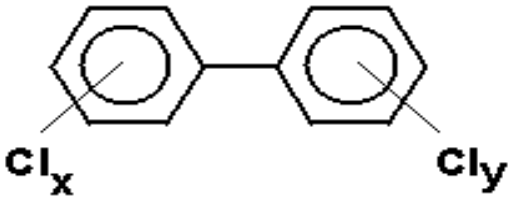
PCB Waste and Environment



- **High industrial use in the 1930s and 1940s**
- **Man-made chemicals - 209 congeners**
- **Industrial products, by-products at industrial processes**
- **Widely applied in industry:**
  - **Close systems**
  - **Open systems**
- **Close:** coolants and lubricants in transformers, dielectric fluids in capacitors, hydraulic fluids and heat-transfer media.
- **Open:** plastificators, additives into carbonless copy paper, lubricants, inks, impregnating and paint agents, glue, wax, cement and plaster additives, lubrication of cast blocks, materials for dust separators, sealing liquids, flame retardants, immersion oils and pesticides.

Why were PCBs used?

- low vapour pressure
- high boiling point (278-415 °C)
- low solubility in water (20 °C, 15 ppb)
- good solubility in many organic solvents and in lubricants
- good thermal conduction
- high dielectric constant
- high-temperature resistance
- inert
- insulting
- lipophilic
- colorless-light yellow-dark brown

Environmental fate

- evaporate very slowly,
- found in soils, surface waters, sediments, air throughout the world,
- resistance to degradation,
- persistent long after their use
- accumulation in the environment,
- eco-toxic,
- enter to human body - inhalation, direct contact, through the skin, food chain,
- transmission in breast milk and across the placenta
- concentration is low in tropical area and higher in temperate or Polar Regions

Goals

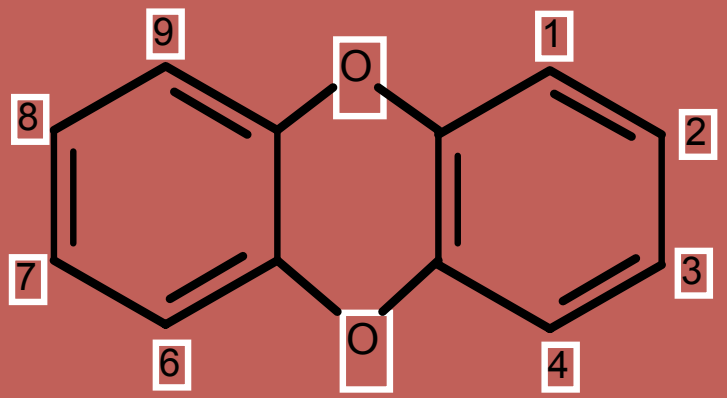
- Inventory of PCB and basic results of PCB
- Implementing of decontamination of waste and equipment containing PCB
- Concentration limit 50 ppm or lower???
- Decontaminate/Dispose.

Strategy to achieve the goals

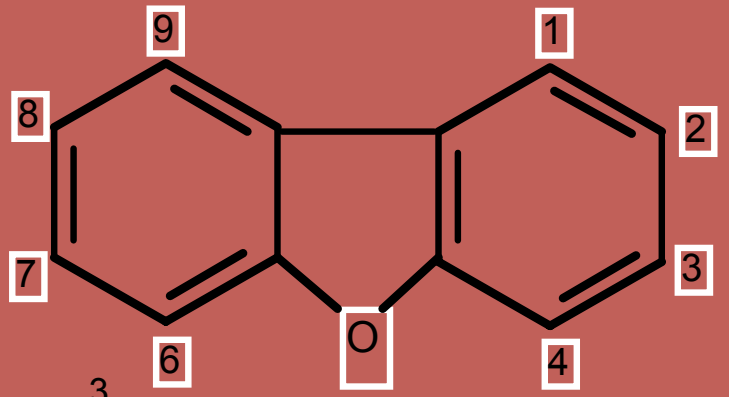
- inventory of PCB
- collection of PCB
- safe and environmentally suitable disposal
- monitoring of activities
- **Necessity**:

