

BIODEGRADATION (BOD/COD)

TEST SUBSTANCE

Identity: A mixture containing perfluorooctanesulfonate, which may also be referred to as PFOS, FC-95, or as a component of FC-780B. (1-Octanesulfonic acid) (CAS # 2795-39-3).

Remarks: The 3M production lot numbers were 1 and 501. The test sample is FC-780B. Current information indicates it is a mixture of 0.58% PFOS, 14% diethylene glycol monobutyl ether, 76.7% water, 5.5% urea, 1.17% Hydroxy foamer, 1.15% sodium octyl sulfate, 0.8% polyoxyethylene monooctylphenyl ether, 0.05% sodium lauryl sulfate, and 0.05% benzotriazole.

The following is an abbreviated summary of multiple biodegradation studies on FC-780B. These studies apply to a mixture with incompletely characterized concentrations of impurities. Data does not accurately reflect degradation potential of the fluorochemical component of the test sample.

METHOD:

Method: Specific methods not noted.
Type: Aerobic BOD and Dichromate reflux COD
GLP: No
Year completed: 1978 - 1982
Contact time: 20 days
Innoculum: Seed was from various sources.

RESULTS

Chemical Oxygen Demand (COD) range: 292,600 – 377,000 mg/kg
Biochemical Oxygen Demand (BOD) range:
5-Day: 23,000 – 165,000 mg/L
10-Day: 44,000 – 290,000 mg/L
15-Day: 192,000 – 380,000 mg/L
20-Day: 205,000 – 490,000 mg/L

Remarks: Testing was conducted on the mixture as described in the Test Substance Remarks field. The values reported apply to that mixture and not the fluorochemical proportion alone.

CONCLUSIONS

No reliable conclusions can be derived from these studies. The indication is that the majority of the product components are readily biodegradable.

Submitter: 3M Company, Environmental Laboratory, P.O. Box 33331, St. Paul, Minnesota, 55133

DATA QUALITY

Reliability: Klimisch ranking = 3. The studies lack description and records of the method followed. The values for the study conducted under Lab Request number 7685 are from a summary sheet only – raw data not found. The inoculum was not properly characterized. The sample purity was not properly characterized and the study lacks analytical confirmation of the amount of fluorochemical proportion in the solution.

REFERENCES

Testing was conducted by multiple laboratories at the request of the 3M Company, Lab Request numbers 4461, 4653, 4657, 4673, 5598, and 7685.

OTHER

Last changed: 6/28/00

TABLE 1
COD AND BOD DATA FOR FC-780B

	501	501	501
LAB REQ. #	4673	4673	4673
LAB	SERCO	Haller	Babcock
DATE	3/28/79	3/28/79	3/28/79
COD	377,000	293,000	345,000
BOD ₅	140,000	165,000	27,000
BOD ₁₀	290,000	190,000	44,000
BOD ₁₅	300,000	192,000	220,000
BOD ₂₀	320,000	205,000	230,000
BOD ₂₀ /COD	0.85	0.70	0.67

LOT	1	1	1
LAB REQ. #	4461	4657	4653
LAB	3M ENV.	3M ENV.	3M ENV.
DATE	11/10/78	4/23/79	5/29/79
COD	360,000	353,000	348,000
BOD ₅	140,000	53,000	34,000
BOD ₁₀	260,000	220,000	210,000
BOD ₁₅	280,000	240,000	240,000
BOD ₂₀	280,000	280,000	270,000
BOD ₂₀ /COD	0.78	0.79	0.78

	<u>Avg.</u>	<u>95% C. I.</u>	<u>Naval Research Lab Washington, DC</u>
COD	346,000	326,000-376,000	387,000
BOD ₅	93,000	28,000-158,000	
BOD ₁₀	202,000	113,000-292,000	
BOD ₁₅	245,000	204,000-287,000	
BOD ₂₀	264,000	221,000-307,000	
BOD ₂₀ /COD	0.76	0.69 - 0.83	0.96

002500

PRODUCT ECOLOGICAL ASSESSMENT
REQUEST FOR LABORATORY WORK

Ref: ENVIR. ASSESS. INQ. # 79037 (78309)

LAB REQUEST NO. 4673

Commercial Chemicals DIVISION
PRODUCT: FC-780 B Lot 501

REQUESTER

Name: Eric A Reiner Phone No. 5079
Request Date: 1-31-79
Project No.: 9970012700 Prob. No. _____
Code No.: _____
Sample Date: 1-26-79 Date Needed: _____
Description: Conduct the following B&O test at 3 outside
Purpose of Tests: Lebs to determine if this product
meets the requirements of MIL-F-24385B

LABORATORY

Date Received Sample: 2-7-79
Analyst: DCS
Date Completed: 3-28-79
Hours Spent: _____
Y _____ B _____ P _____
Please Call Requester If Delays Are Encountered.

PHYSICAL & CHEMICAL PROPERTIES

Heat of Combustion Cal/G (BTU/Lb.)

Density

Ash

Other

780 B
Lot 501

SERCO LAB

#1

HANER LAB

#2

BABCO

#3

WATER POLLUTION

pH

COD

BOD₅

BOD_{Ultimate}

TOC BOD₁₅

BOD₂₀

Oxygen Uptake

Dehydrogenase Activity (TTC)

Other

X

X

X

X

X

377,000

140,000

290,000

300,000

320,000

292,600

145,000

190,000

192,000

205,000

345,000

27,000

44,000

220,000

230,000

BIOASSAY

Specify Organism and Method:

LEACHATE FROM LEACHING TEST

pH

COD

BOD₅

BOD_{Ultimate}

TOC

GC

Bioassay

Other

OTHER

Bioaccumulation

Persistence

Degradation Products

002501

THE HALLER TESTING LABORATORIES

INCORPORATED

336 Leland Avenue
Plainfield, N. J. 07061
P. O. Box 46

TESTING



INSPECTION

CONSULTATION

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may not be published or reproduced without our written permission.

