

## 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-206C and L-5439. (1-Octanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptafluoro-, potassium salt, CAS # 2795-39-3)

**Remarks:** The 3M production lot number was 501. The test sample is referred to as L-5439 and FC-206C. Current information indicates it is a mixture of 0.73% PFOS, 76.09% water, 15% diethylene glycol butyl ether, 4% urea, 1.55% sodium octyl sulfate, 1.47% hydroxy foamer, 1.05% polyoxyethylene monooctylphenyl ether, 0.06% sodium lauryl sulfate, and 0.05% benzotriazole.

*The following is an abbreviated summary of multiple biodegradation studies on FC-206C. These studies apply to the test sample as a mixture with incompletely characterized concentration of impurities. Data does not accurately reflect the biodegradation potential of the fluorochemical component of the test sample..*

METHOD:

**Methods:** Various methods. Most not specified.

**Type:** BOD (Carbonaceous and Total)

**GLP:** No

**Year completed:** 1981-1982

**Contact time:** 20 days

**Inoculum:** Stale sewage from 3M's Cottage Grove facility and seed from various sources.

RESULTS

Chemical Oxygen Demand: 360,000 – 450,000 mg/kg

Total Biochemical Oxygen Demand (BOD):

|         |                         |
|---------|-------------------------|
| 5-Day:  | 28,000 – 279,300 mg/kg  |
| 10-Day: | 180,000 – 340,700 mg/kg |
| 12-Day: | 300,000 mg/kg           |
| 20-Day: | 240,000 – 416,500 mg/kg |

**Carbonaceous-Biochemical Oxygen Demand (C-BOD):**

|         |                         |
|---------|-------------------------|
| 5-Day:  | 120,000 – 251,800 mg/kg |
| 10-Day: | 270,700 – 320,000 mg/kg |
| 12-Day: | 330,000 mg/kg           |
| 20-Day: | 340,000 – 411,000 mg/kg |

**CONCLUSIONS**

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No reliable conclusions can be derived from this study. 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**

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**Reliability:** Klimisch ranking 3. Study lacks description and records of the method followed. The inoculum is not properly characterized. The testing was conducted on a mixture with chemicals having varying degrees of biodegradability, leading to potential misinterpretation of the results. The studies lack information on the purity of the test substance and lack analytical measurements of the concentration of fluorochemical proportion.

**REFERENCES**

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Test was conducted by multiple vendors at the request of the 3M Company, 3M Environmental Lab, St. Paul, MN, Lab Request Numbers 6812S, 7625, 7736, 7737, 7738, and 7903.

**OTHER**

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Last changed: 6/26/00

mg/kg

700,000

TOTAL -VS- CARBONACEOUS BIOCHEMICAL OXYGEN DEMAND (BOD)

2nd Run

Sample Desc.: L-5439, LOT-501, CC814-28  
LN: 68128  
Analyst: M.A. Schell  
Date: 6-23-81

600,000

500,000

400,000

300,000

200,000

100,000

0

BOD5

BOD10

BOD20

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OVERLAPPED LINES

AVERAGE OF SLIDING RESULTS

● = CARBONACEOUS BOD

▲ = TOTAL BOD

001636

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ULTIMATE BOD RESULTS-  
calculated by two methods

