Drinking Water Disinfection and the Free Chlorine Conversion Process FAQs

Why is drinking water disinfected?

Disinfection of drinking water is critical to protecting consumers from disease-causing microorganisms, called pathogens, including bacteria or viruses. Disinfectants are very effective at inactivating (or killing) pathogens and have enormously benefited public health. For example, the incidence of typhoid fever was reduced by 1000-fold in the US in the last century by implementing the disinfection of drinking water.

Even with the advancements in drinking water disinfection practices and decreased incidence of diseases like typhoid fever and cholera in the US, disinfection of drinking water remains critical for public health. Failure to adequately disinfect water have led to high-profile illness outbreaks and deaths (for example, the 1991 Peru cholera epidemic and the 2000 Walkerton, Canada bacterial outbreak).

What are the drinking water disinfection requirements in Texas?

Public water systems are required to disinfect water prior to its entering the distribution system that carries it through pipes for delivery to consumers. Public water systems in Texas are also required to maintain a minimum amount of residual disinfectant throughout the distribution system to make sure levels of harmful microorganisms remain low. Treatment prior to distribution may utilize a number of different disinfectants, but a public water system is required to use either chlorine or chloramine in the distribution system.

What is chloramine?

Chloramine is a long-lasting disinfectant added to public drinking water for disinfection. It is formed by combining chlorinated water with small amounts of ammonia. It is commonly used for disinfection in many public water systems throughout Texas, the United States, and countries around the world.

Why does my public water system use chloramine?

Chloramine is an effective disinfectant and persists over a long period of time, particularly in areas with high temperatures. This makes chloramine useful in Texas' large distribution systems such as those of cities with numerous connections and in rural water systems with fewer connections spread out over a large geographic area.

Chloramine typically produces lower levels of regulated disinfection by-products (such as total trihalomethanes (TTHMs) or haloacetic acids (HAA5)) compared to free chlorine because it is less reactive with naturally occurring organic matter that may be in the water.

What are disinfection by-products?

Disinfection by-products (DBPs) are formed when disinfectants such as chlorine and chloramines react with natural organic matter in drinking water. The EPA regulates some DBPs, such as total trihalomethanes (TTHMs) and haloacetic acids (HAA5) to minimize their health risks. A challenge faced in drinking water disinfection is to protect the public from waterborne diseases while reducing public exposure to DBPs.

Is chloramine safe?

Yes, water disinfected with chloramine is safe for drinking, cooking, bathing, and everyday use. The U.S. Environmental Protection Agency (USEPA), the Centers for Disease Control, and the World Health Organization have determined that chloramine is a safe disinfectant and that water disinfected with chloramine within regulatory standards has no known or expected adverse health effects.

Chloramine, like chlorine, must be removed from the water prior to use in dialysis machines and can be harmful to fish and amphibians. However, proper filters and dechloramination products will address these concerns.

What is a free chlorine conversion ("chlorine burn")?

A free chlorine conversion (also referred to as a "chlorine burn") occurs when a water system that typically uses chloramine removes ammonia (needed to form chloramine) from the treatment process and disinfects the water with only chlorine. Chlorine is more effective than chloramine at inactivating certain types of bacteria. Excess ammonia, which can accumulate in a chloramine-treated distribution system over time, is a source of food for specific types of bacteria that are harmless to people. These bacteria can make it difficult for public water systems to maintain a disinfectant residual, which means that microorganisms that are harmful to people can grow.

The "chlorine burn" is a common practice by many public water systems throughout the country to reduce the number of the bacteria so that a satisfactory disinfectant residual can be maintained throughout the distribution system. Chlorine conversions can be used as a preventative strategy or to stop nitrification (the microbial process that converts ammonia and similar nitrogen compounds into nitrite and nitrate), which can diminish water quality. According to a 2016 EPA survey, 25 to 40 percent of the utilities that use chloramine reported using free chlorine burns to control nitrification[1].

Public water systems should notify their customers prior to a chlorine conversion as changes in taste and odor may briefly occur.

Why is my water system conducting a free chlorine conversion?

A free chlorine conversion is typically conducted for two reasons:

1. It is often conducted as a preventative maintenance measure to kill bacteria that can make the maintenance of disinfection residual problematic. A film can form in the distribution system piping that can contain bacteria which use ammonia as a food source. These bacteria in this film are harmless to people. When the water system stops adding ammonia, the bacteria starve. Therefore, a periodic conversion to free chlorine is effective for inactivating these types of bacteria in piping with biofilm by interrupting the supply of ammonia and can help prevent subsequent issues from occurring.

2. In rare occasions, if the distribution system receives a moderate to excessive amount of ammonia over long periods of time, bacteria using ammonia as a food source can

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[1] USEPA. 2016. Six-Year Review 3 Technical Support Document for Disinfectants/Disinfection Byproducts Rules. Office of Water EPA-810-R-16-012. December 2016.

bloom and cause a loss of disinfectant residual. As a result, the water system may not be able to maintain the minimum required disinfectant residual in the distribution system, and may receive complaints regarding taste/odor.

The conversion to free chlorine, in conjunction with increased flushing activities, assists in removing excess film from the distribution system and also starves these bacteria. The chlorine conversion helps the system return to an environment where the disinfectant residual can be maintained.

Are there any disadvantages to a free chlorine conversion?

Properly conducted free chlorine conversions can often cause the water to have a different taste and/or odor than when using chloramine for disinfection. Customers will likely be able to notice the difference, but there are no health effects associated with the change in taste/odor. Once the water system has returned to using chloramine as the disinfectant, the taste/odor of the water will return to normal.

There may be an increase in the level of disinfection by-products being formed during this short time. Health concerns related to disinfection by-product formation are based on prolonged exposure, and the conversions typically only last two to four weeks at a time. Limited scientific studies following shorter-term exposure to disinfection by-products have been published that did not find any association between exposure and dermatitis (skin rashes).

There have been a number of other studies that investigated maternal exposure to disinfection by-products and birth outcomes (such as small-for-gestational age infants) following shorter-term exposure to disinfection by-products[2]. Evidence in epidemiological studies looking at exposures to disinfection by-products above 80 ppb and pregnancy outcomes is mixed and limited by study shortcomings. Regulatory agencies worldwide continue to evaluate possible associations between disinfection by-products exposure and pregnancy outcomes. Reduction of disinfection by-products may be desirable, but it should never compromise effective disinfection.

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[2] Kogevinas et al. 2016. Drinking Water Disinfection By-products, Genetic Polymorphisms, and Birth Outcomes in a European Mother-Child Cohort Study. Epidemiology 27(6): 903-911.
Weintraub JM, Berger, M, and Bhatia R. 2006. Heterogeneous dermatitis complaints after change in drinking water treatment: a case report. Environmental Health: A Global Access Science Source 5(18): 1-3.