Client Minnesota Mining & Mfg. Co., St. Paul, Minnesota

Project Purchase Order No. 711707 - 400

Subject Laboratory Testing for C.O.D. and B.O.D.

Report No. P-79-4611

Date March 15, 1979

Lab. No. L-2954

Form R-2

The following are the test results of Sample No. 7901 delivered to our
laboratory on February 5, 1979.

TEST RESULTS

C.O.D.	292,600 mg/l
B.O.D.5	165,000 mg/l
B.O.D.10	190,000 mg/l
B.O.D.15	192,000 mg/l
B.O.D.20	205,000 mg/l

THE HALLER TESTING LABORATORIES, INC.

Roger W. Haller
Vice-President

RWH:lg
Reported to:
Minnesota Mining & Mfg. Co.
Bldg. 20, 881 Bush Ave.,
St. Paul, Minnesota 55106
Att: Mr. David Seely -3-

002502

ELY • ROSEVILLE, MN
PERU, ILLINOIS

SANITARY ENGINEERING LABORATORIES, INC.
2982 N. Cleveland Ave. Roseville, Mn. 55113 (612) 636-7173

REPORT OF LABORATORY ANALYSIS
(Methodologies EPA approved)

REPORT NO. 205
02/21/79

PAGE 2 OF 2

CLIENT: 3M Company
DATE COLLECTED:
DATE RECEIVED: 02/01/79
SAMPLE DESCRIPTION: WASTEWATER

COLLECTED BY: CLIENT
PICKED-UP BY:

REC 6

LAB NO: 629
SAMPLE SITE:

4673-1

ANALYSIS:

COD, Chemical Oxygen Demand, mg/l	377000
BOD, 5-day, mg/l	140000
BOD, 10-day, mg/l	290000
BOD, 15-day, mg/l	300000
BOD, 20-day, mg/l	320000

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Approved by: DZ < means "less than"

002503

AGRICULTURAL CONSULTANTS
CHEMISTS
PROVED WATER LABORATORY

PHONE 684-1881
AREA CODE 714

LABORATORIES
3215 CHICAGO AVENUE

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ESTABLISHED 1906

EDWARD S. BABCOCK & SONS, Inc.

P. O. BOX 432
RIVERSIDE, CALIFORNIA 92502



2/26/79

TO 3 M Company
Env. Lab 2-3 E
935 Bush Avenue
St. Paul, MN 55106

Att: David Seely
SAMPLE MARKED 7901

Lab No. 790205-3

Invoice No. 85725

	Submitted	Sampled
By	Hall	
Date	2/5/79	
Time	8:15	

BOD
mg/l

COD
mg/l

5 Day

27,000

345,000

10 Day

44,000

15 Day

220,000

20 Day

230,000

AKB 2/5

AM 2/5

002504

EDWARD S. BABCOCK & SONS, Inc.

DEPT. CHARGE

0012-MONITOR

0222-ENGR

0535

PRODUCT ECOLOGICAL ASSESSMENT
REQUEST FOR LABORATORY WORKRef: ENVIR. ASSESS. INQ. # 78309-1LAB REQUEST NO. 46535Commercial Chemicals DIVISION
PRODUCT: Military Spec Grade
4FFH FC-780B

REQUESTER

LABORATORY ARD 6/30/79Name: Eric A Reiner Phone No. 5079Request Date: 1-26-78Project No.: 9970012700 Prob. No. _____

Code No.: _____

Sample Date: _____ Date Needed: _____

Description: Use Lot 501 only Store other lotPurpose of Tests: To Check again if product meetsmilitary spec for biodegradation and Aquatic toxicity.Date Received Sample: 1-26-79
Analyst: WAS
Date Completed: 5-29-79
Hours Spent: 45
Y _____ B _____ P _____

Please Call Requester If Delays Are Encountered.

PHYSICAL & CHEMICAL PROPERTIES

Heat of Combustion Cal/G (BTU/Lb.)

Density

Ash

Other

FC-780B
Lot 501FC-780B
Lot 501FC-780B
Lot 501FC-780B
Lot 501

WATER POLLUTION

pH

COD mg/l (Replicates)

BOD₅ 4 Seeds

BOD, Ultimate 20 day 4 Seeds

TOC

GC

Oxygen Uptake

Dehydrogenase Activity (TTC)

Other

Chemolite
Settle Settled
SewageChemolite
Settled Activated
Sludge or EffluentPiss eye
Fresh Settled
SewageAss eye
Settled Activated
Sludge

X 353,000

352,000

348,000 AVE = 351,000

X THREE RUNS WERE MADE

X RESULTS.

NOTES ON BOD TEST:

1. The first run, 4 seeds were used and the BOD₅ and BOD₁₀ readings were taken.2. The second run, 3 seeds were used and the BOD₅ and BOD₁₅ readings were taken.3. The third run, 1 seed was used and the BOD₅, BOD₁₀, BOD₁₅ and BOD₂₀ readings were taken.Done at
Bismarck
96 hr TC₅₀

BIOASSAY

Specify Organism and Method:

Killifish
(Fundulus heteroclitus)

LEACHATE FROM LEACHING TEST

pH

COD

BOD₅

BOD, Ultimate

TOC

GC

Bioassay

Other

X SAMPLE SHIPPED OUT 1-24-78

and LR 4657 and LR 4461

SEE LR 4613, FOR ADDITIONAL WORK ON

FC-780B, LOT 501.

