

ACUTE TOXICITY TO FISH (RAINBOW TROUT)

TEST SUBSTANCE

Identity: A mixture containing perfluorooctanesulfonate, which may also be referred to as PFOS, FC-95, or as a component of FC-3052. (1-Octanesulfonic acid) (CAS # 2795-39-3).

Remarks: The 3M production lot number was not noted. The test sample is FC-3052. Current information indicates it is a mixture of 5% PFOS, 39% diethylene glycol butyl ether, 33.58% water, 10% Sultone foamer, 6% sodium octyl sulfate, 6% sodium decyl sulfate, 0.36% sodium lauryl sulfate, and 0.06% benzotriazole.

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

METHOD:

Method: Environment Canada Method EPS 1/RM/9 July 1990

Type: Acute static

GLP: No

Year completed: 1999

Species: *Oncorhynchus mykiss*

Supplier: Spring Creek Trout Hatchery, Lewistown, MT.

Analytical monitoring: Temperature, pH, conductivity, and dissolved oxygen.

Exposure period: 96-hours

Statistical methods: LC₅₀ values calculated by the Trimmed Spearman-Kärber method, while the NOEC was determined via Fisher's Exact Test.

Test fish age: Juveniles

Length and weight: Length = 38 – 49 mm
Average weight = 0.648 g (wet)

Loading: 0.242 g/L

Pretreatment: None

Test conditions:

Dilution water: Dechlorinated City of Duluth, MN tap water, post-carbon. Water was aerated for 24-hours prior to use.

Dilution water chemistry:

Hardness: 44 mg/L as CaCO₃

Alkalinity: 44 - 46 mg/L as CaCO₃

pH: 7.82

Lighting: Cool-white fluorescent lights. A daily photoperiod of 16 hours light and 8 hours dark 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: 40 L glass aquaria containing 26.7 L 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):
 7.36 – 7.82 (control exposure)
 7.15 – 7.59 (125 mg/L exposure)*
 Temperature range (0-96 hours): 14.4 – 15.4 °C
 Conductivity range (0-96 hours):
 126 – 136 µmhos/cm (control exposure)
 136 – 144 µmhos/cm (125 mg/L exposure)*
 Dissolved oxygen range (0-96 hours):
 5.8 – 9.1 mg/L (control exposure)
 4.4 – 9.0 mg/L (125 mg/L exposure)*
 * 125 mg/L (intermediate concentration) exposure values used
 because the highest three concentrations used resulted in total
 mortality by 48 hours.

RESULTS

Nominal concentrations: Blank control, 62.5, 125, 250, 500, and 1000 mg/L

Element values: 96-hour LC₅₀ = 177 (CI not calculable) mg/L
 96-hour NOEC = 125 mg/L

Element values based on nominal concentrations

Remarks: Testing was conducted on a 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 LC₅₀ for rainbow trout was determined to be 177 mg/L. The 96-hour No Observed Effect Concentration (NOEC) was determined to be 125 mg/L.

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

DATA QUALITY

Reliability: Klimisch ranking = 2. This study meets the criteria for quality testing. However, the study lacks information on purity of the test substance

and it lacks analytical confirmation of the amount of fluorochemical proportion in solution.

REFERENCES

This test was conducted by ASci Corporation, Environmental Testing Division, of Duluth, MN at the request of the 3M Company, Environmental Laboratory, St. Paul, MN, Lab Request number W2039-2, 1999.

OTHER

Last changed: 6/26/00.

ORIGINAL

Final Report sent 7/26/99
799

STUDY TITLE

ACUTE TOXICITY OF FC-3052 TO
RAINBOW TROUT (*Oncorhynchus mykiss*)

DATA STANDARD

Environment Canada
Method EPS 1/RM/9 July 1990

STUDY COMPLETED

July 19, 1999

TESTING FACILITY

ASCI Corporation
Environmental Testing Division
4444 Airpark Boulevard
Duluth, MN 55811

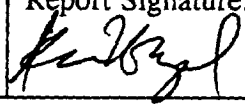
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STUDY IDENTIFICATION NUMBERS

