Overview of Occupational Exposures to Pentachlorophenol

Components, Contaminants, and Common Co-Exposures

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Disclaimer: The findings and conclusions in this presentation are those of the author and do not necessarily represent the views of the National Institute for Occupational Safety and Health.
Background

- PCP was produced in the United States primarily in four chemical plants, from 1936 to 2006.
- PCP was widely used in herbicides, fungicides, and wood preservatives.
- Currently used industrially as a wood preservative for utility poles, railroad ties, and wharf pilings.
Background

- PCP was not restricted to its country of origin, some products were made during this time with PCP produced outside of the U.S.

- Currently there are no companies reporting production activities in the U.S., one facility in North America

- One known formulation facility in Tuscaloosa AL
Background

- PCP is classified by the International Agency for Research on Cancer as a possible human carcinogen (Group 2B)
- Use has been restricted to certified applicators in the U.S. since 1984
- Polychlorinated di-benzo dioxins and polychlorinated di-benzo furans are contaminants formed during the production of PCP

2,3,4,5,6-pentachlorophenol (CAS 87-86-5)
Manufacturing

- All PCP manufactured in the United States was produced by the direct chlorination of phenol in the presence of various catalysts.

- Phenol and chlorophenols were added to a chlorinator tank.

- Chlorination was achieved with vaporized liquid chlorine until the Trichlorophenol stage is reached (60-65°C).

- A catalyst was added, and temperature raised to 70-75°C until a specific gravity of 1.670 was reached.

- Batch temperature was then gradually increased until desired crystallization point of the completed Penta-Chlorophenol state is reached.
Commercial Manufacturing

- PCP manufacturing contaminants included dioxins and dioxin-like compounds (Hepta-, Hexa, and octachloro di-benzo dioxins and furans), but not 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in significant levels.

- PCP finishing options included:-
  - Flake – 1930s to the 1960s
  - Prilling – 1960s (flaking and prilling offered greatest exposure scenarios)
  - Block molding – 1970s to present

- Production peaked in the late 1960s due to demands for NaPCP

- Most production facilities also made other chemical products
Common PCP contaminants

• From Technical Grade PCP analysis
  - Hexachlorodibenzo-\(p\)-dioxins (HxCDD)
  - Hexachlorodibenzofurans (HxCDF)
  - Heptachlorodibenzo-\(p\)-dioxins (HpCDD)
  - Heptachlorodibenzofurans (HpCDF)
  - Octachlorodibenzo-\(p\)-dioxin (OCDD)
  - Octachlorodibenzofurans (OCDF)

• Serum analyses of Human and animal populations use these same markers in determining exposures to PCP
Examples of Company Analysis of Technical Grade PCP Contaminants

<table>
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<tr>
<th>Year</th>
<th>Sample Type</th>
<th>Analyte</th>
<th>Number of Samples</th>
<th>Mean µg/g</th>
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Modern Use Restricted

• Wood Preservatives
  
  o PCP has a long history of use as a wood preservative (restricted use since 1984)
  
  o May be used alone or in conjunction with other chemical substances such as
    ▪ Creosote- can be wood creosote, coal tar creosote, coal tar pitch, or coal tar pitch volatiles
    ▪ Chromated Copper Arsenate (CCA)
Wood Preservative Industry Exposures

- About 27000 workers in the PCP wood preservative industry as of 1991 (NIOSH National Occupational Exposure Survey)

- 2007 Census shows 13,369 workers in the wood preservative industry total. (U.S. Census)

- PCP treatment is still a common operation in the industry today

- Several studies report elevated HpCDD, HxCDD, and OCDD in blood serum samples from people living near active and former wood treatment facilities

- These blood serum markers are very similar to those found in PCP manufacturing workers, though not as high
Wood preservative process and exposure routes

- PCP and or other preservatives impregnated into wood stock at high temperature and pressure
- Wood is then stacked to air dry or kiln dried
- If air dried, evaporation into air or dripping of chemical mixtures onto the ground can occur
- Wood wastes could be burned, waste water often injected in boilers
- Often created chronic low level exposure to surrounding areas
<table>
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<th>Year</th>
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Questions?
Selected References


Selected References

