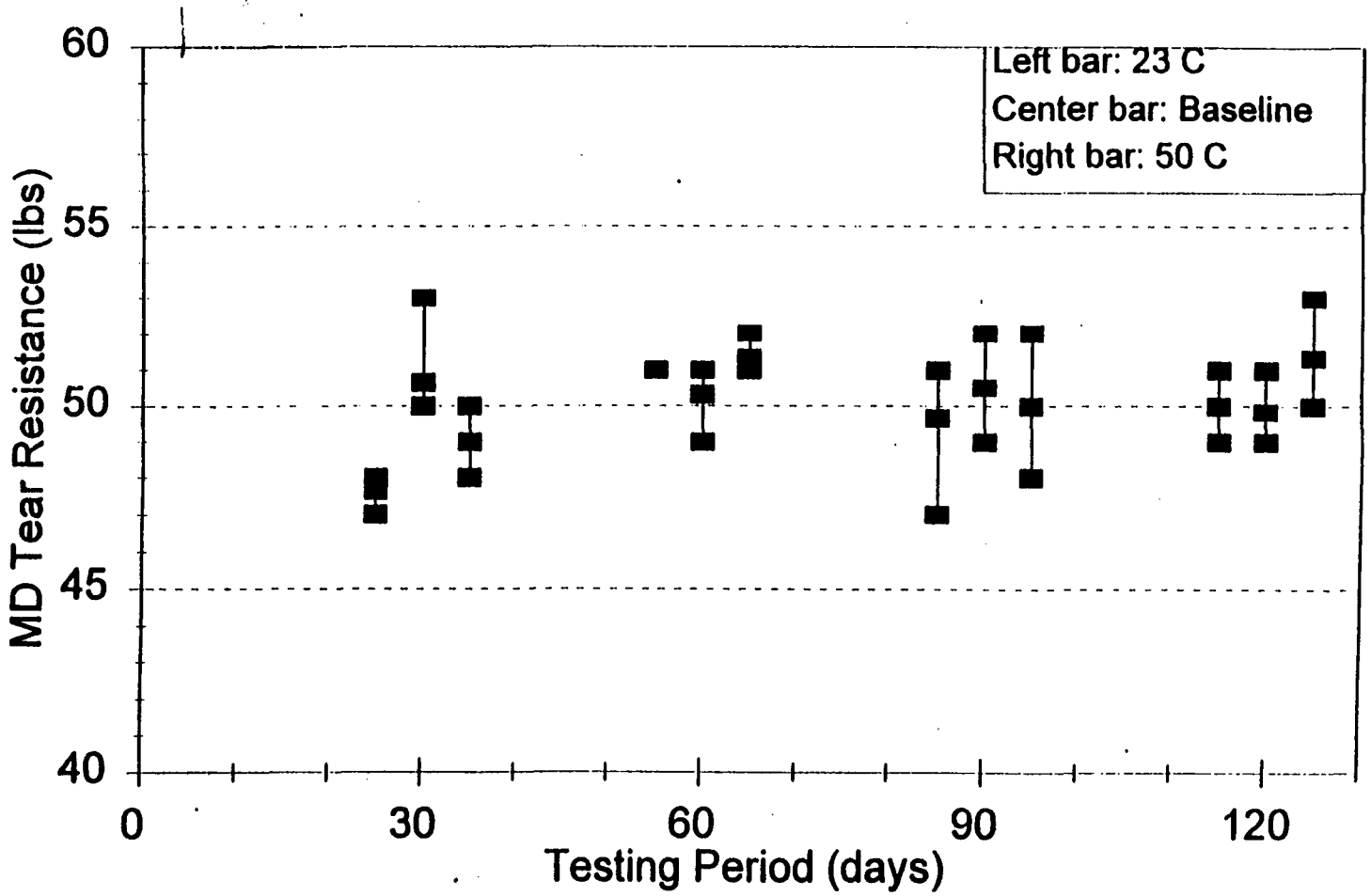
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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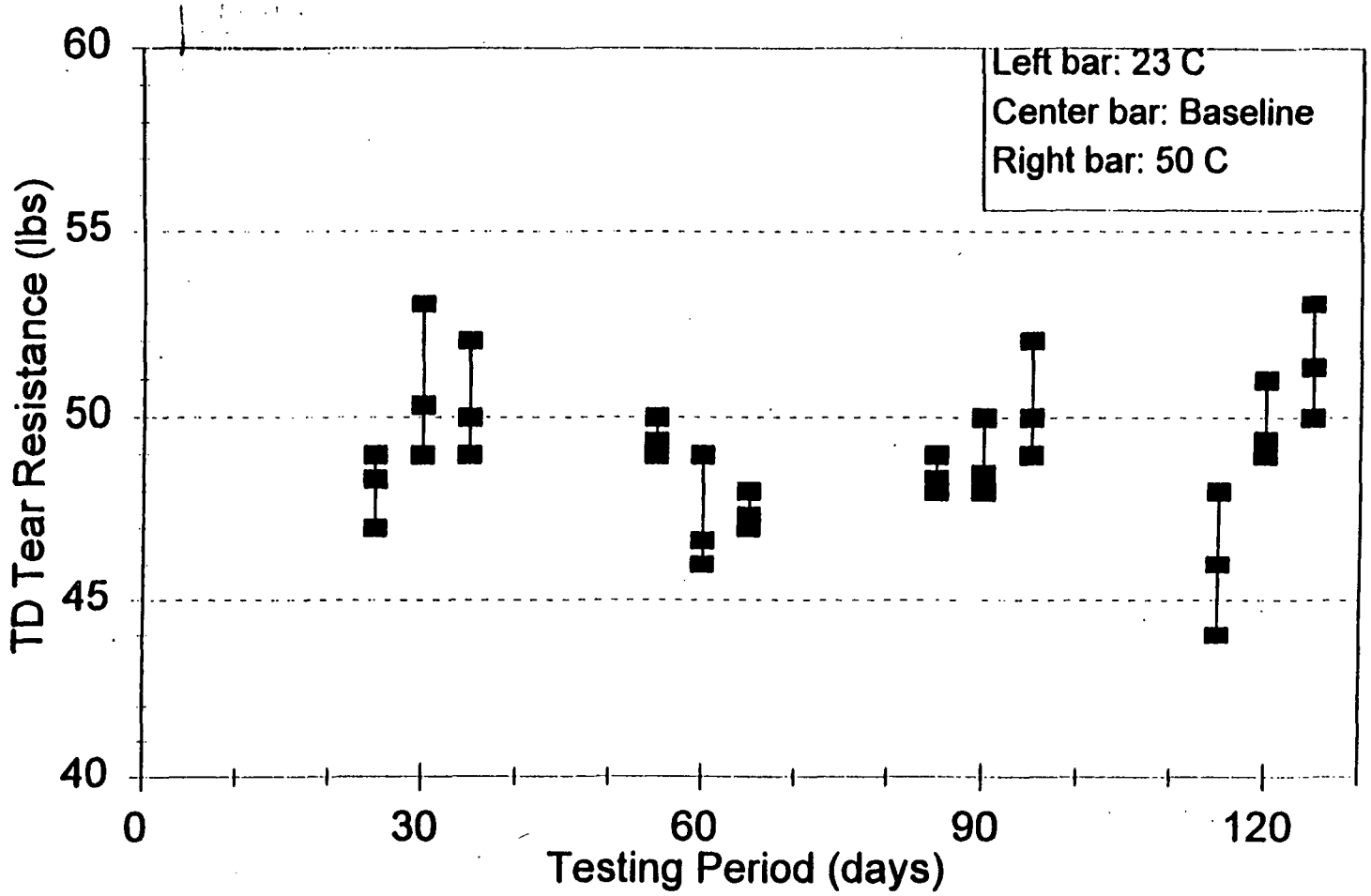
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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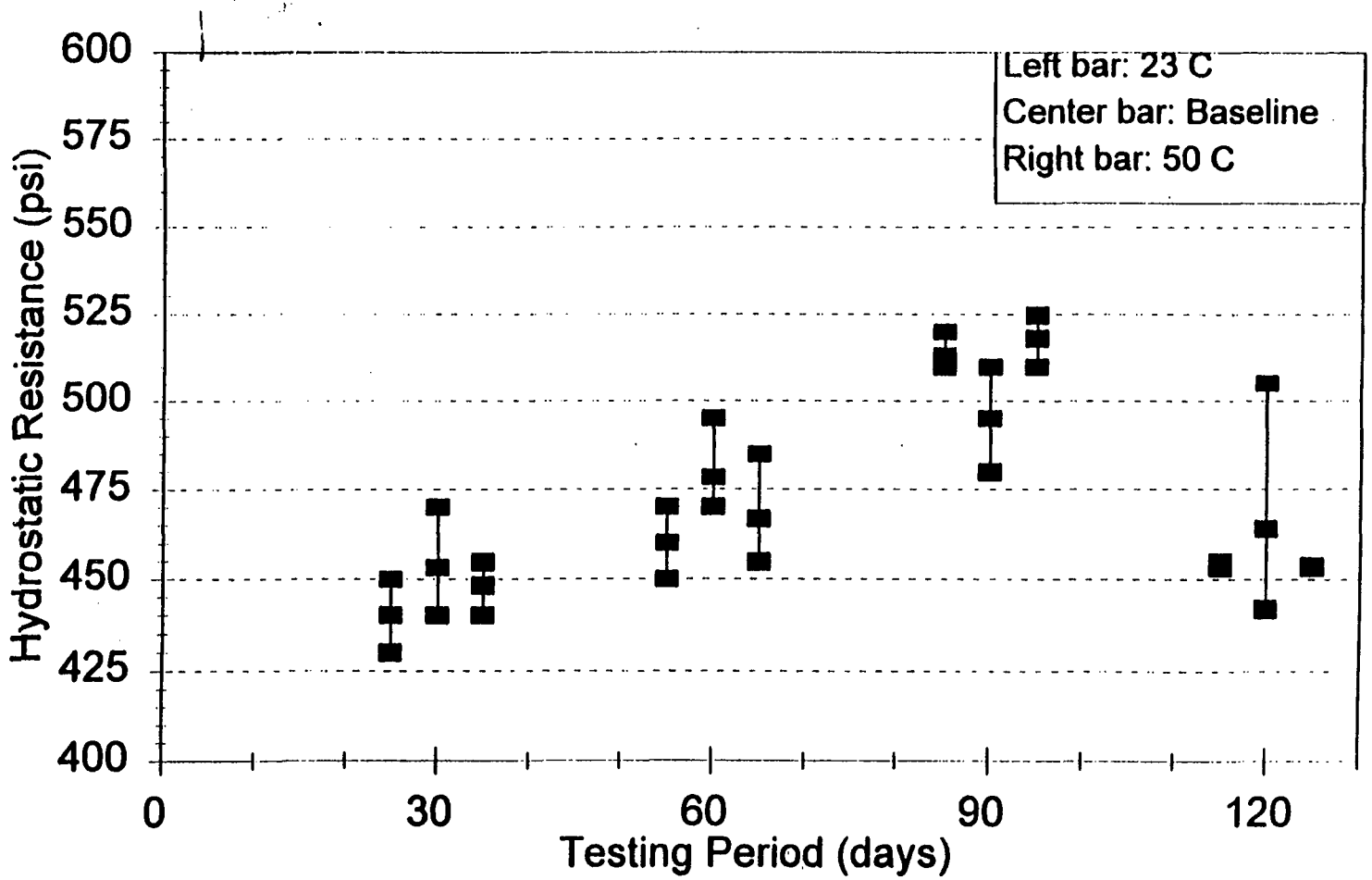
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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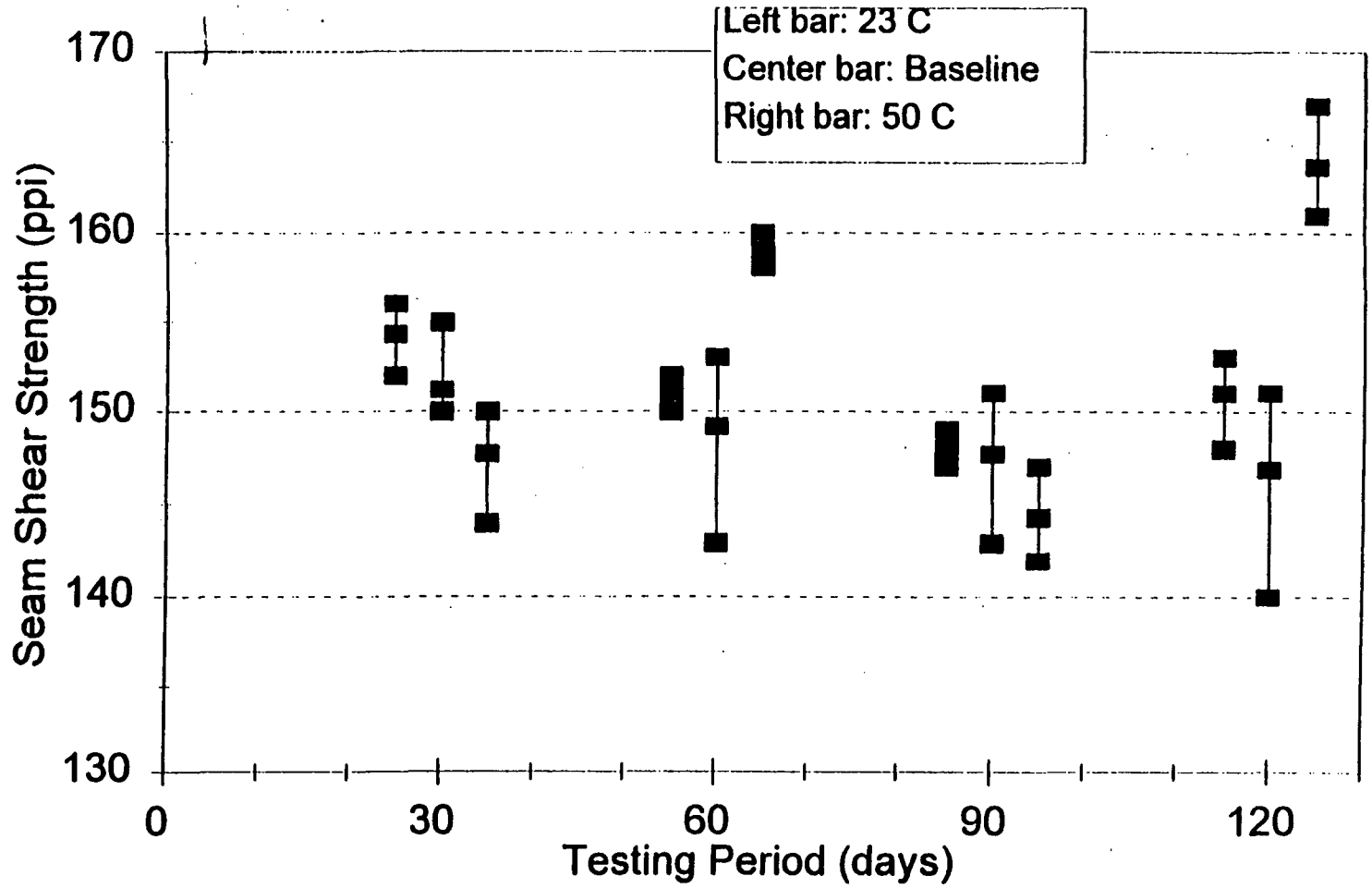
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



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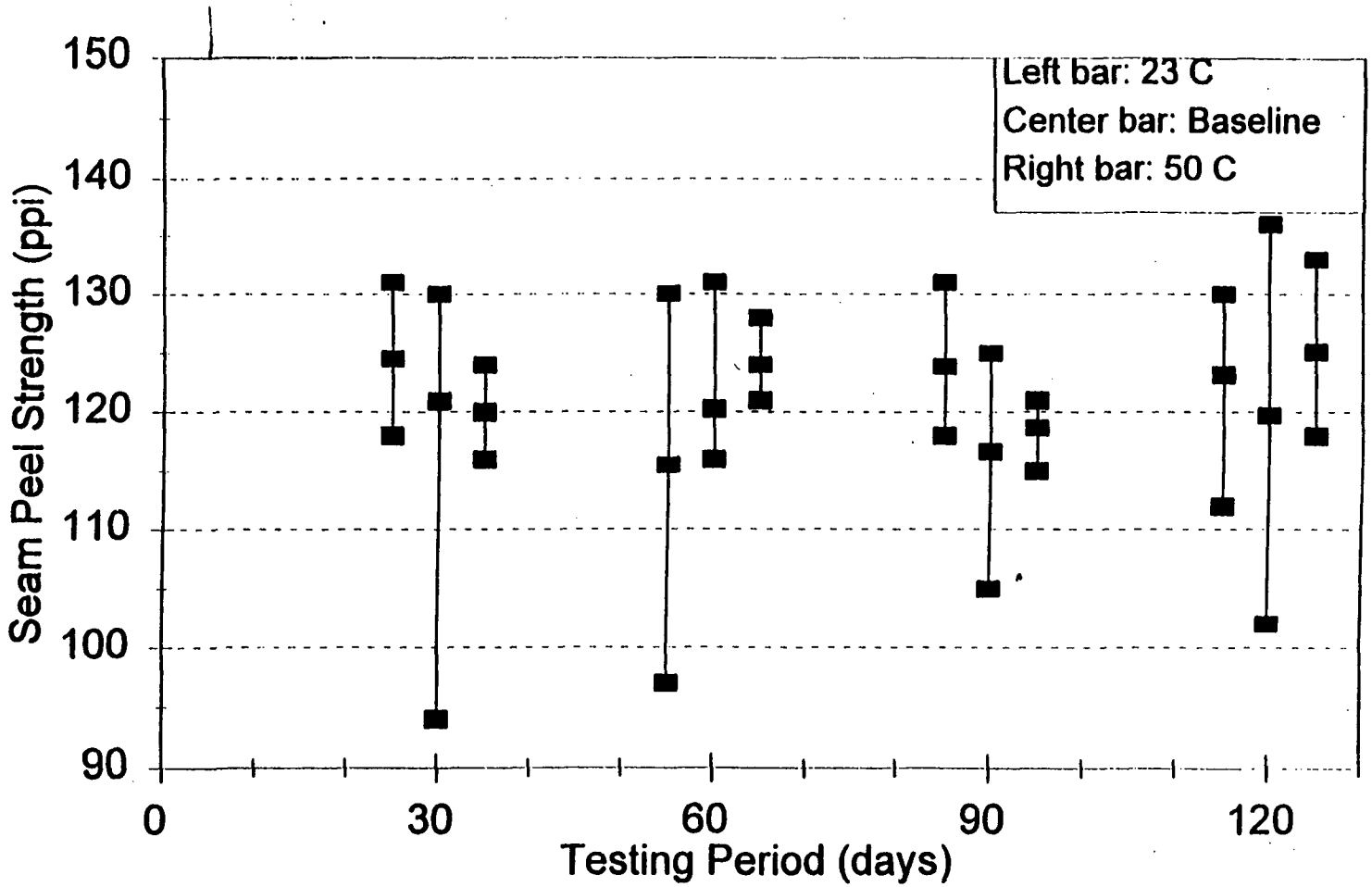
FMC CORPORATION EPA METHOD 9090

