PCBs in Indoor Air? Now What?

(Down the Rabbit Hole We Go!)

March 23, 2022

Timothy J . Snay, LSP, LEP



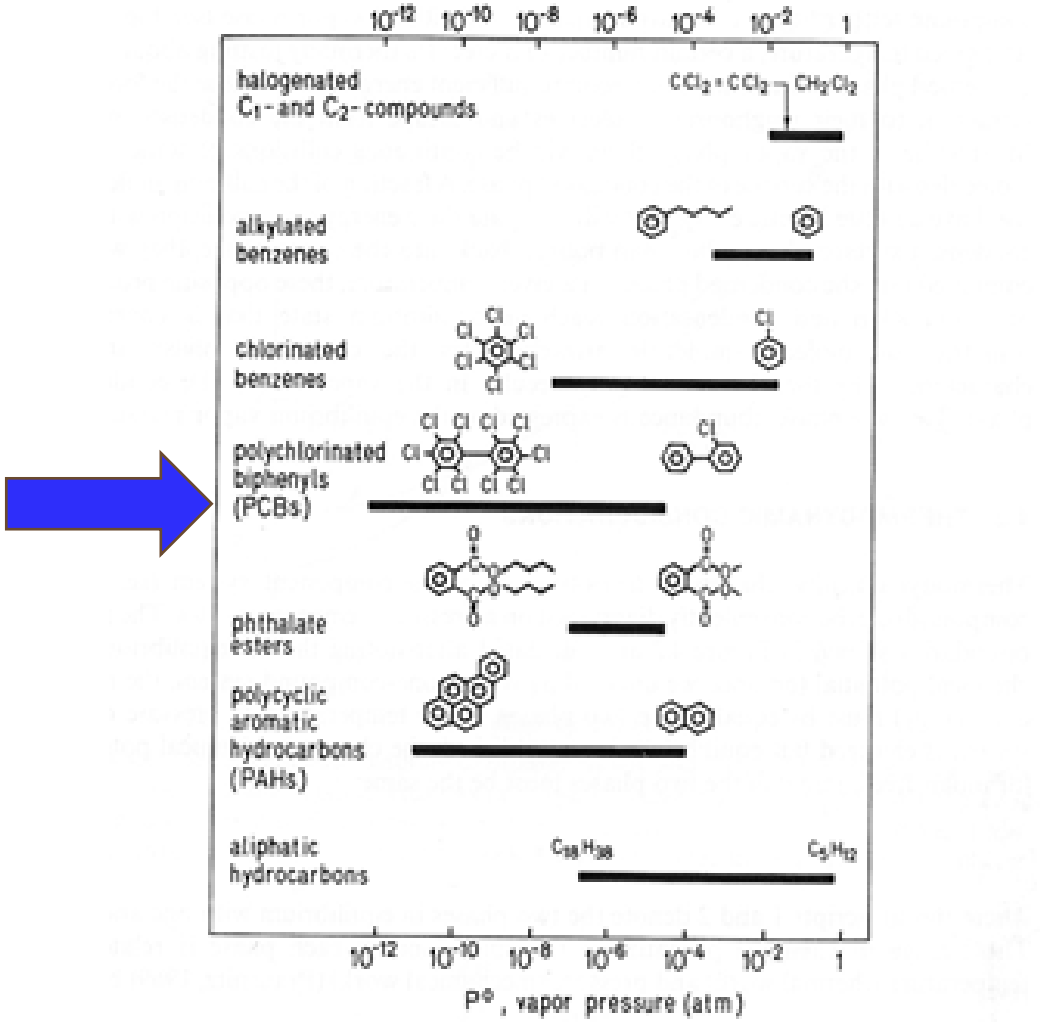

SANBORN HEAD

NEWMOA

How Volatile are PCBs?

