

## About CSIR-NEERI

CSIR-NEERI is endorsed as Stockholm Convention Regional Centre (SCRC) on Persistent Organic Pollutants (POPs) for Asia Region at COP-5 meeting held during 25-29th April 2011 at Geneva. SCRC is serving different parties/countries in the Asia region to help them in their capacity building and transfer of technologies related to POPs and new POPs. Besides India, CSIR-NEERI is serving ten countries of Asia region viz. Bangladesh, Maldives, Mongolia, Myanmar, Nepal, Philippines Thailand, Sri Lanka, UAE and Vietnam. The goal of the SCRC is to provide technical assistance for building capacities of the parties of the Asia region in relation to monitoring and assessment of POPs in the environment, transfer of technologies, raise awareness and promote identification and environmentally sound management (ESM) of POPs and POPs contaminated sites in the region. The Centre is also assisting the parties of Asia region in fulfilling their obligations of the Stockholm Convention



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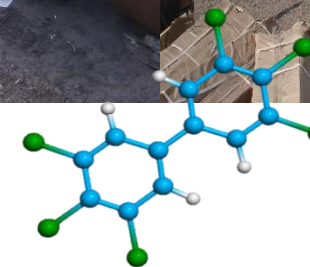
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# Polychlorinated biphenyls (PCBs)



**POPs**  
PERSISTENT ORGANIC POLLUTANTS

**CSIR-National Environmental Engineering Research Institute,  
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Nagpur, India-440020.**

## 1. What are PCBs?

- Polychlorinated biphenyls (PCBs) are a mixture of up to 209 individual chlorinated compounds (known as congeners). There are no known natural source of PCBs.
- Listed by Stockholm Convention under “dirty dozen”.
- Oily liquids or solids; colorless to light yellow (ATDSR, 2014).
- Many commercial PCB mixtures are known in the U.S. by the trade name Aroclor.
- Used extensively in the manufacturing of transformers, capacitors, and other heat transfer devices.
- Do not easily break down or degrade made them attractive for industries.
- Resistant to acids, bases, oxidation, hydrolysis, and temperature change (Kimbrough and Jensen, 2012).

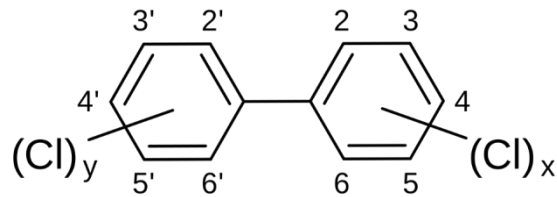


Fig. Structure of PCBs

## 2. Why PCBs are chemical of concern ?

- Toxic to humans and wildlife.
- Classified as probable human carcinogens by the Environmental Protection Agency (EPA) and International Agency for Research on Cancer (IARC).
- Known to cause cancer in humans, such as liver cancer and biliary tract (ATDSR, 2014).
- Listed in the top 10 EPA’s most toxic chemicals.
- High bioconcentration and biomagnification potential, the concentration in aquatic organisms may be as much as one million times higher than the levels in the aquatic environment [ATSDR 2000].
- Stockholm Convention enlisted PCBs as POPs and added in Annexure A &C (complete elimination and unintentional release).



### 3. What are the applications of PCBs?

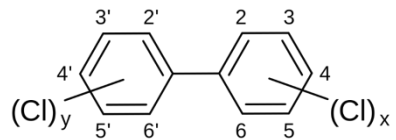
- Use of PCBs includes coolants and insulating fluids (transformer oil) for transformers and capacitors, for open applications such as those used in old fluorescent light ballasts, hydraulic fluids, lubricating and cutting oils etc.