60 mil HDPE GM vs Phos Dock Effluent



Client: FMC Corporation, File: 942-fmc HDPE GM.wb1

EPA METHOD 9090 TEST RESULTS

FMC CORPORATION - POCATELLO

30 mil PVC GEOMEMBRANE

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 30 mil PVC												
Tensile Properties:	3296	3234	3235	3116	3117	3062	3083	2965	2977	3086	2911	2756
Tensile Stress @ Break (psi)	3373	3054	3119	3165	2987	3200	3149	2893	2784	3050	2819	2718
ASTM D882	3388	3218	3219	3207	3392	2991	2991	3279	2963	2998	1963	2800
Machine Direction	3433			3252			2905			3079		
	3266			3266			3072			2749		
	3251			3314			2881			2816		
Average	3335	3169	3191	3220	3165	3084	3014	3046	2908	2963	2564	2758
STD	67	81	51	66	169	87	97	168	88	132	427	34
Coefficient of Variation	2	3	2	2	5	3	3	6	3	4	17	1
Range as % of Baseline	5			6			9			11		
% Change		-5	-4		-2	-4		1	-4		-13	-7
Tensile Properties:	449	458	474	521	492	484	490	467	436	497	470	463
Tensile Elongation @ Break (%)	460	393	484	469	477	512	499	476	415	540	436	506
ASTM D882	470	447	482	532	546	467	512	504	462	498	483	431
Machine Direction	465			564			485			540		
	444			514			500			475		
	433			532			454			449		
Average	454	433	480	522	505	488	490	482	438	500	463	467
STD	13	28	4	28	30	19	18	16	19	33	20	31
Coefficient of Variation	3	7	1	5	6	4	4	3	4	7	4	7
Range as % of Baseline	8			18			12			18		
% Change		-5	6		-3	-7		-2	-11		-7	-7
Tensile Properties:	1636	1627	1749	1488	1509	1645	1483	1424	1612	1377	1459	1575
Tensile Stress @ 100% Elongation (psi)	1658	1652	1592	1551	1474	1612	1495	1364	1547	1397	1440	1545
ASTM D882	1647	1639	1673	1470	1530	1596	1403	1482	1538	1413	1404	1546
Machine Direction	1664			1434			1389			1385		
	1625			1528			1440			1353		
	1688			1492			1440			1435		
Average	1653	1639	1671	1494	1504	1618	1442	1423	1566	1393	1434	1555
STD	20	10	64	38	23	20	38	48	33	26	23	14
Coefficient of Variation	1	1	4	3	2	1	3	3	2	2	2	1
Range as % of Baseline	4			8			7			6		
% Change		-1	1		1	8		-1	9		3	12
Tensile Properties:	2162	2150	2195	1965	1992	2072	1979	1923	2052	1855	1921	1961
Tensile Stress @ 200% Elongation (psi)	2196	2179	2032	2063	1949	2056	1991	1839	1963	1857	1908	1940
ASTM D882	2193	2169	2125	1948	2024	2021	1876	2003	1965	1880	1876	1945
Machine Direction	2214			1908			1857			1846		
	2166			2034			1932			1791		
	2228			1991			1921			1896		
Average	2193	2166	2117	1985	1988	2050	1928	1922	2000	1854	1902	1949
STD	24	12	67	52	31	21	49	67	37	33	19	9
Coefficient of Variation	1	1	3	3	2	1	3	3	2	2	1	0
Range as % of Baseline	3			8			7			6		
% Change		-1	-3		0	3		-0	4		3	5

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TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
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Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 30 mil PVC												
Tensile Properties:	2964	2820	3013	2659	3006	2773	2859	2713	2887	2740	2756	2856
Tensile Stress @ Break (psi)	3048	2888	2858	2690	2913	2710	2798	2802	2806	2735	2728	2839
ASTM D882	3023	2920	3167	2655	2675	2671	2833	2853	2901	2814	2800	2769
Transverse Direction	2921			2684			2850			2796		
	2777			2791			2805			2826		
	3013			2755			2819			2726		
Average	2958	2876	3013	2702	2865	2718	2827	2789	2865	2773	2761	2821
STD	91	42	126	52	139	42	22	58	42	40	30	38
Coefficient of Variation	3	1	4	2	5	2	1	2	1	1	1	1
Range as % of Baseline	9			5			2			4		
% Change		-3	2		6	1		-1	1		-0	2
Tensile Properties:	439	472	482	475	514	497	512	480	492	515	501	503
Tensile Elongation @ Break (%)	469	438	445	469	501	482	484	465	464	478	488	491
ASTM D882	492	484	519	455	462	445	531	477	484	521	512	462
Transverse Direction	500			475			490			505		
	469			492			497			515		
	494			455			517			505		
Average	477	465	482	470	492	475	505	474	480	507	500	485
STD	21	19	30	13	22	22	16	6	12	14	10	17
Coefficient of Variation	4	4	6	3	4	5	3	1	2	3	2	4
Range as % of Baseline	13			8			9			8		
% Change		-3	1		5	1		-6	-5		-1	-4
Tensile Properties:	1540	1422	1569	1338	1467	1389	1349	1289	1467	1318	1345	1476
Tensile Stress @ 100% Elongation (psi)	1536	1490	1527	1301	1426	1439	1383	1342	1474	1359	1337	1513
ASTM D882	1495	1410	1601	1335	1345	1411	1280	1352	1466	1333	1331	1531
Transverse Direction	1419			1332			1327			1325		
	1403			1368			1289			1327		
	1469			1372			1279			1281		
Average	1477	1441	1566	1341	1413	1413	1318	1328	1469	1324	1338	1507
STD	53	35	30	24	51	20	39	28	4	23	6	23
Coefficient of Variation	4	2	2	2	4	1	3	2	0	2	0	2
Range as % of Baseline	9			5			8			6		
% Change		-2	6		5	5		1	11		1	14
Tensile Properties:	2022	1867	1961	1769	1911	1779	1799	1729	1849	1735	1754	1851
Tensile Stress @ 200% Elongation (psi)	2013	1976	1942	1739	1871	1811	1826	1803	1864	1780	1747	1873
ASTM D882	1968	1879	2023	1770	1776	1810	1719	1815	1859	1748	1754	1904
Transverse Direction	1870			1753			1792			1751		
	1844			1793			1739			1761		
	1932			1821			1722			1711		
Average	1942	1907	1982	1774	1853	1800	1766	1782	1857	1748	1752	1876
STD	67	49	33	27	57	15	41	38	6	21	3	22
Coefficient of Variation	3	3	2	2	3	1	2	2	0	1	0	1
Range as % of Baseline	9			5			6			4		
% Change		-2	2		4	1		1	5		0	7

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TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	Baseline	60 Day 23C	60 Day 50C	Baseline	90 Day 23C	90 Day 50C	Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 30 mil PVC												
Tear Resistance:	11	13	12	11	11	13	11	11	11	11	11	11
Tear Resistance (lbs)	11	13	13	12	11	13	11	11	11	11	13	13
ASTM D1004	11	12	11	11	13	13	12	11	10	12	12	12
Machine Direction	11			12			11			12		
	12			11			10			11		
	11			11			12			13		
Average	11	13	12	11	12	13	11	11	11	12	12	12
STD	0	0	1	0	1	0	1	0	0	1	1	1
Coefficient of Variation	3	4	7	4	8	0	6	0	4	6	7	7
Range as % of Baseline	9			9			18			17		
% Change		13	7		3	15		-1	-4		3	3
Tear Resistance:	10	11	11	11	11	12	10	10	10	10	9	11
Tear Resistance (lbs)	11	10	11	11	10	12	10	10	10	10	11	11
ASTM D1004	11	11	11	11	11	12	11	10	11	11	12	12
Transverse Direction	10			10			11			11		
	11			10			10			10		
	11			10			10			11		
Average	11	11	11	11	11	12	10	10	10	11	11	11
STD	0	0	0	1	0	0	0	0	0	1	1	0
Coefficient of Variation	4	4	0	5	4	0	5	0	5	5	12	4
Range as % of Baseline	9			10			10			10		
% Change		0	3		2	14		-3	0		2	8
Puncture Resistance:	65	64	56	67	63	60	68	67	68	54	59	62
Load @ Rupture (lbs)	62	57	57	65	63	59	68	71	67	57	62	61
FTMS 101C Method 2065	61	54	56	63	62	59	61	64	71	60	60	65
	65			64			70			58		
	68			66			65			49		
	65			61			70			57		
Average	64	58	56	64	63	59	67	67	69	56	60	63
STD	2	4	0	2	0	0	3	3	2	4	1	2
Coefficient of Variation	4	7	1	3	1	1	5	4	2	6	2	3
Range as % of Baseline	11			9			13			20		
% Change		-9	-12		-3	-8		0	2		8	12
Hydrostatic Resistance:	110	110	110	95	100	105	110	110	115	110	100	110
Load @ Rupture (psi)	110	110	110	95	100	100	110	110	120	100	90	105
ASTM D751	110	105	115	90	105	100	105	115	115	90	110	120
	110			95			110			110		
	110			100			115			100		
	110			100			110			100		
Average	110	108	112	96	102	102	110	112	117	102	100	112
STD	0	2	2	3	2	2	3	2	2	7	8	6
Coefficient of Variation	0	2	2	4	2	2	3	2	2	7	8	6
Range as % of Baseline	0			10			9			20		
% Change		-2	2		6	6		2	6		-2	10

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Quality Review/Date

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 30 mil PVC												
Indentation Hardness:	94	95	97	92	96	97	98	97	99	98	97	98
Reading	94	96	96	96	95	97	94	97	99	98	97	98
ASTM D2240	96	97	95	98	97	97	97	95	97	98	97	97
(with SHORE A DUROMETER)	96			95			97			99		
	96			96			96			98		
	95			97			95			99		
Average	95	96	96	96	96	97	96	96	98	98	97	98
STD	1	1	1	2	1	0	1	1	1	0	0	0
Coefficient of Variation	1	1	1	2	1	0	1	1	1	0	0	0
Range as % of Baseline	2			6			4			1		
% Change		1	1		0	1		0	2		-1	-2
Specific Gravity:	1.25	1.24	1.25	1.24	1.23	1.24	1.23	1.24	1.27	1.23	1.25	1.25
Specific Gravity (grams/cu.cm)	1.25	1.25	1.25	1.28	1.25	1.25	1.24	1.25	1.25	1.25	1.25	1.25
ASTM D792, Method A	1.25	1.24	1.25	1.25	1.27	1.25	1.24	1.24	1.24	1.25	1.24	1.24
Machine Direction	1.25			1.26			1.24			1.25		
	1.25			1.25			1.23			1.24		
	1.25			1.26			1.24			1.25		
Average	1.25	1.24	1.25	1.26	1.25	1.25	1.24	1.24	1.25	1.25	1.25	1.25
STD	0.00	0.01	0.00	0.01	0.02	0.00	0.00	0.00	0.01	0.01	0.00	0.00
Coefficient of Variation	0.00	0.46	0.00	0.99	1.31	0.38	0.38	0.38	1.00	0.61	0.38	0.38
Range as % of Baseline	0			3			1			2		
% Change		-0.53	0.00		-0.53	-0.80		0.54	1.35		0	0
Volatiles and Extractables:	-0.58	-0.25	-0.37	-0.26	-0.32	-0.15	-0.45	-0.24	-0.39	-0.34	-0.22	-0.31
Diameter Change (%)	-0.15	-0.25	-0.61	-0.22	-0.38	-0.27	-0.28	-0.26	-0.28	-0.27	-0.25	-0.27
SW 870 - Appendix III-D	-0.67			-0.37			-0.19			-0.31		
Machine Direction	-0.38			-0.08			-0.31			-0.25		
Average	-0.45	-0.25	-0.49	-0.23	-0.35	-0.21	-0.31	-0.25	-0.34	-0.29	-0.24	-0.29
STD	0.20	0.00	0.12	0.10	0.03	0.06	0.09	0.01	0.06	0.03	0.02	0.02
Volatiles and Extractables:	-0.45	0.50	0.05	0.11	0.33	0.17	0.05	0.15	0.21	0.07	0.12	0.21
Diameter Change (%)	0.28	0.48	0.30	-0.03	0.41	0.22	0.09	0.16	0.29	0.05	0.11	0.26
SW 870 - Appendix III-D	0.18			0.28			0.16			0.11		
Transverse Direction	0.23			0.14			0.01			0.08		
Average	0.06	0.49	0.18	0.13	0.37	0.20	0.08	0.16	0.25	0.08	0.12	0.24
STD	0.30	0.01	0.12	0.11	0.04	0.02	0.06	0.01	0.04	0.02	0.00	0.03

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TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOMEMBRANE: 30 mil PVC												
Volatiles and Extractables:	0.47	0.20	0.15	0.42	0.18	0.24	0.37	0.20	0.26	0.37	0.21	0.25
% Volatiles	0.26	0.15	0.18	0.44	0.23	0.30	0.29	0.12	0.23	0.28	0.18	0.24
SW 870 - Appendix III-D	0.32			0.36			0.33			0.34		
	0.31			0.48			0.28			0.29		
Average	0.34	0.18	0.17	0.43	0.21	0.27	0.32	0.16	0.25	0.32	0.20	0.25
STD	0.08	0.03	0.02	0.04	0.03	0.03	0.04	0.04	0.02	0.04	0.02	0.01
Volatiles and Extractables:	42.81	42.90	43.71	37.69	36.26	36.89	41.22	40.07	42.03	42.33	41.24	42.31
% Extractables	42.87	42.79	43.03	36.71	36.92	37.04	37.55	39.65	40.46	39.41	31.56	41.25
SW 870 - Appendix III-D	42.72			33.41			34.98			43.29		
	42.51			35.84			39.62			44.21		
Average	42.73	42.85	43.37	35.91	36.59	36.97	38.34	39.86	41.25	42.31	36.40	41.78
STD	0.14	0.05	0.34	1.59	0.33	0.07	2.34	0.21	0.79	1.80	4.84	0.53
Seam Shear Strength:	68	72	70	67	72	73	63	70	71	64	64	71
Seam Shear Strength (ppi)	63	68	65	71	70	73	65	69	69	65	63	69
ASTM D4437	65	71	75	76	71	75	65	70	70	64	63	70
	68			73			64			68		
	62			73			64			64		
	65			75			64			65		
Average	65	70	70	73	71	74	64	70	70	65	63	70
STD	2	2	5	3	1	1	1	0	1	1	0	1
Coefficient of Variation	3	3	7	4	1	1	1	1	1	1	1	1
Change as % of Baseline	9			12			3			3		
% Change		8	8		-2	2		9	9		-2	8

Note: Peel adhesion testing could not be performed due to lack of seam overlap

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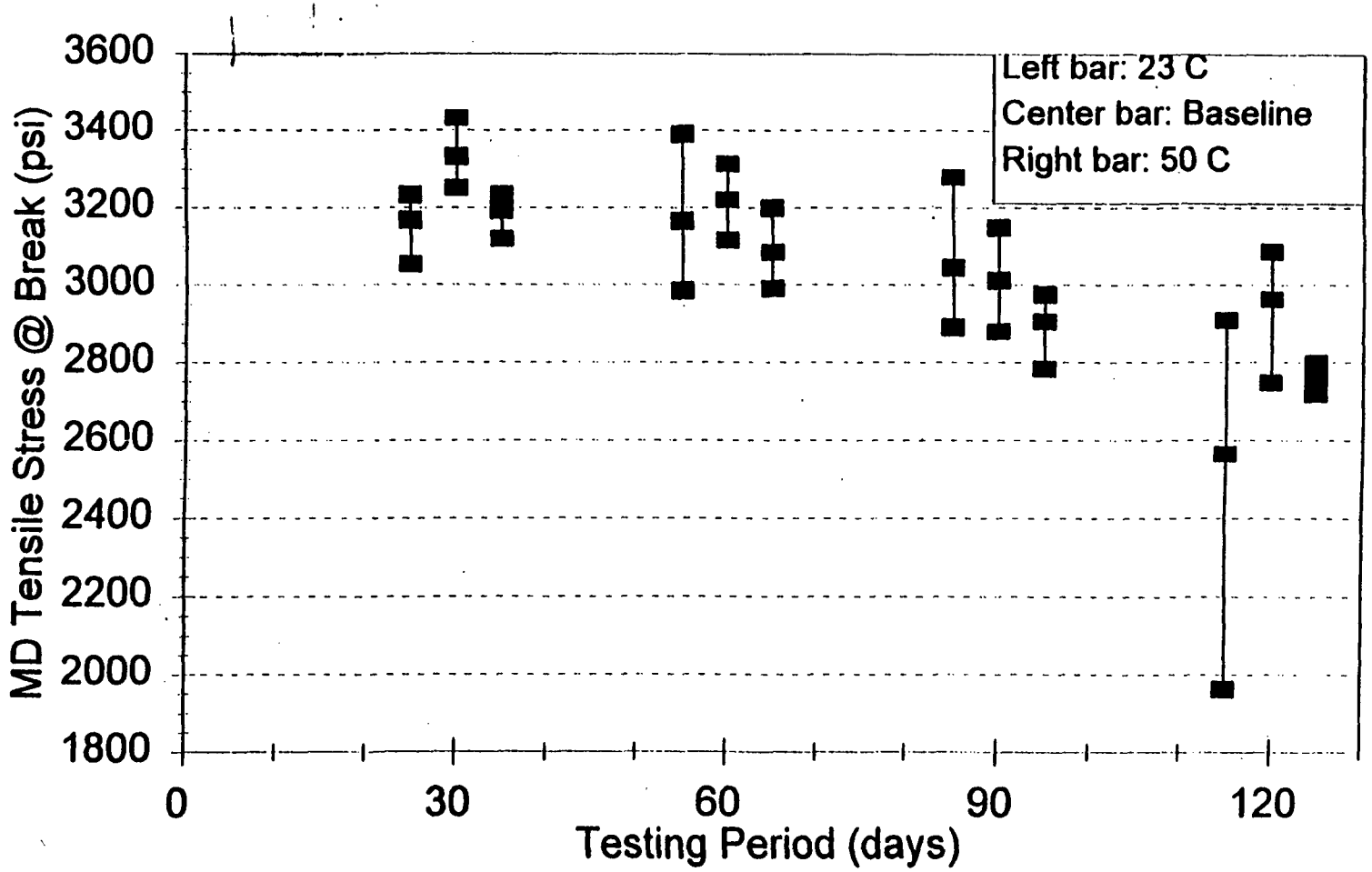
FMC CORPORATION EPA METHOD 9090

PVC GM vs Phos Dock Effluent



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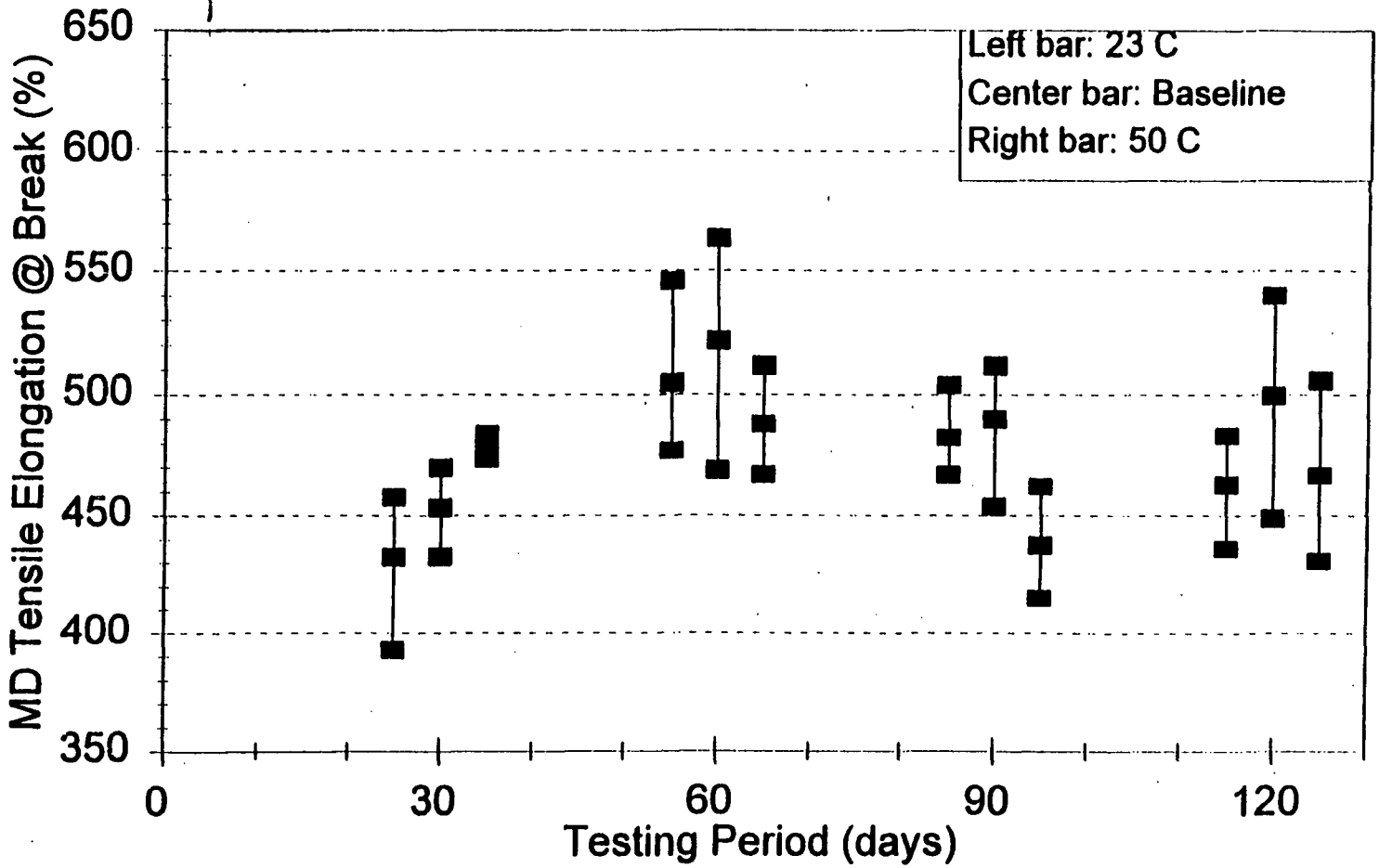
FMC CORPORATION EPA METHOD 9090

