PROJECT NO. 72-L-12
REPORT FILE

Industrial BIO-TEST Laboratories, Inc.
1810 FRONTAGE ROAD
NORTHBROOK, ILLINOIS 60062

BTL-72-129

REPORT TO

MONSANTO COMPANY

FOUR-DAY STATIC FISH TOXICITY STUDIES WITH AROCLOR 1221, AROCLOR 5432, AROCLOR 5442, AROCLOR 5460, AND MCS 1016 IN BLUEGILLS AND CHANNEL CATFISH

JANUARY 12, 1972

IBT NO. A9380

DSW 036832

STLCOPCB4020656

Industrial BIO-TEST Laboratories, Inc.
1810 FRONTAGE ROAD
NORTHBROOK, ILLINOIS 60062

January 12, 1972

Mr. Elmer P. Wheeler
Manager, Environmental Health
Monsanto Company
800 North Lindbergh Boulevard
St. Louis, Missouri 63166

Dear Mr. Wheeler:

Re: IBT No. A5380 - Four-Day Static Fish Toxicity Studies with Aroclor 1221, Aroclor 5432, Aroclor 5442, Aroclor 5460 & MCS 1016 - Bluegills & Catfish

We are submitting herewith our laboratory report dated January 12, 1972, prepared in connection with the above study.

Very truly yours,

J. C. Calandra
President

JCC/kjl

DSW 036833

STLCOPCB4020657

REPORT TO

MONSANTO COMPANY

FOUR-DAY STATIC FISH TOXICITY STUDIES WITH
AROCLOR 1221, AROCLOR 5432, AROCLOR 5442,
AROCLOR 5460, AND MCS 1016
IN BLUEGILLS AND CHANNEL CATFISH

JANUARY 12, 1972

IBT NO. A9380

I. Introduction

At the request of Monsanto Company, four-day static fish toxicity studies using bluegills (Lepomis macrochirus) and channel catfish (Ictalurus punctatus) were conducted with the following five materials:

1. Aroclor 1221
2. Aroclor 5432
3. Aroclor 5442
4. Aroclor 5460
5. MCS 1016

Water samples were collected under the following three bioassay vessel conditions:

1. Test material and fish exposure.

2. Blank exposure (test material concentration under test material and fish exposure, but without fish).

3. Control exposure (fish but no test material).

The water collection schedule is presented in Table I.

DSW 036834

STLCOPCB4020658

TABLE I

TEST MATERIALS: Aroclor 1221, Aroclor 5432, Aroclor 5442, Aroclor 5460 and MCS 1016

Four-Day Static Fish Toxicity Studies

Water Collection Intervals

Bioassay Vessel Conditions	Hours: 0	1	2	3	6	12	24	48	72	96
Test Material Fish Exposure (Test Material plus Fish)										
No Survival Concentration	X									
Partial Survival Concentration	X									
Total Survival Concentration	X	X	X	X	X	X	X	X	X	X
Blank Exposure (Test Material but no Fish)										
No Survival Concentration	X	X	X	X	X	X	X	X	X	X
Partial Survival Concentration	X	X	X	X	X	X	X	X	X	X
Total Survival Concentration	X	X	X	X	X	X	X	X	X	X
Control Exposure (Fish but no Test Material)	X	X	X	X	X	X	X	X	X	X

DSW 036835

STLCOPCB4020659

II. Summary

The result of the four-day static fish toxicity studies using bluegills and channel catfish are summarized below.

Test Material	Four-Day Static TL50 (ppm) Bluegills	Channel Catfish
Aroclor 1221	0.23 ppm	3.34 ppm
Aroclor 5432	>100.0 ppm	>100.0 ppm
Aroclor 5442	>100.0 ppm	>100.0 ppm
Aroclor 5460	>100.0 ppm	>100.0 ppm
MCS 1016	0.65 ppm	0.75 ppm

Respectfully submitted,

INDUSTRIAL BIO-TEST LABORATORIES, INC.

Report prepared by:

John Hamlin, B.A.
Assistant Toxicologist
Acute Toxicity

Report approved by:

Carmen Mastri, B.S.
Senior Group Leader
Acute Toxicity

M. L. Keplinger, Ph.D.
Manager, Toxicology

January 12, 1972
jg:hp

STLCOPCB4020660

III. Investigational Procedure

Healthy fingerlings with an average length of 35 to 75 millimeters were used as test animals. All fish were kept under observation for general health and suitability as test animals for a period of not less than 14 days prior to experimental use. The fish were held in stock tanks and were fed frozen brine shrimp or Purina Trout Chow #2 until three days prior to testing. The fish were maintained at a temperature of 18°C.

