Toxicity Study of Two Oil Spill Reagents Toward Hudson River Fish Species

by

ROBERT REHWOLDT, LAWRENCE LASKO, CHARLES SHAW, and ELLENA WIRHOWSKI

Environmental Science Program
Marist College
Poughkeepsie, N. Y.

The treatment of oil spills is a difficult problem. The choices are really quite limited: application of a sinking agent such as bentonite, application of a dispersant such as linear alkylate sulfonate (LAS) or application of a collecting agent followed by physical absorption from the surface.

Oil spill removal techniques has been given close scrutiny since the Torrey Canyon spill and the toxicity of various types of dispersants have been studied (LA ROCHE et al.,1970, PICKERING, 1966, PICKERING & THATCHER, 1970) and a general review of the effects of detergents on aquatic life is available (ANON.,1965)

While the Hudson River is not a major artery for oil transport, there are a number of off-loading points in the fresh water stretch from Beacon to Albany. A large percentage of the oil off-loaded is No. 2 and No. 4 oils.

The purpose of this research was to determine the median toxicity of No. 2 and No. 4 oils to representative fish species and in addition, determine the effect of a dispersant and collecting agent on this toxicity.

METHODS

Fish were collected and maintained by our facilities, and data analyses were performed by a computer program. Both aspects have been previously described (REHWOLDT et al, 1971).

Reagents were dispersed volumetrically into static bioassay tanks. Concentrations were calculated using densities.

REAGENTS

Dispersant - Linear alkylate sulfonate (LAS) standards were furnished by the United States Environmental Protection Agency. Average molecular weight of LAS was 316.

Collecting Agents - Collecting agent (Herder) was furnished by Shell Oil Company. Analytical analysis of the Herder was not furnished.

Fuel Oils - The No. 2 and No. 4 oils were furnished by a local heating firm.

Bulletin of Environmental Contamination & Toxicology,
Vol. 11, No. 2 © 1974 by Springer-Verlag New York Inc.

ANALYTICAL TECHNIQUES

No daily analysis of the oils was performed. It must be pointed out that the concentrations of oils reported represent total oil added, not oil dissolved in the water column.

The LAS is biodegradable, therefore daily analysis was performed during the toxicity tests. LAS may be determined using a methylene blue spectrophotometric technique (ANON.,1971).

RESULTS AND DISCUSSION

Table I indicates the water quality of the test water maintained during the experiments -

TABLE I

Temperature	19°C	pH	7.1
Hardness	60 mg/l	D.O.	9.2 mg/l

Table II contains the results of the toxicity experiments expressed in terms of TLM, fish species and concentration of material added.

TABLE II

Species	Reagent	TLm* 24-96 hr.
banded killifish (Fundulus diaphanus)	No. 2 oil	28.5 - 26.1
	No. 4 oil	22.5 - 21.0
	Herder	500+
	LAS	2.1 - 1.4
striped bass (Roccus saxatilis)	No. 2 oil	30.6 - 22.2
	No. 4 oil	29.0 - 25.1
	Herder	300+
	LAS	5.1 - 5.1
pumpkinseed (Lepomis gibbosus)	No. 2 oil	42.6 - 39.2
	No. 4 oil	40.1 - 38
	Herder	500+
	LAS	3.1 - 2.7
white perch (Roccus americanus)	No. 2 oil	41.6 - 37.2
	No. 4 oil	32.0 - 31.0
	Herder	500+
	LAS	6.1 - 4.2
American eel (Anguilla rostrata)	No. 2 oil	28.0 - 31.0
	No. 4 oil	28.0 - 25.0
	Herder	500+
	LAS	2.1 - 2.0
carp (Cyprinus carpio)	No. 2 oil	52.5 - 49.1
	No. 4 oil	50.0 - 48.1
	Herder	500+
	LAS	2.2 - 1.5

* concentrations expressed in mg/l for 50% survival.

There are a few generalizations that can be made from Table II. It is apparent that the toxicity of the dispersant far exceeds the toxicity of the oils for all species of fish tested. This is in agreement with results of other experimenters who have used different organisms (SWISHER et al., 1964), although non-ionic dispersants are much less toxic (ENGEL & NEAT, 1971).

It is also apparent that the collecting agent (Herder) is not toxic to the species tested even under unreasonable concentration ranges.

Table III contains the results of the oil toxicity experiments repeated in bioassay tanks containing a sublethal amount of LAS, 1.5 mg/l.

TABLE III

Species	* Reagent	** TLm 24-96 hr.
banded killifish (Fundulus diaphanus)	No. 2 oil	1.4 - 1.1
	No. 4 oil	3.6 - 4.2
striped bass (Roccus saxatilis)	No. 2 oil	0.91 - 0.91
	No. 4 oil	0.82 - 0.62
pumpkinseed (Lepomis gibbosus)	No. 2 oil	1.9 - 1.1
	No. 4 oil	6.2 - 5.0
white perch (Roccus americanus)	No. 2 oil	2.0 - 1.4
	No. 4 oil	1.4 - 1.0
American eel (Anguilla rostrata)	No. 2 oil	5.1 - 4.6
	No. 4 oil	5.5 - 3.2
carp (Cyprinus carpio)	No. 2 oil	8.2 - 6.2
	No. 4 oil	5.1 - 3.1

* 1.5 mg/l added to test tanks

** all concentrations expressed in mg/l

As can be seen the toxicity of the oils increases markedly due to their partial solubilization. In effect, the dispersant brings more toxicant into the water column making it more available to the organism. Other experimenters have observed this increase in toxicity (LA ROCHE et al., 1970).

The oil toxicity experiments were again repeated in the presence of an excessive amount of Herder, 300 mg/l. The presence of the Herder did not significantly alter the toxicity of the oils toward any fish studied.

It would appear, therefore that for No. 2 and No. 4 heating oils, a collecting agent is preferable to a dispersant as far as treating a spill without increasing the toxicity to the aquatic environment.

ACKNOWLEDGEMENT - The authors are indebted to the Central Hudson Gas and Electric Corporation for their support of this project.

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