



PCB Chemistry & Analytical Considerations

Managing PCBs in Caulk in Older Buildings
EBC New England Seminar

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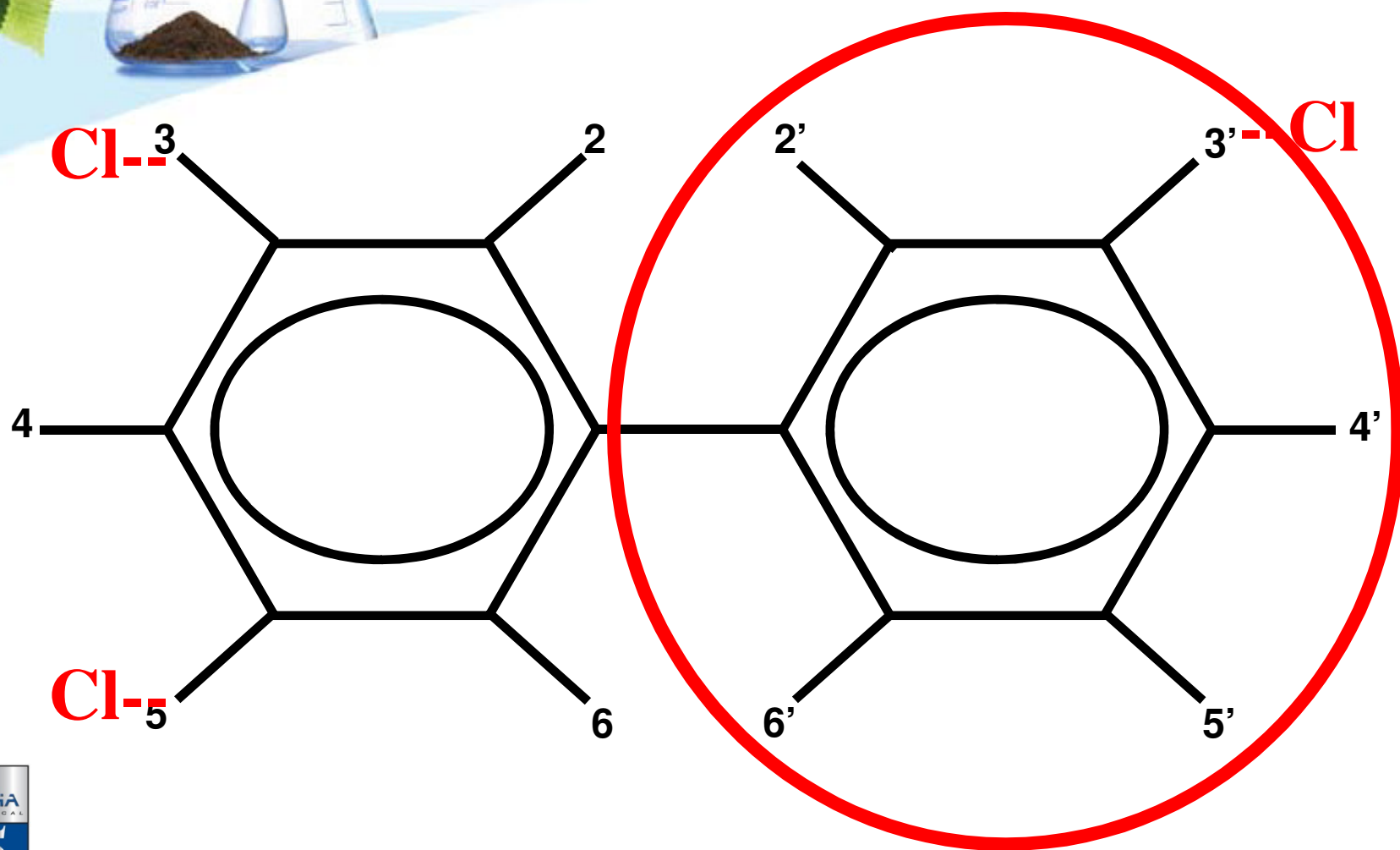




Topics for Discussion

- **Chemistry of PCBs**
- **Methods of Analysis**
- **Sample Matrix Considerations**
- **Potential Screening Approaches**





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Poly – Chlorinated - Biphenyls





