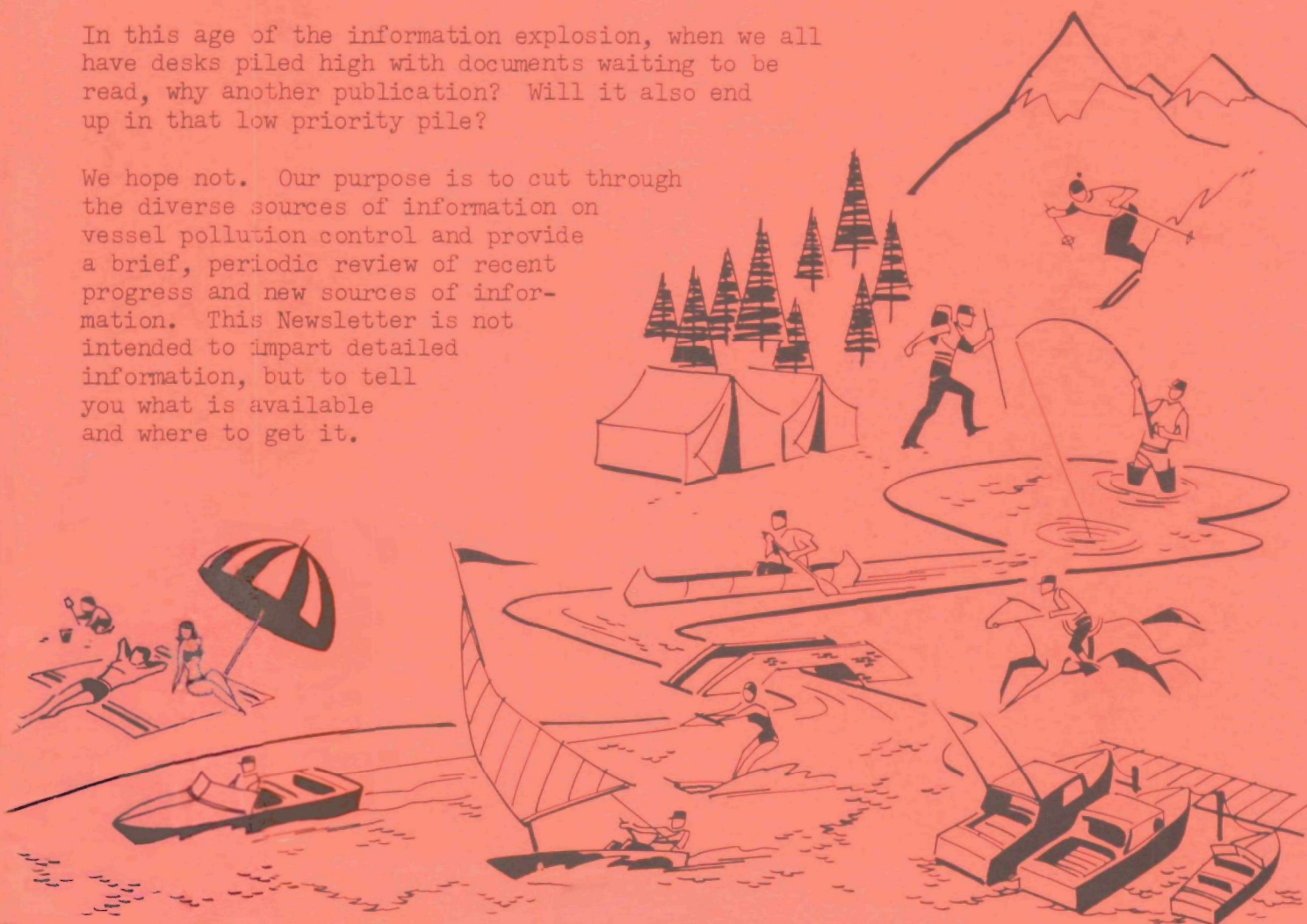


# VESSEL POLLUTION CONTROL RESEARCH NEWSLETTER

## WHY THIS NEWSLETTER?

In this age of the information explosion, when we all have desks piled high with documents waiting to be read, why another publication? Will it also end up in that low priority pile?

We hope not. Our purpose is to cut through the diverse sources of information on vessel pollution control and provide a brief, periodic review of recent progress and new sources of information. This Newsletter is not intended to impart detailed information, but to tell you what is available and where to get it.



## VESSEL POLLUTION: THE PROBLEM

The navigable waters of the United States are used by approximately 46,000 documented commercial vessels, 65,000 nondocumented commercial fishing vessels, 1,500 Federal vessels, and 8 million recreational watercraft. In addition, about 40,000 foreign ship entrances are recorded each year for these waters. Watercraft discharges may include sanitary wastes, oils, litter, bilge water, ballast waters, wash waters, chemicals, and a variety of accidental cargo spills. Some commercial fishing vessels are now designed as floating canneries, discharging both canning wastes and the sanitary wastes of the crew at the site where the vessel is operating.

