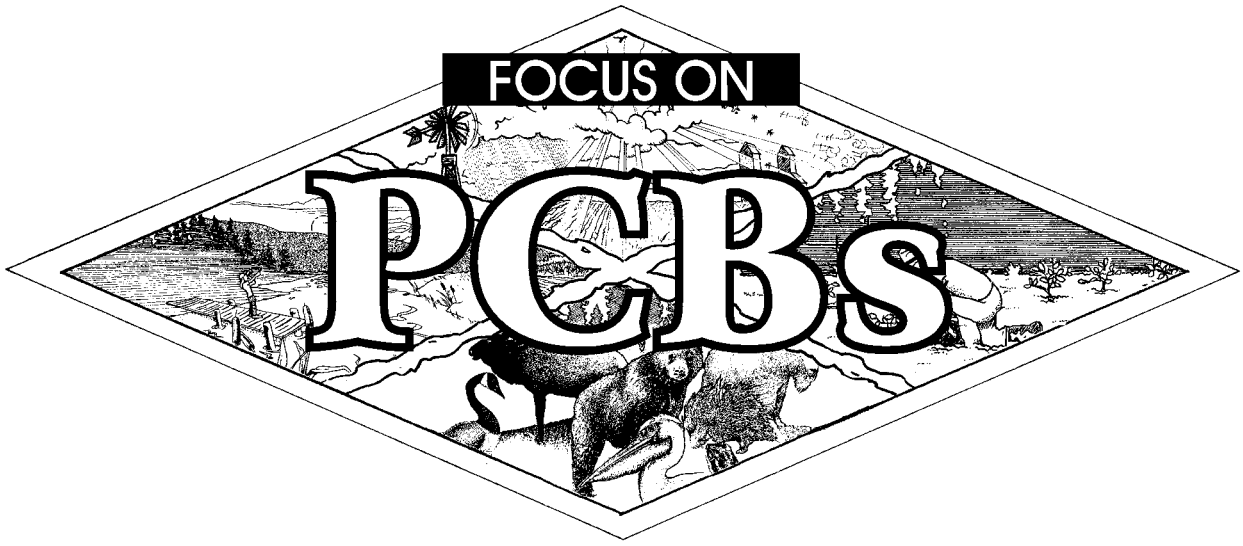

Introduction

Over the past number of years, polychlorinated biphenyls (PCBs) have often been in the news. Why are people concerned about polychlorinated biphenyls? What are they?

PCBs are human produced chemicals. They do not occur naturally. They are made by attaching chlorine molecules to a **biphenyl** molecule. There are 209 possible PCB compounds. All PCBs are heavy, colourless oils or resinous solids. They are very stable since they do not react with other chemicals. They have a high boiling point and do not conduct electricity. They are not soluble in water.

biphenyl: A colorless crystalline compound - $C_{12}H_{10}$

Reports in newspapers, radio and television have linked PCBs to cancer and birth defects. PCBs are a **toxic** substance. The truth is that scientists know some of the effects of PCBs on humans and the environment, but they don't have all the answers yet.

toxic: Capable of causing injury or death, especially by chemical means; poisonous

Since they are so stable, PCBs are found throughout the environment. They are even found in the Arctic and the Antarctic.

Background

The properties of PCBs made them ideal for certain applications. They have been widely used in electrical equipment. PCBs were an ideal coolant for electrical transformers. Other uses for PCBs have been; high temperature lubricating oils, fire retardant in lubricating oils, inks, paints, waxes, plastics and carbonless copy paper.

Millions of people have been directly exposed to PCBs through their workplace or the use of materials containing PCBs. Prior to the establishment of strict controls on their disposal, PCBs were placed in landfill sites like any other waste material. As well, used oils containing PCBs were spread on gravel roads to suppress dust.

Alberta Environment

The stable properties of PCBs have created an environmental problem. Natural processes do not break down PCBs. The accumulation of PCBs in the environment is a serious concern.

Public attention was focused on PCBs in 1968 when 1,300 people in Japan became ill after eating rice oil contaminated with PCBs at a concentration of 2,000 - 3,000 parts per million (ppm). The PCBs had leaked from a heat exchanger in a manufacturing plant. In the 11 years following the accident, 51 people died. Studies continue to assess the long-term health effects of the people's exposure to the compounds.

The incident in Japan was widely reported. In 1972 Japan banned the manufacture of PCBs. The same year, the U.S. Council on Environmental Quality recommended the use of PCBs be severely limited because of growing evidence of the effects of PCBs and their widespread distribution. In 1976, the U.S. government took steps to halt the manufacture and distribution of PCBs. Canada passed similar legislation in 1977.

Some scientists looking at the Japanese incident suggested that the link between exposure to PCBs and cancer was not proven. They indicated that the likely cause of the illness was polychlorinated dibenzofurans (PCDF) and not PCBs. PCDF is produced when PCBs are heated in the presence of air. These are the exact conditions that existed in the Japanese incident. PCDFs are known to be highly toxic and to cause liver cancer.