Protocol reference:  
EAR 2/29/80

# CARBONACEOUS DEMAND ☆

|    |                                                                                                    | BOD5         |               | BOD10         |               | BOD20         |               |
|----|----------------------------------------------------------------------------------------------------|--------------|---------------|---------------|---------------|---------------|---------------|
|    |                                                                                                    | formula #4   | formula #5    | formula #4    | formula #5    | formula #4    | formula #5    |
| 1  |                                                                                                    |              |               |               |               |               |               |
| 2  | Conc. of sample in BOD                                                                             |              |               |               |               |               |               |
| 3  | Dilution bottles:                                                                                  |              |               |               |               |               |               |
| 4  | 3.4 mg/L                                                                                           | 79,600 mg/kg | 102,000 mg/kg | 296,000 mg/kg | 319,000 mg/kg | 334,000 mg/kg | 406,000 mg/kg |
| 5  | 6.9 "                                                                                              | 83,500 "     | 94,500 "      | 301,000 "     | 312,000 "     | 312,000 "     | 348,000 "     |
| 6  | 10 "                                                                                               | 70,200 "     | 77,600 "      | 307,000 "     | 314,000 "     | 337,000 "     | 363,000 "     |
| 7  | 14 "                                                                                               | 74,500 "     | 80,000 "      | 314,000 "     | 319,000 "     | 367,000 "     | 384,000 "     |
| 8  | 21 "                                                                                               | 125,000 "    | 128,000 "     | 328,000 "     | 331,000 "     | -             | -             |
| 9  |                                                                                                    |              |               |               |               |               |               |
| 10 | Average value -                                                                                    | 120,000 "    | 130,000 "     | 310,000 "     | 320,000 "     | 340,000 "     | 360,000 "     |
| 11 | (Rounded to 2 sig. figs.)                                                                          |              |               |               |               |               |               |
| 12 | ⊕ = VALUES INCLUDED IN AVERAGE                                                                     |              |               |               |               |               |               |
| 13 |                                                                                                    |              |               |               |               |               |               |
| 14 |                                                                                                    |              |               |               |               |               |               |
| 15 | Conc. of glucose - glu-                                                                            |              |               |               |               |               |               |
| 16 | tamic acid reference                                                                               |              |               |               |               |               |               |
| 17 | solution in BOD dilution                                                                           |              |               |               |               |               |               |
| 18 | bottles:                                                                                           |              |               |               |               |               |               |
| 19 | 3.0 ml/300 ml                                                                                      | 198 mg/l     | 205 mg/l      | 212 mg/l      | 220 mg/l      | 226 mg/l      | 250 mg/l      |
| 20 | 5.0 "                                                                                              | 206 "        | 210 "         | 221 "         | 225 "         | 238 "         | 252 "         |
| 21 | 7.0 "                                                                                              | 203 "        | 206 "         | 222 "         | 225 "         | 236 "         | 247 "         |
| 22 |                                                                                                    |              |               |               |               |               |               |
| 23 | Average value -                                                                                    | 200 "        | 210 "         | 220 "         | 220 "         | 230 "         | 250 "         |
| 24 | (Rounded to 2 sig. figs.)                                                                          |              |               |               |               |               |               |
| 25 |                                                                                                    |              |               |               |               |               |               |
| 26 |                                                                                                    |              |               |               |               |               |               |
| 27 |                                                                                                    |              |               |               |               |               |               |
| 28 | NOTE: Formula #4 corrects for the DO depletion of the non-seeded dilution water blanks, and uses a |              |               |               |               |               |               |
| 29 | seed control dilution to calculate the seed correction value.                                      |              |               |               |               |               |               |
| 30 |                                                                                                    |              |               |               |               |               |               |
| 31 | Formula #5 uses the seeded dilution water blanks to calculate the seed correction and to           |              |               |               |               |               |               |
| 32 | compensate for any DO depletion caused by the dilution water.                                      |              |               |               |               |               |               |
| 33 |                                                                                                    |              |               |               |               |               |               |
| 34 | ☆ NITRIFICATION INHIBITOR USED                                                                     |              |               |               |               |               |               |
| 35 | BEST COPY AVAILABLE                                                                                |              |               |               |               |               |               |

001637

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### ULTIMATE BOD RESULTS- calculated by two methods

