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-3041. (1-Octanesulfonic acid) (CAS # 2795-39-3).

Remarks: The 3M production lot number was 2300. The test sample is FC-3041 (cc 809-1). Current information indicates it is a mixture of 6% PFOS, 36% diethylene glycol butyl ether, 36.05% water, 12% Sultone foamer, 9% sodium octyl sulfate, 0.55% sodium lauryl sulfate, and 0.4% tolyltriazole.

The following summary applies to a mixture with incompletely characterized concentrations of impurities. Data may not accurately reflect the biodegradability of the fluorochemical component of the test sample.

METHOD:

Method: BOD Protocol of EAR (2/29/80).
Type: Aerobic
GLP: No
Year completed: 1981
Contact time: 20 days
Inoculum: Stale sewage, Chemolite, Cottage Grove, MN.

RESULTS

Biochemical Oxygen Demand (BOD):

5-Day:	164,000 – 329,000 mg/kg
12-Day:	645,000 mg/kg
20-Day:	642,000 mg/kg

CONCLUSIONS

No conclusions given.

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

DATA QUALITY

Reliability: Klimisch ranking 3. The study lacks description and records of the method followed. The inoculum is not properly characterized. There is no characterization of the test substance purity, and the study lacks analytical confirmation of the amount of fluorochemical proportion in solution. The testing was conducted on a mixture of chemicals having varing degrees of biodegradability, leading to potential misinterpretation of the results.

REFERENCES

This study was conducted by the 3M Company, Environmental Laboratory, St. Paul, MN, Lab Request number 6508S, 1981.

OTHER

Last changed: 6/26/00

FILE: LR6508 S

SEC. W.A. Schiel

DATE 3/13/81 SHEET NO.

3M ENVIRONMENTAL LABORATORY

ANALYSIS FORM 1038A

ULTIMATE BOD

		BOD 5	BOD 12	BOD 20	
		A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R
1	CONCENTRATION OF																
2	SAMPLE IN BOD																
3	BOTTLES																
4																	
5	8.5 mg/l	329,000		645,000		642,000	} all reported results should be rounded										
6							to 2 significant figures.										
7	17 "	278,000		—		—											
8																	
9	34 "	164,000		—		—											
10																	
11																	
12	RESULTS EXPRESSED IN mg/kg																
13																	
14																	
15	RESULTS CALCULATED ACCORDING TO SEC. 3.7 OF BOD PROTOCOL (EAR 2/29/80),																
16	FORMULA NO. 5.																
17																	
18																	
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Environmental Laboratory
BOD Work Sheet - Samples

3M

Lab Req. No. ▶ 6508 S	BOD Run No. ▶ 81-1
Analyst: W. A. Schiel — Date Started: 2/13/81	5 - Day BOD Readings
	Analyst: W. A. Schiel — Date: 2/18/81

Sample Description: FC-3041, LOT 2300, (CC809-1)

Initial Dilution: 0.128 g of Sample diluted to 100 ml with DI water

Initial Dilution Factor: 100/0.928 (Dilution factor = 1 if undiluted)

Bottle No.	Conc. of Sample[1]	Sample Size[2]	Initial D.O. (D_1)	Present D.O. (D_2)	Total D.O. Depletion ($D_1 - D_2$)	Depletion Due To Sample	5 / BOD - Day	Average 5 / BOD - Day
22	8.5	2.0	8.75	5.40	3.35	2.80	329,000 mg/kg	*
80	17	4.0	8.80	3.50	5.30	4.76	278,000 mg/kg	
88	34	8.0	8.75	2.60	6.15	5.61	164,000 mg/kg	
64	51	~~16~~ 12	8.75	<0.5		—	—	
18	68	16	8.75	<0.5	—	—	—	

* Note sliding values.