The many watercraft of all classes which use American waters are capable of utilizing the water resources in any of our 50 states and can deposit varying amounts of wastes at any location causing localized pollution. It is estimated that the total daily waste discharged from all watercraft approximates the wastes from a city of one-half million people, such as Buffalo, New York or San Diego, California. The ubiquity of the problem demands that its dimensions, sources, and effects be examined and remedies developed.

Federal assistance will be necessary for the development and demonstration of treatment and control devices that can handle the domestic sewage requirements of the various classes of watercraft that will meet the forthcoming water quality standards to be developed for vessels.

The Edison Water Quality Laboratory has been designated as the Federal Water Quality Administration's national center for research on controlling pollution caused by wastes from watercraft. This report describes on-going and completed FWQA research, development and demonstration projects for controlling waste pollution from watercraft; outlines the problem of pollution from outboard motors; discusses water quality standards for vessels; and details proposed research and development needs for controlling vessel pollution which will be accomplished through grants, contracts, and in-house efforts.

It is our intention by this and subsequent periodic reports to keep interested parties informed as to our efforts in alleviating pollution caused by watercraft.

## **COMPLETED R&D PROJECTS**

1. "Collection, Underwater Storage, and Disposal of Pleasurecraft Wastes", 15020DHE 09/69, by Underwater Storage Inc. and Silver, Schwartz, Ltd., Joint Venture

A pilot plant was designed, constructed and operated to show the feasibility of providing a facility for the collection, storage and disposal of waste from recreational watercraft.

An on-board holding tank was installed in each of ten boats for total impoundment of all effluent and for the connection to a dockside sewage collection system through a quick-connect coupling. Each boat was provided with a pump, tank and macerator. At dockside, each boat holding tank was pumped directly into a piped collection system.

The dockside collection system was installed with a flexible hose connector at each slip for attachment to the respective boat. The collection system was installed for gravity flow to an underwater storage tank fabricated of synthetic rubber, impregnated with nylon fibers and fastened to the river bed by a system of patented anchors. The underwater storage tank received and held the effluent for periodic discharge to an on-shore pump station to sewage trucks for delivery to a sewage plant.

Flow meters were installed at the marina for recording waste flow to the underwater storage tank and amount extracted from the tank. Samples of waste material entering and leaving the underwater storage tank were taken for laboratory analysis.

The project demonstrated that on-board storage of watercraft waste and subsequent discharge to an underwater storage tank was effective and economical. This project showed that discharge of sewage from boats into rivers, lakes, waterways and estuaries could be eliminated.

2. "Storage of Wastes from Watercraft and Disposal at Shore Facilities", 15020DHB 03/70, by General Dynamics, Inc.

This program was undertaken to establish the effectiveness and acceptability of a watercraft impoundment system in controlling the principal waste sources, sanitary and galley waste, with disposal at a shore facility. A demonstration unit was designed, built, and installed by Electric Boat on a commercial tugboat, and operationally tested and evaluated under routine working conditions for a period of two months. Results of the test data were analyzed, and component performance and system effectiveness were evaluated. Equipment and installation costs, as well as system operation costs, were identified.

Sea water flushing was used for the water closets and urinal, but water conservation was used in the form of specially designed sanitary flush control and galley sink volume control devices to allow the use of a relatively small (120 gallon capacity) holding tank. The corrosion-resistant tank was provided with a level sensing system, an odor controlled vent line, an automatic flushing system, and a high level alarm. Shore-side transfer of the impounded wastes by suction pump-out

of the truck via a quick-connect deck fitting was demonstrated. Solid galley waste was stored in a specially designed trash compactor.

All components and subsystems performed effectively and reliably throughout the test phase. The system was judged simple to operate and required minimal operating attention and maintenance.

Copies of these final reports can be obtained by writing to:

Planning and Resources Office  
Office of Research and Development  
Federal Water Quality Administration  
Washington, D.C. 20242

## ON-GOING R&D PROJECTS

1. CONTRACTOR: General Electric Company  
3198 Chestnut Street  
Philadelphia, Pennsylvania 19101

TITLE OF PROJECT: "Treatment of Watercraft Wastes",  
1502ODHF

FWQA PROJECT OFFICER: Kurt Jakobson  
Chief, Oil and Vessel Pollution  
Research Section  
Federal Water Quality Administration  
Washington, D.C. 20242

DESCRIPTION OF PROJECT: Development of an electrocoagulation waste treatment system which will be tested aboard a vessel in both fresh and salt waters. Tests will be performed to measure changes in hydraulic loading, input conditions, control parameters, flow schemes and other significant variables. Capital and operating costs will also be determined. Expected completion date for this project is March 30, 1971.

