

# *Persistent, Bioaccumulative and Toxic Chemicals*

## A Synopsis



## What are Persistent, Bioaccumulative Toxins

**Persistent, Bioaccumulative Toxins (PBTs)** are chemicals and/or pollutants that:

- remain in the environment for a long time (**persist**) without breaking down;
- accumulate in the environment and build up in the tissues of humans, fish, and animals (“**bioaccumulative**”); and
- are toxic (causing cancer and other health problems) to living organisms, including humans.

These substances can build up to levels that can be harmful to human and ecological health. These contaminants travel long distances in the atmosphere and can move readily from land to air and water. PBTs do not break down or react with other chemicals as easily as other chemicals (i.e., they are *persistent*). They also adhere to fatty tissues in living organisms. These two properties prevent PBTs from diluting as they move away from a source. In many cases, their concentration can actually increase in the environment. As PBTs are passed “up the food chain,” their concentrations can also increase as they accumulate in fatty tissues of animals such as fish, poultry, and cows. PBTs include man-made and naturally occurring substances. Many of these substances have only been in existence for a relatively short period of human history. A few of these substances -- mercury, for example -- are naturally occurring. It is the refinement and concentrated human use of these substances that creates the problem.

Many PBTs are associated with a range of adverse human health effects, including effects on the nervous system and reproductive system, associated developmental problems, cancer, and genetic impacts. They affect not only our generation, but future ones as well because they are passed in the womb and through breast-feeding. Particular risks may be posed to the developing fetus or young child where critical organs, such as the central nervous systems, are still under development. Also, certain individuals who eat, for economic or cultural reasons, large amounts of fish from local waters contaminated with certain PBTs may be at higher risk for adverse effects. Also, birds and mammals at the

top of the food chain are often exposed to higher risk as a result of consuming food from lower on the food chain contaminated with PBTs.

Industries which are potential sources of PBTs are those that manufacture, process, or otherwise use any of the chemicals listed below. Consumer products manufactured by these industries may also contain PBT chemicals. Industrial facilities where the 53 PBT chemicals are used include, but are not limited to:

- Treatment Storage and Disposal Facilities (TSDF) that incinerate or otherwise treat, store or dispose of hazardous waste or sewage sludge.
- Industrial Facilities that:
  - operate chlor-alkali processes;
  - manufacture:
    - chlorinated organic compounds,
    - pesticides,
    - organic or inorganic chemicals,
    - tires and/or inner tubes,
    - other rubber products,
    - plastics and material resins,
    - paints,
  - Portland cement,
  - pulp and paper,
  - asphalt coatings, or
  - electrical components;
  - operate cement kilns;
  - operate metallurgical processes such:
    - smelting,
    - metal recovery furnaces,
    - blast furnaces,
    - coke ovens,
    - metal casting and stamping;

- operate petroleum bulk terminals;
- operate petroleum refineries;
- operate industrial boilers that burn coal, wood, or petroleum products.
- electric utilities that burn coal and/or petroleum products.

### Sources, Health Effects and Methods of Exposure of PBTs

A wide range of activities produce and release PBTs into the environment. These include highly visible sources (e.g., large industrial processes) that have been the traditional focus of pollution control strategies. However, there are also numerous smaller sources of PBTs that cumulatively may release an equal or greater amount of PBTs. Examples of these smaller (and often “non-point”) sources include automobiles, consumer products, and agricultural and home-use pesticides. EPA has identified 53 chemicals as PBT chemicals. This list is presented in Annexure-1. Out of the 53 chemicals EPA has short listed 12 as priority PBT pollutants. A comprehensive list of the priority PBT pollutants, their health effects, methods of exposure to these PBTs and their sources to the environment is presented below:

Name of the PBT	Health Effects	Methods of exposure	Sources to our environment
Aldrin/Dieldrin	<ol style="list-style-type: none"> <li>1. Decreases the effectiveness of our immune system</li> <li>2. May increase infant mortality</li> <li>3. Reduces reproductive success</li> <li>4. May cause cancer</li> <li>5. May cause birth defects</li> <li>6. Damages the kidneys</li> </ol>	<ol style="list-style-type: none"> <li>1. By eating contaminated fish and shellfish</li> <li>2. Infants are exposed from breast milk</li> </ol>	<ol style="list-style-type: none"> <li>1. Soil surrounding wooden structures treated for termites</li> <li>2. Soil or sediment</li> <li>3. Improper use or disposal</li> <li>4. Contaminated fish and shellfish</li> <li>5. Contaminated dairy products and meat</li> </ol>
Benzo(a)pyrene	<ol style="list-style-type: none"> <li>1. Likely causes cancer in humans</li> <li>2. Causes skin disorders in humans and animals</li> <li>3. Causes harmful developmental and reproductive effects</li> </ol>	<ol style="list-style-type: none"> <li>1. In the home by breathing air contaminated by smoke from fireplaces, wood stoves, furnaces burning coal or oil and from food preparation.</li> <li>2. Eating meats and fish that have been smoked or charbroiled</li> </ol>	<ol style="list-style-type: none"> <li>1. Wildfires and prescribed burnings</li> <li>2. Primary aluminum production</li> <li>3. Coke ovens</li> <li>4. Residential wood stoves</li> <li>5. Burning of scrap tires</li> <li>6. Open trash burning</li> <li>7. On-road vehicles</li> <li>8. Asphalt roofing manufacturing</li> <li>9. Industrial boilers</li> </ol>