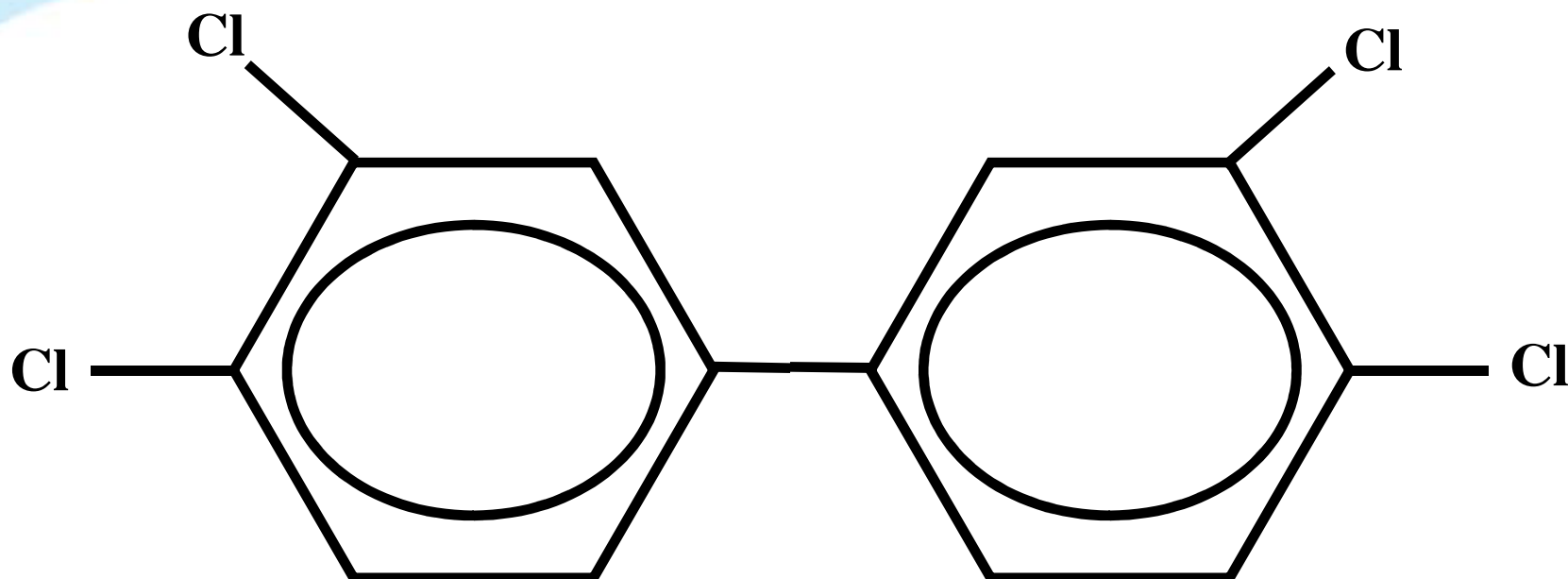
What are PCBs?

- Polychlorinated Biphenyls chemical structure having two benzene rings connected by one bond and having 1 -10 chlorines on the ring
- 10 possible positions leads to 209 possible combinations
 - 209 individual PCB compounds – **CONGENERs**
 - Common analytical subsets: NOAA & WHO lists
- Can be grouped according to the # of chlorine atoms
 - Level (or Degree) of chlorination
 - **HOMOLOGUES (Homologs)**