Transformers



Heat transfer fluids, Lubricants, and Plasticizers



Applications of Polychlorinated biphenyls (PCBs)



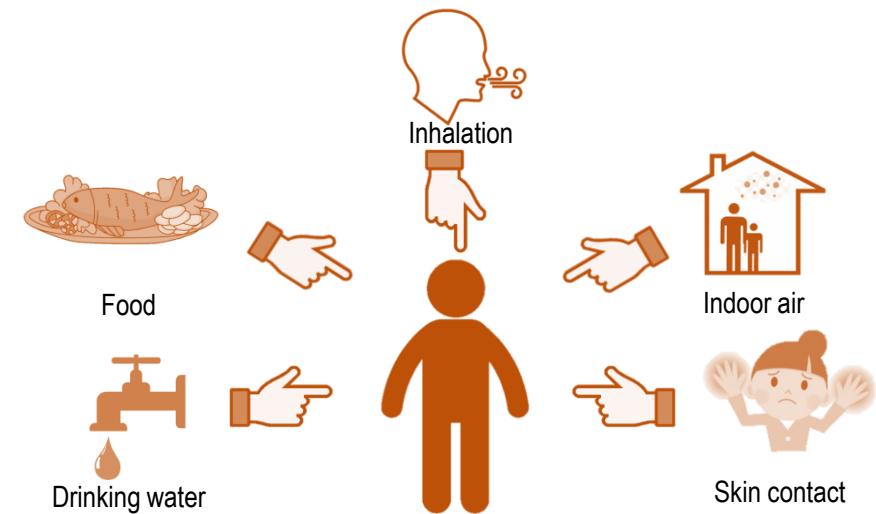
Hydraulic fluids



Capacitors

### 4. How we are exposed?

- Food is the main source of exposure to PCBs for the general population viz. consumption of contaminated foods, particularly meat, fish, and poultry.
- Occupational exposure to PCBs occurs mainly via the inhalation and dermal routes during maintenance or repair of old equipment or during waste-site cleanup or disposal activities.
- Released to the environment from hazardous waste sites; illegal or improper disposal of industrial wastes and consumer products.



Possible ways of human exposure

## 5. What are the environmental impacts of PCBs?

- Persistent in environment; half-lives can vary from 10 days to one-and-a-half years. Enters the air, water, and soil during their manufacture, use, and disposal; from accidental spills and leaks during their transport; and from leaks or fires in products containing PCBs.
- Resistant to biodegradation.
- Highly lipophilic; hence partition out of the water and become adsorbed preferentially to sediments.
- Sediments plays a vital role in bioaccumulation of these compounds.
- Toxic to fish and may cause reproductive failure, suppression of the immune system in various wild animals-seals and mink.
- Can travel long distances in the air and be deposited in areas far away from where they were released.

## 6. Existing guidelines and standards for PCBs

Regulatory body	Matrix	Standard Limits (ppm)
<b>EPA</b>	drinking water	0.0005
<b>Food safety and standards (contaminants, toxins and residues)</b>	Food (Inland and Migratory Fish )	2.0
	Food (Marine Fish, Crustaceans and molluscs)	0.5
<b>FDA</b>	Infant foods, Eggs Milk and other dairy products	0.2-3
	Fish and Shellfish	
	Poultry and Red meat	

## 7. What are the health impacts of PCBs?

- Causes pigmentation of nails and mucous membranes and swelling of the eyelids, along with fatigue, nausea, and vomiting.
- Showed developmental delays and behavioral problems in children born to mothers' consuming PCBs contaminated food.
- Poorer short-term memory function.
- Suppress the human immune system and are listed as probable human carcinogens.
- Toxic to aquatic animals.

## 8. Status of India for PCBs?

- India has never been a manufacturer or producer of PCBs.
- Applications were met only through imports.
- Until the 1980's, India used to import PCBs-containing electrical equipment from various countries (transformers and capacitors for large facilities used for specific applications) .
- The Ministry of Environment, Forests and Climate Change has issued an order to regulate PCBs in India on 6th April, 2016.
- The use of Polychlorinated Biphenyls in any form shall be completely prohibited by 31st December, 2025. Moreover, the exemption of PCBs use have been allowed only for the research purpose after due permission from the Ministry of Environment, Forests and Climate Change.
- A static PCB disposal facility is underway in Bhilai Steel Plant and also some mobile units will be operational soon for disposal of PCBs. The plant will be non combustible and it will use Plasma Arc Gasification technology.
- NIP 2011 covers the region wise distribution of PCBs in India. Major sector is power sector (71%) followed by steel industry (18%).