OTHER

Bioaccumulation

Persistence

Degradation Products

Recyclability

Burnability

Weathering

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002505

1-22

12 RUN

BOD5 IN BLACK / BOD10 IN RED

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9-22

TEST #1

SEED #1 - PIGS EYE PRIMARY EFFLUENT	
USING SEEDED BLANKS FOR SEED CORREC- TION	STANDARD METHOD SEED CORRECTION
0.01 ml/l 205,000 + 350,000 + 65,000	225,000 + 400,000 + 45,000
0.02 265,000 + 73,500 +	240,000 + 80,000 +
0.03 245,000	250,000
AVERAGE + 140,000 (2) 310,000 (2)	135,000 (3) 345,000 (2)

SEED #2 - CHEMOLITE STALE SANITARY SEWAGE	
USING SEEDED BLANKS FOR SEED CORREC- TION	STANDARD METHOD SEED CORRECTION
115,000 240,000 + 53,500	135,000 345,000 + 33,500
265,000	280,000
295,000 (2)	325,000 (2)

SEED #3 - PIGS EYE DECANTED MIXED LIQUOR	
USING SEEDED BLANKS FOR SEED CORREC- TION	STANDARD METHOD SEED CORRECTION
190,000 330,000 + 85,000	250,000 + 445,000 + 115,000
270,000 + 90,000 +	270,000 + 110,000 +
240,000	270,000
90,000 (1) 300,000 (2)	155,000 (3) 365,000 (2)

SEED #4 - CHEMOLITE DECANTED MIXED LIQUOR	
USING SEEDED BLANKS FOR SEED CORREC- TION	STANDARD METHOD SEED CORRECTION
175,000 340,000 + 140,000	235,000 + 400,000 + 170,000
270,000 + 145,000 +	270,000 + 165,000 +
240,000	270,000
145,000 (2) 280,000 (2)	190,000 (3) 350,000 (2)

TEST #2

0.01 ml/l 130,000 245,000 + 90,000	150,000 330,000 + 100,000
0.02 240,000 + 73,500 +	245,000 + 80,000 +
0.03 240,000	255,000
AVERAGE + 73,500 (1) 265,000 (2)	90,000 (2) 295,000 (3)

70,000 240,000 + 28,500	91,500 345,000 + 62,500
265,000	280,000
260,000 (2)	295,000 (2)

120,000 240,000 + 80,500	180,000 345,000 + 120,000
270,000 + 83,500 +	270,000 + 105,000 +
240,000	270,000
83,500 (1) 285,000 (2)	115,000 (2) 350,000 (2)

165,000 340,000 + 150,000	225,000 + 400,000 + 180,000
270,000 + 150,000 +	270,000 + 170,000 +
255,000	255,000
150,000 (2) 270,000 (2)	190,000 (3) 335,000 (2)

TEST #3

0.01 ml/l 120,000 240,000 + 90,000	140,000 330,000 + 100,000
0.02 240,000 + 70,000 +	245,000 + 80,000 +
0.03 230,000	245,000
AVERAGE + 70,000 (1) 260,000 (3)	88,500 (2) 290,000 (3)

75,000 240,000 + 50,000	96,500 345,000 + 61,500
260,000	280,000
270,000 (2)	305,000 (2)

110,000 240,000 + 85,000	175,000 345,000 + 115,000
270,000 + 78,500 +	270,000 + 105,000 +
240,000	270,000
78,500 + 225,000 (2)	105,000 (2) 340,000 (2)

185,000 340,000 + 170,000	245,000 + 400,000 + 200,000
270,000 + 155,000 +	270,000 + 175,000 +
240,000	270,000
165,000 (2) 275,000 (2)	205,000 (3) 335,000 (2)

BOD STANDARD

ml/300ml

2.0
4.0
6.0

225 225 225 240 +	255 255 255 255 +
225 (2) 240 (2)	235 (2) 270 (2)

200 170 + 200 +	235 215 + 215 +
185 (2) 240 (2)	200 (2) 270 (2)

195 215 + 210 +	285 260 + 245 +
215 (2) 250 (2)	255 (2) 305 (2)

190 190 + 190 +	250 250 + 250 +
190 (2) 240 (2)	230 (2) 300 (2)

AVERAGE
OF (+)
NUMBERS

AVERAGE = THE AVERAGE OF DILUTIONS WITH AT LEAST 2.0 mg/l DO DEPLETION

002506

NOTES ON 1ST RUN

4-23-79

There were not any unseeded dilution water controls set-up during this run.

W. A. Schulz
4-23-79

The initial D.O. of the sample dilutions were assumed to be the same as the seeded blank average value.

Wade A. Schulz
4-23-79

Between the 10th and 15th days of incubation the sample dilutions froze because of a defective thermostat control. Therefore only the BOD₅ and BOD₁₀ were reported.

Wade A. Schulz
5-15-79

Calculation Methods

① Using seeded blanks for seed correction:
$$\text{mg/l BOD} = \frac{\text{DO of Seeded blanks (avg.)} - \text{DO of sample dilution}}{\text{ml sample / 300 ml dilution}} \times 300 =$$

② Standard method seed correction: BEST COPY AVAILABLE

$$\frac{(D_1 - D_2) - (B_1 - B_2) f}{P} = \text{mg/l BOD}$$

(see page 549 of Standard Methods - 14th Ed.)

call me if you have any questions

00250 Wade

3-22

BOD5
2-19-79
W.A. Schul

2nd Run

ENVIRONMENTAL LABORATORY
BOD WORK SHEET
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LR Page No. 46535

Date: 2-14-79 W.A. Schul

Dilution Water: 182

Seed: DESCRIPTION BELOW

Bk. Avg.

