



The PCB Story



Canadian Council of
Resource and
Environment Ministers

The PCB Story

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The PCB story

The PCB story began in 1881 and it may not be over for another couple of decades. It is a story of a relatively useful group of chemical compounds called polychlorinated biphenyls that have created a highly publicized, global environmental problem. From its laboratory beginnings in 1881 to that future day when the last quantities of concentrated PCBs are destroyed, the story provides useful insights into how hazardous chemical wastes have been, are being and perhaps should be handled in our industrialized society.

The joint publication of *The PCB Story* by federal, provincial and territorial governments in Canada is meant to stimulate greater public understanding and involvement in the process of controlling PCBs and other hazardous wastes.



What are PCBs?

Polychlorinated biphenyls (PCBs) are synthetic chemical compounds consisting of chlorine, carbon and hydrogen. First synthesized in 1881, PCBs are relatively fire-resistant, very stable, do not conduct electricity and have low volatility at normal temperatures. These and other properties have made them desirable components in a wide range of industrial and consumer products. Some of these same properties make PCBs environmentally hazardous – especially their extreme resistance to chemical and biological breakdown by natural processes in the environment. PCBs are also known by their various brand names which include Aroclor, Pyranol, Inerteen and Hyvol.

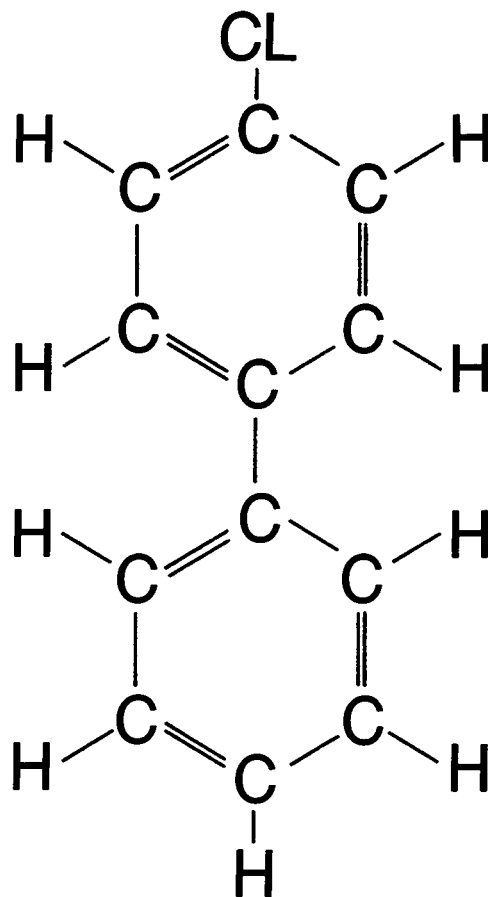
Physical Properties

PCB mixtures are usually light coloured liquids that feel like thick, oily molasses. However, some PCB compounds form sticky, yellow liquids or a brittle gum ranging in colour from amber to black. PCBs are soluble in most organic solvents but are almost insoluble in water. They are also denser than water, so when added to it they sink to the bottom.

Most PCBs are non-volatile at normal temperatures (i.e., below 40°C). However, overheating of electrical equipment containing PCBs can produce emissions of irritating vapours. PCBs are completely destroyed only under extreme heat (over 1100°C) or in the presence of certain combinations of chemical agents and heat.

Physical Characteristics of PCB Liquids

Colour	crystal clear to pale yellow
Vapours	invisible
Odour	bitter smell
Texture	somewhat slippery
Weight	heavier than water



Typical molecular structure of polychlorinated biphenyls (PCBs)

Where do PCBs come from?

Polychlorinated biphenyls (PCBs) are a prominent group of chemicals within a class of synthetic substances known collectively as chlorinated organic compounds. All of the PCBs that were produced in North America came from a single manufacturer, Monsanto Company in the United States. While their North American manufacture was banned in 1977, PCBs are still being produced in some European countries and the U.S.S.R.

Quantities

Approximately 635 000 tonnes of PCBs were produced in North America before their manufacture was banned in 1977. Canada imported approximately 40 000 tonnes of PCBs during that time. Of this amount, just over 24 000 tonnes have been recorded as being in use or in storage in Canada at the present time. The remainder is either in mineral oils at low levels of concentration or is assumed to have already entered the environment.



How were PCBs used?

Commercial production of PCBs began in the United States in 1929 in response to the electrical industry's need for a safer cooling and insulating fluid for industrial transformers and capacitors. This has been the major use for PCBs in Canada. Until other uses were banned in 1977 and 1980, PCBs were also used as hydraulic fluids; as surface coatings for carbonless copy paper; as plasticizers in sealants, caulking, synthetic resins, rubbers, paints, waxes, and asphalts; and as flame retardants in lubricating oils.

Electrical Uses

Most large industrial transformers are filled with over 1 000 kg of a dielectric fluid (i.e., a non-conductor of electricity) which acts as an insulator and a heat exchanging fluid to prevent overheating. Until the introduction of PCBs, mineral oil was virtually the only fluid available with the necessary properties. However, mineral oil was found to be potentially hazardous, especially in applications where power surges could occur. Power surges in electrical equipment can cause arcs, and a sustained high-energy arc can ignite mineral oil.

In response to increasing concern over the risk of fires with oil-filled transformers, the electrical industry set out to find an alternative dielectric fluid. The unique properties of PCBs – their inertness, fire-resistance, and insulating properties – made

them ideally suited to the task. So, beginning in the 1930s, a generic fluid called “askarel”, containing 40 to 70 percent PCBs, was introduced in transformers where high-voltage arcing was likely or where fire risk reduction was of primary concern (i.e., where the transformers were situated inside buildings).

Smaller quantities of dielectric fluids are used in electrical capacitors for the same reasons. Capacitors allow for the more efficient use of electrical power by automatically correcting the power factor. They vary in size considerably, from the size of an ice cube to much larger than a refrigerator. Small capacitors can be found in fluorescent light ballasts and electronic equipment. Larger capacitors are usually found in industrial settings and commercial buildings. Almost every capacitor manufactured between 1930 and 1980 contains PCB dielectric liquids.

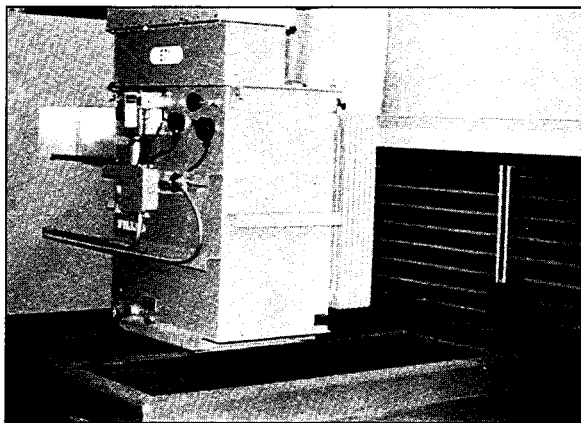


Photo: Ontario Hydro

Askarel (PCB) transformer with containment well

Other Uses

PCBs' fire-resistant nature, together with their thermal stability, also made them excellent choices as hydraulic and heat transfer fluids used in heavy equipment and heat exchangers. They were also used to improve the waterproofing characteristics of surface coatings and offered advantages to the manufacturers of carbonless copy paper, printing inks, plasticizers, special adhesives and lubricating additives. All these uses were banned in Canada in 1977.

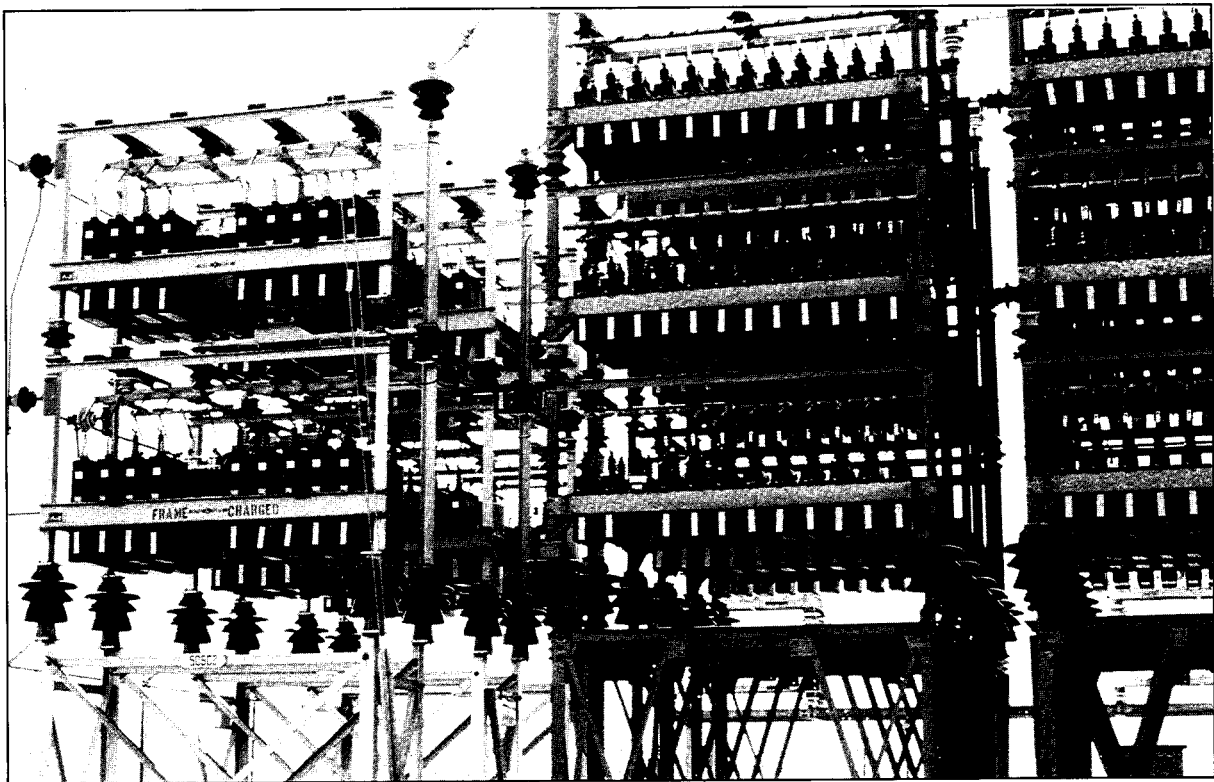


Photo: Ontario Hydro

Banks of PCB capacitors in service

What is the history of the PCB problem?