Name of the PBT	Health Effects	Methods of exposure	Sources to our environment
		<ol style="list-style-type: none"> <li>3. Smoking tobacco products</li> <li>4. Inhaling vehicle exhaust</li> <li>5. Inhaling fumes from working with coal tar and asphalt, working near charbroiling and high temperature frying equipment, working in coal coking operations and other industrial operations such as asphalt and aluminum production.</li> </ol>	<ol style="list-style-type: none"> <li>10. Meat charbroilers</li> </ol>
Chlordane	<ol style="list-style-type: none"> <li>1. Likely causes cancer and may cause liver cancer</li> <li>2. Can cause behavioral disorders in children if they were exposed before birth or while nursing</li> <li>3. Harms the endocrine system, nervous system, digestive system, and liver</li> </ol>	<ol style="list-style-type: none"> <li>1. Infants may be exposed through breast milk</li> <li>2. By eating contaminated fish and shellfish</li> <li>3. Unborn children exposed through the mother's blood stream</li> <li>4. Highest exposure from living in homes that were treated with chlordane for termites</li> </ol>	<ol style="list-style-type: none"> <li>1. Found in particles in the water column</li> <li>2. Other treated soils</li> <li>3. Soil surrounding wooden structures controlled for termites</li> <li>4. Water sediments</li> <li>5. Transport by atmosphere from other regions; deposited in rain, snow, dust</li> </ol>
DDT	<ol style="list-style-type: none"> <li>1. Probable human carcinogen</li> <li>2. Damages the liver</li> <li>3. Temporarily damages the nervous system</li> <li>4. Reduces reproductive success</li> <li>5. Can cause liver cancer</li> <li>6. Damages reproductive system</li> </ol>	<ol style="list-style-type: none"> <li>1. By eating contaminated fish and shellfish</li> <li>2. Infants may be exposed through breast milk</li> <li>3. By eating imported food directly exposed to DDT</li> <li>4. By eating crops grown in contaminated soil</li> </ol>	<ol style="list-style-type: none"> <li>1. DDT in soil can be absorbed by some growing plants and by the animals or people who eat those plants</li> <li>2. DDT in water is absorbed by fish and shellfish in those waterways</li> <li>3. Atmospheric deposition</li> <li>4. Soil and sediment runoff</li> <li>5. Improper use and</li> </ol>

Name of the PBT	Health Effects	Methods of exposure	Sources to our environment
			disposal
Hexachlorobenzene	<ol style="list-style-type: none"> <li>1. Damages bones, kidneys, and blood cells</li> <li>2. Can harm the immune system</li> <li>3. Lowers the survival rates of young children</li> <li>4. Can cause abnormal fetal development</li> <li>5. Harms the liver, endocrine, and nervous system</li> <li>6. May cause cancer</li> </ol>	<ol style="list-style-type: none"> <li>1. Infants exposed through breast milk</li> <li>2. During pregnancy, unborn children can be exposed through the mother's blood stream</li> <li>3. By eating foods such as meat and poultry if those animals are exposed from contaminated feed</li> <li>4. By drinking dairy products where the cattle have been exposed through their feed</li> <li>5. By eating contaminated fish and shellfish</li> <li>6. Breathed in in urban air</li> </ol>	<ol style="list-style-type: none"> <li>1. By-product when making other chlorine-containing compounds</li> <li>2. Found in water sediments</li> <li>3. By-product when manufacturing some pesticides</li> <li>4. Use of HCB-contaminated pesticides</li> <li>5. Found in chlorination treatment of process water and wastewater</li> <li>6. Incineration of municipal and hazardous wastes</li> <li>7. By-product when making chemical solvents (chemicals used to dissolve other chemicals)</li> </ol>
Alkyl- Lead	<p>Initial symptoms            anorexia ,insomnia            tremor            weakness,            fatigue            nausea and vomiting            mood shifts such as            aggression or            depression            impairment of            memory            acute alkyl-lead poisoning</p> <ul style="list-style-type: none"> <li>• mania</li> <li>• convulsions</li> <li>• delirium</li> <li>• fever</li> <li>• coma</li> <li>• and in some cases even death</li> </ul>	<p>ingestion or inhalation of inorganic lead compounds emitted as exhaust through the combustion process</p>	<ol style="list-style-type: none"> <li>1. piston driven aircraft gasoline</li> <li>2. auto racing gasoline</li> <li>3. recreational marine gasoline</li> </ol>