ASCI Study ID# 5010-068

3M Lab Request# W2039-2

1.0 GENERAL INFORMATION

Study Title	Acute Toxicity of FC-3052 to Rainbow Trout (<i>Oncorhynchus mykiss</i>).	
Data Standard	Environment Canada Method EPS 1/RM/9 July 1990.	
Sponsor	3M Environmental Technology and Safety Services, Building 2-3E-09, 935 Bush Avenue, St. Paul, MN 55133.	
Sponsor's Representative	Susan A. Beach, 3M Environmental Technology and Safety Services, Building 2-3E-09, 935 Bush Avenue, St. Paul, MN 55133. Tel No. (651) 778-7452.	
Sponsor's Lab Request#	W2039-2.	
Testing Facility	ASCI Corporation Environmental Testing Division, 4444 Airpark Boulevard, Duluth, MN 55811; Tel. No. (218) 722-4040.	
Principal Investigator	Joseph Dierkes.	
Project Director	Joe Amato.	
Testing Facility Director	Donald Mount.	
Definitive Test Dates	July 15-19, 1999.	
Data Validation and Report Review	Alan Mozol.	Report Signature: 
Retention of Raw Data and Final Report	Ten years from the date study is completed.	
Location of Raw Data and Final Report	ASCI Corporation Environmental Testing Division, 4444 Airpark Boulevard, Duluth, MN 55811; Tel. No. (218) 722-4040.	

2.0 OBJECTIVE(S)

To determine the 96-h LC₁₀, LC₅₀, and 96-h NOEC (no observed effect concentration) of the test chemical, FC-3052, for rainbow trout (*Oncorhynchus mykiss*) under static test conditions.

This study was conducted according to Environment Canada Reference Method EPS 1/RM/9 July 1990, "Acute Lethality Test Using Rainbow Trout."

3.0 TEST METHODS

Test Chemical	<i>Properties:</i> FC-3052, dark amber/brown colored liquid, specific gravity ca. 1.1 (water = 1), vapor pressure ca. 16 mm Hg calculated at 20°C, stable, and miscible with water. <i>Test concentrations:</i> 0 (dilution water control), 62.5, 125, 250, 500 and 1000 mg/L based on range-finding test results. Test solutions prepared by direct addition to each replicate test chamber.
Test Organisms	<i>Source:</i> Healthy, juvenile rainbow trout (<i>Oncorhynchus mykiss</i>) obtained from a commercial supplier. <i>Holding/acclimation:</i> Held and acclimated for 24 days in the test dilution water. Less than 1% mortality occurred during holding/acclimation period. At test termination, they were 3.8-4.9 cm in length and 0.414-0.928 g in weight with a mean weight of 0.648 ± 0.169 g. Loading rate was 0.242 g/L. <i>Use in test:</i> Did not feed 24 h before test initiation. Used 10 organisms/replicate and 2 replicates/test concentration.
Dilution Water (PC Water)	<i>Source:</i> Dechlorinated City of Duluth, MN, tap water. The most recent chemical analysis is in Raw Data Package. <i>Characteristics:</i> At test time, the water had a hardness of 44 mg/L (as CaCO₃) and a pH of 7.82. Aerated for more than 24 h prior to using in the test.

Exposure Chambers	<i>Type:</i> 40-L glass aquaria. <i>Use in test:</i> 26.7 L of dilution water or test solution/chamber. During the test, kept covered, except when experimental observations were made. Solutions were not aerated during the exposures.
Incubation	<i>Duration:</i> 96 h. <i>Daily photoperiod:</i> 16 h light and 8 h dark, maintained using cool-white fluorescent lamps. <i>Temperature:</i> 15° ± 1°C.
Observations	<i>Biological:</i> Daily- Test organisms with abnormal behavior and signs of stress, and dead test organisms. <i>Water chemistry:</i> (1) At test initiation- total hardness and alkalinity, (2) daily- temperature, DO, and pH, and specific conductivity. All determinations were made according to APHA methods (1998).
Endpoint Calculations	24-, 48-, 72-, and 96-h lethal concentrations (LC₅₀s), and 96-h LC₁₀ and no observable effect concentration (NOEC). LC₅₀s determined via Trimmed Spearman-Kärber Method, LC₁₀ determined via EPA ICp Method, and NOEC determined via Fisher's Exact Test.