For the first 25 years of their use, few concerns were raised about any negative impacts of PCB compounds. In the late 1960s, however, the discovery of PCBs in birds in Sweden and the poisoning of 1200 people by rice oil containing PCBs in Japan both focussed public attention on the problem. By 1972, scientific evidence suggested that PCBs posed a serious potential hazard to the environment and human health. While both the manufacture and most non-electrical uses of PCBs were banned in Canada in 1977, the 1985 accidental spill of PCBs being transported near Kenora, Ontario, has again raised public concern — this time over the safe transport and disposal of this hazardous material.

A Chronology

- 1966 PCBs were discovered in the fatty tissue of birds in Sweden by scientists searching for another chlorinated hydrocarbon, DDT.
- 1968 In the Yusho poisoning incident in Japan, 1200 people contracted various disorders after eating rice oil contaminated with PCBs and other chlorinated hydrocarbons. The chemicals had leaked undetected from a heat exchanger used in the food processing plant, heavily contaminating the rice oil.
- 1970 Scientific investigations confirmed the presence of PCBs in the U.S. environment.
- 1985 In the highly-publicized Kenora spill, approximately 400 litres of transformer oil containing 56 percent PCBs leaked from a transformer being transported on a flat-bed trailer, contaminating sections of a 100-kilometer stretch of the Trans-Canada Highway in northern Ontario, as well as other vehicles travelling the same route. The transformer was being shipped from Quebec to a storage site in Alberta.



What action has been taken to control PCBs?

The Yusho poisoning incident and the confirmation of the presence of PCBs in the environment in the United States led to a voluntary partial restriction in sales of PCB fluids by Monsanto Company, the sole manufacturer of PCBs in North America. In 1973, the Organization for Economic Cooperation and Development (OECD) urged all member countries to limit the use of PCBs and develop control mechanisms. PCBs have not been manufactured in North America since 1977 and their use as a constituent in new products manufactured in or imported into Canada was prohibited by regulations in 1977 and 1980.

In both the United States and Canada, the continued use of PCBs is allowed only in existing closed electrical and hydraulic systems. The U.S. has embarked on an accelerated phase-out program, whereby PCB-filled equipment is being replaced as quickly as possible. Under present Canadian legislation, electrical equipment containing PCBs is to be allowed to continue in service until it reaches the end of its service life (in some cases, another 20 to 40 years). In the meantime, strict maintenance and handling procedures in force by owners of PCB equipment in Canada, as well as regulatory control and close monitoring by provincial and federal governments, help ensure the safe operation of this equipment.

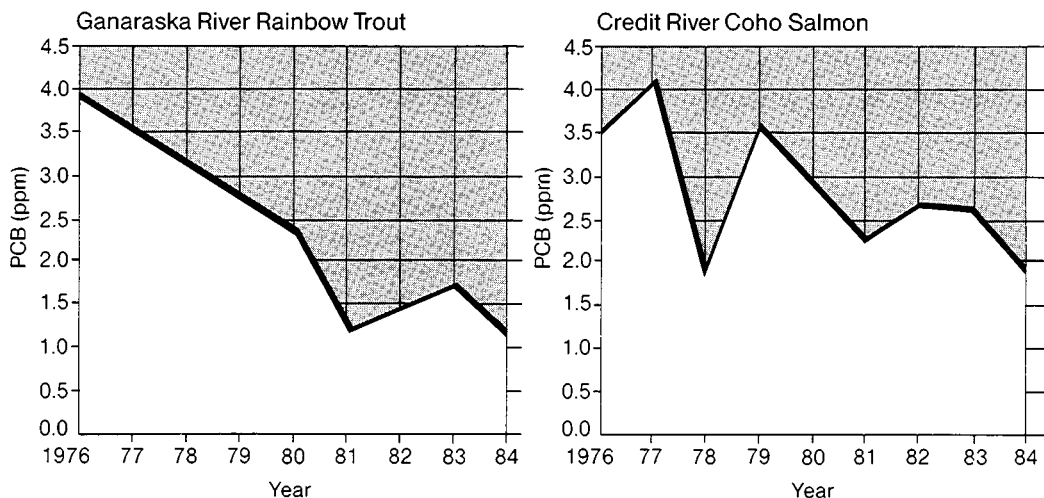
In 1985, the federal and provincial governments implemented more stringent regulations to ensure the safe handling and transportation of PCBs and other hazardous substances. Recent evidence suggests that early control actions seem to have been effective in gradually reducing levels of PCBs in the Canadian environment.

A Chronology

- | | | | |
|------|--|------|---|
| 1972 | The Monsanto Company, the sole North American manufacturer of PCBs, began voluntarily to restrict sales of PCBs. The restriction limited sales to closed systems, such as electrical transformers and capacitors, where the likelihood of release was remote. These restrictions eventually reduced the use of PCBs by half. | 1973 | The Organization for Economic Cooperation and Development urged all member countries to limit the use of PCBs to enclosed uses and to develop control mechanisms to eliminate the release of PCBs into the environment. |
| | | 1976 | <i>The Toxic Substance Control Act</i> was passed in the United States. <i>The Environmental Contaminants Act</i> was passed in Canada. |

- 1977 The manufacture of PCBs was halted in North America by regulation under the *Toxic Substance Control Act*.
- 1977 PCBs were the first class of substances to be regulated under the new *Environmental Contaminants Act (1976)*, administered by Environment Canada. *Chlorobiphenyl Regulations No. 1* prohibited most non-electrical uses of PCBs in Canada. Also under the authority of the Act, a national inventory of PCB-filled equipment was undertaken by Environment Canada.
- 1979 An Environmental Contaminants Act Board of Review, established in response to industry objections to proposed amendments to the Chlorobiphenyl Regulations, recommended:
- that the federal and provincial governments (if they are convinced that high temperature incineration is the best method of disposal) should find a PCB disposal site and satisfy public concern over the associated hazards;
 - that uniform PCB regulations should be introduced and administered by the provinces;
- 1980 An amendment to *Chlorobiphenyl Regulations No. 1* under the federal *Environmental Contaminants Act* restricted the use of PCBs to existing electrical equipment, such as transformers and capacitors; heat transfer and hydraulic equipment; and vapour diffusion pumps and electromagnets in use before September 1, 1977, by prohibiting the import or manufacture of any PCB-filled equipment. This regulation also prohibited the operation of PCB-filled electromagnets over food or feed, and prohibited the use of PCBs as a new filling or make-up fluid in any equipment. It allows, however, the use of PCBs in machinery intended to destroy the chemical structure of PCBs.
- 1981 A code of good practice for the handling, storage and disposal of PCBs in electrical equipment was developed by Environment Canada and introduced through training workshops in all utilities.
- 1982 Ontario introduced regulations to control the transport and storage of PCB wastes.

Average PCB Levels in Lake Ontario Fish (1976-84)



source: Ontario Ministry of the Environment

July 1985 Regulations under the federal *Transportation of Dangerous Goods Act* came into effect, increasing the level of control and safety in the interprovincial and international transport of a full range of hazardous substances, including PCBs. Parallel and complementary provincial regulations were implemented in most provinces.

August 1985 Two additional *Chlorobiphenyl Regulations* (No. 2 and No. 3) under the federal *Environmental Contaminants Act* were proclaimed. The *Chlorobiphenyl Regulations No. 2 (Product)* prohibit importing, manufacturing and offering for sale specified equipment that contains PCBs in a concentration greater than 50 parts per million by weight. The *Chlorobiphenyl Regulations No. 3 (Release)* prohibit the wilful release of more than 1 gram per day of PCBs from certain equipment such as transformers in the course of

specified activities; and prohibits the wilful release of more than 50 parts per million of PCBs during the course of other activities (e.g. discharging effluent), except for road oiling, where the limit is 5 parts per million.