Protocol reference:  
EAR 2/29/80

| ULTIMATE BOD RESULTS-<br>calculated by two methods |                                                                                                    | BOD5             |       |            |       | BOD10      |       |            |       | BOD20      |       |            |       |
|----------------------------------------------------|----------------------------------------------------------------------------------------------------|------------------|-------|------------|-------|------------|-------|------------|-------|------------|-------|------------|-------|
| Protocol reference:<br>EAR 2/29/80                 |                                                                                                    | formula #4       |       | formula #5 |       | formula #4 |       | formula #5 |       | formula #4 |       | formula #5 |       |
| TOTAL DEMAND                                       |                                                                                                    |                  |       |            |       |            |       |            |       |            |       |            |       |
| 1                                                  | Conc. of sample in BOD                                                                             |                  |       |            |       |            |       |            |       |            |       |            |       |
| 2                                                  | Dilution bottles:                                                                                  |                  |       |            |       |            |       |            |       |            |       |            |       |
| 3                                                  | mg/L                                                                                               | 136,000          | mg/kg | 131,000    | mg/kg | 320,000    | mg/kg | 319,000    | mg/kg | 316,000    | mg/kg | 377,000    | mg/kg |
| 4                                                  | "                                                                                                  | 97,100           | "     | 94,400     | "     | 320,000    | "     | 319,000    | "     | 325,000    | "     | 355,000    | "     |
| 5                                                  | "                                                                                                  | 103,000          | "     | 102,000    | "     | 319,000    | "     | 319,000    | "     | 338,000    | "     | 358,000    | "     |
| 6                                                  | "                                                                                                  | 77,600           | "     | 76,300     | "     | 330,000    | "     | 330,000    | "     | 366,000    | "     | 381,000    | "     |
| 7                                                  | "                                                                                                  | 63,900           | "     | 63,000     | "     | 326,000    | "     | 326,000    | "     | -          | "     | -          | "     |
| 8                                                  |                                                                                                    |                  |       |            |       |            |       |            |       |            |       |            |       |
| 9                                                  | Average value -                                                                                    | *SLIDING RESULTS |       |            |       | 320,000    | "     | 320,000    | "     | 340,000    | "     | 360,000    | "     |
| 10                                                 | (Rounded to 2 sig. figs.)                                                                          |                  |       |            |       |            |       |            |       |            |       |            |       |
| 11                                                 | ⊕ = VALUES INCLUDED IN AVERAGE                                                                     |                  |       |            |       |            |       |            |       |            |       |            |       |
| 12                                                 |                                                                                                    |                  |       |            |       |            |       |            |       |            |       |            |       |
| 13                                                 |                                                                                                    |                  |       |            |       |            |       |            |       |            |       |            |       |
| 14                                                 |                                                                                                    |                  |       |            |       |            |       |            |       |            |       |            |       |
| 15                                                 | Conc. of glucose - glu-                                                                            |                  |       |            |       |            |       |            |       |            |       |            |       |
| 16                                                 | tamic acid reference                                                                               |                  |       |            |       |            |       |            |       |            |       |            |       |
| 17                                                 | solution in BOD dilution                                                                           |                  |       |            |       |            |       |            |       |            |       |            |       |
| 18                                                 | bottles:                                                                                           |                  |       |            |       |            |       |            |       |            |       |            |       |
| 19                                                 | 3.0 ml/300 ml                                                                                      | 222              | mg/l  | 220        | mg/l  | 241        | mg/l  | 240        | mg/l  | 240        | mg/l  | 260        | mg/l  |
| 20                                                 | 5.0 "                                                                                              | 211              | "     | 210        | "     | 225        | "     | 225        | "     | 264        | "     | 276        | "     |
| 21                                                 | 7.0 "                                                                                              | 215              | "     | 214        | "     | 238        | "     | 238        | "     | 244        | "     | 253        | "     |
| 22                                                 |                                                                                                    |                  |       |            |       |            |       |            |       |            |       |            |       |
| 23                                                 | Average value -                                                                                    | 220              | "     | 210        | "     | 230        | "     | 230        | "     | 250        | "     | 260        | "     |
| 24                                                 | (Rounded to 2 sig. figs.)                                                                          |                  |       |            |       |            |       |            |       |            |       |            |       |
| 25                                                 |                                                                                                    |                  |       |            |       |            |       |            |       |            |       |            |       |
| 26                                                 |                                                                                                    |                  |       |            |       |            |       |            |       |            |       |            |       |
| 27                                                 |                                                                                                    |                  |       |            |       |            |       |            |       |            |       |            |       |
| 28                                                 | NOTE: Formula #4 corrects for the DO depletion of the non-seeded dilution water blanks, and uses a |                  |       |            |       |            |       |            |       |            |       |            |       |
| 29                                                 | seed control dilution to calculate the seed correction value.                                      |                  |       |            |       |            |       |            |       |            |       |            |       |
| 30                                                 |                                                                                                    |                  |       |            |       |            |       |            |       |            |       |            |       |
| 31                                                 | Formula #5 uses the seeded dilution water blanks to calculate the seed correction and to           |                  |       |            |       |            |       |            |       |            |       |            |       |
| 32                                                 | compensate for any DO depletion caused by the dilution water.                                      |                  |       |            |       |            |       |            |       |            |       |            |       |
| 33                                                 |                                                                                                    |                  |       |            |       |            |       |            |       |            |       |            |       |
| 34                                                 |                                                                                                    |                  |       |            |       |            |       |            |       |            |       |            |       |
| 35                                                 |                                                                                                    |                  |       |            |       |            |       |            |       |            |       |            |       |

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001638

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LAB REQUEST NO. 7625  
REQUESTOR NAME: EAR  
DEPARTMENT: 0535  
PROJECT NO: 9970012600  
DATE RECEIVED: 01/13/1982  
DESC: FC-203C & FC-206C

CONTRACT LAB(S):  
EXP COMP DATE: 03/10/1982  
DATE COMPLETED: 03/16/1982  
PROJECT LEAD:  
PHONE NO:  
3M FAX NO: 651-778-6176