Name of the PBT	Health Effects	Methods of exposure	Sources to our environment
Mercury	<ol style="list-style-type: none"> <li>1. May cause cancer</li> <li>2. Damages the stomach and large intestine</li> <li>3. Permanently damages the brain and kidneys</li> <li>4. Permanently harms unborn children</li> <li>5. Can cause lung damage, increased blood pressure and heart rate</li> </ol>	<ol style="list-style-type: none"> <li>1. By eating contaminated fish and shellfish</li> <li>2. Accidental mercury spills</li> <li>3. Incinerators and facilities burning Hg-containing fuels (i.e. coal or other fossil fuels, mercury-containing wastes)</li> <li>4. In some cases, unborn children are exposed through the mother's blood and infants may be exposed through breast milk</li> </ol>	<ol style="list-style-type: none"> <li>1. Manufacturing activities Mining (especially gold mining) and smelting</li> <li>2. Wastewater entering lakes, rivers, etc.</li> <li>3. Waste from dental cavity-filling material</li> <li>4. Emissions from coal burning</li> <li>5. Combustion of various fuels</li> <li>6. Mixed waste incineration</li> <li>7. Medical waste incineration</li> <li>8. Old paint</li> </ol>
Mirex	<ol style="list-style-type: none"> <li>1. Classified by the EPA as probably causing cancer in humans</li> <li>2. Harmful effects on stomach and intestines</li> <li>3. Damages the liver and kidneys</li> <li>4. Harms the eyes and thyroid gland</li> <li>5. Causes damage to the nervous system and the reproductive system</li> <li>6. May be the cause of increased miscarriages</li> </ol>	<ol style="list-style-type: none"> <li>1. Infants may exposed through breast milk</li> <li>2. Eating contaminated fish and shellfish</li> <li>3. To some extent it may be in drinking water</li> <li>4. Inhalation</li> </ol>	<ol style="list-style-type: none"> <li>1. Contaminated bottom sediments in water ways</li> <li>2. Surface water contamination, sediments</li> <li>3. Clean up and removal of contaminated soil</li> </ol>
Octachlorostyrene			<ol style="list-style-type: none"> <li>1. By-product of wastes from the electrolytic production of chlorine prior to 1970 when graphite anodes and coal tar pitch binder</li> </ol>

Name of the PBT	Health Effects	Methods of exposure	Sources to our environment
			<p>were used</p> <ol style="list-style-type: none"> <li>Formed when graphite anodes are used during electrolytic production of magnesium from magnesium chloride</li> </ol>
Polychlorinated biphenyls (PCBs)	<ol style="list-style-type: none"> <li>Probable human carcinogen</li> <li>Damages the stomach</li> <li>Skin irritation</li> <li>Liver and Kidney damage</li> <li>Thyroid gland injuries</li> </ol>	<ol style="list-style-type: none"> <li>By eating contaminated fish and shellfish</li> <li>Infants may be exposed through breast milk</li> <li>Unborn children may be exposed while in the womb</li> <li>May be in milk, meat, and their by-products</li> <li>Breathing indoor air in buildings where electrical equipment contains PCBs</li> </ol>	<ol style="list-style-type: none"> <li>Poorly maintained hazardous waste sites containing PCBs</li> <li>Illegal/improper dumping of PCB wastes such as transformer fluids</li> <li>Leaks or releases from electrical transformers containing PCBs</li> <li>Improper disposal of PCB-containing consumer products</li> <li>Old microscope oil and hydraulic fluids</li> <li>Old T.V.'s and refrigerators, lighting fixtures, electrical devices, or appliances containing PCB capacitors made before 1977.</li> <li>Sediments in the bottom of lakes, river, or our ocean constantly release small amounts of PCBs into the environment</li> </ol>
Dioxins and Furans	<ol style="list-style-type: none"> <li>changes in markers of early development and hormone levels</li> <li>At higher doses dioxins can cause a serious skin disease in humans called chloracne.</li> </ol>	Specifically from the animal fats associated with eating beef, pork, poultry, fish, milk, dairy products	<ol style="list-style-type: none"> <li>Incineration of Municipal Solid Waste</li> <li>Incineration of Medical Waste</li> <li>Secondary Copper Smelting</li> <li>Forest Fires</li> <li>Land Application of</li> </ol>

