Guidelines at a Glance

Canadian Soil Quality Guidelines March 2005

Polychlorinated Biphenyls (PCBs)

This fact sheet describes the Canadian Soil Quality Guidelines for polychlorinated biphenyls (PCBs) to protect environmental health. It is part of the series *Guidelines at a Glance*, which summarizes information on toxic substances and other parameters for which there are Canadian Environmental Quality Guidelines.

The National Guidelines and Standards Office of Environment Canada coordinates the development of Canadian Environmental Quality Guidelines in cooperation with the Canadian Council of Ministers of the Environment (CCME).

Where do polychlorinated biphenyls come from?

Polychlorinated biphenyls (PCBs) are synthetic compounds that contain chlorine and can occur in 209 different configurations, called congeners. PCBs are stable at high temperatures, very volatile, attracted to lipids (fats), and they repel water. PCBs were first made in 1881, and industries began using them in 1929. PCBs were used in electric insulators, lubricants, hydraulic fluids, flame retardants, ink solvents, and waterproofing materials, among other products. After 1971, PCBs were most commonly used for insulating and cooling closed electrical systems such as capacitors and transformers. PCB manufacture and processing were stopped in North America in 1979 because of concerns for the environment and human health. Prior to restrictions, however, about 370,000 tonnes of PCBs are estimated to have been released to the environment across the globe.

In the past, PCBs were released to soil by leaks from electrical transformers, wastes that had been spread over land, spills during transport, and leaks from inappropriate disposal in landfills. PCBs were also released to the atmosphere from waste incineration. Today, most PCBs are recycled by natural processes through different parts of the Canadian environment. They enter soil in particles, in rain or as a gas absorbed from the atmosphere.

What happens to polychlorinated biphenyls released into the environment?

PCBs tend to bond with soil particles. The particular PCB congener, as well as the type of soil, amount of organic matter, and amount of moisture, affect how readily and how strongly PCBs bond with soil. PCBs move well through soil if organic solvents (e.g., ethanol) are present, but they don't move well with water flow. PCBs resist being broken down by physical, chemical, and biological processes but do degrade very slowly. Some PCBs move as gas from the soil to the atmosphere.

Because of their attraction to fats and the slow rates at which they are metabolized, PCBs accumulate and magnify in food webs. Even at low exposure rates, PCBs can accumulate to high levels in plants and animals. Plants can take PCBs directly from the soil with their roots or get PCBs from the atmosphere into their leaves. Invertebrates such as worms and insects can absorb PCBs from direct contact with the soil and by ingesting soil. Birds and mammals accumulate PCBs by eating contaminated food.

What effects can polychlorinated biphenyls have on terrestrial forms of life?

PCBs have numerous effects on terrestrial forms of life. Soil microbes, which are important for decomposition, recycling, and other processes, show lower nutrient recycling rates and lower respiration rates when exposed to PCBs. PCB exposure can inhibit plant growth, root growth, water uptake, and leaf development. Effects on invertebrates vary from none to a decrease in numbers and death at high PCB levels. Birds and mammals store PCBs in their fatty tissues. Birds transfer PCBs to their eggs with the consequences of lower rates of hatching, thinner shells, and lower growth rates of the offspring. Other effects on birds include lower egg production, behaviour changes, and death. In mammals, PCBs

tend to be transported by blood to the liver and other organs. PCBs have toxic effects on the immune, nervous, and reproductive systems of mammals, and they can be passed to a fetus through the placenta and to offspring through mother's milk.

What levels of polychlorinated biphenyls are safe for plants and animals that live in or on Canadian soils?

The Canadian Soil Quality Guidelines (CSoQG) depend on the type of land and its use. Each guideline was based on a number of scientific studies that examined the impacts of PCBs on the plants and animals that live in or on our soils. The guidelines are for total PCBs present in the soil.

The CSoQG to protect against adverse effects to environmental health on agricultural land is 0.5 milligrams of PCBs per kilogram of soil. The CSoQG for residential land and parkland is 1.3 milligrams of PCBs per kilogram of soil. The CSoQG for commercial and industrial lands is 33 milligrams of PCBs per kilogram of soil.

If the level of PCBs measured in soil is less than the corresponding guideline, one would not expect to see direct adverse health effects. In places where the CSoQGs for PCBs are exceeded, adverse effects will not necessarily occur. Whether effects will occur depends on the amount by which the guideline levels are exceeded, the kinds of plants and animals that live there, and the soil characteristics (e.g., organic carbon and water content). Further investigation at a particular site is needed to determine whether or not there is a negative impact. Also, some PCBs have toxic effects similar to the effects of dioxins and furans, which are also synthetic compounds. These compounds often occur together with PCBs at a site, so guidelines for dioxins and furans should also be considered.

How do levels of polychlorinated biphenyls in Canadian soils compare to the guidelines?

PCB levels were measured in soil from 30 agricultural fields in eight provinces and from eight fields that had been treated with sludge in Ontario. In all 30 agricultural fields, PCB measurements were detected, but were within the guidelines, with levels ranging from 0.15 to 0.24 milligrams per kilogram of soil. Only two of the eight sludge-treated fields had PCBs; the highest level was 0.51 milligrams per kilogram of soil.

Rural parkland sites in Ontario had 0.02, or less, milligrams of PCBs per kilogram of soil, and old urban parkland sites had 0.03, or less, milligrams of PCBs per kilogram of soil. Data are not available for PCB levels in commercial and industrial lands in Canada.

How can CSoQGs be used to make a difference?

In general, Canadian Soil Quality Guidelines can be used by Canadian federal, provincial, and territorial governments on a voluntary basis to set local guidelines and clean-up targets. CSoQGs are most commonly used in environmental assessments as benchmarks or yardsticks to which measured levels are compared. Anyone can use the guidelines to determine if the level of PCBs measured in a soil sample has the potential to cause adverse environmental effects.

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