THESE ARE PROPOSED MIL-SPEC AFFF MATERIALS. PLEASE LET ME REVIEW COPIES OF  
WORK SHEETS

| SAMPLE | DATE     | CODE                    | DESCRIPTION | RESULT              | MDL or (95% C.I.) |
|--------|----------|-------------------------|-------------|---------------------|-------------------|
| 1      |          | FC206C                  | L-6518      |                     |                   |
|        | BOD-05   | BOD-05                  |             | 28000 MG/KG         |                   |
|        | BOD-10   | BOD-10                  |             | 180000 MG/KG        |                   |
|        | BOD-20   | BOD-20                  |             | 290000 MG/KG        |                   |
|        | COD-RFX  | COD (DICHROMATE REFLUX) |             | 380000 MG/KG        |                   |
|        | FOAM-POT | FOAMING POTENTIAL       |             | SEE ATTACHED REPORT |                   |
| 2      |          | FC203C                  | L-6519      |                     |                   |
|        | BOD-05   | BOD-05                  |             | 56000 MG/KG         |                   |
|        | BOD-10   | BOD-10                  |             | 450000 MG/KG        |                   |
|        | BOD-20   | BOD-20                  |             | 580000 MG/KG        |                   |
|        | COD-RFX  | COD (DICHROMATE REFLUX) |             | 730000 MG/KG        |                   |
|        | FOAM-POT | FOAMING POTENTIAL       |             | SEE ATTACHED REPORT |                   |
| 3      |          |                         | DUP 1       |                     |                   |
|        | C-BOD-05 | BOD-05 (CARBONACEOUS)   |             | 25000 MG/KG         |                   |
|        | C-BOD-10 | BOD-10 (CARBONACEOUS)   |             | 120000 MG/KG        |                   |
|        | C-BOD-20 | BOD-20 (CARBONACEOUS)   |             | 290000 MG/KG        |                   |
|        | COD-RFX  | COD (DICHROMATE REFLUX) |             | 360000 MG/KG        |                   |
| 4      |          |                         | DUP 2       |                     |                   |
|        | C-BOD-05 | BOD-05 (CARBONACEOUS)   |             | 49000 MG/KG         |                   |
|        | C-BOD-10 | BOD-10 (CARBONACEOUS)   |             | 300000 MG/KG        |                   |
|        | C-BOD-20 | BOD-20 (CARBONACEOUS)   |             | 600000 MG/KG        |                   |
|        | COD-RFX  | COD (DICHROMATE REFLUX) |             | 740000 MG/KG        |                   |

5-04-82

## ENVIRONMENTAL LABORATORY FINAL REPORT

LAB REQUEST NO. 7903

REQUESTER NAME: EAR  
EPT: 0535  
PROJECT NO: 9970012600  
DATE RECEIVED: 3-31-82  
TEST: FC 206C FC-203C MIL SPEC TESTING

CONTRACT LAB: GAL  
CONTRACT LAB COST: 368  
3M E-L HOURS: 0  
EST CMPLT DATE: 4-26-82  
DATE COMPLETED: 5-03-82

THE PURPOSE OF THIS REQUEST IS TO TEST OUR EXPECTATION THAT THE CAUSE OF  
ALBRIGHT LAB'S HIGH BOD 20/COD RESULTS IS NITRIFICATION CAUSED BY THEIR BOD  
SEED

| SAMPLE | DATE    | CODE   | DESCRIPTION          | TEST                                                                             | RESULT                                                                                                |
|--------|---------|--------|----------------------|----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| 1      | 1-08-82 | LT 501 | FC-203C              | *BOD 05<br>*BOD 10<br>*BOD 20<br>*C-BOD 05<br>*C-BOD 10<br>*C-BOD 20<br>*COD-RFX | 519000MG/KG<br>520700MG/KG<br>615750MG/KG<br>253700MG/KG<br>557300MG/KG<br>671000MG/KG<br>776450MG/KG |
| 2      | 1-08-82 | LT 502 | FC-206C              | *BOD 05<br>*BOD 10<br>*BOD 20<br>*C-BOD 05<br>*C-BOD 10<br>*C-BOD 20<br>*COD-RFX | 279300MG/KG<br>340700MG/KG<br>416500MG/KG<br>123700MG/KG<br>270700MG/KG<br>411000MG/KG<br>407250MG/KG |
| 3      |         | #1     | FC-203C<br>KNOX SEED | *BOD 05<br>*BOD 10<br>*BOD 20<br>*C-BOD 05<br>*C-BOD 10<br>*C-BOD 20             | 512800MG/KG<br>578300MG/KG<br>670000MG/KG<br>357600MG/KG<br>523700MG/KG<br>641000MG/KG                |
| 4      |         | #2     | FC-206C<br>KNOX SEED | *BOD 05<br>*BOD 20<br>*C-BOD 05<br>*C-BOD 10<br>*C-BOD 20<br>*BOD 10             | 247700MG/KG<br>395500MG/KG<br>251800MG/KG<br>310500MG/KG<br>374000MG/KG<br>322500MG/KG                |