It should be noted that PCB releases to the environment may be further controlled by other statutes, such as the federal *Fisheries Act* or provincial legislation.

Results

Recent research findings indicate that past control of the manufacture and restriction of the use of PCBs to closed systems such as transformers and capacitors has resulted in a gradual decline of PCB levels in the environment. Studies performed in the Great Lakes and other major surface waters, using concentrations in fish as the indicator, document a slight decline.

Where can PCBs be found today?

Of the 40 000 tonnes of PCBs imported into Canada, just over 24 000 tonnes can be accounted for today. Of this amount, 61 percent has been found in electrical transformers still in use, another 12 percent in electrical capacitors, and 27 percent in storage waiting for disposal. Apart from these inventoried amounts, most of the remaining 16 000 tonnes of PCBs is assumed to have already been dispersed in the environment in various fashions. Because of this dispersal over the years, traces of PCBs can be found in all reaches of Canada and in virtually every living organism, including humans. This picture is the same around the world.

Inventory by Sector

A comprehensive inventory of the over 200 000 pieces of equipment across Canada which contain concentrated PCB fluids has been carried out cooperatively by the federal and provincial/territorial governments. This inventory indicates that the industrial sectors controlling the largest

amount of PCBs are electrical utilities at 20.4 percent and forestry/pulp/ paper industries at 11.3 percent. Commercial storage facilities account for 22.4 percent of the total. A total quantity of 24 000 tonnes has been accounted for.

Inventory by Province

The same inventory of concentrated PCB fluids indicates that the largest proportion of the total quantity of 24 000 tonnes is located in Ontario (39 percent) and Alberta (23 percent).

Storage Facilities

There are approximately 6 500 tonnes of concentrated PCB liquids currently in storage awaiting disposal. This volume will increase as PCB-filled electrical equipment is phased out, and until approved disposal facilities are in place. Major commercial storage facilities are situated in:

- Saint-Basile-Le-Grand, Quebec
- Shawinigan North, Quebec
- Nisku, Alberta
- Smithville, Ontario

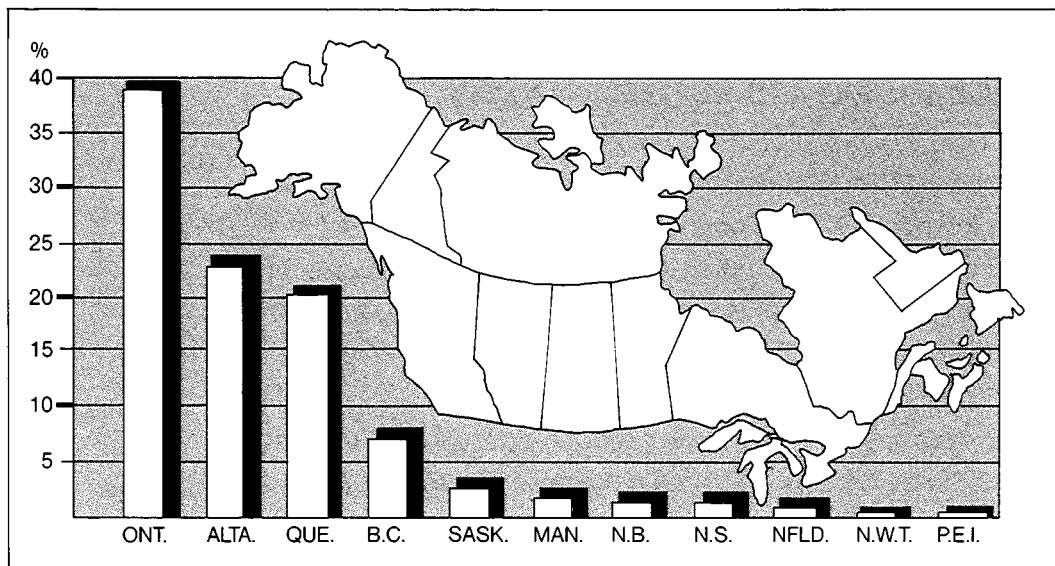
As well, most electrical utilities and large manufacturing facilities have established secure storage facilities for their own PCBs when this was necessary.

In addition to the storage of concentrated PCB liquids, quantities of mineral oil contaminated with PCBs are also in storage awaiting destruction or treatment.

Environmental Dispersal

Because of their stability and mobility, PCBs can be found widely dispersed in the environment in Canada, and indeed the world. They have been found in polar bears in the Arctic, fish in the Great Lakes, and human beings throughout the world. Traces can be found in the atmosphere, in soil and sediments, and in human milk. There is some indication of elevated levels in the vicinity of some urban and industrial centres.

PCB Inventory by Province (1985)



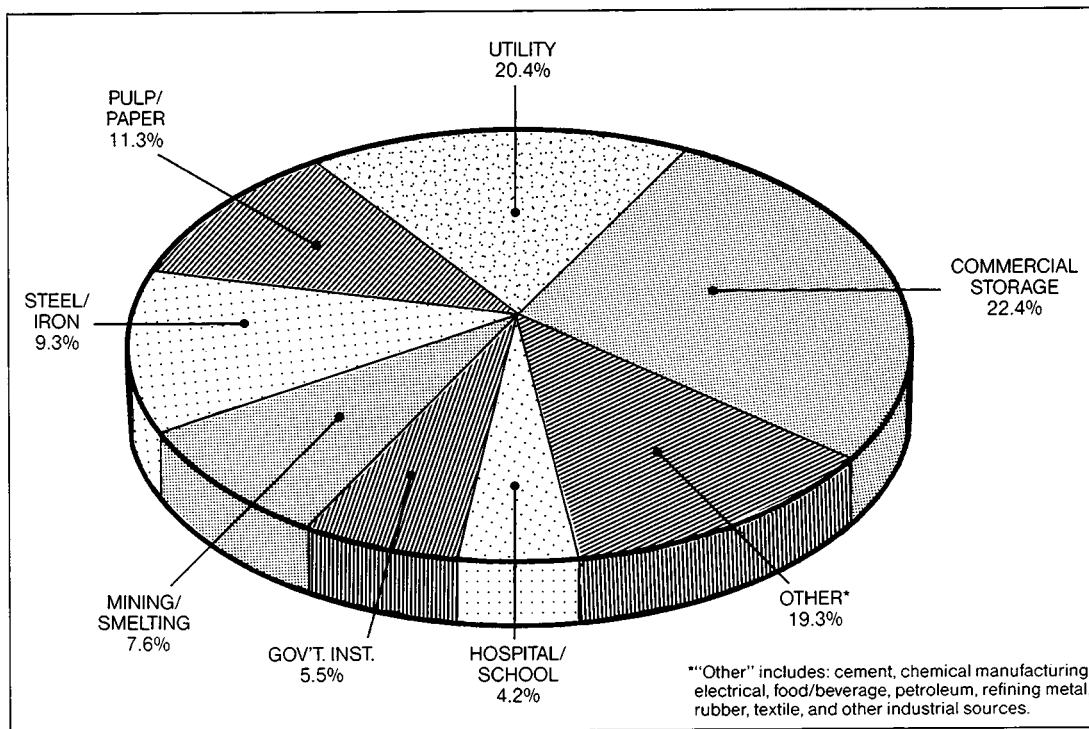
source: Environment Canada

PCB Inventory by Application by Province (1985)

Application	Electrical	Mechanical	Storage for Disposal ¹	Total	% Total Canada
(Tonnes)					
B.C. and Yukon	1 462.2	9.8	224.3	1 696.3	7.0
Alta.	607.1	0	5 011.7	5 618.8	23.1
Sask.	596.1	0	21.5	617.6	2.5
Man.	451.5	0	17.3	468.8	1.9
N.W.T.	101.0	0	5.8	106.8	0.4
Ont.	8 680.1	8.8	880.6	9 569.5	39.5
Que.	4 781.7	0	233.3	5 015.0	20.6
N.B.	392.7	0	21.3	414.0	1.7
N.S.	372.3	0	49.8	422.1	1.7
P.E.I.	14.1	0	0.8	14.9	0.1
Nfld.	322.9	0	43.6	366.5	1.5
Total	17 781.7	18.6	6 510.0	24 310.3	100.0
% Total Canada	73.1	0.1	26.8	100.0	

¹Includes on-site and commercial storage.

PCB Inventory by Industry Sector (1985)



source: Environment Canada

How have PCBs entered the environment?

Because their hazardous nature has only recently been understood, PCBs have been routinely disposed of over the years, without any precautions being taken. As a result, large volumes of PCBs have been introduced into the environment through open burning or incomplete incineration; by vapourization from paints, coatings and plastics; by direct entry or leakage into sewers and streams; by dumping in non-secure landfill sites and municipal disposal facilities; and by other disposal techniques (e.g. ocean dumping) which did not destroy the material. Despite regulation, some PCBs have been illegally dumped through ignorance, through negligence or wilfully. Accidental spills and leaks, while of local significance, have been relatively minor sources of PCB contamination of the global environment.

Incomplete Incineration

Without knowing the hazard involved, many PCBs were incinerated as a manufacturing waste (sometimes in order to recover the chlorine content), burned as a component in waste oil for its heat content, or even disposed of through open burning. Because PCBs are only completely destroyed through very high temperature incineration (i.e., over 1100°C), it is assumed that most of these PCBs were dispersed in the environment either through vapourization or by clinging to the fly ash and landing on soil or water.