2. CONTRACTOR: Uniroyal, Inc.  
Research Center  
Wayne, New Jersey 07470

TITLE OF PROJECT: "Treatment of Boat Wastes", 1502ODGR

FWQA PROJECT OFFICER: Ernie Karvelis  
Chief, Biology Section  
Edison Water Quality Laboratory  
Federal Water Quality Administration  
Edison, New Jersey 08817

DESCRIPTION OF PROJECT: A feasibility and demonstration study for the use of a flexible waste collection and storage system for a variety of small watercraft where very little space is available. Economic and installation parameters have also been completed and the final report is currently under review.

3. GRANTEE: Rensselaer Polytechnic Institute  
Troy, New York 12181

TITLE OF PROJECT: "Control of Pollution From Outboard Engine Exhaust", 1502OENN

FWQA PROJECT OFFICER: Patrick Tobin  
Oil and Hazardous Materials  
Research Section  
Edison Water Quality Laboratory  
Federal Water Quality Administration  
Edison, New Jersey 08817

DESCRIPTION OF PROJECT: To determine the output and distribution of two-cycle outboard engine exhaust products, their effects on water quality and the potential impact on the biological community. Work completion date on this project was August 31, 1970. Final report is now being written.

4. GRANTEE: Ocean Science & Engineering, Inc.  
4905 Del Ray Avenue  
Washington, D.C. 20014

TITLE OF PROJECT: "R/V ALCOA SEAPROBE Sewage Treatment Plant", 1502OFZS

FWQA PROJECT OFFICER: Leo T. McCarthy, Jr.  
Acting Chief, Vessel Pollution Control  
Research Section  
Edison Water Quality Laboratory  
Federal Water Quality Administration  
Edison, New Jersey 08817

DESCRIPTION OF PROJECT: To demonstrate the effectiveness of a closed circuit recirculating flush system designed to preclude any overboard discharge from the sanitary facilities while the vessel is in port or in restricted waters. Involved is chemical treatment, separation of solids and recirculation of sterile flushing liquid. Project was awarded in October 1970.

For more detailed information concerning on-going vessel pollution control projects, please contact one of the following:

1. FWQA Project Officer

or

2. Vessel Pollution Control Research Section  
Edison Water Quality Laboratory  
Federal Water Quality Administration  
Edison, New Jersey 08817

## POLLUTION FROM OUTBOARD MOTOR OPERATIONS

Pollution resulting from the operation of outboard engines may be caused by the basic design of the engine itself and/or by improper maintenance of the engine.

Outboard motor design. Almost all of the outboard motors currently in use incorporate a two-cycle gasoline engine. Unlike the four-cycle engine— which uses separate piston strokes for intake and exhaust — the two-cycle engine combines the intake and exhaust cycle into the ending of the power stroke and the beginning of the compression stroke. Upon ignition of the compressed fuel vapor in the cylinder, the downward power stroke of the piston places fuel vapor in the crankcase under pressure. This pressure in turn forces fuel vapor from the crankcase into the firing portion of the cylinder through the now open intake port of the cylinder. Spent gases in the cylinder are at the same time forced out through the open exhaust port by inflow of the new fuel vapor. This basic operation is termed "crankcase scavenging" and requires an airtight crankcase to allow the vaporized fuel mixture in the crankcase to be forced up into the cylinder by the downward piston stroke.

In the operation explained above, exhausting of some fresh, unused fuel vapor with the spent material is unavoidable. However, a greater discharge of pollutants results from the fact that the crankcase must be airtight and that an opening in it for direct application of lubricant to the internal moving parts cannot be permitted. Lubricating oil is therefore pre-mixed with the fuel supply in a fixed proportion. The fuel-oil-air mixture is then fed from the fuel tank to the crankcase. A portion of this mixture condenses on the internal parts of the engine and — since gasoline is more volatile than oil — most of the gasoline revaporizes leaving a thin film of oil on the engine parts. This condensate is not burned since it does not reach the combustion chamber and eventually trickles down to the bottom of the crankcase and accumulates as a liquid. Since the process



is repetitive, this liquid would eventually accumulate to such a volume that the piston could not operate. To avoid this condition — known as "hydraulic lock" — the pool of liquid is vented directly to the air or water through the exhaust system when it reaches a certain point.

Because of its operating design, the two-cycle engine therefore discharges varying amounts of unburned gasoline and oil directly to the air or water.

Outboard motor maintenance. Operation of an improperly tuned engine can result in fuel wastage as much as 15 percent greater than those obtained from normal operation of the same engine in a perfectly tuned condition. Failure to make necessary replacements — spark plugs, ignition points, and other fuel system parts — results in further incomplete fuel combustion, as does a carburetor which is adjusted to feed a mixture too rich in fuel. Misproportioning the gasoline-oil fuel mixture can also result in improper fuel combustion through fouling of the spark plugs.