PVC GM vs Phos Dock Effluent



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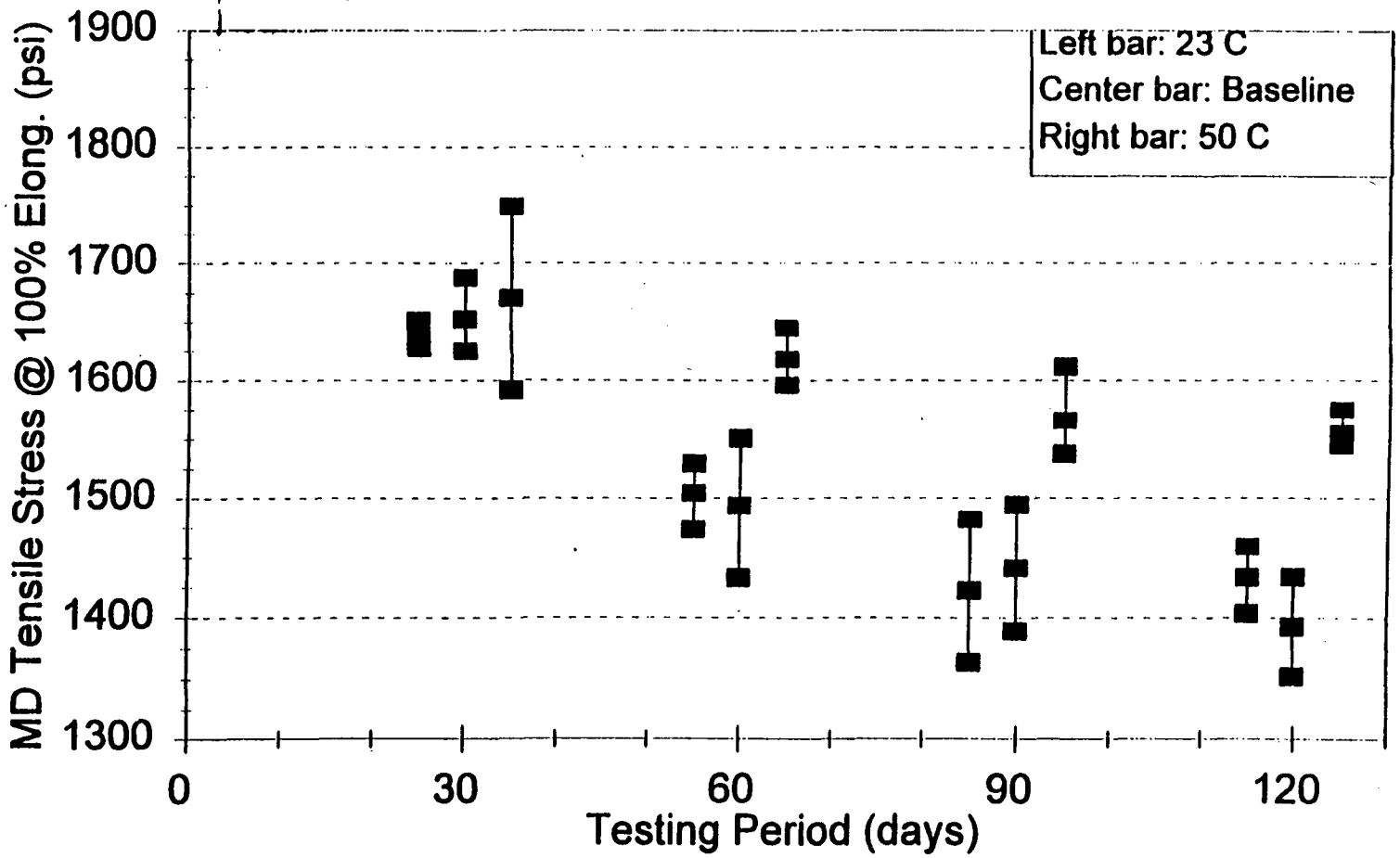
FMC CORPORATION EPA METHOD 9090

PVC GM vs Phos Dock Effluent



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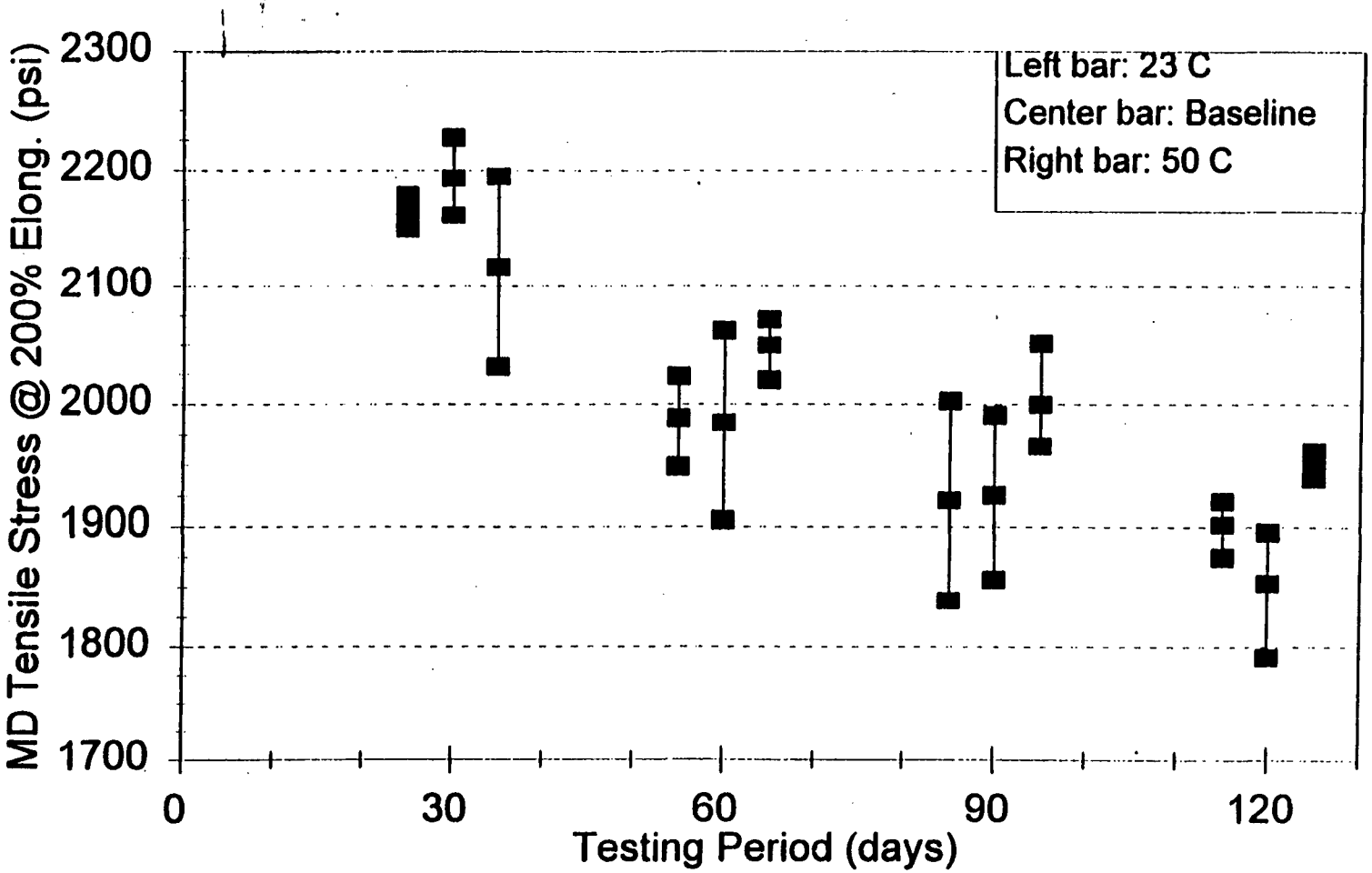
FMC CORPORATION EPA METHOD 9090

PVC GM vs Phos Dock Effluent



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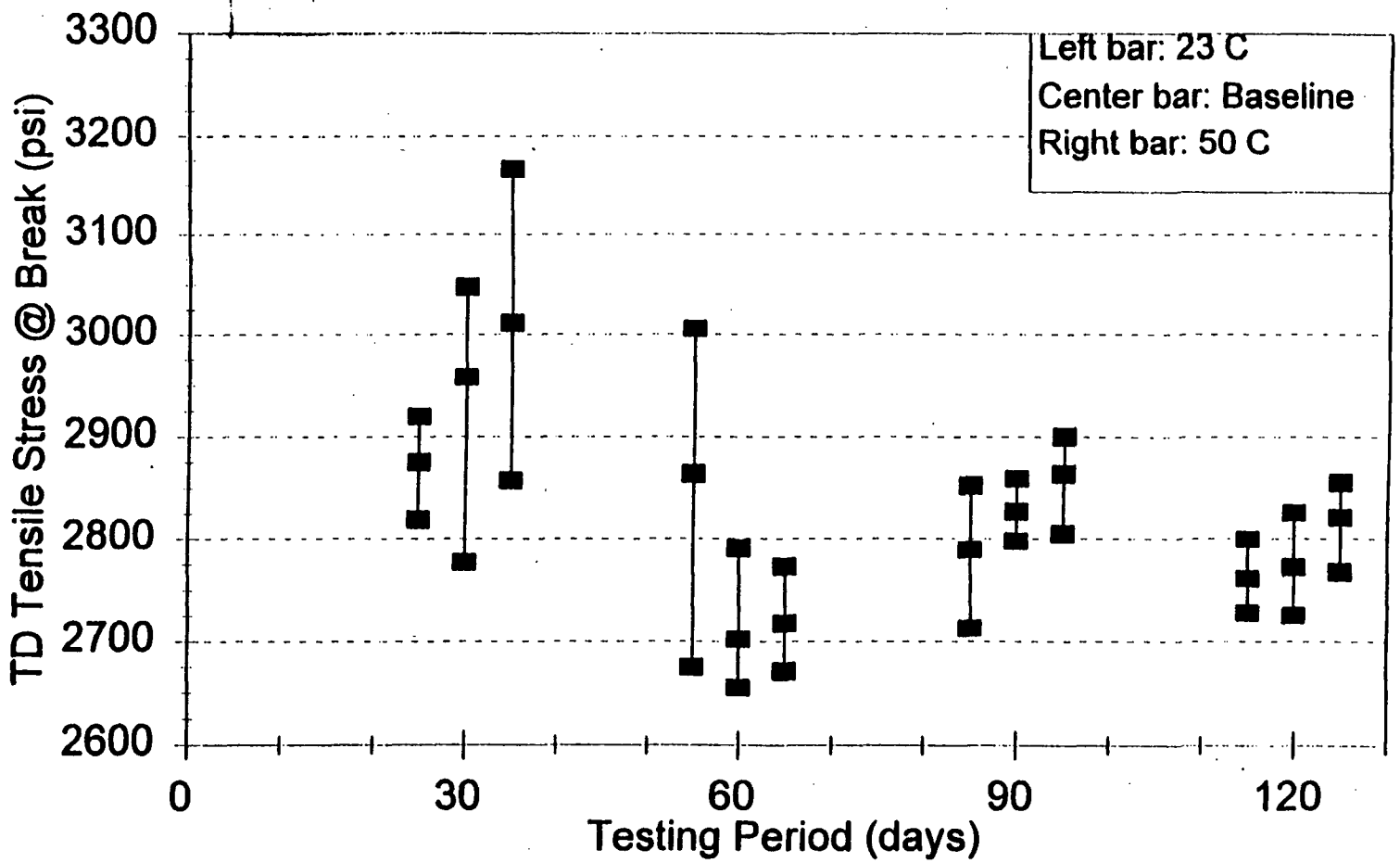
FMC CORPORATION EPA METHOD 9090

PVC GM vs Phos Dock Effluent



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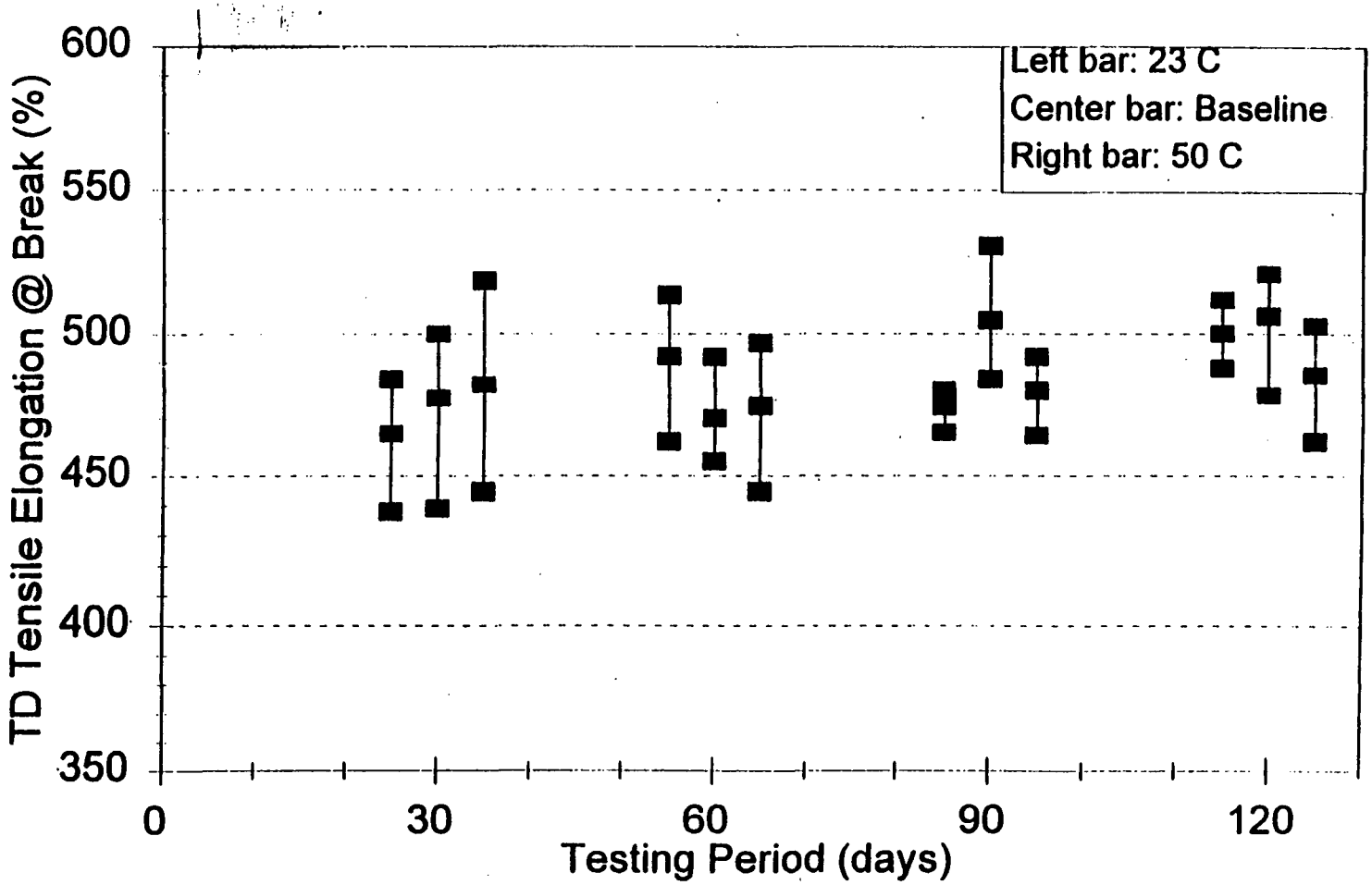
FMC CORPORATION EPA METHOD 9090

PVC GM vs Phos Dock Effluent



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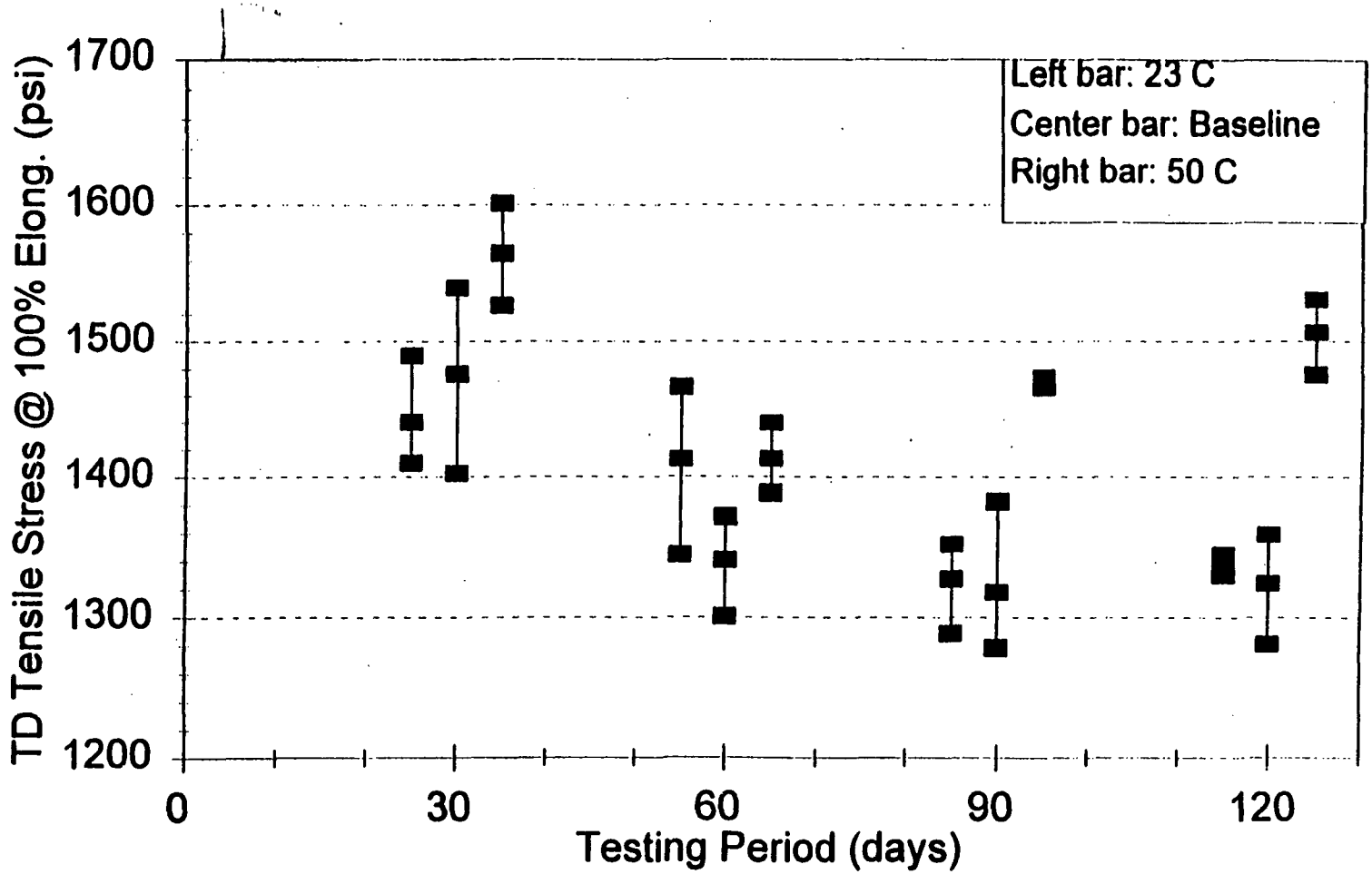
FMC CORPORATION EPA METHOD 9090