Non-secure Landfills

PCBs, contained in material such as carbonless copy paper or certain paints which were sent to landfill sites or municipal waste disposal facilities never designed for such hazardous wastes, may have been carried as leachate into nearby streams and rivers, or into groundwater. This material may also have been burned or evaporated at some of these facilities.

Accidental Spills

While not major sources of PCB contamination in the environment except in a local sense, accidental spills and leaks do contribute to the problem and certainly serve to raise public concern, given the media attention they often receive. Between 1972 and 1983, there were 333 reported spills of PCB fluids in Canada involving the release of approximately 89 tonnes of material.

Oiling of Roads

Up to 1978, a common use of transformer fluid was to dispose of the material to scrap yards and oil recyclers. In Ontario, PCBs were detected in road oil at levels as high as 75 parts per million. Ontario has since introduced regulations to set allowable levels at 25 parts per million and more recently 5 parts per million.

What makes PCBs environmentally hazardous?

Ironically, one of the properties of PCBs which most contributed to their widespread industrial use — their chemical stability — is also one of the properties which causes the greatest amount of environmental concern. This unusual persistence coupled with its tendency to accumulate in living organisms, means that PCBs are stored and concentrated in the environment. This bioaccumulation raises concern because of the wide dispersal of PCBs in the global environment and the potential adverse effects they can have on various organisms, including humans.

Persistence

Virtually all of the PCBs that have ever entered the environment are still there. This essentially inert family of chemicals is only slowly degraded by weathering and microbial processes.

Bioaccumulation

PCBs are soluble in an organic medium, such as fat tissue, but are virtually insoluble in water. This allows them to be stored and concentrated in fat tissue as they move up the food chain through aquatic plants, birds, fish and other animals, and eventually to humans who consume the fish and animals.

Dispersal

Airborne transport of PCBs is undoubtedly a factor in their dispersal because scientific data gathered around the world show the presence of low levels of PCBs in areas remote from industry, such as Bermuda, Hawaii, the polar ice cap and in rainfall.

Toxicity

Even though PCBs bioaccumulate in the food chain, it is impossible to conclusively link observed effects in the environment to PCBs, due in part to the presence of many other chemicals of concern. While there is a wide range of opinion on the subject of just how PCBs affect living organisms, all agree that the long-term risks of even low-level exposure to PCBs are significant enough to warrant concerted action to reduce PCB levels in the environment even further.



What are the health effects of PCBs?

While there have been many laboratory experiments and other studies which have tried to determine the full health effects of PCBs on humans, none has been definitive. As a result, even expert opinion varies significantly on this subject. Scientists generally agree it is unlikely that serious injury would result from short-term low-level exposure to PCBs. However, most are concerned about possible adverse health effects of long-term exposure to even low concentrations of these substances. PCBs can enter the body through skin contact, by the inhalation of vapours or by ingestion of food containing PCB residues.

The most commonly observed health effect from extensive exposure to PCBs is chloracne, a painful and disfiguring skin condition, similar to adolescent acne. Liver damage can also result. People who might be exposed to PCBs include those servicing some types of electrical equipment, maintenance workers who clean up spills or leaks of PCB fluids, employees of scrap metal or salvage companies, and waste collection workers.

Effects on Organisms

In laboratory experiments with a variety of organisms, PCBs have been shown to produce a variety of effects ranging from the disruption of photosynthesis in microscopic plants, to effects on reproduction in higher animals. Marine and freshwater invertebrates as well as most species and life stages of fish are particularly sensitive to PCBs. Birds also seem especially sensitive. Effects which have been noticed include death of the embryo and in some cases, abnormalities at birth.

Animal studies indicate that PCBs, through long-term exposure, can severely affect reproduction, are carcinogenic and have immunotoxic effects. They also have been reported to cause lipid peroxidation, increased serum cholesterol levels, and in some species produce liver toxicity.

Effects on Humans

Although PCBs are widely recognized as a potential hazard to human health, the full extent of health implications is not known. Brief exposure does not appear to constitute a major health hazard but contact may cause skin rashes, swelling of eyelids, hyper-pigmentation (the darkening of nails, skin and mucous membranes), headaches, or vomiting. Extended high-level exposure has resulted in cases of chloracne.

The worst incident of human exposure was the 1968 Yusho incident when 1 200 people in Japan consumed rice oil heavily contaminated with PCBs over a period of time ranging from 20 to 190 days. These people experienced reproductive dysfunction, severe cases of chloracne, hyper-pigmentation, eye discharges, headaches, vomiting, fever, visual disturbances, and respiratory problems. The effects experienced could not be conclusively attributed to PCBs since polychlorinated dibenzofurans (PCDFs), considered more toxic than PCBs, were a major contaminant of the PCBs.

Some PCB mixtures are suspect human carcinogens. The evidence for this comes from laboratory studies in which rats and mice developed liver cancers. However, no adequate studies have yet been carried out to determine whether long-term PCB exposure in humans is associated with cancer. Similarly, the potential effects of PCBs on human reproduction have yet to be ascertained. The very long-term (i.e., multigenerational) effects of PCBs are still under study.

When PCBs in transformers are involved in fires, particularly in buildings, the combustion of these materials can result in the production of highly toxic substances (chlorinated dibenzofurans and dioxins) thus increasing the hazard associated with smoke inhalation.

How are governments dealing with PCBs?

Like many other countries, Canada began to take action on PCBs following the 1973 recommendations of the Organization for Economic Cooperation and Development (OECD). The Canadian approach, involving both federal and provincial levels of government, has had five components: regulation, inventory control, safe handling, emergency response, and safe destruction. Apart from the actual completion of destruction facilities, the five elements of the approach are well advanced in most provinces.

Following the Kenora spill in April 1985, federal and provincial Environment Ministers decided to apply more resources and increased cooperation to accelerate progress towards the shared objective of safely eliminating PCBs from the Canadian environment. They have since approved and are implementing a joint "PCB Action Plan" aimed at achieving this objective.

Other Countries

The 1973 Organization for Economic Cooperation and Development decision to urge member nations to restrict the use of PCBs and to develop phase-out strategies, got many countries working on the problem. Most countries, including Canada, adopted a "natural attrition" policy for phasing out PCBs from authorized closed-system uses, at the end of this equipment's service life. In the United States, an accelerated phase-out policy has been adopted. In Japan and Sweden, PCBs have been completely banned. On the other hand, PCBs are today still being manufactured in some European countries and the U.S.S.R.

The Canadian Strategy

Canada's federal and provincial governments have been collaborating since the late 1970s on a joint strategy to deal with the PCB problem. The five components of this approach are as follows:

1. The development and implementation of regulations which first restricted the use of PCBs to closed systems (1977); next ensured a phase-out, through natural attrition, of these closed-system uses (1980, 1985); and most recently increased safeguards on the transportation and disposal of PCBs (1985).
2. The development of a comprehensive inventory (begun in 1977, and updated annually) of PCBs currently in use or in storage in Canada; the implementation of remedial action for those identified as unsafe; and the establishment of an ongoing monitoring program.
3. The development, in cooperation with industry groups, of guidelines, codes of practice, training programs and storage and transportation regulations on the safe handling and disposal of PCBs (1981 to present).
4. The establishment of emergency response capabilities for handling accidental spills or leaks of PCBs and other hazardous substances.
5. The siting, construction and licensing of the destruction facilities required for the safe disposal of PCBs and other hazardous wastes.

Federal/Provincial Jurisdictions

Provincial governments have jurisdiction over the storage, clean-up of spills, and disposal of PCBs within their borders. However, provincial legislation and regulations are encouraged to at least meet minimum national environmental quality objectives and standards set down in federal statutes.

The federal government is responsible for the inter-provincial and international movement of PCBs, setting and enforcing national standards for the use and release into the environment and for safeguarding Canada's boundary waters.

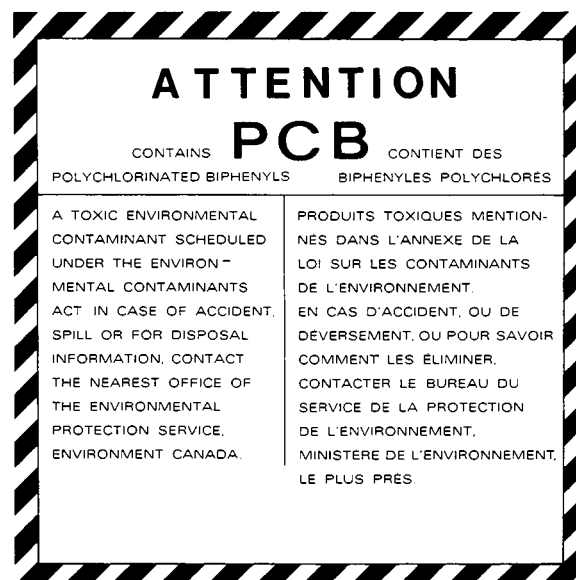
A Federal/Provincial/Territorial Committee on Hazardous Wastes was established in 1980 under the auspices of the Canadian Council of Resource and Environment Ministers (CCREM). This Committee became the CCREM Waste Management Committee in 1985 and serves as a forum for the coordination of efforts to control PCBs and hazardous wastes, in conjunction with the Toxic Substances Steering Committee of CCREM.