  cooperation State authorities and Private sector

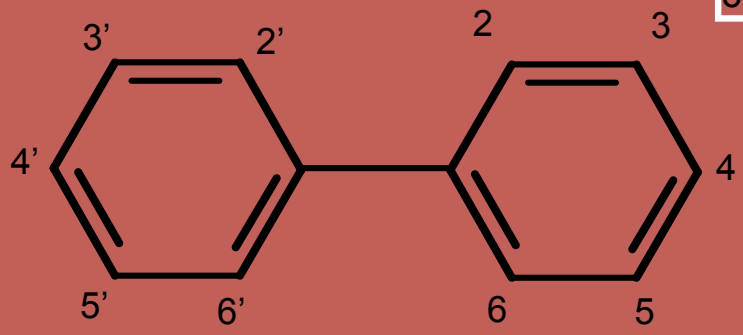
Dioxins, Furans, PCBs



PCDD



PCDF



PCB

Fates of organic species

- Transport
- Degradation due to:
  - hydrolysis (needs water)
  - photodegradation (needs uv light)
  - biodegradation (micro organisms)

Fates of organics (cont)

- Substances persist in the environment if they resist attack by these mechanisms
- most of these mechanisms are water related (most of biota is water)
- low water soluble species tend to have high fat solubility
- low water soluble species tend to have long peristence
- increased concentrations increases lifetimes

Persistence and Bioaccumulation

- slow degradation --> **persistence**
- solubility in lipids (fats) generally results in **bioaccumulation** (increased concentration as you move up the food chain)

Bioaccumulation

1x in water column

250x in phytoplankton

500x in zooplankton

45,000x in mysid shrimp

835,000x in smelt

2,800,000x in Lake Trout

25,000,000x in Herring gull

Brief history of PCBs

Polychlorinated Biphenyls (Francis, 1994)

- 210 isomers are PCBs
- Developed 1930s as high boiling point, stable heat transfer fluids
- 50% capicators and transformers, 20% plasticizers, also used in hydraulic fluids, inks, lubricants, waxes, cutting oils, adhesives
- peak production in 1970 in US

How much PCB was produced?

- 1930-1970 in US 1 billion lbs cumulative produced.
- peak year 85 million lbs/year produced in 1970.
- in world: 200 million lbs/year in 1970.
- US: after 1970 only in closed systems, after 1977 stopped totally.
- Names: Aroclor, Phenoclor, Fenclor, ...

PCBs released

- In the US in 1970: estimated 55 million lbs/year lost to environment.
- 80% to atmosphere through burning of paper, plastic or pain.
- 20% to surface water due to leaks, disposal of industrial wastes, leaching and atmospheric fallout.
- still PCBs left in transistors, etc.

Fate of PCBs?

- Different PCBs decompose at different rates
- Most chlorinated are generally most toxic and decompose slowest
- generally very persistent, highly soluble in fat, not very soluble in water

