PCBs in Building Materials

Background & Risk Reduction Options

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PCBs in Building Materials

Background & Risk Reduction Options

- Division of Capital Asset Management and Maintenance
- Overall "landlord" for the Commonwealth
- Capital Expenditures of $450 Million
- 6,000 buildings
- 1,600 buildings constructed between 1950 and 1975

PCBs in Building Materials
KEY CONCEPTS

- Regulatory Framework
- Conceptual Site Model
- Nature and Extent
- Source Removal
- Cover Systems
- Activated Metals Treatment System

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PCBs in Building Materials
REGULATORY FRAMEWORK

- **Toxic Substance Control Act** (TSCA)
- **Regulations**
  - 40 CFR 761.1 through 40 CFR 761.398
  - 310 CMR 40.0000
- **Regional Guidance Documents**
  - PCBs in Building Products: FAQs
  - Checklists for Self-Implementing Cleanup and Disposal § 761.61(a)(3) and Risk-Based Cleanup and Disposal
  - Standard Operating Procedure (SOP) for Sampling Porous Surfaces for PCBs

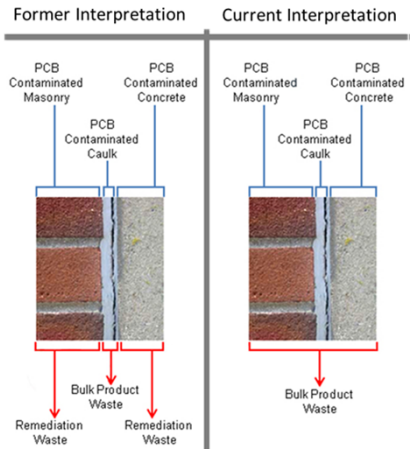
PCBs in Building Materials
REGULATORY FRAMEWORK

- **Regulatory Thresholds**
  - TSCA >50 milligrams per kilograms (ppm)
  - MCP > 2 ppm (today)
  - MCP > 1 ppm (Proposed regulation changes)
- **How Clean is clean (unrestricted use)**
  - TSCA < 1 milligrams per kilograms (ppm)
  - MCP < 2 ppm (today)
  - MCP < 1 ppm (Proposed regulation changes)

PCBs in Building Materials

REGULATORY FRAMEWORK

- PCB Bulk Product waste is "source" material containing > 50 ppm
- Material that has become contaminated due to the adjacent presence of PCB Bulk Product Waste is considered " Bulk Remediation Waste
- Recent EPA Reinterpretation of PCB Bulk Product Waste vs PCB Remediation Waste



PCBs in Building Materials

Conceptual Site Model

- Regulatory Framework
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PCBs in Building Materials
Conceptual Site Model

Common Uses of PCBs in Building Materials

- Adhesives
- Asphalt Roofing Materials
- Caulking
- Fluorescent Light Ballasts
- Grout
- Insulating Coatings Mixed With Asbestos
- Paints
- Plasticizers
- Tar Paper

PCBs in Building Materials
Conceptual Site Model

PCBs in Building Materials

Conceptual Site Model

PCBs in Building Materials

Conceptual Site Model

PCBs in Building Materials

Conceptual Site Model

- PCBs are persistent
- The persistence generally increases with the degree of chlorination
- The presence of PCBs increases the pliability of the caulk
  - More PCBs …. More pliable the caulk
  - Not always the case

PCBs in Building Materials

Conceptual Site Model

- PCBs may migrate into surrounding materials
- Why Migrate?
  - Brownian Motion
  - Kinetic Theory
  - Concentration Gradient
- Increased Temperatures → Increased Motion
- Difference between Porous & Non-Porous

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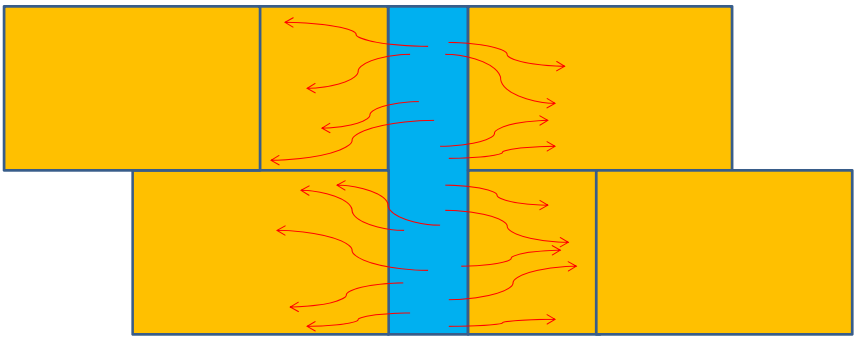
Conceptual Site Model

