EBC PCB Management Program

Managing PCB Impacted Building Materials

EBC
Environmental
Business
Council of
New England, Inc.

Welcome and Program Introduction

Frank Ricciardi, P.E., LSP

Chair, EBC PCB & Emerging Contaminants Subcommittee

Program Chair & Moderator

Vice President, Weston & Sampson

Industry Standard of Care for PCB Building Material Projects

Frank Ricciardi, P.E., LSP

Vice President

Weston & Sampson

welcome

Weston & Sampson SM

transform your environment

Standard of Care
PCBs in Building Materials

Frank Ricciardi, PE, LSP

Weston & Sampson

ACEC Definition

- Standard of care – “A **Professional Engineer** is negligent if he/she fails to use the skill and **care** that a reasonably careful **professional engineer** would have used in similar circumstances.”

Why is Standard of Care Important?

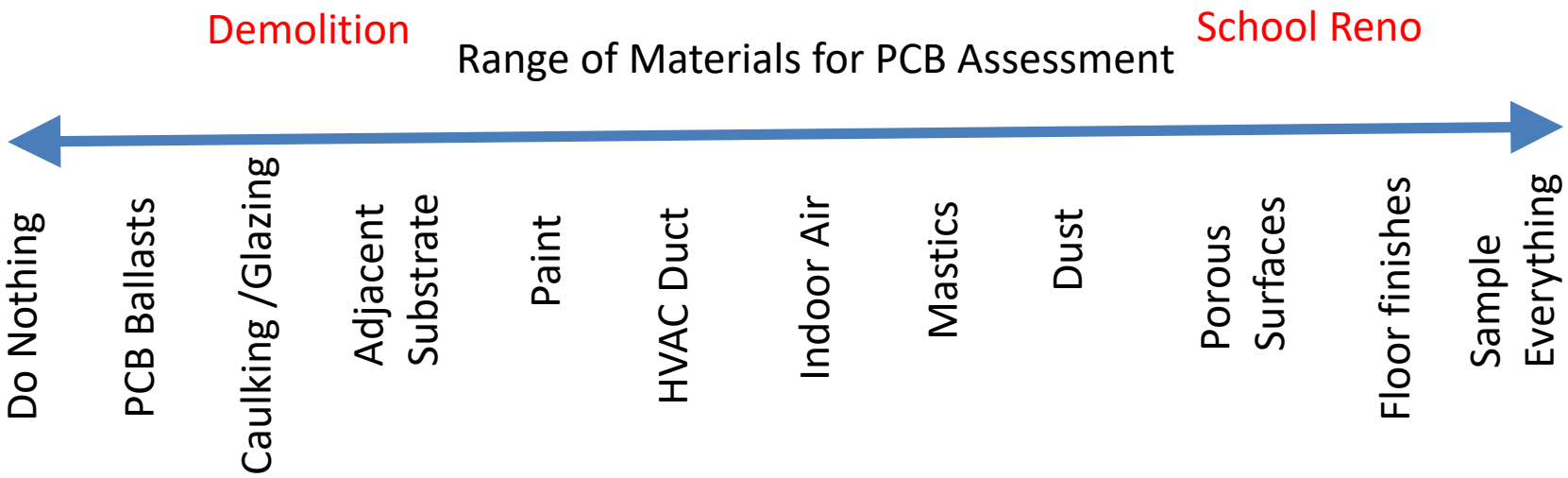
- Used to determine if an engineer (or contractor/consultant) is NEGLIGENT
- Lawsuits etc.
- Drives the industry and reasonable practices for addressing PCBs
- Very important to this topic – WHY?

Wild, Wild, West?

- Approaches to handle these issues vary from:
- Ignorance – bury head in the sand on the issue
- Absurdity – Sample everything in the building for PCBs
  - (Labs prefer this approach!)

Middle Ground
(Standard of Care??)

- These seminars are intended to help!



- Is there a one size fits all – of course not!
- Need to evaluate RISK - develop a prudent plan

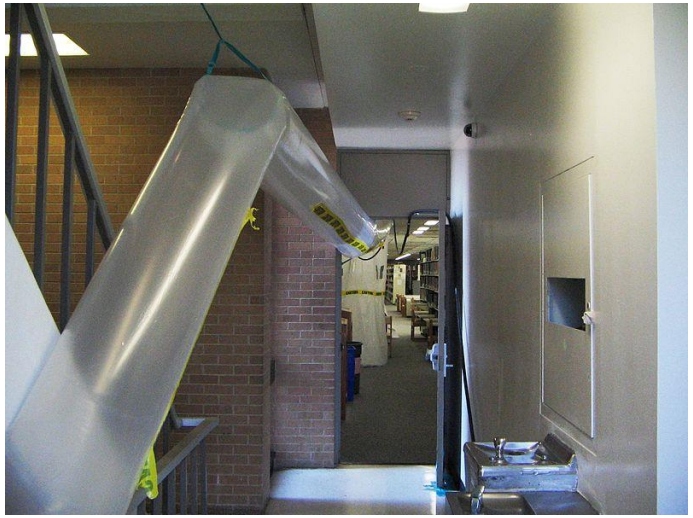
What is Prudent?

- Due diligence – need to do research!!
- Develop sampling based on building history/materials
  - Dates of construction/significant renovations
  - Correspond to dates of PCB material use?

- Building occupants? Ages?
- Cost/benefit analysis
- Presumptive Approach? Assume PCBs present and abate accordingly without sampling
  - Accurate inventory of potential sources
  - Comply with disposal facility acceptance criteria
- (Labs don't like this!)

Considerations for PCB Abatement Projects

- For Demolition
  - Facilitate lawful disposal of materials
  - Protect workers
  - Develop dust control plan
- For Renovation
  - All of above plus!
  - Risk Assessment
  - Ages of building occupants
  - Time of occupancy (e.g. work hours or residential)
  - Cleaning procedures
  - Clearance sampling
  - Cost benefit of renovation versus demolition
  - Deed restrictions??



Due Diligence – Assessment Standard of Care

- Define project scope (Demo or Renovation)
- Define building construction/reno dates
- Were PCB materials being used? (Late 1920's to early 1980's –ISH)
- Develop list of potential PCB sources
- Plan for assessment or presumptive approach
- Develop the story! - communicate to client, EPA, Contractors, Building Occupants

Bad Standard of Care

Excluded Product vs. Reabsorption Word of Caution

- For building materials with <50 mg/kg PCBs; possibly excluded product
- Need to show lines of evidence
- Could High levels of PCBs in other building materials travel through air to contaminate other surfaces?? REABSORPTION!
- Important to document for cleanup plan – Remediation Waste vs Bulk Product
- We will discuss with Ms. Tisa

Analytical Standard of Care

- Are you using the correct SOPs?
- Are you using the correct analytical method?
- Have you consulted with the lab?
  - Method requirements, containers, hold times, canisters/regulators
- Air sampling – homologs/congeners – when to use each (Risk Assessment)
- Bulk sampling – are you giving the lab what they need?

Abatement Standard of Care

- Protection of building occupants/ abatement workers
- Preventing spread of PCB dust
- Removal done using controlled environments (enclosures, negative air, HEPA vacuums etc.)
- Final cleaning of dust and equilibration time before clearance sampling key
- Reoccupancy or demo? Air sampling?

Disposal Standard of Care

- Communicate with disposal facility
- Do you have the correct data? Sampling methods? TCLP or Totals?
- Can the facility accept your waste?
- Is the facility in compliance with its permit (Does it have a permit? Do I call state DEP?)
- Transportation documents – are they correct? Dual wastes?
- Shipping requirements/packaging
- Hazardous waste exemption for PCB Bulk product?

Clearance Sampling Standard of Care

- For reoccupancy, clearance sampling
- When should clearance sampling occur?
  - Final cleaning done – no visual dust
  - Confirm that all PCB sources eliminated (paint, ducts, ceiling plenums)
  - HEPA Vac – wet wiping
  - Air exchanges important to flush air
  - Equilibration period while dust settles important
  - Sampling method – sufficient to show no risk (ng/m3) TO-4A or TO 10A

Encapsulation and Deed Restrictions

- When PCB impacted materials cannot be removed
- Encapsulation – Many techniques; develop based on material being isolated
- Building area limited to “Low-occupancy” use
- EPA Disposal Approval will include restriction approval
- State restrictions may come into play (AULs etc.)
- Long-term monitoring and maintenance requirements

Summary

- Standard of Care for every aspect of abatement project
- Establish client/owner expectations early
- Careful due diligence necessary
- Cost/benefit analysis
- Communicate and document everything!
- Be prepared for changes
- Risk Assessment and Lab are key
- Beware of cowboys and PCB PHDs!

thank you

westonandsampson.com

Comparison of Passive and Active Air Sampling (PAAS) Methods for PCBs:
A Pilot Study in New York City Schools

Gary Hunt

Vice President & Principal Scientist

TRC

Comparison of Passive and Active Air Sampling (PAAS) Methods for PCBs – A Pilot Study in New York City Schools

Presented By
Gary Hunt, QEP
TRC Environmental Corp.
Lowell MA 01854

EBC PCB Management Program
Managing PCB Impacted Building Materials
Tuesday, July 17, 2018

Nixon Peabody LLP
100 Summer Street
Boston, Massachusetts

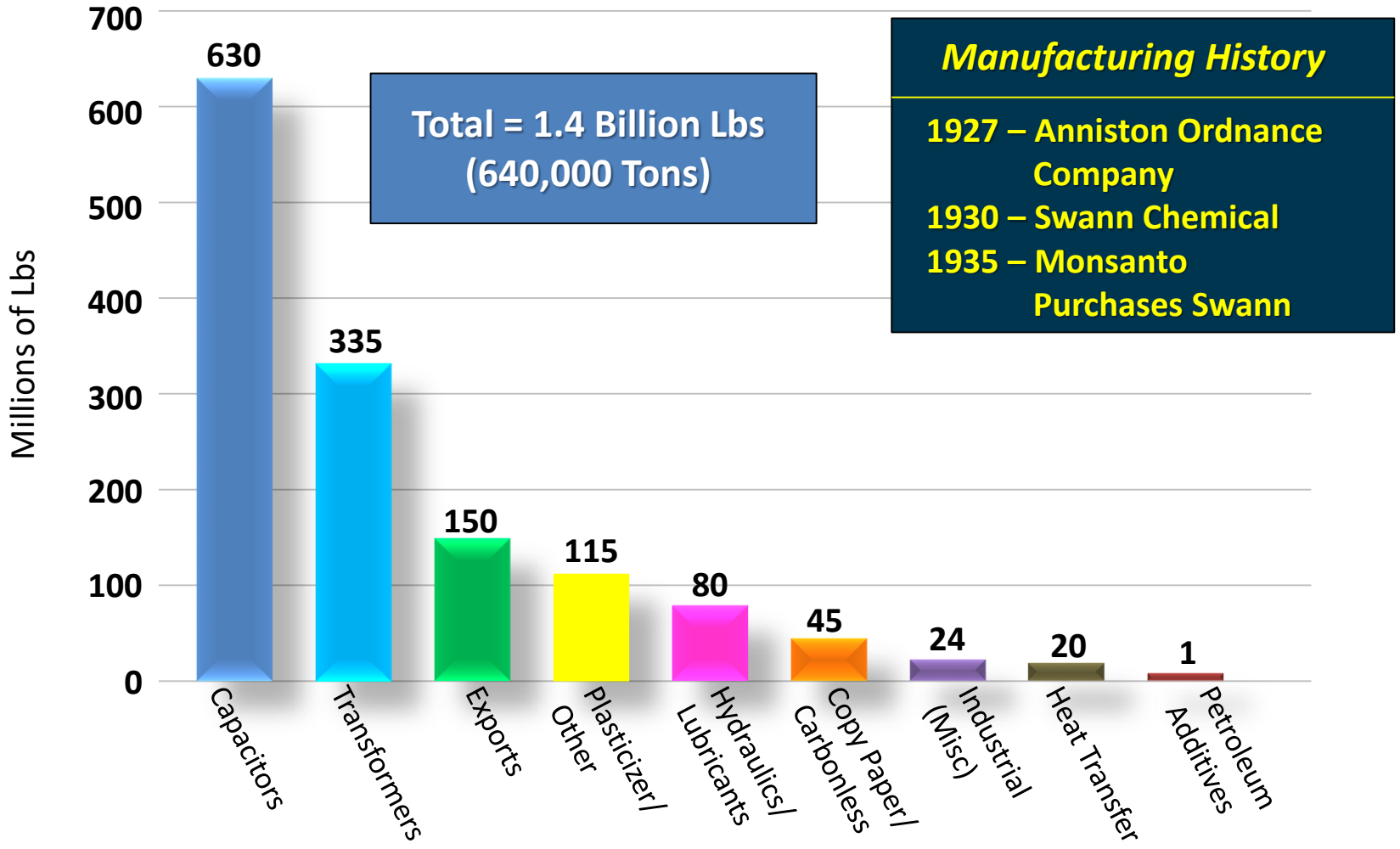
Topics of Discussion

1) PCBs – General Background
2) NYC Pilot Study
3) Ballast and Caulking – PCB Sources
4) PAAS Pilot Study Description
5) PAAS Methodology
6) PCB Results
7) Quality Assurance / Quality Control
8) Recommendations for Further Study and Data Analyses Plans

PCBs In General

- 1.4 billion pounds of PCBs produced in U.S. between 1925 and 1978.
- Used in consumer products, electrical equipment, and building materials.
- Beginning in 1950, caulk containing PCBs was used in constructing and renovating buildings throughout the entire country.
- Congress banned the manufacture of PCBs in 1978 (TSCA).
- EPA issued its first national guidance on PCBs in caulk in September 2009.

Domestic Uses of PCBs (1930 – 1975)
(Based upon sales records)



Source: USEPA PCBs in the US – Industrial Use and Environmental Distribution, February 1976 (EPA 560/6-76-005)

Pilot Study Background – New York City

- The City reached an agreement with EPA to conduct a pilot study of five New York City school buildings to further evaluate the risk and management of PCB Caulk.
  - The ultimate goal of the Pilot Study is to develop a citywide approach for assessing and managing PCB Caulk in schools built between 1950 and 1978.
- First and only study in the U.S. of this scope and magnitude.

