

PCBs in Caulk and Paint

Presenter : Giselle Rodriguez

Construction Engineering Research Laboratory

Engineer Research and Development Center

Environment, Energy, Security & Sustainability

Symposium & Exhibition

Wednesday, June 16 2010



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US Army Corps of Engineers

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Report Documentation Page

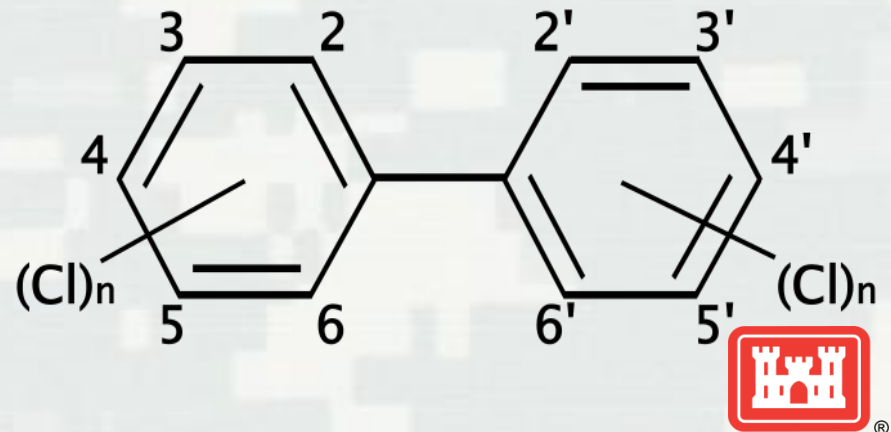
Form Approved
OMB No. 0704-0188

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1. REPORT DATE 16 JUN 2010		2. REPORT TYPE		3. DATES COVERED 00-00-2010 to 00-00-2010	
4. TITLE AND SUBTITLE PCBs in Caulk and Paint				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Army Engineer Research and Development Center, Construction Engineering Research Laboratory, Champaign, IL, 61826-9005				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES Presented at the NDIA Environment, Energy Security & Sustainability (E2S2) Symposium & Exhibition held 14-17 June 2010 in Denver, CO.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 22	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Polychlorinated Biphenyls

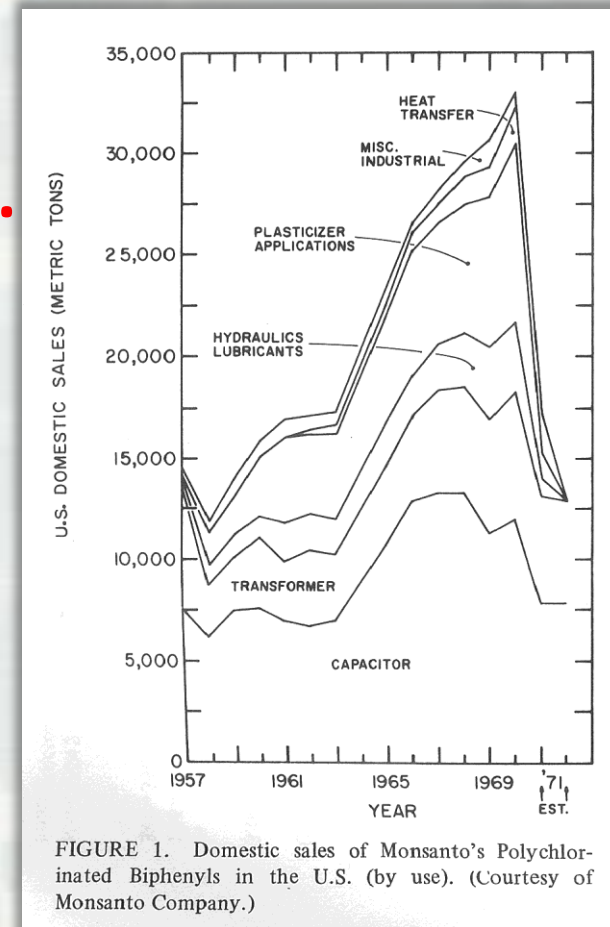
- Polychlorinated Biphenyls – PCBs
- Organic Compound
- Different congeners – *different properties*
- Marketed under the trade name **Aroclor**
- Aroclor 1260
 - ▶ 12 carbon atoms
 - ▶ 60% chlorine by mass.



