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WATER

Chloramine: A Chlorine Alternative in Drinking Water

Fact Sheet • April 2010

Only a few decades ago, limited access to safe drinking water was a major cause of disease and death around the world. The ability to remove bacteria and toxins from our water was one of the greatest public health advances of all time. Chlorine is the most common disinfectant used to treat our drinking water.[1] However, many consumers complain about the taste and odor problems associated with chlorine. Reaseachers and regulators are growing increasingly concerned about the disinfection by-products (DBPs), such as trihalomethanes and trihaloacetic acid, that chlorine treatment produces.[2] In response, some water systems now use chloramine to remove harmful organisms from drinking water.

This has prompted community action groups to begin organizing local campaigns against the use of chloramine as a disinfectant in their drinking water. Why? Chloramines are powerful and can accumulate in enclosed environments such as indoor swimming pools, small bathrooms and shower stalls. Across the country, people have reported skin, eye and respiratory problems that they believe to be associated with chloramine's use as a disinfectant in drinking water. Also unsettling is that the U.S. Environmental Protection Agency (EPA) has acknowledged that "there are few studies on how monochloramine affects human health"; further, it notes, "there are few studies on the disinfection byproducts that form when monochloramine reacts with natural organic matter in water."[3] Fortunately, the National Sanitation Foundation has certified *some** carbon /charcoal filters which can reduce chloramine from drinking water.[4]

What Is Known About Chloramine

Chloramine is a disinfectant chemical used either in place of chlorine or more commonly, as a secondary disinfectant product. It is a mixture of chlorine and ammonia. The result is a chemical that is more stable than chlorine. Water treated with chloramine does not have the taste and odor problems of chlorine. However water operators across

*See the National Sanitation Foundation's consumer contaminant guide for more information about the specific filters that reduce chloramine: http://www.nsf.org/consumer/drinking_water/contaminant_chloramine.asp?program=WaterTre

the country are not making the shift for taste reasons. The primary advantages of chloramine is that this more stable compound does not produce the dangerous DBPs, trihalomethanes and trihaloacetic acid, produced by chlorine. Additionally, chloramine is among the least expensive disinfectant alternatives to chlorine.[5] The stability of chloramines also allows the disinfectant properties to persist over a longer distance in the water distribution system than chlorine.[6]

A 2005 survey by the American Water Works Association found that approximately one-third of all utilities now use chloramines.[7] The EPA, the agency responsible for regulating chloramines, estimates that more than one in five Americans uses drinking water treated with chloramines.[8] According to the EPA, chloramines have been used to treat drinking water for over 90 years and they maintain that is safe to use for drinking, cooking, bathing and other household uses. [9]

EPA Guidelines for Chloramine

Maximum Contaminant Level Goal (MCLG)	The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.	4 mg/L
Maximum Contaminant Level (MCL)	The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards	4 mg/L

The Connection Between Chloramine and Lead

A major concern about chloramine is that it can corrode lead and copper in pipes. When chloramine is used in water treatment it changes the chemical properties of the water. Certain conditions related to pH, alkalinity and dissolved inorganic carbonate levels in the water can cause lead to dissolve from pipe material. Research suggests that, “the introduction of chloramines to water systems with lead-containing pipes, fixtures or solder may increase the amount of dissolved lead in water because of the changes in water chemistry; interactions with additives such as coagulants or fluoridation agents may remove lead dioxide scales originally formed during decades of chlorine-based disinfection.”[20]

Chloramination may also result in nitrification, where ammonia transforms into nitrite and then into nitrate in the presence of bacteria. Nitrification can lower the pH of the water, which can increase corrosion of lead and copper.[21,22]

Some cities have also begun using ferric acid, instead of alum or other nonchloride coagulants to avoid DBPs and remove organic matter from water systems. Plant managers in Virginia and North Carolina observed spikes in lead levels after they switched from nonchloride coagulants to ferric acid.[23]

Researchers believe this is what happened in Washington, DC in 2004 and Durham, NC in 2006. The water treatment systems started using chloramine and experienced high levels of lead in drinking water in the sections of the systems with lead pipes.[24] But, both cities had also switched to ferric acid, thus making the specific cause of lead spikes even more difficult to determine. Regardless the cause, lead in drinking water is a major public health risk, especially for young children. Lead poisoning causes learning disabilities, hyperactivity and irreversible brain damage.[25]

What Is Unknown About Chloramine

Health Effects of the Disinfection Byproducts

The EPA has set the maximum residual disinfectant levels (MRDL) for both chlorine and chloramines at 4 milligrams per liter (mg/L). The MRDL is the highest acceptable amount of disinfectant measured at the tap considered to be safe.[10] The maximum contaminant level goal (MCLG), the level recommended to ensure public health and safety, is 4 mg/L for chloramine.[11] In establishing these levels, the major concern is not about either chloramine or chlorine toxicity, but about adequately managing their disinfectant byproducts.

