# Activated Magnesium for Treatment of PCBs in Building Materials

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# Outline

- Background - Issue of PCBs in Building Materials
- Background - from ZVI to ZVMg
- Treatment of PCBs in Paints
  - ESTCP Demo
  - Additional work at UCF
- Future Work and Related Issues

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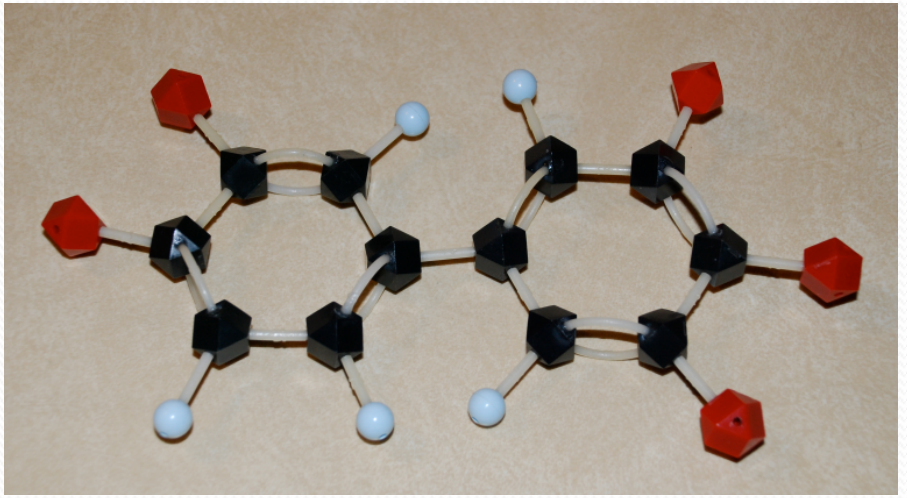
# PCBs in Paints & Other Building Materials

- Prior to 1979, PCBs were used extensively in:
  - industrial paints
  - caulking material
  - coatings
  - adhesives
- PCB added to enhanced structural integrity, reduced flammability and boosted antifungal properties



# PCB Issues

- Painted equipment with PCB
  - high cost for disposal
- Painted buildings and structures
  - impacts to surrounding soil and storm water
  - additional costs for disposal during demolition or renovation
- Caulking material in buildings
  - possible impacts to indoor air quality
  - exposure mitigation and disposal issues during renovation
- Caulking material in outside concrete
  - impacts to surface water
  - Issues with PCB use

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# PCBs in Caulking Material

- Masonry buildings and concrete structures constructed between the 1940s and late 1970s
- Used in concrete expansion joints
- Caulk may contain up to 15% PCBs
- PCBs also migrate into concrete

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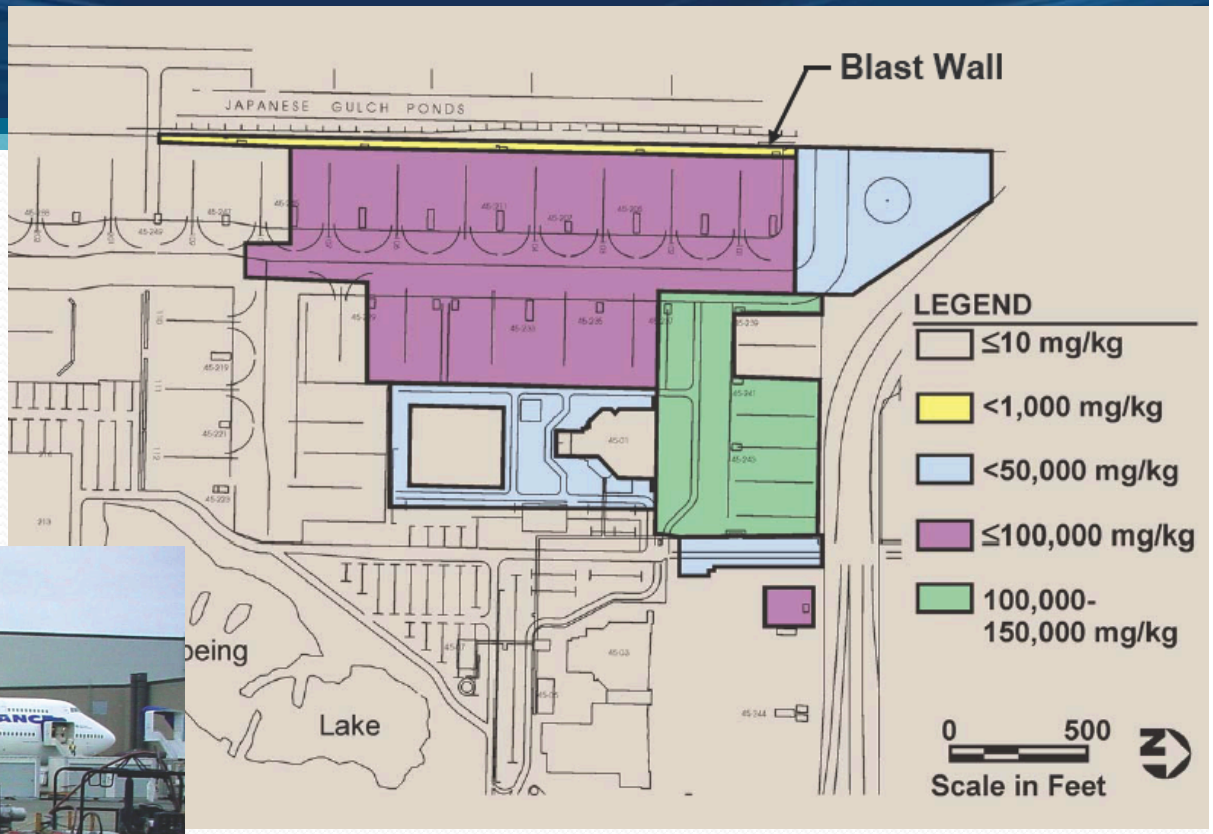
# Boeing, Everett, WA