Blanks:

Bottle No.	Sample Size	Description	INITIAL D.O. (D _i)	D.O. AFTER INCUBATION	STD. METH. CALCULATION	SUBTRACTING BLANK CALCULATION
1	-	Unseeded	9.2	8.45		
9	-	Dilution H ₂ O	9.2	8.40		
5	-	Blanks	9.2	8.40		
SEED #1 Pipe ex. Stale * Sewage, filtered through Whatman #10. 14 paper filter } seed concentration and filter of dilution water * Influent (after bar screen)						
12	10	Seed Controls	9.05	3.45		
102	20		8.90	<0.5	-	-
14	40		8.25	<0.5	-	-
17	3.0	FC-780B, LOT 501	-	5.65	320,000	250,000
73	6.0	(initial sample DO =	-	3.70	260,000	220,000
4	9.0	8.80 mg/l) 1.00ml → 100ml	-	2.40	220,000	190,000
Initial dilution of sample with D.H. H ₂ O						
9 #1	3.0	duplicate	-	5.65	320,000	250,000
19 #	6.0	(see above)	-	3.30	280,000	240,000
13	9.0		-	1.90	230,000	210,000
INCLUDE WITH FC-780B, LOT 1 RESULTS (LR #46575)						
71	3.0	FC-780B, LOT 1	-	5.60	330,000	250,000
9	6.0	(initial sample DO = 8.8	-	4.50	220,000	180,000
23	9.0	mg/l) 1.00ml → 100ml	-	2.55	210,000	190,000
Initial dilution of sample with D.H. H ₂ O						
20	3.0	duplicate	-	5.05	380,000	310,000
134	6.0	(see above)	-	3.85	250,000	210,000
13	9.0		-	2.40	220,000	190,000
8	4.0	STANDARD -	-	4.95	290	240
5	5.0	150mg Glucose and	-	4.20	280	240
47	6.0	150mg Niacin acid	-	3.30	280	240
per liter (initial sample DO = 9.2)						
					002508	4-22

no
BODS
2-19-79
W.A.

5
-79
W.A. Schind

ENVIRONMENTAL LABORATORY
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Page No. 46535
Date: 2-14-79 U.S.
Dilution Water: 182
Seed: DESCRIPTION BELOW
Bk. Avg.

Blanks: _____, _____, _____, _____

Blk. Ave.

Bottle No.	Sample Size	Description	INITIAL D.O. (D _i)	DO AFTER INCUBATION	STD. METHOD CALCULATION	SUBTRACTION OF BLANK CALCULATION
		SEED #2 Papa Eye Eff. + Filtered through Whatman #14				
						used concentration = 2ml/liter of dilution water → settled mixed liquor approximate
20	25	SEED CONTROLS	9.1	6.90		
21	50		9.1	5.85		used for calculation seed correction
1	3.0	FC-780B, LOT 501	-	6.35	290,000	200,000
21B	6.0	(initial sample DO =	-	4.95	210,000	170,000
14	9.0	8.80 mg/l) 1.00 ml → 1000 ml	-	4.00	170,000	150,000
		(initial dilution of sample with 0.6 H ₂ O)				
59	3.0	"	-	6.45	270,000	190,000
28	6.0	duplicate	-	5.40	190,000	150,000
2	9.0		-	3.90	180,000	150,000
17	4.0	BOD STANDARD	-	5.05	310	250
22	5.0	150 mg Glucose and	-	4.60	270	230
23	6.0	150 mg Glutamic acid per liter (initial D.O. = 9.2 mg/l)	-	3.75	270	230
BEST COPY AVAILABLE						
					002509	5-22

BOD5
2-19-79
W.A. Schind

2nd Run
ENVIRONMENTAL LABORATORY

BOD WORK SHEET

BEST COPY AVAILABLE

Blanks: _____

LR
Page No. 46535

Date: 2-14-79 W.A. Schind

Dilution Water: 188

Seed: See below

Bk. Avg. _____

Bottle No.	Sample Size	Description	INITIAL D.O.	DO AFTER INCUBATION	STD. METHOD CALCULATION	SUBTRACTION OF BLANK CALCULATION
		<u>SEED #3</u> chemically eff. x seed concentration / filter Filtered through of dilution water Whatman® 10.41 & settled mixed liquor supernatant				
20	25	Seed Controls	9.1	6.55		
12	50		9.1	5.20		cell for ml correction
6	3.0	FC-780B, LOT 501	-	6.60	260,000	180,000
3	6.0	(initial sample D.O. =	-	5.60	180,000	140,000
25	9.0	9.8 mg/l)	-	4.10	170,000	140,000
		1.00 ml → 1000 ml (initial dilution of sample with D.O. H ₂ O)				
19	3.0	"	-	4.56.50	270,000	190,000
9	6.0	duplicate	-	5.00	210,000	170,000
24	9.0		-	3.85	180,000	150,000
7	4.0	BOD STANDARD	-	5.25	290	240
41	5.0	150mg Glucose and	-	4.60	270	230
22	6.0	150mg Glutamic acid	-	3.80	270	230
		per liter of D.O. H ₂ O				
		(initial DO = 9.2 mg/l)				

002510

6-22

BODIF
3-01-79
W.A. Scheil

* unable to calculate results because of near
total D.O. depletion of seed controls.

Page No. 46535

ENVIRONMENTAL LABORATORY

BOD WORK SHEET

Date: 2-14-79 W.A. Scheil

Dilution Water: 180

Seed: DESCRIPTION BELOW

Blanks: 2nd Run

Bk. Avg.

