

# 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

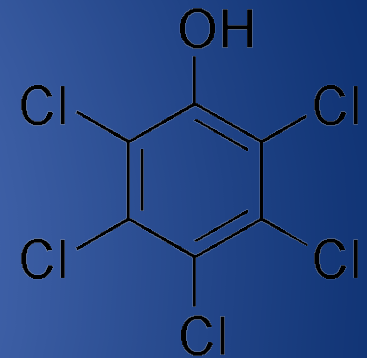
- PCP was produced in the United States primarily in four chemical plants, from 1936 to 2006
- PCP was widely used in herbicides, fungicides, and wood preservatives
- Currently used industrially as a wood preservative for utility poles, railroad ties, and wharf pilings

# 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<sup>o</sup> C)
- A catalyst was added, and temperature raised to 70-75<sup>o</sup>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

Year	Sample Type	Analyte	Number of Samples	Mean $\mu\text{g/g}$
1976	PCP	2,3,7,8-TCDD	2	0
1965	PCP	HpCDD	1	110
		OCDD	1	140
1970	PCP	HxCDD	3	24.6
		HpCDD	3	24
		OCDD	1	15
1976	PCP	HxCDD	6	12.2
		HpCDD	5	100
		OCDD	6	283
1977	PCP	HxCDD	1	4.2
		OCDD	1	584



# Modern Use Restricted

- Wood Preservatives
  - PCP has a long history of use as a wood preservative ( restricted use since 1984)
  - 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

## EPA Toxic Release Inventory Data for PCP

TRI On-Site and Offsite Reported Disposed of or otherwise released (in pounds), for facilities in "NAICS 321-Wood Products, and NAICS 562Hazardous Waste/Solvent Recovery for PENTACHLOROPHENOL" CHEMICAL, U.S.				
Year		Industry		Lbs Disposal or Other releases
2006		NAICS 321-Wood Products		1307.2
		NAICS 562-Hazardous Waste/Solvent Recovery		1131.6
2008		NAICS 321-Wood Products		2965.9
		NAICS 562-Hazardous Waste/Solvent Recovery		2596.1
2010		NAICS 321-Wood Products		3940.1
		NAICS 562-Hazardous Waste/Solvent Recovery		328209
2011		NAICS 321-Wood Products		4785
		NAICS 562-Hazardous Waste/Solvent Recovery		89450

# Questions?



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