The PCB Action Plan

At a meeting in Montreal in May 1985, federal and provincial Environment Ministers committed themselves to an accelerated, joint action plan to safeguard the public and the environment from possible PCB contamination. The PCB Action Plan applies greater resources and increased cooperation to the following tasks:

1. Ensuring a nation-wide system of destruction facilities to handle PCBs and other hazardous wastes.
2. Ensuring all provinces have implemented regulations governing the internal transport of dangerous goods in keeping with existing federal legislation; and establishing a system of prenotification for interprovincial shipments of PCBs.
3. Establishing interim environmental quality objectives for PCBs in air, water and soil, and jointly developing permanent objectives.
4. Improving coordination of existing emergency response capabilities, and evaluating existing training programs related to spill response, as well as the handling and storage of PCBs.
5. Increasing the access to information on PCBs and other hazardous wastes, both between jurisdictions and to the general public.
6. Evaluating different options and timetables for the phase-out of remaining, authorized, PCB-filled equipment.

A majority of the tasks in the PCB Action Plan are scheduled for completion by the end of 1986. Obviously, the timing of destruction facilities is heavily dependent on public involvement processes and construction lead times on a case-by-case basis.



Label used to identify PCBs

What specific legislation is in place to control PCBs?

While the federal government and some provincial governments have regulations referring specifically to PCBs, most relevant legislation addresses the general problem of hazardous wastes and other dangerous goods.

Federally, three regulations and one amendment under the *Environmental Contaminants Act (1976)* have restricted the use of PCBs and controlled their phase-out throughout the country. The recent introduction of the federal *Transportation of Dangerous Goods Act (TDGA)* increases control over the interprovincial and international movement of PCBs and many other categories of hazardous goods. Highway transport of these goods within provinces is controlled by parallel provincial legislation. However, there are no regulations in place to deal comprehensively with the management of PCBs and other hazardous wastes “from cradle to grave”.

Provincially, there are wide variations in the degree to which, and the manner in which, PCBs and other hazardous wastes are controlled. While all provinces have legislation under which hazardous wastes could be controlled, not all have developed regulations to do so. Where provincial regulations have not been introduced, federal guidelines have often been used in their stead. All provinces have legislation implementing the requirements of the federal *Transportation of Dangerous Goods Act* in their jurisdiction.

Federal Legislation

The federal *Environmental Contaminants Act* was enacted in 1976 to permit control of chemicals entering and contaminating the environment. Under this Act, the following regulations have been established specifically to control the use, sale, and dispersal of PCBs and contaminated materials.

- *Chlorobiphenyl Regulations No. 1 (1977)*.
This regulation restricts the use of PCBs to only electrical equipment (e.g. transformers and capacitors), heat transfer equipment, hydraulic equipment, and vapour diffusion pumps already in service; and prohibits PCB use in all new equipment manufactured or imported thereafter, except for electrical capacitors, transformers and associated switchgear.
- *Chlorobiphenyl Regulations No. 1 – Amendment (1980)*.
This amendment restricts PCB use to existing electrical equipment by prohibiting the import or manufacture of any PCB-filled equipment; prohibits the operation of PCB-filled electromagnets over food or feed; and prohibits the use of PCBs as a new filling or make-up fluid in any equipment.
- *Chlorobiphenyl Regulations No. 2 (1985)*.
This regulation, effective August 1, 1985, sets a maximum concentration of 50 parts per million by weight of chlorobiphenyls that may be contained in specified electrical equipment at the time they are imported, manufactured or knowingly offered for sale.

- *Chlorobiphenyl Regulations No. 3 (1985)*. This regulation, effective August 1, 1985, sets 1 gram per day as the maximum quantity of chlorobiphenyls that may be wilfully released into the Canadian environment in the course of commercial, manufacturing and processing activities involving specified equipment; and 50 parts per million by weight as a general release prohibition.

The regulations under the federal *Transportation of Dangerous Goods Act* came into effect on July 1, 1985. They increased levels of control and safety in the transport of 98 industrial waste categories and some 3016 goods designated as hazardous (one of which is chlorobiphenyls). The *Act* states that interprovincial or international movement of such wastes must be manifested using bills of lading with specific information. Under the *Act*, *Protective Direction No. 1* makes mandatory the use of rigid, leakproof containers to transport PCBs or articles containing PCBs. Articles which cannot be contained in this manner must be drained of PCBs. The container must be secured to the transport vehicle.

Other federal statutes such as the *Ocean Dumping Control Act*, the *Fisheries Act*, and the *Canada Shipping Act* can also be used to regulate PCBs although these have not so far been used.

Provincial Legislation

Regulations and guidelines vary from province to province and primarily address proper handling, transportation and storage, as well as occupational safety. Where provincial regulations have not been introduced, federal guidelines have often been used. This is an outline of current provincial legislation.

British Columbia

- PCBs are controlled by the *Waste Management Act*, the *Environment Management Act*, and the *Workers' Compensation Act*.

Alberta

- PCBs have been identified as hazardous wastes and are controlled by the *Hazardous Chemicals Act*. Regulations on the storage of hazardous wastes are also in place.

Saskatchewan

- PCBs are listed under *Environmental Spill Control Regulations* of the *Environmental Management and Protection Act*.

Manitoba

- PCBs are designated as a hazardous substance under the *Dangerous Goods Handling and Transportation Act*.

Ontario

- PCBs are controlled using regulations under the *Environmental Protection Act*. Ontario is currently the only province with a regulation specific to the management of PCB wastes. Ontario also has a regulation specific to the establishment and control of mobile PCB destruction facilities. The *Ontario Water Resources Act* can also be used to control PCBs in wastewater discharges.

Quebec

- PCBs are listed in the *Liquid Waste Regulation* and the *Solid Waste Regulation* of the *Environmental Quality Act*, and in the *Transport of Waste Regulation* of the *Transport Act*. Hazardous waste regulations have recently been introduced which make specific reference to PCBs.

Atlantic Provinces

- Each Atlantic province has legislation that could be used to control PCBs but no specific regulations exist at this time.

What are the substitutes for PCBs?

Safer alternatives have been found to take the place of PCBs in all their previous applications. As PCB-filled transformers come to the end of their service life, they are being replaced either with dry-type transformers (for smaller sizes only) or with transformers containing an approved dielectric fluid, such as silicone oils or transformer-grade mineral oil.

Dry-type Transformers

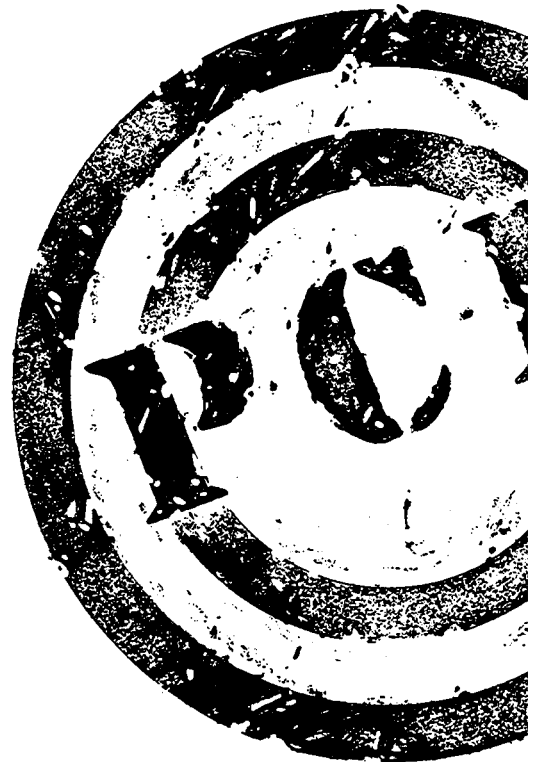
New and better mechanical insulation materials have meant that dry-type transformers, using air as the coolant, are being used in a broader range of sizes and applications — often replacing PCB-filled equipment coming out of service.

Other Dielectric Fluids

Finding suitable and safe alternative fluids to PCBs for use in electrical transformers has not been an easy task. A number of candidate chemicals have been rejected for reasons of high toxicity or unreliable operating characteristics.

However, a few new fluids have been found with the demanding array of properties required for reliability and public safety. Of these, silicone oils are the most common. These essentially inert chemicals underwent extensive environmental testing prior to introduction. They are not very toxic, do not persist in the environment, and biodegrade down to silica — the major component of common sand.

Transformer-grade mineral oil also continues to be used in new transformers designed for applications not requiring as high a level of fire protection.



How has industry responded to the PCB problem?

Industry has generally operated in good faith on the PCB issue, cooperating with government initiatives to control the problem. Monsanto Company in the U.S. showed good corporate responsibility when it voluntarily began to limit PCB sales in 1972. Electrical manufacturers and utilities in Canada have complied with government regulations and cooperated with government programs and training initiatives to identify and safeguard PCB-filled equipment. More recently, the trucking industry has moved quickly to implement the *Transportation of Dangerous Goods Act* in spite of concerns over possible impacts on liability insurance rates.