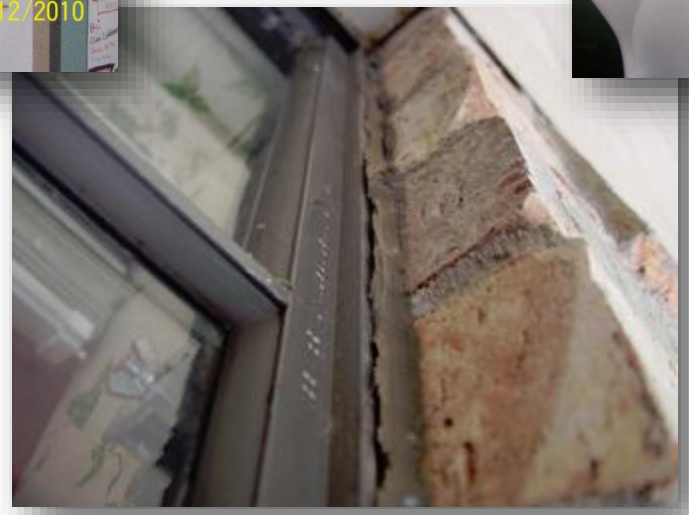
PCB Ballasts

Typical ballast in a NYC school fluorescent light fixture

Typical PCB Caulk Locations

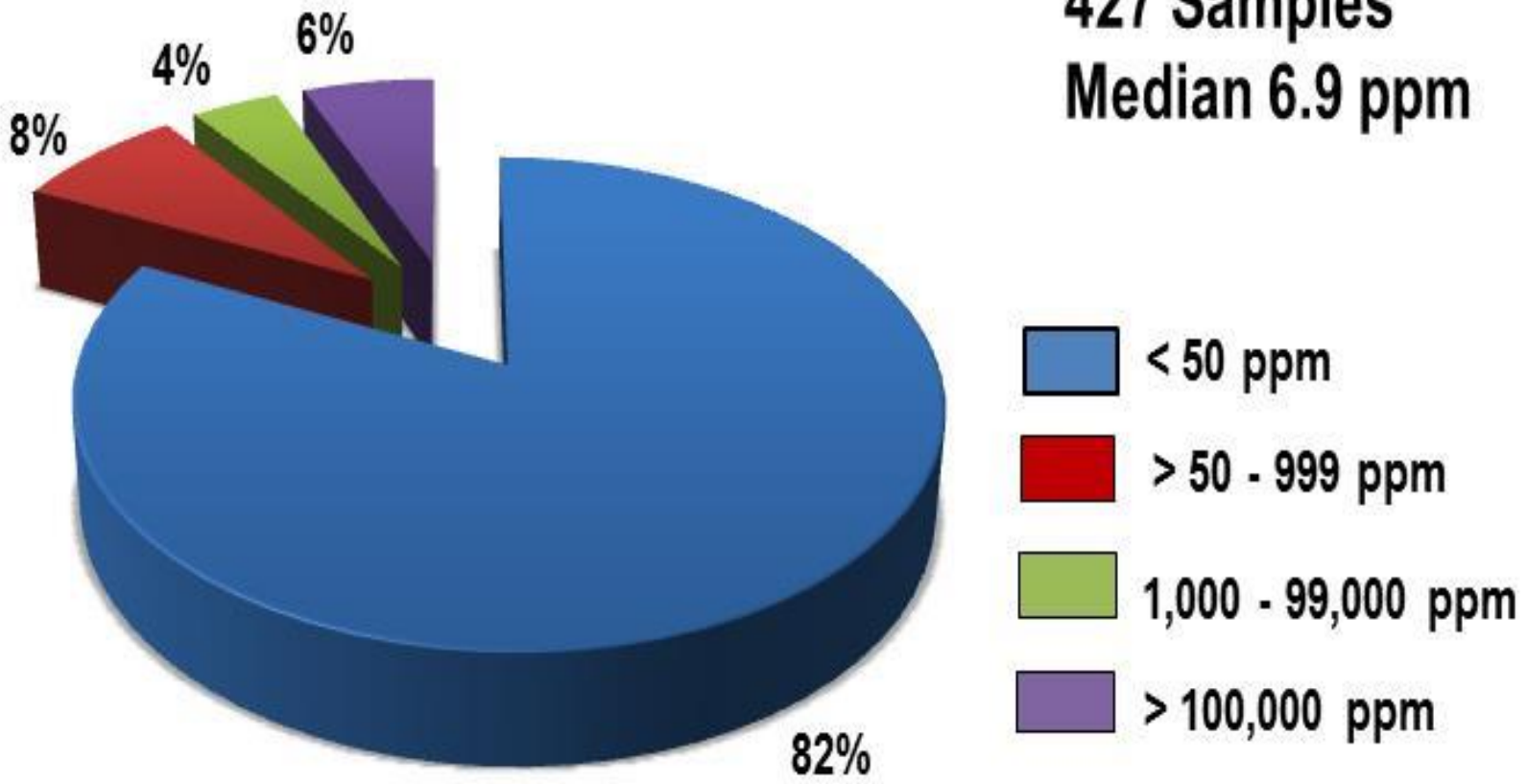
Door Frames

Bathroom Fixtures



Window Casings

PCB Interior Caulk
NYC Schools Pilot Study Results



Source: EPA/600/R-12/051

PAAS Pilot Study– Purpose and Objectives

- Side-by-side comparison of passive and active sampling methods in actual school settings.
- Assess whether a passive sampling method for PCBs could be used as a cost effective approach in lieu of active sampling for measurement of PCBs in schools.
- Comparison of total PCB concentrations resulting from both Aroclor® and congener-specific analyses.

Study Design – Key Features

- Side-by-side contemporaneous sampling events with both passive and active sampling methods (EPA Method TO-10A).
- Screening level measurements performed using active method at two (2) of five (5) NYC pilot schools expected to have PCB concentrations in the range of 50-500 ng/m^3.
- PAAS study conducted over a six (6) day period employing both sampling methods.
- Analyses performed using both Aroclor® method (SW-846 8082A) and PCB congener method (EPA Method 1668A).

Summary of Screening Results (Sept. 15, 2016)[a]

School A	
Sampling Location	Total PCBs (ng/m^3)
Room 118 (therapist office)	49.8
East Stairs (top half-landing)	205.8
School B	
Sampling Location	Total PCBs (ng/m^3)
Northeast Stairs B (top half-landing)	400
Southwest Stairs D (top half-landing)	478

[a] Schools and locations were acceptable for use in the PAAS Study. Results in the range of 50-500 ng/m^3

Active Sampling Method Description

- SKC Air Check® XR-5000 Personal Pump.
- Flow rate 2.5 lpm.
- 48-hour sampling period.
- Samples in series 3 x 48 hrs = 6-day passive sampling duration.
- 7.2 m^3 / event x 3 = 21.6 m^3 total.

Passive Sampling Method Description

- TISCH Model TE-200-PAS (2 dome design)
- PUF disks 5.5-inch diameter x 0.5-inch depth
- Sampling rate 0.8 m^3/day* = 4.8 m^3 (6-day event)

---

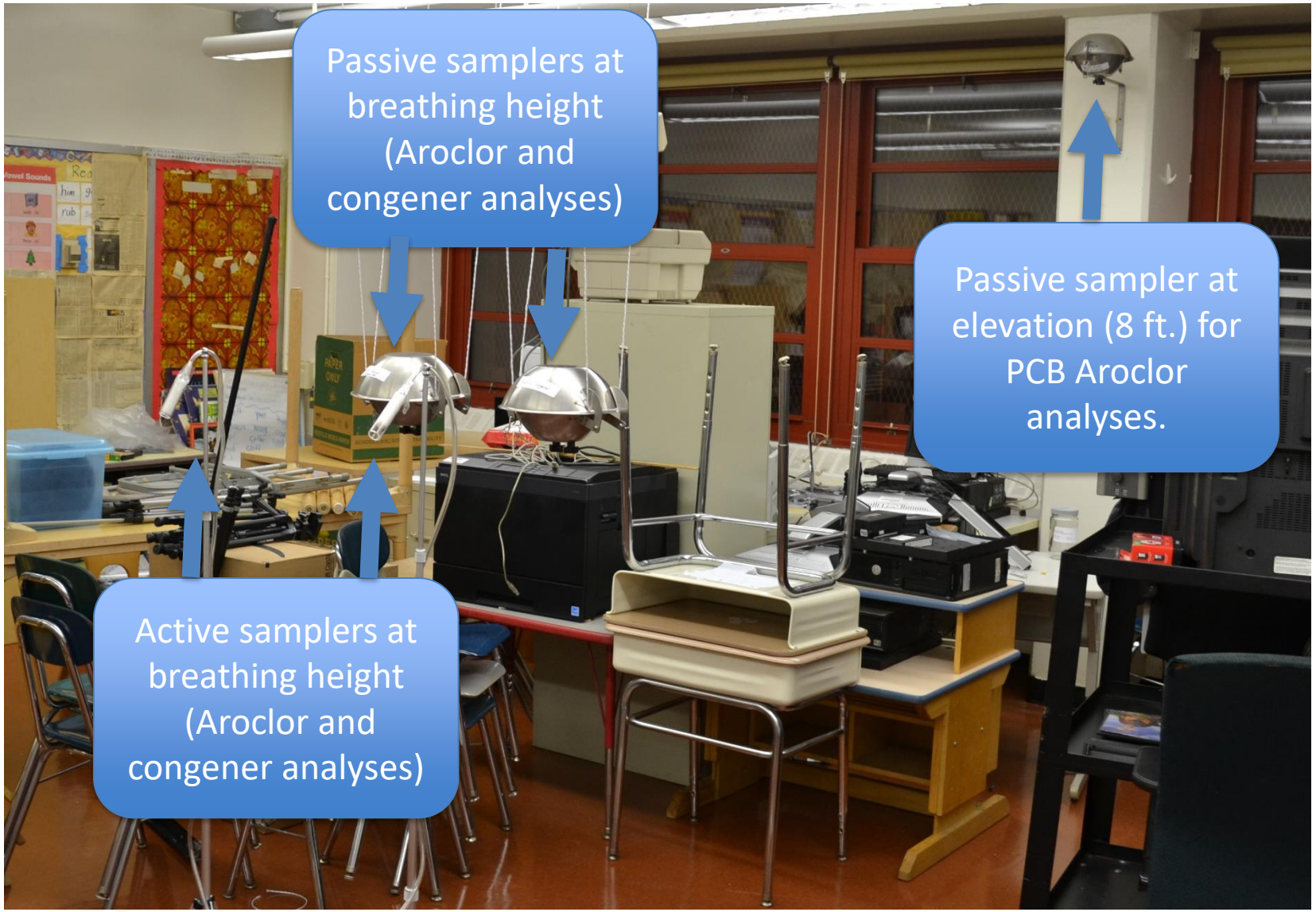
*Hazrati and Harrad, Calibration of polyurethane foam (PUF) disk passive air samplers for quantitative measurement of polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs): Factors influencing sampling rates, Chemosphere 67 (2007).

Sampling Locations

Samplers were deployed at each of the eight (8) locations as follows:

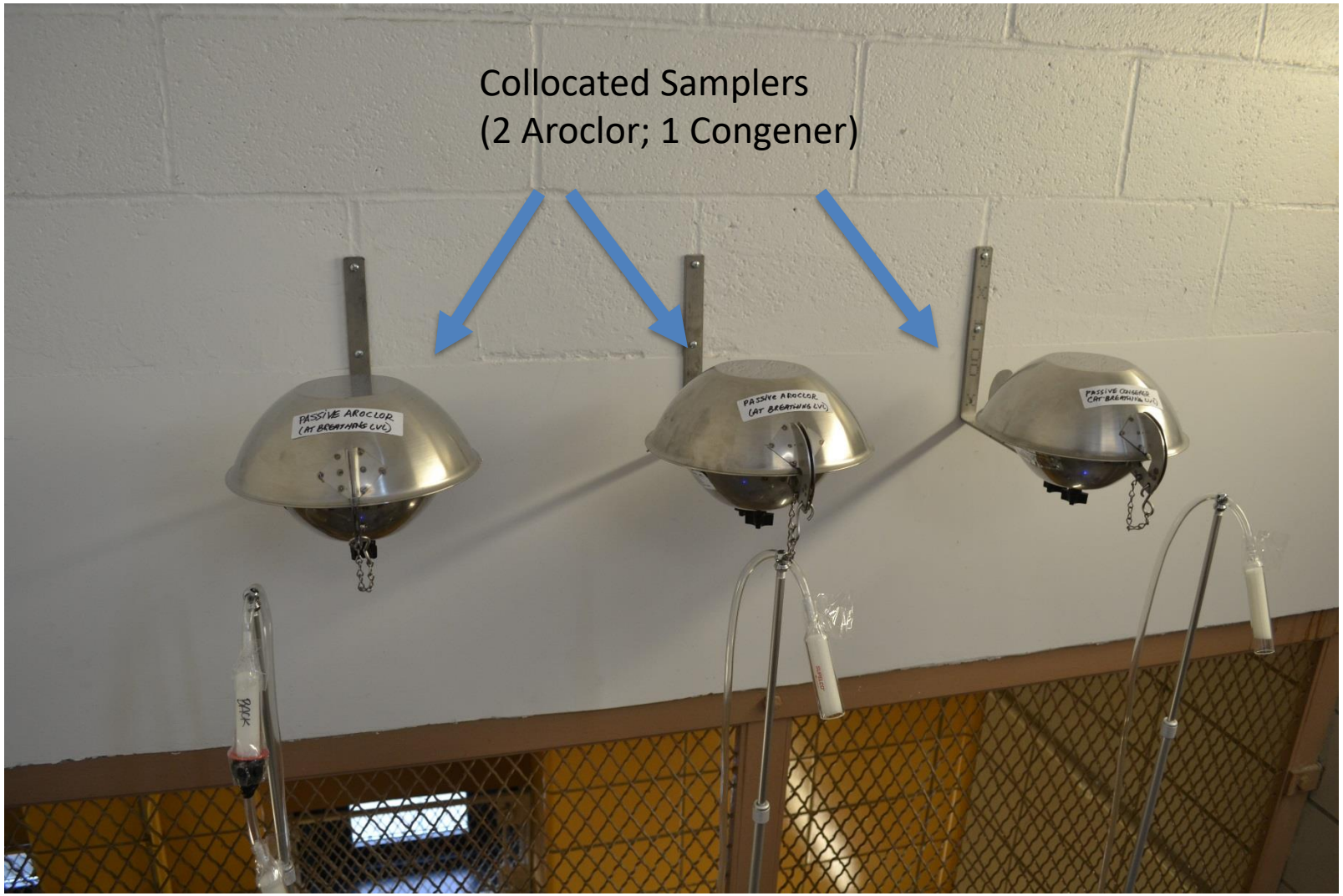
- Two collocated passive samplers in the center of the room or mounted to the stairwell wall at approximately 4½ feet (breathing zone height), one for PCB Aroclor® analysis and one for PCB congener analysis.
- Two collocated active samplers in the center of the room or near stairwell at approximately 4½ feet (breathing zone height), one for PCB Aroclor® analysis and one for PCB congener analysis.
- One passive sampler mounted on the wall at an elevation of approximately 8 feet above floor level for PCB Aroclor® analysis to evaluate impact of placement on results (vs. breathing height).

School A Classroom Sampling Locations



School B Passive/Active Stairwell Location

School B Passive/Active Stairwell Location – Breathing Height



Physical Parameters Monitored – PAAS Study

Parameter	Instrument	Comment
Temperature	Dickson TP 425	Monitored continuously at each sampling location.
Humidity	Dickson TP 425	Monitored continuously at each sampling location.
Barometric Pressure	Extech SD 700	Monitored at one representative location in each school.
Air Flow	TSI 964 Straight Air Velocity Probe	Room exhaust vents; near passive sampler inlets.