Bottle No.	Sample Size	Description	INITIAL D.O. (D _i)	D.O. AFTER INCUBATION	STD. METH. CALCULATION	SUBTRACTING BLANK CALCULATION
1	-	Unseeded	9.2	8.00		
9	-	Dilution H ₂ O	9.2	8.05		
5	-	Blanks	9.2	8.05		
		(SEED #1) Rice eye stale Shewaga, filtered through Whatman No. 14 paper filter				
		seed concentration = 2 ml/liter of dilution water				
		BEST COPY AVAILABLE				
12	10	Seed Controls	9.05	<0.5		
102	20		8.90	<0.5		
14	40		8.25	<0.5		
17	3.0	FC-780B, LOT 501	-	4.2	*	*
73	6.0	(initial sample DO =	-	<0.5	*	*
4	9.0	8.80 mg/l)	-	<0.5	*	*
		1.00ml → 100ml (initial dilution of sample with D.O. H ₂ O)				
9	3.0	duplicate	-	3.8	*	*
19	6.0	(see above)	-	<0.5	*	*
13	9.0		-	<0.5	*	*
21	3.0	FC-780B, LOT 1	-	3.3	*	*
9	6.0	(initial sample DO = 8.8	-	<0.5	*	*
23	9.0	mg/l) 1.00ml → 100ml	-	<0.5	*	*
		→ (initial dilution of sample with D.O. H ₂ O)				
20	3.0	duplicate	-	4.25	*	*
134	6.0	(see above)	-	<0.5	*	*
13	9.0		-	<0.5	*	*
8	4.0	STANDARD -	-	3.8	*	*
5	5.0	150mg Glucose and	-	3.05	*	*
47	6.0	150mg Nitramic acid	-	1.55	*	*
		per liter (initial				
		DO = 9.2)				

002511

PRODUCT ECOLOGICAL ASSESSMENT
REQUEST FOR LABORATORY WORK

Ref: ENVIR. ASSESS. INQ. # 78309-2
Commercial Chemicals DIVISION
PRODUCT: FC-780B Lot 1

LAB REQUEST NO. 46578

REQUESTER

Name: Eric Reiner Phone No. 5079
Request Date: 1-29-79
Project No.: 9970012800 Prob. No. _____
Code No.: _____
Sample Date: _____ Date Needed: _____
Description: Determine ultimate BOD
Purpose of Tests: To see if product is similar to lot 501

LABORATORY

ARD 4/24/79
Date Received Sample: 1-29-79
Analyst: WAS
Date Completed: 4-23-79
Hours Spent: 12
Y _____ B _____ P _____
Please Call Requester If Delays Are Encountered.

PHYSICAL & CHEMICAL PROPERTIES

Heat of Combustion Cal/G (BTU/Lb.)

Density

Ash

Other

FC-780B
Lot 501

duplicate

#1

WATER POLLUTION

pH

COD

BOD₅

BOD, Ultimate

TOC

GC

Oxygen Uptake

Dehydrogenase Activity (TTC)

Other

X 352,000 X 353,000
* } see attached data sheet and BOD
* } work sheets.

BIOASSAY

Specify Organism and Method:

LEACHATE FROM LEACHING TEST

pH

COD

BOD₅

BOD, Ultimate

TOC

GC

Bioassay

Other

OTHER

Bioaccumulation

Persistence

Degradation Products

002513

BOD 15

3-01-79

01-79
W. A. Schind

ENVIRONMENTAL LABORATORY

BOD WORK SHEET

Thanks:

2nd Run

Date: 2-14-79 W. Q. S. & A.

Dilution Water: 180

Seed: See below**Bk. Avg.**[illegible]

3RD Run

ENVIRONMENTAL LABORATORY

BOD WORK SHEET

46535

Date: 5/16/72

Dilution Water: 18.2

Seed: *Pige Eye - Raw*

Bk. Avg. _____

3 ml/l

Blanks: _____

Bottle No.	Sample Size ml	Description	D.O.	Depletion	5 Day BOD	Avg. mg/l
		FC-780B LOT 501				
		0.25 ml → 250 ml				
		Initial DO = 7.0 mg/l				
		f = 1000				
16	1.0		8.20	0.80	105 x f	105,000
7	3.0		8.00	1.00	55.0 x f	55,000
78	5.0		7.80	1.15	42.0 x f	42,000
8	7.0		7.60	1.35	38.5 x f	38,500
77	9.0					

5-21-72
W.A.S.

DL = { 9.0
9.00
8.95
8.95

* missed DO reading → forgot to record. (W.A.S.)

The initial DO of the Dilution Water = 9.00

Seed correction = 0.45 mg/l for all dilutions

Calculations:

STANDARD

SEE PG

SUB-BLANK

1.0	8.20	-	-
3.0	8.00	-	-
5.0	7.80	43,000 *	37,000 *
7.0	7.60	39,000 *	35,000 *
9.0		* see note above	
		↓	↓
		41,000	36,000
			34,000

avg. of * values
(as reported)

mg/l

W.A.S. 5-16-72

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302 Run
ENVIRONMENTAL LABORATORY
BOD WORK SHEET

46535
 Date: 3-16-79
 Dilution Water: 18l
 Seed: Pipe Eye - Raw
 Bk. Avg. _____

Blanks: _____

3 ml/l

Bottle No.	Sample Size ml	Description	D.O.	Depletion	15-Day BOD	Avg.
		FC-780B				
		LOT 501				
		0.25 ml → 250 ml	5-31-79 W.A.S. Schind	Standard	see PC	Sub. Blank
		Initial DO = 7.0 mg/l				
10	1.0		5.5	-	-	
7	3.0		3.7	410,000	260,000	230,000
78	5.0		1.9	350,000	260,000	250,000
8	7.0		0.5			
79	9.0					
		avg of 4 values =		380,000	260,000	240,000
		(as reported)			mg/l	

Schind
 W.A.S.
 3-16-79

3rd Run
ENVIRONMENTAL LABORATORY
BOD WORK SHEET

46535
 Date: 3-16-79
 Dilution Water: 18L
 Seed: Pige Eye - Raw
 Bk. Avg. _____

Blanks: _____

3 ml/l

Bottle No.	Sample Size ml	Description	D.O.	Depletion	20-Day BOD	Avg
		FC-780B				
		LOT 501				
		0.25 ml → 250 ml				
		Initial DO = 7.0 mg/l				
			4-05-79			
			W. A. Schind			
					42 1/2 PC	
10	1.0		4.8	830,000	280,000	230,000
7	3.0		2.95	460,000	280,000	260,000
78	5.0		0.90	400,000	290,000	280,000
8	7.0					
77	9.0					
		avg of 4 values =		430,000	280,000	270,000
		(as reported)				
					mg/l	

W. A. Schind
 3-16-79

002519

Bk. Avg

15-22

ENVIRONMENTAL LABORATORY

BOD WORK SHEET

Page No. 46535

Date: 3-16-79

Dilution Water: 184

3ml/l Seed: Pige Eye - Ra

Bk. Avg.