- PCBs have historically been considered “non-volatile”. Let’s compare vapor pressures to gain some perspective:

Compound	Vapor Pressure (mm Hg)
Benzene	95
Trichloroethene	69
Mercury	0.002
Monochloro PCBs	0.0083
Dichloro PCBs	0.0018
Tetrachloro PCBs	0.00009
Octachloro PCBs	0.0000002

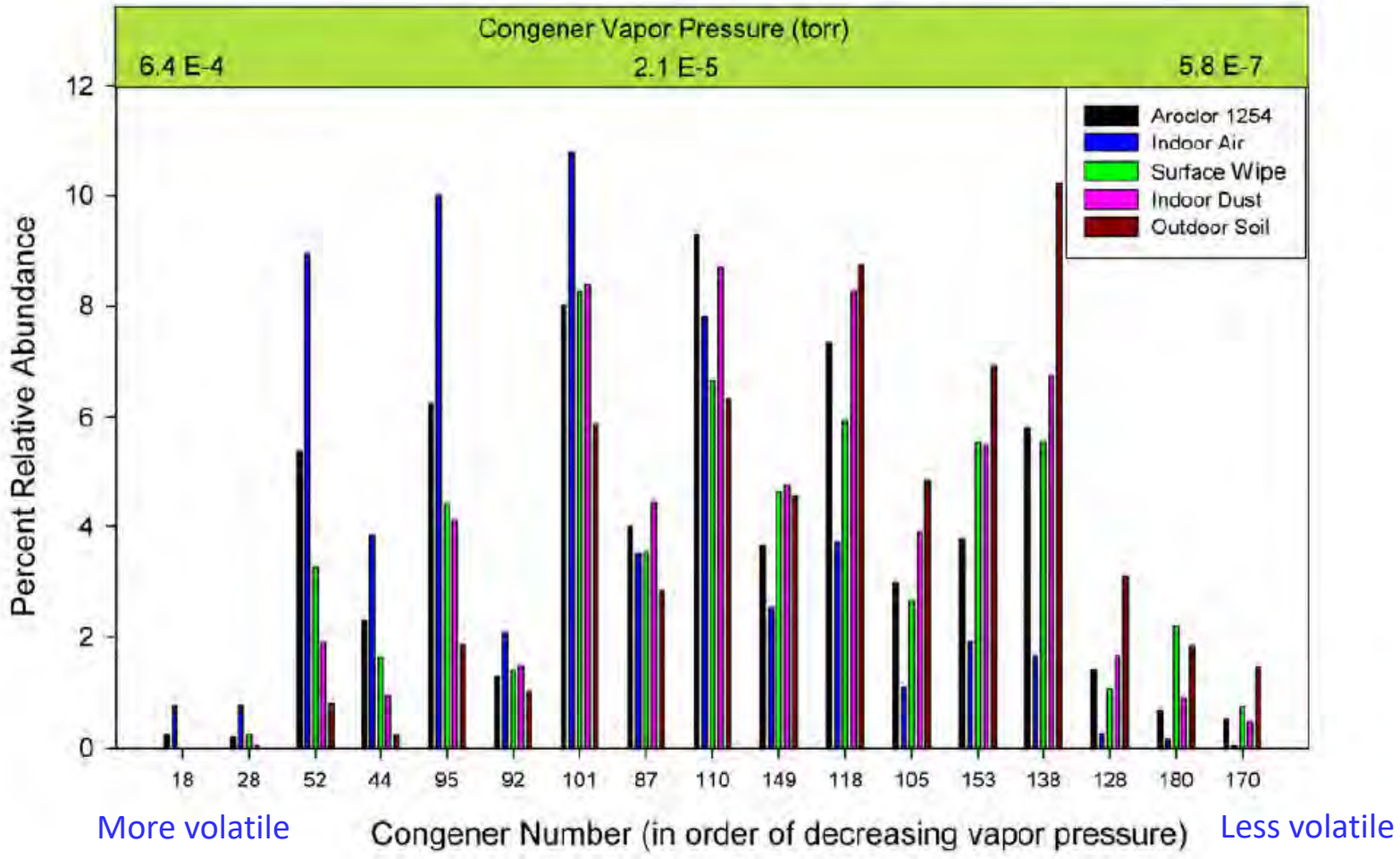


4.1 Ranges at 25°C in saturation vapor pressure (P°) values for some important ss of organic compounds.

SANBORN HEAD

How Volatile are PCBs?

From U.S. EPA's *Polychlorinated Biphenyls (PCBs) in School Buildings: Sources, Environmental Levels, and Exposures* (September 30, 2012)



SANBORN HEAD

What are “Safe” Concentrations of PCBs In Indoor Air?