QA/QC Measures

Type	Description	Results
Field Duplicates	Collocated Samples; One pair active and one pair passive at each school; PCB Aroclor® analyses only.	RPD ≤ 30% for all pairs; met QAPP criteria.
Breakthrough Checks	One sample per school active only; separate analyses PCB Aroclors® front and back half PUF.	≤ 100 ng / Trap back half; met QAPP criteria.
Field Spikes	PUF cartridges spiked with Aroclor® 1254 in lab, sent to field and no air drawn over cartridge; one per school.	Aroclor® 1254 Percent recovery met QAPP criteria (50-150%).
Field Blanks	One field blank per school for each method (active and passive) PCB Aroclor® analyses performed.	PCB Aroclors® not detected.
Field Surrogate	All passive and active sample media pre-spiked with DCB. Percent recovery data used to evaluate collection efficiency.	All surrogate percent recovery data met QAPP criteria.

Summary of PCB Congener Results (EPA Method 1668A)

	Total PCB Concentration (ng/m^3)		RPD %
School A Locations	Active	Passive	
Room 118 (therapist office)	**75.5**	**23.5**	**52.5**
East Stairs (top half-landing)	**171**	**111**	**42.5**
North Stairs (top half-landing)	**97.2**	**110**	**12.3**
West Stairs (top half-landing)	**103**	**93.3**	**9.9**
School B Locations			
Northeast Stairs B (top half-landing)	**198**	**210**	**5.9**
Southeast Stairs A (top half-landing)	**229**	**329**	**35.8**
Northwest Stairs C (top half-landing)	**164**	**178**	**5.5**
Southwest Stairs D (top half-landing)	**233**	**333**	**35.3**
		Average	**25.0**

Notes: ng/m^3 - nanograms per cubic meter.

PCBs - Polychlorinated Biphenyls.

% RPD = [ABS Passive – Active] / [Active + Passive /2] x 100.

Comparison of PCB Aroclor® Results – Collocated Samples

Location	Sample Type	ng/m³ A	ng/m³ B	% RPD
School A East Stairs Landing	Active	236	228	3.4
School A West Stairs Landing	Passive	95.3	112	16.1
School B Northwest Stairs C Landing	Active	310	282 Avg: 296	9.5
School B Northwest Stairs C Landing	Passive	260	269 Avg: 265	3.4

$\% \text{ RPD} = [\text{ABS } (X_2 - X_1] / [X_2 + X_1 /2] \times 100$

Comparison of Precision Results (% RPD) Types of Active / Passive Collocated Sample Pairs

Type	% RPD	Type	% RPD
Active School A	3.4	Active Average (A/B)	6.5
Active School B	9.5	Passive Average (A/B)	9.8
Passive School A	16.1	School B Active vs. Passive (Average Values)	11.0
Passive School B	3.4		

Some Future Plans and Further Data Analyses

- Do congener-specific data support Aroclor® 1254 identification (Method 8082)?
- Do congener-specific data provide any evidence that high molecular weight PCB congeners that are likely particle bound are not represented in passive samples?
- Use results from active samples to develop a correction factor for passive samples (calibrate passive samplers).
- Did sampler placement affect results? Sampler at breathing height vs. sampler at elevation (8 ft).
- Side-by-side comparison of both types of TISCH passive samplers (TE-200-PAS and TE-300-PAS).

Acknowledgements

- **Co-Authors**

M. Lorber[1], K. Thomas[2], M. Maddaloni[3], E. Gerdts[4], E. Denly[5], J. Bourbon[6], A. Sigona[4]

[1]*Retired, United States Environmental Protection Agency, Chevy Chase, MD, USA, 20815*

[2]*USEPA, Office of Research and Development, Research Triangle Park, NC, USA, 27709*

[3]*USEPA - Region 2, Office of the Regional Administrator, New York, NY, USA, 10007*

[4]*TRC Environmental Corporation, New York, NY, USA, 10018*

[5]*TRC Environmental Corporation, Lowell, MA, USA, 01854*

[6]*USEPA - Region 2, Division of Environmental Science and Assessment, NJ, USA, 08837*

- **New York City – School Construction Authority (SCA)**
- **Funding provided by USEPA Office of Research and Development (ORD) through Regional Assessment and Research Effort (RARE) Program.**
- **PACE Analytical Laboratories.**

Thank you

Questions?

Gary Hunt, QEP
P:978-656-3551| E: ghunt@trcsolutions.com
www.trcsolutions.com

Appropriate Use of Aroclor, PCB Homolog, and PCB Congener Analyses

Jim Occhialini

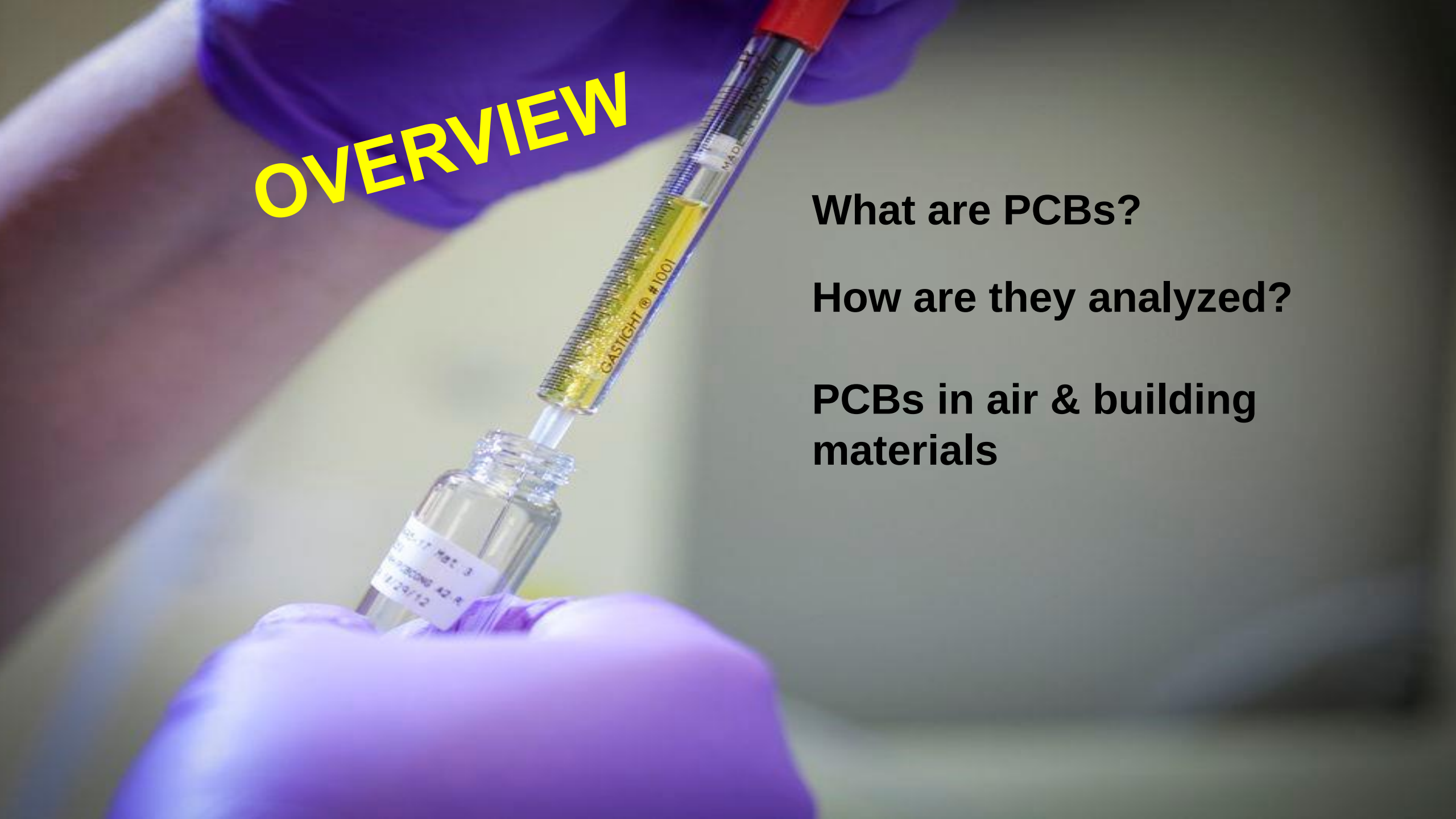
Vice President

Alpha Analytical

Appropriate Use of Aroclor, PCB Homolog, and PCB Congener Analyses

EBC PCB Management Program
Managing PCB Impacted Building Materials

Alpha Analytical
Jim Occhialini

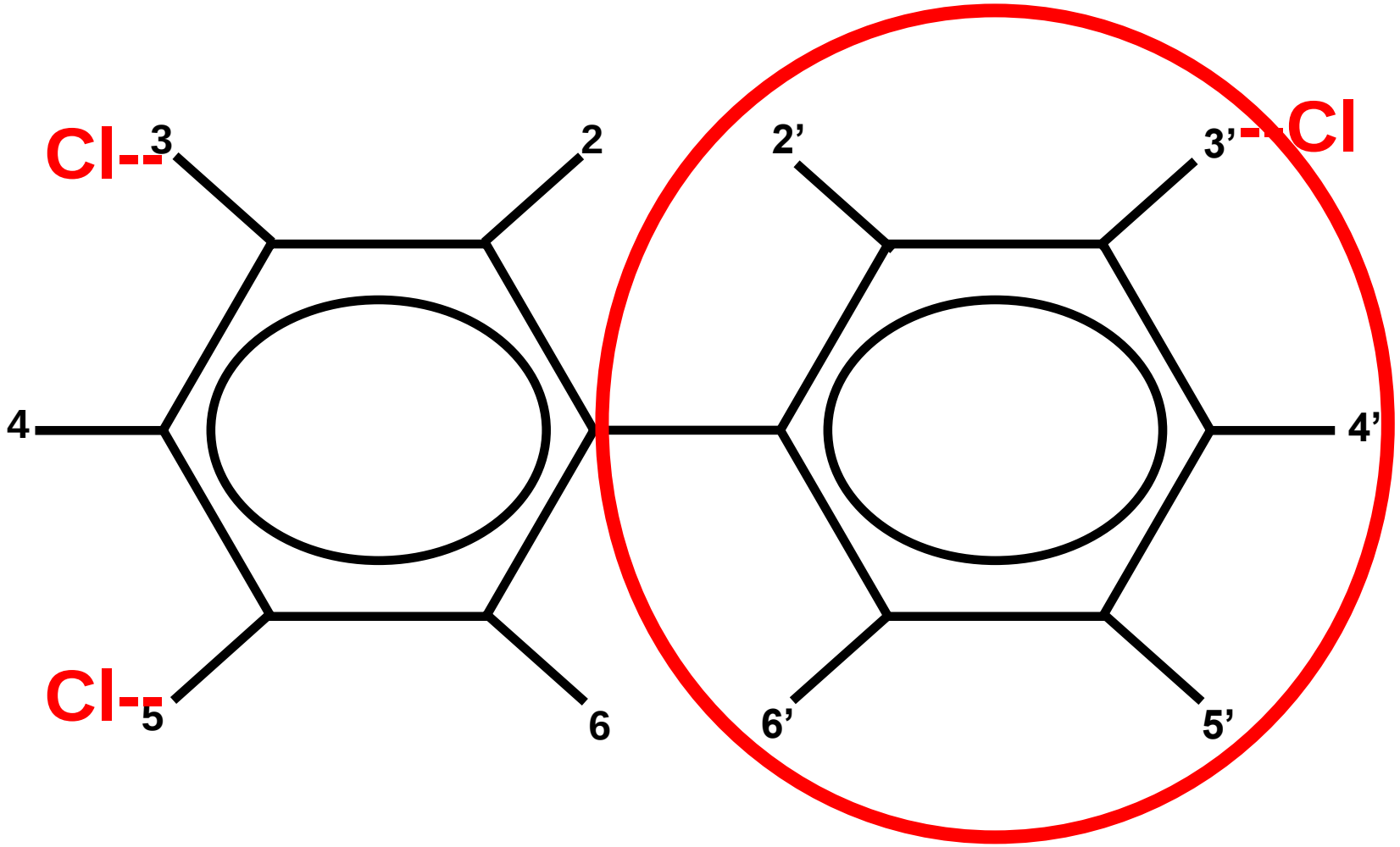


OVERVIEW

What are PCBs?

How are they analyzed?