While there is some room for improvement in the response of major industry groups (which together account for most PCBs in use or storage), the only difficult problem remaining is to reach the literally thousands of small companies – often not members of industry associations – who, for reasons of ignorance more than irresponsibility or economic expediency, may mishandle PCB-containing equipment.

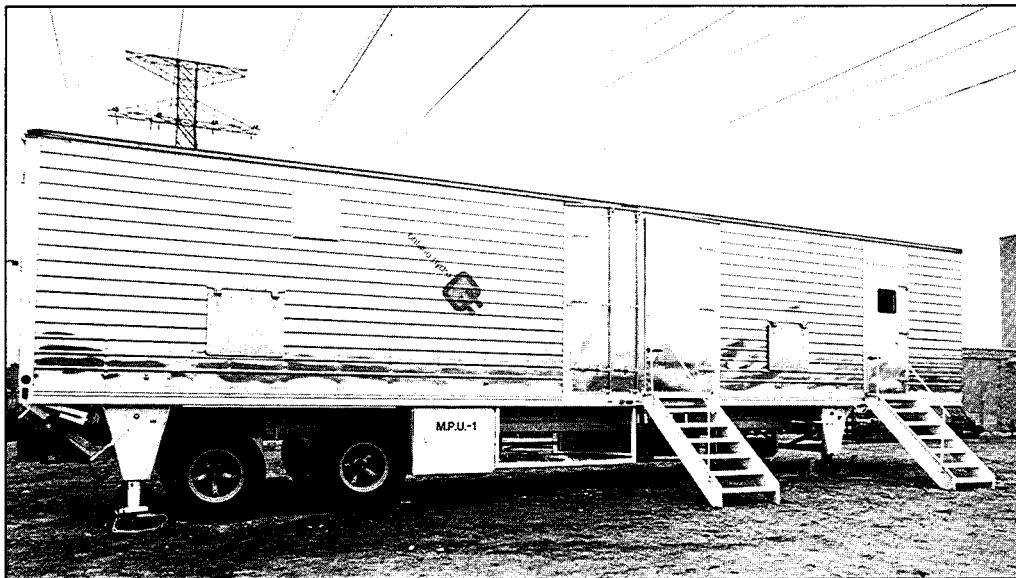


Photo: Ontario Hydro

Mobile decontamination facility for removing low levels of PCBs from mineral oils

Electrical Industry

Electrical equipment manufacturers in Canada, in compliance with government regulations, stopped using PCBs in 1980. Electrical utilities have cooperated with government efforts to inventory PCB-filled equipment, to apply special labelling, and to replace equipment in particularly hazardous applications. Utilities have also adopted a code of good conduct related to PCBs which includes implementing proper handling procedures, training maintenance staff, building special storage facilities, and instituting a phase-out program. Some have adopted accelerated timetables for replacing PCB-filled equipment in sensitive areas such as schools, hospitals, and sports arenas before the end of their service life. Utilities have also established programs to identify and deal with mineral oils contaminated with low levels of PCBs and have either commenced or are planning to treat such oils to destroy the PCBs and reclaim the oil.

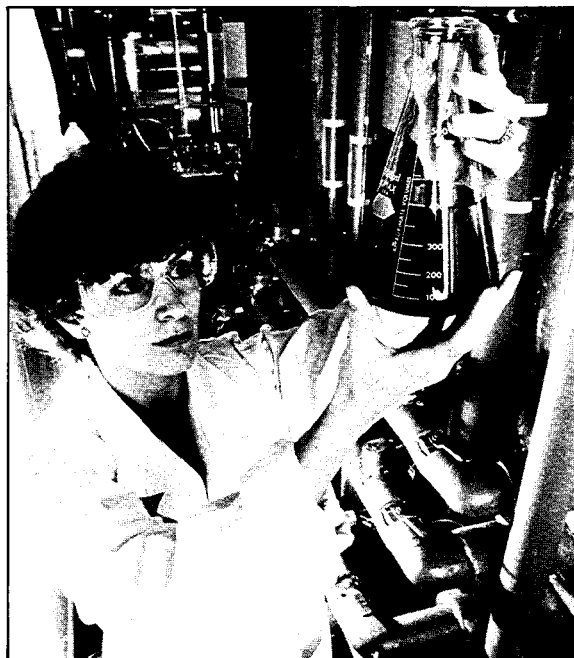


Photo: Ontario Hydro

Inside mobile decontamination facility



Photo: Ontario Hydro

Proper handling procedures of PCB's

Other Industry

As is the case with other hazardous wastes, when they are informed of the problems and proper methods of handling and disposing of PCBs, people in industry generally want to do the right thing. While information has been communicated to the majority of people who handle PCBs in Canada, there remains the challenge of reaching the thousands of small companies who handle small amounts of PCBs. Be they small manufacturers with PCB-filled capacitors or heat exchangers, scrap metal dealers with PCB-filled equipment in their yards, or small trucking firms carrying used equipment, these companies generally do not belong to industry associations and may well not be aware of the hazards involved.

The trucking industry has been participating in joint government-industry efforts to control hazardous material for years, and has recently been very active in informing its members about the requirements of the new *Transportation of Dangerous Goods Act*.

Why are PCBs still a problem today?

PCBs are still a serious environmental problem because of their wide dispersal and extreme persistence in the environment, and because the last stage of a complete life cycle management system is only now being put into place.

It has taken almost a decade of public consultation to find sites for the first of perhaps five industrial waste disposal facilities needed to safely handle PCBs and other hazardous wastes in Canada. Only one is actually under construction and a number have yet to be sited. While the technology for safely destroying PCBs has been proven and in use in other countries for many years, legitimate public concerns, together with the so-called "NIMBY (Not-In-My-Back-Yard)" syndrome and perhaps some errors in approach on the part of industry and governments, have caused many proposed facilities to be shelved or defeated by local opposition. Without these facilities, the proper management of PCBs is impossible to achieve and the risks of accidental spills and improper disposal are significant.

Persistence

PCBs' persistence in the environment causes problems when their biological "sinks" get disturbed — for example, when harbours or rivers get dredged. This can stir up PCBs in the sediments and make them available for further dispersal and bioaccumulation.

Dispersal

While dispersal in the natural environment is a major concern, PCBs are also widely dispersed in the built environment, being present, albeit in minute quantities, in millions of electrical capacitors found in electronic equipment and fluorescent light fixtures. While these PCBs are sealed and often encased in metal, they can create hazards when concentrated in one location (e.g. as waste materials in salvage companies' yards) or when involved in a fire.

Disposal

The major factor contributing to the current PCB problem is that there are no facilities in place anywhere in Canada licensed to safely destroy the large volume of high-concentration PCB fluids currently in storage and use. Some provinces are in

the process of establishing destruction facilities for hazardous wastes, but progress is necessarily slow to ensure that public concerns over possible impacts on health and the community are addressed. Yet, until such facilities are operational, the risks of leakage, spills and improper disposal will continue and the implementation of any accelerated equipment phase-out policy will make little sense.

Transport

While the 1985 Kenora spill also pointed out the problem of ensuring public safety during the transport of PCBs and other hazardous wastes, it is generally agreed that the provisions of the *Transportation of Dangerous Goods Act* (which were not yet in place at the time of the Kenora spill) will significantly improve the situation.

What do others have to say about PCBs?

As in most public issues, there is a range of perspectives and opinion on the subject of PCBs. Some of this range is reflected in the following quotations.

Private Sector Representatives

R.J. Redhead,
Chairman, Public Affairs Committee
Institute of Chemical Waste Management
National Solid Waste Management
Association (NSWMA)

PCB disposal is a political problem, not a technical problem. The private sector waste managers in the U.S.A. are destroying PCB waste now — within stringent U.S. government safety standards. Canada needs a regulatory and social climate in which to implement treatment facilities. We have the tools, let us do the job.

Dr. Derek Wisdom
Technical Adviser
Les Transports Provost Inc.
Ville d'Anjou, Québec

It is a sad reflection on our news media that despite the high profile and amount of copy devoted to polychlorinated biphenyls, the public is still woefully misinformed as to the nature of the hazards presented by PCBs. The overwhelming impression, even amongst educated people, is that these are actually toxic and life threatening. In reality, the ill effects stem principally from long-term exposure and consequently, PCBs only present a problem because they do not biodegrade easily and because they bioaccumulate in living creatures. By the federal government's own definitions (Transport of Dangerous Goods Regulations Part III), PCBs are not included as poisonous substances. This is consistent with the classification of PCBs under U.S. and international regulations.

Governments, especially local governments, are all too ready to cater to the demands of a misinformed public and — having a blind faith in the curative powers of interdictory regulations — they tend to create as many problems as they solve. It should be noted that safe and effective methods of destruc-

tion of PCBs have been established but, to date, their implementation has been blocked by local government's NIMBY (Not-In-My-Backyard) syndrome.

The banning of the production, disposal and, in some instances, the storage of PCBs has not solved the problems of those currently in existence. By the actions of different levels of government, these have been consigned to circulate in limbo, being hounded from one place of storage to another like lepers of biblical times. The trucking industry is essentially an innocent party in this matter since it is government action which has created the demand for such goods to be transported unnecessarily and, consequently, there is considerable pressure on our industry to meet such a demand.

