Facts about Chloramine Drinking Water Treatment

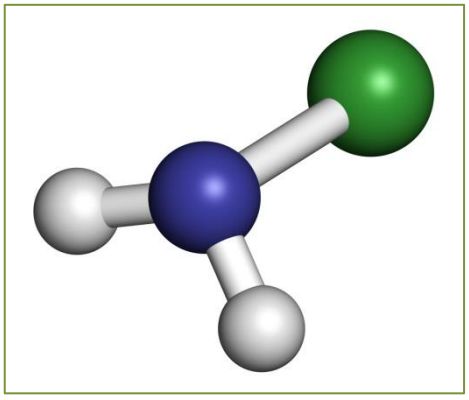
By Stephen A. Hubbs, PE

One in five Americans drink water disinfected with chloramine, a technology that has been in use since the early decades of the 20th century. Chloramine is produced at water treatment plants by combining chlorine and ammonia.

Cities that treat water with chloramine include Denver (since 1918), Portland (since 1929) and Boston (since the 1930s), among many others. Historically, some cities that used chloramine in the early 20th century were forced to suspend their use when ammonia was in short supply during World War I.[1]

Chloramine is chiefly a *secondary* disinfectant. Secondary disinfectants are added to water that has already been disinfected with a primary disinfectant, often chlorine. (Chlorine can be both a primary and a secondary disinfectant.) Secondary disinfectants are used to help protect treated water from recontamination with pathogens as it flows through the distribution network to the consumer.

Properties of Chloramine



A representation of a molecule of monochloramine, the member of the chloramine family used for drinking water treatment: Blue = nitrogen; green = chlorine; gray - hydrogen

Chloramine has a particularly long-lasting residence time in water, which is helpful for long journeys through miles of pipes. It also helps reduce taste and odor complaints among consumers. An additional benefit is that compared to chlorine, chloramine forms lower levels of regulated disinfection byproducts. Disinfection byproducts are unwanted products of chemical reactions between disinfectants and naturally-occurring organic matter. As EPA rules on allowable levels of disinfection byproducts in drinking water have become more stringent, more water utilities are employing chloramine for secondary disinfection.

A limitation of chloramine treatment is the potential to set up *nitrification* in the distribution system. Nitrification occurs when small amounts of excess ammonia promote the growth of "nitrifying" bacteria in the distribution system. Nitrification increases when the water temperature rises. Nitrifying

[1] Hoek, K, Herzner, J., Feldman, E, Becker, W., Schindler, S., and Freud, S. (Nov., 2010). "Survey says? Major water utilities shed light on chloramine disinfection." *Opflow*, the American Water Works Association.

bacteria can be difficult to eradicate and cause water quality problems, but they do not directly cause disease.[2] Strategies to avoid nitrification include reducing the residence time of water in the distribution system. Some water systems control nitrification by seasonally switching from chloramine to chlorine.[3]

Q & A on Chloramine Disinfection	
Does Chloramine Add Lead to Drinking Water?	*Chloramine itself does not add lead to drinking water. Conversion from free chlorine to chloramines can alter the chemistry of lead deposits on the pipe wall, and has resulted in release of lead in household plumbing, but this can be avoided with proper treatment. For example, several years ago, lead levels in Washington D.C.'s drinking water rose when the water disinfectant was switched from chlorine to chloramine. The problem was solved with the addition of polyphosphate. Polyphosphate forms an insoluble coating on pipe interiors, helping to prevent the public's exposure to lead through drinking water.*
Does Chloramine Causes People to Break out in Rashes?	*According to an article in the AWWA journal Opflow, upon conversion to chloramine, there is an increased potential for customer complaints about skin rashes and breathing problems. The article notes, however, that these problems have not been directly linked to the conversion to chloramine. One utility in the survey reported that as chloramine degrades, customers sometimes report atypical tastes and odors.*
Does Chloramine Kill Aquarium Fish?	*It is true that chloramine is lethal to aquatic animals and, like chlorine, must be removed from tap water with treatment products that are readily available from pet stores. Consult your veterinarian with questions about chloramine and your aquatic animal. Pet dogs, cats and birds can safely drink chloramine-treated water.*

[2] Nitrifying bacteria can deplete chlorine in the water, raising the risk of waterborne illness if chlorine levels are not monitored and adjusted.

[3] Lauer, W.C. (July, 2014). "How do we optimize chloramine production and control?" Question of the Month, *Opflow*, the American Water Works Association.

Is Chloramine Dangerous to People Who Undergo Kidney Dialysis?	*Like chlorine, chloramine must be removed from municipal water before it is used for kidney dialysis. Chlorine and chloramine can harm kidney dialysis patients during the dialysis process if they permeate the dialysis barrier and come into contact with the blood of a dialysis patient. At levels used to disinfect drinking water, chloramine-treated water is safe for drinking, cooking and bathing use by kidney dialysis patients.*

Water Treatment Operators: Using the Available Tools

Water treatment operators have a variety of tools in the water treatment "tool box." When it comes to choosing disinfectants, operators must consider a variety of factors ranging from the quality of the available source water to the characteristics of the distribution system. Chloramine disinfection is one significant tool in water operator's tool box. Used smartly, it helps accomplish the goal of delivering safe drinking water to the public.

Steve Hubbs retired from water treatment operations at the Louisville Water Company in 2004. He was involved in the development of the first DBP regulation in 1975-1979 and remains an active volunteer in the drinking water community today.