All stock tanks and bioassay vessels contained reconstituted water. The following compounds were added in the amounts stated per liter of deionized water:

30 mg calcium sulfate
30 mg magnesium sulfate
48 mg sodium bicarbonate
2 mg potassium chloride

Preliminary screening was conducted in order to find the general toxic level of each test material. Once this level had been determined, three to five concentrations of each test material were selected for the respective bioassays. Bioassay vessels were filled with 12.5 liters of reconstituted water. Ten fish were tested at each concentration.

After a 24-hour acclimatization period, calculated amounts of each test material were dispensed into the respective vessels. The test dilutions were prepared within one hour of the start of the bioassay.

Following the introduction of the test material, the fish were observed for 96 hours, during which time all mortalities and/or untoward

DSW 036837

STLCOPCB4020661

behavioral reactions were recorded. The concentration of dissolved oxygen was measured for all solutions in which mortalities occurred in order to determine if the test water contained adequate oxygen.* Concentrations of dissolved oxygen of 4 mg/L (4 ppm) for warm water fish (bluegills and channel catfish) were considered adequate for testing. The pH of the test solution was also determined when mortalities were recorded. All fish were collected, rinsed with deionized water, and preserved by freezing for future residue analysis.

At the end of the observation period, the four-day median tolerance limits (TL_{50}'s) of each test material were calculated, if possible, employing the technique of Litchfield and Wilcoxon**.

In addition, water samples were collected at selected time intervals as listed in Table 1.

* Hach OX-2-P Dissolved Oxygen Test Kit, Hach Chemical Company, Ames, Iowa.

** Litchfield, J. T., Jr. and Wilcoxon, F., "A Simplified Method of Evaluating Dose-Effect Experiments," J. Pharm. & Exp. Ther. 96, 99 (1949).

DSW 036838

STLCOPCB4020662

IV. Results

A. Survival, DO, and pH Data

The survival, dissolved oxygen content, and pH data for bluegills and channel catfish are presented in Tables II through XI.

DSW 036839

STLCOPCB4020663

TABLE II

TEST MATERIAL: Arcolor 1221

Four-Day Static Fish Toxicity Study - Bluegills

Survival, DO, and pH Data

Concentration* (ppm)	Number of Survivors Hours: 1-6	24	48	72	96	Percent Survival	Dissolved Oxygen (ppm) and pH 1-6 Hr. DO	pH	24 Hr. DO	pH	48 Hr. DO	pH	72 Hr. DO	pH	96 Hr. DO	pH
0.10	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-
0.18	10	9	6	6	6	0	-	-	5.6	6.9	3.8	6.8	-	-	-	-
0.32	10	9	4	3	3	30	-	-	6.2	6.8	5.4	6.9	3.6	6.6	-	-
0.56	10	5	1	0	0	0	-	-	7.2	7.0	6.8	7.0	5.3	7.0	-	-
1.00	10	8	8	0	0	0	-	-	6.8	6.8	-	-	3.1	6.9	-	-

Four-Day TL_{50} = 0.23 ppm
95% Confidence Limits of TL_{50} = 0.16 - 0.32 ppm

- = Not determined.

* The test material was dispensed into the bioassay vessels in the form of a 0.1 percent (w/v) dilution in acetone. Concentrations are expressed in terms of Aroclor 1221.

DSW 036840

STLCOPCB4020664

TABLE III

TEST MATERIAL: Aroclor 5432

Four-Day Static Fish Toxicity Study - Bluegills

Survival, DO, and pH Data

Concentration* (ppm)	Number of Survivors Hours: 1-6	24	48	72	96	Percent Survival	Dissolved Oxygen (ppm) and pH 1-6 Hr. DO	pH	24 Hr. DO	pH	48 Hr. DO	pH	72 Hr. DO	pH	96 Hr. DO	pH
1.0	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-
10.0	10	10	10	10	9	90	-	-	-	-	-	-	-	-	1.6	6.8
100.0	10	10	10	10	9	90	-	-	-	-	-	-	-	-	1.0	6.8

Four-Day TL_{50} > 100.0 ppm

- = Not determined.

* The test material was dispensed into the bioassay vessels in the form of a 10.0 percent (w/v) dilution in acetone. Concentrations are expressed in terms of Aroclor 5432.