- Example



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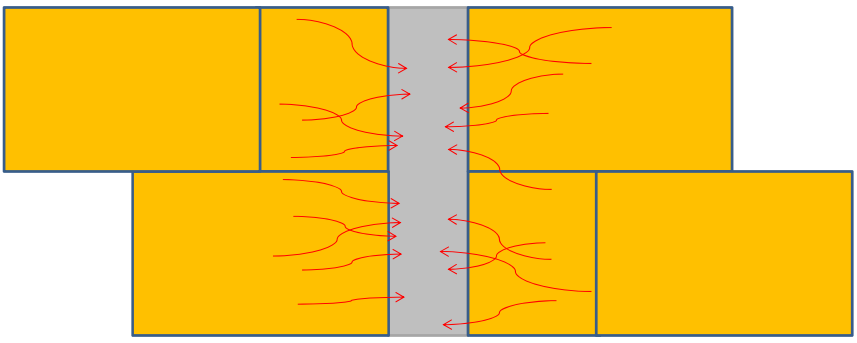
Conceptual Site Model



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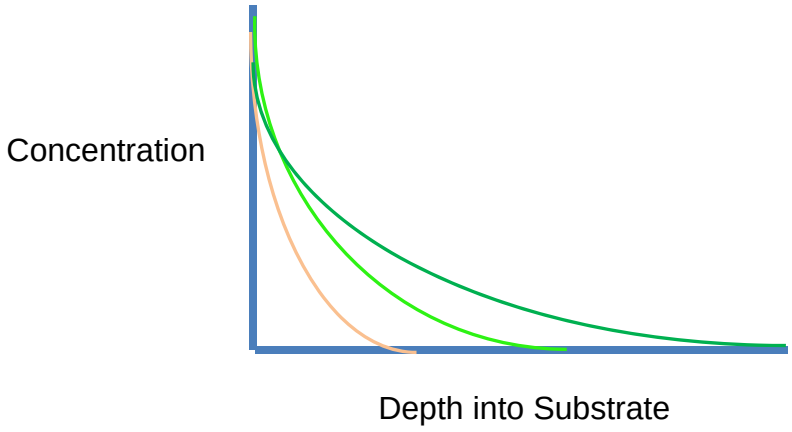
Conceptual Site Model

- Possible Curve(s) for PCB Migration



PCBs in Building Materials

Conceptual Site Model

- Vapor loss of PCBs appears to be an important fate mechanism.
- The rate of volatilization decreasing with increasing chlorination.
- The volatilization rate may be low
- The total loss by volatilization over time may be significant because of the persistence and stability of PCBs.

PCBs in Building Materials
KEY CONCEPTS

- Conceptual Site Model
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PCBs in Building Materials
Nature and Extent

- Evaluate the Site-specific conditions
  - Historic records
  - Exploration
  - Media
  - Sampling
  - Analyses