It Depends…

What does the term “safe” mean?

- Cancer Risk vs. Other Health Effects
- What risk data are available?
  - Risk data for Aroclor mixtures is limited
    - U.S. EPA has reference doses (non-cancer risk) and cancer potency values for high and low toxicity mixtures of PCBs. Aroclor 1016 is considered a low toxicity mixture whereas Aroclor 1254 is considered a high toxicity mixture.
    - Toxicity of the 12 “dioxin-like” congeners vs. Aroclors?
    - The lesser chlorinated PCBs are more volatile….

What are "Safe" Concentrations of PCBs In Indoor Air?

It Depends…

- In 2012, U.S. EPA issued Exposure Levels for Evaluating PCBs in Indoor Air (ng/m^3) based on PCB exposure to below the oral reference dose (RfD) of 20 ng/PCB/kg body weight per day:

Public Health Levels of PCBs in School Indoor Air (ng/m3)

Assuming a background scenario of no significant PCB contamination in building materials and average exposure from other sources, these concentrations should keep total exposure below the reference dose of 20 ng PCB/kg-day.

Age 1-<2 yr	Age 2-<3 yr	Age 3-<6 yr	Age 6-<12 yr Elementary School	Age 12-<15 yr Middle School	Age 15-<19 yr High School	Age 19+ yr Adult
70	70	100	300	450	600	450

- Current Version

Age: 1-<2 yr	Age: 2-<3 yr	Age: 3-<6 yr	Age: 6-<12 yr elementary school	Age: 12-15< yr middle school	Age: 15-<19 yr high school	Age: 19+ yr adult
100	100	200	300	500	600	500

https://www.epa.gov/pcbs/exposure-levels-evaluating-polychlorinated-biphenyls-pcbs-indoor-school-air

SANBORN HEAD

What are “Safe” Concentrations of PCBs In Indoor Air?

It Depends…

- In 2021, U.S. EPA issued Regional Screening Levels for the “Composite Worker” and the “Resident” (based on an Excess Lifetime Cancer Risk of **$1x10^{-6}$**).

Composite Worker: 21 ng/m^3 or 610 ng/m^3

Resident: 4.9 ng/m^3 or 140 ng/m^3

Contaminant		Carcinogenic Target Risk (TR) = 1E-06	Carcinogenic Target Risk (TR) = 1E-06
Analyte	CAS No.	Carcinogenic SL TR=1E-06 (ug/m^3)	Carcinogenic SL TR=1E-06 (ug/m^3)
~Aroclor 1016	12674-11-2	6.1E-01	1.4E-01
~Aroclor 1221	11104-28-2	2.1E-02	4.9E-03
~Aroclor 1232	11141-16-5	2.1E-02	4.9E-03
~Aroclor 1242	53469-21-9	2.1E-02	4.9E-03
~Aroclor 1248	12672-29-6	2.1E-02	4.9E-03
~Aroclor 1254	11097-69-1	2.1E-02	4.9E-03
~Aroclor 1260	11096-82-5	2.1E-02	4.9E-03
~Aroclor 5460	11126-42-4		

https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

SANBORN HEAD

What are “Safe” Concentrations of PCBs In Indoor Air?

It Depends…

- In 2021, the State of Vermont issued School Action Levels (as developed by the Vermont Department of Health):

Age Group	School Action Level (ng/m^3)
Pre-Kindergarten	30
Kingergarten through 6th Grade	60
7th Grade through 12th Grade	100

https://dec.vermont.gov/sites/dec/files/wmp/Sites/20220202%20Adoption%20of%20SALs%20as%20Interim%20Environmental%20Media%20Stanards.pdf

SANBORN HEAD

What about "Background" Concentrations of PCBs In Air?