BOD TEST RESULTS
2. (ML) G
3.35 TDEP
2.80366666667 DDS
420.55 x f = BOD
329,000 mg/kg

BOD TEST RESULTS
4. (ML) G
5.3 TDEP
4.757333333 DDS
356.8 x f = BOD
278,000 mg/kg

BOD TEST RESULTS
8. (ML) G
6.15 TDEP
5.614666667 DDS
210.55 x f = BOD
164,000 mg/kg

Note: 1. Conc. = Concentration of sample (ml/l or (mg/l)) in BOD bottles.

2. Sample Size = ml or g of sample or diluted sample added to BOD Bottle.

Comments

COD - ~720,000 mg/kg

Calculation performed accorded to sec. 3.7 (formula #5) of BOD Protocol, EAR, 2-29-80. Calculation method used seeded dilution H_2O to make seed correction.

Form 19756 PWO

Environmental Laboratory
BOD Work Sheet - Samples

3V

Lab Req. No. ▶ 6508 S	BOD Run No. ▶ 81-1
Analyst W. A. Schell / Date Started 2/13/81	12 Day BOD Readings
	Analyst W.A. Schell / Date 2/25/81

Sample Description: FC-3041, LOT 2300, (CC809-1)

Initial Dilution	0.128 g of Sample diluted to 100 ml with DI water
Initial Dilution Factor	100/0.128 (Dilution factor = 1 if undiluted)

Bottle No.	Conc. of Sample[1]	Sample Size[2]	Initial D.O. (D_1)	Present D.O. (D_2)	Total D.O. Depletion ($D_1 - D_2$)	Depletion Due To Sample	12 Day BOD	Average Day BOD
22	8.5	2.0	8.75	2.40	6.35	5.51	645,000 mg/kg	
80	17	4.0	8.80	< 0.5				
88	34	8.0	8.75	< 0.5				
64	51	~~16~~ 12	8.75	—				
18	68	16	8.75	—				

BOD TEST RESULTS
2. ML*G
6.35 TDEP
5.505686667 DDS
825.85 80 F= BOD
645,000 mg/kg

Note: 1. Conc. = Concentration of sample (ml/l or mg/l) in BOD bottles.
2. Sample Size = ml or g of sample or diluted sample added to BOD Bottle.

Comments
COD - ~720,000 mg/kg

Form 1975S PWO

Environmental Laboratory
BOD Work Sheet - Samples

3M

Lab Req. No. ▶ 65088 | BOD Run No. ▶ 81-1

Analyst: W. A. Schmidt | Date Started: 2/13/81 | -20 Day BOD Readings

Analyzed: [signature] | Date: 3-05-81

Sample Description: FC-3041, LOT 2300, (CC809-1)

Initial Dilution: 0.128 g of Sample diluted to 100 ml with DI water

Initial Dilution Factor: 100/0.128 (Dilution factor = 1 if undiluted)

Bottle No.	Conc. of Sample[1]	Sample Size[2]	Initial D.O. (D_1)	Present D.O. (D_2)	Total D.O. Depletion ($D_1 - D_2$)	Depletion Due To Sample	20 / BOD - Day	Average / BOD - Day
22	8.5	2.0	8.75	2.00	6.75	5.47	642,000 mg/kg	
80	17	4.0	8.80	—				
88	34	8.0	8.75	—				
64	51	(was 16) 12	8.75	—				
18	68	16	8.75	—				

BOD TEST RESULTS
2. MEAN
6.75 TDEP
5.47853333 DDS
821.78 x 5 = BOD

642,000 mg/kg

Note: 1. Conc. = Concentration of sample (ml/l or mg/l) in BOD bottles.
2. Sample Size = ml or g of sample or diluted sample added to BOD Bottle.