David Armour
President & Chief Operating Officer
The Electrical and Electronic Manufacturers
Association of Canada (EEMAC)

A very large majority of transformers in service in Canada are filled with pure mineral oil which acts as both a cooling and insulating medium. In some special applications, the flammable characteristic of oil is not acceptable in transformers.

For these special applications in the 1930s, alternative liquids were made available to us. These fluids were very costly but had the qualities of being flame-proof. They contained PCBs.

When concerns about the possible environmental health hazards associated with PCBs were made known in the 1970s, we stopped using them in our products.

Today, our major concern is the lack of any national policy relating to the disposal of existing PCB-filled equipment or wastes; or a single definition of what constitutes hazardous levels of PCB contamination in electrical equipment.

Mr. Wallace S. Read
President
Canadian Electrical Association (CEA)

The members of the Canadian Electrical Association — Canada's electric utilities — have, since 1977, recognized the possibility of environmental risks associated with polychlorinated biphenyls (PCBs) and have accepted their responsibility to the Canadian public.

Because of their high flashpoint and low flammability, PCBs have been used as a cooling agent in some transformers and electrical equipment since 1927. During the past decade, utilities across Canada have put comprehensive programs in place to identify, label and control equipment contain-

ing PCBs. The utilities have extensive knowledge and expertise in the safe use and handling of these chemicals.

The CEA is convinced that existing federal regulations along with the procedures adopted by the CEA member utilities, fully protect the public and the environment.

While no evidence of long-term health hazards to humans has been established, CEA believes that the persistent nature of PCBs, coupled with the heightened public concern, make the orderly phase-out through attrition of these chemicals appropriate when facilities for their safe destruction are approved and put in place.

Environmental Group Representatives

Ray Vles
Executive Director
Friends of the Earth — Canada
/Les amis de la terre du Canada

PCBs are a classic case of the 'shoot first, ask questions later' approach to chemicals. By the time their health and environmental hazards were discovered, the environment was already contaminated. More than ten years and many thousands of dollars later, PCBs remain a threat to the environment. Since most chemicals in use today have not been adequately tested, we can expect PCB-type problems in the future. Action must be taken now to prevent environmental contamination including a rigorous program of testing and regulations of chemicals, the development of alternatives to hazardous chemicals, and the enforcement of proper use and disposal practices. The lesson of PCBs is that prevention is the only real solution.

Colin Isaacs,
Executive Director
Pollution Probe Foundation
Toronto, Ontario

PCBs are just the tip of a massive toxic chemical problem facing Canada and all industrialized countries. While the health effects of low-level ingestion of many toxic substances have not been clearly

defined, we do know that continuing discharge can only have negative effects both on the environment and on public health. Public trust in government and industry will only be restored when decision-making processes are seen to be open and above board, with environmental concerns being given the weight which Canadians coast to coast are demanding.

Daniel Green
Co-President
Société pour vaincre la pollution (SVP)
Montréal, Québec

In the spring of 1985, Canadians found out the hard way that the PCB threat is still very much with us. The continuing episodes of PCB spills across the country demonstrate that our governments do not have at present a means to protect us against the hazards of toxic waste. What we need to solve the problem is more than just legislation; we need a political commitment from our governments, cooperation from the industry and participation from the public.

How are PCBs being disposed of today?

At present, there are no facilities in Canada licensed to destroy highly concentrated PCB liquids. As they come out of use, fluids and equipment containing PCBs are placed in temporary storage pending the availability of more permanent disposal facilities. This has left large amounts of PCBs in sites, often on the generators' own premises. It is difficult to ensure that these sites meet minimum federal and provincial standards. Local concerns have so far prevented the siting of the new storage and disposal facilities needed to clean up the existing sites considered hazardous.

Storage

Since 1977, PCB wastes, including the transformers and capacitors that contain them, have been stored awaiting permanent disposal facilities. These PCBs in temporary storage include those at industry and utility locations, in provincially approved central storage facilities, and even in sites run by small enterprises such as electrical contractors. The condition of these storage sites varies. The provincially approved commer-

cial storage sites are perhaps the most secure, but they are either full or are not permitted to accept wastes from outside provincial boundaries.

Disposal

At present, there are no facilities in Canada licensed to destroy highly concentrated PCB wastes. Nor can Canadian authorities simply transport the problem elsewhere, since the U.S.



Photo: Ontario Hydro

Shipping container with containment tray being used as a temporary PCB waste storage facility

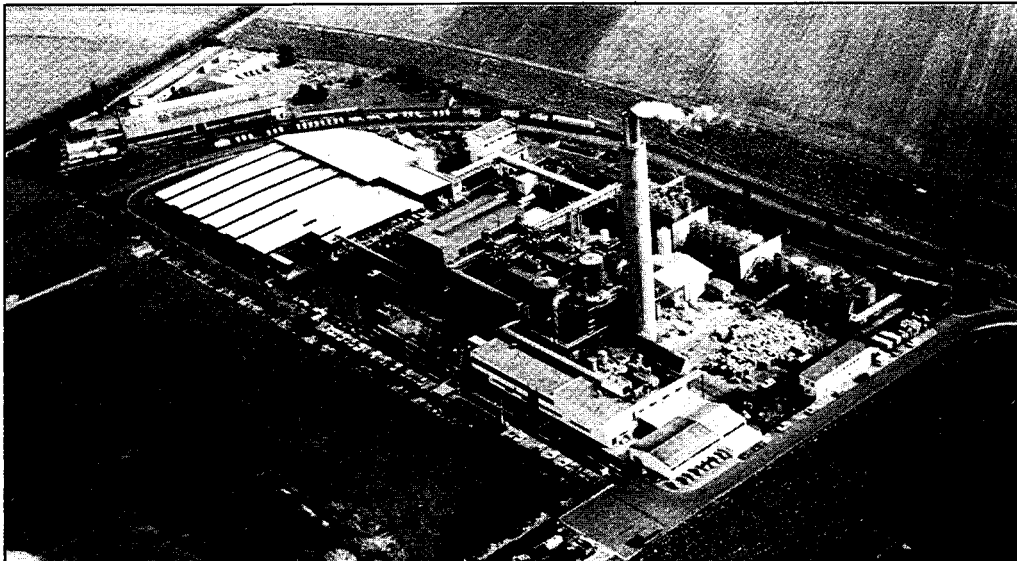


Photo: Ontario Hydro

Rotary kiln incineration plant in Beibersheim, West Germany

banned PCB waste imports in 1980 and most European sites will no longer accept international shipments.

A number of provinces have initiated plans to establish and operate disposal facilities for PCBs and other hazardous wastes. British Columbia has taken an active role in determining suitable mobile technologies for destroying PCBs in Western Canada. Alberta has selected a site for a destruction facility (at Swan Hills) and expects it to be operational some time in 1988. In Regina, Saskatchewan, an enclosed facility for a mobile decontamination process has been used to treat low-concentration PCB wastes in the province since 1983. Ontario has just selected a site for a hazardous waste destruction facility in the Niagara Peninsula and it is now undergoing detailed evaluation as part of an extensive approvals process. In addition, Ontario has recently given its approval in principle for the use of mobile destruction units in the province and a regulation specific to their establishment and control is in place. The Maritime provinces and Newfoundland are also considering the use of mobile units. Quebec has initiated a search for a suitable location for high-level destruction facilities. Tests and commercial operation of low-level PCB treatment processes have been carried out in several provinces.

There are no plans to use landfilling as a long-term disposal method for PCBs or other hazardous wastes in Canada. Only decontaminated or stabilized materials that cannot be otherwise treated are being considered for this approach.

Other Countries

Most industrialized countries are using high temperature incineration facilities, usually at fixed locations, to dispose of their PCB wastes. Germany, France, Denmark, and the U.S. all use primarily rotary kiln incinerators. Norway and Germany also use cement kilns, a technology developed in Canada. Some shipboard incinerators are also employed. Underground storage is used in Germany in a salt mine and landfilling of solid PCB wastes is used in the U.S. in geological areas with extremely low permeability.

In addition to Canada, a number of countries (e.g. Australia, Finland, Great Britain, Greece, Japan, New Zealand, Portugal, Sweden and Switzerland) currently lack disposal facilities of their own. These countries either store PCB wastes pending the establishment of destruction facilities, or transport them across international boundaries to established facilities in other countries. Some of these countries also use facilities aboard ships such as "Vulcanus II" which operates out of The Netherlands.

What safe destruction technologies are available?

Virtually everyone agrees that the only long-term solution to the PCB problem is to destroy the remaining volume of the chemical not yet dispersed in the environment. The best, most widely used and proven technology for destroying PCBs is high temperature incineration (greater than 1200°C for 2 seconds dwell time). Properly done, this has been shown to destroy PCBs at an efficiency of 99.9999 percent, leaving an inorganic ash. Smoke stack “scrubbers” are used to remove the hydrogen chloride gas and other compounds which can be formed as by-products of combustion.

