

Original: Fish Division  
cc: Mr. Powers, Dow Chemical Co.  
Mr. Milton Adams  
Education-Game

INSTITUTE FOR FISHERIES RESEARCH

DIVISION OF FISHERIES  
MICHIGAN DEPARTMENT OF CONSERVATION  
COOPERATING WITH THE  
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ADDRESS  
UNIVERSITY MUSEUMS ANNEX  
ANN ARBOR, MICHIGAN

ALBERT S. HAZZARD, PH.D.  
DIRECTOR

REPORT NO. 810

THE RESULTS OF PRELIMINARY TOXICITY TESTS ON  
CERTAIN WASTES FROM THE STYRENE  
MANUFACTURING PROCESS

by

George Washburn and John Greenbank

At the request of the Director of the Michigan Stream Control Commission and of Mr. T. J. Powers of the Dow Chemical Company, the Institute for Fisheries Research has undertaken some toxicity tests on waste materials from the styrene manufacturing process. The object has been to ascertain, roughly, the threshold of tolerance of certain fresh-water fishes for these wastes. The materials were delivered to the Institute on August 1, 1942, and consisted of five 5-gallon samples. The descriptions which accompanied the samples were as follows:

- "1. Mixed Waste Waters--Styrene Development includes all wastes except #2 and #5 as described below plus all condenser waters.
- "2. Ethylene Waste--2B Cracking is the effluent from recovery unit. Might contain small traces of alcohol and benzene.
- "3. Styrene Still--Condensate Decanter is water containing small amounts of styrene.
- "4. Ethyl Benzene Plant HCl Scrubber--might contain up to 15 per cent HCl with traces of hydrocarbons.
- "5. Ethyl Benzene Plant-Composite Wash Water--might contain hydrocarbons and is caustic in reaction."

Fish Used in Tests

Two species of fish were used--smallmouth black bass and black bullheads. The former is a moderate to sensitive fish, while the latter is an extremely hardy one. The smallmouth were obtained from the Federal Hatchery at Northville, Michigan, on August 1, 1942. They were 2 to 3 inches long, and of this year's hatch. The bullheads were seined from Sisterka Pond near Rawsonville, Michigan, on August 13. They were about  $1\frac{1}{2}$  inches long, uniform in size, and were taken from a single school.

The fish were conditioned by holding them in laboratory tanks for a few days before starting the tests.

Procedure

The experiments were performed in the experimental aquarium room of the University Museum of Zoology. A temperature of about 80°F. was maintained throughout the experiment. A range of various concentrations of each stock solution was made up. Two-quart glass jars were employed, and each contained one liter of solution. The solution was pre-aerated for twenty minutes before the fish were introduced, and there was continuous aeration throughout each run. Usually two fish were used to a jar.

The dilution water came from the water treatment tank of the aquarium. It contained enough buffer salts to buffer the test solutions to approximately a neutral pH.

An arbitrary time of 96 hours was allowed for a run. If at the end of that time the fish were alive and apparently in good condition, the run was concluded.

The accompanying tables gives the results of this preliminary set of runs. It is to be emphasized that this set of results is in no way final. Further tests are anticipated. The results given here simply serve to indicate, roughly and comparatively, the general toxicity tolerance ranges of these fish for these particular wastes.

Tests performed by: George Washburn

Supervision: Professor Carl L. Hubbs, University Museums;  
Dr. A. S. Hazzard, Director, Institute for Fisheries Research.

INSTITUTE FOR FISHERIES RESEARCH

By George Washburn and  
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Report approved by: A. S. Hazzard

Report typed by: R. Bauch

Table 1  
Results on Smallmouth Bass (Micropterus dolomieu).

