

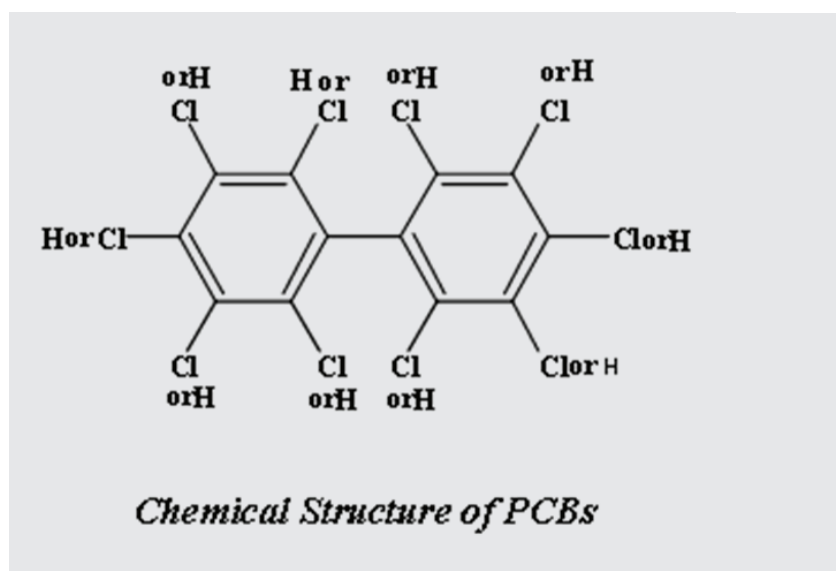


POLYCHLORINATED BIPHENYLS (PCBs)

A PERSISTENT ORGANIC POLLUTANT

Introduction

Polychlorinated biphenyls, commonly known as chlorobiphenyls or PCBs, are synthetic organic chemicals belonging to a broad family of chlorinated aromatic hydrocarbons. PCBs were first manufactured by Monsanto and were accepted as an important industrial breakthrough for various usage. Though PCBs are being produced in industrial processes, there are also PCBs like substances released unintentionally in the environment during industrial activities. Later, it was found that PCBs are highly toxic in nature and appropriate steps were taken to ban or reduce the use of PCBs to the extent possible.



PCBs AS PERSISTENT ORGANIC POLLUTANTS IN STOCKHOLM CONVENTION

PCBs are found to be persistent in the environment and are classified as Persistent Organic Pollutant (PoP) under the Stockholm Convention. In this convention PCBs have been included in both the “Annexure – A” (Part II) and “Annexure – C” of the Convention.

As per the provision of Annexure A, the Parties are to prohibit and/or take the necessary legal and administrative measures to eliminate

the production and use of PCBs. Parties are expected to make determined efforts to identify and label the equipment and remove PCB-containing equipment, notably certain electrical transformers and capacitors from use by 2025.

And as per Annex C, Parties must take measures to reduce the unintentional releases of PCBs from the environment with the goal of continuing minimization and feasible & ultimate elimination.

