



Analytical Options

Indoor Air Impacts from PCBs in Building Products: Why It Matters & How to Properly Collect Air Samples

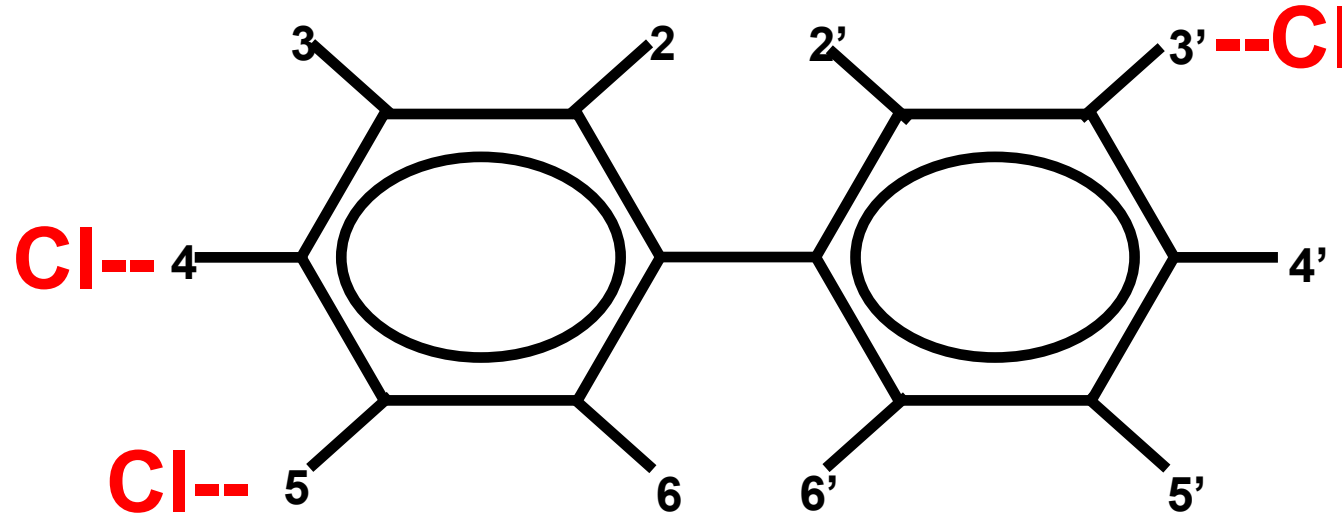
Wednesday, March 9, 2022
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Poly – Chlorinated - Biphenyls



- 2 phenyl groups connected by a single bond
 - and having 1 -10 chlorine atoms on the rings
 - 10 possible positions leads to 209 possible combinations

• **209 individual PCB compounds – CONGENERs**

Chlorinated Biphenyls by Homolog Series

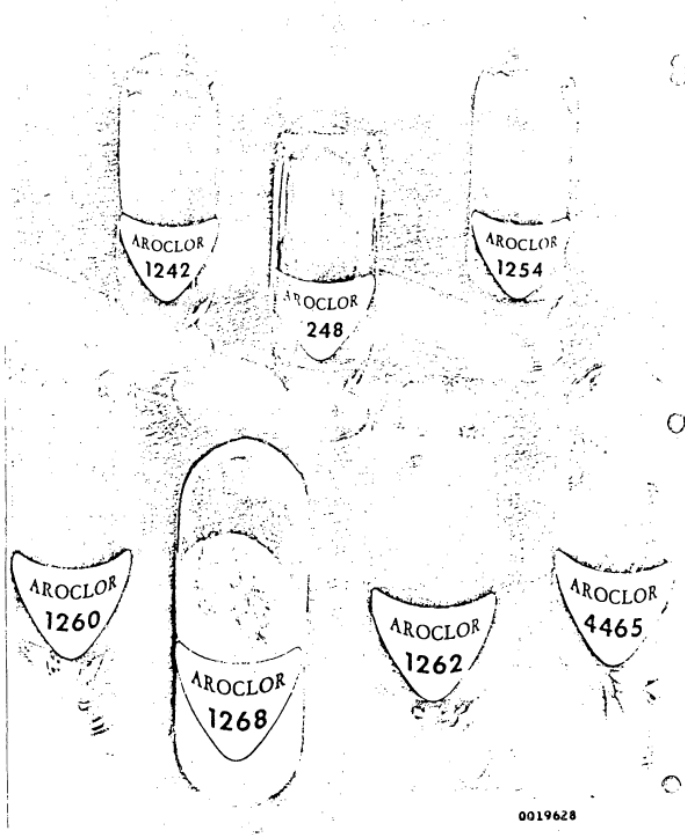
- PCBs can be grouped according to the # of chlorine atoms
 - Level (or Degree) of chlorination
 - 10 HOMOLOGS (Homologues)**