For information on the effects and magnitude of pollution from outboard motors, as well as suggested solutions, the reader is referred to the references listed below:

1. Aubrey, W., et al. "Inland Water Pollution by Recreational Boating", Junior Project No. 08-11, Union College, Schenectady, New York, March 1970.
2. Dietrick, K. R. "Investigation Into the Pollution of Water by Two-Stroke Outboard Motors", Gesundheitsingenieur, 1964, 85:342-347.
3. Eberan-Eberhorst, Robert, "Die Wasserverunreinigung durch den Aussenbordmotor mit Mischungsschmierung", Motor Technische Zeitschrift, XXVI, 1965.
4. English, J. N., et al. "Pollutional Effects of Outboard Motor Exhaust: Field Studies", Journal WPCF 35:1121.
5. English, J. N., et al. "What Does Outboard Motor Exhaust Contribute to Water?", Robert A. Taft Sanitary Engineering Center, January 17, 1961

6. English, J. N., et al. "Pollutional Effects of Outboard Motor Exhaust: Laboratory Studies", Journal WPCF 35:923.
7. Environmental Engineering, Inc., "Effect of Power Boat Fuel Exhaust on Florida Lakes", distributed by Marine Exhaust Research Council (BIA).
8. Ferren, W. P. "Outboard's Inefficiency Is a Pollution Factor", National Fisherman, April 1970.
9. Muratori, A. "How Outboards Contribute to Water Pollution", The Conservationist, June-July 1968.
10. Pflaum, W., et al. "Der Aussenbordmotorbetrieb und die Gewasserverschmutzung", Motor Technische Zeitschrift, XXIX, March 1968.
11. Snell, Foster D., Inc., "Outboard Motor Tests Using PetroSave and Kleenzaust Devices", September 20, 1965.
12. Stewart, R., and Howard, H. H. "Water Pollution by Outboard Motors", The Conservationist, June-July 1968.
13. Stillwell and Gladding, Inc., "Pollution Factors of Two-Cycle Outboard Marine Engines", October 20, 1969.

## WATER QUALITY IMPROVEMENT ACT OF 1970

On April 3, 1970 this Act became Public Law 91-224 in which Section 13 was directed at "Control of Sewage from Vessels". A summary of this law as it concerns vessel pollution is as follows:

1. As soon as possible after the enactment of this section, the Secretary of the Interior, after consultation with the Coast Guard, and after giving appropriate consideration to the economic costs involved and within limits of available technology, shall promulgate Federal standards of performance for marine sanitation devices.
2. Initial standards and regulations shall become effective for new vessels two years after promulgation; and for existing vessels, five years after promulgation.

As of this date, Federal standards have not been promulgated. However, we believe that the regulations established in 1969 by New York State are of interest for guideline purposes:

<u>Parameter</u>	<u>Requirements</u>
a. Floating solids; settleable solids	None attributable to sewage
b. Suspended solids	Not more than 50 ppm
c. BOD 5-day	Not more than 50 ppm
d. Organisms of the coliform group	The median MPN value in any series of samples shall not be in excess of 70 per 100 ml.

## FWQA RESEARCH NEEDS

FWQA research activities in the future should be directed at the following areas:

1. Examine sewage treatment systems for large vessels — greater than 35 people. Systems which may be considered are incineration, separator/chlorinators, biological systems, ionizer-oxidizers, reverse osmosis and ultra-filtration and distillation.
2. Studies to characterize all wastes, including galley and shower discharges aboard different sizes and types of vessels.
3. Development of simple performance evaluation tests to permit the U.S. Coast Guard to have some means of measuring treatment effectiveness/efficiency when enforcing the standards promulgated by PL 91-224.
4. Examine the economics and limitations of existing sewage treatment devices designed for watercraft.
5. Determine the degree and effects of pollution caused by outboard motor operation on different types of water bodies.

**FWQA PERSONNEL INVOLVED IN WATERCRAFT WASTES POLLUTION CONTROL  
R&D PROGRAMS**

Headquarters, Washington, D.C.

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INQUIRIES

Please address all correspondence relating to research for con-  
trolling pollution caused by wastes from watercraft to:

Vessel Pollution Research Section  
Edison Water Quality Laboratory  
Federal Water Quality Administration  
Edison, New Jersey 08817

Vessel Pollution Research Section  
Division of Applied Science & Technology  
Federal Water Quality Administration  
Washington, D.C. 20242

or call

Edison:

Commercial telephone number: (201) 548-3347, Ext. 53  
FTS telephone number: (201) 846-4625

Washington, D.C.:

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