APPLICATIONS OF PCBs

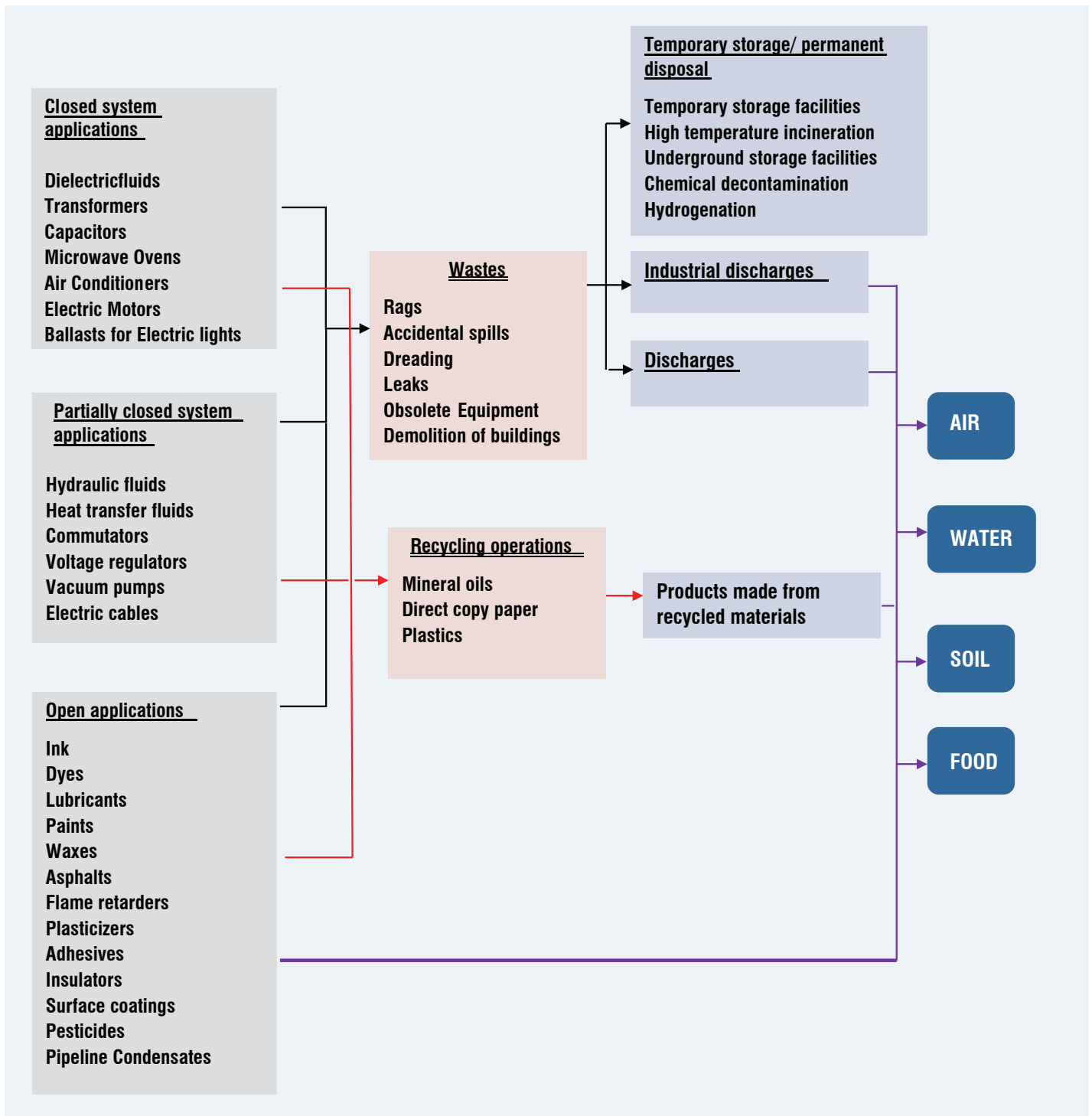
The PCBs have certain exceptional chemical properties like non-flammability, chemical stability, high boiling point, and electrical insulating properties, so PCBs were used widely in many industrial and commercial applications including electrical equipments, heat transfer, and hydraulic equipment; as plasticizers in paints, plastics, and rubber products; in pigments, dyes, and carbonless copy paper and many other industrial applications. After the toxic properties of PCBs were detected, many countries have ceased its production. By 1980s many countries across the globe stopped the production and use of PCBs. However, in exceptional cases, the former Soviet Union and some Central European countries continued to produce and use PCBs.

FACTS ABOUT PCBs

- PCBs are persistent organic pollutants (POPs).
- Production and use of PCBs are banned under the Stockholm Convention.
- Trans-boundary movement of PCBs are banned under the Rotterdam Convention & the Basel Convention.
- Half-life of PCBs in human body is 10-15 yrs.
- US EPA & International Agency for Research on Cancer (IARC) recognizes PCBs as Carcinogens.
- 10,000 tons of PCBs have been recorded in India
- Power sector reported largest PCBs storage.
- As per the Stockholm Convention, India has to eliminate PCBs by 2025.
- No technology is available in India for sound disposal of PCBs.