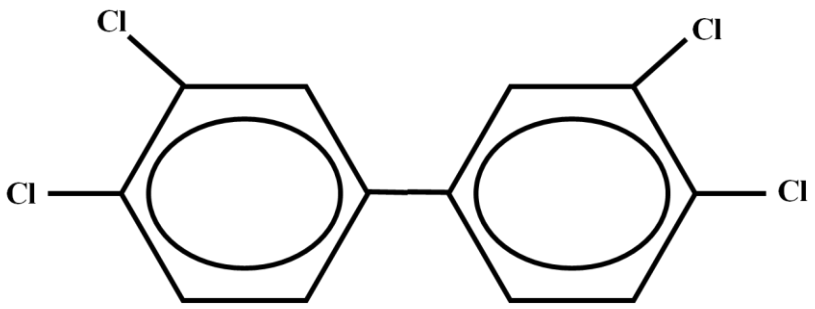
PCBs in air & building materials



Poly – Chlorinated - Biphenyls

PCB Chemistry Overview

- 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**



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

BZ 77 ***(Ballschmiter & Zell)***

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

Chlorinated Biphenyls by Homolog

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

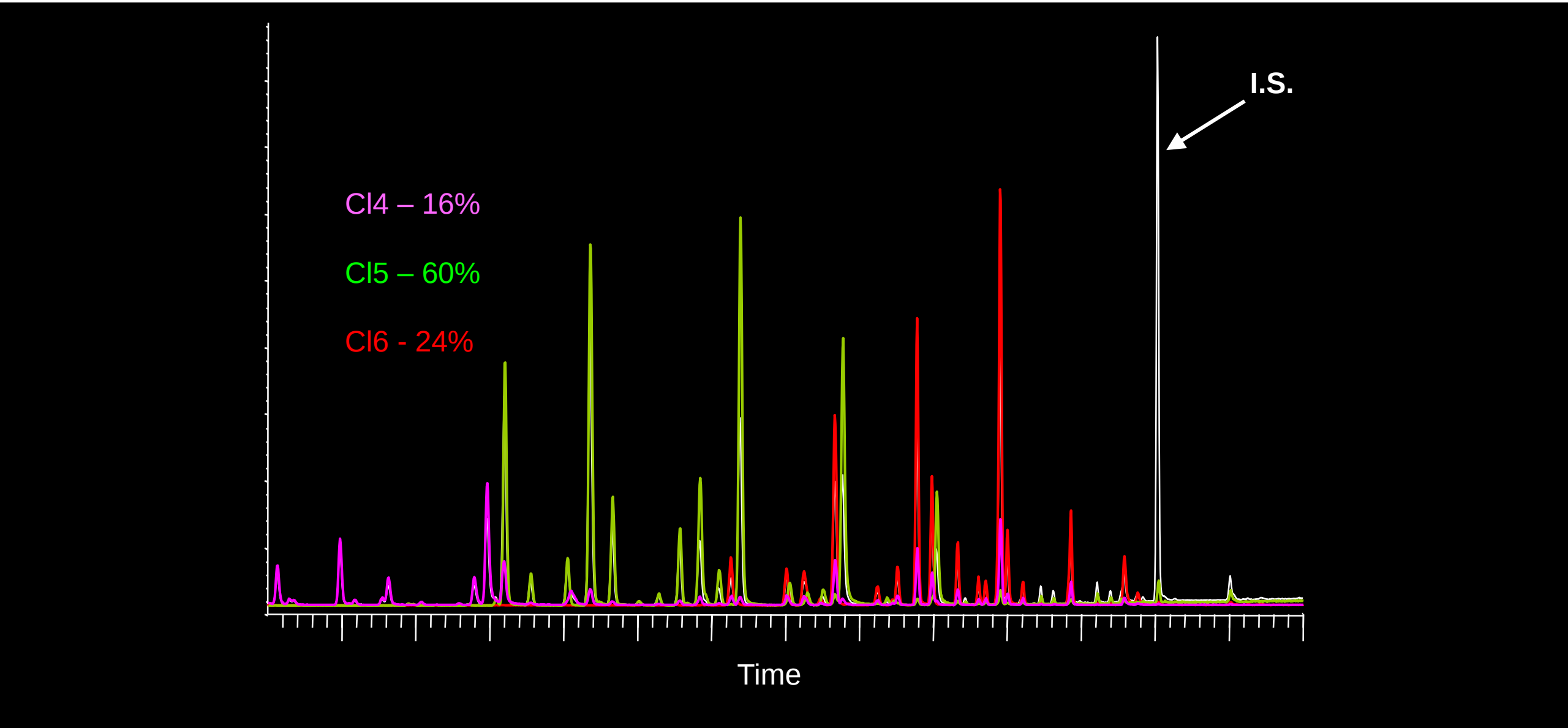
Technical grade mixtures of congeners, made by batch chlorination of biphenyl

Nine Aroclors:

1221, 1232, 1242/1016, 1248,

1254, 1260, 1262, 1268

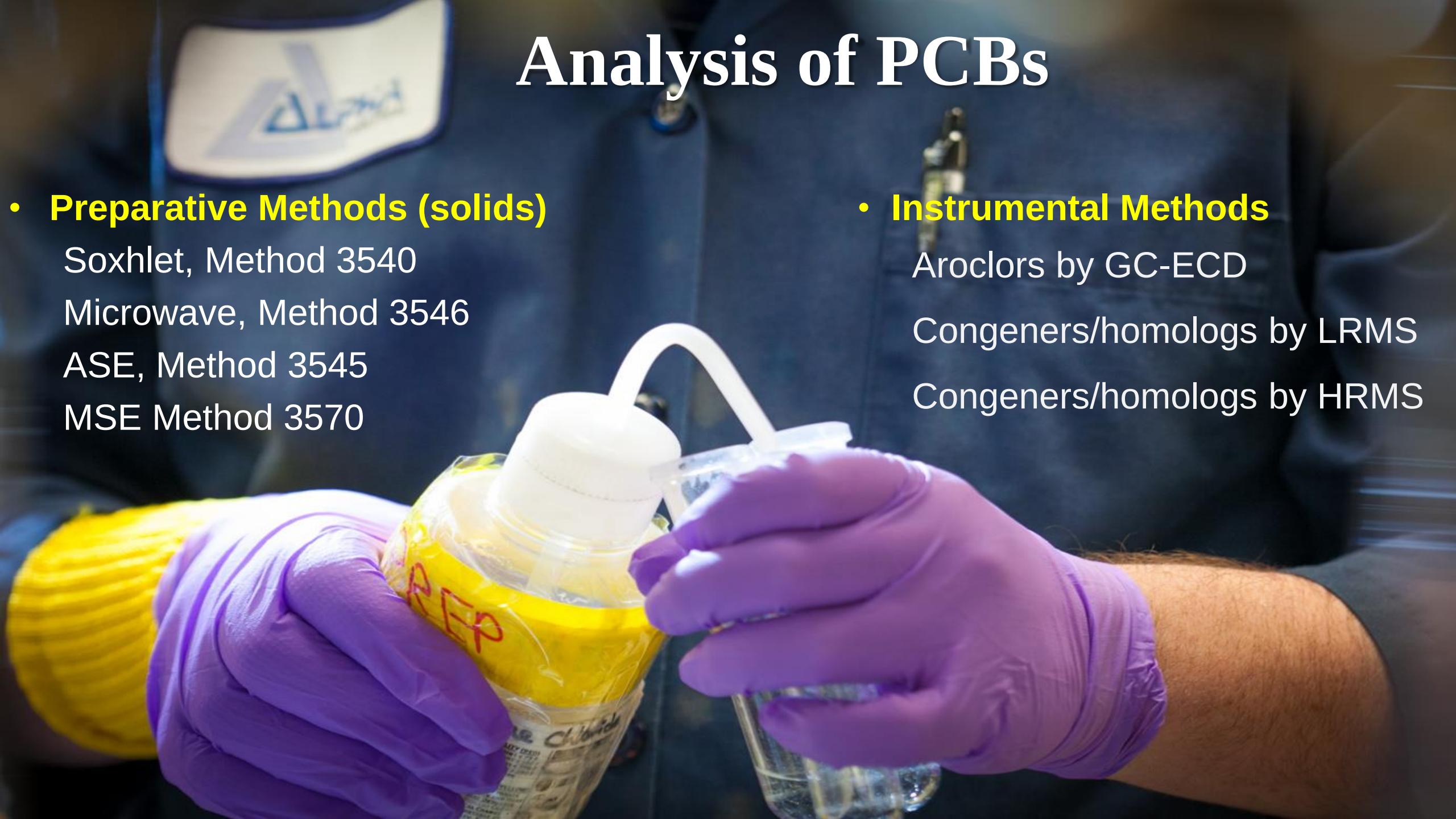
Total 1254 Composition



Analysis of PCBs

- **Preparative Methods (solids)**
  - Soxhlet, Method 3540
  - Microwave, Method 3546
  - ASE, Method 3545
  - MSE Method 3570

- **Instrumental Methods**
  - Aroclors by GC-ECD
  - Congeners/homologs by LRMS
  - Congeners/homologs by HRMS



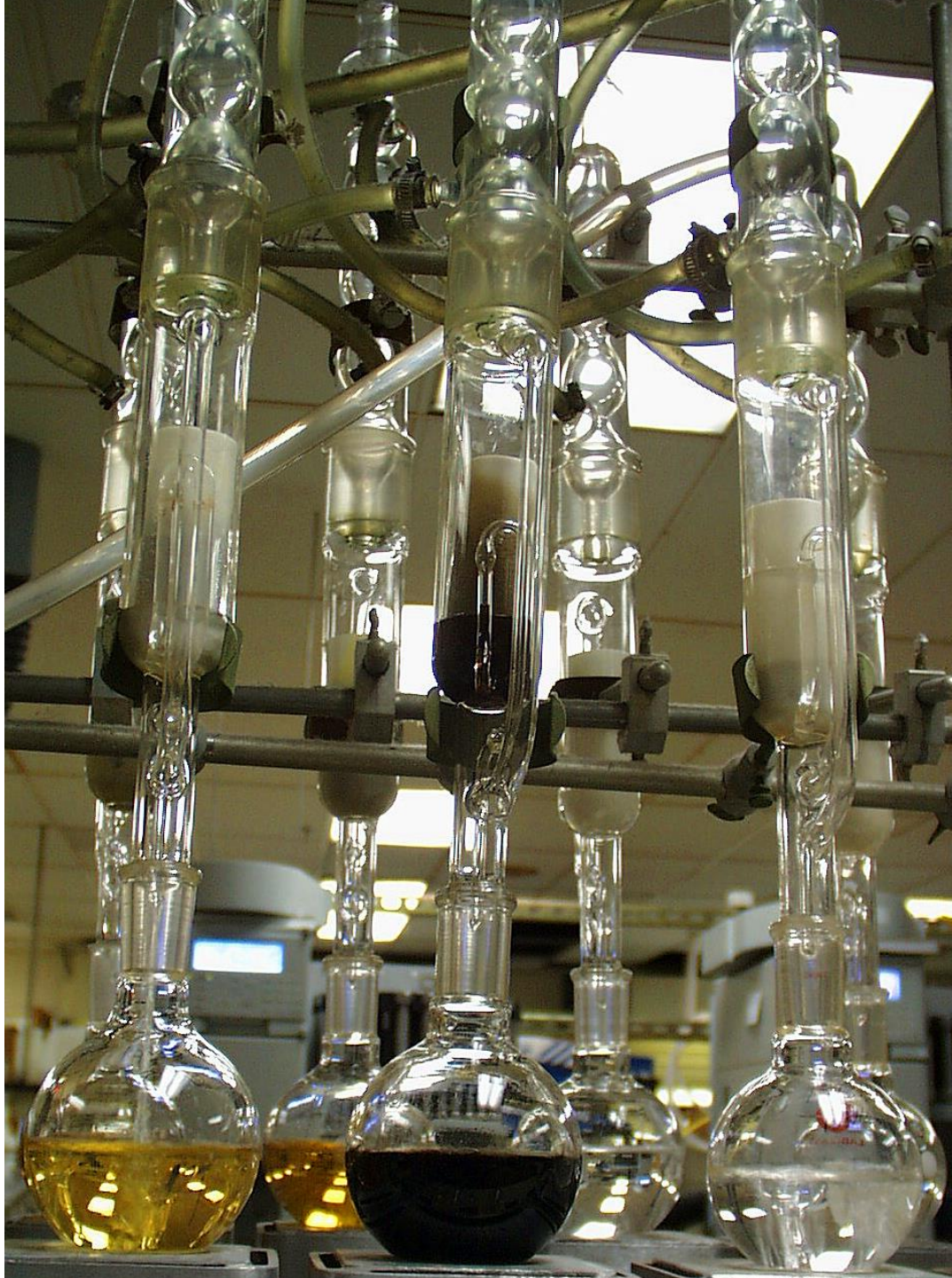
PCB Analysis at TSCA Sites

- 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.
  - Not much options with building materials
  - Study must be approved prior to sampling

Soxhlet Extraction

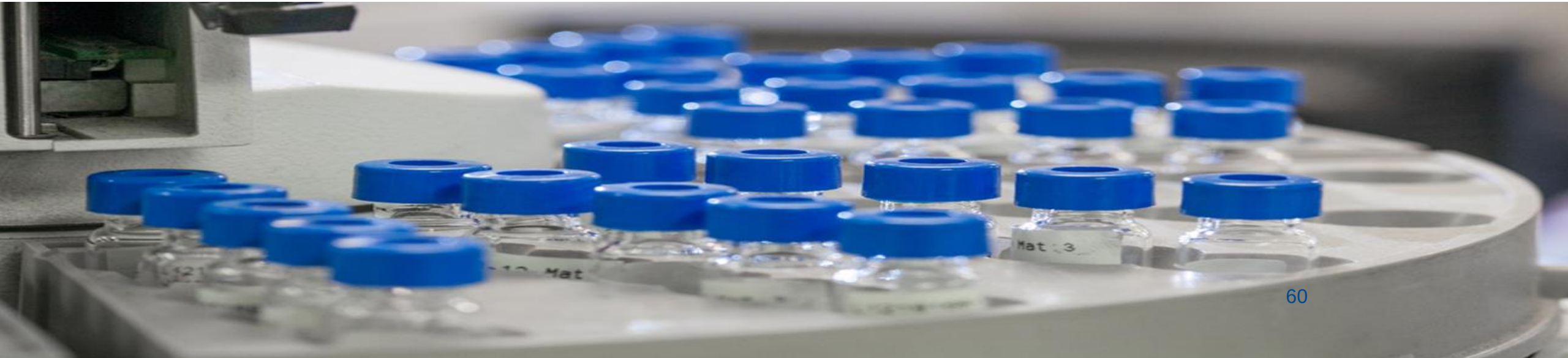
Dr. Franz Ritter von Soxhlet

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



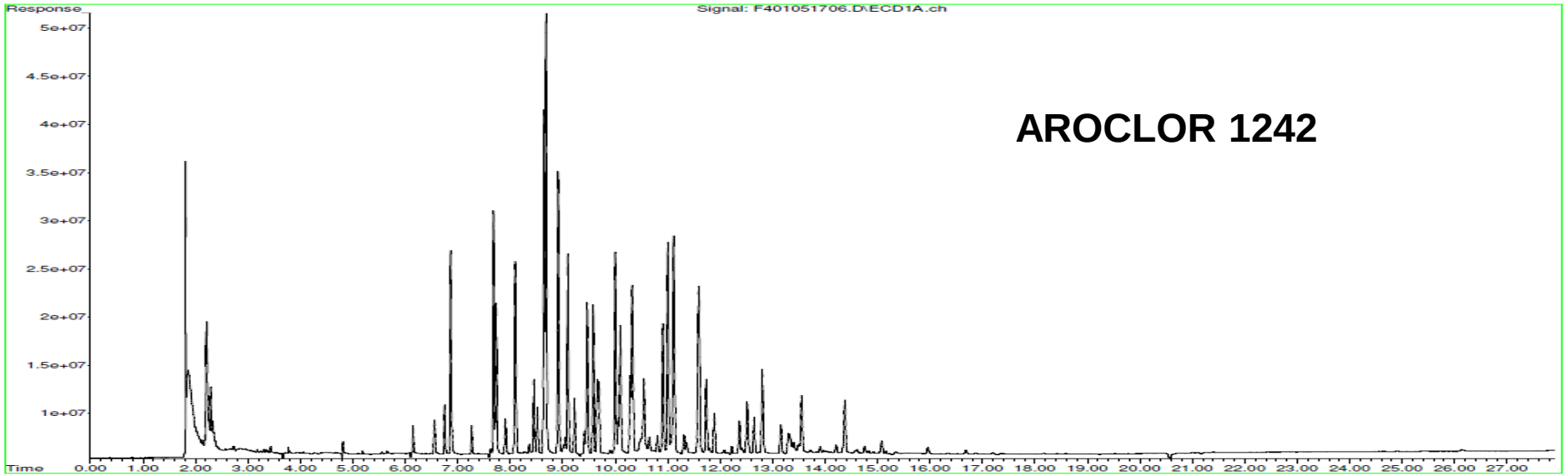
Traditional PCB Analytical Options

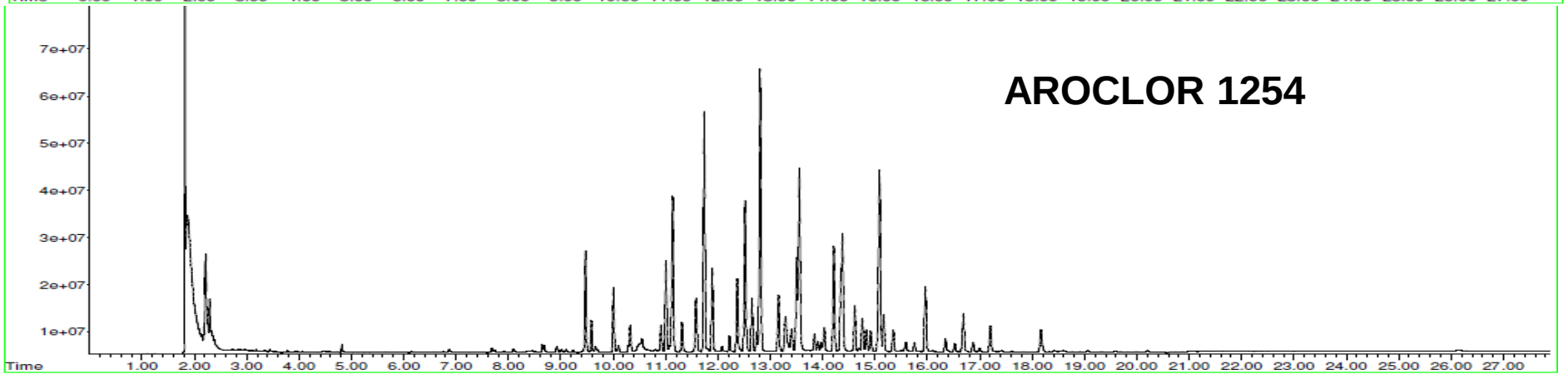
- Aroclor analysis
  - Gas chromatography w/electron capture detection (GC-ECD)
    - Common methods – EPA 8082, 608
- Congener and/or homolog analysis
  - Gas chromatography / high resolution mass spectrometry (GC/HRMS)
    - Common methods – EPA 1668
  - Full 209 congener list, subsets & homologs

