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Project Summary

Organic Compounds in Surface Sediments and Oyster Tissues from the Chesapeake Bay

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Detailed in the first part of this report is a development and discussion of the methodology used to extract and analyze sediment and oyster tissue samples from Chesapeake Bay for organic compounds. The method includes extraction, fractionation, and subsequent analysis using glass capillary gas chromatography and glass capillary gas chromotography-mass spectrometry (GC-MS). An extensive list of the mass spectral data and related information is contained in the appendices. The complete bank of processed data is also available on computer tapes at the Virginia Institute of Marine Science and at the Environmental Protection Agency's Chesapeake Bay Program. Also included in this report are the results of volatile halogenated organic compounds determined in water collected near the outfalls of several facilities using chlorine, as well as from river mouths. Distributions of the total, and some specific, organic compounds within the Bay are presented in histograms. Analyses clearly show that unsubstituted polynuclear aromatic hydrocarbons are the most prominent toxic pollutants in the Bay. The application of two different search routines, one concentrating on compounds at levels greater than 50 ppb and the other on temporal changes, allows a quick determination of where problem areas may exist and where additional investigation may be indicated.

This Project Summary was developed by EPA's Chesapeake Bay Program, Annapolis, MD, 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

The production and use of synthetic organic compounds has greatly increased since the Second World War, and the loadings of these chemicals into the environment have thus greatly increased. Many of these chemicals are absorbed by plants, ingested by animals, and accumulated through food webs; this may lead to acute or chronic toxic effects in the organisms or make them unfit for human consumption.

The purpose of this project was to monitor the concentrations of synthetic organic compounds in sediments and in oyster tissue samples at representative areas of the Bay, at the mouths of the major tributaries, and at locations where high concentrations of organic compounds are likely to be present. Also, the concentrations of volatile halogenated organic compounds in the water column were determined at outfalls of several facilities where chlorine is used and at the mouths of the major tributaries.

An analytical scheme was developed to extract, identify and quantitate as broad a spectrum of organic compounds as possible with glass capillary gas chromatography and gas chromatography-mass spectrometry. This analysis limited the compounds that could be identified to those that are stable and volatile enough to pass through a gas chromatograph.

Procedure/Methodology

A Hewlett-Packard 3354B laboratory automation system was used to collect, process, and store chromatographic data, and software packages were used to do the following:

a) calculate concentrations of gas chromatographic (G.C.) peaks by reference to internal standards, discriminate against peaks with less than a predetermined minimum concentration, and calculate the relative aromatic retention index and the pesticide retention index,

b) display both processed and normalized data on the HP3354B system console (H.P. 2648 terminal) and line printer (H.P. 9866B),

c) plot bar graphs from processed data,

d) plot chromatograms from raw data,

e) compare G.C. peaks in samples collected at a particular station at different times and flag samples with concentrations of a given peak that are either ten times larger or smaller than the concentration in the first sample,

f) compare peaks in gas chromatograms of samples from all Bay stations and flag stations where the concentrations of some peaks exceed 50 ppb, and

g) search data files for peaks eluting within a specified retention index window and list sample identification codes, retention times, and concentrations.

Results

Baltimore Harbor, The Chesapeake and Delaware Canal, and the Susquehanna River may be sources of organic pollutants in the sediments of the Chesapeake Bay. In the search for organic compounds at concentrations greater than 50 ppb in sediments, it was generally found that more uniform and more highly concentrated organic pollutants were contained in the upper portion of the Bay than in the lower part and that unsubstituted polynuclear aromatics (PNAs) are the major group of compounds present. Concentration sums of organic compounds in lower Bay sediments tended to be higher at river-mouth stations than at open Bay stations or at stations close to the Eastern Shore. In the upper Bay, samples collected from river-mouth stations also tended to contain high concentrations. In the search for changes in concentration over time, it was observed that sediment concentrations from the mouth of the Susquehanna River are highly variable. This is due to the differences in sediment composition (percent silt/clay and sand) over time and indicates that Bay sediments may be static for some time but may shift in response to storms and seasonal changes. Thus, areas that are sinks for organic pollutants at some times of the year may become sources at other times. Organic compounds at concentrations greater than 50 ppb in oyster tissue primarily included the higher substituted naphthalenes, fluorenes, dibenzo thiophenes, and phenanthrenes.

The volatile halogenated organic compounds identified were chloroform, 1,1,1-trichloroethane, carbon tetrachloride, trichloroethylene, bromodichloromethane, dibromochloromethane, tetrachloroethylene, and bromoform.

Recommendations

This study was developed as an investigation of organic compounds in estuarine sediments and in oyster tissue. Although many organic compounds, both natural and synthetic, can be found in the sediments, this research focused on those compounds most likely to exhibit toxicity to Bay biota.

Sediment composition is a major determinant of the content of organic compounds; therefore, sampling for organic compounds in sediments should include some sediment particle size analysis.

Further research into organic compounds in estuarine sediments should accomplish the following: (a) further delineation of oyster/sediment concentration relationship, (b) more sampling to define temporal changes in sediment concentrations, (c) investigation of sources of PNAs, and (d) investigation of the toxicity of sediment concentrations to biota.

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***Duane Wilding** is the EPA Project Officer (see below).*
This Project Summary covers the following two reports:
"Organic Compounds in Surface Sediments and Oyster Tissues from the Chesapeake Bay," (Order No. PB 83-187 443; Cost: $17.50, subject to change).
"Organic Compounds in Surface Sediments and Oyster Tissues from the Chesapeake Bay—Appendices," (Order No. PB 83-187 450; Cost: $23.50, subject to change).
The above reports will be available only from:
National Technical Information Service
5285 Port Royal Road
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The EPA Project Officer can be contacted at:
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