Blanks:

[illegible]

ENVIRONMENTAL LABORATORY BOD WORK SHEET

300 Run

46535

Date: 3-16-79

Dilution Water: 18.4

3ml/l Seed: Pige Eye - R

Bk. Avg.

Blanks: _____

Bottle No.	Sample Size	Description	D.O.	Deposition	Avg.
		Seeded Dilution	Initial	after 15 min incubation	
		H ₂ O Blanks			
		3ml/l			
9			8.9	6.3	
128			9.0	6.3	
1			8.85	6.35	
		Avg =		6.32	
		SEED CONTROLS			
21	2		9.0	4.9	
134	4		9.0	3.55	
90	8		8.9	2.1	
22	16		8.75		
		Unseeded Dilution			
		H ₂ O Controls			
115			9.0	6.65	2.35
83			9.0	6.85	2.15
23			9.0	6.75	2.25
4			9.0	6.70	2.30
					Deposition avg = 2.26
					Corrected value for blank = 5.78
					W.A. Schulz 3-16-79

ENVIRONMENTAL LABORATORY
BOD WORK SHEET

File No. 46535

Date: 3-16-79

Dilution Water: 18 p

3ml/l Seed: Pige Eye - R

Bk. Avg.

Blanks: _____

[illegible]

3rd Run ENVIRONMENTAL LABORATORY BOD WORK SHEET

Date: 2-16-79

Dilution Water: 18V

Seed: Pig Eye - Ran

Bk. Avg.

Blanks: _____

3 ml/l

Bottle No.	Sample Size ml	Description	D.O.	Depletion	5-Day BOD	Avg.
		BOD/COD STD 15				
		Initial DO = 9.0				
		TV = 282 mg/l				
71	1.0		9.00	7.30	1.70	320
30	2.0		9.00	6.40	2.60	325
140	3.0	DC =	9.00	5.30	3.70	325
42	4.0		9.00	4.25	4.75	325

The initial DO of the dilution H₂O = 9.00

Seed correction on all dilutions = 0.85 mg/l

Calculations

STANDARD

2.9 & PC

SUB BLANK

1.0	7.30	370	340	320
2.0	6.40	320*	300*	300*
3.0	5.30	320*	310*	310*
4.0	4.25	320*	310*	310*

avg. of * values =
(as reported)

320 mg/l 310 mg/l

310 mg/l

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W. A. Schil
3-16-79

00252

19-22

ENVIRONMENTAL LABORATORY
BOD WORK SHEET

3rd Run

Date: 4653 S
3 16 12

Dilution Water: 18 l

Seed: Pipe Eye - Red

Bk. Avg.

Blanks:

3 ml/l

Bottle No.	Sample Size ml	Description	D.O. mg/l	Depletion	10-Day BOD	Avg.
		BOD/COD STD 15				
		Initial DO = 9.0				
		TV = 282 mg/l				
71	1.0		5.95		400	
30	2.0		5.1	460*	330 *	300*
140	3.0		3.95	420*	330 *	320*
42	4.0		2.95	390*	320 *	310*
		avg. of * values = (as reported)		420 mg/l	330 mg/l	310
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W. A. Schil 3-16-79						
002525						

3rd Run
ENVIRONMENTAL LABORATORY
BOD WORK SHEET

Date: *4653.5*
*3-16-77*Dilution Water: *18 L*Seed: *Pigg Eye - R*

Bk. Avg. _____

Blanks: _____

3 ml/L

Bottle No.	Sample Size <i>ml</i>	Description	D.O.	Depletion	15-Day BOD	Avg.
		<i>BOD/COD STD 15</i>				
		<i>Initial DO = 9.0</i>				
		<i>TV = 282 mg/L</i>	<i>WAS 21-79</i>	<i>Standard</i>	<i>520 mg/L</i>	<i>Sub BOD</i>
<i>71</i>	<i>1.0</i>		<i>5.2</i>			
<i>30</i>	<i>2.0</i>		<i>4.15</i>	<i>540 *</i>	<i>320 *</i>	<i>280 *</i>
<i>140</i>	<i>3.0</i>		<i>3.0</i>	<i>480 *</i>	<i>330 *</i>	<i>300 *</i>
<i>42</i>	<i>4.0</i>		<i>1.8</i>	<i>450 *</i>	<i>340 *</i>	<i>320 *</i>
		<i>avg. of * values =</i>		<i>490 mg/L</i>	<i>330 mg/L</i>	<i>300 mg/L</i>
		<i>(as reported)</i>				

W. A. Seidel
3-16-79

002526

ENVIRONMENTAL LABORATORY

BOD WORK SHEET

3rd Run

Date: 3-16-79 ⁴⁶⁵³⁵

Dilution Water: 180

3 ml/l Seed: Pigeon Eye - Ram

Bk. Avg.