Comments: COD - ~720,000 mg/kg

Form 19756 PWO

Other LR Nos. 6544, 6553, 6566, 6574

Environmental Laboratory
BOD Work Sheet - Blanks, Controls, and Standards

Protocol Reference: EAR, 2-29-80

3M

Lab Request No. ▸ 6508 S (original)		BOD Run No. ▸ 81-1	
Analyst: W. A. Scheil	Date Started: 2-13-81	5 · Day BOD Readings	
Seed Type & Source: State sewage, Chemlute	Seed Concentration: 6.0 ml/l	Analyst: W. A. Scheil	Date: 2-18-81

Nonseeded Dilution - Water Blank

Bottle No.	Initial D.O. (A_1)	Present D.O. (A_2)	D.O. Depletion ($A_1 - A_2$)	Average D.O. Depletion ($\bar{A}_1 - \bar{A}_2$)
9	8.80	8.40	0.40	
85	8.80	8.40	0.40	
22	8.80	8.45	0.35	0.383

Seeded Dilution - Water Blank (optional)

Bottle No.	Initial D.O. (C_1)	Present D.O. (C_2)	D.O. Depletion ($C_1 - C_2$)	Average D.O. Depletion ($\bar{C}_1 - \bar{C}_2$)
1	8.80	8.25	0.55	
118	8.80	8.25	0.55	
7	8.85	8.30	0.55	0.55

Seed Controls

Bottle No.	Sample Size	Initial D.O. (B_1)	Present D.O. (B_2)	D.O. Depletion ($B_1 - B_2$)
2	20	8.50	5.90	3.60
3	40	8.05	3.05	5.00
14	80	7.15	<0.5	—
81	160	5.55	<0.5	—

Glucose - Glutamic Acid Standard

Bottle #13 had an air bubble in it at day-5.

Bottle No.	Sample Size	Initial D.O. (D_1)	Present D.O. (D_2)	Total D.O. Depletion ($D_1 - D_2$)	Depletion Due To Standard	5 / BOD · Day	Average 5 / BOD · Day
13	3.0	8.80	~~6.35~~ ~~5.90~~ WAS *	2.45	1.91	191	
123	5.0	8.75	~~4.90~~ ~~3.05~~ 2/18/81	3.85	3.31	199	200 mg/l
120	7.0	8.65	3.50	5.15	4.61	198	

~~Potassium Hydrogen Phthalate Standard (optional)~~ Seeded dilution water blanks with nitrification inhibitor added (~0.1 g/300 ml, HACH® Formula 2533)

Bottle No.	Sample Size	Initial D.O. (D_1)	Present D.O. (D_2)	Total D.O. Depletion ($D_1 - D_2$)	~~Depletion Due To Standard~~ AVE.	~~5 / BOD · Day~~	~~Average 5 / BOD · Day~~
8		8.80	8.30	0.50			
84		8.80	8.30	0.50	0.47		
78		8.75	8.35	0.40			

Form 19755 PWO

Environmental Laboratory
BOD Work Sheet - Blanks, Controls, and Standards

Ction LR Nos. 6545, 6553, 6566, 6574

Protocol Reference: EAR 2-29-80

Lab Request No. ▶ 6508 S (original)		BOD Run No. ▶ 81-1	
Analyst: W. A Schell	Date Started: 2-13-81	12 - Day BOD Readings	
Seed Type & Source: State sewage, Chemolite	Seed Concentration: 6.0 ml/l	Analyst: W. A. Schell	Date: 2/25/81

Nonseeded Dilution - Water Blank

Bottle No.	Initial D.O. (A_1)	Present D.O. (A_2)	D.O. Depletion ($A_1 - A_2$)	Average D.O. Depletion ($\bar{A}_1 - \bar{A}_2$)
9	8.80	8.20	0.60	
85	8.80	8.15	0.65	0.60
22	8.80	8.25	0.55	

Seeded Dilution - Water Blank (optional)

Bottle No.	Initial D.O. (C_1)	Present D.O. (C_2)	D.O. Depletion ($C_1 - C_2$)	Average D.O. Depletion ($\bar{C}_1 - \bar{C}_2$)
1	8.80	7.90	0.90	
118	8.80	7.95	0.85	0.85
7	8.85	8.00	0.85	