\* = CONTRACT LAB

APPROVED AND SUBMITTED BY

DATED

5-5-82

001640



P. O. BOX 4187, 2323 SYCAMORE DR., KNOXVILLE, TENNESSEE 37921 / 615 546-1335

# CERTIFICATE OF ANALYSIS

BEST COPY AVAILABLE

Mr. David Seely  
3M Environmental Eng. & Pollution Control  
Post Office Box 33331  
St. Paul, Minnesota 55101

April 26, 1982

Received: April 1st

Dear Mr. Seely:

Analysis of your compounds gave the following results:

Your# ,                      Our# ,                      Analysis,                      776,450 mg/kg  
 7903-1                      WC-5045                      COD

Seed A (derived from S & W Laboratories)

5 Day BOD                      519,000 mg/kg  
 10 Day BOD                      520,700 mg/kg  
 20 Day BOD                      615,750 mg/kg  
 Carbonaceous BOD 5                      253,700 mg/kg  
 Carbonaceous BOD 10                      557,300 mg/kg  
 Carbonaceous BOD 20                      671,000 mg/kg

$$BOD_5/COD = .79$$

$$BOD_{20}/COD = .86$$

Seed B (from Knoxville Treatment Plant)

5 Day BOD                      512,800 mg/kg  
 10 Day BOD                      578,300 mg/kg  
 20 Day BOD                      670,000 mg/kg  
 Carbonaceous BOD 5                      357,600 mg/kg  
 Carbonaceous BOD 10                      523,700 mg/kg  
 Carbonaceous BOD 20                      641,000 mg/kg

$$BOD_5/COD = .86$$

$$BOD_{20}/COD = .82$$

2

WC-5046

COD                      407,250 mg/kg

Seed A (derived from S & W Laboratories)

5 Day BOD                      279,300 mg/kg  
 10 Day BOD                      340,700 mg/kg  
 20 Day BOD                      416,500 mg/kg  
 Carbonaceous BOD 5                      123,700 mg/kg  
 Carbonaceous BOD 10                      270,700 mg/kg  
 Carbonaceous BOD 20                      411,000 mg/kg

$$BOD_5/COD = 1.02$$

$$BOD_{20}/COD = 1.01$$

*Copies of raw data  
Shets sent to EAR  
4-30-82  
JCS*

001641



P. O. BOX 4187, 2323 SYCAMORE DR., KNOXVILLE, TENNESSEE 37921 / 616 648-1034

# CERTIFICATE OF ANALYSIS

BEST COPY AVAILABLE

Mr. David Seely  
Page 2  
April 26, 1982

Your# ,  
2

Our# ,  
WC-5046

Analysis,

Seed B (from Knoxville Treatment Plant)

|                     |               |
|---------------------|---------------|
| 5 Day BOD           | 247,700 mg/kg |
| 10 Day BOD          | 322,500 mg/kg |
| 20 Day BOD          | 395,500 mg/kg |
| Carbonaceous BOD 5  | 251,800 mg/kg |
| Carbonaceous BOD 10 | 310,500 mg/kg |
| Carbonaceous BOD 20 | 374,000 mg/kg |

$BOD_{20}/COD = .92$

Sincerely yours,

GALBRAITH LABORATORIES, INC.