| Concentration,<br>p.p.m. of stock<br>solution | No. fish<br>used in<br>test | Survival<br>time | Remarks   |
|---|-----------------------------|------------------|---|
| a. Mixed Waste Waters                         |                             |                  |   |
| 1,000,000                                     | 2                           | 96 hr. +         |   |
| 700,000                                       | 2                           | " " "            |   |
| 300,000                                       | 2                           | " " "            | Fish alive at<br>termination of<br>experiment, 96<br>hours. |
| 200,000                                       | 2                           | " " "            |   |
| 100,000                                       | 2                           | " " "            |   |
| 50,000  | 2                           | " " "            |   |
| b. Ethylene Waste                             |                             |                  |   |
| 100,000                                       | 1                           | 26 hrs.          |   |
|   | 1                           | 56 hrs.          |   |
| 60,000  | 1                           | 66 hrs. 15 min.  |   |
|   | 1                           | ...              | Died at night   |
| 50,000  | 2                           | 96 hrs. +        |   |
| 40,000  | 2                           | " " "            |   |
| 30,000  | 2                           | " " "            |   |
| 20,000  | 2                           | " " "            |   |
| c. Styrene Still                              |                             |                  |   |
| 100,000                                       | 1                           | 26 hrs.          |   |
|   | 1                           | 62 hrs.          |   |
| 75,000  | 1                           | 49 hrs.          |   |
|   | 1                           | 56 hrs.          |   |
| 60,000  | 1                           | 28 hrs.          |   |
|   | 1                           | 96 hrs. +        |   |
| 50,000  | 2                           | " " "            |   |
| 40,000  | 2                           | " " "            |   |
| 30,000  | 2                           | " " "            |   |
| 20,000  | 2                           | " " "            |   |

(Continued)

Table 1  
Results on Smallmouth Bass (Micropterus dolomieu).  
(Continued)

| Concentration,<br>p.p.m. of stock<br>solution | No. fish<br>used in<br>test | Survival<br>time | Remarks    |
|---|-----------------------------|------------------|------------|
| d. Ethyl Benzene HCl Scrubber                 |                             |                  |            |
| 100,000                                       | 1                           | 30 sec.          |            |
|   | 1                           | 30 sec.          |            |
| 50,000  | 1                           | 1 min.           |            |
|   | 1                           | 1½ min.          |            |
| 10,000  | 1                           | 2 min.           |            |
|   | 1                           | 3 min.           |            |
| 5,000   | 1                           | 7 min.           |            |
|   | 1                           | 5 min.           |            |
| 1,000   | 1                           | 15 min.          |            |
|   | 1                           | 21 min.          |            |
| 800   | 1                           | 1 hr. 40 min.    |            |
|   | 1                           | 3 hr. 10 min.    |            |
| 700   | 1                           | ...              | No record. |
|   | 1                           | 10 hr. 55 min.   |            |
| 600   | 1                           | 18 hr. 30 min.   |            |
|   |                             | 96 hrs. +        |            |
| 500   | 2                           | " " "            |            |
| 400   | 2                           | " " "            |            |
| 300   | 2                           | " " "            |            |
| e. Ethyl Benzene Composite Wash               |                             |                  |            |
| 100,000                                       | 1                           | 15 min.          |            |
|   | 1                           | 21 min.          |            |
| 50,000  | 1                           | 16 min.          |            |
|   | 1                           | 18 min.          |            |
| 25,000  | 1                           | 4 hrs. 55 min.   |            |
|   | 1                           | 2 hrs. 20 min.   |            |
| 15,000  | 1                           | 3 hrs. 30 min.   |            |
|   | 1                           | 3 hrs.           |            |

(Continued)

Table 1  
 Results on Smallmouth Bass (Micropterus dolomieu).  
 (Continued)

| Concentration,<br>p.p.m. of stock<br>solution  | No. fish<br>used in<br>test | Survival<br>time | Remarks    |
|--|-----------------------------|------------------|------------|
| e. Ethyl Benzene Composite Wash<br>(Continued) |                             |                  |            |
| 10,000   | 1                           | 3 hrs. 5 min.    |            |
|  | 1                           | 4 hrs. 20 min.   |            |
| 5,000  | 1                           | ...              | No record. |
|  | 1                           | 4 hrs.           |            |
| 3,000  | 1                           | 4 hrs. 25 min.   |            |
|  | 1                           | 3 hrs. 45 min.   |            |
| 1,000  | 1                           | 3 hrs. 10 min.   |            |
|  | 1                           | 3 hrs. 35 min.   |            |
| 800  | 2                           | 96 hrs. +        |            |
| 600  | 2                           | " " "            |            |
| 400  | 2                           | " " "            |            |

Table 2  
Results on Bullheads (Ameiurus melas melas).