DSW 036841

STLCOPCB4020665

TABLE IV

TEST MATERIAL: Aroclor 5442

Four-Day Static Fish Toxicity Study - Bluegills

Survival, DO, and pH Data

Concentration[a] (ppm)	Number of Survivors Hours: 1-6	24	48	72	96	Percent Survival	Dissolved Oxygen (ppm) and pH 1-6 Hr. DO	pH	24 Hr. DO	pH	48 Hr. DO	pH	72 Hr. DO	pH	96 Hr. DO	pH
1.0	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-
10.0	10	10	10	10	9	90	-	-	-	-	-	-	-	-	0.9	6.8
100.0	10	10	10	10	9	90	-	-	-	-	-	-	-	-	2.3	6.7

Four-Day TL_{50} > 100.0 ppm

- = Not determined.

[a] The test material was dispensed into the bioassay vessels in the form of a 10.0 percent (w/v) dilution in acetone. Concentrations are expressed in terms of Aroclor 5442.

DSM 036842

STLCOPCB4020666

TABLE V

TEST MATERIAL: Aroclor 5460

Four-Day Static Fish Toxicity Study - Bluegills

Survival, DO, and pH Data

Concentration* (ppm)	Number of Survivors Hours: 1-6	24	48	72	96	Percent Survival	Dissolved Oxygen (ppm) and pH 1-6 Hr. DO	pH	24 Hr. DO	pH	48 Hr. DO	pH	72 Hr. DO	pH	96 Hr. DO	pH
1.0	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-
10.0	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-
100.0	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-

Four-Day TL_{50} > 100.0 ppm

- = Not determined.

* The test material was dispensed into the bioassay vessels in the form of a 10.0 percent (w/v) dilution in acetone. Concentrations are expressed in terms of Aroclor 5460.

DSW 036843

STLCOPCB4020667

TABLE VI

TEST MATERIAL: MCS 1016

Four-Day Static Fish Toxicity Study - Bluegills

Survival, DO, and pH Data

Concentrations* (ppm)	Number of Survivors Hours: 1-6	24	48	72	96	Percent Survival	Dissolved Oxygen (ppm) and pH 1-6 Hr. DO	pH	24 Hr. DO	pH	48 Hr. DO	pH	72 Hr. DO	pH	96 Hr. DO	pH
0.10	10	10	9	9	9	90	-	-	-	-	5.7	7.6	-	-	-	-
0.18	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-
0.32	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-
0.56	10	9	9	9	9	90	-	-	6.9	7.4	-	-	-	-	-	-
1.00	10	2	0	0	0	0	-	-	5.5	7.7	5.5	7.6	-	-	-	-

Four-Day TL_{50} = 0.65 ppm

- = Not determined.

* The test material was dispensed into the bioassay vessels in the form of a 0.1 percent (w/v) dilution in acetone. Concentrations are expressed in terms of MCS 1016.

DSW 036844

STLCOPCB4020668

TABLE VII

TEST MATERIAL: Aroclor 1221

Four-Day Static Fish Toxicity Study - Channel Catfish

Survival, DO, and pH Data

Concentration* (ppm)	Number of Survivors Hours: 1-6	24	48	72	96	Percent Survival	Dissolved Oxygen (ppm) and pH 1-6 Hr. DO	pH	24 Hr. DO	pH	48 Hr. DO	pH	72 Hr. DO	pH	96 Hr. DO	pH
0.56	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-
1.00	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-
1.80	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-
3.20	10	6	6	6	6	60	-	-	4.7	6.5	-	-	-	-	-	-
5.60	8	3	2	0	0	0	7.8	7.1	7.0	6.9	6.8	6.7	5.4	6.9	-	-

Four-Day TL_{50} = 3.34 ppm

- = Not determined.

* The test material was dispensed into the bioassay vessels in the form of a 1.0 percent (w/v) dilution in acetone. Concentrations are expressed in terms of Aroclor 1221.

DSM 036845

STLCOPCB4020669

TABLE VIII

TEST MATERIAL: Aroclor 5432

Four-Day Static Fish Toxicity Study - Channel Catfish

Survival, DO, and pH Data

Concentrations* (ppm)	Number of Survivors Hours: 1-6	24	48	72	96	Percent Survival	Dissolved Oxygen (ppm) and pH 1-6 Hr. DO	pH	24 Hr. DO	pH	48 Hr. DO	pH	72 Hr. DO	pH	96 Hr. DO	pH
1.0	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-
10.0	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-
100.0	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-

Four-Day TL_{50} > 100.0 ppm

- = Not determined.

* The test material was dispensed into the bioassay vessels in the form of a 10.0 percent (w/v) dilution in acetone. Concentrations are expressed in terms of Aroclor 5432.

