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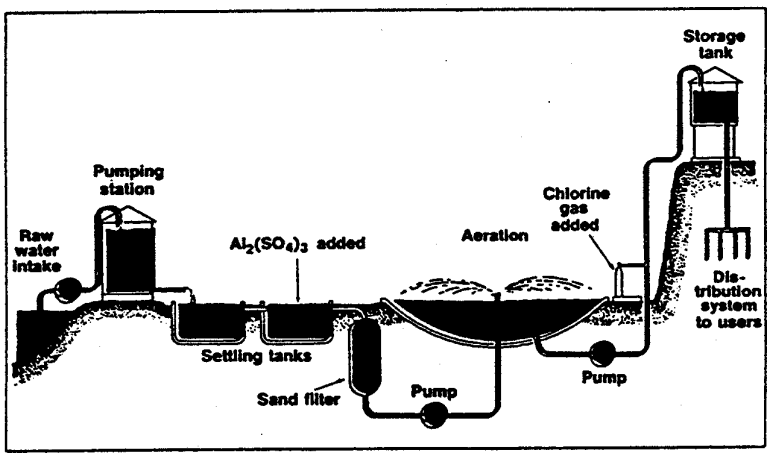

WATER DISINFECTION WITH CHLORINE: IS IT SAFE?

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For more than 80 years, the disinfection of drinking water, primarily with chlorine, has been the cornerstone of public health programs to prevent waterborne infectious diseases. Until the mid-1970s, the primary concerns about chlorination were how to expand its use and improve its efficiency. Concerns about chlorination began to change, however, after it was discovered in 1974 that naturally occurring organic materials in some water sources could react with chlorine to form chloroform and other trihalomethanes. Since this time, other disinfection by-products (DBPs) have also been identified in treated drinking water.

Now, public health officials must deal with controlling drinking water contaminants associated with the

widely used water treatment practice of chlorination, which has generally been accepted as safe and beneficial. The chlorination dilemma has caused much bewilderment among government officials and the public. Many citizens, who are already concerned about potential health risks, especially cancer, from exposure to chlorinated hydrocarbons in their environment, now find that some of these same types of chemicals may be present in their drinking water as by-products of chlorination.

What we have with drinking water chlorination is a special situation of competing risks that must be balanced. We must weigh the importance of disinfection versus no disinfection, compare the efficiency and safety of chlorination with other methods of disinfection, and determine the risks of exposure to certain levels of DBPs under continued chlorination. The current scientific view is that DBPs should be reduced when feasible, but priority must always be placed on reducing acute microbial risks. The health risks reported to be associated with long-term consumption of water disinfected by chlorine or other disinfectants are extremely small and uncertain. These risks pale in comparison with the real, immediate, and potentially grave risks posed by drinking water contaminated with microbial pathogens.

Why do we Disinfect Drinking Water?

Of all the different types of contaminants commonly found in water, especially those that cannot be detected by simple visual inspection, microbial agents are the ones most likely to be life threatening. That is why we now disinfect all public water systems in the United States, to ensure that the water is free of waterborne disease causing organisms.

What is Chlorination?

Chlorination is the name applied to the process of introducing chlorine, usually in the gaseous-free element (Cl_2) form, to public water supplies. This free chlorine acts as a powerful oxidizing agent for the purpose of killing microbial organisms that may remain in water after preliminary purification. Most of these organisms have already been removed by other treatment processes prior to chlorination.

Why is Chlorine Still Used to Disinfect Drinking Water?

Chlorine is still the water disinfectant of choice by most water utilities for a number of reasons. Even though chlorine in its elemental form is an extremely poisonous gas and very reactive oxidizing agent, making it hazardous to deal with, it is these same properties that gives chlorine its ability to kill most disease causing organisms at very low concentrations. Because chlorine is so widely used in industry, it is readily available at low prices. Chlorine has the ability to keep on killing organisms as it is pumped in treated water throughout a distribution system. Many alternatives to chlorine have been tested, especially during recent years, but in general, they are less effective and more expensive.

Although there seems to be a growing public fear of drinking water with a small residual level of chlorine in

it, this small residual elemental chlorine level at the tap is the single best indicator that the water is free of microbial contamination. If all the chlorine has been used up in oxidation processes before the end of the pipeline—your faucet—you do not know whether your water is safe to drink or not.

