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Report on toxicity to fish of an oily waste taken from the tail race of the Ford Motor Company

by

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On April 23, 1947 two employees of the Michigan Stream Control Commission brought to the Institute for Fisheries Research for testing with fish a sample of oily waste taken from the tail race of the Ford Motor Company. The waste was attributed to be the source of toxicity in the Rouge River (See I.F.R. Report No. 1113).

Experiments were undertaken to determine the toxicity of the oily waste under controlled laboratory conditions. For test fish creek chubs (Semotilus a. atromaculatus) ranging in total length from 2.9 to 3.8 inches were obtained from a commercial bait dealer in Ann Arbor. Ann Arbor City tap water, to which a small amount of sodium thiosulphate had been added to remove any chlorine, was used. The experimental test equipment consisted of one-gallon glass jars with plastic covers and provided with individual air dispersers from the laboratory compressed-air line by means of rubber and glass tubing.

Each test jar was filled with 3,000 c.c. of the specially treated tap water and aerated 5 minutes before the 4 test fish were introduced.

After 5 minutes, to allow the fish to become accustomed to their new environment, the given weight of the oily waste was added to the water in the test jar at the surface. The waste was weighed on analytical balance. The physical properties of the oily waste made it impossible to get all the weighed sample into the water; some of the waste remained on the watch-glass and some of it adhered to the side of the test jar above the surface of the water, as the air bubbles from the air disperser agitated the water. Following the introduction of the waste, aeration was continued for a period of 96 hours (duration of the test) or as long as any fish remained alive in the test medium. Creek chubs (Semotilus a. atromaculatus) placed in similar jars filled with the treated tap water were used as controls. All fish in the control jars lived to the termination of the tests and at no time during the experiments did any of the control fish show any sign of distress.

Three runs were made to determine the tolerance limit of creek chubs to the oily waste. The upper limit of the first run was not high enough. However, one fish was affected in the 450-milligram solution after seventy-five minutes exposure but within 16 hours the fish appeared normal again and continued to live to the termination of the test (See table 1). For the second run 600; 1,000; 1,300; 1,600; and 2,000 milligrams of waste added to 3,000 c.c. of water were used and complete kills were obtained in concentrations greater than 1,000. In the 2,000-milligram solution the 4 fish were dead within 140 minutes; in the 1,600- and 1,300-milligram medium all the fish were dead within 195 minutes; in the 1,000-milligram solution it took 255 minutes to kill the 4 test fish. At 600 milligrams 2 fish survived the test although all the fish had lost their sense of equilibrium after an exposure of

135 minutes. In the final run concentrations of 550, 580, 600, 620, and 650 milligrams were used. The highest concentration was the only one in which there was a complete kill. All fish were dead within 240 minutes in the 650-milligram solution. In the 550, 580, 600, and 620-milligram medium 4, 2, 2, and 3 fish, respectively, survived to the termination of the test, although all of the fish at times during the experiment had lost their sense of equilibrium.

The oily waste in concentrations of about 550 to 620 milligrams to 3,000 c.c. of water rendered the fish helpless and caused mortality in some instances, during 96 hours of exposure. The first apparent sign of distress was the loss of balance; the fish swam about wobbling from side to side, and after a short time would make periodic spurts through the water. Later the fish were able only to twitch their fins and lateral muscles. Just before dying, only a slight movement of the opercle and mouth could be detected. On the venteral surface of some of the fish, hemorrhagic areas were observed, including some of the minnows which survived the test.

According to the above laboratory test it can be concluded that 450 milligrams of the oily waste to 3,000 cc. of water can be considered the maximum concentration, which will not render creek chubs helpless, and concentrations above 650 milligrams per 3,000 c.c. will cause heavy mortality. In all cases except one the minnows which failed to survive the first 20 hours of exposure were the only ones to die. Apparently some of the toxic substance is changed after exposure to air and water, or else the fish become acclimated at the lower concentrations.

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Table 1.--Survival time of creek chubs in different concentrations (milligrams of waste to 3,000 c.c. of water) of the oily waste from the tail race of the Ford Motor Company.

Time in hours and minutes after waste added	Control	75 milligrams	150 milligrams	300 milligrams	450 milligrams
1:45	4 fish normal	4 fish normal	4 fish normal	4 fish normal	1 fish slightly distressed
7:30	"	"	"	"	1 fish without equilibrium
16:45	"	"	"	"	4 fish normal
96:00	"	"	"	"	" "

Table 2.--Survival time of creek chubs in different concentrations (milligrams of waste to 3,000 c.c. of water) of the oily waste from the tail race of the Ford Motor Company.

Time in hours and minutes after waste added	Control	550 milligrams	580 milligrams	600 milligrams	620 milligrams	650 milligrams
1:30	4 fish normal	4 fish normal	4 fish without equilibrium.	4 fish without equilibrium.	4 fish without equilibrium.	4 fish without equilibrium.
1:45	"	"	2 fish just gill movement.	2 fish just gill movement.	1 fish just gill movement	3 fish just gill movement.
2:25	"	2 fish without equilibrium	4 fish just gill movement	4 fish just gill movement	4 fish just gill movement	1 fish dead
3:10	"	"	" "	" "	" "	1 fish dead
4:10	"	4 fish without equilibrium	" "	" "	1 fish dead	2 fish just gill movement
5:35	"	...	2 fish dead	1 fish dead	...	1 fish dead
5:42	"	2 fish regained equilibrium	...	...	...	...
8:10	"	3 fish regained equilibrium	2 fish just gill movement	1 fish regained equilibrium	1 fish improving	...
16:00	"	4 fish normal	1 fish regained equilibrium	...	...	1 fish dead (all dead)
27:05	"	"	...	3 fish regained equilibrium	2 fish regained equilibrium	...
49:00	"	"	2 fish normal	3 fish normal	3 fish normal	...
89:30	"	"	" "	1 fish dead	" "	...
96:00	"	"	" "	2 fish normal	3 fish normal	...

Table 3.--Survival time of creek chubs in different concentrations (milligrams of waste to 3,000 c.c. of water) of the oily waste from the tail race of the Ford Motor Company.

Time in hours and minutes after waste added	Control	600 milligrams	1,000 milligrams	1,300 milligrams	1,600 milligrams	2,000 milligrams
0:45	4 fish normal	4 fish normal	4 fish normal	4 fish normal	4 fish normal	4 fish normal
1:30	"	"	1 fish without equilibrium	4 fish without equilibrium	4 fish without equilibrium	4 fish without equilibrium
2:05	"	3 fish without equilibrium	3 fish without equilibrium	"	1 fish dead	2 fish dead
2:15	"	"	"	"	1 fish dead	1 fish dead
2:20	"	"	"	"	2 fish without equilibrium	1 fish dead (all dead)
2:25	"	4 fish without equilibrium	4 fish without equilibrium	"	...	...
2:35	"	"	"	1 fish dead	2 fish without equilibrium	...
2:40	"	"	"	2 fish dead	"	...
2:45	"	"	1 fish dead	1 fish without equilibrium	"	...
3:15	"	4 fish with gill movement	3 fish with only gill movement	1 fish dead (all dead)	2 fish dead (all dead)	...
4:15	"	1 fish dead	3 fish dead (all dead)	...	...	...
17:45	"	1 fish dead 2 fish with gill movement	...	...	...	...
19:30	"	2 fish improving	...	...	...	...
22:45	"	2 fish normal	...	...	...	...
96:00	"	"	...	...	...	...