DSM 036846

STLCOPCB4020670

TABLE IX

TEST MATERIAL: Aroclor 5442

Four-Day Static Fish Toxicity Study - Channel Catfish

Survival, DO, and pH Data

Concentration[a] (ppm)	Number of Survivors Hours: 1-6	24	48	72	96	Percent Survival	Dissolved Oxygen (ppm) and pH 1-6 Hr. DO	pH	24 Hr. DO	pH	48 Hr. DO	pH	72 Hr. DO	pH	96 Hr. DO	pH
1.0	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-
10.0	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-
100.0	10	10	10	10	8	80	-	-	-	-	-	-	-	-	1.3	6.8

Four-Day TL_{50} > 100.0 ppm

- Not determined.

[a] The test material was dispensed into the bioassay vessels in the form of a 10.0 percent (w/v) dilution in acetone. Concentrations are expressed in terms of Aroclor 5442.

DSM 036847

STLCOPCB4020671

TABLE X

TEST MATERIAL: Aroclor 5460

Four-Day Static Fish Toxicity Study - Channel Catfish

Survival, DO, and pH Data

Concentration* (ppm)	Number of Survivors Hours: 1-6	24	48	72	96	Percent Survival	Dissolved Oxygen (ppm) and pH 1-6 Hr. DO	pH	24 Hr. DO	pH	48 Hr. DO	pH	72 Hr. DO	pH	96 Hr. DO	pH
1.0	10	10	10	9	9	90	-	-	-	-	-	-	2.6	7.0	-	-
10.0	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-
100.0	10	10	9	9	7	70	-	-	-	-	3.7	7.2	-	-	1.0	6.9

Four-Day TL_{50} > 100.0 ppm

- = Not determined.

* The test material was dispensed into the bioassay vessels in the form of a 10.0 percent (w/v) dilution in acetone. Concentrations are expressed in terms of Aroclor 5460.

DSM 036848

STLCOPCB4020672

TABLE XI

TEST MATERIAL: MCS 1016

Four-Day Static Fish Toxicity Study - Channel Catfish

Survival, DO, and pH Data

Concentration* (ppm)	Number of Survivors Hours: 1-6	24	48	72	96	Percent Survival	Dissolved Oxygen (ppm) and pH 1-6 Hr. DO	pH	24 Hr. DO	pH	48 Hr. DO	pH	72 Hr. DO	pH	96 Hr. DO	pH
0.10	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-
0.18	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-
0.32	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-
0.56	10	10	10	10	10	100	-	-	-	-	-	-	-	-	-	-
1.00	10	7	0	0	0	0	-	-	3.3	7.2	3.0	7.4	-	-	-	-

Four-Day TL_{50} = 0.75 ppm

- = Not determined.

* The test material was dispensed into the bioassay vessels in the form of a 0.1 percent (w/v) dilution in acetone. Concentrations are expressed in terms of MCS 1016.

DSW 036849

STLCOPCB4020673

B. Reactions

The reactions noted following introduction of the test materials are presented in Tables XII through XXI.

DSW 036850

STLCOPCB4020674

TABLE XII

TEST MATERIAL: Aroclor 1221

Four-Day Static Fish Toxicity Study - Bluegills

Summary of Reactions

Concentration (ppm)	Reaction	Time of Onset Following Dose Administration (hours)	Duration of Reaction (hours)	Time of Death Following Dose Administration (hours)
0.10	None	-	-	-
0.18	Swimming: Gyrating	12	24	24,48
	Quiescent	48	24	
0.32	Quiescent	48	24	24-72
0.56	Surfacing	24	No recovery noted	24-72
	Twitching	24	24	
	Quiescent	48	No recovery noted	
1.00	Motionless: Flaccidity	1-6	24	24,72
	Surfacing	1-6	24	
	Swimming: Erratic	12	Until	
	Gyrating	48	death	
	Respiratory rate: Rapid	24		

DSM 036851

STLCOPCB4020675

TABLE XIII

TEST MATERIAL: Aroclor 5432

Four-Day Static Fish Toxicity Study - Bluegills

Summary of Reactions

Concentration (ppm)	Reaction	Time of Onset Following Dose Administration (hours)	Duration of Reaction (hours)	Time of Death Following Dose Administration (hours)
1.0	None	-	-	-
10.0	Quiescent	72	No recovery noted	96
	Surfacing	96		
100.0	Quiescent	72	No recovery noted	96
	Surfacing	96		

DSM 036852

STLCOPCB4020676

TABLE XIV

TEST MATERIAL: Aroclor 5442

Four-Day Static Fish Toxicity Study - Bluegills

Summary of Reactions

Concentration (ppm)	Reaction	Time of Onset Following Dose Administration (hours)	Duration of Reaction (hours)	Time of Death Following Dose Administration (hours)
1.0	Quiescent	96	No recovery noted	-
10.0	Quiescent	72	No recovery noted	96
	Surfacing	96		
100.0	Quiescent	72	No recovery noted	96
	Motionless: Flaccidity	96		