“Dioxin-Like” Congeners



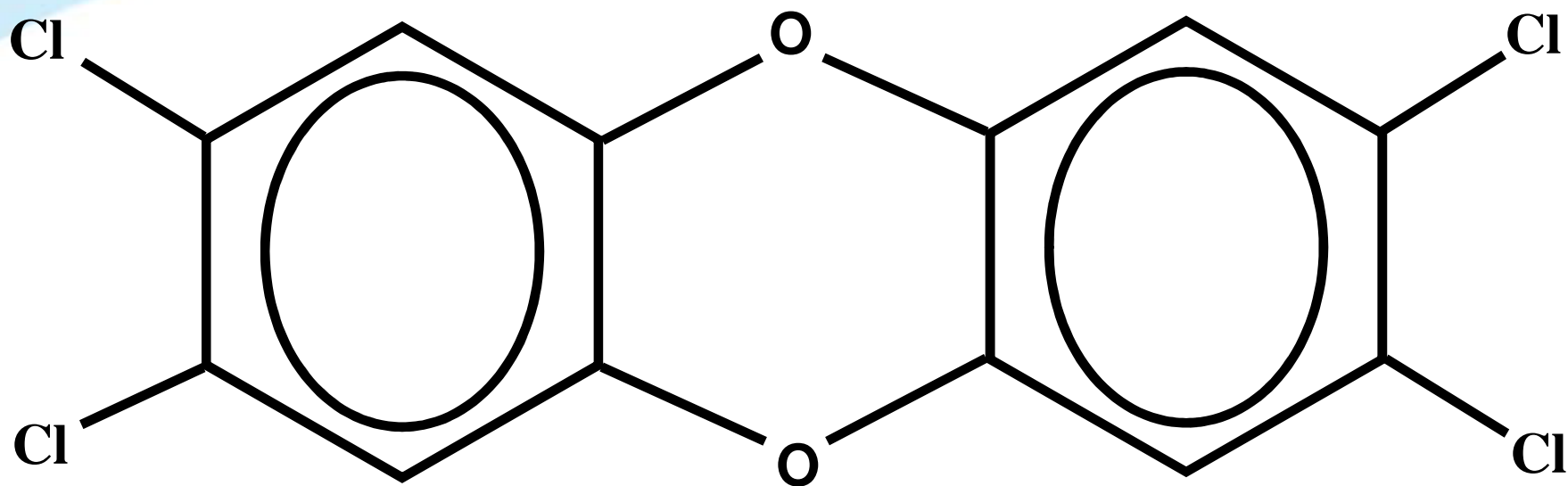
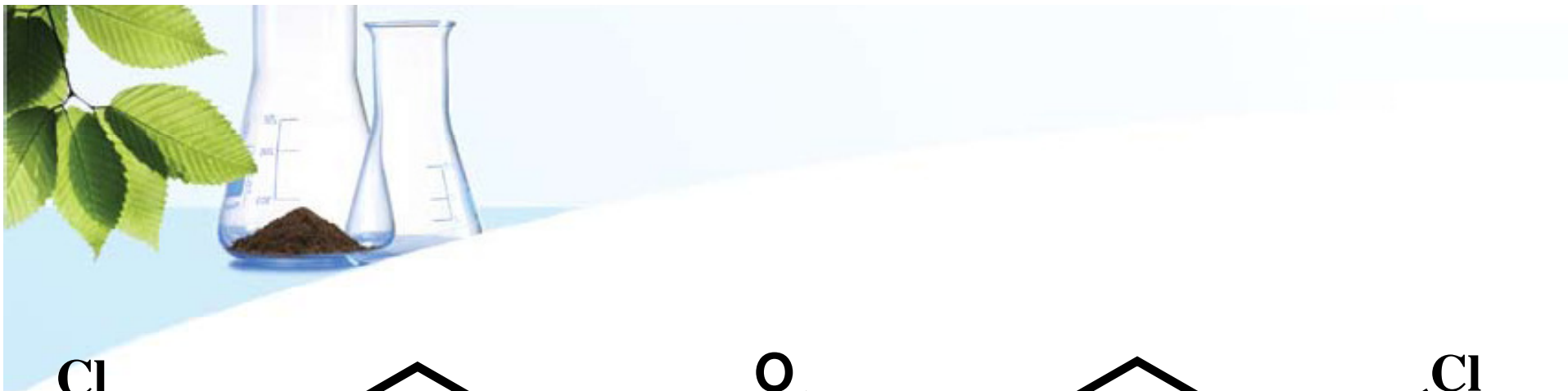
3,3',4,4' – Tetrachlorobiphenyl (*IUPAC*)

BZ 77 (Ballschmiter & Zell)



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2,3,7,8-Tetrachlorodibenzodioxin



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Aroclors

- Most commonly known commercial trade name for PCB mixtures
- Mixtures of PCB congeners
- Nine Aroclors:
 - 1221, 1232, 1242/1016, 1248, 1254, 1260, 1262, 1268

