ACUTE TOXICITY TO FISH (BLUEGILL SUNFISH)

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 number was 788-20. 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 summary applies to a mixture with incompletely characterized concentrations of impurities. Data may not accurately reflect toxicity of the fluorochemical component of the test sample.

METHOD:

Method: Methods for Acute Toxicity tests with Fish, Macroinvertebrates, and Amphibians, EPA-660/3-75-009, 1975
Type: Acute static
GLP: No
Year completed: 1978
Species: *Lepomis macrochirus*
Supplier: Dale Fattig Fish Farm, Brady, NE.
Analytical monitoring: Dissolved oxygen, pH, and temperature.
Exposure period: 96-hours
Statistical methods: LC_{50} values and 95% confidence intervals were calculated using the U.S. EPA (Duluth) Probit computer program.
Test fish age: Juveniles
Length and weight: Average length = 45 mm
Average weight = 0.92 g (wet)
Loading: 0.57 g/L
Pretreatment: None.
Test conditions:
Dilution water: Carbon filtered well water, St. Paul, MN
Dilution water chemistry:
Hardness: 232 mg/L as $CaCO_3$
Alkalinity: 220 mg/L as $CaCO_3$
Conductivity: 405 µmhos/cm

Lighting: A daily photoperiod of 16 hours light and 8 hours dark with a 30 minute transition period was maintained throughout the testing period.
Stock and test solution preparation: The test material was added directly to the dilution water on a weight/volume basis.

Concentrations dosing rate: Once
Stability of the test chemical solutions: Not noted
Exposure vessels: All glass aquaria (35x20x20 cm) containing 16 L of test solution.
Number of replicates: 2
Number of fish per replicate: 10
Number of concentrations: five plus a blank control
Water chemistry during the study:

pH range (0-96 hours):

7.7 – 8.0 (control exposure)
7.6 – 7.9 (1800 mg/L exposure)*

Temperature range (0-96 hours): 18-18 °C
Dissolved oxygen range (0-96 hours):

5.2 – 10 mg/L (control exposure)
0.1 – 10 mg/L (1800 mg/L exposure)*

* 1800 mg/L (intermediate concentration) exposure values used because the highest two concentrations resulted in total mortality by 48 hours.

RESULTS

Nominal concentrations: Blank control, 1000, 1350, 1800, 2400, and 3200 mg/L.

Element values: 96-hour LC_{50} = 1500 (1300 –1700) mg/L
96-hour LC_{50} = 1600 (1400 –1800) mg/L (replicate)

Element values based on nominal concentrations

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

The test sample 96-hour LC_{50} for bluegill sunfish was determined to be 1500 mg/L with a 95% confidence interval of 1300 to 1700 mg/L for one replicate, and 1600 mg/L with a 95% confidence interval of 1400 to 1800 mg/L for the other replicate.

Remarks: Low DO levels in the first 48 hours (<60% saturation) could have initially impacted the organisms. Even though it did increase slightly in the next 48 hours, it was still <40% saturated by 96 hours.

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

DATA QUALITY

Reliability: Klimisch ranking = 2. The study meets the criteria for quality testing. However, the sample purity was not properly characterized and the study lacks analytical confirmation of the amount of fluorochemical proportion in the solution.

REFERENCES

This study was conducted by the 3M Company, Environmental Laboratory, St. Paul, MN, 1978.

OTHER

Last changed: 6/28/00

Form 6747 11 A

TDB

TECHNICAL REPORT SUMMARY

Date: November 15, 1978

TO: TECHNICAL COMMUNICATIONS CENTER – 201-2CN

nportant – If report is printed on both sides of paper, send two copies to TCC.)

Division: Environmental Laboratory (EE & PC)	Dept. Number: 0535
Project: Commercial Chemicals	Project Number: 9970012600
Report Title: FC 780B (lot 788-20): Results of Aquatic 96 Hr. LC_{50} Tests	Report Number: 004
To: D. L. Bacon	
Author(s): A. N. Welter	Employee Number(s): 09362
Notebook Reference:	No. of Pages Including Coversheet: 6

SECURITY ▶ ☑ Open (Company Confidential) ☐ Closed (Special Authorization) | 3M CHEMICAL REGISTRY ▶ New Chemicals Reported ☐ Yes ☒ No

KEYWORDS: (Select terms from 3M Thesaurus. Suggest other applicable terms.)

EE & PC - Div. (Environmental-Lab) Toxicity (Aquatic)

CURRENT OBJECTIVE:

To determine the acute LC_{50} value for the bluegill sunfish (*Lepomis macrochirus*) exposed to varying concentrations of FC-780B.

REPORT ABSTRACT: (200-250 words) This abstract information is distributed by the Technical Communications Center to alert 3M'ers to Company R&D. It is Company confidential material.

The acute static 96 h LC_{50} for bluegill sunfish (*Lepomis macrochirus*) exposed to varying concentrations of FC-780B ranged from 1.5 to 1.6 g/l.