*Gail R. Hutchens*

Gail R. Hutchens  
Vice President

GRH:yd

001642

4-05-82

## ENVIRONMENTAL LABORATORY FINAL REPORT

LAB REQUEST NO. 7737

EQUESTER NAME: EAR

EPT: 0535

PROJECT NO: 9960012600

DATE RECEIVED: 2-16-82

ESC: FC-206-C AND FC-203C MIL SPEC TESTING

CONTRACT LAB: SERCO

CONTRACT LAB COST: 860

3M E-L HOURS: 0

EST CMPLT DATE: 4-06-82

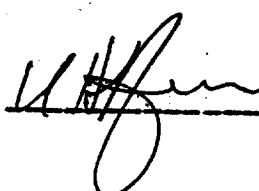
DATE COMPLETED: 4-01-82

EE ALSO LRS 7625 7736 7738

| SAMPLE | DATE | CODE   | DESCRIPTION  | TEST                                      | RESULT                                               |
|--------|------|--------|--------------|-------------------------------------------|------------------------------------------------------|
| 1      |      | FC203C | LOT501 L6519 | *BOD 05<br>*BOD 10<br>*BOD 20<br>*COD-RFX | 130000MG/L<br>370000MG/L<br>440000MG/L<br>737000MG/L |
| 2      |      | FC206C | LOT502 L6518 | *BOD 05<br>*BOD 10<br>*BOD 20<br>*COD-RFX | 71000MG/L<br>190000MG/L<br>240000MG/L<br>370000MG/L  |
| 3      |      | FC-780 | LOT 501      | *BOD 05<br>*BOD 10<br>*BOD 20<br>*COD-RFX | 48000MG/L<br>160000 MG/L<br>210000MG/L<br>287000MG/L |
| 4      |      | FC203C | #1 INHIBITED | *BOD 05<br>*BOD 10<br>*BOD 20             | 58000MG/L<br>140000MG/L<br>440000MG/L                |
| 5      |      | FC206C | #2 INHIBITED | *BOD 05<br>*BOD 10<br>*BOD 20             | 28000MG/L<br>65000MG/L<br>260000MG/L                 |
| 6      |      | FC-780 | #3 INHIBITED | *BOD 05<br>*BOD 10<br>*BOD 20             | 21000MG/L<br>51000MG/L<br>220000 MG/L                |

\* = CONTRACT LAB

APPROVED AND SUBMITTED BY



DATED

4-6-82

001643



1931 West County Road C2  
Roseville, Minnesota 55113 (612) 636-7173

LABORATORY ANALYSIS REPORT NO: 263  
03/18/82

PAGE 1

3M Company  
Bldg. 2-3E-09 P.O. Box 33331  
St. Paul MN 55133  
Mr. Keith Hoffmann  
Lab Coordinator

DATE COLLECTED:  
DATE RECEIVED: 02/16/82  
COLLECTED BY: CLIENT  
PICKED UP BY: CLIENT  
SAMPLE TYPE: PRODUCT SAMPLE

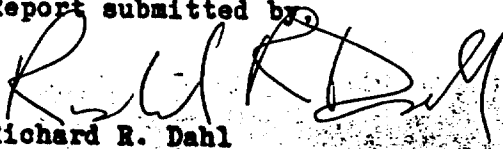
SERCO SAMPLE NO: 749 750 751  
SAMPLE DESCRIPTION:

ANALYSIS:

|                                   | FL 253C<br>7737-1 | 206C<br>7737-2 | 751B<br>7737-3 |
|-----------------------------------|-------------------|----------------|----------------|
| BOD, 5-day, mg/L                  | 130000            | 71000          | 48000          |
| BOD, 10-day, mg/L                 | 370000            | 190000         | 160000         |
| BOD, 20-day, mg/L                 | .59 440000        | .64 240000     | .73 210000     |
| BOD, carbonaceous, mg/L           | 58000             | 28000          | 21000          |
| BOD, 10-day carbonaceous, mg/L    | 140000            | 65000          | 51000          |
| BOD, 20-day carbonaceous, mg/L    | .59 440000        | .7 260000      | .72 220000     |
| COD, Chemical Oxygen Demand, mg/L | 737000            | 370000         | 287000         |

All analyses were performed using EPA or other recognized methodologies.

Report submitted by:

  
Richard R. Dahl  
Project Manager

< means "not detected at this level"

SANITARY ENGINEERING LABORATORIES, INC.