PVC GM vs Phos Dock Effluent



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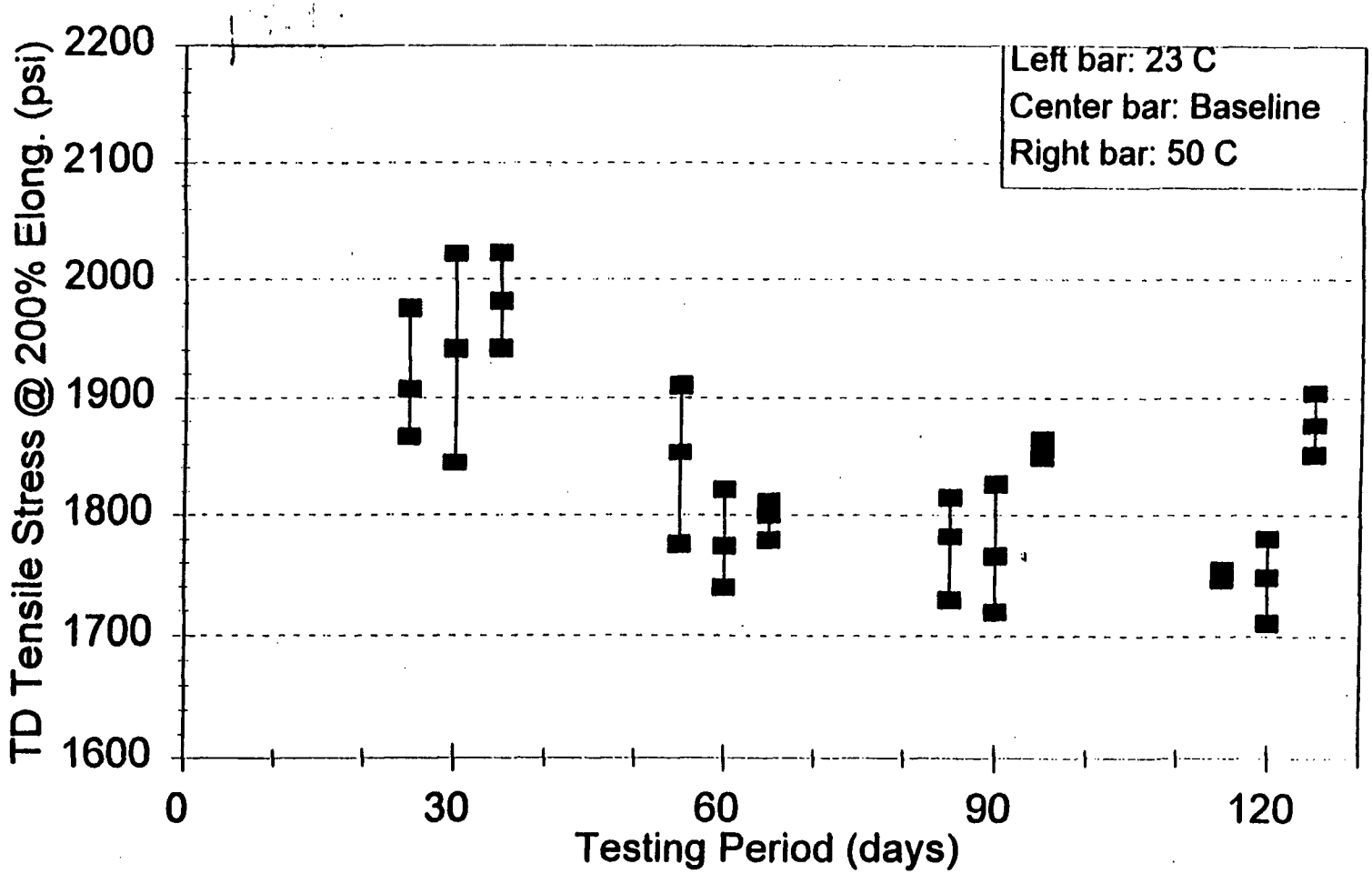
FMC CORPORATION EPA METHOD 9090

PVC GM vs Phos Dock Effluent



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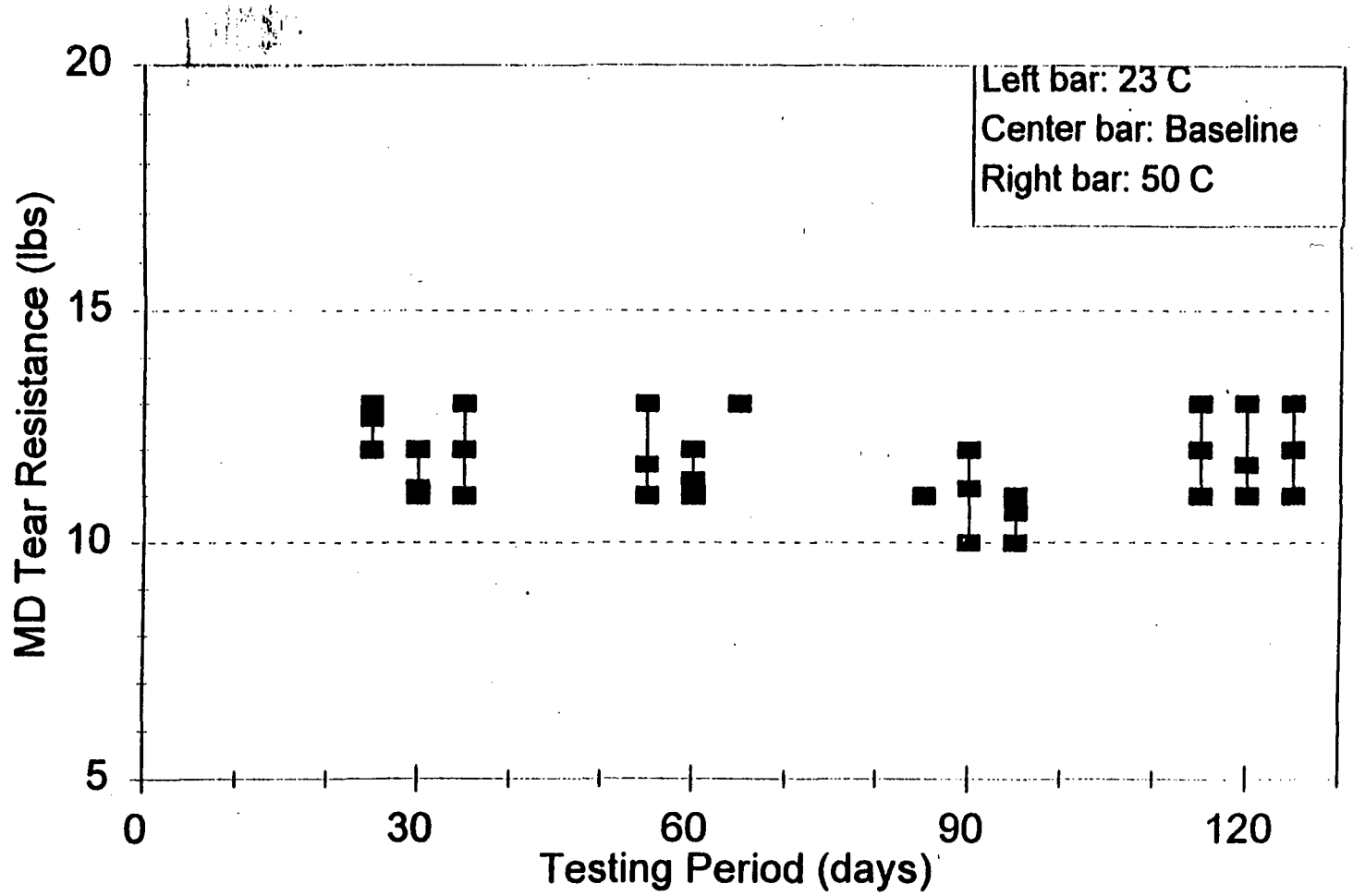
FMC CORPORATION EPA METHOD 9090

PVC GM vs Phos Dock Effluent



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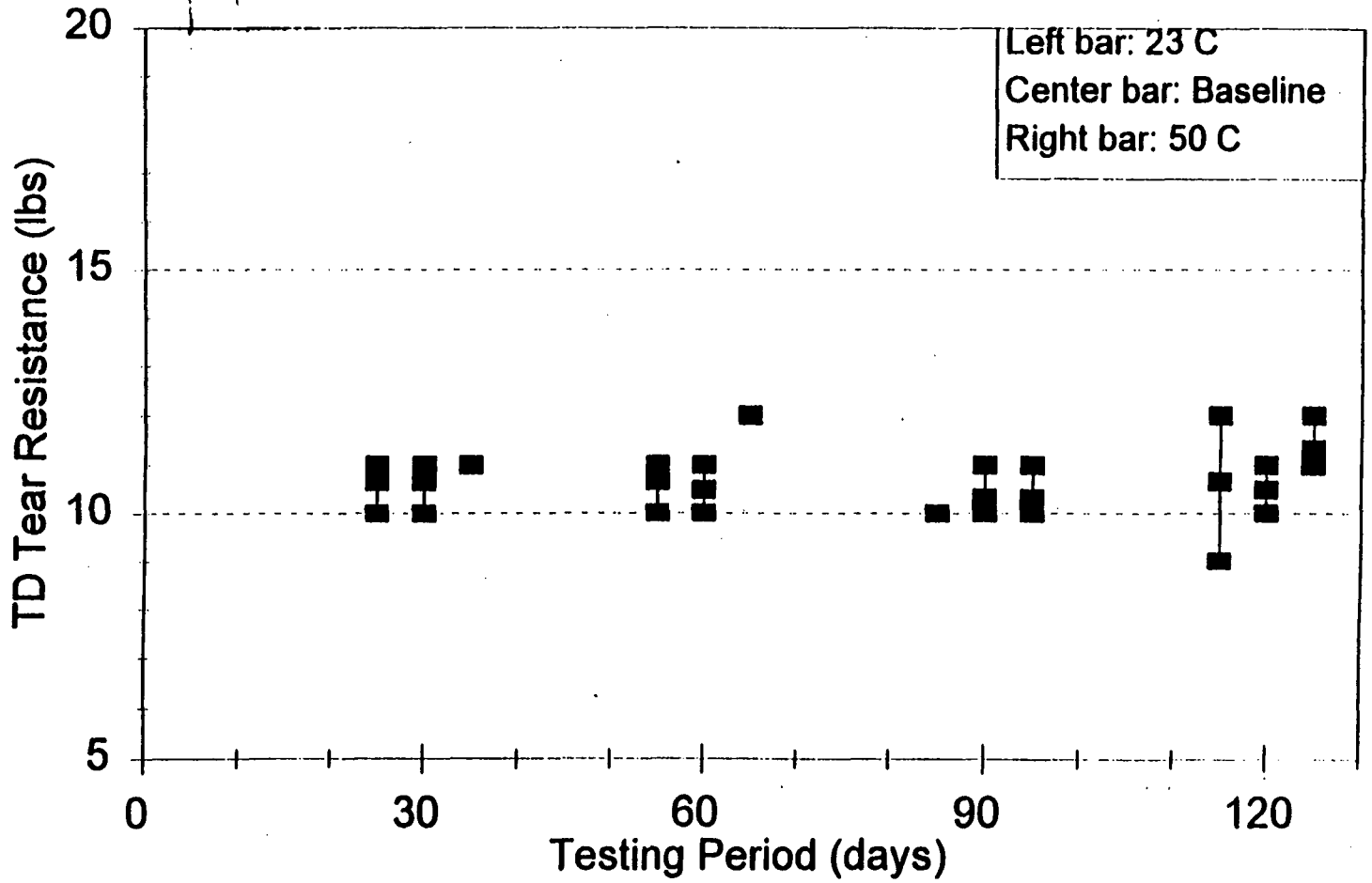
FMC CORPORATION EPA METHOD 9090

PVC GM vs Phos Dock Effluent



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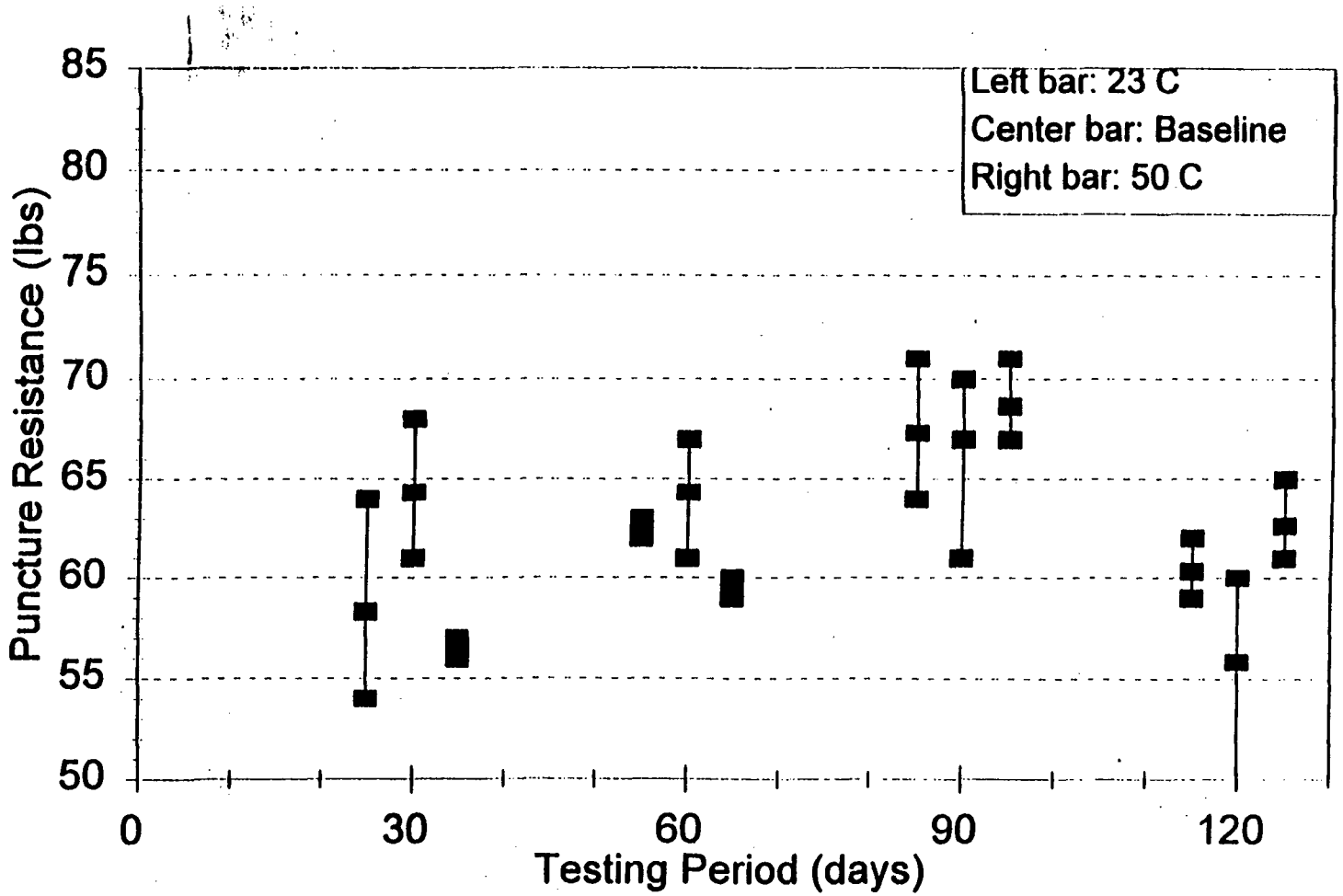
FMC CORPORATION EPA METHOD 9090

PVC GM vs Phos Dock Effluent



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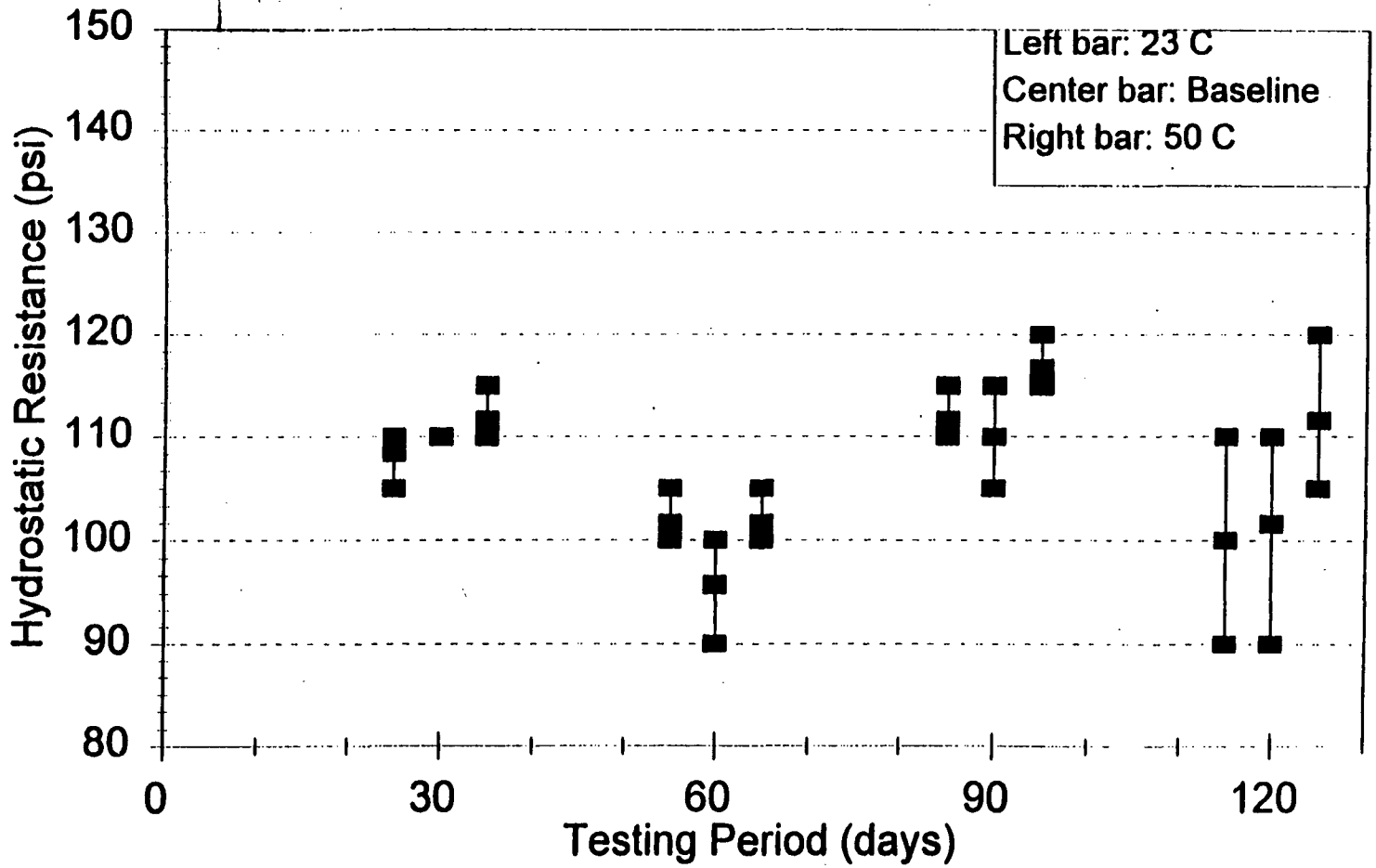
FMC CORPORATION EPA METHOD 9090

PVC GM vs Phos Dock Effluent



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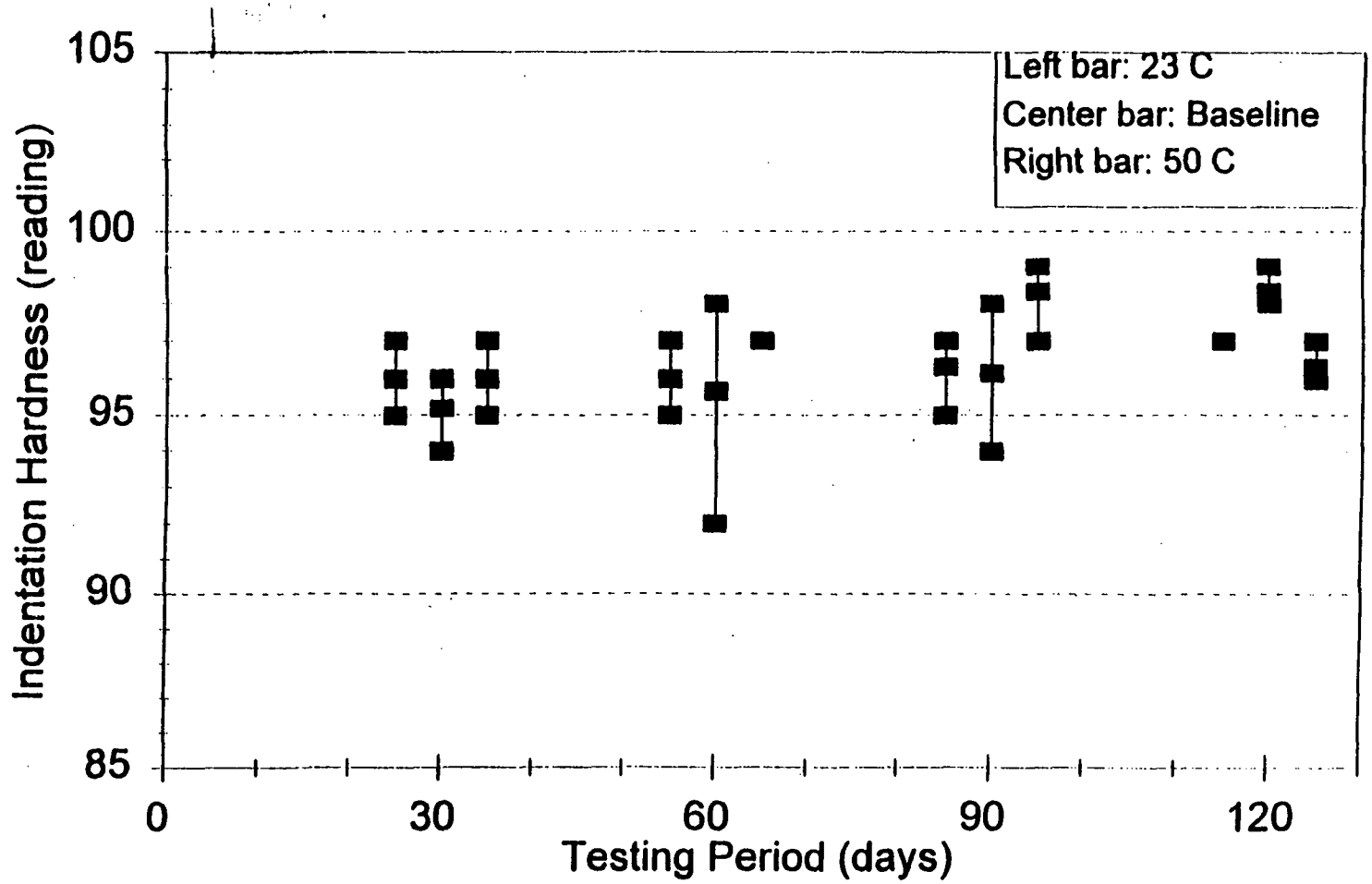
FMC CORPORATION EPA METHOD 9090

