



## Project Summary

# Testing of Toxicology and Emissions Sampling Methodology for Ocean Incineration of Hazardous Wastes

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As part of the Environmental Protection Agency's strategy to evaluate at-sea incineration technology, the report addresses the development and testing of a system to expose marine organisms to hazardous waste emissions in order to assess the potential toxicity of incinerator plumes at sea as they may come in contact with the marine environment through air-sea exchange and initial mixing.

A sampling train was designed and tested at EPA's land based hazardous waste incinerator using transformer oil as a waste feed. The incinerator was operated under conditions which would be appropriate for at-sea incinerators.

The sampling train (Marine Incineration Biological Assessment Sampler - MIBAS) provides a sea water sample containing a plume emission for the marine organisms testing.

Five toxicity-test protocols were refined and/or developed for use in this program: (1) a sea urchin fertilization test; (2) a chronic test using macroalgae *Champia parvula*; (3) a 7-day chronic test using growth and reproduction of the crustacean *Mysidopsis bahia*; (4) a 7-day growth and survival test with the fish *Mendia beryllina*; and (5) a 7-day life cycle test using the archannelid worm *Dinophilus gyrocilatus*.

The results of applying these tests during a hazardous waste burn are given in the report.

*This Project Summary was developed by EPA's Air and Energy Engineering Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).*

### Introduction

As part of the Environmental Protection Agency's (EPA) overall strategy developed to evaluate both the potential benefits and risks associated with the incineration of hazardous wastes at sea, an overall environmental research strategy has been formulated. This strategy focuses on the acquisition of scientific information and on the development of new techniques designed to expand our knowledge of: (1) the chemical nature of incinerator emissions; (2) the behavior and fate of incinerator emission plumes; (3) the possible extent of exposure of marine organisms to these emissions; and (4) the possible environmental consequences of such exposure. An integral part of this strategy is the formulation of a firm scientific basis for the assessment of environmental risk through the development of a rational, scientifically defensible methodology for this assessment.

The overall objectives of Study Area 1 of the research strategy, all addressed in this report, were threefold:

- 1) The development of a method to obtain samples of incinerator emissions (Level 1).
- 2) The development of a method to introduce these emissions to an appropriate selection of marine bioassays (Level 1).
- 3) The laboratory and field testing, validation, and refinement of this system (Levels 1 and 2).

The final outcome of Study Area 1 should be validated, documented, reproducible methodology based on a field-tested system. It is important to note that the Study Area 1 program was designed to develop and document these methods, and was not intended to determine the actual toxicity of incinerator emissions. Toxicity of emissions will be determined later, during at-sea research burns.

Study Area 1 concerns the development and testing of a system to expose marine organisms to hazardous waste incinerator emissions in order to assess the potential toxicity of incinerator plumes at sea as they may come in contact with the marine environment through air-sea exchange and initial mixing in seawater. Since this integrated methodology will ultimately be used during ocean incineration research experiments, or "research burns," the development of such methodology must result in a mobile, rugged system suitable for use aboard incinerator ships.

The development and testing of such a system was designed to occur in two levels of study. During the Level 1 studies, completed in 1985, the apparatus for the acquisition of incinerator emissions and the mixing of these emissions with an aqueous seawater medium was developed and validated in the laboratory in field-tested using a pilot scale combustion chamber.

An emissions sampling train, designed for direct seawater impingement and emission condensation was developed for use in this study to test organic toxicity of incinerator ship emissions collected by techniques representing ocean exposure. The resultant Marine Incineration Biological Assessment Sampler (MIBAS) was laboratory-tested and validated during runs that included gas-phase spikes of Principal Organic Hazardous Constituents (POHCs) found in actual polychlorinated biphenyl (PCB) waste incinerator emissions. The final sampling train performance was highly repeatable, with an overall capture of about 50% for characteristic semi-volatile and non-volatile constituents.

During the Level 1 studies, five toxicity-test protocols were refined and/or developed for use in this program: (1) a sea

urchin fertilization test; (2) a chronic test using macroalgae *Champia parvula*; (3) a 7-day chronic test using growth and reproduction of the crustacean *Mysidopsis bahia*; (4) a 7-day growth and survival test with the fish *Menidia beryllina*; and (5) a 7-day life cycle test using the archiannelid worm *Dinophilus gyrocilatus*. These tests, all applied to simulated hazardous waste incinerator emissions, proved suitable for further use.

Water quality adjustments of the MIBAS samples prior to use of the samples in bioassays proved critical due to the high acidity and altered salinity of MIBAS water samples. Of greatest importance were adjustment protocols developed for pH, ionic strength, and ionic composition adjustments. Standard protocols were developed and were reported elsewhere.

Level 2 of this research was designed to test this integrated emissions sampling/marine bioassay system on emissions from a research burn of PCB-containing wastes conducted at EPA's Combustion Research Facility in Jefferson, Arkansas. This land-based testing of the methodology occurred in March 1986. This report presents the results of the Level 2, land-based testing and, together with the Level 1 results previously reported addresses Items 1, 2, and 3 of Study Area 1 of EPA's ocean incineration research strategy.

## Discussion

The land-based incineration tests performed and reported here were not as successful as would have been expected from the results obtained on pilot studies conducted previously using the same apparatus and techniques. Recovery of spiked compounds in the spiked MIBAS samples were low, and several significant problems were encountered in the performance of the toxicity test protocols. The toxicological tests specified for use in the ocean incineration research strategy are suitable for use as important assessment tools in the future. Modifications to the Mobile Bioassay Laboratory and some refinement of the test protocols are needed in order to confidently apply these protocols to at-sea research burns.

The problems encountered in validating the performance of the MIBAS sampling system must be overcome before it can be applied confidently at sea. Additional validation of the MIBAS train through additional field trials, including the use of on-site chemical determinations followed by more definitive and rigorous multicomponent spiking experiments, is recommended. These additional validation runs

should be performed on the research incinerator under a variety of conditions (e.g., hot furnace, fuel oil burn only; hot furnace chlorinated waste burn) followed by a repeat of the land-based toxicological testing sequence, in order to fully validate this promising methodology.

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*The complete report, entitled "Testing of Toxicology and Emissions Sampling Methodology for Ocean Incineration of Hazardous Wastes," (Order No. PB 88-219 472/AS; Cost: \$32.95, subject to change) will be available only from:*

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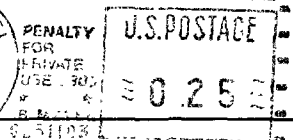
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