Since that time, several studies of people who have been exposed to large amounts of PCBs in their work have not shown a connection between PCBs and any health effects at all. Some workers have been found to have 2,900 parts per billion (ppb) of PCBs in their body. This is 1,000 times higher than the average population. Their incidence of cancer was no higher than the general population. No other health effects were detected.

Studies with animals exposed to PCBs have not been conclusive. Mice and rats exposed to PCBs have become ill with cancer. Dogs similarly exposed did not get cancer. It appears the debate about PCBs continues in an atmosphere of half-truths. People are taking sides based on their feelings, not knowledge.

PCB Management Issues

Lack of knowledge - One of the major issues in PCB management is the lack of knowledge about the effects of the chemical on man, other animals and the environment.

Media coverage of the issue rarely stresses this lack of information. Most coverage refers to PCBs as toxic or cancer causing. More recent studies that show PCBs to be less harmful than first thought are not reported.

In a complex topic like this, sound, unbiased information is hard to find. Most of the studies are reported in scientific journals that are not readily available or easily understood by the average person. When considering the issue of PCBs, it

is important to consult a number of sources and understand the bias of the sources you are using.

Persistence in the environment - Because PCBs are stable, they persist, unchanged in the environment for a long time. Normal chemical and bacterial action does not break down the PCB molecule. The compounds become concentrated 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.

With other chemicals this build-up in the environment has been a serious problem. As an example, the build-up of DDT caused some birds to lay eggs with very thin shells and caused a serious decline in their populations. However, no effects have been found in the environment, which can be directly blamed on PCBs. As the use of PCBs declines, their concentration in the environment appears to be falling.

Current uses of PCBs - Polychlorinated biphenyls are no longer manufactured in North America. They were never manufactured in Canada. They are still found in older electrical transformers and capacitors, heat transfer equipment, and electro-magnets. However, when this equipment is serviced, other fluids replace the PCBs. PCBs or PCB contaminated materials, must be disposed of appropriately.

Eventually all equipment now using PCBs will be converted to using other fluids. However, none of these fluids have the stability or non-conductive properties of PCBs. Some people feel that the use of these fluids can be a greater hazard than using PCBs. These alternate fluids have been known to explode and catch fire. The argument could be made that we are replacing a ‘hypothetical’ health risk from PCBs with a known increase in fire hazard.

Disposal of PCBs – In Alberta, we have a fully integrated hazardous waste management facility located near Swan Hills that is approved to treat and destroy PCB wastes. They must be stored and destroyed so they do not escape into the environment.

The federal government maintains an inventory of all PCB equipment and waste in Canada. This inventory helps officials to determine the amount of PCBs in use in Canada, to ensure that PCBs are handled in an environmentally safe manner and to monitor the phase-out of PCB filled equipment. The federal government also regulates the transportation of PCBs in and out of Canada and across provincial boundaries.

Regulation of the disposal and storage of PCBs is a provincial responsibility. Storage sites are licensed and inspected regularly by provincial government inspectors. The inspections ensure that the material is secure and is not entering the environment. The owner or producer of the PCBs, or PCB contaminated material, is responsible for their proper disposal or storage.

The province of Alberta has been working very diligently to insure the removal of PCB electrical equipment and PCB wastes for over a decade.

Long term storage of PCB contaminated materials is not encouraged. Storage sites must be managed carefully. Containers must be strong and leak proof. They must be stored in such a way so that if a leak were to occur, the PCBs would not escape into the environment.

At the Swan Hills site, PCBs and PCB contaminated wastes are destroyed using high temperature incineration. For concentrated wastes, incineration at 1200^{o}C for longer than 2 seconds will destroy the PCBs.

Biological methods of disposal are being studied and tested. Microorganisms are being developed that will break down PCBs. At present, these microorganisms cannot break down the higher chlorinated PCBs. This method, when perfected, holds the greatest promise for spill cleanup because it allows destruction of the chemical where it happens.

Chemical methods of disposal are being studied. The major problem is that high levels of energy are required to remove the chlorine atoms and this process requires very reactive chemicals. Chemical methods can only handle liquids with relatively low levels of PCB contamination.

Conclusion

The debate about PCBs continues. The combination of well publicized 'cancer' stories, incomplete stories and the lack of real knowledge combine to make PCBs an issue of the heart and not the head. In this story, what people feel has become more important than what is known.

It also points out the dilemma of our modem world. Every year thousands of new chemicals are created. Many of these have never been seen before. Once created, they may sit on a shelf until someone finds a use for them. For many of them it is difficult to predict what the effects will be on people or the environment.

Is it better to err on the side of caution and conduct extensive and lengthy tests before permitting use of these new chemicals? How long should these tests take? PCBs were not found in the environment until 30 years after they began to be used extensively. The question of risk to the environment versus the benefits from a particular substance have to be examined very carefully.

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