Last 2 digits: % Cl by mass

12

carbon atoms

54% Cl

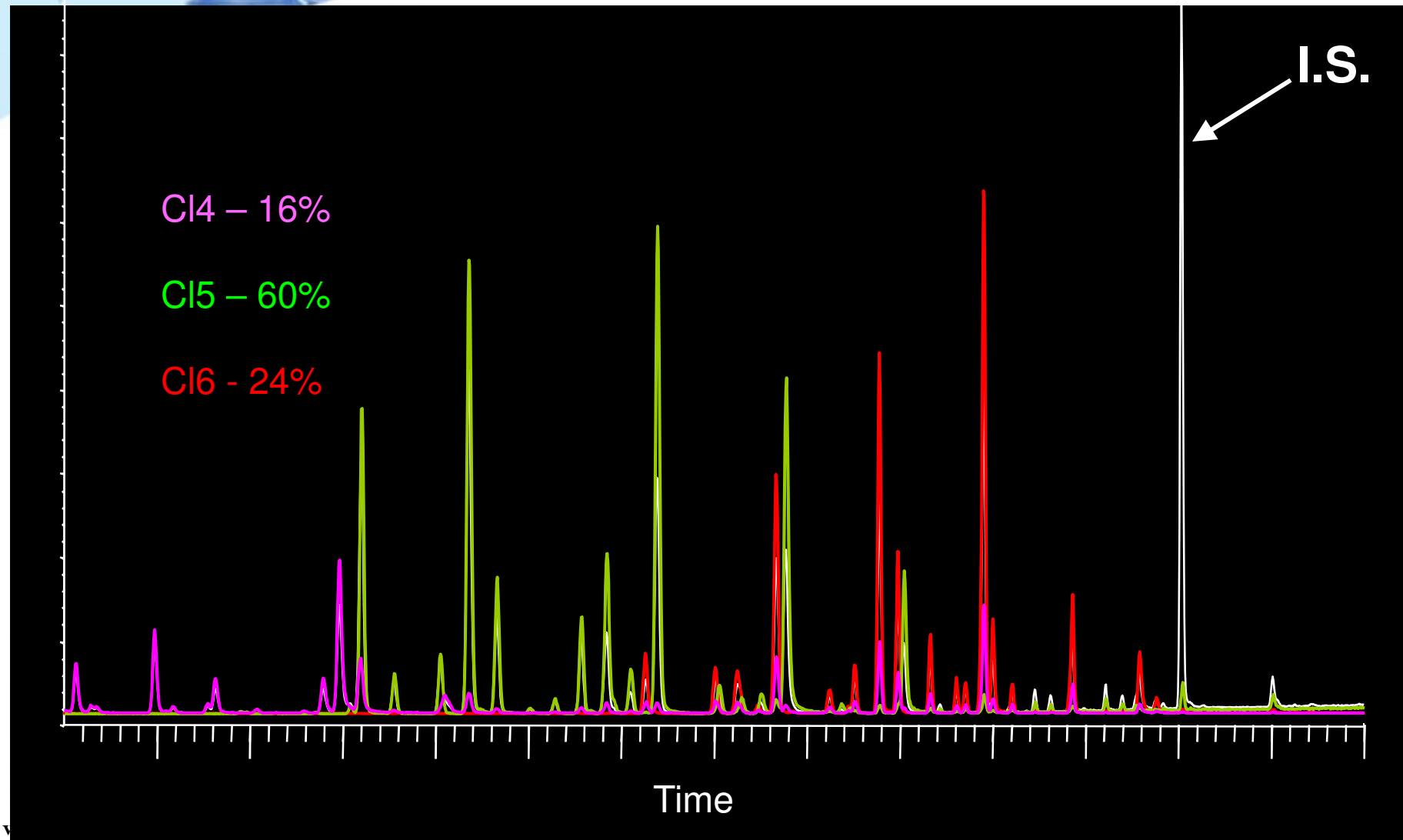


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Total 1254 Composition





Analysis of PCBs

- **Preparative Methods**

- Extraction
 - Clean-up
 - Concentration

- **Determinative Methods**

- Instrumental analysis
 - GC, GC/MS



- **Method 8082**

- GC/ECD (instrumental method)
- **NEED TO SPECIFY EXTRACTION**





PCB Analysis under TSCA

- TSCA Subpart B 761.292
 - Extraction method 3540C Soxhlet
 - Extraction method 3550B Sonication
 - EPA Reg 1, CAM & RCP do not allow sonication
- TSCA Subpart Q 761.320
 - Alternative extraction procedures/Comparability Study
 - Matrix-matched, i.e. sand, clay, loam, etc.
 - Building materials may difficult
 - More suitable for soxhlet anyway
 - Study must be approved prior to sampling