## 50 miles of joints with PCBs

Garson, McCormack, Sugino and Molinari, 2004. Airport Flightline Expansion Joints – Unexpected Source of PCB Contamination. *Fourth International Conference on Remediation of Chlorinated and Recalcitrant Compounds*, Monterrey CA., May 2004.

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# PCB In Schools

## Costs mounting for PCB remediation at Estabrook

Funding request likely to be brought to Town Meeting

Photos Zoom

**By Michael Phillis/Staff Writer**
**Lexington Minuteman**
Posted Sep 16, 2010 @ 08:30 AM
Last update Sep 16, 2010 @ 03:07 PM

Recommend Be the first of your friends to recommend this.

Lexington — **Estabrook Elementary School** reopened Monday after remediation work successfully reduced air concentrations of **polychlorinated biphenyls (PCBs)** to acceptable short-term levels.

Like the school year, remediation efforts have only just begun, however. Further mitigation is needed to meet Environmental Protection Agency (EPA) guidelines.

# Current EPA Guidance:

**CURRENT BEST PRACTICES FOR PCBS IN CAULK FACT SHEET**
**Removal and Clean-Up of PCBs in Caulk and PCB-Contaminated Soil and Building Material**
Last Updated: September 2009

Caulking containing PCBs at levels > 50 ppm is not authorized for use under PCB regulations and must be removed

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# Reality Is:

- Unclear what regulation requires people to test for PCBs unless renovations are being conducted or there are other impacts
- Actions have been initiated because of:
  - impacts to indoor air
  - impacts to storm water from caulk in concrete outside
  - impacts to water in reservoirs
  - demolition / renovation

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# Use of Zero-Valent Metal

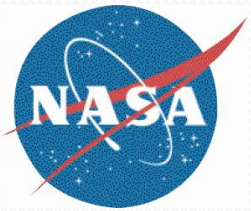
- Granular Zero-Valent Iron (ZVI) accepted treatment for chlorinated solvents, Cr(VI) and other metals
- Bimetal systems
  - nickel, platinum, palladium with ZVI
- Other reduced metals
  - zinc, magnesium, sodium

# Standard Reduction Potentials

| | | |
|---|---|---|
| $Fe = Fe^{++} + 2e^-$ | +0.41 | ZVI (ZVFe) |
| $Zn = Zn^{++} + 2e^-$ | +0.76 | ZVZn |
| $Mg = Mg^{++} + 2e^-$ | +2.38 | ZVMg |
| $Na = Na^{++} + 2e^-$ | +2.71 | ZVNa |

# BTS and AMTS

- NASA and UCF developed technology for treatment of PCBs
- BTS – Bimetalic Treatment System
  - Mg metal (ZVMg) with Pd
- AMTS – Activated Metal Treatment System
  - Mg metal (ZVMg) in acidified ethanol



# BTS / AMTS Technology Rationale

- Zero-valent metal (magnesium) (ZVMg) has strong reducing capabilities and can destroy PCBs with palladium (Pd) as a catalyst or activated with acid
- Solvent paste can extract PCBs from surfaces
- Solvent paste with ZVMg can extract PCBs and degrade PCBs in the paste