Empirical Formula	Molecular Weight	# Isomers	
$C_{12}H_{10}$	154.1	1	
$C_{12}H_9Cl$	188.0	3	Monochlorobiphenyls
$C_{12}H_8Cl_2$	222.0	12	Dichlorobiphenyls
$C_{12}H_7Cl_3$	256.0	24	Trichlorobiphenyls
$C_{12}H_6Cl_4$	289.9	42	Tetrachlorobiphenyls
$C_{12}H_5Cl_5$	323.9	46	Pentachlorobiphenyls
$C_{12}H_4Cl_6$	357.8	42	Hexachlorobiphenyls
$C_{12}H_3Cl_7$	391.8	24	Heptachlorobiphenyls
$C_{12}H_2Cl_8$	425.8	12	Octachlorobiphenyls
$C_{12}H_1Cl_9$	459.7	3	Nonochlorobiphenyls
$C_{12}Cl_{10}$	493.7	1	Decachlorobiphenyl

Aroclors

Monsanto trade name *(there are numerous other trade names)*

Technical grade mixtures of congeners, made by batch chlorination of biphenyl



Nine Aroclors:

1221, 1232, 1242/1016, 1248,
1254, 1260, 1262, 1268

PCB Analysis at TSCA Sites

- TSCA Subpart B 761.272 / 761.292

- Sample preparation

- Extraction method 3540C Soxhlet
- Extraction method 3550B Sonication

- Sample analysis

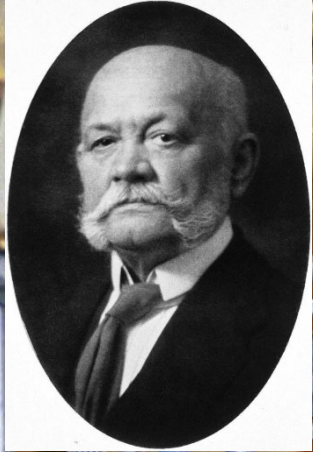
- Method 8082 GC-ECD

PART 761—POLYCHLORINATED BIPHENYLS (PCBs)
MANUFACTURING, PROCESSING, DISTRIBUTION IN
COMMERCE, AND USE PROHIBITIONS

**§761.272 Chemical extraction and
analysis of samples.**

Use either Method 3500B/3540C or Method 3500B/3550B from EPA's SW-846, Test Methods for Evaluating Solid Waste, or a method validated under subpart Q of this part, for chemical extraction of PCBs from individual and composite samples of PCB remediation waste. Use Method 8082 from SW-846, or a method validated under subpart Q of this part, to analyze these extracts for PCBs.

Sample Prep: Soxhlet Extraction




Dr. Franz Ritter von Soxhlet

<http://ihm.nlm.nih.gov/images/B24055>

“closed loop distillation process”

**Used for air samples by TO-4 / TO-10
Soils, building materials**

**18 hr extraction,
not including set up and take down**

- [Environmental Topics](#) ▼
- [Laws & Regulations](#) ▼
- [Report a Violation](#) ▼
- [About EPA](#) ▼

Polychlorinated Biphenyls (PCBs)

[CONTACT US](#)

- [PCBs Home](#)
- [Learn about PCBs](#)
- [Policy and Guidance](#)
- [Cleanups](#)
 - [Cleanup of PCB Waste](#)
 - [Facility Approval Streamlining Toolbox \(FAST\)](#)
 - [Risk -based Disposal Approvals](#)
 - [Disposal and Storage](#)

Alternate PCB Extraction Methods and Amendments to PCB Cleanup and Disposal Regulations

On this page:

- [Rule Summary](#)
- [Rule History](#)
- [Additional Resources](#)