Table 2: Fort Edward NY, Background Monitoring Results

Year	Number of Samples	Number of Exceedances	Range (ng/m³)	Average (ng/m³)
Phase 1 (2009)	200	0	0.40 – 42.09	6.82
2011	210	0	0.07 - 37.3	4.38
2012	220	0	0.06 - 62.84	7.28
2013	195	0	0.38 – 54	5.6
2014	199	0	0.05 - 50.1	6.06
2015	201	0	0.01 - 13.93	2.35
All Phase 2	**1025**	**0**	**0.01 - 62.84**	**5.13**

Source: General Electric 2009g, 2012d, 2013b, 2014c, 2015f, 2016h

Table 1: GE and NYSDEC Pre-dredging, Background Monitoring Results

Study	Location	Year	Dates	Range (ng/m³)	Average (ng/m³)
GE	Fort Edward Boat Launch	2005	August 17 – September 28	0.82 – 3.73	2.41
NYSDEC	Lock 6	2005-2006	November 2005 – November 2006	0.3 - 2.8	0.64
NYSDEC	Lock 7 (2)				0.47
NYSDEC	Lock 7 (4)				0.65
NYSDEC	Lock 8				0.07

Source: GE 2005j; NYSDEC 2007.

Taken from "Final Second Five-Year Review Report for the Hudson River PCBs Superfund Site," April 2019.

School	Outdoor Concentration (ng/m³)	
	Median	95th %
1	0.21	0.614
2	0.584	2.378
3	0.183	0.496
4	0.36	0.957
CJ Schools	0.159	1.423

Taken from "Airborne PCBs and OH-PCBs inside and outside urban and rural schools" Environmental Science Technology, July 2017.

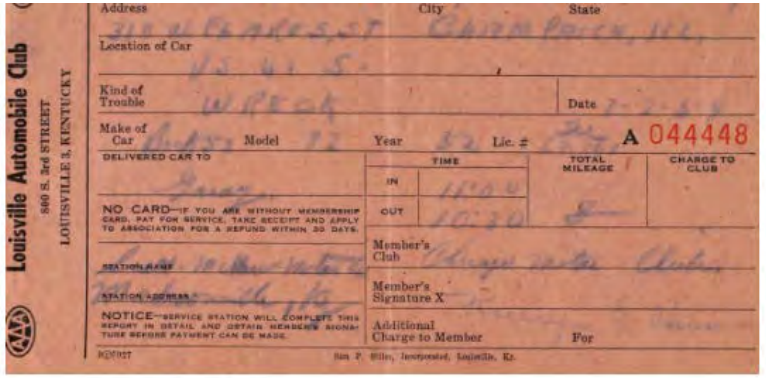
SANBORN HEAD

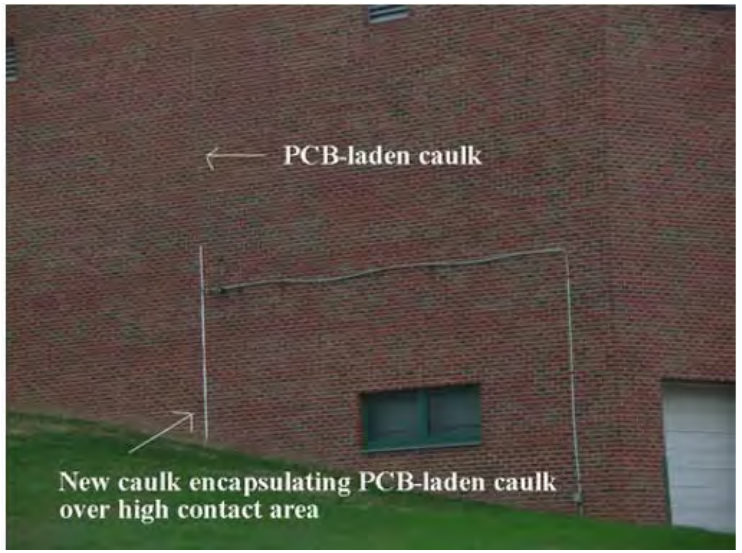
Historical Uses of PCBs

- U.S. Industrial Use of PCBs

PCB Use	Pounds (Million)	% of Total
Capacitors	630	50.3
Transformers	335	26.7
Plasticizers	115	9.2
Hydraulics/lubricants	80	6.4
Carbonless copy paper	45	3.6
Heat transfer fluids	20	1.6
Petroleum additives	1	0.1
Miscellaneous uses	27	2.2
Totals	**1,253**	**100**