4.0 RESULTS

Test Chemical Toxicity (Parenthetic values are 95% confidence intervals). Pertinent data are in Table 1.	24-h LC ₅₀ : 330 mg/L (301 mg/L-362 mg/L).
	48-h LC ₅₀ : 177 mg/L (Not Reliable).
	72-h LC ₅₀ : 177 mg/L (Not Reliable).
	96-h LC ₅₀ : 177 mg/L (Not Reliable).
	96-h LC ₁₀ : 138 mg/L, Confidence Interval not Reliable.
	96-h NOEC: 125 mg/L.

Ranges of Water Chemistry Parameters	<i>Total hardness (as CaCO₃ mg/L): 44.</i> <i>Alkalinity (as CaCO₃ mg/L): 44-46.</i> <i>Temperature (°C): 14.4-15.4.</i> <i>DO (mg/L): 4.4-9.1.</i> <i>pH: 7.15-7.82.</i> <i>Specific conductivity (μmhos/cm): 126-185.</i>
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5.0 TEST QA/QC

QA/QC Criteria	Data
Mortality in control exposure must not be more than 10%.	0% mortality.
The lowest DO concentration at test termination must be at least 60% of the air saturation value at test temperature.	The lowest DO concentration measured was 44% of the air saturation value at 15.0°C. The lowest DO concentration observed was at the 96 hour test interval at the 125 mg/L NOEC. The lowest DO concentration observed at the time of complete mortality in the 250 mg/L test concentration was 64% of saturation. The data show dissolved oxygen deprivation did not cause toxicity observed.
Test duration must be 96 h.	The test duration was 96 h.
Reference Substance Toxicity Test (this test is optional).	Data package for the sodium chloride test with this fish batch is in Raw Data Package.

6.0 REFERENCES

American Public Health Association (APHA). 1998. Standard Methods for the Examination of Water and Wastewater. APHA, Washington, D.C.

Environment Canada. 1990. Acute Lethality Test Using Rainbow Trout. Conservation and Protection. Ottawa, Ontario. Report EPS 1/RM/9.

Hamilton, M.A., R.C. Russo, and R.V. Thurston, 1977. Trimmed Spearman-Kärber Method for Estimating Median Lethal Concentrations in Toxicity Bioassays. Environ. Sci. Technol. 11(7): 714-719; Correction 12 (4): 417 (1978).

U.S. Environmental Protection Agency. 1993. A Linear Interpolation Method for Sublethal Toxicity: The Inhibition Concentration (IC_p) Approach.

West Inc., & University of Wyoming, Laramie, Wyoming. 1996. Toxstat Software Package, Version 3.5.

TABLE 1. ACUTE TOXICITY OF FC-3052 TO RAINBOW TROUT (*O. mykiss*)

Test Chemical Nominal Conc. (mg/L)	Cumulative Number of Dead Organisms and Percent Mortality ^a			
	24 h	48 h	72 h	96 h
0 (control)	0 (0)	0 (0)	0 (0)	0 (0)
62.5	0 (0)	0 (0)	0 (0)	0 (0)
125	0 (0)	0 (0)	0 (0)	0 (0)
250	2 (10)	20 (100)	20 (100)	20 (100)
500	20 (100)	20 (100)	20 (100)	20 (100)
1000	20 (100)	20 (100)	20 (100)	20 (100)

^a Percentages are in parenthesis.

**EFFECT AND NO-EFFECT CONCENTRATIONS WITH
CORRESPONDING 95% CONFIDENCE INTERVALS**

LCs and NOEC	Data (mg/L)	95 % Confidence interval
24-h LC ₅₀	330	301-362
48-h LC ₅₀	177	Not reliable
72-h LC ₅₀	177	Not reliable
96-h LC ₅₀	177	Not reliable
96-h LC ₁₀	138	Not reliable
96-h NOEC	125	Not applicable