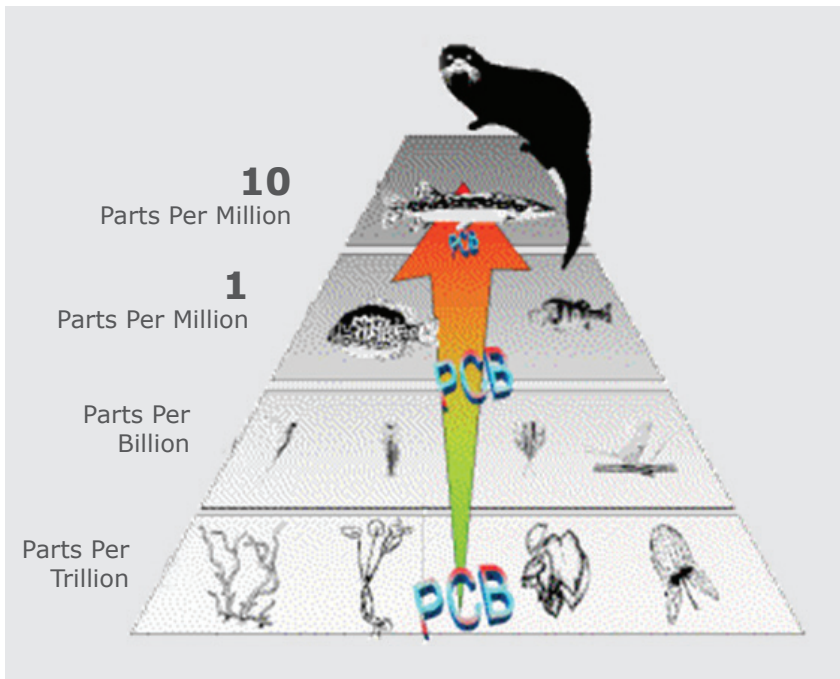


SOURCES OF PCBs IN ENVIRONMENT



Source: UNEP

Bio-magnification



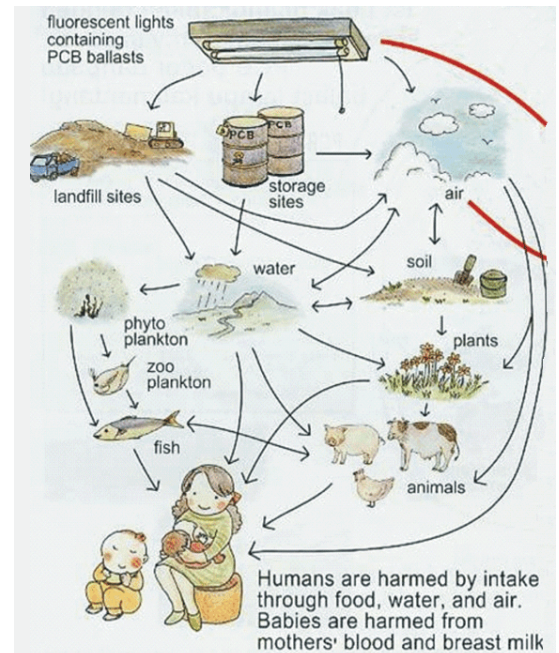
EXPOSURE PATHWAY OF PCBs IN HUMAN

- Old fluorescent lighting fixtures and electrical devices.
- Contaminated lipophilic food- The main dietary sources of PCBs are fish, meat, and dairy products.
- Inhaling of toxic air near hazardous and contaminated waste sites.
- Drinking a water contaminated with PCBs.
- During repair and maintenance of PCB transformers.
- Accidents, Fires and Spills from transformers.
- Contact with soil and sediments contaminated with PCBs (Children are at great risk to PCB contamination in soil).

EFFECTS OF PCBs ON ENVIRONMENT

PCBs are persistent organic pollutants (POPs), i.e. chemical substances which are persistent, bio-accumulative and causing adverse effect to human health & environment. Once in the environment, PCBs do not break down easily and therefore remain for longer period in air, water and soil.

PCBs can be carried long distances in the environment and have been found in snow and sea water in areas far away from the source of release. In general, the lighter the form of PCBs, the further it can be transported from the site of release. If released in the atmosphere, PCBs exist in the vapor phase however, after being released in water they are generally adsorbed on the sediments and suspended matters. PCBs also accumulate in the leaves of the plants and food crops. In the food chain process, PCBs enter into the fish and other aquatic organisms and finally bio accumulates in the human tissues.



EFFECT OF PCBs ON HUMAN HEALTH

Various studies have found that exposure to PCBs leads to serious health afflictions.

Acute effect

- Skin rashes
- Itching and burning
- Eye irritation
- Skin and fingernail pigmentation changes
- Disturbances in liver function and the immune system
- Irritation of the respiratory tract
- Headaches, dizziness, depression, memory loss, nervousness, fatigue, and impotence (Environment Canada 1985).

Chronic effect

- Elevated risk of cardiovascular disease, hypertension and diabetes
- Liver damage
- Reproductive & development effects
- Possibly cancer
- Pregnant women exposed to high levels of PCBs in the workplace or from eating fish contaminated with PCBs had babies with lower birth weight, lessened motor skills and weak immune systems.

GLOBAL EFFORTS TOWARDS SOUND MANAGEMENT OF PCBs

- The **Stockholm Convention** prohibits any new production and use of PCBs by the countries, who are parties to the convention. Further, these countries are required to eliminate the use of PCBs in existing equipment by 2025 and also ensure environmentally sound management of PCBs contaminated waste by 2028.
- **PCBs Elimination Network (PEN)** has been formed under the Stockholm Convention to exchange information and improve coordination & cooperation among the stakeholders from different sectors for Environmentally Sound Management (ESM) of PCBs.
- The **Basel Convention** on the Control of Transboundary Movement of Hazardous Wastes and their Disposal and the **Rotterdam Convention** on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade have provisions to deal with PCBs and PCBs waste.