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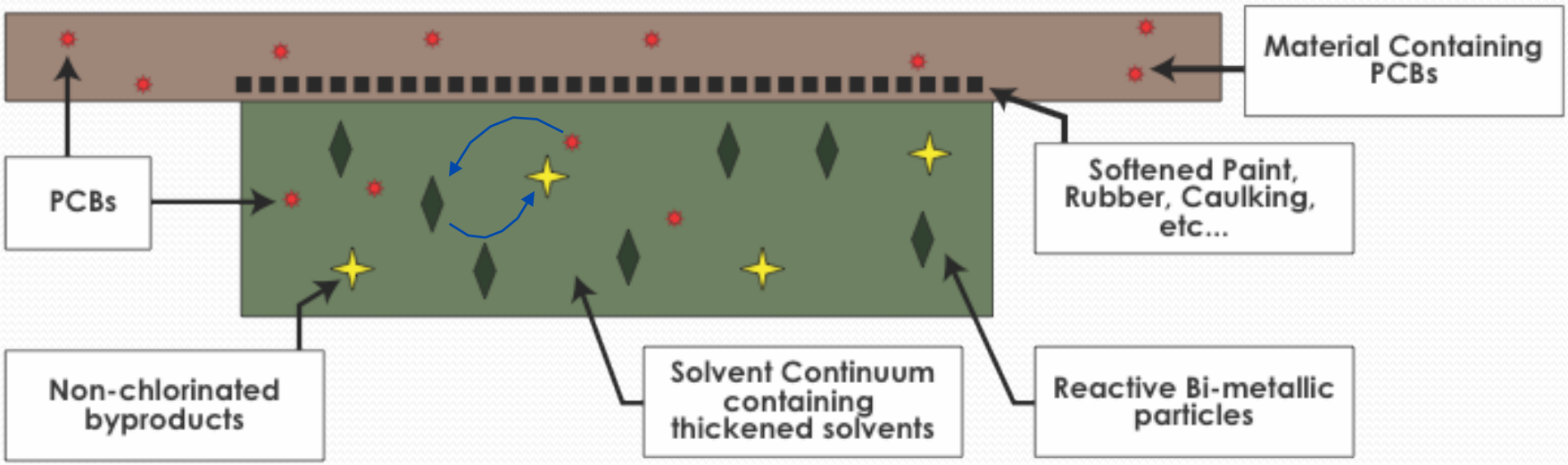
# Technical Approach

## One step treatment with BTS or AMTS



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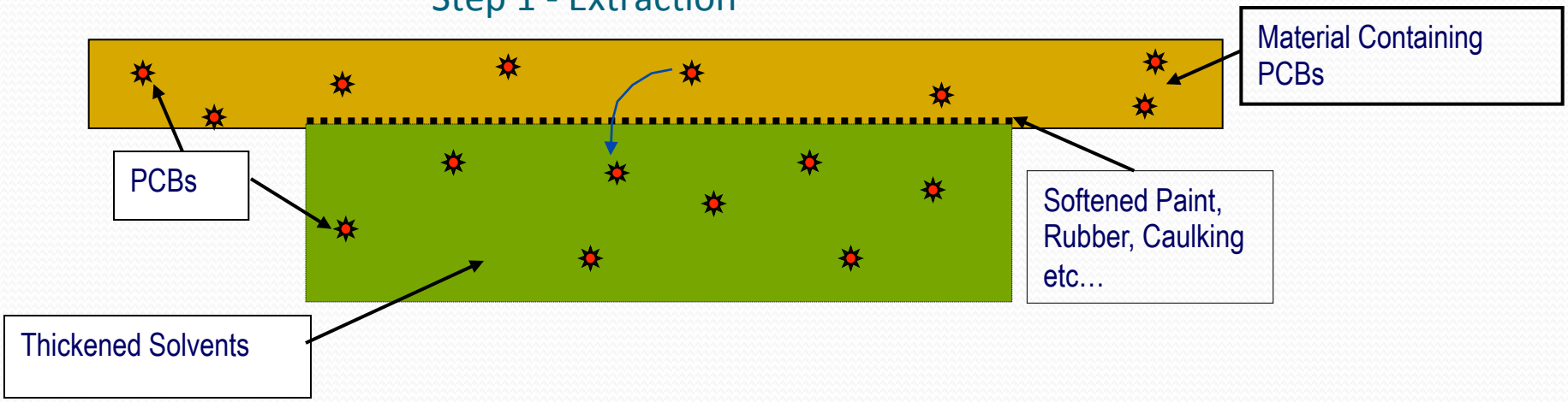
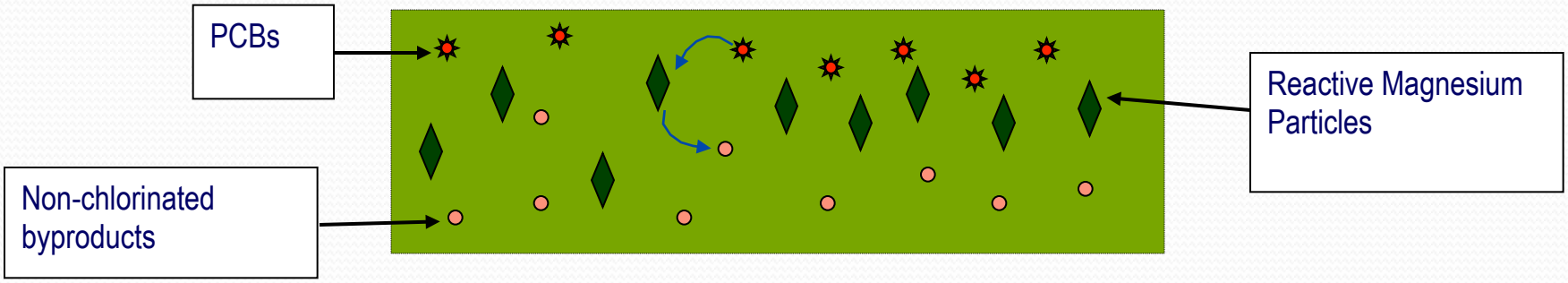
# Two step treatment with BTS or AMTS