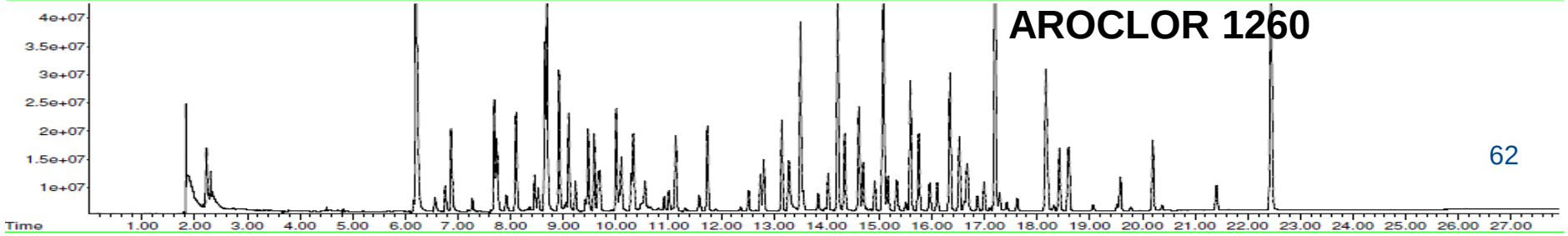


Analysis of PCB Aroclors by GC-ECD

- Qualitative analysis *(identifying aroclors present)*
  - GC retention time
    - Chromatographic pattern recognition
    - Identification of unique Aroclor peaks
    - Specific peak ratios
- Challenges
  - Mixtures, multi component analytes
  - Alteration of aroclor pattern in environment (i.e. “weathering”)
    - Some physical degradation, biological transformation
  - Quantitative issues:
    - Total PCBs by summation of aroclors?
    - Other ECD-sensitive compounds can interfere

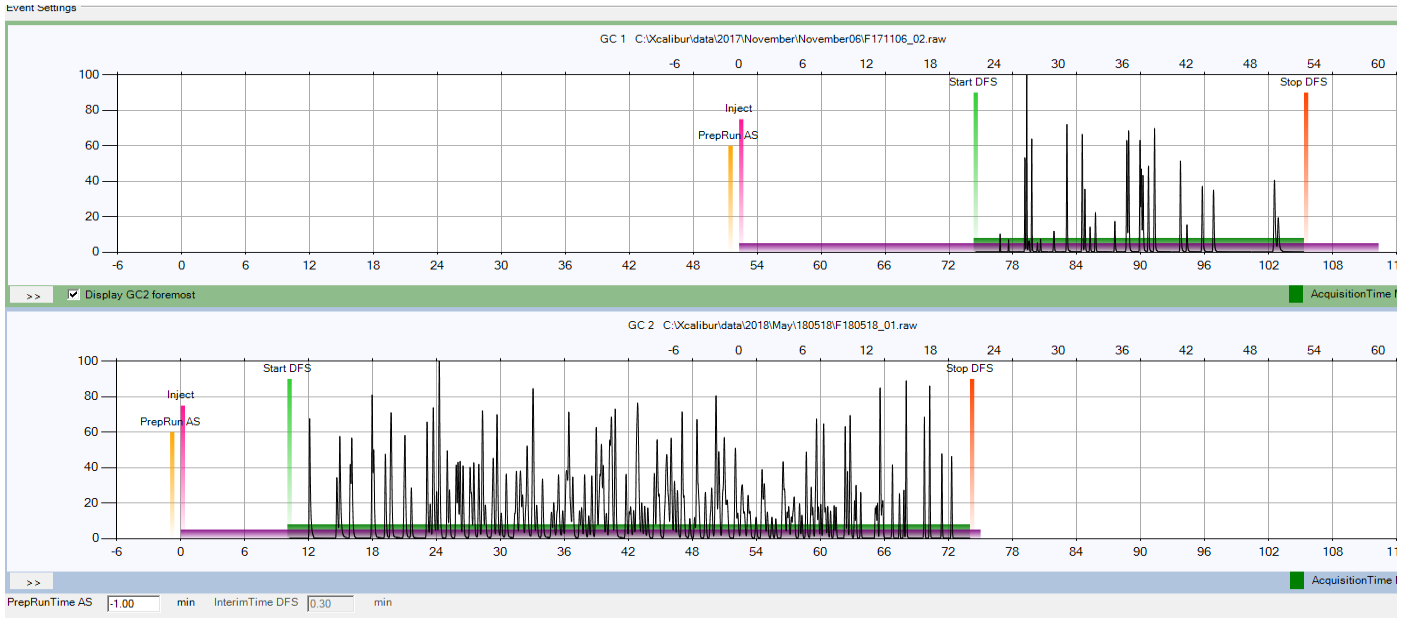

Response
Signal: F401051706.D\ECD1A.ch
AROCLOR 1242
Time


AROCLOR 1254
Time


AROCLOR 1260
Time

PCB Congeners/Homologs by GC / HRMS

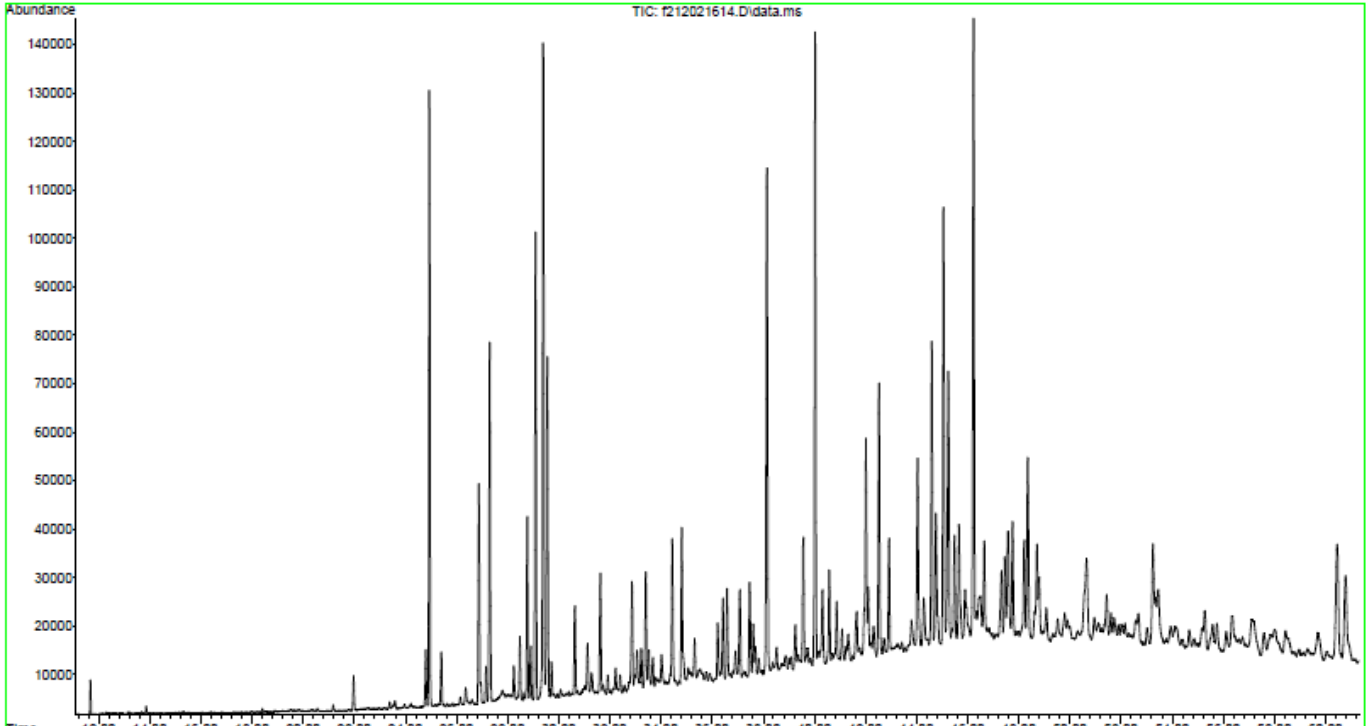
- Mass spectrometer provides qualitative certainty
  - Extremely sensitive
    - Dilutions required for contaminated samples
  - More costly than aroclor analysis

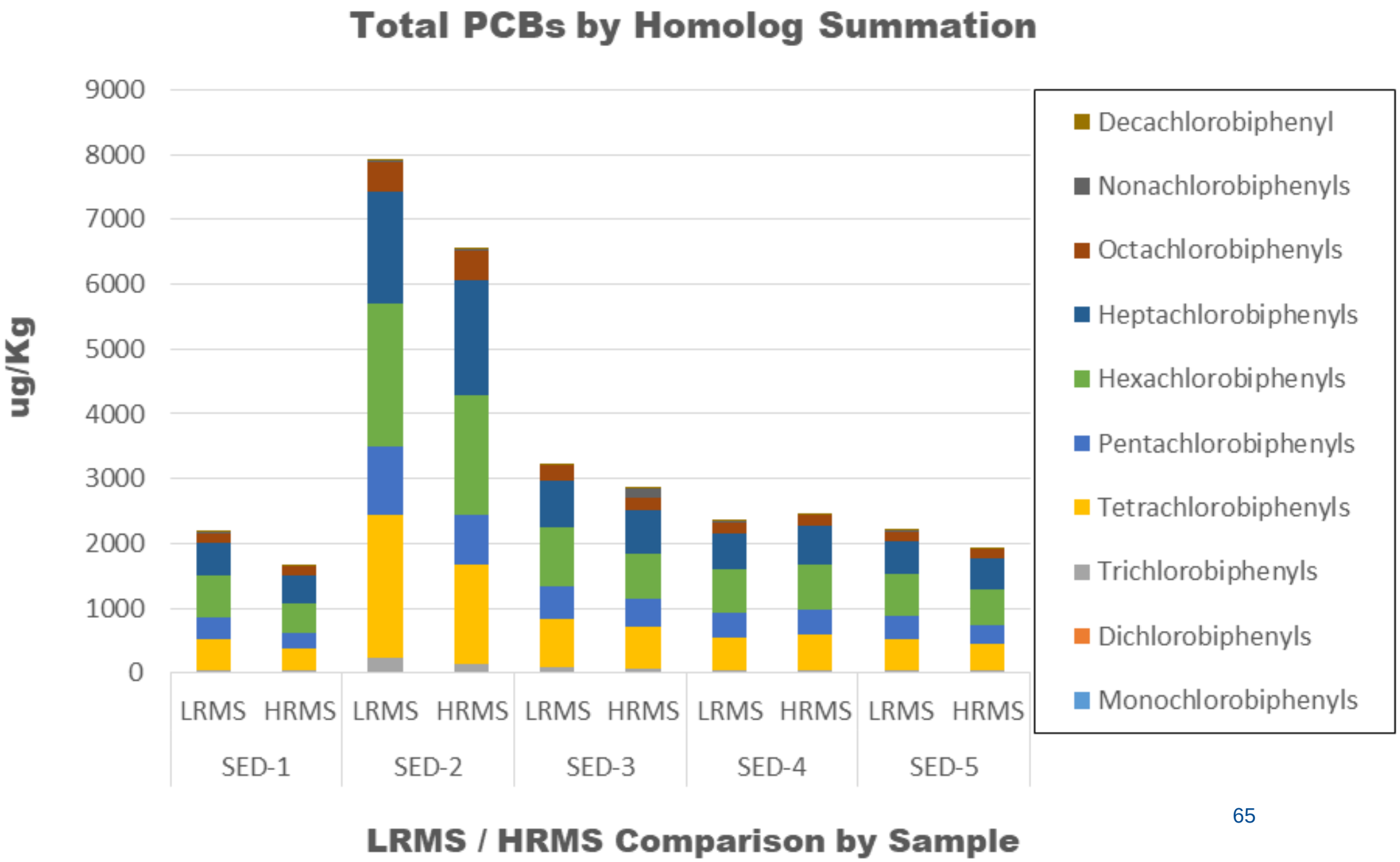


PCB Congeners/Homologs by GC / HRMS

- PCB analysis by GC / LRMS
  - LRMS vs HRMS?