PVC Geomembrane vs Phos Dock Effluent



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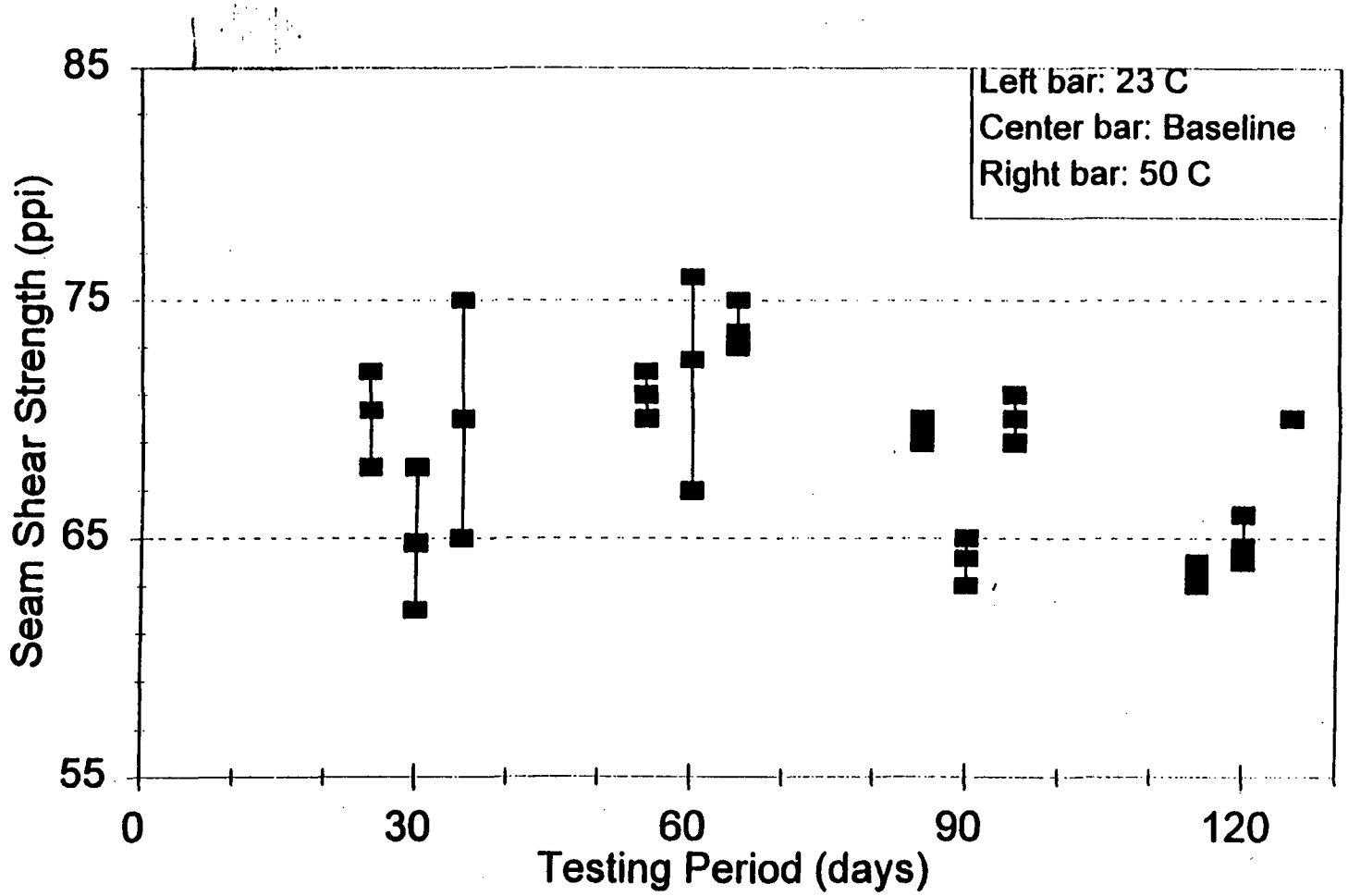
FMC CORPORATION EPA METHOD 9090

PVC GM vs Phos Dock Effluent



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EPA METHOD 9090 TEST RESULTS

FMC CORPORATION - POCATELLO

HDPE GEONET

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEONET: HDPE GEONET												
Tensile Properties:	77	65	61	77	68	68	61	64	59	68	68	58
Load at Break (lbs/in)	76	63	66	68	66	68	69	72	71	61	67	66
Machine Direction	74	61	75	69	73	69	64	63	67	64	69	67
ASTM D5035	65			75			62			65		
	71			76			63			63		
	73			65			69			61		
Average	73	63	67	72	69	68	65	66	66	64	68	64
STD	4	2	6	5	3	0	3	4	5	2	1	4
Coefficient of Variation	5	3	9	6	4	1	5	6	8	4	1	6
Range as % of Baseline	17			17			12			11		
% Change		-13	-7		-4	-5		3	2		7	0
Transmissivity:	N/A	N/A	N/A	1.70E-03	1.82E-03	1.83E-03	N/A	N/A	N/A	1.37E-03	1.49E-03	1.44E-03
ASTM D4716 (m2/sec)	N/A	N/A	N/A	1.63E-03	1.83E-03	1.81E-03	N/A	N/A	N/A	1.25E-03	1.37E-03	1.30E-03
Machine Direction	N/A	N/A	N/A	1.64E-03	1.83E-03	1.84E-03	N/A	N/A	N/A	1.19E-03	1.33E-03	1.28E-03
Hydraulic Gradient: 0.5	N/A			1.67E-03			N/A			1.47E-03		
Compressive Load: 1000 psf	N/A			1.63E-03			N/A			1.42E-03		
	N/A			1.64E-03			N/A			1.37E-03		
Average	0	0	0	1.65E-03	1.83E-03	1.83E-03	0	0	0	1.35E-03	1.40E-03	1.34E-03
STD	0	0	0	2.54E-05	4.71E-06	1.25E-05	0	0	0	9.62E-05	6.80E-05	7.12E-05
Coefficient of Variation	N/A	N/A	N/A	1.54E+00	2.58E-01	6.83E-01	N/A	N/A	N/A	7.15E+00	4.87E+00	5.31E+00
Range as % of Baseline	N/A	N/A	N/A	4			N/A	N/A	N/A	21		
% Change		N/A	N/A		11	11		N/A	N/A		4	-0

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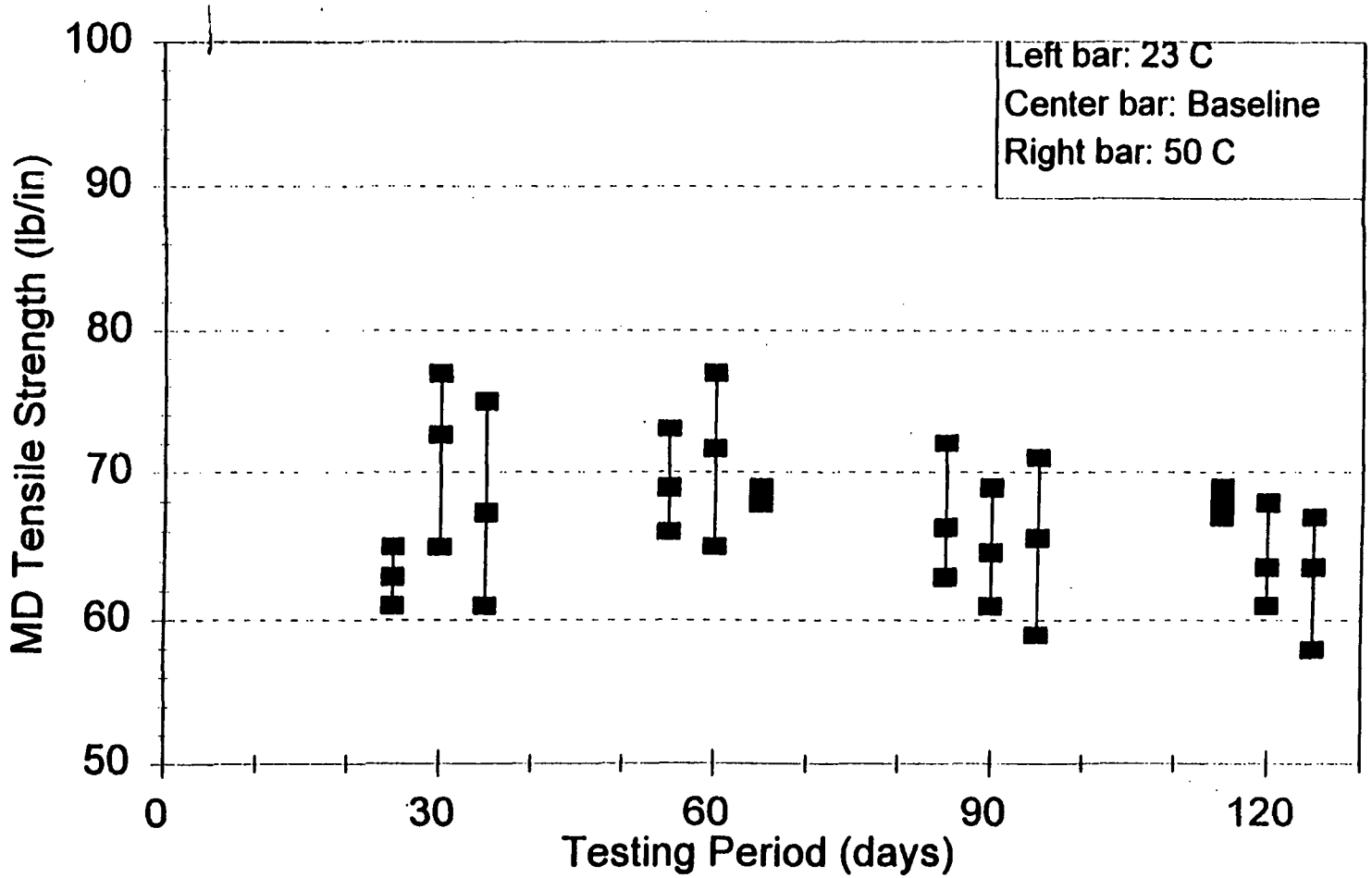
FMC CORPORATION EPA METHOD 9090

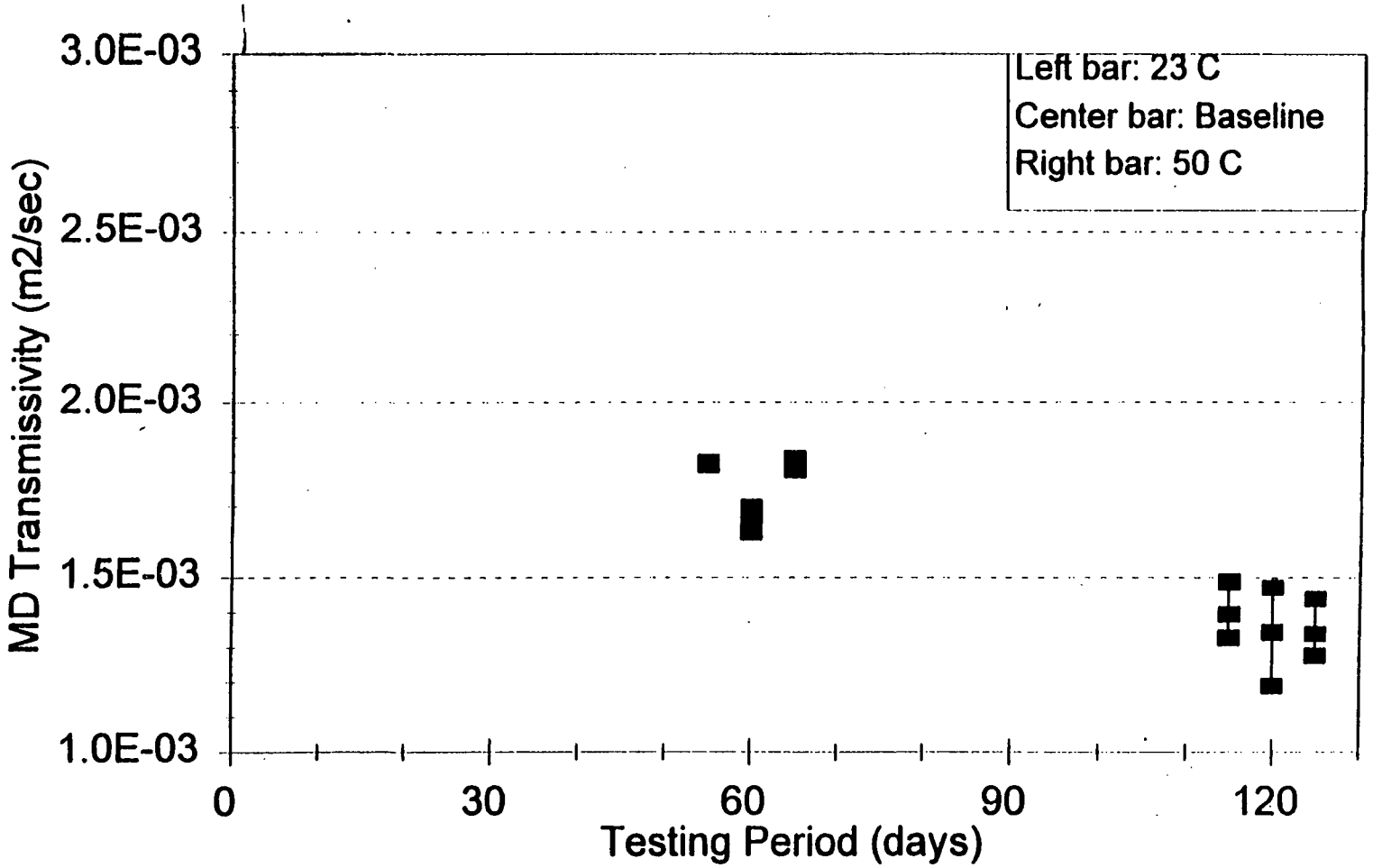
HDPE Geonet vs Phos Dock Effluent



Client: FMC Corporation, File: 942-net.wb1

FMC CORPORATION EPA METHOD 9090

HDPE Geonet vs Phos Dock Effluent



Client: FMC Corporation, File: 942-net.wb1

EPA METHOD 9090 TEST RESULTS

FMC CORPORATION - POCATELLO

HDPE GEOPIPE

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

ort Date: July 25, 1997
ssued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEONET: HDPE GEOPIPE												
Arc Bend Strength:	882	785	899	818	843	868	833	801	827	856	863	830
Load @ 5% deflection (lbs)	794	846	858	816	852	847	865	808	809	847	846	843
ASTM D 2412	822	891	942	879	878	859	839	832	829	832	851	871
	822			913			900			861		
	811			805			829			842		
	821			842			862			878		
Average	825	841	900	846	858	858	855	814	822	853	853	848
STD	27	43	34	39	15	9	24	13	9	15	7	17
Coefficient of Variation	3	5	4	5	2	1	3	2	1	2	1	2
Range as % of Baseline	11			13			8			5		
% Change		2	9		1	1		-5	-4		0	-1
Arc Bend Strength:	792	685	802	750	749	768	740	708	740	752	765	738
Load @ 10% deflection (lbs)	692	745	760	723	754	743	766	710	718	748	748	749
ASTM D 2412	723	798	832	781	780	762	739	733	734	759	758	769
Hydraulic Gradient: 0.5	726			810			796			789		
Compressive Load: 1000 psf	711			707			737			781		
	721			748			775			764		
Average	728	743	798	753	761	758	759	717	731	766	757	752
STD	31	46	30	34	14	11	22	11	9	15	7	13
Coefficient of Variation	4	6	4	5	2	1	3	2	1	2	1	2
Range as % of Baseline	14			14			8			5		
% Change		2	10		1	1		-6	-4		-1	-2

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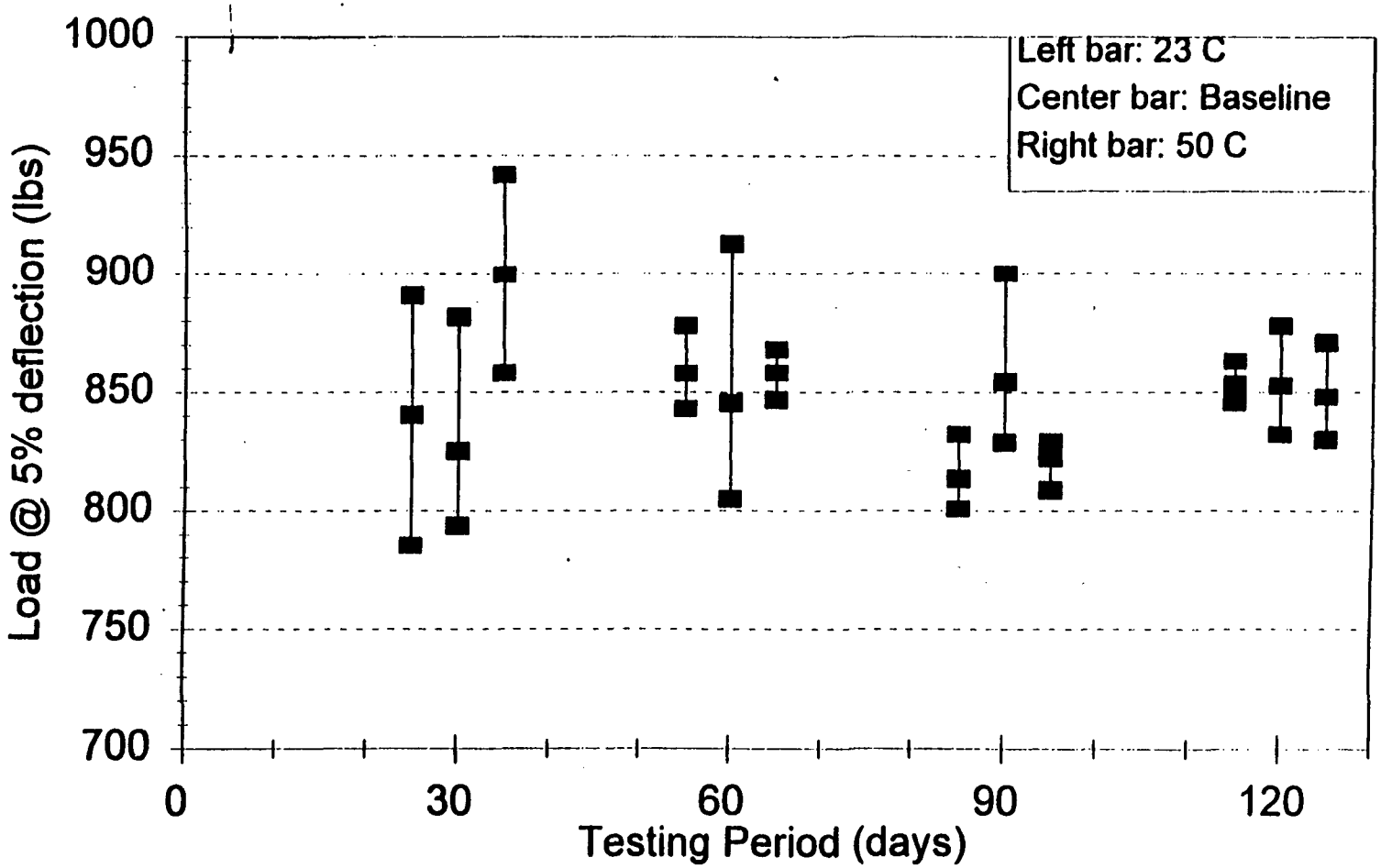
FMC CORPORATION EPA METHOD 9090

