Short Course on PCBs in Mines

ABSTRACT

Abandonment of Polychlorinated Biphenyl (PCB)-containing electrical equipment in surface or underground mines can result in PCB contamination of ground and surface waters which can contribute to local human health hazards and to the already existing PCB contamination of the ocean which is considered to be the final sink for PCBs[1]. The use of PCBs in mines has been documented during U.S. Environmental Protection Agency Region 8 mine inspections. PCBs used as dielectrics in transformers, capacitors, and fluorescent light ballasts are common throughout industry worldwide. References to regulations are to the United States PCB regulations at 40 CFR Part 761. This paper is written for a domestic and international audience and describes environmental hazards, how to identify PCBs, hidden sources to look for, potential liabilities, and what to do if you find PCBs.

PCB PROPERTIES

The physical and chemical properties that make PCBs valuable commercially also make them environmentally detrimental. PCBs are very stable and resist breakdown from high temperature and aging.

There is no longer any doubt that PCBs present threats to human health and the environment. PCBs are one of the 12 chemicals targeted by the global Stockholm Convention on Persistent Organic Pollutants (POPs). "POPs are chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of living organisms, and are toxic to humans and wildlife. POPs circulate globally and can cause damage wherever they travel.[2]"

PCBs bioconcentrate* in "phytoplankton—unicellular alga in the surface layers of fresh water lakes, rivers, and the ocean…[that] play a key role in regulating atmospheric carbon dioxide concentrations."[3] "Phytoplankton is the primary food source, directly or indirectly, of all sea organisms. Data shows that PCBs affect the productivity of phytoplankton and the composition of phytoplankton communities."[4,5] About 50% of the world's oxygen is produced by phytoplankton in the oceans.[6]

Polychlorinated Biphenyls were first commercially manufactured in the United States in 1929 and were first regulated in 1979. A common misperception is that because the regulations banned the manufacture of PCBs in 1979, PCBs are no longer a problem and PCB-containing electrical equipment is no longer in use. This is not correct because the regulations authorized the use of PCBs in transformers, capacitors, and fluorescent light ballasts for the useful life of the equipment, much of which remains in service. Today, the mining industry still uses PCB-containing electrical equipment, some of which continues to be abandoned underground.

PCBs were manufactured in the US under the trade name Aroclor. Mixtures of PCBs and solvents were sold under the trade names that appear on the manufacturer nameplates of PCB electrical equipment. Some of the more common PCB dielectric trade names are: Pyranol, Interteen, Elemex, and Chlorextol. There are many others. They contain, on average, about 60% PCBs. The generic name for these fluids is Askarel.

PCBs are not the only chemicals used in mines. Underground repair facilities have

* Bioconcentration is defined as uptake of a chemical from water alone, and bioaccumulation is the result of combined uptake via food, sediment, and water.

used chlorinated solvents such as trichloroethane, tetrachloroethene, and methylene chloride for cleaning and degreasing equipment. The release of these solvents, in addition to constituting their own threats of ground water contamination, can mobilize PCBs. Some mines maintain their own landfills which contain improperly disposed PCBs and solvents.

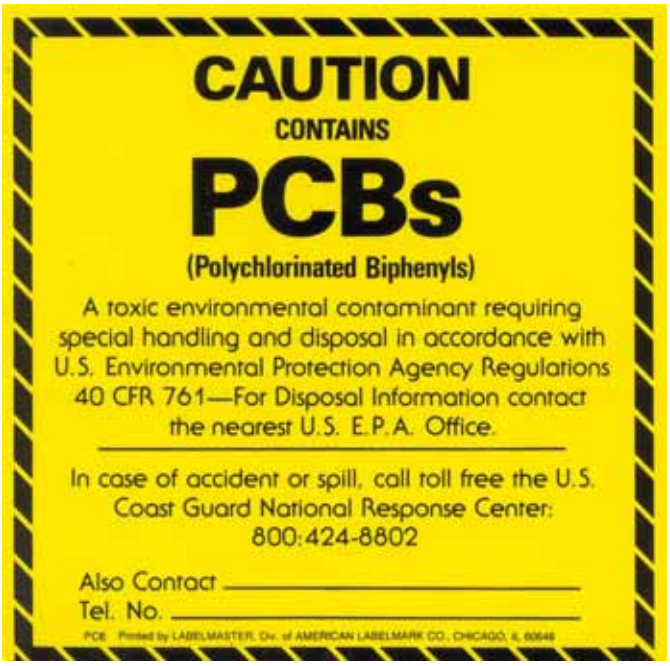

Fig. 1
PCB marks may also have a white background.

Fig. 2
76-gallon PCB (Pyranol) transformers in the Eagle Mine at Gilman, Colorado

IDENTIFYHING PCB-CONTAINING ELECTRICAL EQUIPMENT

PCB transformers

PCB transformers (Fig. 2) may carry a PCB mark (Fig. 1) or a PCB trade name on the manufacturer nameplate. Transformers with "oil" or "mineral oil" on the manufacturer nameplate originally contained only mineral oil dielectrics but may have been contaminated with PCBs. Rebuilt transformers may carry replacement nameplates that do not correctly identify the dielectrics.