Alternatives to incineration include chemical treatment for mineral oils to destroy low levels of PCBs and bacterial treatment. Chemical treatment methods are well developed and used commercially but bacterial treatment methods are still under development. Both methods appear to have limited capacity for dealing with highly concentrated PCB liquids.

Many destruction technologies can be adapted to mobile facilities and carried by truck, rail or ship.

Incineration and Thermal Destruction

Conventional incineration of PCBs produces hydrogen chloride, various oxides and other by-products of combustion. The hydrogen chloride and other pollutants must be removed from the effluent gases before being discharged to the atmosphere using conventional “scrubbers”. Solids handled by conventional incineration are completely oxidized, usually leaving an inorganic ash.

Incineration is an established technology that is used in a variety of waste management applications. As such, it is the technology of choice when regulators consider alternative methods for destroying high-level PCBs. The minimum operating conditions for the efficient destruction of PCBs (i.e., 99.9999 percent destroyed) are:

- a 2 second dwell time at 1200°C and 3% excess oxygen; or
- a 1.5 second dwell time at 1600°C and 2% excess oxygen.

Some of the established incineration technologies are:

1. Liquid injection incineration;
2. Rotary kiln incineration;
3. High efficiency boiler incineration.

Liquid injection incinerators burn a support fuel and accept PCB liquid wastes as part of their total fuel requirement. They are not designed to accept solids, such as capacitors. The incinerator should be fitted with a gas scrubbing system to remove by-products of combustion including hydrogen chloride from the flue gas. This is the technology of choice for high concentration PCB liquid wastes like askarel.

The *rotary kiln* in combination with a liquid injection incinerator is the most versatile technology for destruction of hazardous wastes and can be used for disposal of most PCB waste materials. These incinerators can handle both liquid and solid materials, but large quantities of solid residues (ash and burned-out metal for instance) can be produced when solid wastes are incinerated. Emission controls are also needed.

Commercial hazardous waste incinerators are often a combination of liquid injection and rotary kiln incinerators as the kiln itself may only partially destroy PCBs. Gases from the rotary kiln are ducted into the secondary combustion chamber for further processing.

High efficiency boilers, which are used for steam and/or electricity generation, may be fired by oil, coal or natural gas, and often approach the time and temperature conditions of liquid injection incinerators. There are incentives to use these boilers to destroy PCBs, such as in energy recovery and in lower transportation costs. These boilers, however, may be of limited use for PCB destruction because of a lack of hydrogen chloride emission controls, marginal time-temperature conditions or tendency for boiler corrosion. Their use should be limited to liquid wastes with low concentrations of PCBs (i.e., less than 500 parts per million).

Thermal destruction technologies include:

1. Radiant energy processes;
2. Low temperature oxidation.

Radiant energy processes use heat to start a chemical reaction within PCBs or between PCBs and another chemical. The plasma arc pyrolysis process, developed in Canada, is one such process which is still under development.

Low temperature oxidation processes achieve the same results as incineration, only at lower temperatures. Depending on the specific process used, catalysts, special oxidants, protracted residence times, or extreme pressure are used in place of high temperature. These processes are still in development stages and not commercial yet.

Chemical Treatment

Chemical treatment approaches use specialized chemical reactions to destroy the molecular structure of PCBs.

Chemical dechlorination processes use different chemicals and processes to break apart the PCB molecule, rearranging it to form other chemical compounds that are considered harmless and environmentally safe. Most of the available processes use a sodium compound to strip away the chlorine atoms which give the PCB molecule its extreme chemical and biological stability. Most applications involve destruction of PCBs that contaminate otherwise valuable oil, which can then be reused.

Biological Treatment

Biological treatment of PCBs involves the use of naturally occurring soil bacteria or special mutant bacteria products to treat PCB-contaminated soil. This method is still at the testing stage but appears to have limited potential given the long treatment time required. However, it could offer a low cost alternative to the excavation and landfilling of slightly contaminated soils.

Mobile Facilities

Many destruction technologies, including many of the incineration or thermal destruction approaches, are able to be adapted to mobile facilities. This approach may be more acceptable to some communities than a permanent facility as no one community would be used for extensive disposal of wastes and there is no permanent inconvenience. It would also minimize the risks involved in transporting large volumes of PCB wastes to a stationary facility. At present, no mobile incineration facilities exist in Canada although a mobile chemical treatment unit for transformer oil with low PCB contamination is operating in Manitoba. A privately-owned low-level unit located in Saskatchewan is available on a contract basis.

Incineration at sea is another form of mobile facility. Ships such as the "Vulcanus II", operating out of The Netherlands, are specifically designed for the incineration of hazardous organic liquid wastes. This approach appeals to some because destruction takes place far from residential communities and hydrogen chloride scrubbing of the resulting flue gas is not necessary because these emissions are neutralized on contact with sea water. However, major disadvantages to this approach include having to transport wastes to ports, install suitable temporary storage, and handle the material during loading and processing over sensitive marine environments.

What about other hazardous wastes?

PCBs are only one example of the many chemicals that enter the environment in quantities, concentrations or under conditions that may harm the environment and, thereby, man. A total of 3 million tonnes of these hazardous wastes are generated every year in Canada, whereas PCBs in use and storage amount to only about 25 000 tonnes, or about 1 percent of the total. While PCBs are certainly one of the most persistent chemicals entering the environment, they are far from being the most toxic. Therefore, it is vital that *all* hazardous wastes in Canada — not just PCBs — receive the careful management and disposal attention required to eliminate or adequately reduce their hazard.

Sources

Sources of hazardous wastes can be grouped into four categories:

1. By-products of industrial manufacturing processes;
2. Discarded consumer products which have become useless or contaminated;
3. Residues of hazardous materials which accidentally enter the environment through spills related to storage or transportation;
4. Discarded products and residues from laboratories and institutions.

The more common hazardous wastes are acids from metallurgical processes, inorganic residues from the chemical manufacturing industry and "still bottoms", the leftovers from oil refining. These wastes contain oil, phenols, arsenic, mercury, lead, and a large number of other chemicals. Also, there are hazardous products like PCBs, insecticides and herbicides which, due to their persistence or toxicity, require special treatment and disposal.

Treatment

Many of these hazardous wastes now receive proper treatment and safe disposal either at the site on which they are generated or in specially designed commercial treatment facilities. New hazardous waste destruction facilities which are under development in several provinces will often be capable of destroying PCBs as well as other hazardous wastes. Waste exchanges facilitate the reuse of wastes from one industry as the raw material for another.



Could the PCB story repeat itself?

The chances of another single chemical product becoming such a significant and widespread environmental problem as PCBs, are reducing every year.

Our understanding of the nature and effects of chemical contamination is still emerging — especially when it comes to long-term effects and the combined effects of the many different chemicals present in the environment. However, our knowledge of major chemical groups is quite advanced and we have in place an “early warning system” of environmental monitoring, allowing us to detect and measure even trace amounts of chemicals. In Canada, we also have the legislation, and the public awareness and support, to react to problems more quickly and effectively than in the past. There are also very real financial pressures on chemical manufacturers, due to potential lawsuits and liability insurance problems, to ensure that new products are environmentally benign.

Controls on Chemicals

While the current array of controls on chemicals could at best be called a “response system”, a full “preventive system” would be very expensive. For example, to adequately test a new chemical’s environmental impact, including possible long-term effects, can cost up to \$1.5 million and could delay the product’s introduction by several years. With between 200 and 1 000 new chemicals being introduced each year worldwide, such a system would have significant economic consequences. On the other hand, after-the-fact remedial solutions for a problem chemical like PCBs can also be extremely expensive and disruptive, even without the human health consequences factored in.

Today in Canada, the only requirement for a company manufacturing or importing a chemical for the first time is that a notification must be submitted to Environment Canada and include any information in the company’s possession pertaining to human health and the environment. However, current proposals to amend the *Environmental Contaminants Act* would require the submission of a mandatory set of data for all new chemicals in Canada. Indications of significant adverse effects on human health and the environment would result in appropriate controls on the chemical.

What can we conclude about PCBs?

The process of minimizing and ultimately eliminating PCB contamination in the Canadian environment is well under way. Due to early control efforts, recent evidence suggests that PCB levels in the environment are diminishing. The challenge now is to finish the job.

The technology exists to handle, store and destroy PCBs safely. Regulations are in place and statutory authority is available. The cooperation of industry and utilities is assured. And recent events have focussed needed public attention and political will on the problem. However, the problem is not yet fully under control because no destruction facilities exist in Canada to relieve overtaxed temporary storage facilities. The siting and construction of these treatment facilities is the urgent challenge posed by PCBs.

Until the necessary destruction facilities are in place, control rests in the hands of the industry people handling PCBs and the government people monitoring them. Given the critical shortage of adequate storage sites and the fallibility of complex administrative systems, the risks to the environment and potentially to human health will continue until the large inventory of stored PCBs is safely destroyed.



Photo: Ontario Hydro

How can I get more information on PCBs?

In addition to federal and provincial environment ministries, public libraries can be good sources of published information on PCBs. You can also contact appropriate industry associations or environmental organizations. The following is a partial list of some of the more widely available publications on the subject. More technical documents can be accessed through libraries in universities and colleges.

Environmental Effects

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