PCBs Manufacture

- First PCBs were synthesized in **1881**.
- Manufactured by:
 - ▶ **Anniston Ordnance Company**
1927
 - ▶ **Swann Chemical Company**
1930
 - ▶ **Monsanto Industrial Chemical**
1935-1977

- Sauget, Illinois and Anniston, Alabama
- Production peak - **1970**



The chemistry of PCB's, 1974



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PCB Ban

- Federal law banned U.S. production of PCBs
 - ▶ July 2, 1979
- Toxic Substances Control Act (TSCA)
 - ▶ Bans the manufacture, processing, use and distribution in commerce of PCBs
 - ▶ Gives EPA authority:
 - *To develop, implement and enforce regulations for the use, manufacture, cleanup and disposal of PCBs*
- Current PCB regulations
 - Code of Federal Regulations (CFR) at **40 CFR 761**



Potential PCB sources

- Any of these products if manufactured before 1979:
 - ▶ Capacitors or transformers
 - ▶ Mineral-oil filled electrical equipment
 - ▶ Fluorescent light ballasts
 - ▶ Waste or debris from the demolition of buildings and equipment manufactured, serviced, or coated with PCBs
 - ▶ Waste containing PCBs from spills, such as floors or walls contaminated by a leaking transformer



Potential PCB sources

- ▶ Plastics
- ▶ Molded rubber parts
- ▶ Applied dried paints
- ▶ Oil-based paints
- ▶ Coatings/Sealants
- ▶ Caulking
- ▶ Adhesives and tapes
- ▶ Carbonless copy paper
- ▶ Galbestos
- ▶ Sound-deadening materials
- ▶ Insulation



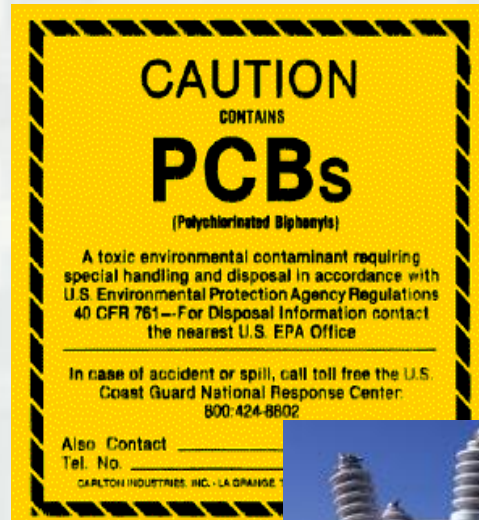
PCBs in Transformers

- **Transformers** are devices that can increase or decrease the voltage level of an electrical current.
 - ▶ filled with dielectric fluid, *PCB-based oil mixtures*
 - ▶ Manufactured between 1929 and 1977
- Trade names for PCBs in transformers
 - ▶ Abestol, Aroclor, Askarel, Chlophen
 - ▶ Chlorextol, DK, EEC-18, Fenclor
 - ▶ Inerteen, Kennechlor, No-Flamol, Phenoclor
 - ▶ Pyralene, Pyranol, Saf-T-Kuhl, Solvol
 - ▶ Non-Flammable Liquid



PCBs in Transformers

- 40 CFR 761
- **PCB Transformer**
 - ▶ PCBs at concentrations **≥ 500 ppm**
 - ▶ Requirements for management:
 - PCB Transformers must be registered
 - Visual inspections
 - Proper PCB identification labels
 - Records of inspections and maintenance
 - ▶ PCB transformers may be disposed:
 - TSCA chemical waste landfill



PCBs in Caulk

- **Caulk** is a flexible material used to seal gaps to make windows, door frames, masonry and joints in buildings and other structures watertight or airtight.
 - ▶ PCBs imparted flexibility
 - ▶ Used in many buildings, including schools, in the 1950s through the 1970s
- September 2009, EPA provided new guidance to communities



PCBs in Caulk

- Exposure may occur by:
 - ▶ Release from the caulk into the air
 - ▶ Dust
 - ▶ Surrounding surfaces and soil
 - ▶ Direct contact.
- The link between the concentrations of PCBs in caulk and PCBs in the air or dust is not well understood.



<http://www.epa.gov/pcbsincaulk/caulkexposure.htm>



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PCBs in Caulk - Recent Studies