There is nothing wrong with purchasing a point-of-use filter to remove residual chlorine from your public drinking water supply, if that gives you better peace of mind. Filters that remove elemental chlorine will also remove chlorinated hydrocarbons. However, any filter system you install must be maintained or it may cause problems. Keep in mind that any main-line filter, such as a point-of-entry filter system that removes chlorine, leaves the rest of your plumbing from outside the filter susceptible to microbial contamination. Also, if you purchase any type of filter, make sure it carries an NSF seal, meaning it has been independently tested to perform as stated on the label.

Health Benefits of Chlorination

The health benefits of chlorination are without reproach. Its ability to prevent waterborne diseases has been proved over and over again. As chlorination of public water supplies has grown, death rates due to typhoid and other waterborne diseases have fallen sharply. Many scientists now attribute the chlorination of public water supplies with saving as many human lives as any other single human health practice ever adopted. Those countries which do not practice chlorination still have major outbreaks of waterborne diseases on a regular basis. These outbreaks usually kill thousands of people.

Our history books are full of stories about many diseases being transmitted through drinking water. For examples, the plague known as the Black Death which swept over Europe and killed about 25% of the population during the fourteenth century, and a mid-1600s epidemic that killed 70,000 Londoners in one year, were both believed to be transmitted by contaminated water. However, not until an 1854 cholera epidemic in London was traced to a public well being contaminated with human wastes from a broken sewer connected to the home of someone stricken with the disease—-was water transmission of diseases actually confirmed.

With the birth of bacteriology in the 1870s, it became possible to identify the causative agents of disease. Now, as epidemics occurred, bacteriologists were able to identify the causative agents of specific diseases as being in drinking water at the time of the epidemic. Such was the case with several typhoid and cholera epidemics in Europe during the late 1800s.

As cities grew during the late nineteenth century, their water supplies came more and more from waters that had already been used by other cities or from wells which were very close to cesspools or sewers. This increased the possibility for an epidemic caused by a waterborne disease. The principle diseases known to have spread in this fashion were cholera, typhoid, paratyphoid, and dysentery.

By the late 1800s, public health officials knew something had to be done to protect drinking water supplies. One-time chlorination of a contaminated well in the 1850s appeared to have been a success, so continuous chlorination of water was first attempted in England in 1904. In 1908, water at the Union Stockyards in Chicago received continuous chlorination. Then in 1909, Jersey City, New Jersey, began chlorinating its water and became the first city in the United States to chlorinate a public water supply continuously. Continuous chlorination or some similar method of disinfection has been universally applied to all public surface water systems in the U.S. and even to many groundwater systems considered susceptible to contamination from nearby surface water.

What is Being Done About Disinfection By-Products?

Several approaches are currently being taken to reduce public exposure to these chlorinated by-products. Other methods of disinfection are being studied, such as the use of other chemicals as well as ozonation (oxidation with ozone) and radiation treatment with ultraviolet light. All methods appear to have their drawbacks. In the United States, public water utilities now follow strict testing requirements for these chlorinated by-products and systems using surface water sources remove much of the organic carbon prior to chlorination to prevent the formation of these chemicals. All of these approaches are more time consuming and more expensive than conventional chlorination.

Has Chlorine Disinfection Eliminated All Waterborne Diseases?

Disinfection with chlorine is not a panacea for preventing all waterborne disease problems. Organisms in certain forms may escape the process and, at times, chlorine levels and contact times may not be adequate to give 100% disinfection. Therefore, whenever possible, multiple barriers such as source water protection and other treatment processes should be optimized. But when economic or other factors limit protection to a single barrier—that barrier should always be disinfection, preferably with chlorine.

Although morbidity and mortality from waterborne disease in highly industrialized countries such as the United States are largely under control, outbreaks still occur. Such outbreaks in the U.S. are not near as dramatic nor as widespread as those in Latin America, for example, but they remind us that no country can be complacent about the vulnerability of its drinking water systems to microbial contamination. In fact, the largest waterborne outbreak reported in the United States since record-keeping began in 1920 occurred in 1993 when contamination of the Milwaukee, Wisconsin, water system with Cryptosporidium caused 400,000 illnesses, 1,000 hospitalizations, and 50 deaths.

References

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