INDIAN SCENARIO

PCBs were never manufactured in India. The requirements of PCBs for numerous applications were met through imports. There were various usage of PCBs in India, though the transformers were the major consumer of PCBs. Some records say that India has stopped the import of PCBs based transformers since 1990s. As per the National Implementation Plan of the Government of India, the current stock of PCB-containing oil is estimated at 10,000 tons, however the information is not conclusive as the estimation does not take

CONTAMINATED SITES

- Bhilai Steel Plant Chhattisgarh,
- Rourkela Steel Plant Orissa,
- Ship Breaking Yard Alang Gujarat,
- Neyveli Lignite Corporation Limited Tamil Nadu,
- Panki Thermal Power Plant, U.P.
- IISCO Steel Plant, West Bengal,
- Dhulekote Storage & Disposal Facility, Haryana.

many sectors into account. There is also very limited information from the private sector enterprises.

PCBs are included as PoPs in the Stockholm Convention. Article 7 of the Stockholm Convention requires the parties to develop a National Implementation Plan (NIP) to demonstrate their obligations to the Convention. As a signatory to the Stockholm Convention, India has developed the NIP and action plans for the sound management of PCBs and PCBs' contaminated waste. Central Power Research Institute (CPRI), Bangalore is designated as the nodal agency for implementing the sound management of PCBs in the country.

India is also a signatory to the Rotterdam Convention and Basel Convention which lays down the provisions to deal with PCBs and PCBs containing waste. The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008 of India has listed requirement of the prior informed consent for the import of PCBs contaminated waste.

India needs to take some concrete actions for the sound management of PCBs and the PCBs contaminated waste to achieve 2025 target set by the Stockholm Convention.

- Facilitate detailed inventory of pure PCBs and PCBs contaminated substances and unintentional PCBs by suitable agencies.

- The legal framework for management and disposal of PCBs needs to be strengthened.
- Regulations on packaging, labeling, and trans-boundary movement of PCBs.
- The country needs to promote the development and use of substitute or modified materials, products and processes to prevent the release of PCBs.
- Introduce polluters pay principle and push for appropriate measures to obtain information from the private players.
- The country requires promoting static and mobile disposal facility and adoption of better technology for appropriate disposal of PCBs.
- Effective evaluation of the technology and non incineration based technology should be prioritized.
- Involve the stakeholders and strengthen coordination among different agencies to establish improved management.
- There is a need to provide training on PCBs, its adverse health effects and appropriate ways of handling PCBs at various stages.
- Extensive public awareness campaign is required particularly for protecting human health from adverse effects of PCBs.

TABLE 1 – Alternatives to PCBs

Uses	PCB-Substitutes
Dielectric fluid in transformers	Mineral oil
	Silicone oil
	Tetrachlorbenzene
	Chloroalkylene
	Biphenyl
	Chlorinated diphenylethane
Dielectric fluid in capacitors	Mixture of Methyl (phenyl-methyl) benzene and Methylbis (phenylmethyl) benzene
	Phenylxylethane
Heat exchange fluid	Mineral oil
	Silicone oil
	Biphenyl
	Diphenyl oxide
Hydraulic fluid	A vegetable based oil (turnip oil)

Source: The Nordic report “A survey of alternatives to 12 persistent organic pollutants”

AVAILABLE TECHNOLOGIES FOR PCBs MANAGEMENT

There are both “incineration and non-incineration” based technologies available for the sound disposal of PCBs.

Some of the Non-Incineration based technologies recognized internationally are:

- Chemical-sodium process
- Plasma arc method
- The reductive method
- Base-catalyzed decomposition process
- Catalytic Hydrogenation Process

REFERENCES

1. <http://www.epa.gov/epawaste/hazard/tsd/pcbs/pubs/about.htm>
2. Guidelines for the Identification of PCBs and Materials Containing PCBs. United Nations Environment Programme, First Issue, 1999.
3. <http://www.ec.gc.ca/bpc-pcb/default.asp?lang=En&n=52C1E9EF-1>
4. PCB Transformers and Capacitors- from management to reclassification and disposal. UNEP 2002.
5. Polychlorinated Biphenyls (PCB) Toxicity. Agency for Toxic Substances and Disease Registry (ATSDR) 2006.
6. National Implementation Plan. Stockholm Convention on Persistent Organic Pollutants, 2011.
7. M.S.M. Mujeebur Rahuman, Luigi Pistone, Ferruccio Trifirò and Stanislav Miertus. Destruction technologies for Polychlorinated Biphenyls (PCBs). ICS-UNIDO Publications, 2000.
8. Destruction and decontamination technologies for PCBs and other PoPs wastes under the Basel convention. A Training Manual for Hazardous Waste Project Managers, 2002.

Compiled and written by:

Piyush Mohapatra | Email: piyush@toxicslink.org

Alka Dubey | Email: alka@toxicslink.org

For more information, please contact:

Toxics Link

H2 (Ground Floor)

Jungpura Extension

New Delhi 110 014

T: +91-(0)11-24328006, 24320711

E: info@toxicslink.org