Name of the PBT	Health Effects	Methods of exposure	Sources to our environment
			Sewage Sludge 6. Cement Kilns 7. Coal Fired Power Plants 8. Residential Wood Burning 9. Chlorine Bleaching of Wood Pulp 10. Backyard burning of household waste may also be an important source.
Toxaphene	1. Injures the kidneys and liver 2. Damages the immune system 3. Harms the adrenal gland 4. Causes changes in the development of unborn children 5. May cause cancer 6. Damages the lungs 7. Damages the nervous system	1. By eating contaminated fish and shellfish 2. By eating foods exposed to toxaphene 3. Infants may be exposed through breast milk 4. Unborn children can be exposed through the mother's blood stream if she is exposed	1. Cattle dip for scabies control 2. Pineapples in Puerto Rico 3. Emergency treatment of cotton, corn, and small grains 4. Bananas in the Virgin Islands

### Reducing PBTs

EPA has identified a number of actions that can be taken to reduce exposures to and uses of PBTs. Some of the near-term actions include:

- Preventing the introduction of new PBTs into commerce that may pose an unreasonable risk to human health and the environment, and requiring testing to confirm a chemical's PBT status.

- Encouraging voluntary reductions of priority PBTs in hazardous waste.
- Giving the public information on mercury emissions from utilities. Beginning in 1999, EPA requires utilities to conduct coal and emissions sampling for mercury in order to analyze the link between mercury emissions and sources.
- Increasing the public's right-to-know about local sources of PBT emissions. EPA's Toxics Release Inventory (TRI) program issued a rule in 1998 to add certain PBTs to the Toxics Release Inventory and lower reporting thresholds for PBTs already on TRI so that the public can be informed about these pollutants.
- Evaluating fish in U.S. water bodies for PBT contamination. EPA's Office of Water will conduct a comprehensive study of PBT contamination in fish tissue as an indication of PBT contamination in our nation's water bodies.

More information on the PBT chemicals and their action plan can be obtained at <http://www.epa.gov/pbt>

## Annexure –1

Table 1. List of 53 chemicals identified by EPA as PBT chemicals

CAS Number	Chemical Name
75-34-3	1,1-Dichloroethane
71-55-6	1,1,1-Trichloroethane
95-50-1	1,2-Dichlorobenzene
120-82-1	1,2,4-Trichlorobenzene
95-94-3	1,2,4,5-Tetrachlorobenzene
541-73-1	1,3-Dichlorobenzene
106-47-7	1,4-Dichlorobenzene
91-57-6	2-Methylnaphthalene
95-95-4	2,4,5-Trichlorophenol
101-55-3	4-Bromophenyl phenyl
83-32-9	Acenaphthene
208-96-8	Acenaphthalene
120-12-7	Anthracene
7440-36-0	Antimony
7440-38-2	Arsenic
191-24-2	Benzo(g,h,i)perylene
7440-41-7	Beryllium
117-81-7	Bis(2-ethylhexyl
85-68-7	Butyl benzyl phthalate
7440-43-9	Cadmium
67-66-3	Chloroform
7440-47-3	Chromium
7440-50-8	Copper
57-12-5	Cyanide
84-74-2	Dibutyl phthalate
None	Dioxins (PCDDs)
95-99-8	Endosulfan, alpha-
33213-65-9	Endosulfan, beta-
206-44-0	Fluoranthene
86-73-7	Fluorene
None	Furans (PCDFs)
76-44-8	Heptachlor
1024-57-3	Heptachlor epoxide
118-74-1	Hexachlorobenzene
87-68-3	Hexachlorobutadiene
58-89-9	Hexachlorocyclohexane, gamma-
7439-92-1	Lead
7439-97-6	Mercury
72-43-5	Methoxychlor
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7440-02-0	Nickel
98-95-3	Nitrobenzene
29082-74-4	Octachlorostyrene
608-93-5	Pentachlorobenzene
82-68-8	Pentachloronitrobenzene
87-86-5	Pentachlorophenol
85-01-8	Phenanthrene
733-26-3	Phenol, 2,4,6-tris (1,1-dimethylethyl)-
108-95-2	Phenol
None	Polycyclic aromatic compounds
129-00-0	Pyrene
7782-49-2	Selenium
7440-66-6	Zinc