001644



4-26-82

## ENVIRONMENTAL LABORATORY FINAL REPORT

LAB REQUEST NO. 7738

GUESTER NAME: EAR

PT: 0535

OBJECT NO: 9960012600

TE RECEIVED: 2-23-82

SC: FC-206C AND FC 203C MIL SPEC TESTING

CONTRACT LAB: CAPS

CONTRACT LAB COST: 450

3M E-L HOURS: 0

EST CMPLT DATE: 4-16-82

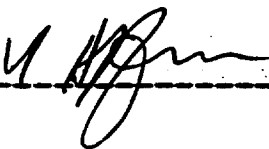
DATE COMPLETED: 4-23-82

E ALSO LRS 7625 7736 7737

| SAMPLE | DATE | CODE   | DESCRIPTION  | TEST                                      | RESULT                                                   |
|--------|------|--------|--------------|-------------------------------------------|----------------------------------------------------------|
| 1      |      | FC203C | LOT501 L6519 | *BOD 05<br>*BOD 10<br>*BOD 20<br>*COD-RFX | 140000MG/KG<br>540000MG/KG<br>570000MG/KG<br>950000MG/KG |
| 2      |      | FC206C | LOT502 L6518 | *BOD 05<br>*BOD 10<br>*BOD 20<br>*COD-RFX | 36000MG/KG<br>260000MG/KG<br>260000MG/KG<br>410000MG/KG  |
| 3      |      | FC-780 | LOT501       | *BOD 05<br>*BOD 10<br>*BOD 20<br>*COD-RFX | 24000MG/KG<br>220000MG/KG<br>240000MG/KG<br>360000MG/KG  |
| 4      |      | FC203C | #1 INHIBITED | *BOD 05<br>*BOD 10<br>*BOD 20             | 63000MG/KG<br>480000MG/KG<br>620000MG/KG                 |
| 5      |      | FC206C | #2 INHIBITED | *BOD 05<br>*BOD 10<br>*BOD 20             | 32000MG/KG<br>260000MG/KG<br>320000MG/KG                 |
| 6      |      | FC-780 | #3 INHIBITED | *BOD 05<br>*BOD 10<br>*BOD 20             | 20000MG/KG<br>210000MG/KG<br>230000MG/KG                 |

\* = CONTRACT LAB

APPROVED AND SUBMITTED BY



DATED

4-26-82

001645



# CAPSULE LABORATORIES

ADVANCED TECHNOLOGY DIVISION

A Division of Economics Laboratory, Inc.

605 West County Road E, St. Paul, MN 55112, (612) 482-8855

April 29, 1982

Mr. Dave Sealey  
3M Environmental Lab  
935 Bush Ave.  
Bldg. 2-3E  
St. Paul, MN 55144

BEST COPY AVAILABLE

Dear Dave,

Enclosed please find the results for COD on your sample # 7738-1. The test was rerun per your request. This time the test was performed using a larger amount of sample. The previous test may have been biased due to the large dilution factor.

If you have any other questions or problems, please call.

Sincerely,

CAPSULE LABORATORIES

*Betsy A. Hannum*

Betsy A. Hannum

Senior Chemist *PaZ.*

BAH:jjd



## TECHNICAL DATA

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April 29, 1982

Samples submitted for testing by SM Environmental Lab on April 26, 1982.

| <u>Sample<br/>Description</u>             | <u>Capsule<br/>Log #</u> | <u>COD</u>    |
|-------------------------------------------|--------------------------|---------------|
| 7738-1<br>(Old Capsule<br>Log #<br>12193) | 13322                    | 720,000 mg/kg |

001647



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# TECHNICAL DATA

April 16, 1982

Samples Submitted by: Minnesota Mining & Manufacturing Company

Samples Received on: February 24, 1982

| Capsule Log #             | 12193                                                                 | 12194                                                                       | 12195                                                                       |
|---------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------|
|                           | 203C                                                                  | 206C                                                                        | 780B                                                                        |
| Sample Description:       | 7738-1                                                                | 7738-2                                                                      | 7738-3                                                                      |
|                           | we got 740,000 + 730,000<br>Series got 737,000<br>us Navy got 744,000 | 3m got 260,000<br>Pac got 450,000<br>Series got 370,000<br>Navy got 349,000 | 3m got 360,000<br>Pac got 450,000<br>Series got 370,000<br>Navy got 349,000 |
| COD                       | 950,000 mg/kg                                                         | 410,000 mg/kg                                                               | 360,000 mg/kg                                                               |
| 5 Day BOD<br>Uninhibited  | 140,000 mg/kg                                                         | 36,000 mg/kg                                                                | 24,000 mg/kg                                                                |
| 5 Day BOD<br>Inhibited    | 63,000 mg/kg                                                          | 32,000 mg/kg                                                                | 20,000 mg/kg                                                                |
| 10 Day BOD<br>Uninhibited | 540,000 mg/kg                                                         | 260,000 mg/kg                                                               | 220,000 mg/kg                                                               |
| 10 Day BOD<br>Inhibited   | 480,000 mg/kg                                                         | 260,000 mg/kg                                                               | 210,000 mg/kg                                                               |
|                           | Navy 517,000<br>Series 446,000<br>3m 580,000                          | Navy 252,000<br>Pac 240,000<br>Series 276,000<br>3m 276,000                 | Navy 237,000<br>Series 320,000<br>Pac 256,000<br>3m 270,000                 |
| 20 Day BOD<br>Uninhibited | 570,000 mg/kg                                                         | 260,000 mg/kg                                                               | 240,000 mg/kg                                                               |
| 20 Day BOD<br>Inhibited   | 620,000 mg/kg                                                         | 320,000 mg/kg                                                               | 230,000 mg/kg                                                               |
|                           | Navy 600,000<br>Series 440,000<br>Pac 400,000                         | 290,000<br>260,000<br>370,000                                               | 230,000<br>220,000<br>250,000                                               |

