

US EPA ARCHIVE DOCUMENT

DATA REVIEW NUMBER : (ES) (103.0) G.3

TEST : Fish Acute LC₅₀

SPECIES : Rainbow Trout, Salmo gairdneri

RESULTS :

24-Hour LC₅₀ = 0.0125 ppm

48-Hour LC₅₀ = 0.0054 ppm

96-Hour LC₅₀ = 0.0025 ppm

CHEMICAL : Permethrin (PP557): ? % purity

TITLE : Determination of The Acute Toxicity of PP557 to Rainbow Trout
(Salmo gairdneri)

ACCESSION NO : 227722

STUDY DATE : February, 1976

RESEARCHER : Hill, R. W. et. al., ICI Limited, Brixham Laboratory

REGISTRANT : ICI United States, Inc.

VALIDATION CATEGORY : Invalid

CATEGORY REPAIRABILITY : No

ABSTRACT :

The continuous flow 24, 48 and 96-Hour LC₅₀'s for rainbow trout versus
PP 557 (permethrin) were determined.

ADDITIONAL INFORMATION/COMMENTS

A. Additional Test Data

1. Methodology/Protocol:

- a. The apparatus used in these studies was a continuous flow through bioassay system which is described in detail in Reference a.
- b. Dosing of the concentrated stock solution was achieved by a series of peristaltic pumps; fresh water was dosed to the system by a further series of peristaltic pumps.
- c. Mixing to achieve the required concentration was carried out in glass splash heads before the test solution passed into the test vessels.
- d. The dilution water was obtained from a 20,000 gallon reservoir which was monitored daily for total hardness. This hardness ranged from 24.5 mg/l to 31.0 mg/l as CaCO_3 over the test period. The values obtained are reported in Table 4.
- e. The test vessels were made of glass of 20 litre capacity and each test vessel was fed with the required test concentration at a rate of 200 ml/minute.
- f. The system was designed to achieve a complete exchange of the test solutions within a period of 3 hours.
- g. Ten Rainbow Trout were used in each concentration tested and a control was run simultaneously with each set of experiments. The temperature was maintained at 13°C throughout the test period.
- h. In initial experiments involved in the preparation of the concentrated stock solutions, acetone was used as the preferred solvent. At high rates of dilution used of the order of 130: 1 required to undertake the test, problems with separation of the compound occurred. In order to overcome this difficulty, dimethyl sulphoxide was used at a fish exposure level of 50 mg/l in the first test series and 10 mg/l in the second series. The reported level of the toxicity of DMSO to Rainbow Trout as a 96 hour LC_{50} value is 32,300 mg/l by Willford (Ref. b).

- i. Series I: 0.1, 0.068, 0.047, 0.033, 0.022 mg/l PP557
Series II: 0.01, 0.0047, 0.0022, 0.001, 0.00068, 0.00047
mg/l PP557.

In Series I the DMSO fish exposure level was 50 mg/l while
in Series II the level was 10 mg/l.

- j. Dissolved oxygen levels in each test wessel were measured
twice daily using a Yellow Springs Incorporated Model 51A
dissolved oxygen meter.
- k. The lowest recorded oxygen level was 96% of the air
saturated value at the test temperature of 13°C.
- l. The pH levels were measured twice daily using a Western
Biological Meter. The values obtained ranged from 7.75
to 8.05 pH units for the series of experiments.
- m. Temperature readins were taken twice daily and no deviation
was recorded from the nominal valuse of 13°C ± 0.5°C for
the tests.
- n. The average weight of the fish was 0.305 gms with a range
from 0.2 to 0.45 gms.
- o. The average length of the fish was 26 mm with a range from
23 to 29 mm.
- p. The fish were held in stock tanks for a period of seven days
at a temperature of 10°C ± 1°C prior to testing and then
acclimatised for a further period of 3 days in the fish exposure
vessels at a temperature of 13°C ± 0.5°C.

2. Additional Test Results:

The individual times of death of the fish were recorded in minutes,
and these were then used to estimate the time for 50% of the test
population to die (ET₅₀) by using the following formula.

$$\text{Log ET}_{50} = \frac{\text{Antilog } \Sigma \log (\log t)}{n}$$

Where t = survival time in minutes for each fish

n = number of test fish used in each concentration (10).

A computer programme was used to process the times of death and obtain the Geometric Median Survival Periods (GMSP).

A toxicity graph was constructed by plotting the ET_{50} values against concentration on logarithmic scales. The graph obtained of this plot was used to read off 24, 48 and 96 hour LC_{50} values.

24 hr LC_{50} values = 0.0125 mg/l as PP557

48 hr LC_{50} value = 0.0054 mg/l as PP557

96 hr LC_{50} value = 0.0025 mg/l as PP557

No deaths occurred at a test level of 0.001 mg/l or in the lower concentrations tested at the 96 hr period. The no effect level found in this study was 0.001 mg/l as PP557.

Toxic Symptoms Observed

There was a noticeable increase in the swimming rate in the 0.1 and 0.068 mg/l concentrations within fifteen minutes of the start of the test. The respiration rate also increased but due to the small size of the test fish used, this was difficult to judge accurately.

The first signs of distress occurred in the 0.1 and 0.068 mg/l concentrations at 160 minutes. The first deaths were recorded at 400 minutes in both concentrations and all of the fish were keeled over at this time.

When deaths occurred in the lower concentrations, the symptoms were similar but extended in time.

All dead fish without exception had the tail and peduncle blackened and all of the fish had some degree of spinal curvature, the severity increasing with concentration. The 0.001 mg/l and lower concentrations were safe at 5760 minutes with no deaths occurring. No toxic symptoms were recorded in the 0.001 mg/l test and this concentration was considered to be a no effect level.

3. References:

- a. Maddock B G and Williams B R H
A continuous Flow Apparatus for Assessing the Toxicity of
Substances of Aquatic Animals.
I C I Brixham Laboratory Report BL/A/1579
- b. Willford W A
Toxicity of Dimethyl Sulfoxide (DMSO) to fish
Investigations in Fish Control No 20
United States Department of the Interior Resource Publication 37
Washington D C
April 1967

B. Validation Category/Rationale:

This study is invalid because the methodology of the study does not provide for the determination of lethal concentrations which cause 50% mortality at 24, 48 and 96 hours. The methodology used determines Geometric Median Survival Periods (GMSP) (or, in other words, the estimated time for 50% of a test population to die) at each toxicant concentration level tested. It appears this method was chosen, for 100% mortality occurred in all concentrations (except the no effect level concentration), and, in most cases, it occurred prior to 24 hours. Said data, therefore, precludes the development of any statistically derived best estimate of the LC₅₀ at 24, 48 or 96 hours.

C. Category Repairability/Rationale

As is, this study can never be reclassified to supplementary or core status for a definitive test must meet both of the following criteria so that the LC₅₀ or EC₅₀ can be calculated with reasonable accuracy:

- a. Except for the controls, the concentration of toxicant in each treatment must be at least 60% of the next higher one for BASIC tests and at least 50% of the next higher one for EFFLUENT tests.
- b. One treatment other than the control must have killed or affected less than 35% of the organisms exposed to it, and one treatment must have killed or affected more than 65% of the organisms. This requirement does not apply to EFFLUENT tests if 100% effluent does no kill or affect more than 65% of the organisms exposed to it.

This data cannot meet these criteria.