Rule Summary

Basic Information

Legal Authorities

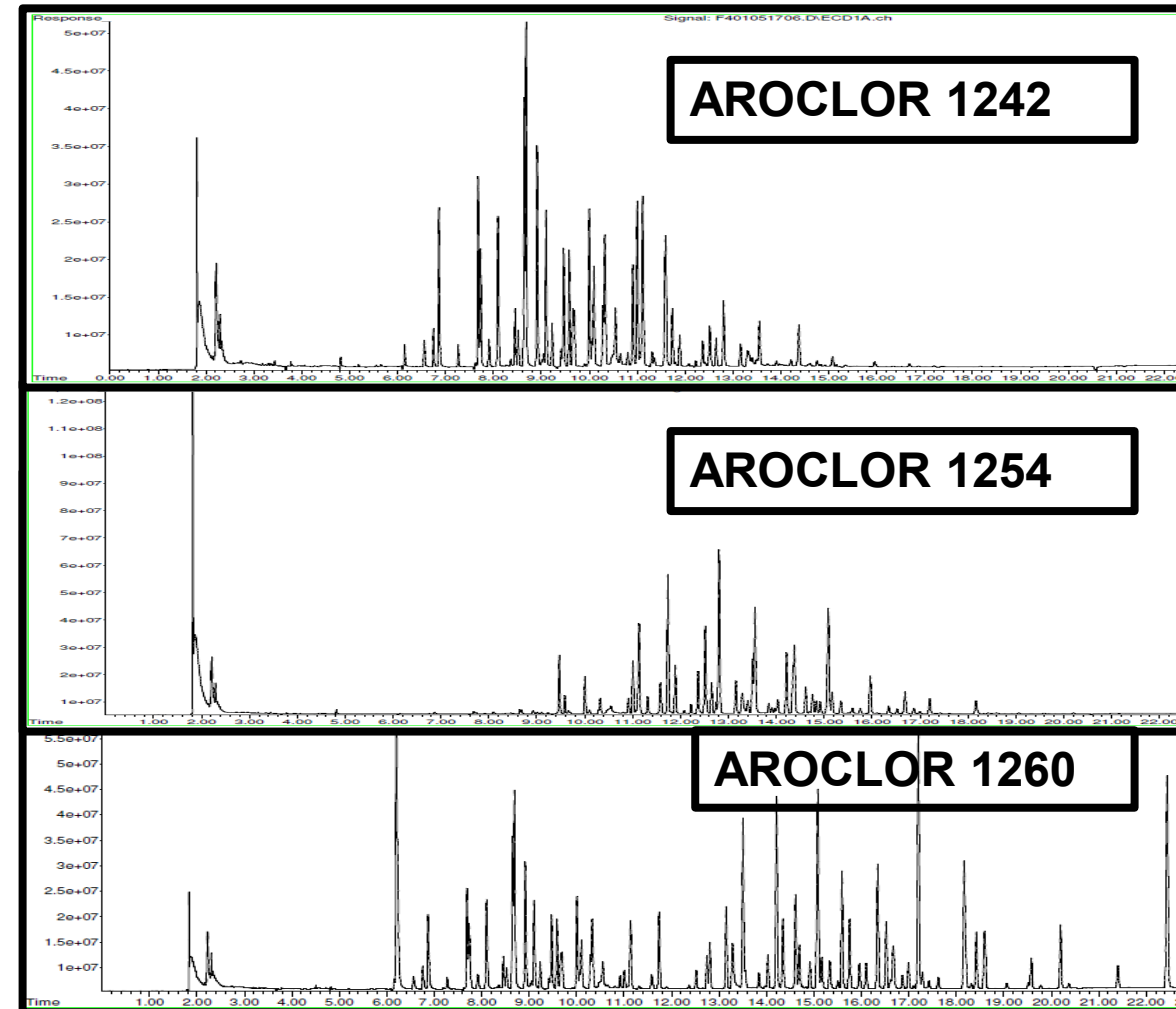
- 15 U.S.C. § 2605(e)