DSW 036853

STLCOPCB4020677

TABLE XV

TEST MATERIAL: Aroclor 5460

Four-Day Static Fish Toxicity Study - Bluegills

Summary of Reactions

Concentration (ppm)	Reaction	Time of Onset Following Dose Administration (hours)	Duration of Reaction (hours)	Time of Death Following Dose Administration (hours)
1.0	None	-	-	-
10.0	Quiescent	72	No recovery noted	-
100.0	Quiescent	24	No recovery noted	-

DSW 036854

STLCOPCB4020678

TABLE XVI

TEST MATERIAL: MCS 1016

Four-Day Static Fish Toxicity Study - Bluegills

Summary of Reactions

Concentration (ppm)	Reaction	Time of Onset Following Dose Administration (hours)	Duration of Reaction (hours)	Time of Death Following Dose Administration (hours)
0.10	None	-	-	48
0.18	None	-	-	-
0.32	Quiescent	96	No recovery noted	-
0.56	Quiescent	48	No recovery noted	24
1.00	Twitching	24	Until	24,48
	Swimming: On side	24	death	

DSM 036855

STLCOPCB4020679

TABLE XVII

TEST MATERIAL: Aroclor 1221

Four-Day Static Fish Toxicity Study - Channel Catfish

Summary of Reactions

Concentration (ppm)	Reaction	Time of Onset Following Dose Administration (hours)	Duration of Reaction (hours)	Time of Death Following Dose Administration (hours)
0.56	None	-	-	-
1.00	None	-	-	-
1.80	Quiescent	1-6	24	-
	Surfacing	1-6		
	Swimming: Gyrating	1-6		
3.20	Quiescent	1-6	No recovery noted	24
	Motionless: Flaccidity	1-6		
	Swimming: On side	48		
5.60	Quiescent	1-6	Until death	1-72
	Motionless: Flaccidity	1-6		
	Surfacing	1-6		

DSM 036856

STLCOPCB4020680

TABLE XVIII

TEST MATERIAL: Aroclor 5432

Four-Day Static Fish Toxicity Study - Channel Catfish

Summary of Reactions

Concentration (ppm)	Reaction	Time of Onset Following Dose Administration (hours)	Duration of Reaction (hours)	Time of Death Following Dose Administration (hours)
1.0	Quiescent	96	No recovery noted	-
	Surfacing	96		
10.0	Quiescent	72	No recovery noted	-
	Surfacing	96		
100.0	Quiescent	72	No recovery noted	-
	Surfacing	96		

DSW 036857

STLCOPCB4020681

TABLE XIX

TEST MATERIAL: Aroclor 5432

Four-Day Static Fish Toxicity Study - Channel Catfish

Summary of Reactions

Concentration (ppm)	Reaction	Time of Onset Following Dose Administration (hours)	Duration of Reaction (hours)	Time of Death Following Dose Administration (hours)
1.0	Quiescent	96	No recovery noted	-
	Surfacing	96		
10.0	Quiescent	72	No recovery noted	-
	Surfacing	96		
100.0	Quiescent	72	No recovery noted	96
	Surfacing	96		

DSW 036858

STLCOPCB4020682

TABLE XX

TEST MATERIAL: Aroclor 5460

Four-Day Static Fish Toxicity Study - Channel Catfish

Summary of Reactions

Concentration (ppm)	Reaction	Time of Onset Following Dose Administration (hours)	Duration of Reaction (hours)	Time of Death Following Dose Administration (hours)
1.0	Quiescent	72	No recovery noted	72
10.0	Quiescent	48	No recovery noted	-
100.0	Quiescent	24	No recovery noted	48, 96
	Surfacing	96		

DSM 036859

STLCOPCB4020683

TABLE XXI

TEST MATERIAL: MCS 1016

Four-Day Static Fish Toxicity Study - Channel Catfish

Summary of Reactions

Concentration (ppm)	Reaction	Time of Onset Following Dose Administration (hours)	Duration of Reaction (hours)	Time of Death Following Dose Administration (hours)
0.10	None	-	-	-
0.18	None	-	-	-
0.32	Quiescent	96	No recovery noted	-
9.56	Quiescent	72	No recovery noted	-
1.00	Quiescent	1-6	Until death	24.48
	Swimming: Inverted	1-6		
	On side	1-6		

DSW 036860

STLCOPCB4020684