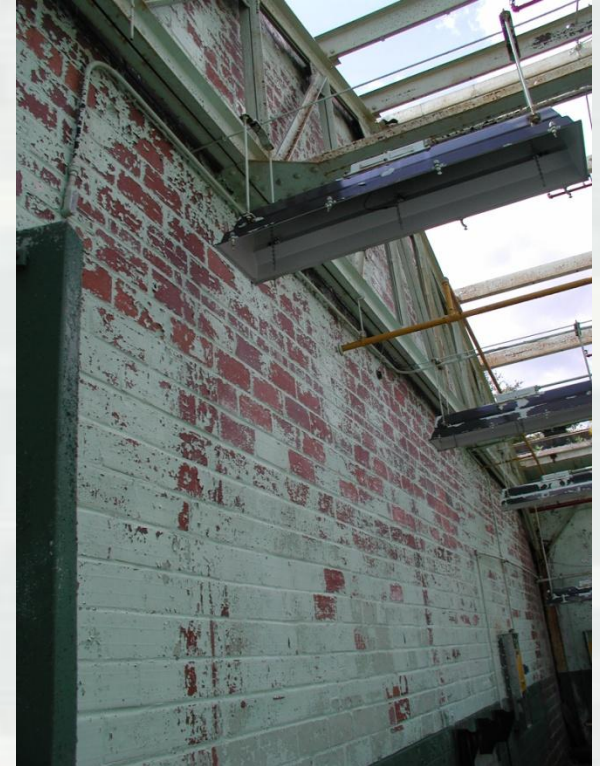
■ New York City Schools

- ▶ Agreement with EPA to address PCBs in caulk
- ▶ The city will conduct a study in five schools
- ▶ Assess and reduce potential exposure
 - Cleaning schools
 - Improving ventilation
 - Addressing deteriorating caulk
- ▶ City will ensure any PCB waste is removed
- ▶ After finalizing the study a plan will be developed and implemented - *identify, prioritize, and address*



PCBs in Paint

- PCBs were used in paints
 - ▶ To enhance structural integrity
 - ▶ Reduce flammability
 - ▶ Increase antifungal properties
- PCBs imparted heat resistance to the paints
- EPA reports PCBs concentrations in dried paint at a range from 1 ppm to 97,000 ppm



PCBs in Paint

172

THE CHEMICAL FORMULARY

Swimming Pool Paint

Lacquer Phase:	Formula	For Concrete		For Steel
		No. 1	No. 2 ^a	No. 3 ^b
"Parlon" (20-cp)		100.0	100.0	100.0
"Duraplex" C-49 (100%) ^c		50.0	50.0	50.0
"Aroclor" 1254		50.0	50.0	50.0
Titanium Dioxide (Rutile)		112.0	112.0	50.5
Magnesium Silicate		115.0	116.0	50.7
Phthalocyanine Green		2.9	3.0	1.3
"Bentone" 34		13.0	12.0	5.0
"Tween" 60		—	8.5	—
Epichlorohydrin		1.0	—	0.6
Xylene		450.0	210.0	285.0
"Solvesso" 100		90.0	50.7	28.0
Water Phase:				
Methylcellulose (4000 cp)		—	7.6	—
Sodium Oleate		—	15.7	—
Distilled Water		—	520.0 ^d	—
Properties:				
Solids, wt %		45.1	64.1	50.0
Pigment vol-con, %		35.0	35.0 ^d	20.0
Viscosity, Krebs units		74.0	—	75.0
Viscosity, Brookfield, cp				
No. 4 spindle, 30 rpm		—	6,000	—
No. 4 spindle, 12 rpm		—	12,000	—

^a Emulsion, prepared by slow addition of water phase to lacquer phase with mixing until smooth emulsion is formed

^b Meets gloss requirements of Federal Specification TT-P-95

^c Made compatible by the presence of "Aroclor" 1254

^d In lacquer phase

Masonry Paints

	For Bricks, For Swimming Pools, Asbestos Shingles, and Similar Surfaces			
	No. 1	No. 2	No. 3	No. 4
"Parlon" S10	—	—	5.30	—
"Parlon" S20	8.00	11.50	—	8.60
"Duraplex" C-49	4.00	—	—	—
"Clorafin" 40	—	4.35	1.95	—
"Aroclor" 1254	4.00	—	—	—
"Duraplex" D-65A (85%)	—	7.11	3.27	—
Raw linseed oil	—	—	—	6.40
Linseed oil, heat-bodied, viscosity Z3	—	—	—	6.40
Titanium dioxide	15.20	10.30	20.60	11.40
Zinc oxide	—	3.90	4.10	4.30
"Asbestine" 3X	15.20	6.40	10.40	7.20
Mica (325 mesh white waterground)	—	5.10	6.30	5.80
"Bentone" 34	1.60	—	2.50	2.90
"Amsco Solv" D	—	33.74	31.46	31.16
"Solvesso" 100	—	13.40	10.60	12.00
Turpentine	—	3.54	3.20	3.30
Xylene	51.96	—	—	—
Epichlorohydrin	0.04	0.06	0.03	0.04
"ERL" 2774	—	0.60	—	0.40
Cobalt naphthenate, 6%	—	—	0.03	0.10
"Dyphos"	—	—	0.26	—

Aroclor 1254 most commonly used for paints

The Chemical Formulary – VOL XV, 1970



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PCBs in Paint



PCB containing paint at closed Army ammunition plants has compromised and delayed the decontamination processes.