## Step 1 - Extraction




## Step 2 – PCB Destruction



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# ESTCP BTS Demonstration Project

- US Department of Defense, Environmental Security Technology Certification Program (ESTCP)
- ESTCP-funded project (SI-0610) to demonstrate the efficacy of a Bimetallic Treatment System (BTS) technology to extract and treat PCBs from building materials (paint, caulk, concrete)

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# Field Demonstration 1

## Vertical Integration Building (VIB), Cape Canaveral Air Force Station

# Application of Paste

Hand Application
(non-active paste)

Spray Application
(active paste)

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# Field Demonstration 2
# BADGER ARMY AMMUNITION PLANT, WI

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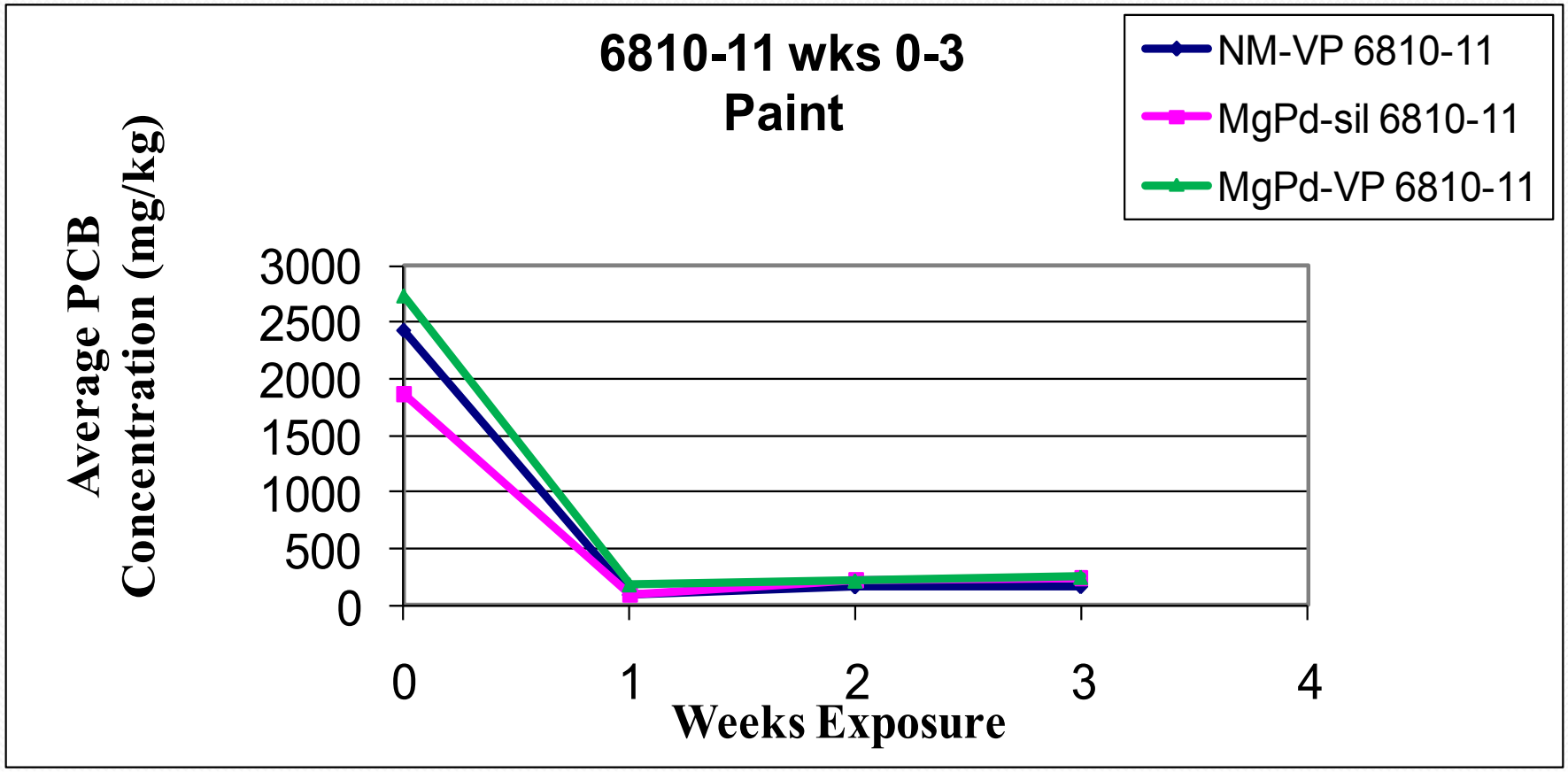
- 56 samples were analyzed for PCBs including painted concrete, wood and metal
- PCB concentrations from paint samples taken from structures range from 30 to 55,000 mg/kg