| Concentration,<br>p.p.m. of stock<br>solution | No. fish<br>used in<br>test | Survival<br>time | Remarks   |
|---|-----------------------------|------------------|---|
| a. Mixed Waste Waters                         |                             |                  |   |
| 1,000,000                                     | 2                           | 96 hrs. +        |   |
| 800,000                                       | 2                           | " " "            |   |
| 600,000                                       | 2                           | " " "            | Fish alive at<br>termination of<br>experiment, 96<br>hours. |
| 400,000                                       | 2                           | " " "            |   |
| 200,000                                       | 2                           | " " "            |   |
| b. Ethylene Waste                             |                             |                  |   |
| 250,000                                       | 1                           | 75-90 hrs.       | Died at night.  |
|   | 1                           | 96 hrs. +        |   |
| 200,000                                       | 1                           | 75-90 hrs.       | Died at night.  |
|   |                             | 96 hrs. +        |   |
| 150,000                                       | 1                           | 75-90 hrs.       | Died at night.  |
|   | 1                           | 96 hrs. +        |   |
| 120,000                                       | 1                           | 61 hrs.          |   |
|   | 1                           | 96 hrs. +        |   |
| 100,000                                       | 2                           | 96 hrs. +        | Fish alive at<br>termination of<br>experiment, 96<br>hours. |
| 80,000  | 2                           | " " "            |   |
| 60,000  | 2                           | " " "            |   |
| 40,000  | 2                           | " " "            |   |
| c. Styrene Still                              |                             |                  |   |
| 350,000                                       | 2                           | 96 hrs. +        |   |
| 250,000                                       | 2                           | " " "            |   |
| 180,000                                       | 2                           | " " "            | Fish alive at<br>termination of<br>experiment, 96<br>hours. |
| 100,000                                       | 2                           | " " "            |   |
| 80,000  | 2                           | " " "            |   |

(Continued)

Table 2  
 Results on Bullheads (Ameiurus melas melas).  
 (Continued)

| Concentration,<br>p.p.m. of stock<br>solution | No. fish<br>used in<br>test | Survival<br>time | Remarks        |
|---|-----------------------------|------------------|----------------|
| d. Ethyl Benzene HCl Scrubber                 |                             |                  |                |
| 2,000   | 1                           | 51 min.          |                |
|   | 1                           | 40 min.          |                |
| 1,000   | 1                           | 1 hr. 30 min.    |                |
|   | 1                           | 1 hr. 10 min.    |                |
| 800   | 2                           | 96 hrs. +        |                |
| 700   | 2                           | " " "            |                |
| 500   | 2                           | " " "            |                |
| e. Ethyl Benzene Composite Wash               |                             |                  |                |
| 50,000  | 1                           | 15 min.          |                |
|   | 1                           | 18 min.          |                |
| 10,000  | 1                           | 8 hrs.           |                |
|   | 1                           | 8 hrs.           |                |
| 5,000   | 1                           | 11 hrs. 30 min.  |                |
|   | 1                           | 12 hrs.          |                |
| 3,000   | 1                           | 15 hrs.          |                |
|   | 1                           | 24 hrs.          |                |
| 2,000   | 1                           | 12 hrs. 30 min.  |                |
|   | 1                           | 48 hrs.          |                |
| 1,600   | 1                           | 26 hrs. 30 min.  |                |
|   | 1                           | 69 hrs. +        | Died at night. |
| 1,400   | 1                           | About 85 hrs.    | " " "          |
|   | 1                           | 96 hrs. +        |                |
| 1,200   | 2                           | " " "            |                |
| 1,000   | 2                           | " " "            |                |
| 800   | 2                           | " " "            |                |
| 500   | 2                           | " " "            |                |

(Copy)

August 26, 1942

Mr. T. J. Powers  
The Dow Chemical Company  
Midland, Michigan

Dear Mr. Powers:

I am sending you a preliminary summary of the results obtained so far in toxicity tests involving wastes from your styrene process. You will note that these results are in no way final; further work still is to be done. However, since you are anxious for some preliminary information, it is possible that you may get some rough ideas of the toxicity potentialities of these wastes from these figures.

Mr. Washburn is out of town for a few days but upon his return expects to continue the tests.

To date we have not received from you the analyses of these wastes.

Sincerely yours,

INSTITUTE FOR FISHERIES RESEARCH  
A. S. Hazzard, Director

John Greenbank  
Fisheries Research Technician

JG:VA  
Encl.