Source: U.S. EPA



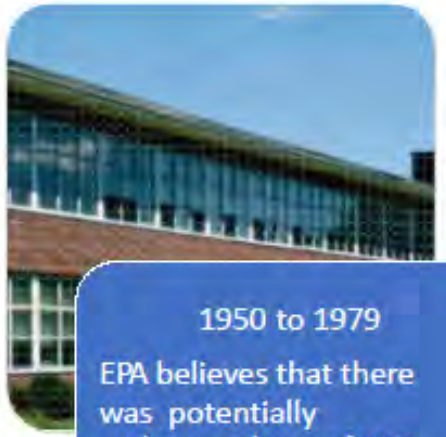


SANBORN HEAD

EPA's PCBs in Buildings Guidance

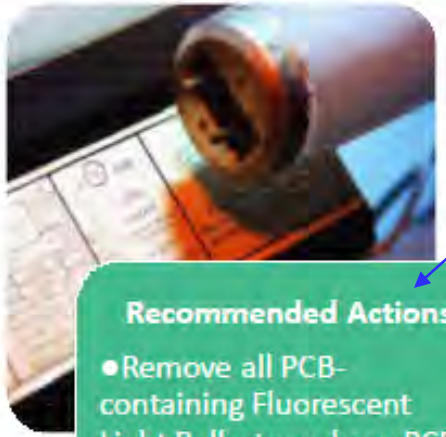
Actions for Reducing Exposures to PCBs in Indoor Building Environments

No reference to sampling



1950 to 1979

EPA believes that there was potentially widespread use of PCB-containing building materials in schools and other buildings built or renovated between about 1950 and 1979.



Recommended Actions

- Remove all PCB-containing Fluorescent Light Ballasts and any PCB-stained fixtures
- Implement best management practices: proper ventilation, cleaning, and hygiene.

Renovation and Repair

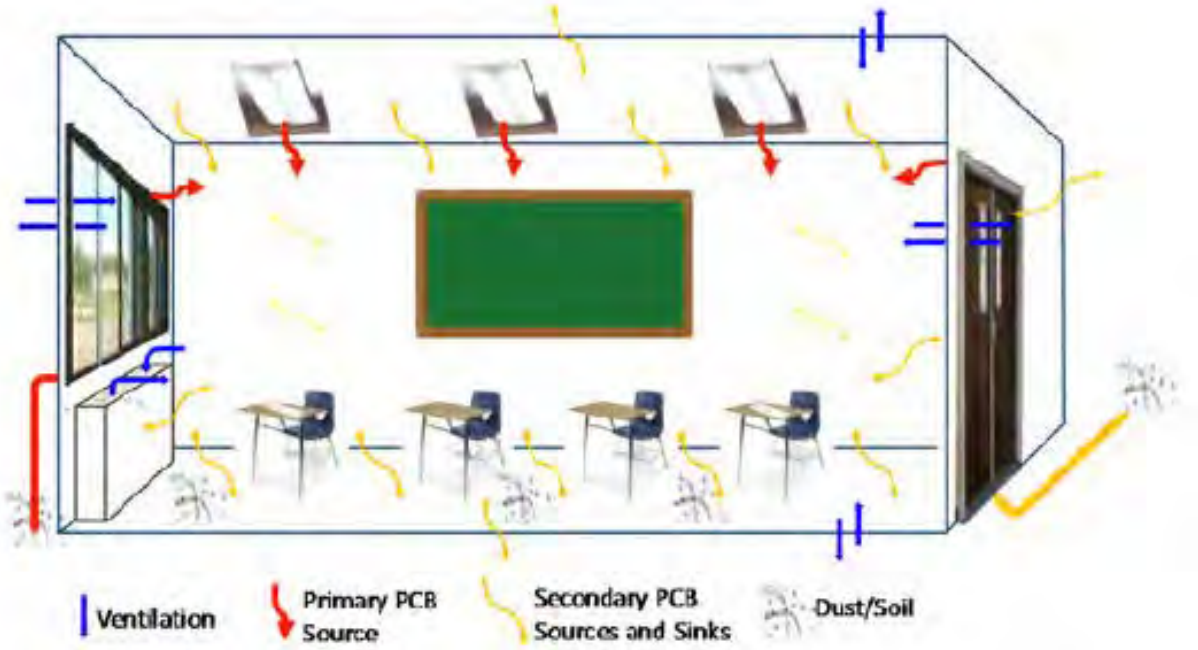
Remove other PCB sources (e.g., PCB-containing caulk) during planned renovation and repairs.