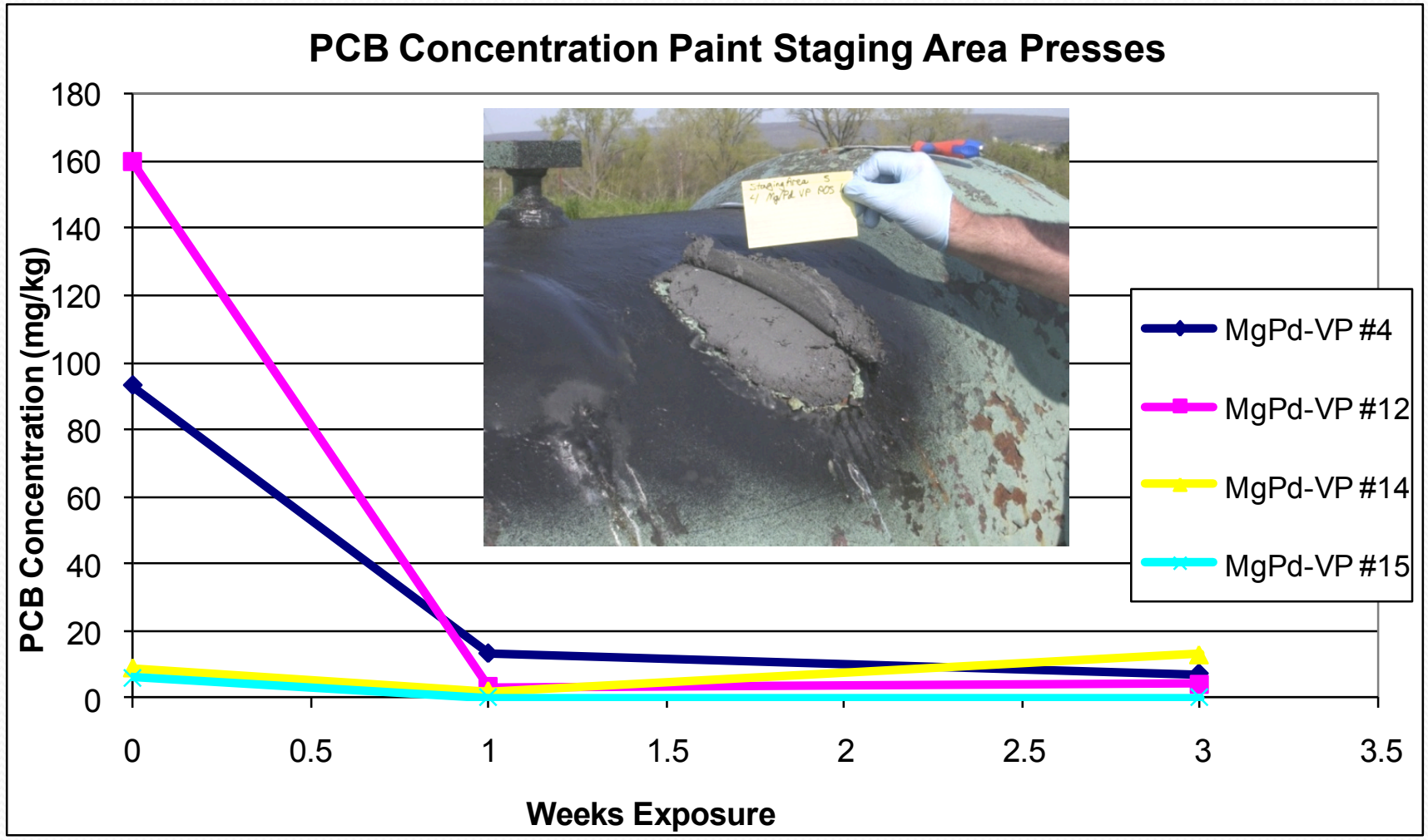
Painted Surfaces

# Paint on Concrete Bunkers




Concentrations in paint after 1, 2 and 3 weeks exposure to BTS on concrete bunker