- GC / LRMS applications
  - When you need more than aroclors…
  - Contaminated sites, sediments and/or complex PCB matrix
  - Passive sampling
  - Get regulatory approval




Total PCBs by Homolog Summation
ug/Kg
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
LRMS
HRMS
SED-1
SED-2
SED-3
SED-4
SED-5
Decachlorobiphenyl
Nonachlorobiphenyls
Octachlorobiphenyls
Heptachlorobiphenyls
Hexachlorobiphenyls
Pentachlorobiphenyls
Tetrachlorobiphenyls
Trichlorobiphenyls
Dichlorobiphenyls
Monochlorobiphenyls
LRMS / HRMS Comparison by Sample

PCB Analysis by GC/LRMS - History

- Method 625 (acid / base-neutral extractables, SVOCs)
  - PCB aroclors listed as potential analytes
- Method 680
  - Adopts / modifies the approach introduced in Method 625
  - Method was not widely used at the time
- NOAA Technical Memorandum NMFS-NWFSC-59, 2004
  - Replaces earlier document utilizing GC-ECD
- Method 8270, performance based, modified
- EPA currently working on a LRMS congener method

Representative PCB Analytical Reporting Limits

- Aroclors by GC-ECD
- Sensitivity
  - Aroclors
    - Aqueous: RL 0.25 ug/L
    - Soil/Sediment: RL 33.3 ug/Kg

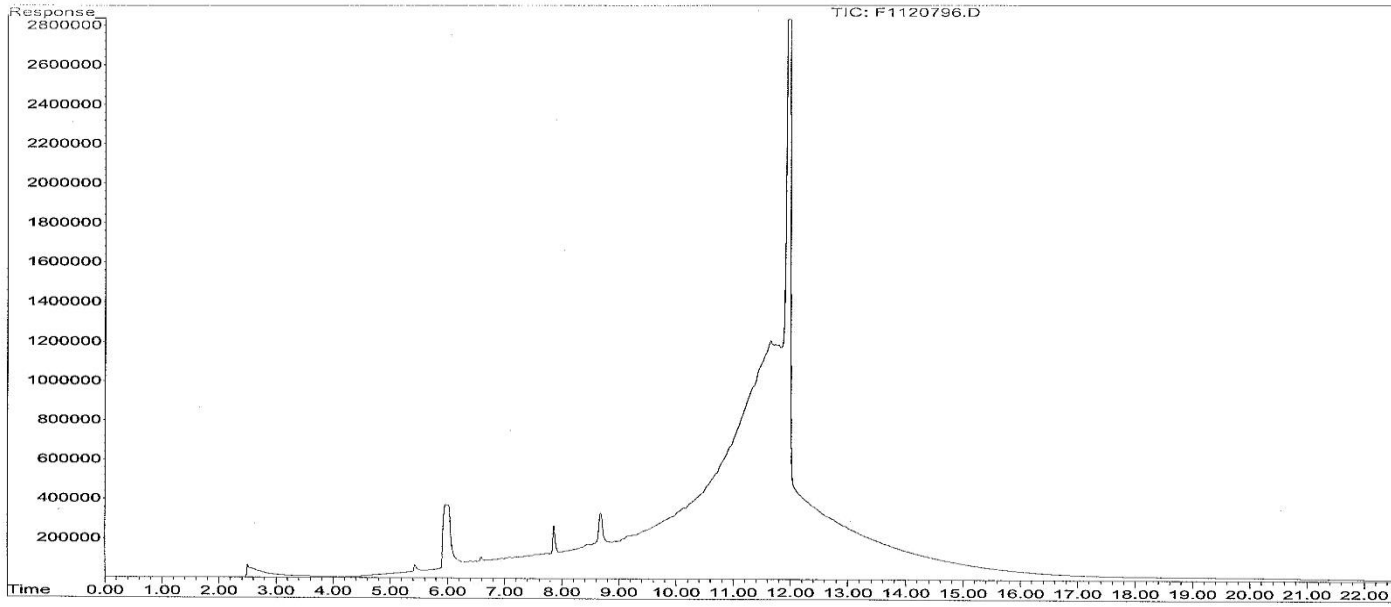
- Congeners/Homologs by GC-LRMS
- Sensitivity
  - Homologs
    - Aqueous: RL 0.5 ng/L
    - Soil/Sed/Tissue:RL 0.4 ug/Kg
  - Congeners
    - Aqueous: RL 0.5 ng/L
    - Soil/Sed/Tissue: RL 0.4 - 0.04 ug/Kg
    - Co-eluters

- Congeners/Homologs by GC-HRMS
- Sensitivity
  - Homologs
    - Aqueous: 10 pg/L RL
    - Soil/Sed/Tissue:1 ng/Kg RL
  - Congeners
    - Aqueous: 10 pg/L RL
    - Soil/Sed/Tissue: 1ng/Kg RL
    - Co-eluters

Analysis of Building- Related Materials

- Bulk product waste?
- Caulking & paints
  - Can be difficult matrix
  - Potential for high concentrations
- Concrete & bricks
  - Sealers
- Surfaces
  - Wipe testing, 100 CM^2
- All of the above – soxhlet extraction

```
File        :O:\Organics\DATA\ECD1-5890\2009\DEC\DEC07\F1120796.D
Operator    : ECD1:JR
Acquired    :  9 Dec 2009   3:02 pm using AcqMethod A1081760.M
Instrument  :   ECD1-5890
Sample Name: L0916458-66,42,2
Misc Info   : WG392179,WG390050
Vial Number: 96
```



PCBs in Air

Some considerations:

- Vapor phase & particulate borne
  - Sampling method includes both sources
- <u>Lesser chlorinated congeners potentially over-represented</u>
  - Aroclors?
- EPA TO-10A
  - FLOW RATE: 1.0 – 5.0 L/min, PUF cartridge
    - Sample Time 4 to 24 hours, Air Volume 240 to 7200 liters
  - Range is 0.01 to 10 mg/m3 for a 40-L air sample
- EPA TO-4
  - FLOW RATE: 200 – 280 L/min, PUF cartridge
    - Sample Time 4 to 24 hours, Air Volume 48 M3 to 403 M3
  - Reporting Limit ~ 0.0014 ug/M3 at 240 Liters for 24hrs

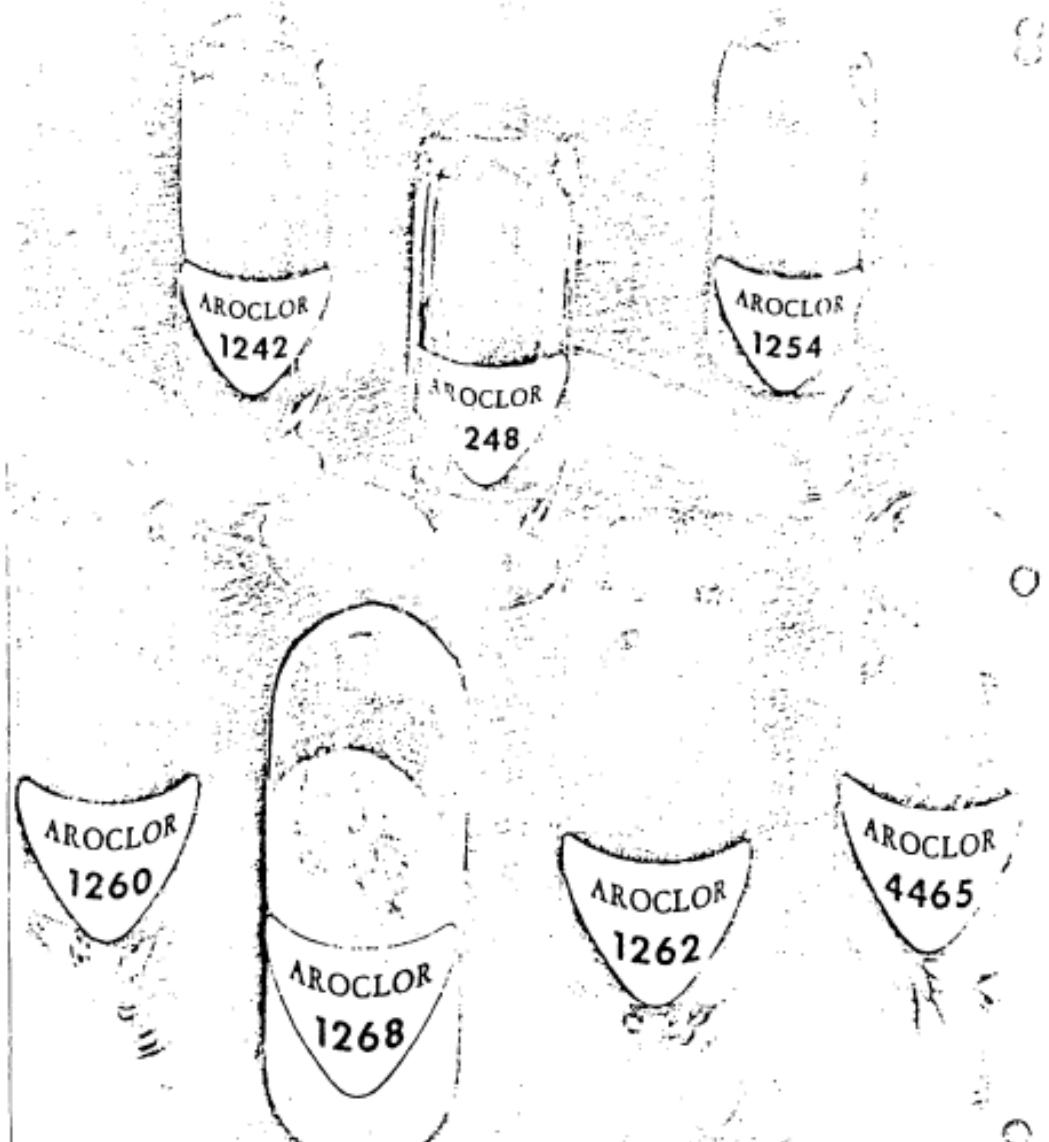
Jim Occhialini
jocchialini@alphalab.com
(508) 380-8618

THE aroclors...

aroclors for...

- fire retardant
- inert
- shear resistant
- heat stable
- lubricating
- physically "adjustable"
- adhesive
- non-volatile
- low cost
- thermoplastic

FILM FORMING
IMPREGNATING
INSULATING
HEAT TRANSFER
DEDUSTING
INERT MATRIXES
PLASTICIZING
BULKING
COATING
"TACKIFYING"
REDUCING VOLATILITY



Risk Assessment Techniques for Determining Clearance of Renovated Building Areas

Steve Zemba

Project Director

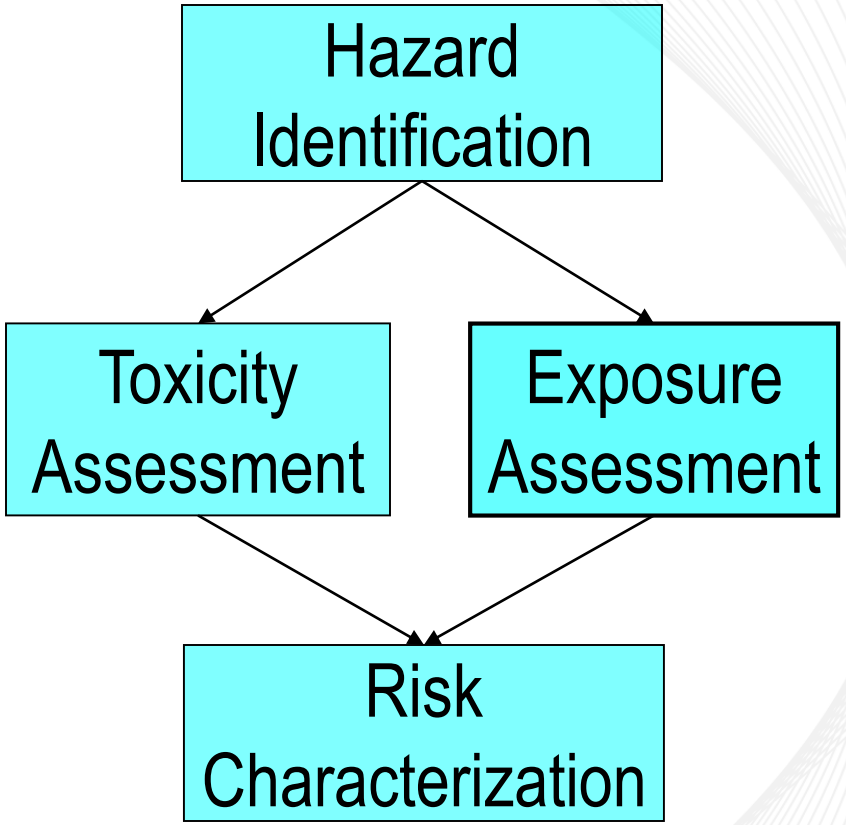
Sanborn, Head & Associates, Inc.

Health Risk Assessment Perspectives on PCBs in Building Materials and Indoor Air

Stephen G. Zemba, Ph.D., P.E.

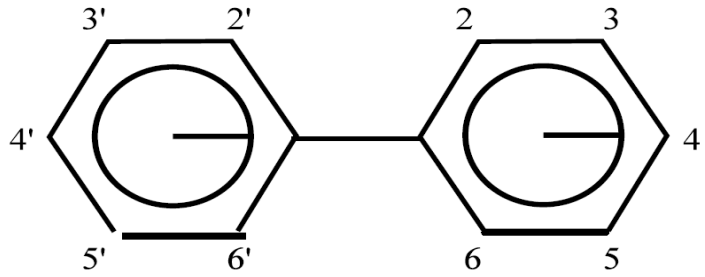
Sanborn Head & Associates

(SZemba@SanbornHead.com)



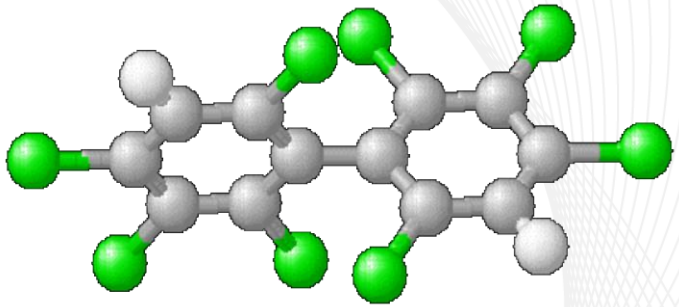
SANBORN HEAD 1993 - 2018

Overview



Polychlorinated biphenyls (PCBs)

- PCBs synthesized 1929, used in >1,000 products
- High occupational exposures (1930's & 40's) caused:
  - liver failure and chloracne
  - but not cancer (Golden & Kimbrough, 2009)
- Standards and guidelines
  - **OSHA** PELs: 500,000 – 1,000,000 ng/m^3
  - **U.S. EPA** Schools: 100 – 600 ng/m^3



Indoor Air Screening Levels

EPA's Exposure Levels for Evaluating Polychlorinated Biphenyls (PCBs) in Indoor School Air (ng/m^3)
(https://www.epa.gov/pcbs/exposure-levels-evaluating-polychlorinated-biphenyls-pcbs-indoor-school-air)

Age 1-<2	Age 2-<3	Age 3-<6	Age 6-<12	Age 12-<15	Age 15-<19	Age 19+
100	100	200	300	500	600	500