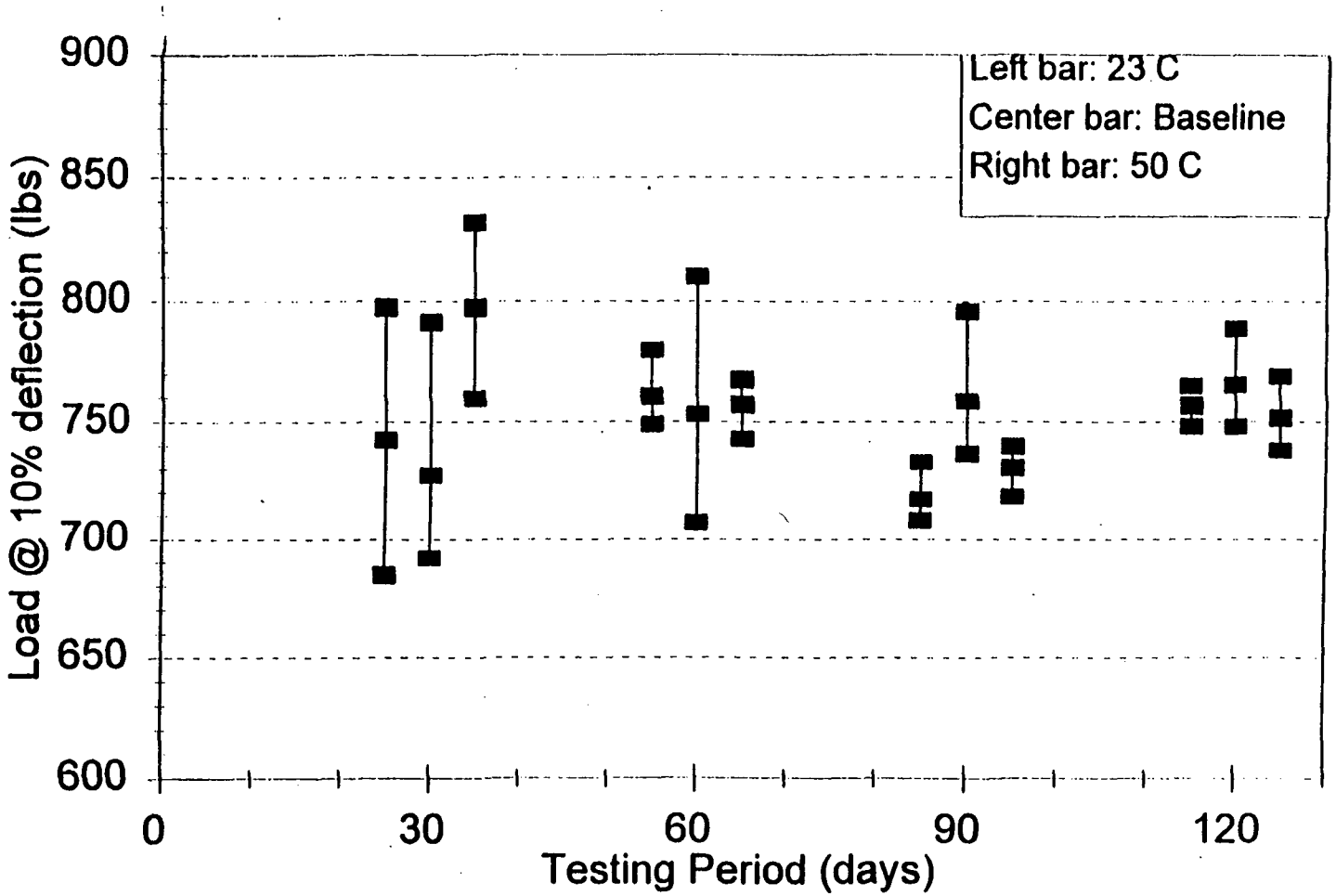
HDPE Geopipe vs Phos Dock Effluent



Client: FMC Corporation, File: 942-pipe.wb1

FMC CORPORATION EPA METHOD 9090

HDPE Geopipe vs Phos Dock Effluent



Client: FMC Corporation, File: 942-pipe.wb1

EPA METHOD 9090 TEST RESULTS

FMC CORPORATION - POCATELLO

WOVEN GEOTEXTILE COMPONENT - BENTOFIX GCL

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOTEXTILE: Bentofix GCL - woven textile component												
Grab Tensile Properties:	149	141	145	144	146	149	137	146	148	140	145	147
Maximum Strength (lbs)	132	150	137	138	143	141	129	147	145	149	136	150
ASTM D4632	150	145	140	144	152	151	142	150	150	152	138	153
Machine Direction	146	136	147	158	153	151	136	158	143	135	153	157
	131	147	143	139	153	165	133	150	126	161	146	145
	147			136			128			142		
	137			130			150			143		
	142			147			131			154		
	140			149			131			146		
	145			154			149			130		
Average	142	144	142	144	149	151	137	150	142	145	144	150
STD	6	5	4	8	4	8	8	4	9	9	6	4
Coefficient of Variation	5	3	2	6	3	5	6	3	6	6	4	3
Range as % of Baseline	13			19			16			21		
% Change		1	0		4	5		10	4		-1	4
Grab Tensile Properties:	21	19	24	21	19	21	19	19	21	17	18	18
Elongation @ Max. Strength (%)	17	19	18	21	19	19	16	23	23	20	18	18
ASTM D4632	18	19	17	20	19	23	17	21	19	22	18	20
Machine Direction	20	18	19	21	20	21	20	21	26	20	20	19
	21	15	18	21	23	25	25	24	22	21	19	18
	12			21			29			19		
	16			18			19			20		
	19			19			18			21		
	18			19			16			19		
	19			21			21			18		
Average	18	18	19	20	20	22	20	22	22	20	19	19
STD	3	2	2	1	2	2	4	2	2	1	1	1
Coefficient of Variation	14	9	13	5	8	9	20	8	10	7	4	4
Range as % of Baseline	50			15			65			25		
% Change		-1	6		-1	8		8	11		-6	-6
Tear Resistance:	71	72	88	80	90	75	72	85	64	73	76	96
Trapezoidal Tear Strength (lbs)	86	67	78	85	79	79	80	81	71	75	74	64
ASTM D4533	79	74	90	92	77	85	81	61	86	73	84	84
Machine Direction	73	73	85	74	68	79	86	70	79	83	90	75
	78	75	81	79	88	94	91	85	96	79	83	88
	68			67			79			83		
	80			67			102			75		
	74			87			84			81		
	68			84			86			79		
	65			81			76			73		
Average	74	72	84	80	80	82	84	76	79	77	81	81
STD	6	3	4	8	8	7	8	9	11	4	6	11
Coefficient of Variation	8	4	5	10	10	8	10	12	14	5	7	14
Range as % of Baseline	28			31			36			13		
% Change		-3	14		1	4		-9	-5		5	5

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TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOTEXTILE: Bentofix GCL - woven textile component												
Puncture Resistance:	143	155	179	128	149	152	129	164	165	134	135	145
Load @ Rupture (lb)	140	117	198	148	155	148	132	146	121	134	148	148
ASTM D4833	123	116	181	165	137	154	132	148	158	124	133	153
	132	106	229	125	134	162	137	141	145	131	163	140
	145	147	145	149	157	152	134	134	153	125		
	121			131			144			142		
	126			146			143			130		
	117			143			110			143		
	138			132			118			149		
	157			146			114			134		
Average	134	128	186	141	146	154	129	147	148	135	145	147
STD	12	19	27	12	9	5	11	10	15	8	12	5
Coefficient of Variation	9	15	15	8	6	3	9	7	10	6	8	3
Range as % of Baseline	30			28			26			19		
% Change		-4	39		4	9		13	15		8	9
Mullen Burst Strength:	540	560	525	450	475	460	435	550	455	425	465	425
Burst Strength (psi)	430	510	475	465	485	545	470	410	470	445	435	430
ASTM D3786	460	450	525	540	460	435	455	455	370	425	430	450
	405	505	475	415	480	480	460	490	460	430	455	425
	485	500	470	450	445	460	450	410	495	430	435	454
	530			460			430			425		
	430			460			455			420		
	405			450			420			415		
	525			520			445			435		
	430			490			470			465		
Average	464	505	494	470	469	476	449	463	450	432	444	437
STD	50	35	25	35	15	37	16	53	42	14	14	13
Coefficient of Variation	11	7	5	7	3	8	4	11	9	3	3	3
Range as % of Baseline	29			27			11			12		
% Change		9	6		-0	1		3	0		3	1
Permittivity:	0.040	0.070	0.050	0.050	0.060	0.070	0.055	0.055	0.060	0.060	0.070	0.075
(sec -1)	0.040	0.060	0.060	0.050	0.060	0.050	0.055	0.055	0.060	0.055	0.065	0.080
ASTM D4491	0.030	0.060	0.060	0.030	0.050	0.050	0.055	0.050	0.065	0.045	0.065	0.075
	0.050	0.060	0.070	0.040	0.050	0.040	0.060	0.045	0.050	0.050	0.065	0.070
	0.040	0.070	0.070	0.040	0.050	0.060	0.060	0.050	0.055	0.055	0.080	0.055
	0.040			0.040			0.045			0.055		
	0.050			0.030			0.055			0.065		
	0.050			0.050			0.060			0.060		
	0.060			0.040			0.060			0.060		
	0.050			0.030			0.065			0.065		
Average	0.045	0.064	0.062	0.040	0.054	0.054	0.057	0.051	0.058	0	0	0
STD	0.008	0.005	0.007	0.008	0.005	0.010	0.005	0.004	0.005	0	0	0
Coefficient of Variation	18	8	12	19	9	19	9	7	9	11	11	12
Range as % of Baseline	67			50			35			35		
% Change		42	38		35	35		-11	2		28	25

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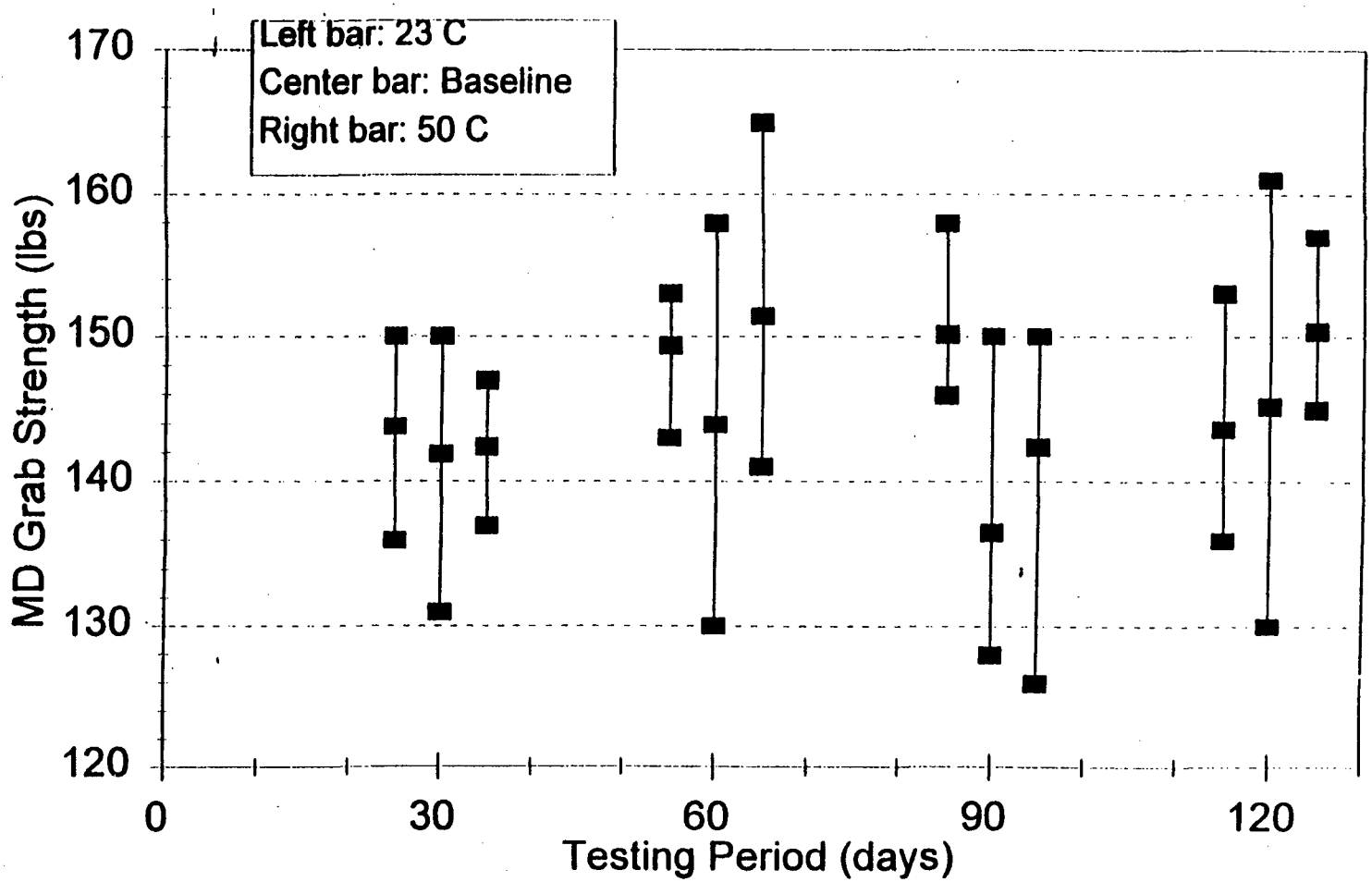
FMC CORPORATION EPA METHOD 9090

GCL (WV GT) vs Phos Dock Effluent



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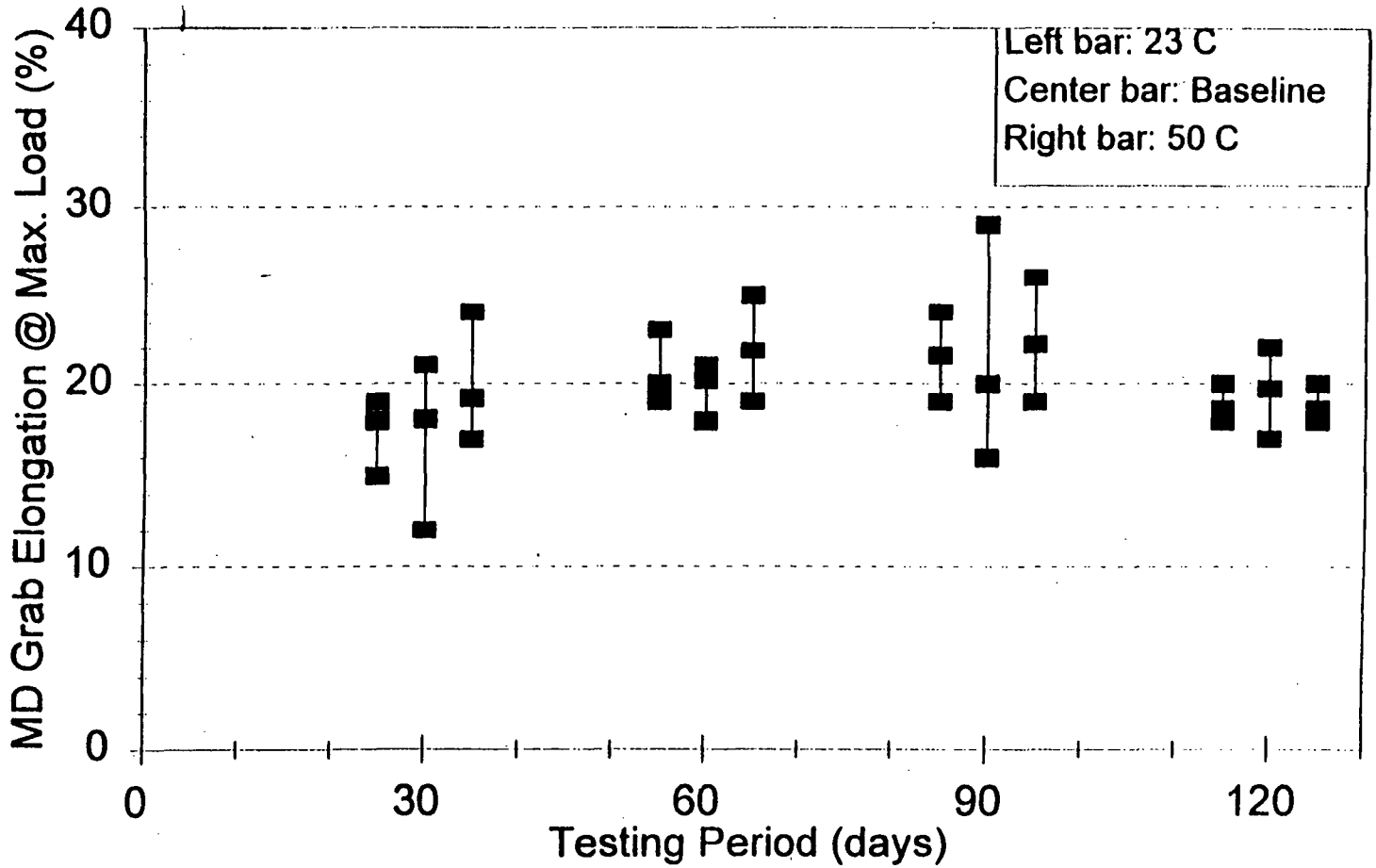
FMC CORPORATION EPA METHOD 9090

GCL (WV GT) vs Phos Dock Effluent



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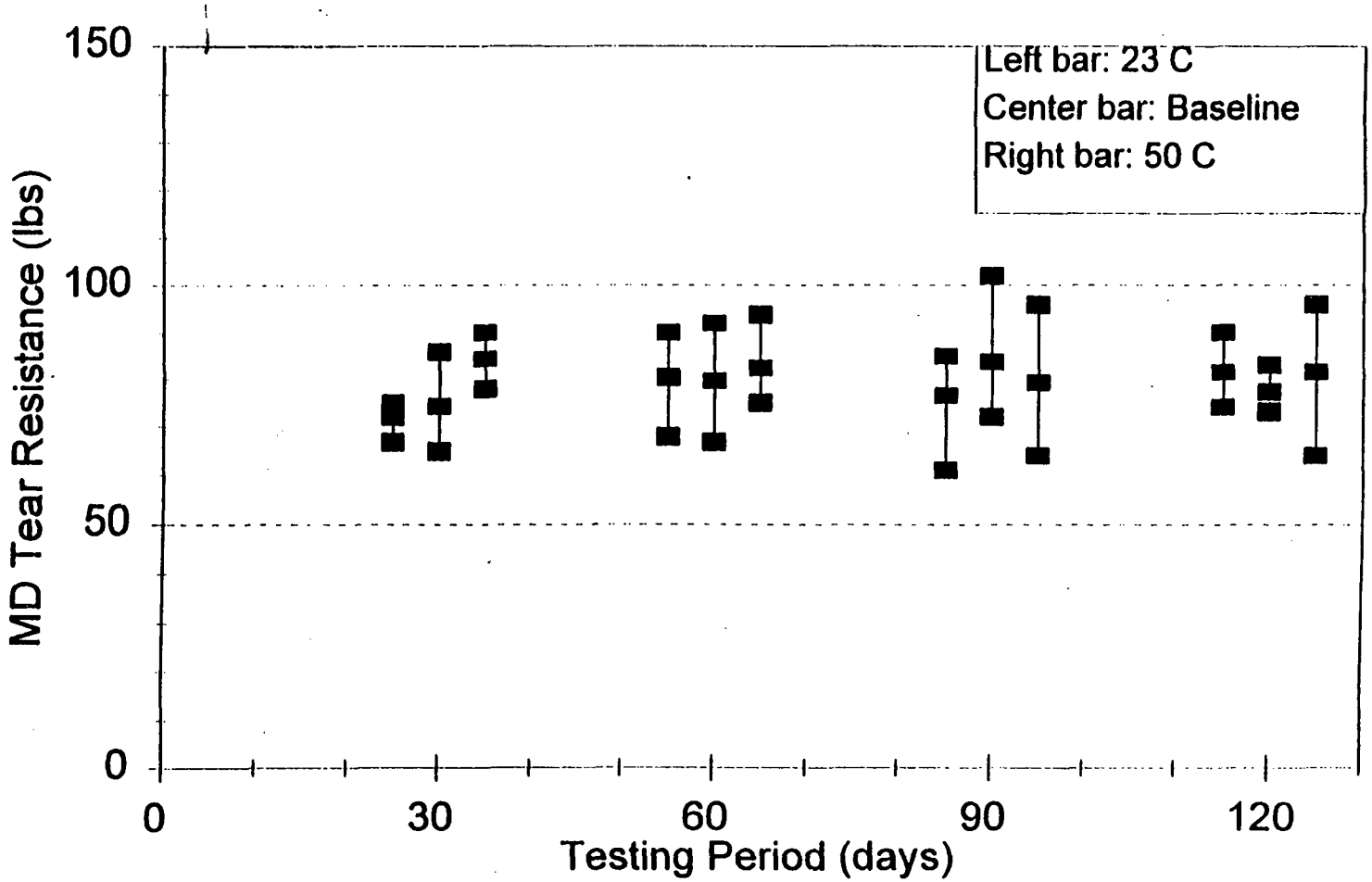
FMC CORPORATION EPA METHOD 9090

