TOXICITY TO AQUATIC PLANTS (E.G., ALGAE)

TEST SUBSTANCE

Identity: Perfluorooctanesulfonate; may also be referred to as PFOS or FC-95 or as part of the mixed product FM-3820 (see Remarks). (1-Octanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro-, potassium salt, CAS # 2795-39-3)

Remarks: The test sample is FM-3820, a mixture of the test substance in diethylene glycol butyl ether and water (approximately 24-28% test substance in diethylene glycol butyl ether and water). Calculations were made to adjust test values using the upper limit concentration of the test substance (28%) in the test sample and no adjustment was made for the presence of the diethylene glycol butyl ether or water when noted below. These calculations assumed that all toxicity was due to the presence of the Perfluorooctanesulfonate substance.

METHOD

Method: OECD 201
Test: Static acute
GLP: No
Year completed: 1991
Species: *Selenastrum capricornutum*
Source: Originally from the Culture Collection of Algae at the University of Texas at Austin, maintained in culture medium at EnviroSystems Division, Resource Analysts, Inc., Hampton, NH.
Analytical monitoring: Temperature and pH
Element basis: Growth rate
Exposure period: 96-hours
Start date: 4/29/91
End date: 5/3/91
Test organisms laboratory culture: Algae cultures had been actively growing in sterile enriched media identical to media used for the test and maintained at test conditions.

Test Conditions:
Test temperature range: 23.0 – 23.1°C

Dilution water: Synthetic media prepared with sterile deionized water according to U.S. EPA standard, 1978.
Dilution water source: Not noted.
Stock and test solution preparation: A primary stock solution was prepared in algal medium at a concentration of 1000 mg/L. The primary stock solution was proportionally diluted with algal medium to prepare the five additional test concentrations directly in the test vessels.
Exposure vessels: 250 mL glass Erlenmeyer flasks capped with inverted glass beakers and containing 100 mL of test solution.
Agitation: Shaken continuously
Number of replicates: three
Initial algal cell loading: 1.0 X 10^4 cells/mL
Number of concentrations: Five plus a negative control
Water chemistry:
pH range (0 – 96 hours)
8.0 – 10.3 (control exposure)
7.2 – 8.1 (1000 mg/L exposure)
Test temperature range (0 – 96 hours)
23.0 – 23.1°C
Light levels: (0 – 96 hours)
40 uEin/sec/m^2 from continuous cool-white fluorescent lighting

RESULTS

Nominal concentrations: Bk control, 62.5, 125, 250, 500, and 1000 mg/L.
Test Sample Element value:
24-hour EC_{50} (growth rate) = <62.5 mg/L (CI not calculable)
48-hour EC_{50} (growth rate) = 707 (500-1000) mg/L
72-hour EC_{50} (growth rate) = 284 (249-325) mg/L
96-hour EC_{50} (growth rate) = 255 (222-293) mg/L
96-hour NOEC (growth rate) = 125 mg/L

Perfluorooctanesulfonate concentration adjusted Element value:
24-hour EC_{50} (growth rate) = <17.5 mg/L
48-hour EC_{50} (growth rate) = 198 mg/L
72-hour EC_{50} (growth rate) = 80 mg/L
96-hour EC_{50} (growth rate) = 71 mg/L
96-hour NOEC (growth rate) = 35 mg/L

All element values based on nominal concentrations

Statistical methods: EC_{50} values were calculated using the binomial or moving average method. The NOEC was calculated using Dunnett's test. The average specific growth rate was calculated as the natural log of the number of cells per ml at 96 hours minus the natural log of the number of cells per ml at 0 hours divided by the exposure period. The percent change from control is calculated by subtracting the sample average specific growth rate from the control average specific growth rate, dividing that value by the average specific growth rate in the control and multiplying that value by 100. The percent change from control was used to compute EC_{50} and NOEC values.

Control response: Not noted.

Mean Growth data:

Nominal Concentration, mg/L	Number of Cells per mL	Average Specific Growth Rate (μ)	Percent Inhibition via Growth Rate
Negative Control	448,000	0.040	--
62.5	198,000	0.031	22
125	281,000	0.035	12
250	221,000	0.032	20
500	12,000	0.002	95
1000	11,000	0.001	98

Observations: The number of algal cells/ml in each test vessel was determined by means of direct microscopic counts with a hemacytometer.

Reversibility of Growth Inhibition: Not noted.

CONCLUSIONS

The test substance 96-hour EC_{50} and 95% confidence interval for *Selenastrum capricornutum* was determined by growth rate to be 255 (222-293) mg/L. The 96-hour NOEC was determined by Dunnett's procedure to be 125 mg/L.

If you attribute all toxicity to the Perfluorooctanesulfonate component of the test substance (FM-3820) using the 28% upper concentration limit, the 96-hour EC_{50} (growth rate) = 71 mg/L and the 96-hour NOEC (growth rate) = 35 mg/L

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DATA QUALITY

Reliability: Klimisch ranking = 3. The study lacks analytical measurement of test substance concentrations in the test solutions, determination of the mode of toxicity, insufficient characterization of sample purity, and insufficient explanation of observed anomalies in toxicity readings. Additionally, the write-up did not indicate the test vessels were sterile, and data is for a mixture and toxicity cannot be positively attributed to Perfluorooctancesulfonate as the diethylene glycol butyl ether could also contribute to the toxicity.

REFERENCES

This study was conducted at EnviroSystems Division , Resource Analysts, Incorporated at the request of the 3M Company.

OTHER

Last changed: 5/3/00