Voltage regulators and mineral oil transformers may have been contaminated with PCBs, and the dielectrics should be tested before disposal. Voltage regulators and substation transformers can become regulated PCB articles if internal, small PCB starting capacitors leak, PCB concentrations can be established using SW 846-Method 8082,[7] (See ASTM D-4059).

Fig. 3
Marked PCB capacitor on the left

PCB capacitors

By 1976, 95 % of the capacitors produced in the United States were filled with PCBs[8] (Fig.3). PCB capacitors contain 100% PCBs, aroclors, 1242 or 1016. Look for a a PCB trade name on the nameplate. If there is none, or if the capacitor was manufactured prior to July 2, 1979, the capacitor likely contains PCBs. A means of identifying capacitors that do not contain PCBs is a manufacturer emplaced "No PCBs" mark required between1978 and 1998.

Fig. 4
Fluorescent light ballast

Fluorescent light ballasts

Typical fluorescent light ballasts (Fig. 4) manufactured before May 31, 1979 contain a small capacitor buried in the tar or asphalt potting material. These capacitors hold about an ounce of PCBs. Asphalt material in fluorescent light ballasts manufactured before 1978 has been found to have a better than 50% chance of containing regulated levels of PCBs.[9] As with capacitors, a means of identifying fluorescent light ballasts that do not contain PCBs is a manufacturer emplaced "No PCBs" mark required between 1978 and 1998.

Fig. 5
Lead jacket electrical cable

Electrical cable

Electrical cable (Fig. 5) can contain PCBs. In some cases, the cable is enclosed in a lead jacket which makes it difficult to handle. If electrical cable contains liquids or damp insulation, PCBs should be suspected.

MINES AND PCBs

Underground and surface mines and the attendant crushing, milling, and smelting facilities may use PCB-containing electrical equipment. PCBs transformers are usually grouped in substations underground. PCB capacitors are in similar locations. PCB capacitors can be in electric locomotives. In coal mines, PCB capacitors can be in wheel or skid-mounted power centers (Fig. 6).

Fig. 6
Coal mine power center containing PCB capacitors

PCB REPLACEMENT

PCB and mineral oil filled transformers are being replaced by dry-type transformers. PCB capacitors are available that do not contain PCB dielectrics. Fluorescent light ballasts are no longer manufactured with PCBs.

PCB MANAGEMENT AND DISPOSAL

Be aware of hidden sources of PCBs. The largest single hidden PCB source resulting in improper disposal is transformer bushings. The dielectrics in bushings have no fluid connections with the dielectrics in the transformers to which they are attached so analysis of the transformer dielectric will not reveal anything about PCBs in the bushing. "Pot heads,"cable termination apparatus that connect transformers to incoming power sources, can be filled with a tar-like material that can contain very high concentration PCBs. Any tar-like or asphalt-like material used as an insulator or dielectric should be suspected of containing PCBs. Small motors often require starting capacitors that can contain PCBs. Voltage regulators and substation transformers can contain load tap changers operated by small motors that contain PCB starting capacitors. Small motor capacitors can leak, contaminating the dielectric fluid. Asphalt material in fluorescent light ballasts. along with lubricants and caulks, are other potential sources. Air compressors have been serviced with PCB containing lubricants. Oil-filled switches, circuit breakers, and enclosures should also be suspect.

In the United States, PCB contamination can result in liabilities under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) at any concentration if there is an actual or threatened release of PCBs to the environment which presents an "imminent and substantial" endangerment to public health or the environment. Because PCBs are considered hazardous substances under CERCLA, EPA can also act whenever there is an actual or threatened release even in cases where there is no imminent and substantial endangerment.[10]

It is of utmost importance, to keep in mind the dangers and persistence of PCBs in the environment when deciding on storage locations and disposal. Incineration of PCB-containing dielectrics is the preferred destruction method. The PCB regulations require 99.9999% destruction of the PCBs.[11] Inefficient incinerators or open burning can vaporize and disperse PCBs and convert them to even more hazardous dioxins. Disposal of PCB-containing dielectrics in landfills is not permitted because of the potential for ground water contamination.

The extent and complexity of underground mines present opportunities for abandonment or illegal disposal of hazardous wastes. The presence of hazardous wastes may not be evident until they are found in the local ground water.

Abandoned underground electrical equipment may remain intact and not release PCBs for a very long time. Testing waters issuing from abandoned mines may not indicate whether or not PCBs are present in intact electrical equipment.

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This paper adapted from "Identification, Management, and Proper Disposal of PCB-Containing Electrical Equipment Used in Mines." The views in this article express the opinions of the author and do not necessarily reflect EPA policies

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