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
PCBs in Building Materials

REGULATORY FRAMEWORK

• **Toxic Substance Control Act (TSCA)**

• **Regulations**
  – 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

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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)
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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
- Conceptual Site Model
- Nature and Extent
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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
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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

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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

• Possible Curve(s) for PCB Migration

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.
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Nature and Extent

• Evaluate the Site-specific conditions
  - Historic records
  - Exploration
  - Media
  - Sampling
  - Analyses
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Nature and Extent

- Historic Records
  - Building/Structure requires Permits
  - Local Building Department

- Record Type
  - Design Drawings & Specifications
    - How it was supposed to be built
  - Record Drawings & Submittals
    - How it was built.
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Nature and Extent

• Exploration
  – Site visit
  – Readily available access
  – Selective Demolition

• 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
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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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KEY CONCEPTS

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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

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Source Removal
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MCP KEY CONCEPTS

• Conceptual Site Model
• Nature and Extent
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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

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Cover Systems

• Properties in Selecting Encapsulants
  – Elongation
  – Dry film thickness
  – Hardness
  – Drying or curing time
  – Compatibility
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Cover Systems

- USEPA at Research Triangle Park
- Bench-Scale Testing of Ten encapsulants
- Used an Process to simulate Ageing
### PCBs in Building Materials

#### Cover Systems

<table>
<thead>
<tr>
<th>Escapant</th>
<th>Maximum Allowable PCB Concentration in the Source, $C_{\text{max}}$ (μg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>For $W_{\text{max}} = 1 \mu g$/100 cm$^2$</td>
</tr>
<tr>
<td>Lacquer primer</td>
<td>7.4</td>
</tr>
<tr>
<td>Acrylic-latex enamel</td>
<td>8.8</td>
</tr>
<tr>
<td>Oil enamel</td>
<td>14</td>
</tr>
<tr>
<td>Polyurethane</td>
<td>18</td>
</tr>
<tr>
<td>Acrylic-solvent</td>
<td>19</td>
</tr>
<tr>
<td>Acrylate-waterborne</td>
<td>19</td>
</tr>
<tr>
<td>Epoxy-waterborne</td>
<td>34</td>
</tr>
<tr>
<td>Polyurea elastomer</td>
<td>69</td>
</tr>
<tr>
<td>Epoxy-low VOC</td>
<td>120</td>
</tr>
<tr>
<td>Epoxy-ac solvent</td>
<td>430</td>
</tr>
</tbody>
</table>

*See Table 2.10 for the accuracy of the wipe sample data.*

*Results are rounded to two significant digits.*
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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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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)
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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.
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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

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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.

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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 - 81 mg/kg

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

Sample ID #: 2K-8B

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

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

2K-8A-801: Below Detection Level

2K-8B-801: 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

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)
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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

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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
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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
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](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](http://www.epa.gov/nrmrl/pubs/600r11156a_v2.pdf)

• *Part 3. Evaluation of the Encapsulation Method*
  [http://www.epa.gov/nrmrl/pubs/600r11156b_v2.pdf](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](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](http://www.epa.gov/nrmrl/pubs/600r12034_v2-1.pdf)
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Thank you!

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