PCBs in Caulk: Myth and Reality

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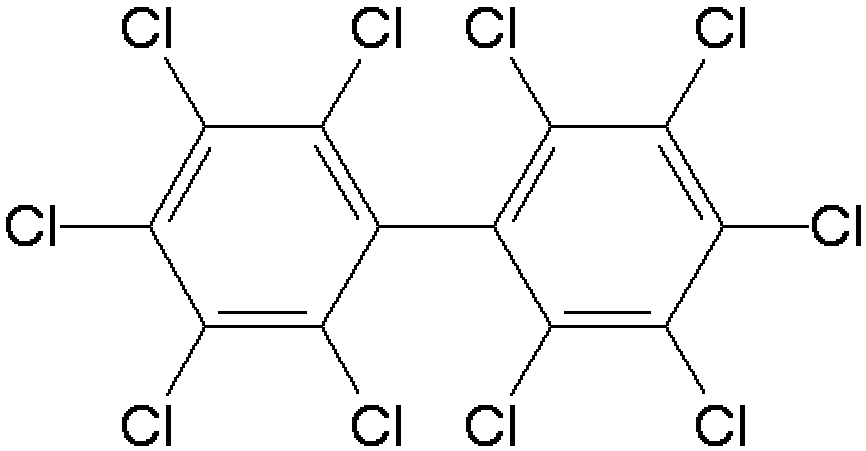
The Basics - PCBs



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The Basics

- PCBs = polychlorinated biphenyls
- Manufactured 1926 – 1977
- Heat stable, fire resistant, good heat transfer characteristics
- They're everywhere! They're everywhere!
  - Ubiquitous in the environment
  - Oils – transformer, lubricating, hydraulic
  - Plasticizer - % concentrations in plastic toys
  - Inks
  - Paper bleaching – formed from chlorine process

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The Basics

- Large, high- and low-voltage capacitors
- Liquid-cooled electric motors
- Fluorescent light ballasts
- Electromagnets
- Liquid-filled cable
- Gasketing and dampening felt
- Microscopy mounting media and immersion oil
- Switches
- Voltage regulators
- Vacuum pumps
- Paints
- Sealants

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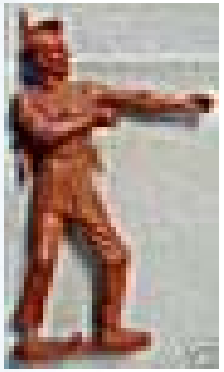
PCBs

- Plasticizer



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The Basics

- Estimated 1.5 million tons produced world-wide
  - Arochlor (Monsanto)
  - Kanechlor (Kanegafuchi, Japan)
  - Chlophen (Bayer, Germany)
  - Phenochlor and Pyralene (Prodolec, France)
  - Santotherm (Mitsubishi, Japan)
- Chlorine content
  - Arochlor 1232 = 32%
  - Arochlor 1242 = 42%
  - Arochlor 1260 = 60%
  - Arochlor 1016 = 41%

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The Basics

- Homologues
- Isomers
- Congeners

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The Basics

- Reports of PCBs in the environment started coming out c. 1968
- The range of PCB-concentrations in mother's milk in the last ten years is between 0.5 and 2.5 mg/kg milk fat. The average concentrations have been decreasing constantly since 1984. (German study)
- In the environment:
  - Sediment associated
  - Lipophilic
  - Not very water soluble

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Potential Human Health Issues

- Developmental problems and reduced mental abilities in infants and children born to women who were exposed to PCBs
- Problems with the nervous, immune, circulatory and hormonal systems
- Liver damage, brain disorders, and skin problems
- Increased risk of cancer
- The risk for fish consumers is at least 10 times greater than for all other population groups
  - Wisconsin DNR

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Properties of PCBs in caulk

- Low vapor pressure
- Insoluble (generally) in water
- Not readily biodegraded
- Theoretically locked into polymeric structure of the sealant (trapped in the layers of long chain polymers)

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U.S. Regulation

- OSHA Permissible Exposure Limit (PEL)
  - 1 mg/m^3 for PCBs containing 42% Cl
  - 0.5 mg/m^3 for PCBs containing 54% Cl

- USEPA
  - Caulks and other sealants not leachable
  - Established a separate category for their disposal
    - Bulk Product Waste (June 29, 1998): "containing PCBs which are tightly bound within the matrix of PCB bulk product wastes"

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Swiss Study

- Swedish study linked indoor air levels to presence of PCB-containing sealants
- Findings:
  - 720 ng/m^3 to 13,000 ng/m^3 =
  - 0.000720 mg/m^3 to 0.013 mg/m^3

Swiss level limit value (LLV) = 0.1 mg/m^3

– Kohler, Zennegg and Waeber, ES&T (2002)

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U.S.

- University of Rhode Island:
  - Spent $3.8 million to clean duct work and surfaces, replaced 220 window units, and provided blood screening for faculty in building where PCBs found
  - Linked to PCBs in window caulk and gasketing
- French Hill Elementary School, Westchester Co., NY - Concerned parent collected a caulk and soil sample after a window upgrade the previous year
  - $300,000+ project
    - window caulk encapsulation
    - exterior decontamination
    - soil remediation
  - See: www.pcbsinschools.com

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Making a connection

- Despite high PCB indoor air levels in schools, there was only a moderate increase in blood concentrations of teachers, mainly due to congeners with low chlorination.
  - Gabrio, *et al.*, Chemosphere (2000)

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Making a connection

- German study:
  - Schwenk, et al. (Chemosphere, 2002)
    - linked existence of PCB-containing sealants in school buildings to elevated PCB blood levels in teachers.

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Making a connection

- Finnish study
  - Building containing PCB materials
  - PCBs in blood levels of residents showed no significant difference to control group
    - Priah, Hellman and Sorvari (Chemosphere 2005)

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Making a connection

- What is missing from these and other studies?
  - Evaluation of other PCB influences in the building being studied – what other sources may be present?
  - What PCBs are we measuring v. which are present?
  - Implications of other epidemiologic influences – what other exposures are occurring?

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What are the Potential Issues?

- Questions about release from material matrix may require greater study
- Recently reported studies are silent or equivocal on the influences of other PCB sources to the conclusions being made

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What to do?

- Evaluate the specific situation
- Do not acquire data unless you have an unequivocal benchmark for it
- OSHA PELs establish a workplace exposure limit
  - However
    - there is a question of involuntary exposure
    - there may be a perceived obligation for a higher level of protection in educational institutions where children are present

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