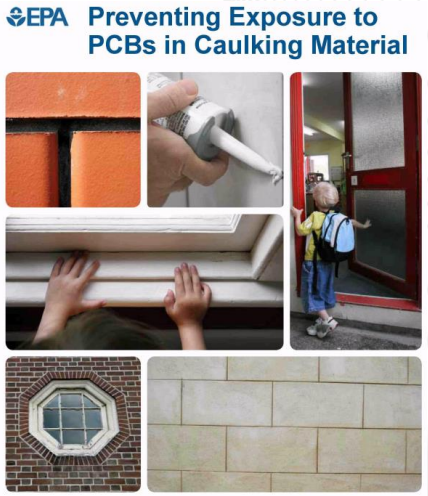
EPA's Regional Screening Levels (ng/m^3)
(https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables, TR=1E-06)

	High Risk (dust)	Low Risk (evaporated)	Lowest Risk (99.5% <4 Cl)
Residential	4.9	28	140
Industrial	21	120	610

SANBORN HEAD 1993 - 2018

PCB Concentrations Measured in Indoor Air

Location	Date	Concentrations (in ng/m^3)
Lederle Center, U-Mass Amherst	2006	220 – 640
Estabrook School, Lexington, MA	2010	300 – 1,800
Burke School, Peabody, MA	2011	260 – 740
New Bedford (MA) High School	2011	3 – 1,450
Boston (MA) Day Care Center	2012	110 – 200

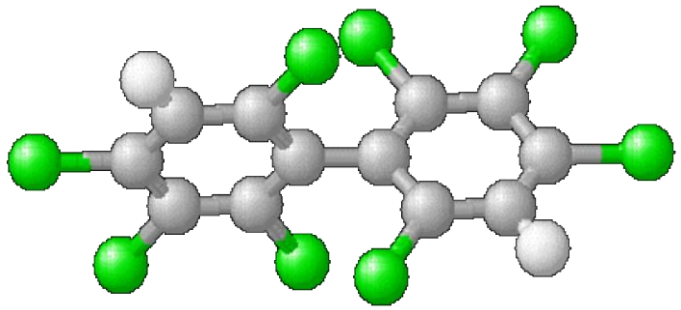


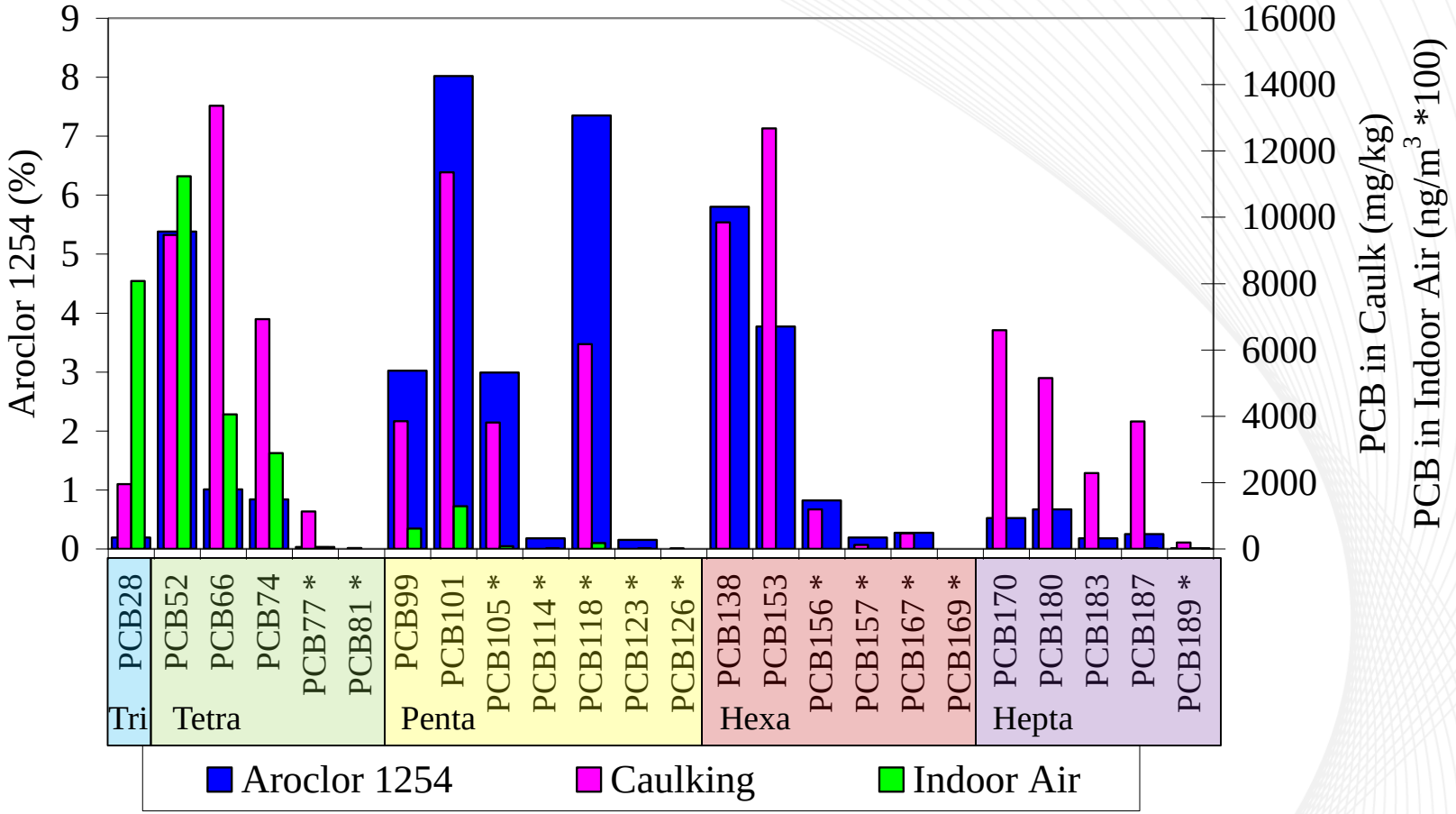
SANBORN HEAD 1993 - 2018

PCBs in Denmark Homes

Danish Health Protection Agency, 2012

- 83 PCB-contaminated apartments
- 27 congeners in caulking, indoor air, & serum
- Plotted against Aroclor 1254 composition



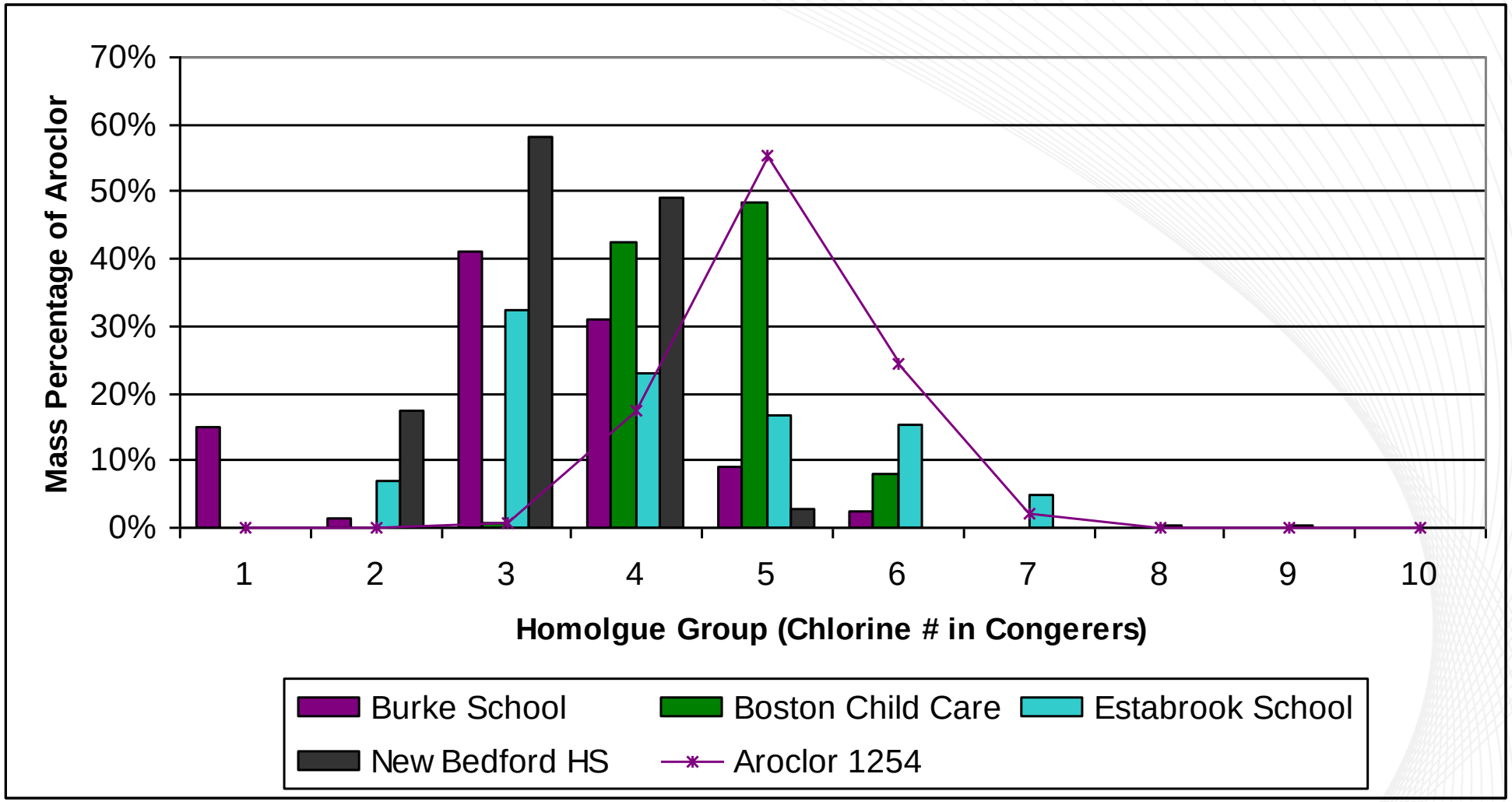


* indicates dioxin-like (co-planar) congener

SANBORN HEAD 1993 - 2018

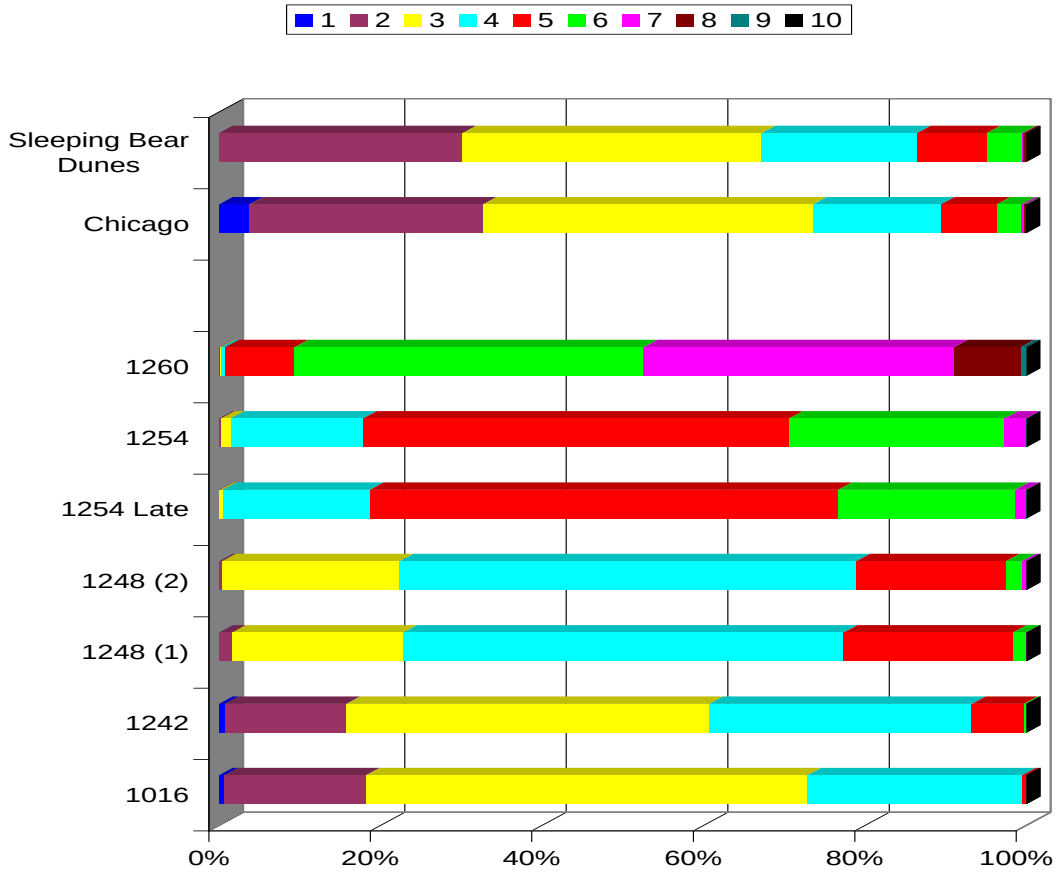
PCB Homologue Groups in Indoor Air in MA Schools

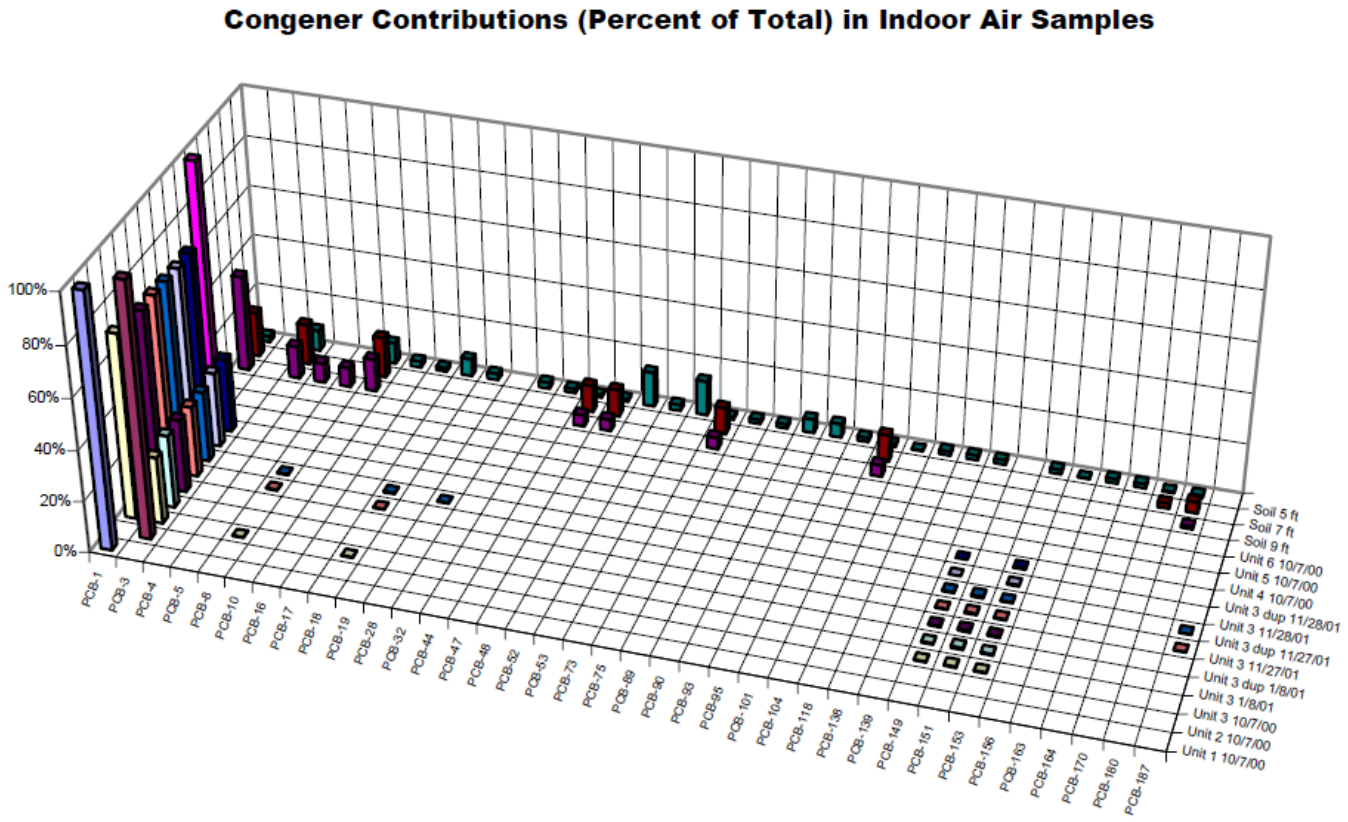
- Patterns shift to lower chlorinated congeners
- Child care center an exception