Field Detection Technologies

- Enzyme-linked immunosorbent assay (ELISA)
 - ▶ Antibodies bind with a selected environmental contaminant
- Antibody-antigen reaction
 - ▶ PCB-specific antibodies
 - ▶ Colorimetric Reaction
 - Amount of color inversely proportional to concentration



RaPID Assay PCB Test Kit



PCB in soil Pocket Colorimeter Test



PCB Rapid Strip Test Kit



Field Detection Technologies

■ L2000 PCB/Chloride Analyzer

- ▶ Principle of total organic chlorine detection
- ▶ Electrochemical analysis using an ion-specific electrode
- ▶ Wipe sampling kit

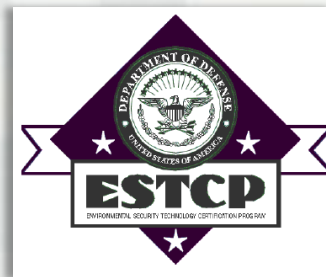


Recommended use: Aroclor known – no halogenated organics



Bimetallic Treatment System (BTS)

- Removes and degrades PCBs from structures and coatings such as paint and adhesives utilizing an in situ approach
- Two step process:
 - ▶ Extract PCBs without destroying the paint
 - ▶ Partition the PCBs into an environmentally friendly solvent



Bimetallic Treatment System (BTS)

- Applied to paint by wipe or spray
- Solvent Solution with catalyzed zero-valent metal
 - ▶ Ethanol and limonene
 - ▶ Mg/Pd bimetallic
- Mixture forms a paste - spray sealed
- Removes PCBs from paint
 - ▶ 80% within 4 hours
 - ▶ 100% within 48 hours



<http://nasaksc.rti.org/Bimetallic.cfm?pageID=BimetallicTechnology>

The technology has been field demonstrated at Cape Canaveral Air Station, Fl and Badger Army Ammunition Plant, WI.



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Recent Studies

Abrasion-Resistant Floor Finish	
<i>Solids</i>	
"Parlon" S20	50
"Aroclor" 1254	25
"Duraplex" C-55	25
<i>Solvents</i>	
"Solvesso" 100	80
Xylene	10

The Chemical Formulary – VOL XV, 1970

- **PCB blood levels in teachers**
 - ▶ Germany
 - ▶ 151 teachers from 5 different schools
 - ▶ Study found moderate elevations of blood levels of PCB-28 and PCB-101 among teachers in some schools
- **PCBs in wood floor finish**
 - ▶ Cape Cod, MA
 - ▶ Detected PCBs in indoor air in 31% of 120 homes
 - ▶ Study found elevated blood PCB concentrations in residents of homes.

Gabrio T. et al., PCB-blood levels in teachers, working in PCB-contaminated Schools, Chemosphere 40(2000)1055-1062

Rudel R. et al, PCB-containing wood floor finish is a likely source of elevated PCBs in residents' blood, household air and dust: a case study of exposure, Environmental Health 2008, 7:2



New Concerns

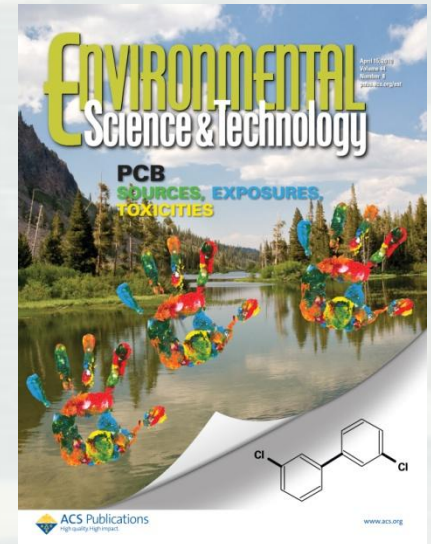
■ PCB 11 – 3,3'-dicholorbiphenyl

- ▶ Byproduct of manufacturing process
- ▶ Linked to the manufacture of organic yellow coloring – *diarylide pigment*
- ▶ Suspected to be released when paint vaporizes
- ▶ Has been discovered in consumer products
 - Printed newspaper
 - Yellow cereal boxes
 - Plastic bags
- ▶ Present in air samples - Chicago, Philadelphia, the Arctic
- ▶ Studies – *University of Iowa and Rutgers University (ES&T)*



What's Next?

- EPA is proposing changes to PCB regulations to address issues like PCBs in caulk
- New procedures should be implemented
- ES&T journal issue dedicated to PCBs
 - ▶ April 15 2010
 - ▶ Volume 44, Issue 8, pages 2747-3200
- Public Works Technical Bulletin (PWTB)



Questions?

Sponsor:

Malcolm McLeod - *HQUSACE*

202-761-0632

Malcolm.e.mcleod@usace.army.mil



Author's Contact Information:

Stephen D. Cospers

stephen.cospers@us.army.mil

(217)-398-5569

Giselle Rodriguez

giselle.rodriguez@usace.army.mil

(217)-373-3434



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