Seed Controls

Bottle No.	Sample Size	Initial D.O. (B_1)	Present D.O. (B_2)	D.O. Depletion ($B_1 - B_2$)
2	20	8.50	4.85	~~4~~ 3.65
3	40	8.05	1.15	6.90
14	80	7.15	—	—
81	160	5.55	—	—

Glucose - Glutamic Acid Standard

Bottle No.	Sample Size	Initial D.O. (D_1)	Present D.O. (D_2)	Total D.O. Depletion ($D_1 - D_2$)	Depletion Due To Standard	12 / BOD - Day	Average 12 / BOD - Day
13	3.0	8.80	5.70	3.10	2.26	226	
123	5.0	8.75	4.05	4.70	3.86	232	230
120	7.0	8.65	2.45	6.20	5.37	230	

mg/l

Potassium Hydrogen Phthalate Standard (optional)

Seeded dilution water blanks used nitrification inhibitor added (~0.1g/300 ml, HACH® Formula 2533)

Bottle No.	Sample Size	Initial D.O. (D_1)	Present D.O. (D_2)	Total D.O. Depletion ($D_1 - D_2$)	Depletion Due To Standard	12 / BOD - Day	Average / BOD - Day
8	X	8.80	8.05	0.75	AVE. Depletion		
84	X	8.80	8.10	0.70	0.70		
78	X	8.75	8.10	0.65			

Form 19755 PWO

Other LR Nos. 6544, 6553, 6566, 6574

Environmental Laboratory
BOD Work Sheet - Blanks, Controls, and Standards

Protocol Reference: EAR, 2-29-80

Lab Request No. ▶ 6508 S (original)		BOD Run No. ▶ 81-1	
Analyst: W. A. Scheil	Date Started: 2-13-81	20 - Day BOD Readings	
Seed Type & Source: State Sewage, Chemolite	Seed Concentration: 6.0 ml/l	Analyst: J. P. Gore	Date: 3-05-81

Nonseeded Dilution - Water Blank

Bottle No.	Initial D.O. (A_1)	Present D.O. (A_2)	D.O. Depletion ($A_1 - A_2$)	Average D.O. Depletion ($\bar{A}_1 - \bar{A}_2$)
9	8.80	8.00	0.80	
85	8.80	8.00	0.80	
22	8.80	8.10	0.70	0.767

Seeded Dilution - Water Blank (optional)

Bottle No.	Initial D.O. (C_1)	Present D.O. (C_2)	D.O. Depletion ($C_1 - C_2$)	Average D.O. Depletion ($\bar{C}_1 - \bar{C}_2$)
1	8.80	7.40	1.40	
118	8.80	7.50	1.30	
7	8.85	7.70	1.15	1.28

Seed Controls

Bottle No.	Sample Size	Initial D.O. (B_1)	Present D.O. (B_2)	D.O. Depletion ($B_1 - B_2$)
2	20	8.50	< 0.50	—
3	40	8.05	—	—
14	80	7.15	—	—
81	160	5.55	—	—

Glucose - Glutamic Acid Standard

Bottle No.	Sample Size	Initial D.O. (D_1)	Present D.O. (D_2)	Total D.O. Depletion ($D_1 - D_2$)	Depletion Due To Standard	20/BOD - Day	Average 20/BOD - Day
13	3.0	8.80	3.30	5.50	4.23	423	
123	5.0	8.75	2.10	6.60	5.39	323	340
120	7.0	8.65	1.15	7.50	6.25	268	

Potassium Hydrogen Phthalate Standard (optional) Seeded dilution water blanks with nitrification inhibitor added (~0.1g/300 ml, HACH® Formula 2533)

Bottle No.	Sample Size	Initial D.O. (D_1)	Present D.O. (D_2)	Total D.O. Depletion ($D_1 - D_2$)	Depletion Due To Standard AVG.	20/BOD - Day	Average/BOD - Day
8	X	8.80	7.70	1.10			
84	X	8.80	7.65	1.15	1.08		
78	X	8.75	7.75	1.00			

Form 19766 PWO