ANALYSIS OF POLYCHLORINATED NAPHTHALENES IN PCB PRODUCTS AFTER SEPARATION BY GEL PERMEATION CHROMATOGRAPHY

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INTRODUCTION

Polychlorinated naphthalenes (PCN) have been produced on a commercial basis since World War I[1]. The use of PCN was dominated by applications where high thermal stability was necessary e.g. in dielectric fluids in transformers and capacitors. PCN have also been used as pesticides[2,3]. The production of PCN was early restricted due to some serious occupational health effects[4]. Furthermore, PCN are ubiquitous environmental contaminants detected in wildlife all over the world[5,6,7]. PCN are also present in human adipose tissue and mothers milk[8,9]. PCN are known to have dioxin-like properties e.g. EROD- and AHH-enzyme induction[10], and the presence of these compounds in biota, including humans is therefore of public concern.

PCN was reported in the early 70-ties to be present as contaminants in PCB products [11,12]. However, no quantitative data were reported. The aim of the present study was to develop a method to isolate and quantify PCN in PCB products.

EXPERIMENTAL

Nine PCB products were examined: Aroclor 1016, 1232, 1242, 1248, 1254, 1260, and Clophen A30, A40, A50.

PCN was isolated from the PCB products by high-resolution - gel permeation chromatography (HR-GPC). Each one of the PCB products (20 mg) was dissolved in tetrahydrofuran and hexachlorobenzene (1.0 μg) was added as an internal standard. The volume was adjusted to 200 μl, and a 100 μl aliquot was subjected to HR-GPC. Tetrahydrofuran was used as the mobile phase. Two fractions were collected, the first containing PCB, polychlorinated dibenzofurans and polychlorinated quarterphenyls, and the second containing PCN. The PCN fractions were then fortified with a injection spike,

2,3,3',4,4',5,5'-heptachlorobiphenyl (75 ng), prior to gas chromatography/ mass spectrometry (GC/MS) analyses.

GC/MS was performed on an Finnigan ITS 40 iontrap mass spectrometer equipped with a gas chromatograph and a DB-5 (J&W Scientific) fused silica capillary column. The PCN components were identified through the isotopic patterns of the molecular ion clusters and the relative retention times versus octachloronaphthalene. Ion chromatograms of the sum of the M^+, $(M+2)^+$ and $(M+4)^+$ ions were used for quantification.

RESULTS AND DISCUSSION

The concentrations of chloronaphthalene (CN) congeners are shown in Figure 1. The total PCN concentrations range from 1.8 to 870 μg/g PCB product. The highest concentrations of PCN were found in products containing 30-40% chlorine. The levels in Clophen A30 and A40 exceeded the concentrations in Aroclor 1232 and 1242 by factors of 5 and 8, respectively.

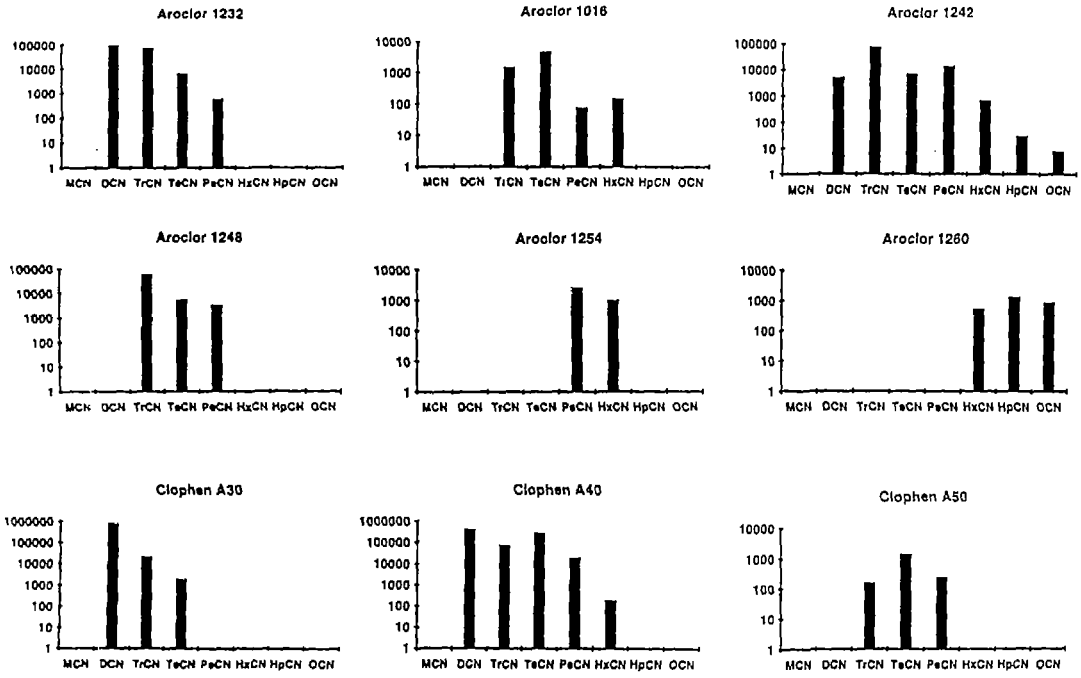

Figure 1: Levels of PCN in nine PCB products (ng/g PCB).

The degree of chlorination of CN congeners was found to be somewhat higher than the chlorination degree of the corresponding PCB products.

The relative levels of PCN congeners follow a general trend in most of the PCB products. However, in Clophen A40 and Aroclor 1242 the total concentrations of tetraCN isomers are lower than those of both tri- and pentaCN. Furthermore, these two products were also found to contain the widest range of PCN isomers with 2-8 (Aroclor 1242) and 3-7 chlorine (Clophen A40) substituents.

It is not possible to relate the origin of the PCN congeners present in the PCB products to any particular reaction during the production. It is known however, that minor amounts of naphthalene has been present in biphenyl to be used for PCB production[13]. Consequently, chlorination of naphthalene will occur simultaneously with the chlorination of biphenyl.

ACKNOWLEDGMENTS

This study was given financial support by the Swedish Environmental Protection Agency; project program PETOS.

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