See also the document, *PCBs in Building Materials: Questions and Answers at:*

https://www.epa.gov/pcbs/questions-and-answers-about-polychlorinated-biphenyls-pcbs-building-materials

Sources of PCBs in Indoor Air

- Many Sources!
  - Primary Sources:
    - Failed light ballasts (probably not a current source given most have probably been replaced)
    - Caulking
    - Paints
  - Secondary Sources ("sinks" where airborne PCBs have been adsorbed):
    - Carpet
    - Furniture with foam cushioning (same material as used in PUF cartridges for indoor air sampling)



Sampling Options

- Bulk Samples
  - Potential “Source” Materials
    - Caulking
    - Paints
  - Substrate Samples
    - Concrete
    - Brick
    - Wood
    - CMU
- Wipe Samples
  - High-contact surfaces
  - Duct-work

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 1
5 Post Office Square, Suite 100
Boston, MA 02109-3912

STANDARD OPERATING PROCEDURE FOR SAMPLING POROUS SURFACES FOR POLYCHLORINATED BIPHENYLS (PCBs)

May 2011

SANBORN HEAD

Migration Pathways

- Movement of air throughout the building
  - Heating system(s):
    - Forced Hot Air?
    - Baseboard Heat?

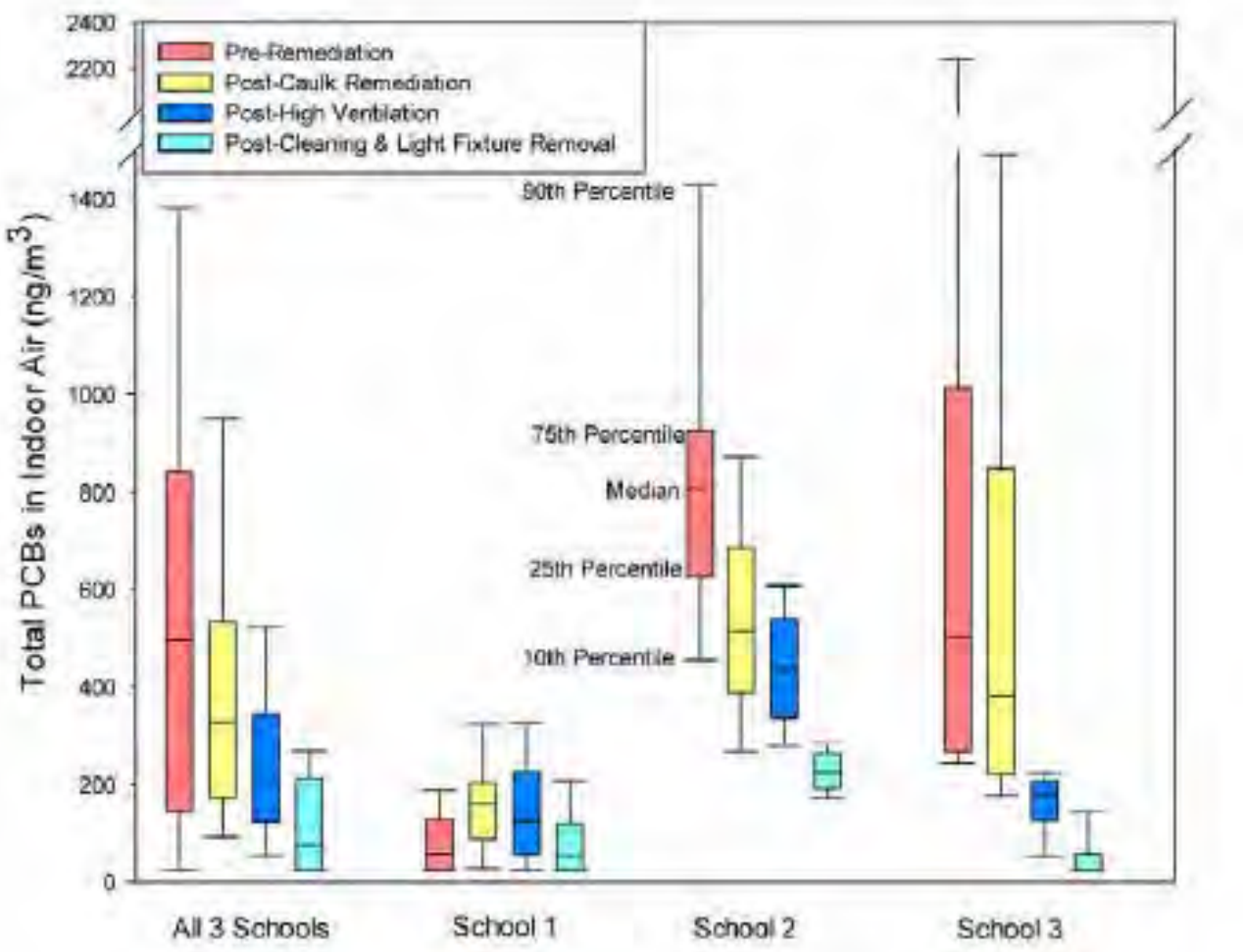
- Dust generation during facility maintenance
  - Abrasion of PCB-containing building materials
  - Repair of PCB-containing building materials (i.e., caulking)