GCL (WV GT) vs Phos Dock Effluent



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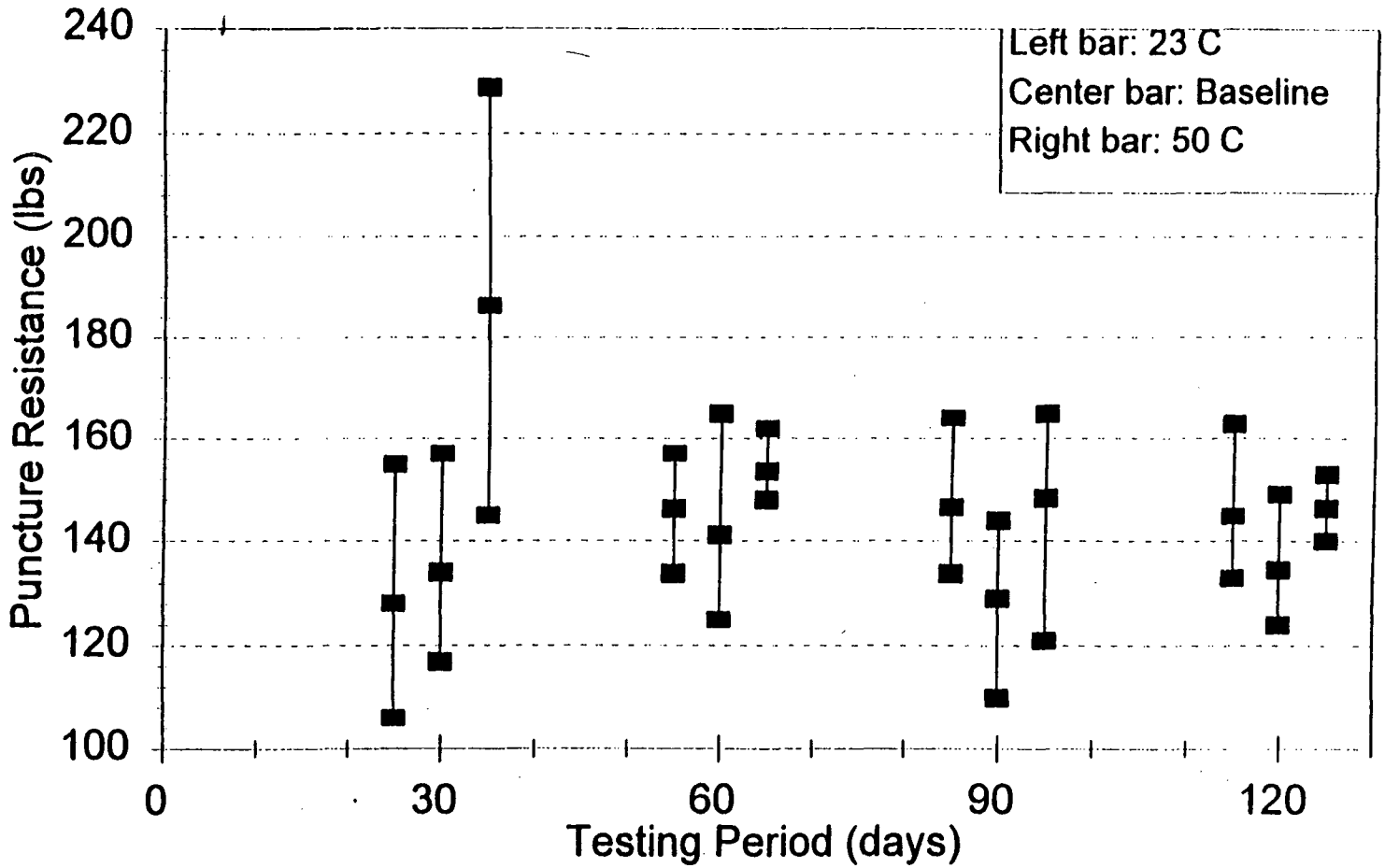
FMC CORPORATION EPA METHOD 9090

GCL (WV GT) vs Phos Dock Effluent



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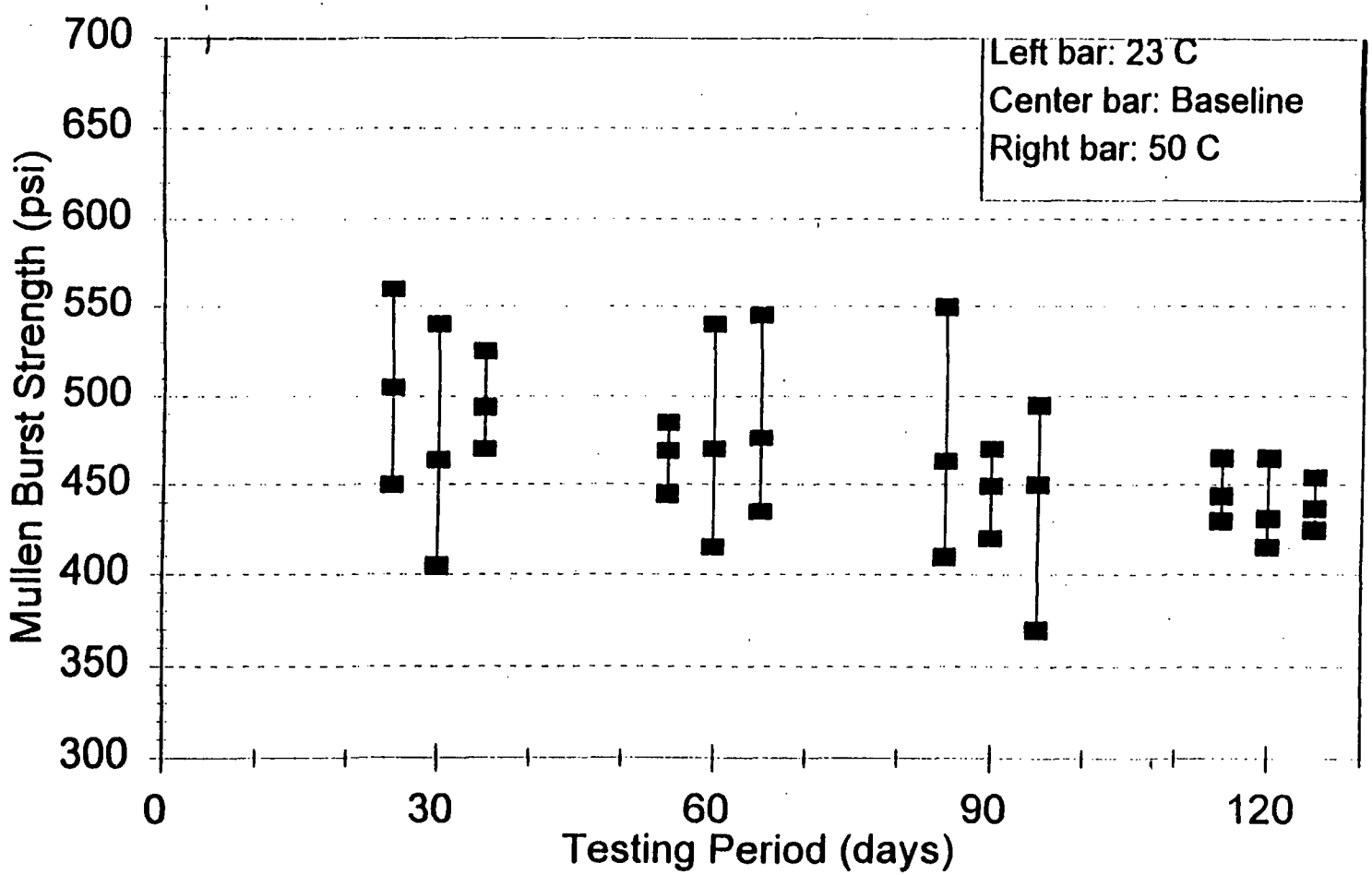
FMC CORPORATION EPA METHOD 9090

GCL (WV GT) vs Phos Dock Effluent



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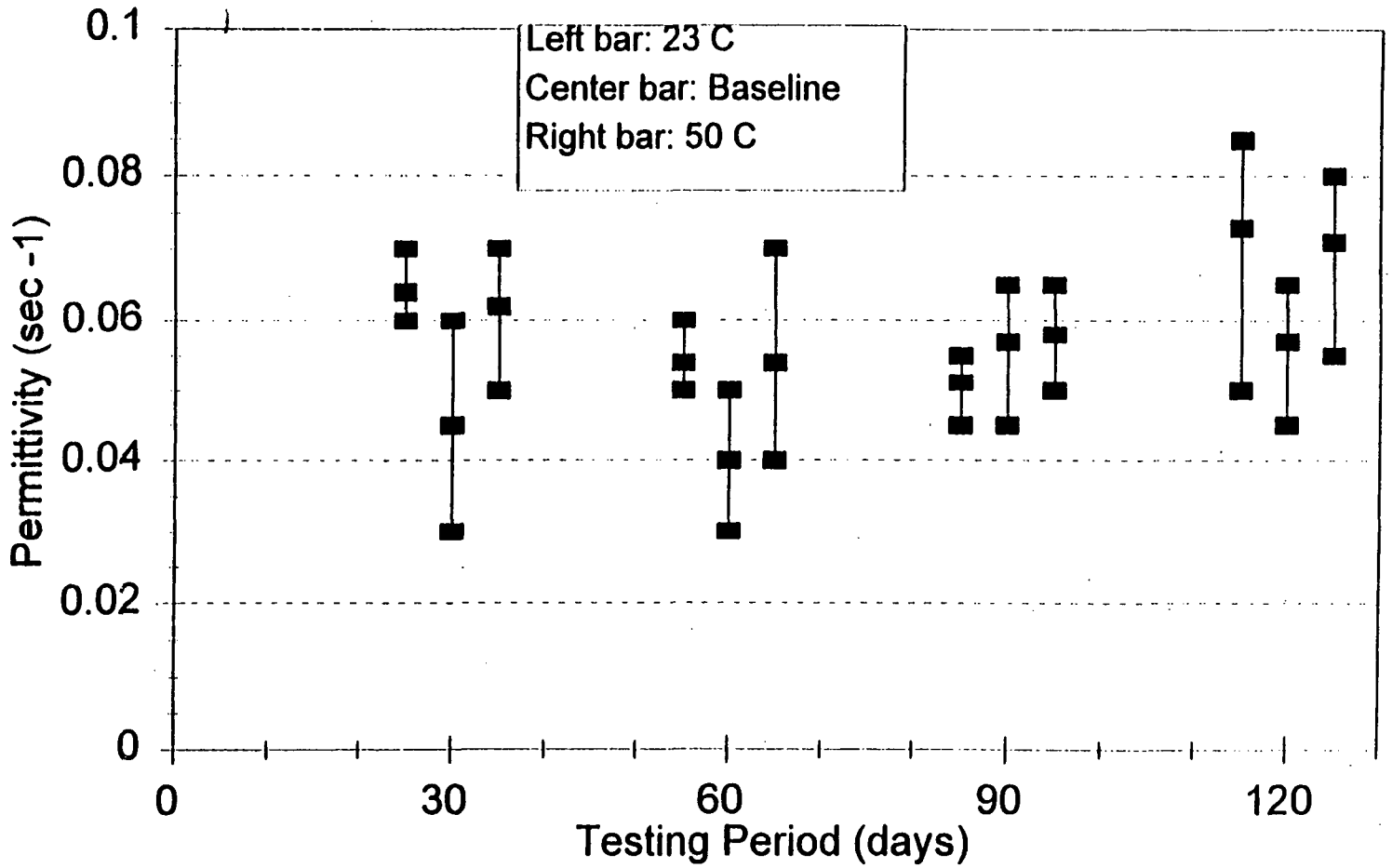
FMC CORPORATION EPA METHOD 9090

GCL (WV GT) vs Phos Dock Effluent



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EPA METHOD 9090 TEST RESULTS

FMC CORPORATION - POCATELLO

NONWOVEN GEOTEXTILE COMPONENT - BENTOFIX GCL

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOTEXTILE: Bentofix GCL -nonwoven textile component												
Grab Tensile Properties:	74	63	86	65	69	76	56	64	81	94	83	91
Maximum Strength (lbs)	68	69	85	87	68	79	72	88	71	74	117	88
ASTM D4632	71	74	88	85	72	76	64	101	65	61	79	92
Machine Direction	72	61	70	66	74	75	85	88	64	74	88	106
	90	65	72	69	87	70	83	87	72	67	109	85
	74			74			98			61		
	72			75			81			77		
	71			66			77			85		
	92			65			53			73		
	80			67			61			71		
Average	76	66	80	72	74	75	73	86	71	74	95	92
STD	8	5	8	8	7	3	14	12	6	10	15	7
Coefficient of Variation	10	7	9	11	9	4	19	14	9	13	16	8
Range as % of Baseline	31			31			62			45		
% Change		-13	5		3	5		17	-3		29	25
Grab Tensile Properties:	194	196	188	201	205	209	179	175	291	220	207	177
Elongation @ Max. Strength (%)	192	181	208	198	203	209	177	210	212	215	208	221
ASTM D4632	206	189	211	195	207	208	224	191	249	209	199	187
Machine Direction	195	198	211	173	202	218	215	210	204	229	201	202
	192	184	209	205	205	213	208	198	225	196	217	184
	196			205			270			224		
	202			203			219			193		
	198			191			269			209		
	202			187			213			215		
	199			201			204			198		
Average	198	190	205	196	204	211	218	196	236	211	206	194
STD	4	7	9	9	2	4	30	13	31	12	6	16
Coefficient of Variation	2	3	4	5	1	2	14	7	13	5	3	8
Range as % of Baseline	7			16			43			17		
% Change		-4	4		4	8		-10	8		-2	-8
Tear Resistance:	33	25	35	32	49	36	29	21	28	34	46	41
Trapezoidal Tear Strength (lbs)	28	24	37	26	32	33	30	30	42	43	40	44
ASTM D4533	38	33	37	31	32	30	29	24	34	37	46	47
Machine Direction	30	38	37	27	27	34	20	19	26	24	45	44
	35	47	31	33	34	30	31	20	24	26	32	37
	33			34			31			32		
	34			34			27			31		
	29			28			25			38		
	34			34			25			41		
	35			34			27			43		
Average	33	33	35	31	35	33	27	23	31	35	42	43
STD	3	9	2	3	7	2	3	4	7	6	5	3
Coefficient of Variation	9	26	7	10	21	7	12	17	21	18	13	8
Range as % of Baseline	30			26			40			54		
% Change		2	8		11	4		-17	12		20	22

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TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

Phosphorus Bearing Mixture of Phos Dock Effluent from the North Solids Tank and Northeast Sump

Report Date: July 25, 1997
Reissued: October 21, 1997

Exposure Time and Temperature

Test Parameters	30 Day Baseline	30 Day 23C	30 Day 50C	60 Day Baseline	60 Day 23C	60 Day 50C	90 Day Baseline	90 Day 23C	90 Day 50C	120 Day Baseline	120 Day 23C	120 Day 50C
GEOTEXTILE: Bentofix GCL -nonwoven textile component												
Puncture Resistance:	107	99	125	90	106	102	82	111	110	55	94	111
Load @ Rupture (lb)	108	93	80	99	84	94	70	99	92	64	87	88
ASTM D4833	108	94	89	91	95	94	56	132	109	73	116	92
	91	97	77	83	97	96	76	105	131	85	104	101
	91	99	138	92	79	89	88	94	142	80	92	95
	97			63			90			64		
	101			95			66			48		
	85			92			115			65		
	86			100			81			64		
	95			85			89					
Average	97	96	102	89	92	95	81	108	117	66	99	97
STD	8	2	25	10	10	4	15	13	18	11	10	8
Coefficient of Variation	9	3	24	11	10	4	19	12	15	16	10	8
Range as % of Baseline	24			42			73			56		
% Change		-1	5		4	7		33	44		48	47
Mullen Burst Strength:	325	300	295	210	290	250	220	235	220	370	340	350
Burst Strength (psi)	330	335	360	350	260	250	210	280	230	340	280	390
ASTM D3786	320	295	305	250	270	250	290	265	220	300	310	340
	210	285	340	240	250	240	225	260	240	300	340	300
	215	330	295	230	250	300	285	225	260	360	340	330
	275			260			205			310		
	345			300			200			330		
	310			280			250			330		
	370			250			275			260		
	330			240			290			310		
Average	303	309	319	261	264	258	245	253	234	321	322	342
STD	51	20	26	38	15	21	35	20	15	30	24	29
Coefficient of Variation	17	6	8	15	6	8	14	8	6	9	7	9
Range as % of Baseline	53			54			37			34		
% Change		2	5		1	-1		3	-4		0	7
Permittivity:	3.13	3.98	3.90	3.26	3.47	3.69	3.24	3.28	3.65	3.48	3.12	3.28
(sec -1)	4.01	4.67	4.09	3.77	3.71	3.55	3.41	3.63	3.52	3.44	2.92	3.28
ASTM D4491	4.67	4.57	3.76	3.59	3.98	3.98	3.55	3.45	3.91	3.28	2.92	2.92
	4.62	4.05	4.26	3.11	3.85	4.02	3.70	3.23	3.72	3.36	2.88	2.88
	4.86	3.85	4.47	4.44	3.66	4.10	4.30	3.77	3.50	3.28	2.84	2.8
	3.86			4.05			4.12			3.00		
	3.91			3.86			3.99			2.96		
	4.46			3.22			3.33			2.89		
	3.15			4.17			3.92			3.16		
	4.15			4.21			4.16			2.95		
Average	4.08	4.22	4.10	3.77	3.73	3.86	3.77	3.47	3.66	3	3	3
STD	0.57	0.33	0.25	0.44	0.17	0.21	0	0	0	0	0	0
Coefficient of Variation	14	8	6	12	5	5	9	6	4	7	3	7
Range as % of Baseline	42			35			28			19		
% Change		3	0		-1	3		-8	-3		-8	-5

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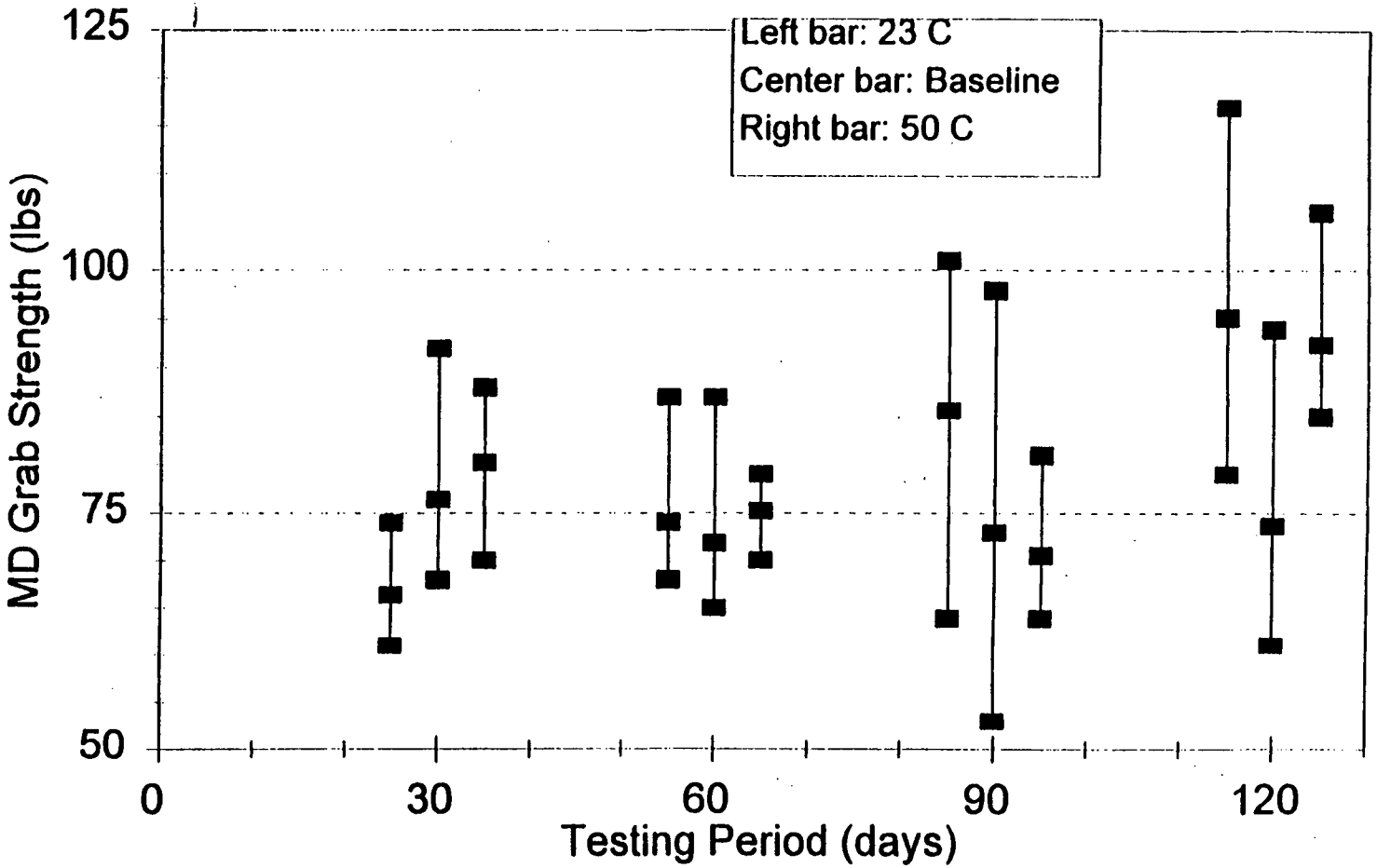
FMC CORPORATION EPA METHOD 9090

