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TITLE:

Polyurethane-Foam Extraction of Polychlorinated Biphenyl (PCB) Contaminated Surface Water.

PERSONNEL:

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PROBLEM:

Evaluate porous polyurethane-foam plugs as an isolation step in the analysis of PCB's in surface waters.

JUSTIFICATION:

Provide an efficient, high-sensitivity analytical method capable of reaching PCB levels compatible with EPA guideline.

SUMMARY:

Polyurethane-foam has been demonstrated to quantitatively extract PCB's from contaminated surface water at rates greater than our present charcoal adsorption technique. The speed of extraction will permit processing of large volumes of water, thereby making it possible to reach PCB levels well below the EPA guideline of 0.01 ppb.

The speed and simplicity of the filtration procedure used in this work suggest that it can be applied to the extraction of water at the sampling site.

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Details

Introduction

During recent months we have been evaluating various procedures to improve sensitivity with respect to the determination of PCB's in surface water samples (Ref. 1 and 2). Our intention has been to provide a method with a detection limit compatible with the Environmental Protection Agency (EPA) guideline of 0.01 parts-per-billion. At the present time our sensitivity depends mostly on the volume of water analyzed. Therefore any method which allows us to efficiently process a large volume of water will improve analytical sensitivity.

Our current technique employs a charcoal column filtration, but is limited by a relatively slow filtration rate - about 1.5 liters per hour. A number of laboratories (including EPA) have evaluated polyurethene foam plugs as a media for extracting PCB's from water (Ref. 3), but with varying degrees of success. This report covers our evaluation of this foam-plug procedure.

Experimental and Results

Preliminary experiments indicated that polyurethane foam from different sources have different capacities for extracting PCB's from water. This is undoubtedly due to the porosity variations in commercial polyurethane. However once the adsorption capability of a given foam has been established the foam filter-bed volume can be adjusted to meet the requirements of the analysis. Foam plugs obtained from Analabs, Inc. (North Haven, Conn.) and made into a filter-bed of ~90 ml volume (4 plugs, 22 x 38 mm) worked efficiently up to 5 microgram of total PCB. The polychlorinated biphenyls are easily eluted from the plugs by rinsing with acetone and hexane.

Water spiked with known quantities of Aroclor 1242 and/or 1254 gave recoveries of 68 to 99% for 1242 and averaged 102% for Aroclor 1254. Filtration rates were varied from 35 to 225 milliliters per minute, with no indication of a loss in extractive efficiency at the higher rates. Extraction of the water samples was performed in a simple and rapid fashion by using the filter-probe concept. Four plugs were pushed down the wide end of a glass cylinder, the other end of which had been formed into a one foot by one quarter inch (ID) tube to serve as the inlet. The water sample was drawn up through the filter body by vacuum from a water suction pump. A flowmeter was connected between the filter and pump to regulate the waterflow.

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Experimental and Results (Continued)

The practicality of the technique was demonstrated on two occasions by filtering 20 liters of laboratory tap water in less than 1.5 hours. The acetone and hexane extracts of the foam plugs were subsequently analyzed giving levels of 0.082 and 0.049 microgram per liter (ppb) of polychlorinated biphenyls. A blank made by elution of the filter without any water passing through was essentially free of PCB peaks.

Discussion

This evaluation has shown that the polyurethane foam filter column holds a distinct advantage over our present charcoal column technique for isolation of PCB's from water. Its faster throughput permits larger amounts of sample to be extracted per unit time. Using a foam column, up to 50 liters can be processed in a reasonable length of time. Sample volumes of this magnitude will lower our limit of detection well below the EPA guideline of 0.01 ppb for surface water.

The recovery of PCB's from the foam plugs is quantitative. However, as indicated, the capacity of the foam must be established, and care taken not to exceed the adsorption capability of a given filter bed. The simplicity and speed of the technique suggest that it can be applied to the extraction of water at the sampling site; provided that a source of vacuum and a means of measuring sample volume are available.

References

1. AR&D Report No. 2274, 1/17/73.

2. AR&D Report No. 2299, 3/23/73.

3. Gesser, H. D., Chow, A. et al, Analytical Letters, 4, 883 (1971).

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