Federal Register

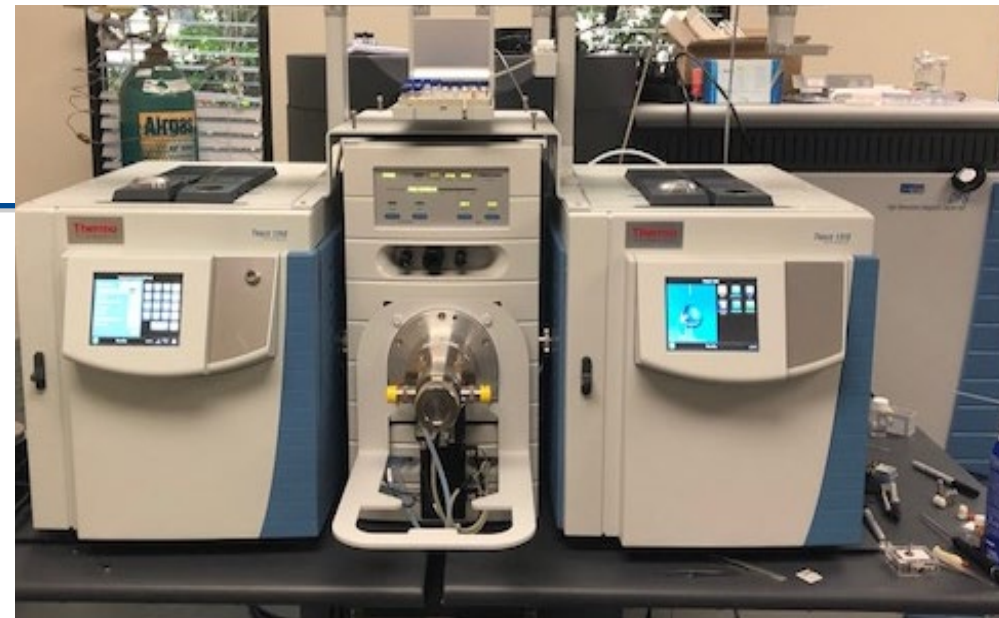
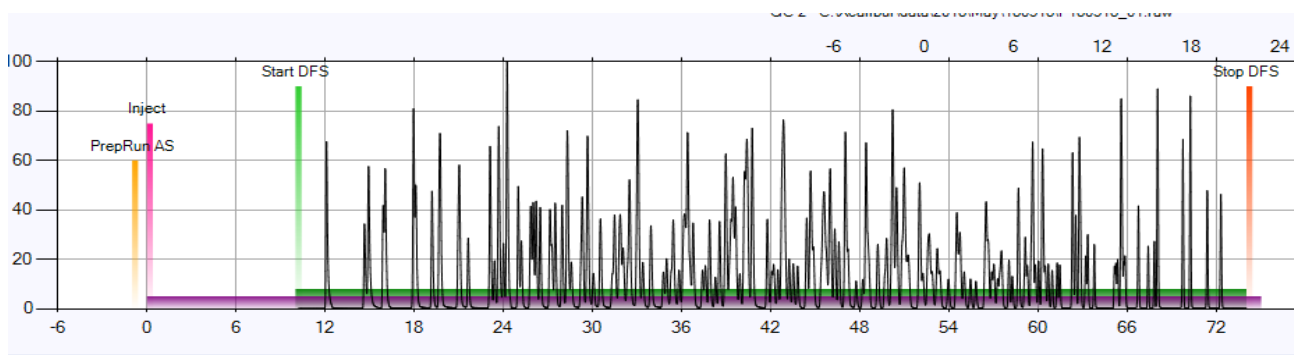
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Method 8082 PCB Aroclor Analysis by GC-ECD

- Qualitative analysis
 - Chromatographic pattern recognition
 - Uses unique aroclor peaks & specific peak ratios
- Challenges
 - Aroclors - multi-component (i.e. mixtures)
 - Multiple aroclors present = mixtures of mixtures
 - Can cause difficulties with “total PCBs”
 - Other chlorinated compounds can interfere
 - Alteration of aroclor pattern in environment
 - “weathering” in environmental media (biodegradation)
 - Implications for air analysis? (partitioning)
 - Vapor phase vs. particulates?
 - Individual congeners will partition differently
 - Method 8082 rules of engagement
 - Potential for false negatives



Congener / Homolog Analysis by GC/HRMS



- Method 1668C PCB congeners and homologs by GC/HRMS
- Reports in the PPT and PPQ range
- Incorporates (27) $^{13}\text{C}_{12}$ extracted internal standards (isotope dilution)
 - 12 dioxin-like plus first and last eluting per homolog group



Congener / Homolog Analysis by GC/LRMS

- Method 680 / 8270 modified for PCB congeners / homologs
 - LRMS can be an attractive option
 - “Weathering” & aroclor mixtures irrelevant
 - Summation of homologs and or congeners – unambiguous total PCB determination
 - Has been approved for TSCA applications on a case-by-case basis
- New LRMS PCB congener Method 1628
 - Not yet approved, initially directed at wastewater applications
 - Uses isotope dilution technique
 - Cost / benefit?



Thank You!

Wrap up

Aroclor analysis

inexpensive w/quantitative & qualitative challenges

Congener/homolog analysis by LRMS

Cost effective total PCB approach where applicable

Congener/homolog analysis by HRMS

Ultimate in sensitivity and data certainty

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