Medium Resolution PCB Congener Analysis for Tissue, Soil, Sediment, and Water Matrices

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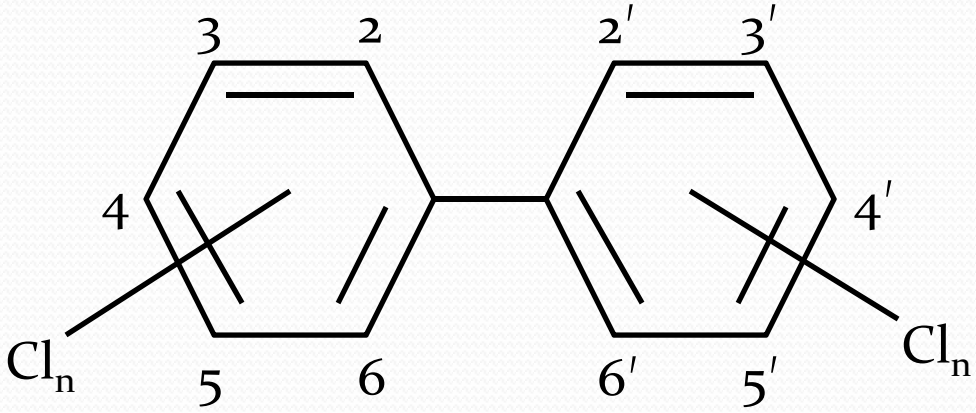
Overview

- PCBs and PCB Analysis
- Aroclor™ vs. Congener Analysis
- Medium Resolution GC/MS Analysis
- Case Studies
- Applicability and Accreditation

Polychlorinated Biphenyls (PCBs)

PCBs are biphenyl molecules with between 1 and 10 Chlorines attached to the two rings.



This allows for 209 PCB congeners that have between 1 and 10 Chlorines.

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PCB Analysis

- PCBs were marketed and sold as Aroclors™.
  - Aroclors™ are: 1221, 1232, 1242, 1248, 1254, 1260, 1262, 1268, and 1016.
- Each Aroclor™ was a mixture of different congeners that contained an amount of Chlorine as a percent.
- Historically, PCBs have been analyzed as these Aroclor™ mixtures by GC/ECD.
  - This is difficult for mixtures of Aroclors™, weathered samples, samples with significant matrix/background.

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PCB Analysis (cont.)

- Subsequently, PCB analysis as congeners was developed using GC/ECD.
  - Poor separation, small number of congeners as analytes.
- EPA 1668A was developed and uses a HRGC/MS to analyze for all of the 209 PCB congeners.
  - Still has some co-eluting congeners.
- CH2M HILL's Applied Sciences Lab developed a GC/MS method using large volume injection and selected ion monitoring to analyze for a subset of approximately 100 PCB Congeners.

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PCB Analysis Comparison

Aroclors™	E1668A	CH2M Hill's Medium Resolution GC/MS
Fast Analysis	Long Analysis	Long Analysis
Only identifiers Aroclors™	Identifies all congeners, homologues	Identifies subset of congeners, homologues
$	**$$$$$**	**$$**
Easy to compare to historical data	Large amounts of new data	Moderate amounts of new data

Medium Resolution GC/MS Analysis

- Using a standard GC/MS with a large volume injection system operating in selected ion monitoring mode ASL is capable of achieving reporting limits similar to EPA 1668A.
  - Standard sample preparation techniques are used.
  - Extracts are cleaned up as needed.
  - 50-100 µL of sample is injected into a programmable inlet.
  - Congeners are separated over 2 hours of analysis time.
    - Congener co-elutions still occur.

Medium Resolution GC/MS Analysis (cont.)

- CH2M HILL's ASL has developed a standard list of approximately 100 congeners.
  - These congeners comprise all congeners present at greater than 1% in a known Aroclor™ mixture.
  - Congeners include all of the WHO/NIST/NOAA coplanar congeners.
  - This ensure that 90% or more of all Aroclors™ that were produced are identified by this method.
  - Additional congeners are added at the request of clients.
- The method utilizes isotopic dilution for calibration and analysis.
  - Labeled surrogate standards are used as internal standards for quantitation.
  - Automatically corrects for extraction/preparation efficiency.

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Medium Resolution GC/MS Analysis (cont.)

- A full and standard quality control/quality assurance system is utilized and monitored for this analysis.
  - Includes blanks, ongoing precision and recovery standards, clean up/travel surrogates, calibration, second source verification, LOD/LOQ determination.
- This method provides the ability to analyze individual congeners or homologues.
- Matrices analyzed include: Water, Soil, Sediment, Tissue, Air (using PUF cartridges labeled with travel surrogates).

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Reporting Limits

Matrix	Reporting Limit
Water (1L)	0.50 ng/L
Soil/Sediment (10 g)	0.10 µg/kg
Tissue (5 g)	0.20 µg/kg
Air	0.5 ng/sampling device

Case Studies-Interlaboratory Study Sample 1

Homologue	ASL Method	E1668	RPD
Total monoCB	0 U	0.68	NC
Total diCB	16.8	16.8	0.2
Total triCB	61.3	60.8	0.8
Total tetraCB	23.3	26.4	12.6
Total pentaCB	2.02	2.59	24.8
Total hexaCB	0.52	0.65	22.1
Total heptaCB	0.07	0.13	60.4
Total octaCB	0.00	0.00	NC
Total nonaCB	0.00	0.00	NC
Total decaCB	0.00	0.00	NC
Total PCB	105	108	3.0

Case Studies-Interlaboratory Study Sample 2

Homologue	ASL Method	E1668	RPD
Total monoCB	0.00	0.62	NC
Total diCB	19.0	17.5	8.1
Total triCB	61.2	58.9	3.8
Total tetraCB	23.3	23.3	0.1
Total pentaCB	1.36	2.74	67.6
Total hexaCB	0.50	0.68	29.7
Total heptaCB	0.05	0.12	87.9
Total octaCB	0.00	0.00	NC
Total nonaCB	0.00	0.00	NC
Total decaCB	0.00	0.00	NC
Total PCB	105	104	1.4

Applicability and Accreditation

- This method utilizes similar techniques as the EPA 1668A method. The main difference is the detector.
  - Reduced mass sensitivity can result in selectivity concerns in complicated matrices (tissues).
- This method has been reviewed and accepted by the State of Oregon NELAP body, ORELAP, and by the DoD ELAP certification body (ACLASS).
- This method has been used by many clients that have sent the data to rigorous data validation.

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