001648

LAB REQUEST NO. 7736  
REQUESTOR NAME: EAR  
DEPARTMENT: 0535  
PROJECT NO: 9960012600  
DATE RECEIVED: 02/16/1982  
DESC: FC-206 C

CONTRACT LAB(S): PACE  
EXP COMP DATE: 03/16/1982  
DATE COMPLETED: 03/12/1982  
PROJECT LEAD:  
PHONE NO:  
3M FAX NO: 651-778-6176

SEE ALSO LRS 7625 7737 7738

| SAMPLE | DATE    | CODE                     | DESCRIPTION  | RESULT | MDL or (95% C.I.) |
|--------|---------|--------------------------|--------------|--------|-------------------|
| 1      |         | FC203C                   | LOT501 L6519 |        |                   |
| PACE   | BOD-05  | *BOD-05                  |              | 500000 | MG/KG WET         |
| PACE   | BOD-10  | *BOD-10                  |              | 620000 | MG/KG WET         |
| PACE   | BOD-20  | *BOD-20                  |              | 800000 | MG/KG WET         |
| PACE   | COD-RFX | *COD (DICHROMATE REFLUX) |              | 810000 | MG/KG WET         |
| 2      |         | FC206C                   | LOT502 L6518 |        |                   |
| PACE   | BOD-05  | *BOD-05                  |              | 250000 | MG/KG WET         |
| PACE   | BOD-10  | *BOD-10                  |              | 300000 | MG/KG WET         |
| PACE   | BOD-20  | *BOD-20                  |              | 350000 | MG/KG WET         |
| PACE   | COD-RFX | *COD (DICHROMATE REFLUX) |              | 450000 | MG/KG WET         |
| 3      |         | FC-780                   | LOT 501      |        |                   |
| PACE   | BOD-05  | *BOD-05                  |              | 190000 | MG/KG WET         |
| PACE   | BOD-10  | *BOD-10                  |              | 210000 | MG/KG WET         |
| PACE   | BOD-20  | *BOD-20                  |              | 250000 | MG/KG WET         |
| PACE   | COD-RFX | *COD (DICHROMATE REFLUX) |              | 350000 | MG/KG WET         |
| 4      |         | FC203C                   | #1 INHIBITED |        |                   |
| PACE   | BOD-05  | *BOD-05                  |              | 470000 | MG/KG WET         |
| PACE   | BOD-10  | *BOD-10                  |              | 580000 | MG/KG WET         |
| PACE   | BOD-20  | *BOD-20                  |              | 730000 | MG/KG WET         |
| 5      |         | FC206C                   | #2 INHIBITED |        |                   |
| PACE   | BOD-05  | *BOD-05                  |              | 240000 | MG/KG WET         |
| PACE   | BOD-10  | *BOD-10                  |              | 300000 | MG/KG WET         |
| PACE   | BOD-20  | *BOD-20                  |              | 370000 | MG/KG WET         |
| 6      |         | FC-780                   | #3 INHIBITED |        |                   |
| PACE   | BOD-05  | *BOD-05                  |              | 170000 | MG/KG WET         |
| PACE   | BOD-10  | *BOD-10                  |              | 210000 | MG/KG WET         |
| PACE   | BOD-20  | *BOD-20                  |              | 250000 | MG/KG WET         |

\* = CONTRACT LAB DATA

**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 BOD<sub>20</sub>/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

001650

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

| <u>Lab</u>             | <u>BOD<sub>20</sub></u><br><u>(mg/kg)</u> | <u>C-BOD</u><br><u>(mg/kg)</u> | <u>COD</u><br><u>(mg/kg)</u> | <u>BOD<sub>20</sub></u><br><u>COD</u> | <u>C-BOD<sub>20</sub></u><br><u>COD</u> |
|------------------------|-------------------------------------------|--------------------------------|------------------------------|---------------------------------------|-----------------------------------------|
| <u>FC-203C Lot 501</u> |                                           |                                |                              |                                       |                                         |
| 3M                     | 580,000                                   | 600,000                        | 730,000<br>740,000           | .79                                   | .81                                     |
| Pace                   | 800,000*                                  | 730,000*                       | 810,000<br>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<br>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<br>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 |