*Assessment of HVAC systems can be challenging; suggest working with an HVAC engineer to fully assess role HVAC system(s) play in PCB distribution in indoor air.

Remediation?

It Depends…

- Renovation vs. Demolition?
  - Renovation may not allow for the removal of contaminated substrates or other secondary sources, which can be a post-remediation source of PCBs to indoor air.
  - Demolition allows for the removal of all sources of PCBs (primary and secondary)



From U.S. EPA's *Polychlorinated Biphenyls (PCBs) in School Buildings: Sources, Environmental Levels, and Exposures* (September 30, 2012)

SANBORN HEAD

Remediation?

An approach to Renovation:

- Removal of source materials (caulking, paint, etc.)
- Limited removal of affected substrate (brick, concrete, CMU)
- Cleaning of HVAC system(s)
- Encapsulation of remaining substrate (or construction of mini-walls)
  - Epoxy
  - Sheet metal
- Ongoing O&M of encapsulated surfaces
  - Repairs
  - Periodic indoor air/wipe sampling
  - How long?

SANBORN HEAD

Performance of Encapsulants

As provided by U.S. EPA: "Encapsulation is a containment method that uses a coating material to separate PCB sources from the surrounding environment to reduce surface and air concentrations of PCBs. Encapsulation is only effective at reducing air concentrations to desirable levels when PCB content in the source is low."

	An epoxy coating	A water based sealer	Acrylic coating (A)	Acrylic coating (B)	Acrylic coating (C)	A polyurethane sealant	A silicone sealant
Summary & Recommendations	Although the implementation and aesthetics received fair ratings, this product is most effective at encapsulating high level residual PCBs and is recommended (or a similar epoxy-type product) for use in the joints after caulking removal.	Given the poor implementability and fair effectiveness, this product is not recommended for use in full-scale implementation.	Given its good ratings in each category, this product is recommended for use on concrete surfaces adjacent to caulk joints; full-scale application would result in minimal changes to the appearance of the façade.	Although this product is easily implementable and effective, the colored finish may not be a desirable option from an aesthetic standpoint.	Although this product is easily implementable and effective, the colored finish may not be a desirable option from an aesthetic standpoint.	Easily implementable, effective, and color options are available to achieve desired outcome. Implementation would result in minimal changes to the appearance of the façade.	Although this product is fairly easy to implement and is effective, the two-inch wide colored strip over the joint may not be a desirable option from an aesthetic standpoint.

From *Literature Review of Remediation Methods for PCBs in Buildings, January 2012.*

Timothy J. Snay, LSP, LEP
Vice President

SANBORN | HEAD & ASSOCIATES, INC.
D 978.496.2110 | M 351.215.4180 | 1 Technology Park Drive, Westford, MA 01886

Solid Waste

Energy

Industrial

Development

CLIENT SERVICE AREAS