# Painted Metal Equipment



# Nitrating Facility
# Painted Metal Tanks

- PCB concentrations in paint on the metals in building 6657-02 were ~10,000 to 53,000 mg/kg
- Post treatment concentration in paint 6,600 to 20,000 mg/kg
- BTS successful at extracting PCBs but need multiple applications of BTS to treat such high starting concentrations in multiple layers of paint

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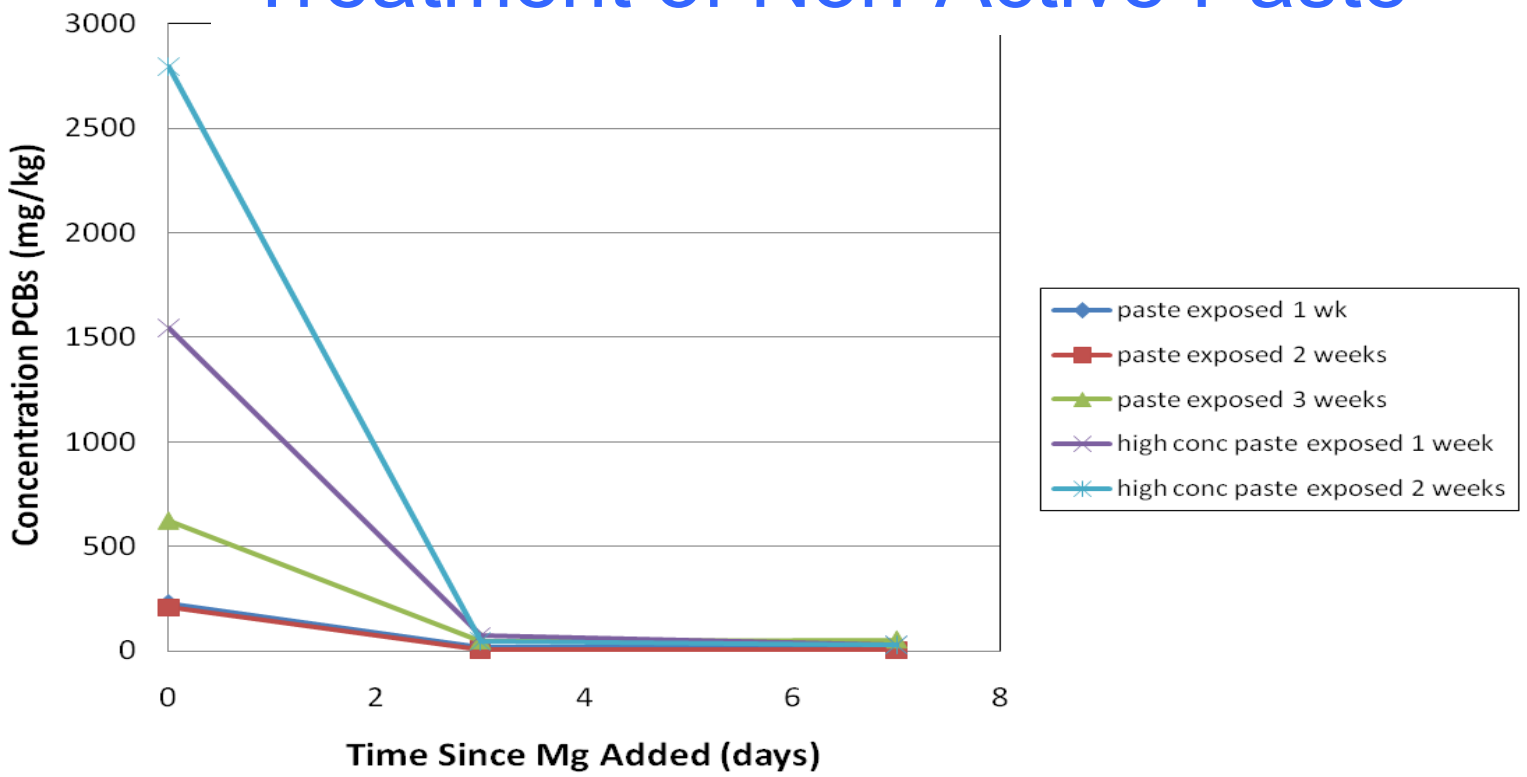
# Treatment of Non-Active Paste