Blanks: _____

[illegible]

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W. A. Schind
3-16-79

002527

22-22

PRODUCT ECOLOGICAL ASSESSMENT
REQUEST FOR LABORATORY WORK

Ref: ENVIR. ASSESS. INQ. # 79037 (78309)

LAB REQUEST NO. 4673

~~Commercial Chemicals~~ DIVISION
PRODUCT: FC-780 B Lot 501

REQUESTER

Name: Eric A Reiner Phone No. 5079
Request Date: 1-31-79
Project No.: 9970012700 Prob. No. _____
Code No.: _____
Sample Date: 1-28-79 Date Needed: _____
Description: Conduct the following BOD test at 30°C
Purpose of Tests: to determine if this product meets the requirements of MIL-F-24385B

LABORATORY

Date Received Sample: 2-1-79
Analyst: DCS
Date Completed: 3-28-79
Hours Spent: _____
Y _____ B _____ P _____
Please Call Requester If Delays Are Encountered.

PHYSICAL & CHEMICAL PROPERTIES

Heat of Combustion Cal/G (BTU/Lb.)

Density

780 B
Lot 501

SECO LAB

HALLER LAB

BABCOCK

#1

#2

#3

DEPT CHG: 10535
EEPC:

REQUEST FOR LABORATORY WORK
FINAL REPORT

LAB REQUEST NO. 4673

Eric If you need more info on this request, please call me.

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--REQUESTOR--

NAME: EAR
PROJECT NO. 9970012700
DESC: FC 780-B LOT 501

--LAB PERSONNEL--

DATE RECEIVED: 2701/1979
ANALYST: DCS
DATE COMPLETED: 3728/1979
HRS SPENT: _____
ACTION DATE 2701/1979

CODE
TYPE
DATE
TIME
FLOW
ADD. DEC.

TEST 01
BOD 140000 MG/L
BOD 10 290000 MG/L
BOD 15 300000 MG/L
BOD ULT (20) 320000 MG/L
COD 377000 MG/L

02
165000 MG/L
190000 MG/L
192000 MG/L
205000 MG/L
292600 MG/L

03
27000 MG/L
44000 MG/L
220000 MG/L
230000 MG/L
345000 MG/L

OTHER

Bioaccumulation
Persistence
Degradation Products

002528

(EE & PC Contact)

Lab Request No. 55983

DEPT. CHARGE

- ☐ 0012 - MONITOR
☐ 0222 - ENGR.
☒ 0535 - PEA

Water and Wastewater

REQUEST FOR LABORATORY WORK

TO: ENVIRONMENTAL ENGINEERING LABORATORY - BUILDING 2-3

KAT 5-22-80

Requester

Lab Personnel

Name: DCS Request Date: 4-14-80
 Project No.: 9970012600 Prob. No.:
 Description: FC 780 B LOT 501 AND STD
 Hold Sample For _____ Days Est. Date Needed: _____
 Special Precautions _____

Date Rec'd. Sample: 4-14-80
 Analyst: GALBRAITH LAB
 Date Completed: 5-20-80
 Hrs. Spent: 9

No.	Sample Description	①	②	③
		FC 780 B LOT 501	STD 270	STD 276
1	Total Hardness, mg/l as CaCO ₃			
2	Calcium Hardness, mg/l as CaCO ₃			
3	"P" Alkalinity, mg/l as CaCO ₃			
4	"M" Alkalinity, mg/l as CaCO ₃			
5	pH			
6	Chloride, mg/l as Cl			
7	Silica, mg/l as SiO ₂			
8	Total Fluoride, mg/l as F			
9	Soluble Fluoride mg/l as F			
10	Manganese, mg/l as Mn			
11	Total Suspended Solids, mg/l			
12	Volatile Suspended Solids, mg/l			
13	Turbidity, NTU			
14	Total Solids, mg/l	BOD 5 mg/l ✓ 80,680	✓ 1734	✓ 223
15	Total Volatile Solids, mg/l	BOD 10 mg/l ✓ 100,790	✓ 2034	✓ 276
16	Conductivity, μ mmhos	BOD 20 mg/l ✓ 358,400	✓ 2834	✓ 303
17	Sulfate, mg/l as SO ₄			
18	Sulfide, mg/l as S			
19	Sulfite, mg/l as SO ₃			
20	Ammonia Nitrogen, mg/l as N			
21	Kjeldahl Nitrogen, mg/l as N			
22	Nitrite, mg/l as N			
23	Nitrate, mg/l as N			
24	Ortho Phosphate, mg/l as P			
25	Total Phosphate, mg/l as P			
26	BOD, mg/l			
27	COD, mg/l (Short, Strong, Dilute)	✓ 352,288	✓ 2490	✓ 297
28	Total Organic Carbon - TOC mg/l as C			
29	Surfactant, mg/l as LAS			
30	Phenol, mg/l			
31	Tannin & Lignin, mg/l			
32	Total Cyanide, mg/l as CN			
33	Oil and Grease, mg/l			
34	Standard Plate Count No./100 ml			
35	Total Coliform, No./100 ml			
36	Fecal Coliform, No./100 ml			
37	Fecal Streptococcus, No./100 ml			

KAT 5-20-80

Comments:

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002529

Internal Correspondence
cc: D. R. Ricker - 53-4N
D. L. Bacon/R. L. Bohon - 21-2W-05

To: J. A. PIGNATO - COMMERCIAL CHEMICALS LAB - 236-2A-01
From: E. A. REINER - ENVIRONMENTAL LABORATORY/EE & PC - 21-2W-5
Subject: MIL-SPEC AFFF BOD AND COD TESTING
Date: MAY 25, 1982

3M

Attached is a summary of the BOD, carbonaceous BOD, and COD test results on FC-203C, FC-206C, and FC-780B. This testing was conducted at the 3M Environmental Laboratory and four outside laboratories. The results were more variable than I had anticipated.