Information Liaison Initials: CKL

CONCLUSIONS

In a replicated static 96-hour LC_{50} aquatic test, the calculated LC_{50} values for bluegill sunfish (*Lepomis macrochirus*) exposed to FC 780 B 788-20 were 1.5 and 1.6 g/l, respectively. Materials possessing an LC_{50} of this order of magnitude are considered to present an insignificant hazard to the aquatic environment.

INTRODUCTION

The test substance FC 780B (788-20) is a yellow minimally viscous fluid.

Tests performed on this material evaluated its aquatic toxicity and the data obtained form the basis of this report.

METHODS

A. Aquatic Testing

The test protocol utilized for this study was modeled after that described by USEPA (1975).[1]

ACCLIMATION PROCEDURE

The bluegill sunfish (*Lepomis macrochirus*) were obtained from a private hatchery.* Stock fish were held in a fiberglass holding tank filled with carbon-filtered well water at 14-15°C. A daily photoperiod of 16 hours light and 8 hours dark with a 30 minute transition period was maintained throughout the acclimation and testing period. The fish were fed Tetra-Min daily, food being withheld 48 hours prior to and throughout the test period. Fish were acclimated for 14 days prior to testing.

An acute short-term (96-hour) static bioassay was performed on FC-780B. Carbon-filtered well water of known composition was used as the diluent (Attachment 1). All glass aquaria, (35 x 20 x 20 cm), containing 16 l of diluent or diluent plus toxicant comprised a study chamber. Ten bluegills, uniform in size were tested at each chemical concentration. Test fish were randomly allocated to each test chamber within 30 minutes following toxicant addition. Bluegill experiments were conducted at 18°C. Mortality, temperature, dissolved oxygen level and pH of all test solutions were measured at 24-hour intervals or until total mortality had occurred.

General observations were recorded relative to swimming pattern and behavioral changes induced by exposure to the test chemical.

* Dale Fattig Fish Farm, Brady, Nebraska
Commercial Fish Food of known composition

These studies were performed in replicate using the following FC 780 B (lot 788-20) concentrations: 1.0, 1.35, 1.8, 2.4 and 3.2 g/l. LC_{50} values with 95% confidence limits were calculated using the US/EPA (Duluth) Probit Computer program. Organisms used in this study were considered to be generally healthy and free of disease.

RESULTS

The bluegill sunfish (*Lepomis macrochirus*) used in this study had an average weight of 0.92 ± 0.36 g and length of 4.5 ± 0.58 cm. The loading factor for these studies was approximately 0.57 g/l, below the maximum recommended loading factor of 0.8 g/l (1). Temperature was maintained at 18°C, while pH ranged from 7.6 to 8.0 pH units throughout this study.

Dissolved oxygen values decreased sharply 48 hours post initiation of this study. Test aquaria solutions were originally clear, becoming cloudy on day 2, an observation which coincided with low D.O. levels (0.1-0.5 mg/l). As the test solution cleared the D.O. levels increased. These abnormally low D.O. levels did not contribute to an increased mortality. This is considered to be presumptive evidence that the calculated LC_{50} values are accurate reflections of test chemical induced mortality, per se.

In this replicated study the 96-hour LC_{50} values were 1.5, range 1.3-1.7 and 1.6, range 1.4-1.8 g/l respectively. These values translate to LC_{50} values of 1500 and 1600 ppm. Chemicals possessing an LC_{50} value in this range are considered to be an insignificant hazard to the aquatic environment (2).

REFERENCES

(1) US/EPA Methods for Acute Toxicity Test with Fish, Macroinvertebrates and Amphibians, Ecological Research Series 660/3-75-009, 1975.

(2) Registry of Toxic Effects of Chemical Substances, '76 Edition, Christensen, H. E. and E. J. Fairchild, Eds. p. XV and Ci, U. S. Department of Health, Education and Welfare; National Institute for Occupational Safety and Health, Washington, D.C. June, 1976.

ENVIRONMENTAL TEST WATER SHEET

LAB REQUEST NO. 4382 (STANDING)

DATE

SHEET

ATTACHMENT #1

ALYSIS FORM

SAMPLE DESCRIPTION:
CARBON FILTERED WELL H_2O – BIOASSAY ROOM

		pH	TOTAL Cl_2 RESIDUAL	C.O.D.	CONDUCTIVITY micromhos/cm	M-ALK.	P-ALK.	TOTAL SOLIDS	TOTAL HARDNESS	AMMONIA			
1	7-18-78	7.8	-	<1	430	221	0	287	236	<0.1			
2	7-25-78	7.7	-	<1	440	219	0	288	236	<0.1			
3	7-31-78	7.7	-	<1	420	221	0	287	236	<0.1			
4	8-14-78	7.7	-	<1	420	222	0	298	236	<0.1			
5	8-21-78	7.6	-	<1	445	221	0	[illegible]	236	<0.1			
6	8-31-78	7.7	-	<1	400	[illegible]	0	[illegible]	[illegible]	<0.1			
7	9-07-78	7.7	-	<1	400	220	0	[illegible]	236	<0.1			
8	9-15-78	7.7	<0.1	<1		222	0		238	<0.1			
9	9-22-78	7.7	<0.1		405	222	0		232	<0.1			
10	9-29-78	7.5	<0.1	<1	405	220	0	313	232	<0.1			

ENVIRONMENTAL ENGINEERING LABORATORY
AQUATIC TOXICITY DATA SHEET

ATB

Type Test Static 96 h LC50 Material Tested FC 78 B Lot No. 255 2

Test Organism Bluegill Vendor Bailey ... Date Rec'd 9/29/78 Batch No 2-1978

Avg. Wt. .719±.359 grams Avg. Size 4.5±.58 cm.