- 10% of activated Mg added to paste after removed from painted structures and successful treatment to below 50 mg/kg even with high starting concentrations

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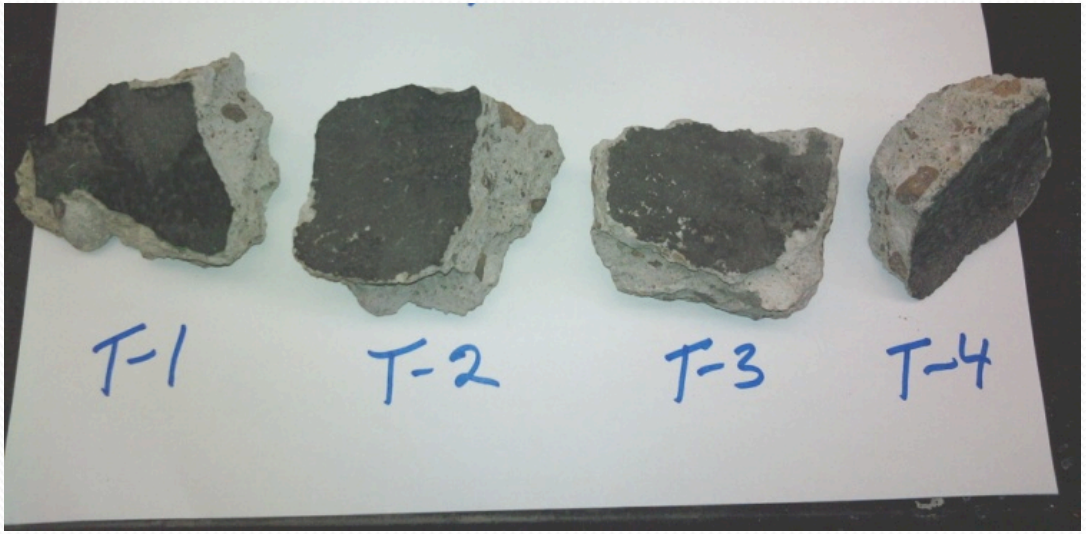
# Conclusions from ESTCP Demonstration

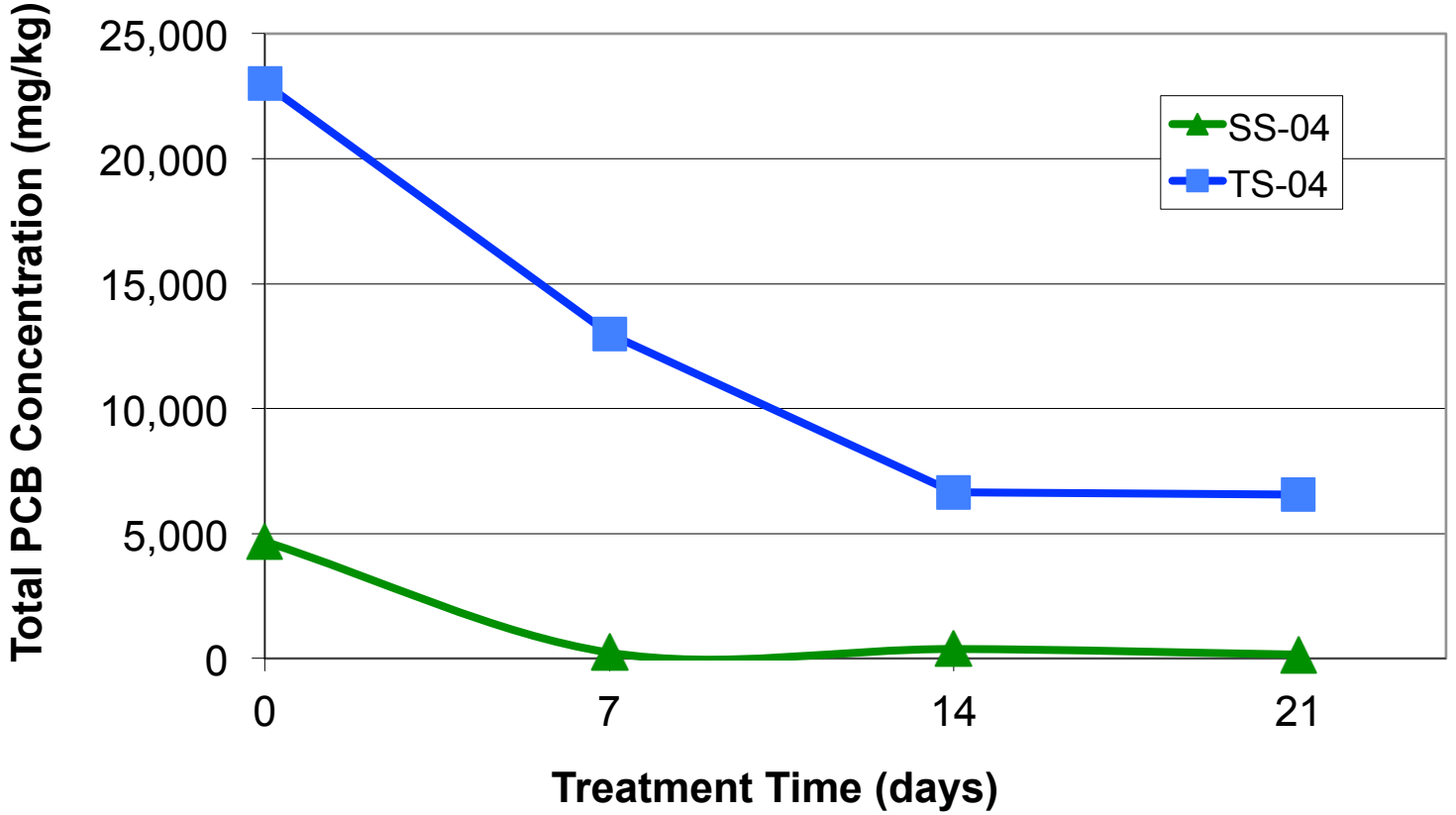
- Demonstrated Removal of PCBs from painted surfaces
- High concentrations may require multiple applications of paste
- Can successfully remove PCBs with non-active paste and treat later by adding acidified ZVMg