In 1998, the EPA established the Stage 1 Disinfection Byproduct Rule, which aimed to decrease the overall levels of chlorine's DBPs in U.S. water systems.[12] Disinfection by-products are formed when chlorine combines with organic matter or other chemicals in the water. Some of these by-products are known carcinogens.[13] Due to concerns about the long-term health effects of exposure to these chemicals, the EPA monitors DBPs carefully.[14] Since implementing the DBP rule, utilities have been searching for alternative disinfection strategies to chlorine; hence the increased use of chloramine.

Chloramine's DPBs are less well-known and currently unregulated. This is worrisome because while chloramine may produce fewer of the known carcinogenic byproducts, its byproducts may be *even more hazardous*. Some examples of chloramine's unregulated DPBs are iodo-trihalomethanes and iodo-acids. Iodo-acids have proven to be highly damaging to cell tissue and has been shown to cause developmental abnormalities in animal tests.[15]

At least one water association has urged EPA to delay the use of chloramine because of the unintended consequences of its DPBs. The National Rural Water Association (NRWA) suggests that, "there is significant uncertainty around the health impacts of these DBPs — the changes could actually make health problems worse."[16]

Complaints of Skin and Respiratory Problems

Citizens groups like People Concerned About Chloramine (PCAC),[17] based in Vermont, and Citizens Concerned About Chloramine (CCAC),[18] based in the San Francisco Bay area, have received complaints about chloramines from people living in 30 states. These groups contend that chloramine causes skin rashes, redness and dry skin. Citizens have also complained that chloramine contributes to gastrointestinal problems and kidney and blood abnormalities.[19] CCAC is urging the EPA to conduct scientific testing of the immediate, acute and long-term health effects of chloramine. Further study of the potential health effects of chloramine use in water treatment are needed given the increasing use of this chemical in drinking water.

Advantages of using chloramine for water disinfection:

- It does not tend to react with organic compounds, so water treated with chloramine does not have the taste and odor problems of chlorine.[26]
- It is more stable than chlorine, the disinfectant benefits last longer and protect against bacterial regrowth in storage tanks and water mains.[27]
- It is a less expensive disinfectant alternative to chlorine and the technology is relatively easy to install and operate;[28]
- It does not produce the disinfection by-products that chlorine treatment produces such as trihalomethanes and trihaloacetic acid, which may cause adverse health effects at high levels.[29]

Concerns with using chloramine as a disinfectant in drinking water:

- Its stability makes it difficult to remove from the water, even by boiling or distilling.[30]
- It is toxic to fish and amphibians. Therefore, water treated with chloramine should not be used in fishbowls and aquariums.[31]
- Its vapor can accumulate in the air of small bathrooms, shower stalls and indoor swimming pools, which may result in respiratory and breathing issues.[32]
- The potential health effects of choramines disinfection byproducts are unknown.[33]
- Without proper treatment of the pipes prior to introducing chloramine, this disinfectant can cause lead to leach from pipes into drinking water potentially exposing the population to unsafe lead levels in drinking water.[34]

Given the Increasing Use of Chloramine, the Following Measures Would Ensure Public Health

- If your water system uses chloramine, some carbon filters are certified to reduce chloramine from drinking water. See the National Sanitation Foundation's consumer contaminant guide for more information about the specific filters that reduce chloramine.[35]
- EPA should develop MCLs for chloramine's disinfection byproducts, including nitrosamines, ido-trihalomethanes and ido-acids.
- EPA must conduct research on the health risks associated with nitrosamines, ido-trihalomethanes and ido-acids
- EPA should develop guidelines for the use of chloramine in water treatment given concerns with the breakdown of lead and copper in the water pipes in systems in Durham, North Carolina, Washington, DC, and other cities across the country.
- Researchers should conduct long-terms studies of the chronic exposure of human populations to drinking water treated with chloramine.

Endnotes

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