SANBORN HEAD 1993 - 2018

PCB Homologue Groups & Congeners in Air Sampling



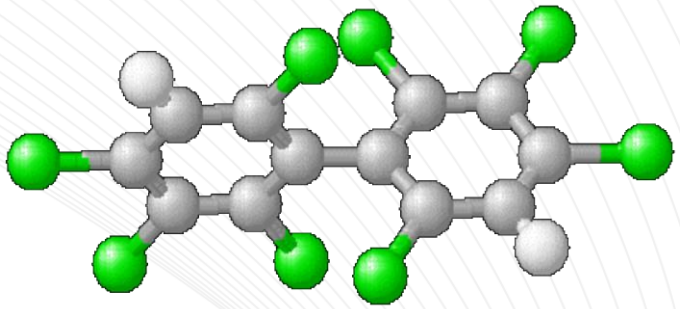


- Norström et al (2010) & ATSDR (2000)
- Outdoor air contains 0.04 – 0.5 ng/m^3 PCBs

- Davis et al (2002) vapor intrusion investigation
- Soils contain up to 160,000 mg/kg PCBs
- PCBs up to 220 ng/m^3, >97% mono PCBs

SANBORN HEAD 1993 - 2018

Toxicological Values for Risk Assessment



- Carcinogenic Potencies (kg-day/mg) (EPA IRIS)
  - High risk/persistence 1 to 2
  - Low risk/persistence 0.3 to 0.4
  - Lowest risk/persistence 0.04 to 0.07
- "Non-cancer" Reference Doses (ng/kg-day) (EPA IRIS)
  - Aroclor 1254 20
  - Aroclor 1016 70
  - 2,3,7,8-TCDD 0.0007
- Neurological Equivalents Reference Doses (ng/kg-day) (Simon, 2007)
  - Aroclor 1254 8
  - Aroclor 1016 70

Case Study #1: "Brownfield" Redevelopment

- Mill building conversion to condominiums
  - PCB-impregnated floors
  - Renovation workers at risk?

- Exposure estimate
  - Assume 3.3 mg/m^3 of dust (high level)
  - 5.8 mg/kg PCB in dust
  - Yields exposure to 20 ng/m^3 of PCBs

- Acceptable/safe levels
  - OSHA PEL: 500,000 $\mu g/m^3$
  - More recent studies: 10,000 $\mu g/m^3$

Case Study #2: Child Care Center

- PCB concentrations measured in indoor air
  - 110 – 200 ng/m^3 at time of study
  - > 300 ng/m^3 previously
  - Exceed EPA guideline of 100 ng/m^3 for 1-2 and 2-3 yr-olds
- Questions
  - Should center be closed?
  - What about < 1 yr-olds?

- Issues and perspectives
  - Homologue profile resembles Aroclor 1254
  - EPA guidelines derive from toxicity study in monkeys
    - Safety factor of 250 applied
    - Humans may be less sensitive to PCBs than monkeys
  - Nursing infants receive ~ 20 times more exposure than EPA's Reference Dose

Case Study #3: "Brownfield" Redevelopment

- Industrial building conversion to luxury apartments
  - PCB-impregnated concrete floors to remain in place
  - Future residents at risk?

- Exposure estimate
  - Measured volatilization rate
  - Indoor air model 44 ng/m^3
  - Homologue pattern indicates low-risk PCBs
- Acceptable/safe level 98 ng/m^3 based on EPA school methodology
- Mitigation through encapsulation (concrete layer plus epoxy)
- Confirmatory indoor air samples ND

Summary

- Levels of PCBs measured in indoor air due to building material sources have been near or greater than recommended exposure levels
- Actual risks to health may be substantially overestimated (or conversely, exposure guidelines are highly protective)
- PCBs found in indoor air emphasize the less chlorinated, and generally less toxic, congeners of the parent mixtures
- PCB-containing building materials can remain a source of PCBs to indoor air for many years
- PCB risk assessment methods are uncertain, could be improved, and will likely evolve

References

ATSDR (2000). Toxicological Profile for Polychlorinated Biphenyls. Atlanta, GA: Agency for Toxic Substances and Disease Registry.

Davis BJ, Beach M, Wade, Klein AK and Hoch K. (2002). Risk Assessment of Polychlorinated Biphenyls (PCBs) in Indoor Air. The Toxicologist, Supplement to *Toxicological Sciences* 66:106. Abstract number 516.

EH&E (2011). Site-specific assessment for Polychlorinated Biphenyls, Estabrook School, Lexington, MA. Environmental Health & Engineering, Needham, MA.

EPA (2009). PCB Exposure Estimation Tool, Version 1.1, U.S. Environmental Protection Agency, October 2, 2009.

Kohler M, Zennegg M, and Waeber R (2002). Coplanar Polychlorinated Biphenyls (PCB) in Indoor Air. *ES&T* 36(22):4735-4740

Norström K, Czub G, McLachlan M, Hu D, Thorne P, and Hornbuckle K (2010). External exposure and bioaccumulation of PCBs in humans living in a contaminated urban environment. *Environ Int* 36(8): 855–861.

Simon T, Britt JK and James RC (2007). Development of a neurotoxic equivalent scheme of relative potency for assessing the risk of PCB mixtures. *Reg Tox Pharm* 48:148-170.

Öberg, T (2001). Prediction of physical properties for PCB congeners from molecular descriptors. *Internet Journal of Chemistry* 4, Article 11.

PCB Abatement Techniques for Complicated Building Projects

Ross Hartman

Executive Vice President

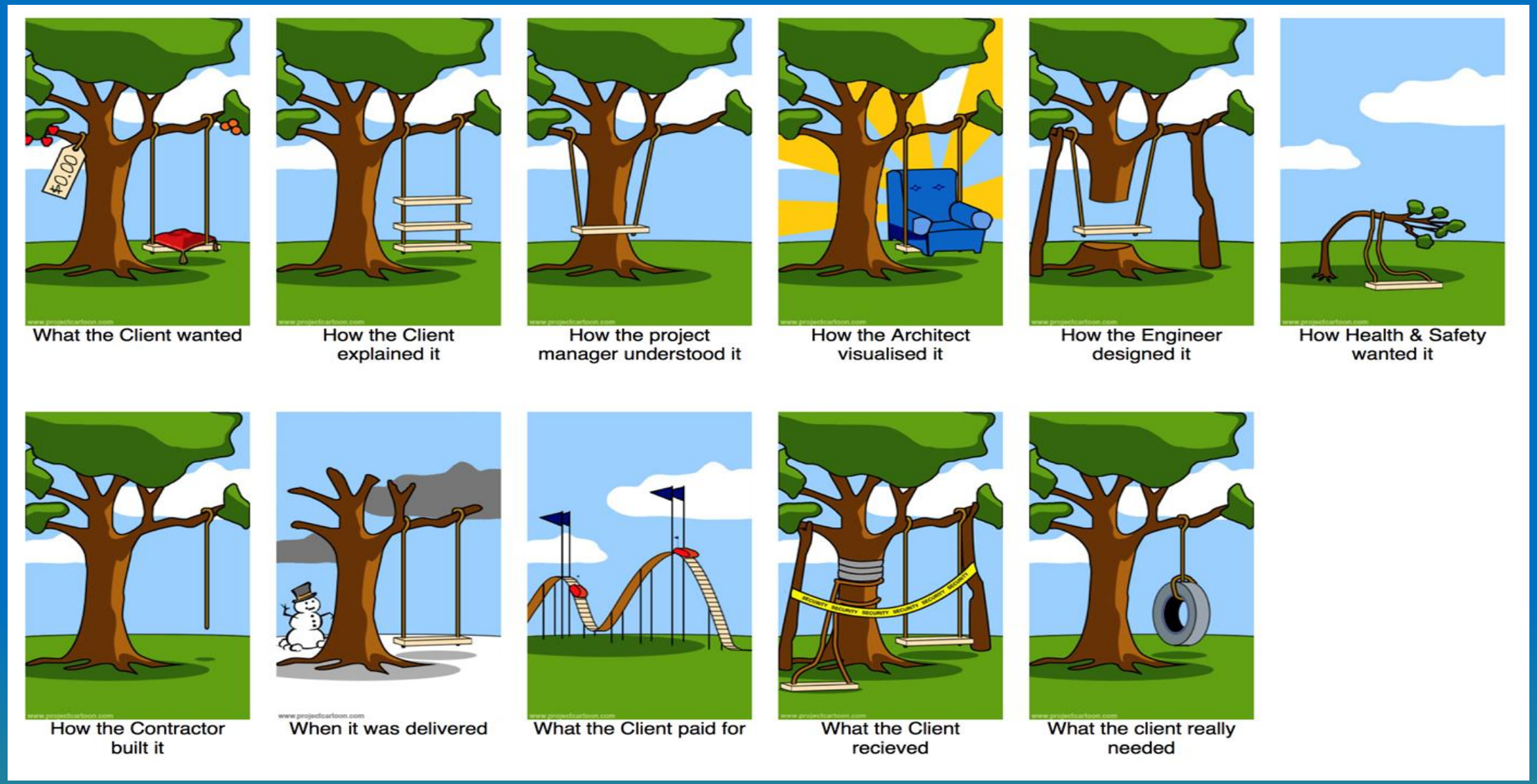
Strategic Environmental Services, Inc.

STRATEGIC
ENVIRONMENTAL SERVICES

PCB & Remediation: Options & Strategies

STRATEGIC ENVIRONMENTAL SERVICES

Clear State Of PCBs



Approach

- Standard of Care for Contractors
  - Public vs private bids
  - Specifications vs Design Build
  - BMP for contractors are typically outlined…but to what degree
    - Based on each company policy and procedures

Approach

- Type of disposal plan will impact cost and project direction
- Scope of Work should coincide with EPA disposal option
- Design Specifications typically have many conflicting agendas
    - Owner – Architects – Consultants – Contractors
    - Lender and insurance

Bulk Product

- Cost Effective and no need for EPA involvement
- No contractor work plan – although not bad practice to have the contractor develop one
- Good option for demolition and window replacements
- Complications around segregation of BPW and Remediation Waste
- Confusion around cut lines into substrate and clearance sampling

  - Window replacements – Jump the frame
  - Contractor safety

STRATEGIC
ENVIRONMENTAL SERVICES

Contractor Work Plan

- Acknowledges the items in EPA approval
- Provides a clear detailed outline of work activities
  - Approach – Disposal – Decon

- Required for SIP and Risk Based Options
  - Must be comprehensive
  - Can delay start of the projects
  - Should provide insight in gaps between plan and approval

STRATEGIC
ENVIRONMENTAL SERVICES

Self-Implementing

- Approved SIP
  - Allows for comprehensive and competitive bids with least likely scenario to generate change orders
  - Firm direction on clearance sampling – Contractor can build into time to complete project
  - Good option for re-occupancy or minimize long term liability having EPA approval
  - Soil issues would likely trigger this direction based on volume – which could lead to other questions

STRATEGIC
ENVIRONMENTAL SERVICES

Risk Based

- Typically involves similar process as a SIP with Risk Based approach to leave material in-place (or cap)
- Usually involves renovation projects with structural issues
- Encapsulants
  - SIKA products – Sika Guard
  - 62 Durable 2 part epoxy – multi colors
  - 760 is a clear coat – water based

- Prep of surface is key
- Caution of pre-treatment
- Application – roll vs spray

STRATEGIC ENVIRONMENTAL SERVICES

Chemicals For Decon

- Approved PODFs (performance-based organic fluid)
  - Kerosene, Diesel Fuel, Terpene Hydrocarbons (turpentine)

- Alternate Decon Materials
  - Capsur – aqueous based solvent – suspend pcbs
  - AMTS (activated metal treatment)
    - Reductive dichlorination

STRATEGIC
ENVIRONMENTAL SERVICES

Paint & PCBs

- Paint on walls
- Difficult to assess which option for abatement
  - Scrap, Power wash, sandblast, Dry Ice, chemical

- Care to not imbed paint into porous surfaces
- Chemical may lead to indoor air issues
- Cost analysis of bulk disposal vs manual removal

Paint & PCBs

Painted Steel

- Considered a porous surface on a non-porous surface – 761.79
- RCRA /TSCA Issue unless TCLP falls out
- Scrap Metal Recovery Ovens (Transformers)
- Smelters – No known approved facilities
- Paint On Wood (Mills)

Waste Approach

Establish Waste Profile

- Samples (bulk or TCLP)
- If the waste doesn't pass a TCLP, as required by disposal
  - remediation waste
- When removing PCB caulk (with significant concentrations) only without substrate, it may fail TCLP

STRATEGIC
ENVIRONMENTAL SERVICES

Waste Approach Continued

Obtain Approvals

- Questions may be asked about other hazards in material

Storage & Shipment

- PCB Bulk Product Waste
  - non-hazardous material Under 761.62 does not require hazardous waste manifests or labeling
- Paperwork
- MA – Authorization paperwork from DEP

STRATEGIC ENVIRONMENTAL SERVICES

STRATEGIC
ENVIRONMENTAL SERVICES

THANK YOU

Moderated Discussion

Moderator: **Frank Ricciardi,** *Weston & Sampson*

Panelists:

- **Ross Hartman,** *Strategic Environmental Services*
- **Gary Hunt,** *TRC*
- **Jim Occhialini,** *Alpha Laboratory*
- **Kim Tisa,** *U.S. EPA Regional PCB Coordinator*
- **Steve Zemba,** *Sanborn, Head & Associates Inc.*