# Treatment of Concrete Floor Material

- AMTS applied, then allowed to react in a jar (pieces) or under sealant (coring) for allotted time
- PCB concentration varies with depth in concrete



# PCBs in Concrete After Treatment



# Further Work

- Understanding regulatory drivers to address PCB in existing buildings
- Development of optimal approaches for different surfaces and materials
- Continued development of AMTS activated paste or emulsion for use in *ex situ* treatment of soils and sediment
- Application of AMTS to other compounds

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# Related Environmental Issues

- Sampling indoor air for PCBs
- Storm water management related to PCBs
- Appropriate disposal of impacted material
- Treatment of soil and sediments impacted by PCBs

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# Questions?

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# Extra Slides

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# EPA Says:

**CURRENT BEST PRACTICES FOR PCBS IN CAULK FACT SHEET**
**Removal and Clean-Up of PCBs in Caulk and PCB-Contaminated Soil and Building Material**
Last Updated: September 2009

Caulk containing PCBs at levels greater than or equal to ( ≥) 50 parts per million (ppm) is not authorized for use under the PCB regulations and must be removed. Although you are not required to remove caulk containing PCBs at levels below 50 ppm, you may wish to because the caulk may present health risks depending on the location, condition, etc. PCBs in caulk are known to contaminate adjacent building material (e.g., masonry, wood, concrete) and soil surrounding the building. Therefore, any surrounding building material that is contaminated by ≥ 50 ppm PCB-containing caulk, such as through leaching of PCBs, must be cleaned up. Safely removing the PCB-containing caulk, while preventing further contamination and cleaning up surrounding materials, should be the focus of cleanup projects.

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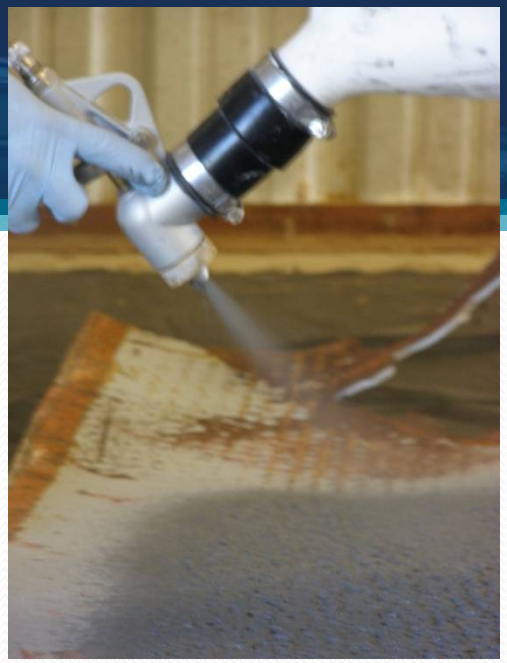
# Application of Sealant

- truck bed liner coating sold as an aerosol spray (toluene-based)
- roof coating sold in spray liquid form (mineral spirits-based)



Application of BTS to VIB samples using pressurized sprayer

Manual application of BTS to VIB samples.