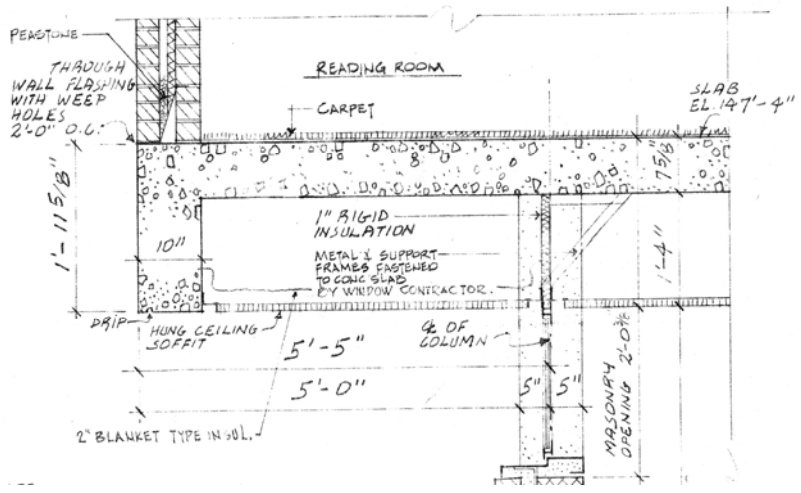
PCBs in Building Materials

Nature and Extent

- Historic Records
  - Building/ Structure requires Permits
  - Local Building Department
- Record Type
  - Design Drawings & Specifications
    - How it was supposed to be build
  - Record Drawings & Submittals
    - How it was built.

PCBs in Building Materials

Nature and Extent



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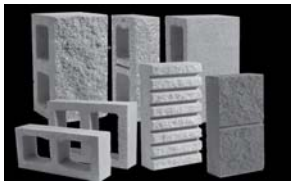
Nature and Extent

- Exploration
  - Site visit
  - Readily available access
  - Selective Demolition

PCBs in Building Materials

Nature and Extent

- Caulk (all caulk is not created equal)
- Understand the porous materials matrix



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Nature and Extent

- Why are you testing?
  - Initial Characterization?
  - Evaluation of disposal options?
  - Effectiveness of remediation?
- What are you testing?
  - Caulk
  - Substrate
  - Encapsulant
  - Air Quality

PCBs in Building Materials

Nature and Extent

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Nature and Extent

PCBs in Building Materials

Nature and Extent

- Standard Operating Procedure (SOP) for Sampling Porous Surfaces for PCBs
  - Addresses sampling techniques for hard and soft porous surfaces
  - Provides for collection of surface samples (0-0.5 inches) and delineation of PCB contamination throughout the thickness of the porous material.
  - Describes QA/QC requirements for the sampling
  - Data and record management

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Nature and Extent

- **What are you interested in?**
  - Aroclors (i.e., 1254)
  - Homologues
  - Congeners
- **Bulk Sample Analyses**
  - Typically will be EPA Method 8082 (GC)
  - Extraction EPA Method 3540c (Soxhlet)
- **Air Sample Analyses**
  - EPA Method TO-10A (Low Volume)
  - EPA Method TO-4 (High Volume)

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Nature and Extent

PCBs in Building Materials
KEY CONCEPTS

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PCBs in Building Materials
Source Removal

- Remove Caulk
- Consider Removing Substrate
  - If the Substrate is left behind and greater than one PPM, the residual material will be considered a PCB Remediation Waste

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Source Removal

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Source Removal

PCBs in Building Materials

MCP KEY CONCEPTS

- Conceptual Site Model
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PCBs in Building Materials
Cover Systems

- Typically Used in a Risk-Based Approach
- Exposure Duration
  - High Occupancy (greater than 6.7 hours per week
  - Low Occupancy (less than 6.7 hours per week)
- Color or clear?
- Products – Still researching
- Verification Wipe data

PCBs in Building Materials
Cover Systems

- Properties in Selecting Encapsultants
  - Elongation
  - Dry film thickness
  - Hardness
  - Drying or curing time
  - Compatibility

PCBs in Building Materials

Cover Systems

- USEPA at Research Triangle Park
- Bench-Scale Testing of Ten encapsultants
- Used an Process to simulate Ageing

PCBs in Building Materials

Cover Systems

Table 2.1. Coating materials tested (product names, binder types, recommended uses, and recommended application methods)

