

CHLORINE AND THE ENVIRONMENT

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The element chlorine is part of many different substances, including common table salt (sodium chloride). Elemental chlorine gas does not exist in nature, but it can be produced by a process which separates the sodium from the chlorine in saltwater. This elemental chlorine reacts strongly with other substances, particularly those containing the element carbon. The substances resulting from these reactions between chlorine and carbon compounds are called *organic compounds of chlorine*.

According to *Technology Review* magazine, chlorine and its compounds are used in about 15,000 products having estimated annual U.S. sales of \$71 billion. Chlorine is used to produce polyvinyl chloride (PVC) plastics, herbicides, pesticides, and pharmaceutical drugs; to bleach pulp and paper; and to disinfect drinking water.

In addition to the 15,000 chlorine products manufactured by humans, nature releases 1,500 to 2,000 chlorine compounds to the environment.

What's the problem with chlorine?

Chlorine compounds and their by-products are suspected to cause a number of environmental and human health problems. One of the earliest examples of this problem was the pesticide DDT, an organic compound of chlorine which imitates the action of certain hormones like estrogen. In the 1950s populations of several bird species, including the bald eagle, dropped drastically. It was suspected that DDT in the environment caused female birds to produce eggs with thin shells, and caused males to be born with feminized reproductive organs. Another group of chlorine compounds, the polychlorinated biphenyls (PCBs), has had similar effects in birds and fish of the Great Lakes region. PCBs were once used widely in the electrical industry. Yet another group, the chlorofluorocarbons (CFCs), breaks down the

Earth's protective ozone layer. CFCs have a multitude of uses, including serving as refrigerants in air conditioners and refrigerators, as an ingredient in polystyrene (Styrofoam®), and as propellants for aerosol cans.

DDT and PCBs are now banned in the United States, and CFCs are being phased out. Still, these chemicals will remain in the environment for years to come, as will their harmful effects. Furthermore, many scientists believe certain still-legal chlorine compounds may imitate human hormones, causing serious health problems, such as low sperm counts, testicular cancer, and breast cancer. Also, the dioxins—which are by-products of combustion, industrial processes involving chlorine, and chlorine bleaching of pulp and paper—are known to cause cancer in laboratory animals.

Some organic compounds of chlorine are *persistent*. That is, they do not biodegrade, or break down, very easily. Some of these compounds *bioaccumulate* in fat tissues. Also, some chlorine compounds *biomagnify*, meaning the concentration of the compounds gets higher in animals higher up the food chain. So, larger animals that feed on smaller animals, as human beings do, can be expected to have higher concentrations of these chlorine compounds in their bodies.

Not everyone agrees that chlorine compounds pose a serious threat to the environment and to human health. Scientifically proving a direct link between chlorine and a human health problem is difficult because it is hard to isolate the effects of any one chemical from those of many other chemicals that may be present in the environment. Determining what dose of a chemical should be considered dangerous is also difficult. Some scientists believe the level of chlorine compounds present in the environment is not high enough to cause real problems.

What should we do about chlorine?

Some feel the risks associated with chlorine are great enough that it should be banned altogether. In 1992, the **International Joint Commission (IJC)**, an environmental advisory group organized by the U.S. and Canadian governments, formally recommended that the use of chlorine and chlorine compounds be phased out. The IJC recently renewed this recommendation in its 1994 biennial report. Greenpeace, an outspoken environmental organization, supports the chlorine ban, but so does the National Wildlife Federation, widely considered to be a moderate environmental group.

Industry's position on the chlorine issue is represented by various organizations, including the **Chlorine Institute**, a nonprofit association of more than 200 chemical industry companies. The Chlorine Institute describes its mission as supporting industry and serving the public by promoting safe use of chlorine. The institute argues that chlorine and its compounds are essential to modern life, and that a complete ban on chlorine would be very costly to society. Instead, industry recommends evaluating each chemical individually and banning only those found to be harmful. This is the system the U. S. **Environmental Protection Agency (EPA)** uses to regulate chemicals. On the other hand, the International Joint Commission argues that individually evaluating chemicals is a slow and tedious process, much too slow to adequately protect the environment and human health. They believe enough evidence exists to eliminate the use of all chlorine compounds.

One option that industry currently has is to voluntarily cut back on the use of chlorine and chlorine compounds, replacing them with other chemicals and other ways of accomplishing the same tasks. However, shifting to chlorine-free technologies is likely to be expensive and time-consuming. And in some cases, the chlorine-free technologies may turn out to be as bad, or worse, for the environment as chlorine.

State governments can examine their existing laws and regulations to evaluate whether they provide

adequate protection to the environment and human health. For example, at the request of the governor, the Michigan Environmental Science Board carried out a six-month investigation of the chlorine issue. In its 1994 report, the board concluded that certain chlorine compounds, namely those that are toxic at low levels and are persistent in the environment, should be of concern. However, the board also concluded that a complete phase out of chlorine, as recommended by the International Joint Commission, is not necessary.

At the federal level, the **EPA** has announced that it will "develop a national strategy for substituting, reducing, or prohibiting the use of chlorine and chlorinated compounds." The agency will form a task force to study the risks associated with chlorine and the possibilities of substituting chlorine-free technologies for those using chlorine. Some suggest that the EPA is taking a middle ground with this action.

Additionally, the EPA will release a new reassessment of the health effects of dioxins. This report is due to be released in late 1995.

What can you do about the chlorine problem?

Here are some ways you can reduce the amount of chlorine and chlorine compounds that make their way into the environment.

- * Use water-based paint removers, which do not contain chlorine compounds.
- * Minimize your use of insecticides around the home and garden.
- * Avoid dry cleaning your clothes. The dry cleaning process uses a chlorine compound.
- * Use fewer plastic and vinyl products. Particularly avoid plastics with the number 3 recycling symbol, which indicates they are PVC, or polyvinyl chloride.
- * Use unbleached paper products.
- * Use less chlorine bleach.

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