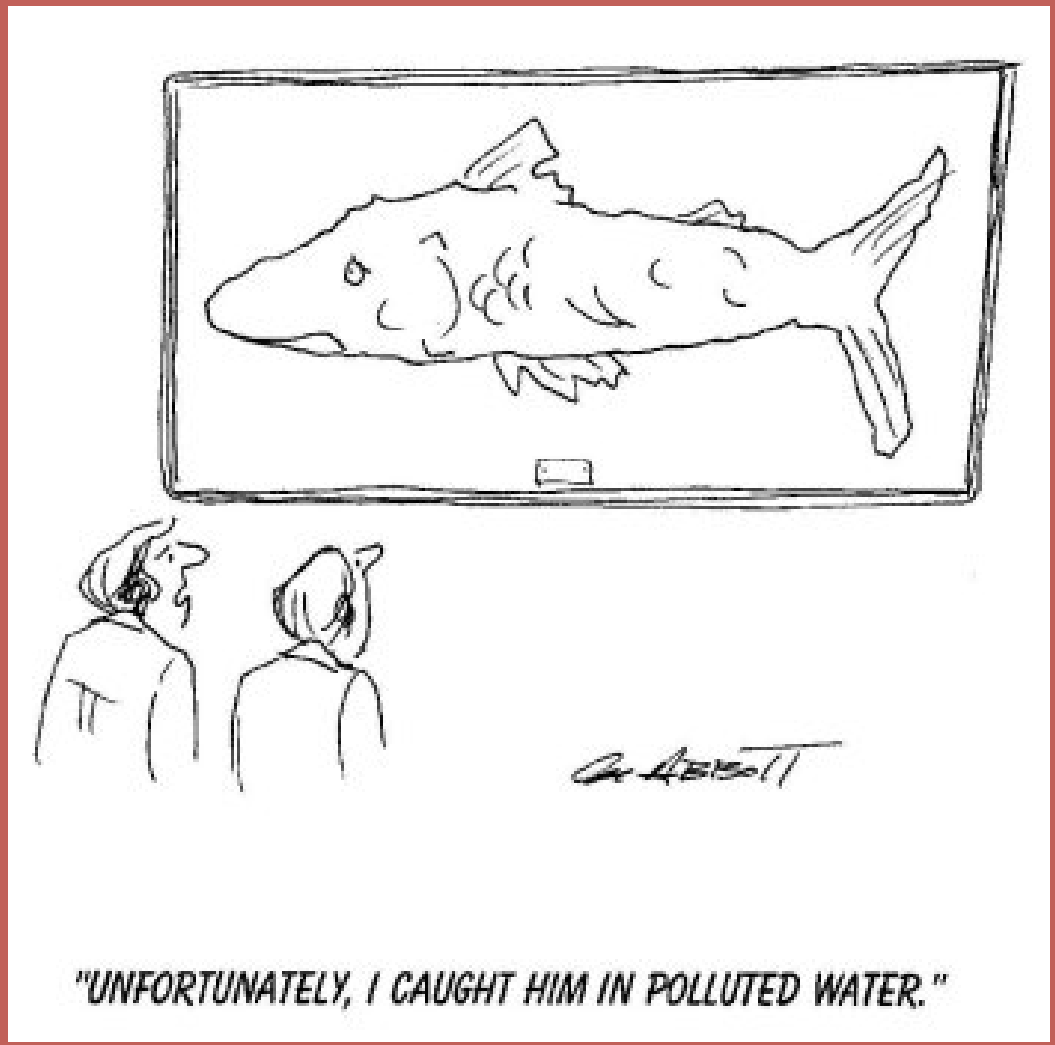
PCB Concentration in Animals?

- Fish in Lake Michigan: 10-15 ppm.
- Shark Liver 218 ppm.
- Brown pelican fat 266ppm.
- Bioaccumulation in Lake Superior from water to fish was 1 million fold.
- Humans: 1-2 ppm. Milk .5 ppm.

Future?

- Still much PCBs remaining in environment.
- Can clean up closed sources.
- Contaminated soils or water is too expensive and contains risk--where do you put soils?

Endocrine Disruptors and Wildlife



Wildlife Population Declines

- male feminization
- reduced male and female fertility
- modified immune system
- altered reproductive behavior
- cancers of reproductive tract

Some Wildlife Observations

- Female fish downstream from pulp mills have developed male organs and have altered behavior
- nearly all birds and fish in the Great Lakes have abnormal thyroids (low iodine?)
- Wadden Sea seals have lowered reproductive success associated with DDT/DDE
- male feminization and reproductive failure of alligators in Lake Apopka, FL associated with DDT/DDE

2 – (General) Technical Guidelines on POPs waste

Provide:

. General guidance on the management of

waste consosting of, containing or contaminated with POPs;

. A Framework for addressing issues referred to

n article 6.2 of the Stockholm Convention, on :

- Low POP Content
- Destruction Efficiency of disposal technologies
- Methods for environmentally sound disposal

3 – Technical Guidelines for ESM of POPs Waste

Issues to be addressed cooperatively (SC/BC)

A - Low POP Content

→ Defines the « border » between POPs and Non-POPs wastes

a. **PCB:** **50 mg/kg**

b. **PCDD/PCDF:** **15 µg TEQ/kg**

c. **All other POPs:** **50 mg/kg**
(aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, HCB, mirex, and toxaphene)

B - Levels of Destruction and irreversible transformat

a) Aqueous emissions: In accordance with pertinent national legislation and international rules, standards and guidelines;

b) Atmospheric emissions: Limit value for PCDD/F emissions to air defined: 0.14 ng TEQ/Nm. All other POPs, in accordance with pertinent national legislation and international rules, standards and guidelines;

c) Solid residues: POPs content should be below the agreed low POP contents

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