ID	Product Name	Short Name	Binder or Base Material	Recommended Use	Recommended Application Method
01	Protective Coatings Series 156 Smooth Enviro-Crete	Acrylate-waterborne	modified waterborne acrylate	concrete and masonry	airless/conventional sprayer, brush, roller
02	All Surface Enamel Latex Base	Acrylic-latex enamel	acrylic latex	wood, metal, drywall, interior/exterior	brush, roller, airless sprayer
03	MODAC Exterior Waterproof Coating F-100 OTC	Acrylic-solvent	solvent acrylic	concrete, cinder block, brick	brush, roller, airless sprayer
04	Sikagard 62 [a]	Epoxy-no solvent	solvent-free epoxy	concrete, steel	brush, roller, airless sprayer
05	Industrial & Marine Coatings Macropoxy 646 [a]	Epoxy-low VOC	low-VOC polyamide epoxy	steel, concrete	airless/conventional sprayer, brush, roller
06	Protective Coatings Series 151-1051 Elasto-Grip FC [a]	Epoxy-waterborne	waterborne modified polyamine epoxy	cementitious and other porous substrates	airless/conventional sprayer, brush, roller
07	Rust-O-Lastic Universal Lacquer Resistant Primer	Lacquer primer	talc and quartz	metals, interior/exterior	brush, roller, airless sprayer
08	All-Surface Enamel Oil Base Gloss	Oil enamel	oil-based enamel	wood, metal, drywall, interior/exterior	brush, roller, airless sprayer
09	EPL-9 Self Leveling Polyurea Elastomer	Polyurea elastomer	polyurea	self-leveling base coat; deck, crack and floor repair	spray
10	Fast-Drying Polyurethane	Polyurethane	polyurethane	wood	natural bristle brush, foam brush, or lambswool applicator

[a] This is a two-part coating system.

PCBs in Building Materials

Cover Systems

Table 6.1. Calculated maximum allowable concentrations in the source for effective c with two mitigation goals based on the PCB concentration in wipe samples

Encapsulant	Maximum Allowable PCB Concentration in the Source, C_{max}, (µg/g) [b]	
	For W_{max} = 1 µg/100 cm²	For W_{max} = 10 µg/100 cm²
Lacquer primer	7.4	74
Acrylic-latex enamel	8.8	88
Oil enamel	14	140
Polyurethane	18	180
Acrylic-solvent	19	190
Acrylate-waterborne	19	190
Epoxy-waterborne	34	340
Polyurea elastomer	69	690
Epoxy-low VOC	120	1200
Epoxy-no solvent	430	4300

[a] See Table 3.10 for the accuracy of the wipe sample data.
[b] Results are rounded to two significant digits.

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Cover Systems

PCBs in Building Materials

Cover Systems

- A "Monitoring and Maintenance Plan" will be required for sites where encapsulation has occurred.
- The MMP typically requires"
  - A description of monitoring/maintenance activities to be conducted
  - Inspection criteria and frequency
  - Sampling protocols and frequency
  - Analytical criteria
  - Reporting requirements
  - Active thresholds and corrective action procedures.

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Cover Systems

- The MMP typically can require:
  - Notification to occupants prior to remediation activities
  - Informational meetings prior to remediation in occupied building.
  - A description of monitoring/maintenance activities to be conducted.
  - A PCB communication Plan that includes public inquiries and responses to those inquiries.
  - A document repository that includes EPA reports, analytical data, and PCB information.

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PCBs in Building Materials
ACTIVATED METAL TREATMENT SYSTEM

- NASA has developed and patented a technology, called *activated metal treatment system* (AMTS), to extract and destroy PCBs from various media through application directly to the contaminated media.
  (http://nasaksc.rti.org/Bimetallic.cfm)