The Galbraith results on FC-206C were typical of their result from past testing, i.e., they had a very high BOD₂₀/COD ratio. This occurred despite the fact that some of this testing was done with a nitrification inhibitor (the C-BOD results) and some of the tests were done using a seed unlikely to contain a large population of nitrifying organisms (seed from the Knoxville waste treatment system). While I had previously thought that their results were due to nitrification, I must now say that I do not know why Galbraith gets such atypically high BOD results.

I plan to use the average data from all of these tests in preparing our Product Environmental Data Sheets and input for our Material Safety Data Sheets. If you have any questions concerning these data, please feel free to contact me on 778-5079.



EAR/mk

Attachment

002530...

BOD, CARBONACEOUS BOD, AND COD DATA ON MIL-SPEC AFFF PRODUCT

<u>Lab</u>	<u>BOD₂₀</u> <u>(mg/kg)</u>	<u>C-BOD</u> <u>(mg/kg)</u>	<u>COD</u> <u>(mg/kg)</u>	<u>BOD₂₀</u> <u>COD</u>	<u>C-BOD₂₀</u> <u>COD</u>
<u>FC-203C Lot 501</u>					
3M	580,000	600,000	730,000 740,000	.79	.81
Pace	800,000*	730,000*	810,000 730,000		
Serco	440,000	440,000	737,000	.60	.60
Capsule	570,000	620,000	950,000	.6	.65
Galbraith	616,000	671,000	776,450	.79	.86
S & W Seed					
Galbraith	670,000	641,000	776,450	.86	.82
Knoxville					
Average	575,000	594,000	782,000	.73	.75
S. D.	85,000	90,000	80,000	.12	.12

* Calculated BOD's from different dilutions were very inconsistent. Pace agreed to repeat this work but inadvertently lost their repeated test results as well. We did not request a third testing nor did we include these values in the averages.

<u>FC-206C Lot 502</u>					
3M	290,000	290,000	380,000 360,000	0.78	0.78
Pace	350,000	370,000	450,000	0.78	0.82
Serco	240,000	260,000	370,000	0.65	0.70
Capsule	260,000	320,000	410,000	0.63	0.78
Galbraith	416,500	411,000	407,250	1.02	1.01
S & W Seed					
Galbraith	395,500	374,000	407,250	.97	.92
Knoxville					
Average	325,000	338,000	396,000	.81	.83
S. D.	73,000	57,00	33,000	.16	.11

<u>FC-780B Lot 501</u>					
3M	240,000	230,000	320,000 330,000	.74	.71
Pace	250,000	250,000	350,000	.71	.71
Serco	210,000	220,000	287,000	.73	.77
Capsule	240,000	230,000	360,000	.67	.64
Average	235,000	232,000	329,000	.71	.71
S. D.	17,000	13,000	28,000	.03	.05

002531

PRODUCT ECOLOGICAL ASSESSMENT
REQUEST FOR LABORATORY WORK

Ref: ENVIR. ASSESS. INQ. #

LAB REQUEST NO. 4461

Comm. Chem. DIVISION
PRODUCT: EC 780 B

REQUESTER

Name: A.N. Welter Phone No. 5379
Request Date: 9/27/78
Project No.: 9970012600 Prob. No. _____
Code No.: _____
Sample Date: _____ Date Needed: ASAP
Description: BOD, COD, Aquatic Toxicity
Purpose of Tests: _____

LABORATORY ARO 11/16/78

Date Received Sample: 9-27-78
Analyst: WAS, MTE
Date Completed: 11-16-78
Hours Spent: 7 hrs - 10 MTE, T=17
Y _____ B _____ P _____

Please Call Requester If Delays Are Encountered.

1 PINT OF SAMPLE

PHYSICAL & CHEMICAL PROPERTIES

Heat of Combustion Cal/G (BTU/Lb.)

Density

Ash

Other

DUPLICATES

WATER POLLUTION

pH

COD

BOD₅

BOD, Ultimate

TOC

GC

Oxygen Uptake

Dehydrogenase Activity (TTC)

Other

#1
✓ 356,000 364,000
✓ * SEE ATTACHED DATA SHEET
✓ * " " "
✓ 104,000 103,000

BIOASSAY

Specify Organism and Method: 96 h LC50

Aquatic Tox Bluegill ✓ 1.5 grams/liter

LEACHATE FROM LEACHING TEST

pH

COD

BOD₅

BOD, Ultimate

TOC

GC

Bioassay

Other

OTHER

Bioaccumulation

Persistence

Degradation Products

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002532

FC-780B
ULTIMATE BOD
ENV. LAB REQ. NO. 4461

D.O.
DEPLETION
BOD
VALUE

D.O.
DEPLETION
BOD
VALUE

D.O.
DEPLETION
BOD
VALUE

D.O.
DEPLETION
BOD
VALUE

D.O.
DEPLETION
BOD
VALUE

1													
2	SAMPLE CONCENTRATION												
3	IN BOD BOTTLES -												
4	(ml/l)												
5													
6	0.0067	0.2	30,000	1.4	210,000	1.8	279,000	2.0	300,000	2.0	300,000		
7	0.013	0.4	30,000	2.3	170,000	3.5	260,000	3.75	280,000	3.6	270,000		
8	0.027	0.7	26,000	3.7	140,000	6.8	260,000	7.2	270,000	>6	-		
9	0.053	1.3	24,000	5.0	94,000	>8	-	-	-	-	-		
10	0.083	2.1	25,000	>8	-	-	-	-	-	-	-		
11													
12													
13	BOD VALUES CALCULATED	25,000		140,000		260,000		280,000		280,000			
14	ACCORDING TO STANDARD												
15	METHODS - 14 th EDITION.												
16													
17													
18													
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35													
36													

* ALL RESULTS EXPRESSED IN mg/l.

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002533

78

DATE

ENG.

FILE

SHEET

002533