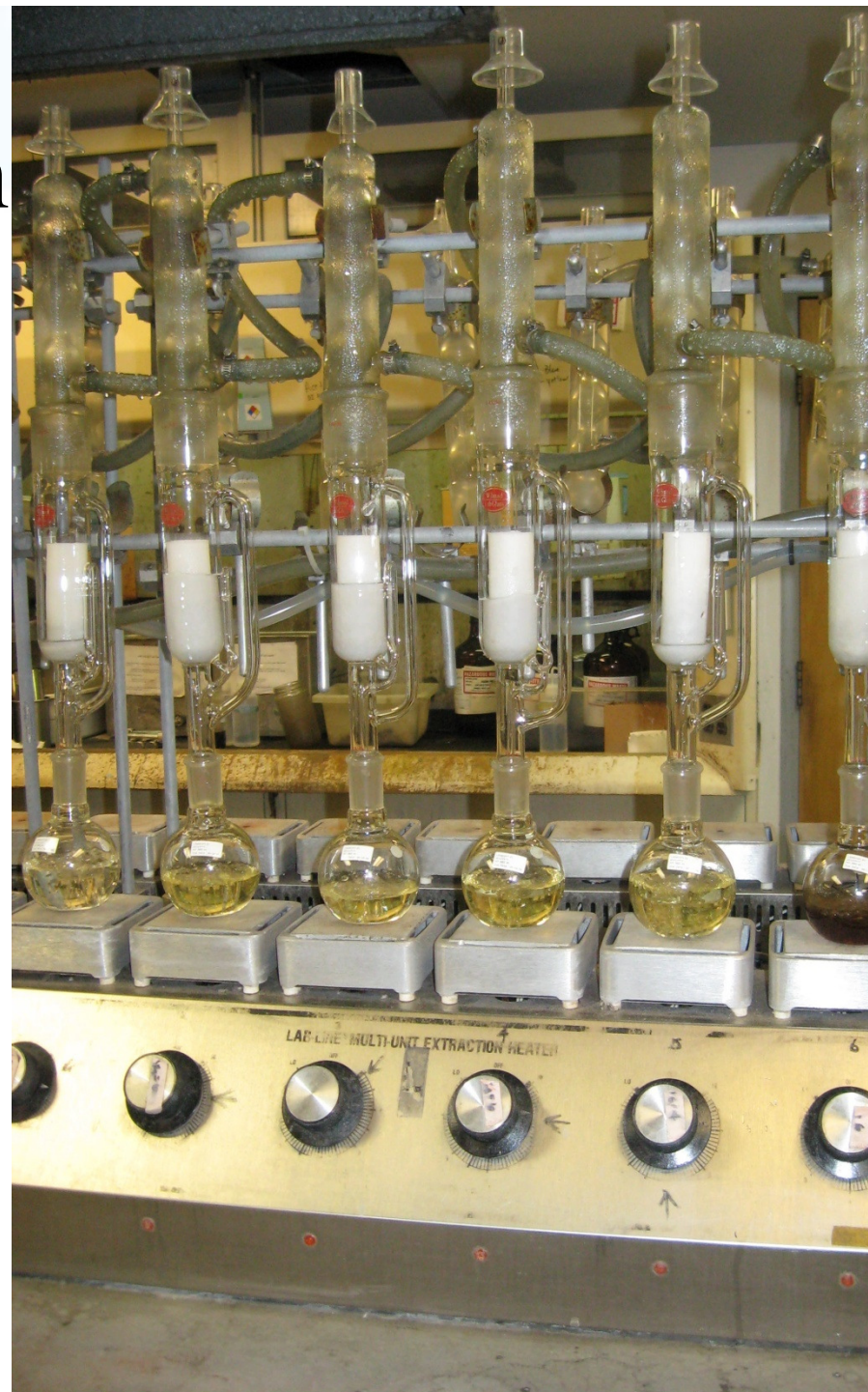
Soxhlet Extraction



Franz von Soxhlet



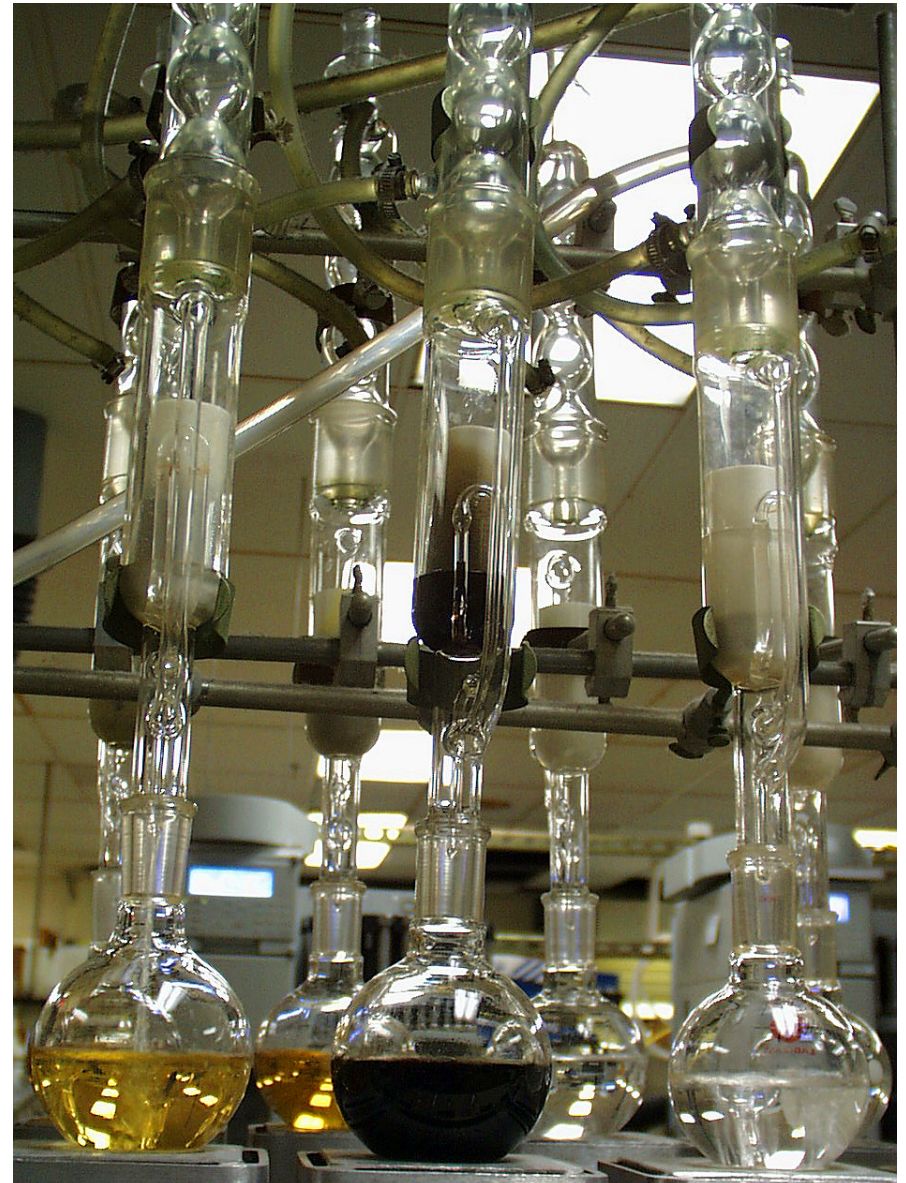
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Method 3540C

Soxhlet Extraction

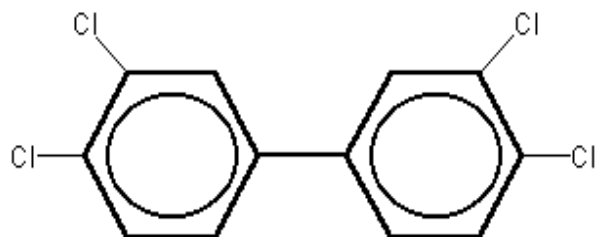
- “closed loop distillation process”
- Solvent
 - MeCl / acetone*
- Amenable to all extractable parameters
- 18 hr extraction





