A Note on Toxaphene in Environmental Samples from the Chesapeake Bay Region

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INTRODUCTION

Although toxaphene [1] is reported to be the most widely used insecticide in the United States (SANDERS, 1975), residues of toxaphene are seldom found in environmental samples. A few of the environmental samples analyzed for chlorinated hydrocarbons as part of the Upper Bay Survey (a study performed for the Maryland Department of Natural Resources) were found to contain toxaphene residues.

METHODS

The sample collection methods are reported in detail elsewhere: rainwater and storm sewer, TZOU, 1975; suspended sediments, MUNSON et al. (in press); and zooplankton, FORNS, 1975. The rainwater samples were extracted by repeated partitioning with small amounts of hexane. The heavy loads of suspend particulates in the storm sewer samples were removed by filtration, and dried and extracted as described below. The suspended sediments from the bay water and storm sewer, and the zooplankton were Soxhlet extracted with 2:1 hexane-acetone (MUNSON, 1975). The extracts were prepared for gas chromatography by treatment with a 1:1 mixture of concentrated sulfuric acid and fuming sulfuric acid (MUNSON, 1972, 1975).

The toxaphene was identified by multi-column, electron-capture, gas-liquid chromatography (GLC). A positive identification of toxaphene was recorded if the major peaks present in the toxaphene standard were present in nearly the same ratios as in the standard on the three different GLC columns used (4% SE30/6% SP2401 on a 80/100 mesh Supelcon support; 1.5% SP2250/1.95% SP2401 on 100/120 Supelcon AW-DMCS; and 5% DC200/2.5% QF1 on 80/100 Chromosorb W-HP). The toxaphene was quantitated by comparing the peak heights in the sample to the peak heights in the standard after constructing the baselines as suggested in the FDA Pesticide Analytical Manual (1968).

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[1] A complex mixture containing polychlorinated bicyclic terpenes with chlorinated camphene predominating.

Bulletin of Environmental Contamination & Toxicology,
Vol. 16, No. 4 © 1976 by Springer-Verlag New York Inc.

RESULTS AND DISCUSSION

The toxaphene first came to our attention because a sample of rainwater contained a pattern of electron-capture peaks completely different from any that we had seen before in samples from the Chesapeake Bay. The residue pattern from this sample and subsequent samples from the Fort Smallwood collection site (shown in Figure 1) were nearly identical to the toxaphene standard. Table 1 presents the concentrations of PCB's (polychlorinated biphenyls) and toxaphene found in the rainwater samples collected as part of the Upper Bay Survey.

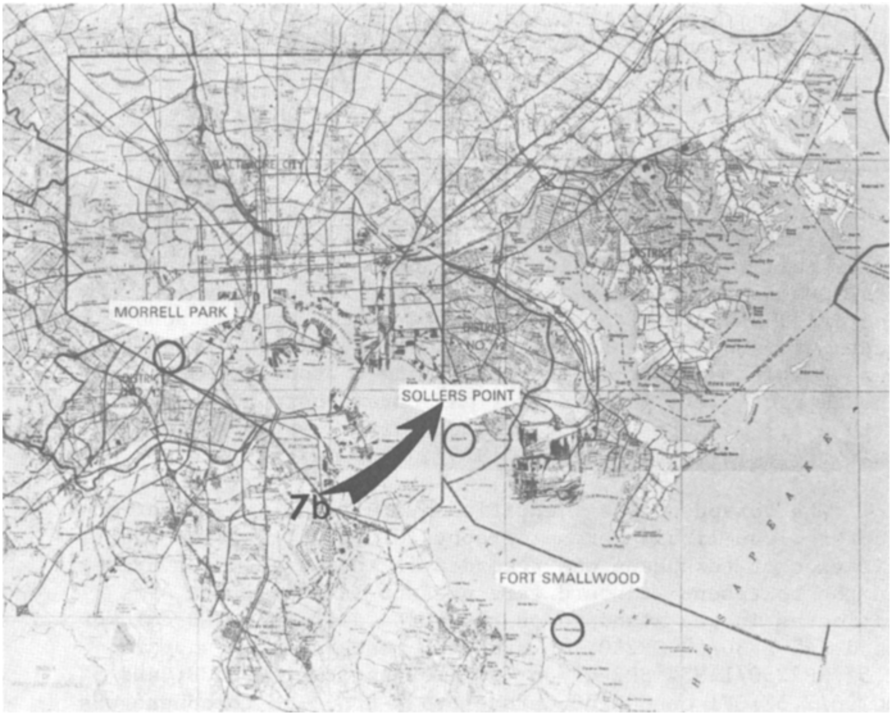

Figure 1. Sampling station locations.

TABLE I
PCB AND TOXAPHENE IN RAINWATER

a. Collected at Fort Smallwood, Maryland

Collection Period 1974	Total PCB (ppt)[a]	Toxaphene (ppt)
30 July - 7 Aug.	2	N.D.
28 Aug. - 4 Sept.	N.D.[b]	280
4 Sept. - 28 Sept.	N.D.	170
28 Sept. - 1 Oct.	N.D.	44
1 Oct. - 16 Oct.	N.D.	86

b. Collected at Sollers Point, Maryland

Collection Period 1974	Total PCB (ppt)	Toxaphene (ppt)
29 July - 30 Aug.	130	N.D.
30 Aug. - 3 Oct.	N.D.	220
3 Oct. - 1 Nov.	120	N.D.

a) parts per trillion (10^{-9} gms per liter)
b) N.D. - not detected

One of the samples from Sollers Point (shown in Figure 1) also contained toxaphene. Of all of the remaining samples (air, storm sewer, ground water, suspended sediments, bottom sediments and zooplankton), only two were found to contain toxaphene: a sample collected from a storm sewer at Morrell Park (Figure 1) 16 October 1975 contained 13 parts per trillion; and a zooplankton sample collected 8 July 1974 station 7b (Figure 1) contained 1.7 parts per million (wet weight). The residue patterns in these two samples did not match the standard as well as the rainwater samples. Some of the smaller peaks were either missing or present in altered ratios.

The data presented here are not complete enough to allow one to generalize about toxaphene inputs to Baltimore Harbor or the adjoining Chesapeake Bay. If one wished to specifically study the occurrence and movement of toxaphene in this aquatic system, one would need to utilize separation procedures to remove the ubiquitous PCB's. The toxaphene residues reported here were visible because, in these particular samples, the toxaphene levels were high and/or the PCB levels were low. It does seem likely that the 1.7 ppm toxaphene value in the zooplankton sample represents a localized problem (or a unique event) because none of the 70 additional zooplankton samples or 70 additional suspended sediment samples collected from the upper Chesapeake Bay showed traces of toxaphene. Had part-per-million level residues been a frequent occurrence the residues probably would have been detected in some additional samples.

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