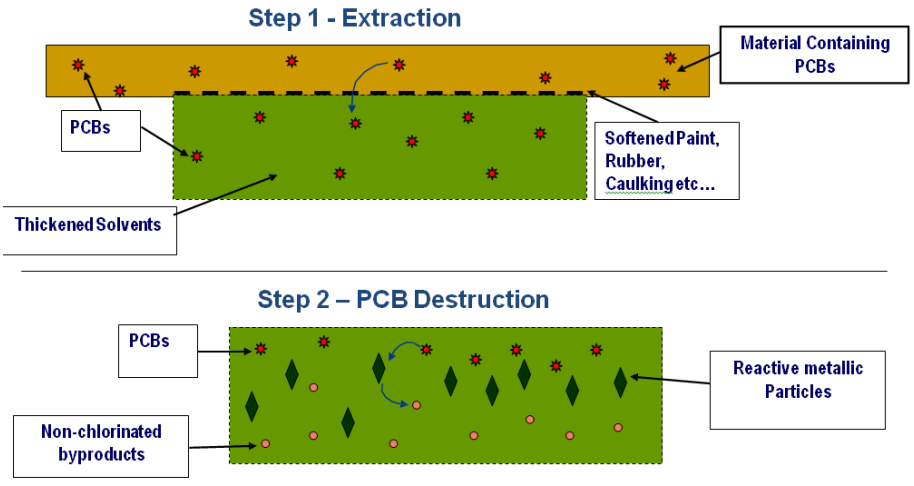
PCBs in Building Materials

ACTIVATED METAL TREATMENT SYSTEM

- The AMTS technology consists of an activated metal (Mg) within a solvent system and a thickening agent to form a paste.
- The technology initially extracts PCB's from materials such as paint, soils, concrete and sludge. The extracted PCB's then react with the activated metal and are degraded (reductively dechlorinated) into benign by-products.

AMTS – How it Works?

Two-Step Process



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ACTIVATED METAL TREATMENT SYSTEM

- Two Approaches on Activated Metal Addition
  - In the Thickened Solvent Paste during applications
  - Added after Paste is removed
- Two Approaches on Solvent Addition
  - Thickened Paste
  - Immersion Approach

PCBs in Building Materials

ACTIVATED METAL TREATMENT SYSTEM

- USEPA at Research Triangle Park
- Bench-Scale Testing
- Results indicated that the impact was only about one centimeter deep.
- After completion of the Study, a new and improved version of the AMTS was unveiled.

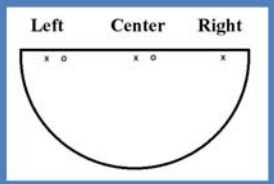
Part 4: Evaluation of an On-site PCB Destruction Method EPA/600/R-11/156C
http://nepis.epa.gov/Adobe/PDF/P100FEC6.pdf

SALEM CONCRETE – SAMPLE COLLECTION

Based on results of initial sampling, complete baseline sampling was performed for PCB contaminated concrete. Samples were taken as Left, Center, and Right at a distance of 0.50 inches from the position of the caulking material. All samples were drilled to a depth of 0.50 inches.

X Baseline sampling

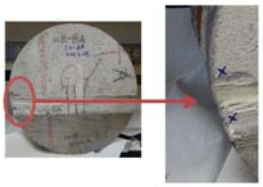
O Two week treatment sampling



Salem State Concrete – Initial Sampling

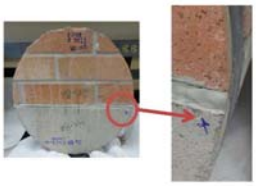
Upon receipt of concrete, initial samples of concrete and CMU were taken to determine which of the materials were contaminated with PCBs. Samples described below are for concrete only.

Sample ID # : 2K-8A



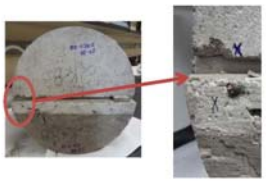
2K-8A-A02 - 51 mg/kg

2K-8A-A01 - 514 mg/kg



2K-8A-B01:
Below Detection Level

Sample ID # : 2K-8B



2K-8B-A02 - 119 mg/kg

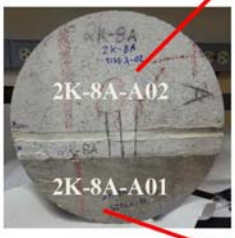
2K-8B-A01 - 3,933 mg/kg

2K-8B-B01:
Below Detection Level

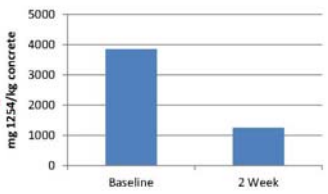
SALEM CONCRETE – AMTS IMPLEMENTATION

Once the initial and baseline samples were taken and the caulking material removed, initial treatment was performed for PCB contaminated concrete. Treatment involved filling an appropriately sized nylon delivery system with non-metal treatment system (NMTS) and applying the treatment system in the location of the removed caulking materials. The NMTS was sealed airtight with aluminum tape and was allowed contact with the contaminated concrete for two weeks.