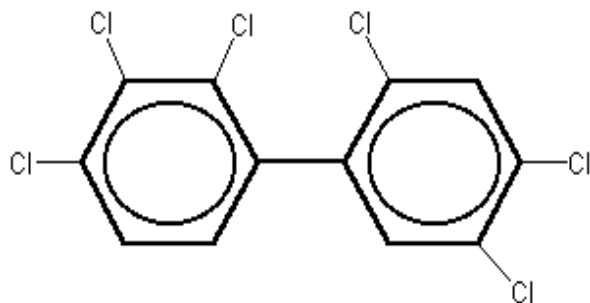
PCB Instrumental Analysis

- Method 8082, GC-ECD
 - Aroclor analysis
 - Pattern recognition & peak ratios



- Method 8082 challenges

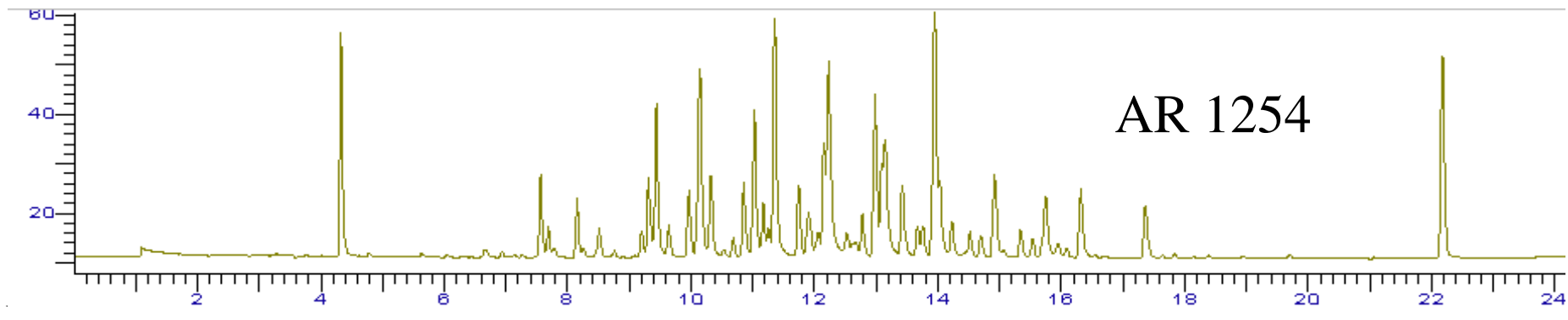
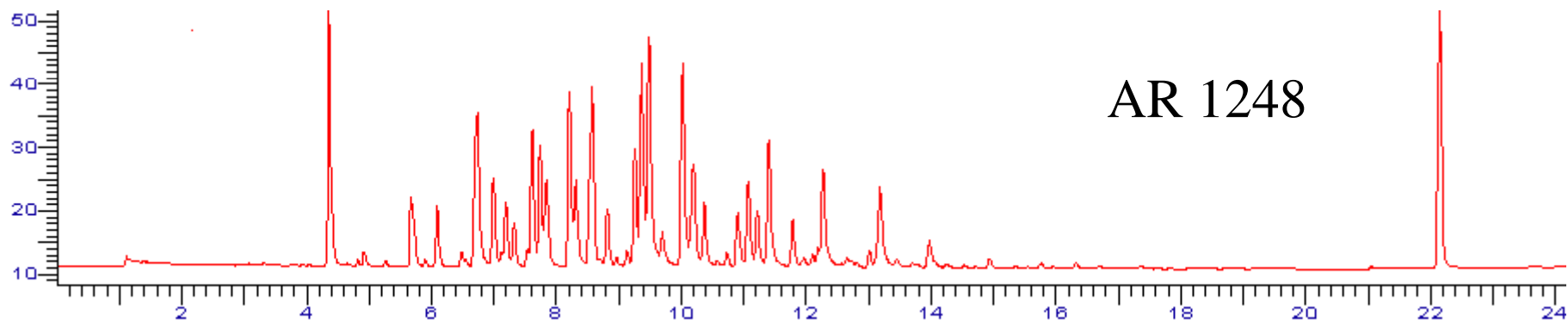
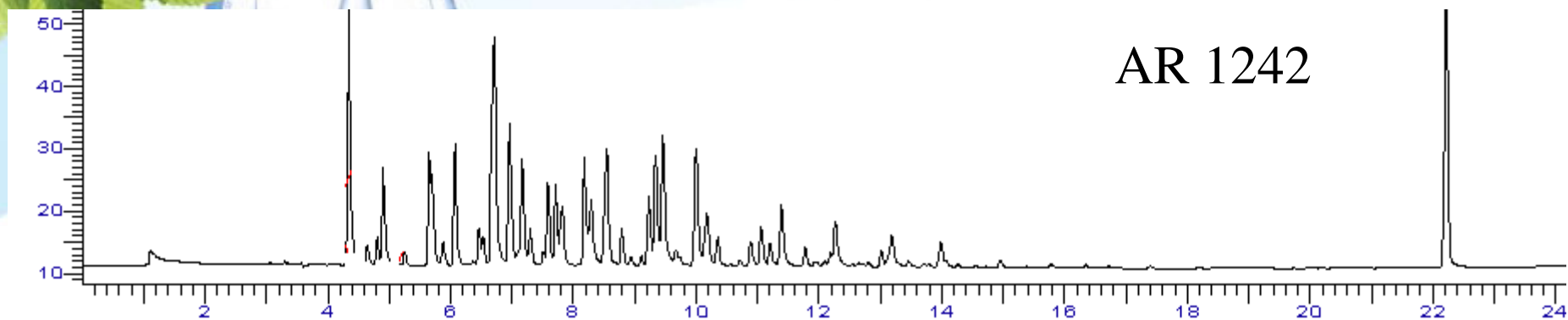
- Complex mixtures of aroclors
- “weathering” & biodegradation



