

Determination of Polychlorinated Biphenyl Levels in Fish

Abstract

Polychlorinated biphenyls are environmental pollutants that accumulate in many of the foods that we eat. PCBs are potentially carcinogenic compounds that were once used as electric fluids in transformers and capacitors. Measuring the level of PCBs in fish is a vital step in determining whether the ecosystem of an area is contaminated. In collaboration with the Maryland Department of the Environment, the measurement of PCBs in local aquatic fish will be determined over the next semesters. I was given the task of formulating the method for determining the level of PCBs in fish during this past semester.

Introduction

What are PCBs?

The presence of polychlorinated biphenyls in aquatic life can be traced to the uses of chemicals in numerous industrial and commercial products. An extremely high thermal and chemical resistance makes them suitable for use as insulating fluids in transformers or as sealants in windows. Their multifaceted structure allowed for large scale manufacturing of PCBs in various products from the 1950s until their ban in the 1980s.

Why are PCBs a Threat?

At times, PCBs would leak out of the products. When exposed to the environment, PCBs begin to accumulate the fatty tissue of animals. Unable to be readily broken down, these substances become highly concentrated towards the top of the food chain. They eventually end up in humans through food consumption. It has been documented that prolonged interaction with PCBs can cause cancer.

My Research

The Maryland Department of the Environment is working in collaboration with Dr. Upal Ghosh, Associate Professor and Graduate Program Director of the Department of Civil and Environmental Engineering at the University of Maryland Baltimore County, to diagnose the PCB contaminants in local fish. As a part of the research project, I was entrusted with creating a method for determining the amount of PCBs that were in a given fish sample.

Materials

- Sonicator
- Food Processor
- Knives and Cutting Board
- Rotary Evaporator
- Glassware
- 100 ml beakers
- 250ml round bottom flasks
- 40ml vials screw caps
- 2ml autosampler vial
- Acetone/Hexane
- Concentrated sulfuric acid
- Funnels, 40mm diameter
- Glass Pasteur pipettes
- Glass column
- Filter paper, glass micro fiber
- Clean glass wool
- Anhydrous sodium sulfate
- Florisil © (60-100 mesh)
- Silica gel

Souvonik Adhya

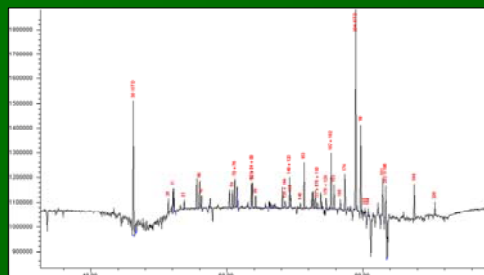
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Method

I was given the task of creating the fish cleanup procedure. A filleted fish sample was diced into small pieces and homogenized using a food processor. 5 grams of the homogenized sample was weighed out and freeze dried overnight to eliminate excess water. The sample was then placed in a 100 ml beaker. Excess sodium sulfate was added to dehydrate the sample. A volume of PCB surrogate was added to the solution. It was measured at the end to see how much of the PCBs are lost during the cleanup. The sample underwent an extraction to transfer PCBs from the fish tissue to the solvent. Prior to performing the extraction, the ultrasonic probe was cleaned with hexane to prevent any contamination. The sample was sonicated for 3 minutes. The elution was collected in a 250 ml round bottom flask and was blown down using a rotary evaporator to 1 ml. The sample then underwent lipid cleanup using concentrated sulfuric acid. The lipids must be removed from the sample to properly isolate the PCBs in the extract. This process was repeated several times until it was apparent that the acid was no longer reacting with lipid. After a treatment with copper to remove any sulfur from the acid, the sample was subjected to a column cleanup using 3 % Florisil © and acidified silica gel to further purify the extract. The elution from the column was collected and concentrated to the 1 ml. Internal standards were added to the sample in preparation for analysis using gas chromatography. The levels of PCBs are measured by integrating the resulting chromatogram.



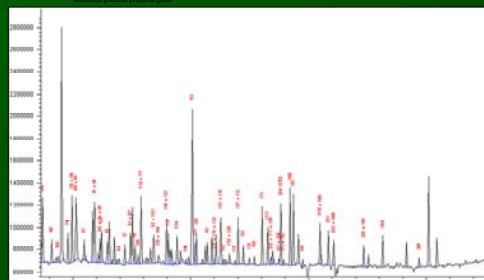
Chromatogram with an poor baseline

Discussion

The method provides a basis to analyze polychlorinated biphenyl levels in local area fish. The sonication extraction method thoroughly elutes the PCBs from the fish tissue. The acid cleanup and column cleanup offers a process that removes almost all substances except the contaminants that are being measured. When examining chromatograms, a smooth base line signifies that the majority of lipids were removed from the solution. The chromatograms that were processed from the trials of the method had clean base lines that would give formidable results if PCB levels were being analyzed. When the experimental trials will be run using local area fish, the sample size must be increased from 5 grams to 50 grams. This may result in the use of more acid during the cleanup portion of the method.

Reference

http://www.environment.gov.au/settlements/publications/chemicals/scheduled_waste/publicpcbtd.pdf



Chromatogram with a clean baseline



GC Analysis

Sonicator

Column Cleanup

Results

The chromatograms show that the fish samples that underwent treatment provide a well defined baseline. The cleanup also yields an acceptable yield in surrogate levels. The procedure that was formulated provides an acceptable cleanup for polychlorinated biphenyls.

Acknowledgments

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