GCL (NW GT) vs Phos Dock Effluent



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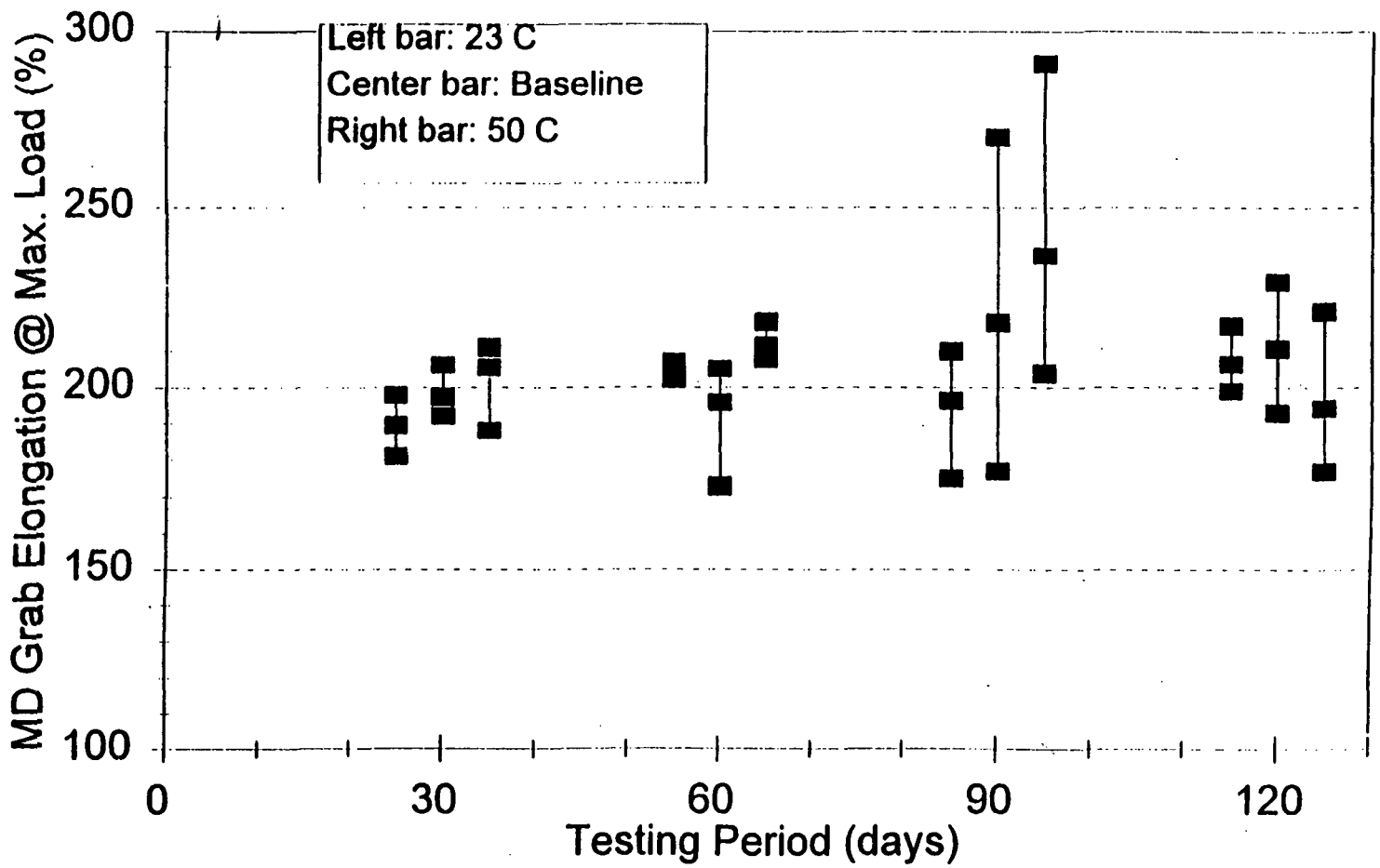
FMC CORPORATION EPA METHOD 9090

GCL (NW GT) vs Phos Dock Effluent



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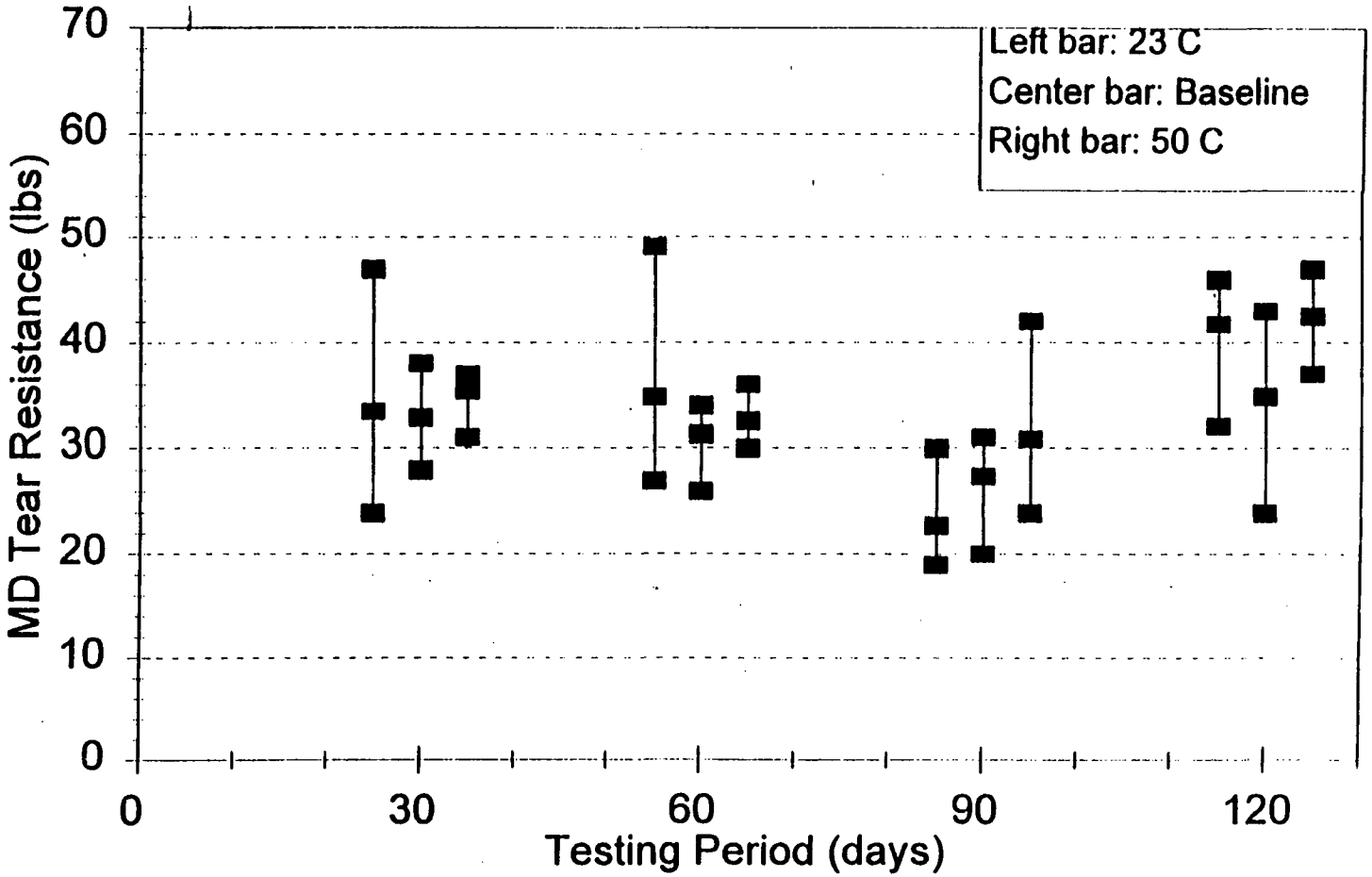
FMC CORPORATION EPA METHOD 9090

GCL (NW GT) vs Phos Dock Effluent



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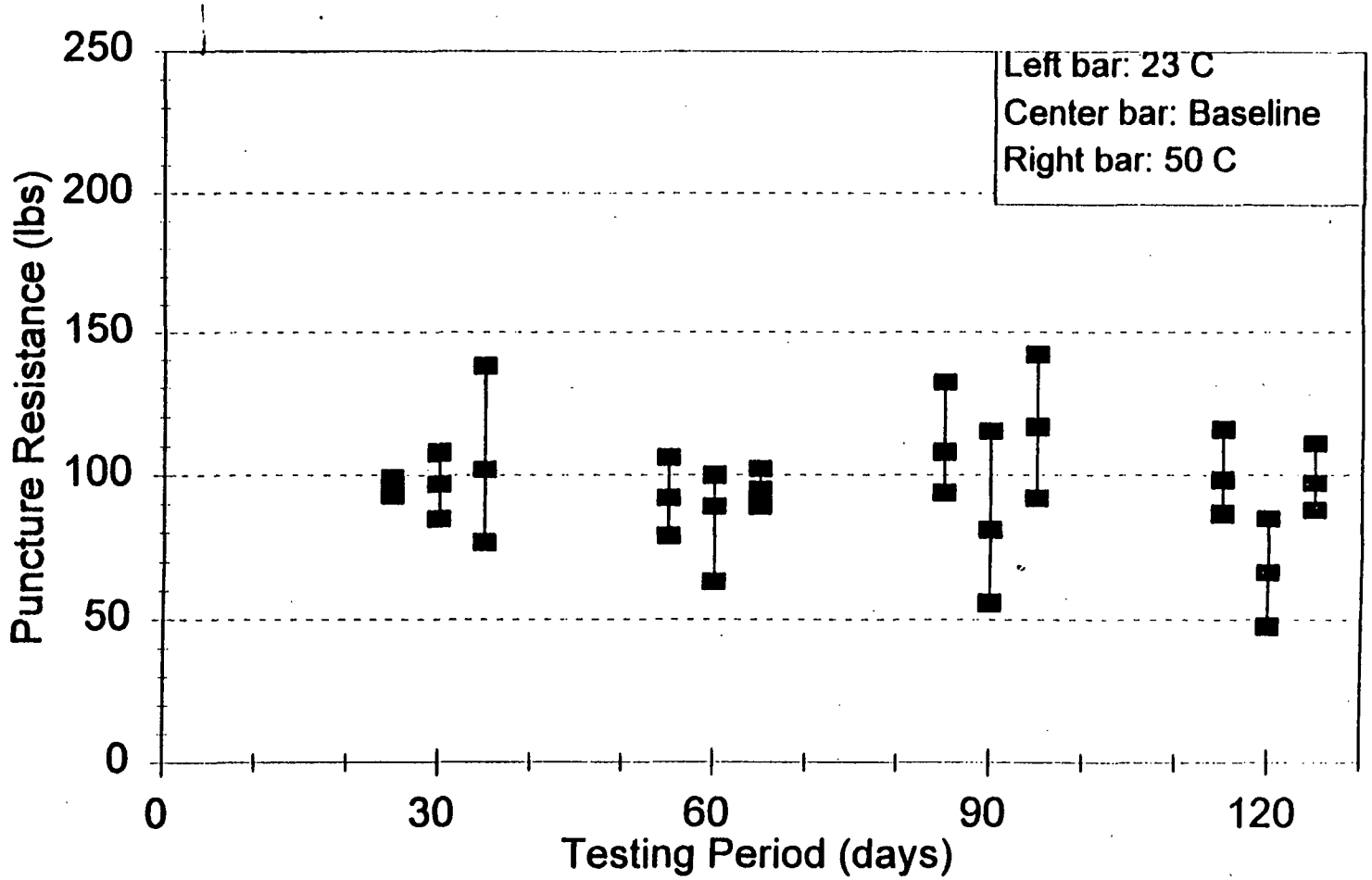
FMC CORPORATION EPA METHOD 9090

GCL (NW GT) vs Phos Dock Effluent



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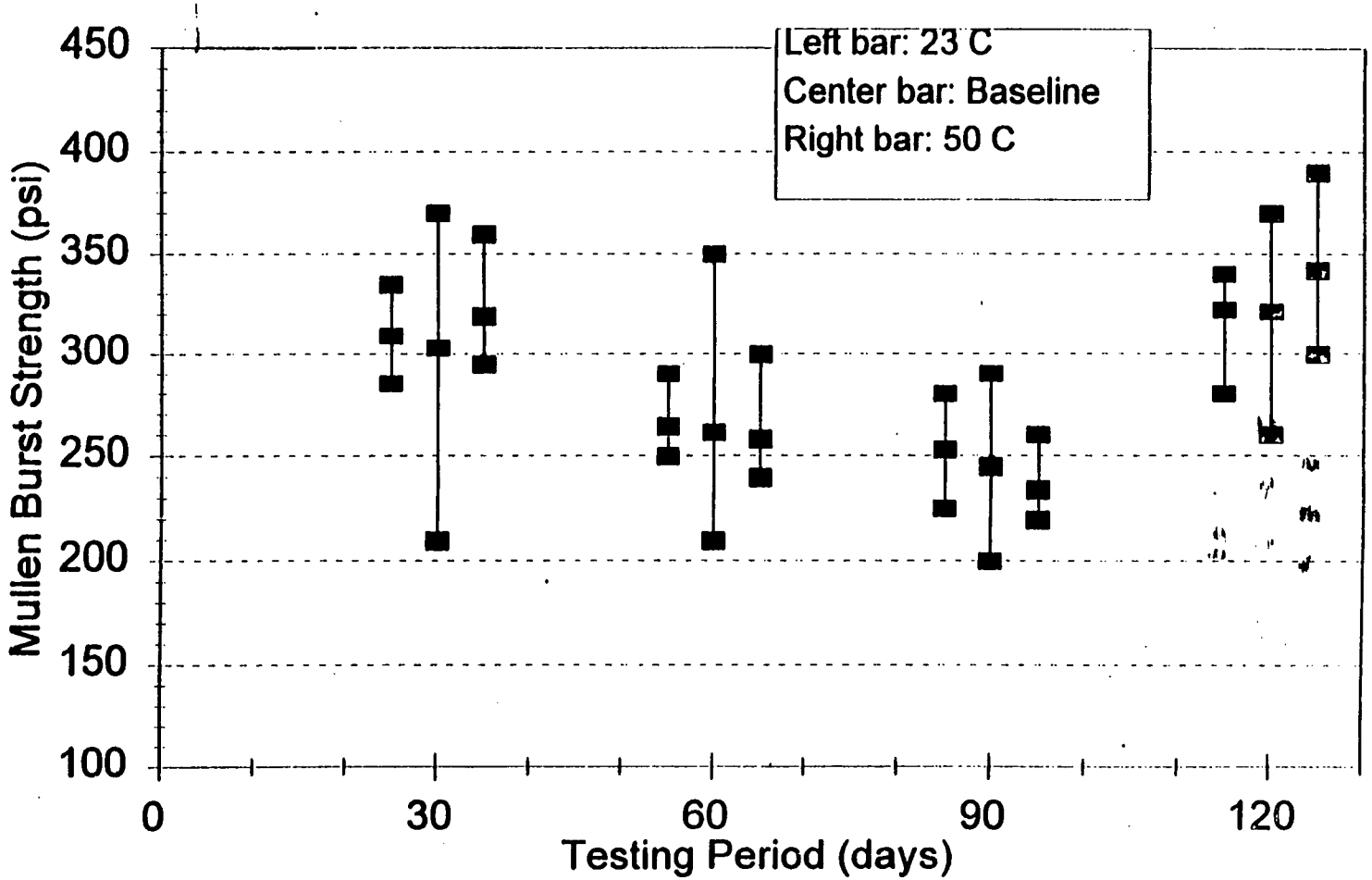
FMC CORPORATION EPA METHOD 9090

GCL (NW GT) vs Phos Dock Effluent



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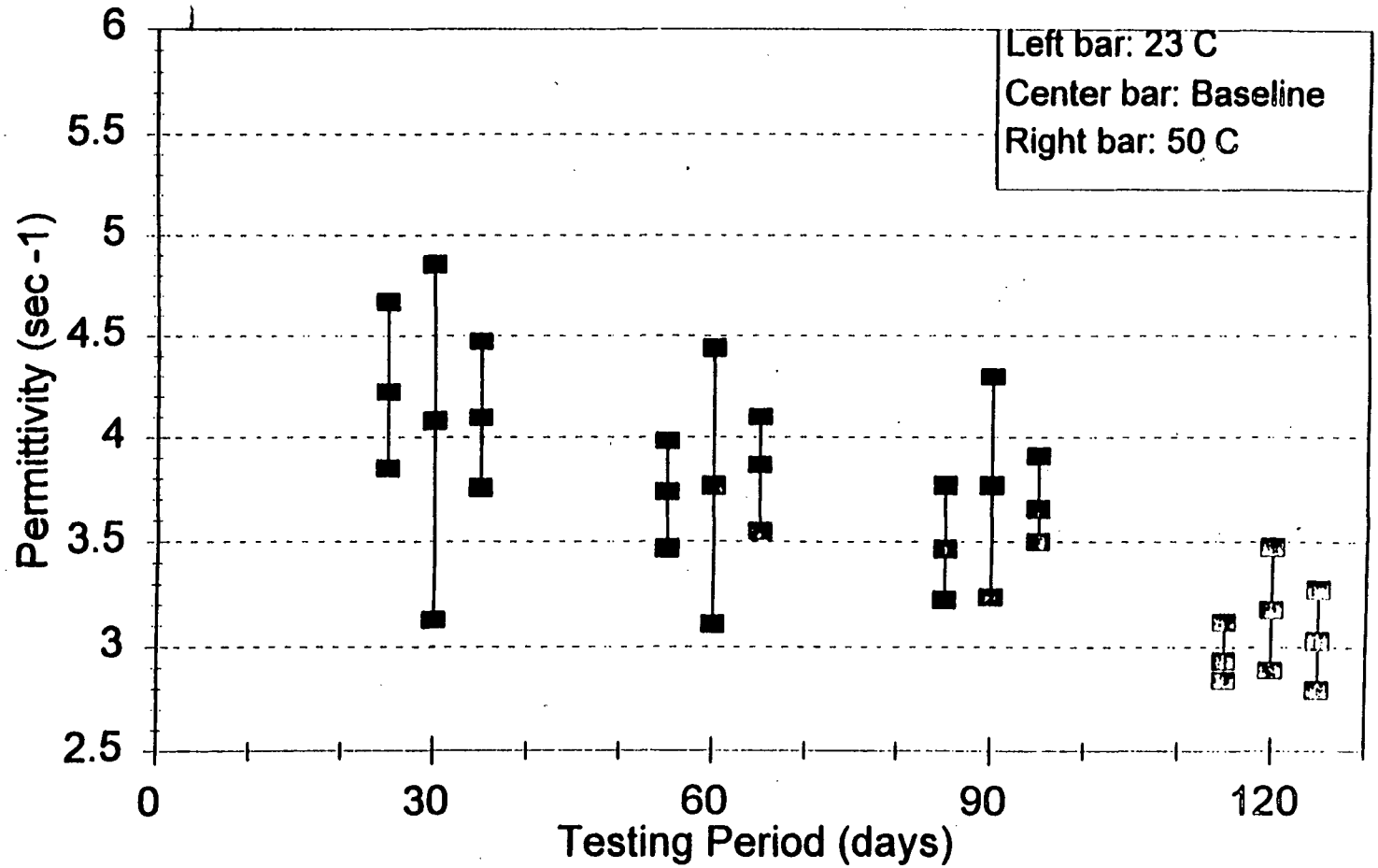
FMC CORPORATION EPA METHOD 9090

GCL (NW GT) vs Phos Dock Effluent



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