Salem Concrete 2 Week Results



CMU 2K-8A-A02

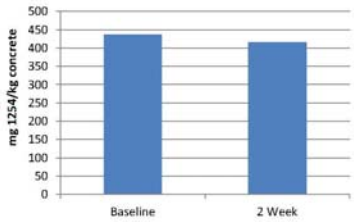


(ethanol extraction)
Baseline = 3,837 mg /kg

2 week treatment = 1,244 mg /kg

% Removal = 68%

Concrete 2K-8A-A01



(ethanol extraction)
Baseline = 437 mg /kg

2 week treatment = 416 mg /kg

% Removal = 5%

AMTS Laboratory Treatability Tests

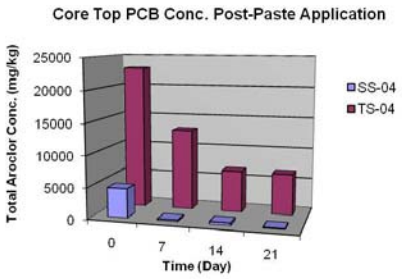
Concrete (floor, slab)

Results for Concrete

	Pretreatment Concentrations (mg/kg)			Post-AMTS 15 Day
Sample ID	Aroclor 1248	Aroclor 1260	Total PCB	Total PCB
E25 T-1 top	24	BDL	24	BDL
E25 T-1 bottom	BDL	BDL	BDL	BDL
E25 T-2 top	18	BDL	18	BDL
E25 T-2 bottom	6	BDL	6	BDL
E25 T-3 top	19	BDL	19	BDL

Pre and Post treatment results for concrete pieces

100% reduction of PCBs in concrete pieces (immersion treatment)



Pre and Post treatment results for concrete cores from facility sub-slab.

57 - 95% reduction of PCBs in concrete cores (surface treatment)

PCBs in Building Materials
AMTS CONCLUSIONS

- Density and Porosity have major impacts on treatment
- Solvent impacts to Indoor Air?
- Significant Testing is Still Required
- Immersion Approach not applicable to most projects.
- Number of applications or length of time may be prohibitive

PCBs in Building Materials
AMTS RECOMMENDATIONS

- Additional Testing needs to improve on QA/QC
- Expectations of a “silver bullet” may be unrealistic
- AMTS Application may be appropriate when combined with Encapsulation

PCBs in Building Materials
SUMMARY

- Use the Approaches that Environmental Professionals use everyday.
  - Conceptual Site Models
  - Review the History of the Site
  - Appropriate Sampling and Analysis
  - Prepare Clear and Concise Reports
- Learn How Buildings are constructed
- Don't jump into air sampling
- COMMUNICATION IS KEY!!!!
  - EPA , the Client, the Laboratory, & Users of the Buildings

PCBs in Building Materials
References

- **Current Best Practices for PCBs in Caulk Fact Sheet - Removal and Clean-Up of PCBs in Caulk and PCB-Contaminated Soil and Building Material (December 2012)**
  - http://www.epa.gov/pcbsincaulk/caulkremoval.htm
- **Cleanup of Polychlorinated Biphenyls (PCBs) (March 2012)**
  - http://www.epa.gov/region1/cleanup/pcbs/
- **PCBs in Schools Research (January 2013)**
  - http://www.epa.gov/pcbsincaulk/caulkresearch.htm
- **Contractors: Handling PCBs in Caulk During Renovation**
  - http://www.epa.gov/wastes/hazard/tsd/pcbs/pubs/caulk/caulkcontractors.htm

PCBs in Building Materials
References

- *Laboratory Study of Polychlorinated Biphenyl PCB Contamination and Mitigation in Buildings:*

  Part 1. Emissions from Selected Primary Sources
  http://www.epa.gov/nrmrl/pubs/600r11156_v2.pdf

  Part 2. Transport from Primary Sources to Building Materials and Settled Dust
  http://www.epa.gov/nrmrl/pubs/600r11156a_v2.pdf

PCBs in Building Materials
References

Part 3. Evaluation of the Encapsulation Method
http://www.epa.gov/nrmrl/pubs/600r11156b_v2.pdf

Part 4: Evaluation of an On-site PCB Destruction Method EPA/600/R-11/156C
http://nepis.epa.gov/Adobe/PDF/P100FEC6.pdf

- *Literature review on mitigation methods for PCBs in Buildings*
  http://www.epa.gov/nrmrl/pubs/600r12034_v2-1.pdf

PCBs in Building Materials

Thank you!

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