## 9. What detection methods are available for PCBs?

- EPA Method 8082A is available for determination of polychlorinated biphenyls (PCBs) as Aroclors or as individual PCB congeners in extracts from solid, tissue, and aqueous matrices, using open-tubular, capillary columns in gas chromatography with electron capture detectors (ECD).



## 10. Technologies used to treat PCBs

PCBs can still be found in the environment such as in soils and sediments, even though their use have been heavily restricted. The most frequent remediation solutions used are phytoremediation, microbial degradation, dehalogenation by chemical reagent, and PCBs removal by activated carbon. (Jing et al., 2018).

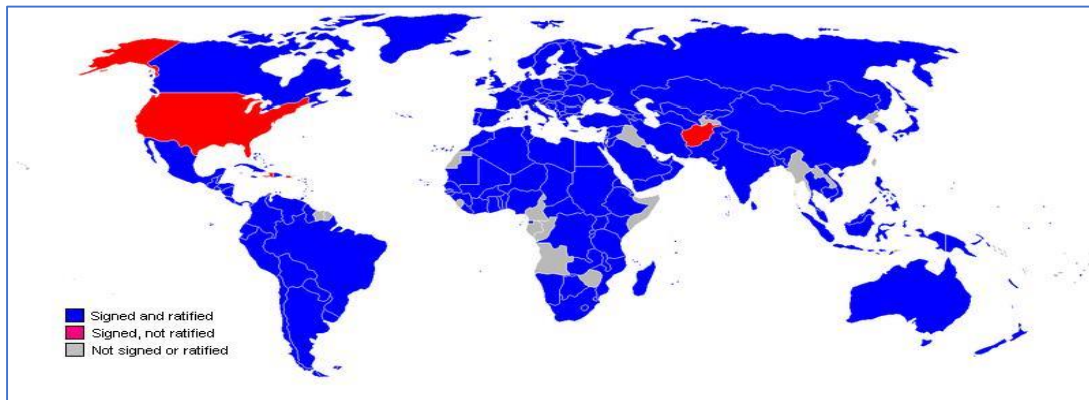
Some new techniques are also available for PCBs removal:

- Supercritical water oxidation
- Ultrasonic radiation
- Bimetallic systems
- Nanoscale zero-valent iron (nZVI) based reductive dehalogenation and biofilm covered activated carbon
- nZVI particles in combination with a second metal
- Electrokinetic remediation



## 11. Stockholm Convention

- Stockholm Convention on POPs is a global treaty adopted on 22 May 2001 in Sweden and entered into force in 2004, with the aim to protect human health and environment from chemicals that remain intact in the environment for more extended period, become widely distributed geographically, accumulates in fatty tissues of humans and wildlife and have harmful effects on human health or on the environment.
- India ratified and became a member of this Convention on 13 January 2006. India is one among the nations which ratified the Stockholm Convention and took various important steps in the progress of the prohibition of POPs. (<http://pib.nic.in/newsite/PrintRelease.aspx?relid=161203>)
- The Government of India, with financial and technical support from the Global Environment Facility (GEF), initiated the NIP development process which involved the ground-level assessment of situation of POPs through inventorization, samples collection, analysis and interpretations (Government of India, 2011).



### References: -

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- Kimbrough, R. D.; Jensen, A. A. (2012). Halogenated Biphenyls, Terphenyls, Naphthalenes, Dibenzodioxins and Related Products. Elsevier. p. 24. ISBN 9780444598929.
- EPA document (<https://archive.epa.gov/epawaste/hazard/wastemin/web/pdf/pcb-fs.pdf>)
- Jing R, Fusi S and Kjellerup BV (2018) Remediation of Polychlorinated Biphenyls (PCBs) in Contaminated Soils and Sediment: State of Knowledge and Perspectives. Front. Environ. Sci. 6:79. doi: 10.3389/fenvs.2018.00079

### Disclamation :-

The above mentioned data was taken from authentic sources and it is cited well wherever needed. CSIR-NEERI is not taking any responsibility of data cited in this document. The data pertaining to Indian climatic condition is still very limited. The main objective behind compiling information on this particular chemical is for public awareness only.