- Low & high resolution GC/MS methods
 - Homologs – total PCBs
 - 209 congeners



Aroclors by Method 8082





Analysis of Building-Related Materials

- Concrete & bricks
 - Sealers
- Surfaces
 - Wipe testing, 100 CM²
- Indoor air
 - Initial indication of a problem?
 - Methods TO-10 low- vol, TO-04 high-vol
 - PUF cartridges
 - Total PCB - Congeners or homologs recommended
- All of the above – soxhlet extraction





Caulking and Paints

- Soxhlet extraction
 - Can be difficult matrix
- Potential for high concentrations!
 - “One bad sample can ruin your whole day(s)”
 - Alpha personal best – 28% PCB
- Laboratory screening
 - Minimize potential for cross-contamination





Screening

- Laboratory screening (*Alpha approach*)
 - Modified extraction, no soxhlet
 - Smaller sample size, surrogate spike, acid clean up
 - Analysis by Method 8082
 - Less robust extraction, low bias of analytical result expected
 - Result < 50 PPM, sample re-extracted soxhlet & re-analyzed
 - Result > 50 PPM, actual concentration determined reported



Field Screening

- Immunoassay based test kits
 - SW-846 Method 4020
- Total organic chlorine / chloride ion test kits
- Field GC
- Most studies based on soils & transformer oils
 - Project specific method development suggested
 - Difficult matrix, aroclor present, other interferences
 - Correlation with lab testing





U.S. EPA Contaminated Site Cleanup Information (CLU-IN)

CLU-IN | Contaminants | **Polychlorinated Biphenyls (PCBs)**

Polychlorinated Biphenyls (PCBs) *Detection and Site Characterization*

PCB analysis can be performed in the field or at a fixed laboratory using a variety of techniques. PCB immunoassay kits utilize analyte-specific antibodies to bind and remove PCBs from complex sample matrices. The process is colorimetric in nature with the change in color indicating approximate concentrations. The color change can be measured using an instrument (e.g., spectrophotometer) or visual color card. Soil samples require an extraction step that can be difficult with very fine-grained materials. The kits are generally calibrated against a specific Aroclor standard (e.g., 1254) but are not able to differentiate between Aroclors. Also, some Aroclors respond better than others. The test can be used as a screening tool during cleanups where a specific cleanup goal such as 1 ppm or 10 ppm has been set and analysis is done to determine whether the contaminant level is above or below the goal. Analysis time varies but can take over 30 minutes per sample.

- Overview
- Policy and Guidance
- Chemistry and Behavior
- Environmental Occurrence
- Toxicology
- **Detection and Site Characterization**
- Treatment Technologies
- Conferences and Seminars
- Additional Resources

- Contaminant Focus Home
- Suggest Resource
- Comments

Ion-specific analysis uses a chloride-specific electrode to measure the amount of chlorine in a sample extract that

[www.clu-in.org/contaminantfocus/default.focus/sec/
Polychlorinated_Biphenyls_PCBs/cat/Detection_and_
Site_Characterization/](http://www.clu-in.org/contaminantfocus/default.focus/sec/Polychlorinated_Biphenyls_PCBs/cat/Detection_and_Site_Characterization/)



Questions?

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