Test Solution Volume 16 Liters/Tank No. Organisms per dose 10

Time Started 11:30 Date Started 10/10/78 Date Completed 10/14/78

Dilution Water Carbon filtered well water (Temp. 18 °C., D.O. 9.9 ppm, pH 7.9)

Investigator Alphonse N. Welter LC 50 (95% Confidence Limits) 1.6 1.9 1.8 1.5 0
(Full Signature)

Conc. mg/1.	Total Amount Added	24-Hours Total No. Dead	24-Hours pH	24-Hours D.O. ppm	48-Hours Total No. Dead	48-Hours pH	48-Hours D.O. ppm	72-Hours Total No. Dead	72-Hours pH	72-Hours D.O. ppm	96-Hours Total No. Dead	96-Hours pH	96-Hours D.O. ppm
Control		0	7.9	6.5	0	8.0	5.4	0	8.0	5.5	0	8.0	5.8
1.0	16	0	7.8	5.6	0	7.7	.5	1	7.7	1.7	1	7.8	1.6
1.35	21.6	0	7.8	5.5	0	7.6	.1	0	7.7	.2	0	7.7	1.4
1.8	28.8	0	7.9	6.5	ANW 7	7.6	.1	7	7.9	.1	9	7.8	.2
2.4	38.4	0	7.7	2.8	10		—	—	—		—	...	
3.2	51.2	0	7.8	4.1	10		—	—			—		
		Calibrated pH at end											
Test Temp. °C		18°			18°			18°					
Signature & Date		ANWelter 10/11/78			ANWelter 10/12/78			ANWelter 10/13/78					

Comments: Solution became cloudy day 2

Effects other than Mortality EC50

Conc. mg/1	Symptoms or Reactions	Total No. Affected 24-Hr.	48-Hr.	72-Hr.	96-Hr.
Control		0	0	0	
1.0		0	10	4	
1.35		0	10	10	
1.8	Surfacing	2	1	1	
2.4		8	—	—	
3.2		5	—	—	
Signature & Date		ANWelter 10/11/78	10/12/78 ANWelter	ANWelter 10/13/78	

Comments:

ENVIRONMENTAL ENGINEERING LABORATORY
AQUATIC TOXICITY DATA SHEET

ATB -

Type Test Static 96h LC50 Material Tested FC 78-8 Lot .. 183 ..

Test Organism Bluegill Vendor Brady Ark. Date Rec'd 9/27/78 Batch No 1-1978

Avg. Wt. .9192±.359 grams Avg. Size 4.5±.58 cm.

Test Solution Volume 16 Liters/Tank No. Organisms per dose 10

Time Started 11:50 AM Date Started 10/10 Date Completed 10/14/78

Dilution Water Carbon filtered well water (Temp. 18 °C., D.O. 10 ppm, pH 7.8)

Investigator (Full Signature) Alphonse N. Welter LC 50 (95% Confidence Limits) 1.5 1.3 1.7

Conc. mg/l.	Total Amount Added gram	24-Hours Total No. Dead	pH	D.O. ppm	48-Hours Total No. Dead	pH	D.O. ppm	72-Hours Total No. Dead	pH	D.O. ppm	96-Hours Total No. Dead	pH	D.O. ppm
Control		0	7.7	6.8	0	7.9	5.4	0	8.0	5.2	0	8.0	5.6
1.0	16	0	7.85	6.5	0	7.7	.2	1	7.7	1.2	2	7.8	2.0
1.35	21.6	0	7.8	6.5	0	7.6	.2	1	7.7	.2	1	7.7	1.7
1.8	28.8	0	7.9	6.0	7	7.6	.1	8	7.7	.1	8	7.8	1.0
2.4	38.4	0	7.7	6.3	9	7.6	.1	10	—	—	10	—	—
3.2	51.2	2	7.9	5.5	10	—	—	—	—	—	—	—	—
		Calibrated pH at and											
Test Temp. °C		18°			18°			18°			18°		
Signature & Date		ANWelter 10/11/78			ANWelter 10/12/78			ANWelter 10/13/78			ANWelter 10/14/78		

Comments: Solution became cloudy day 1

Effects other than Mortality EC50

Conc. mg/l	Symptoms or Reactions	Total No. Affected 24-Hr.	48-Hr.	72-Hr.	96-Hr.
Control		0	0	0	
		0	10	7	
	Surfacing	1	10	4	
		1	3	2	
		2	1	—	
		4	—	—	
Signature & Date		ANWelter 10/11/78	ANWelter 10/12/78	ANWelter 10/13/78	

Comments: