Water Treatment
NOTES

Cornell Cooperative Extension, College of Human Ecology

Chloramine as a Disinfectant

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Chloramine, formed by combining chlorine and ammonia, is used as a drinking water disinfectant just like chlorine itself. Harmful bacteria are killed by the disinfection process so that they no longer cause any illnesses. There are several methods known to disinfect water. Chlorine, chloramine, UV (ultra violet light), ozone or chlorine dioxide can be used. But all of these methods have drawbacks, so in most US water treatment systems chlorine or chloramine disinfection is the most feasible method. Chloramine has been used as disinfectant for over a hundred years, but in the last decade it has become increasingly popular. The main reason for using it as an alternative for chlorine is because it generates fewer by-products. When a drinking water provider switches to chloramine as the main disinfectant, they have to inform their customers well in advance so the appropriate measures can be taken by aquarium owners and others who rely on chloramine free water (see next section). This fact sheet will cover a wide variety of topics that are associated with chloramine disinfection.

In New York state chloramine is almost not used at all. Only two water providers (Seneca, Waterloo County) are using it on a routine basis. The city of Utica is currently doing a study to see if it is a feasible measure. Chloramine is used as a secondary disinfectant in these cases. This means that chlorine is added to the water first and further downstream the ammonia is added, to combine to chloramine.

Health

As yet, chloramine has no direct adverse health influences when consumed in drinking water. In drinking water it is sufficiently diluted and after ingestion it is degraded in the stomach. Both people and animals can safely drink chloraminated drinking water. Chloramine is harmful when it enters the bloodstream directly, but it can be applied to clean open wounds without concern. However, chloramine can contain risks or problems for reptiles, aquarium fish, kidney dialysis patients and industrial water users.

Reptiles and fish can take up the chloramine in the water directly through their gills into the bloodstream. To circumvent these risks, the water used for aquariums could be filtered or purified by adding chemicals. These products are generally available at pet shops in areas where chloramine is added to drinking water.

Dialysis centers, where kidney patients are treated and industrial water users, who need a more highly processed water supply (e.g. laboratories, soft drink bottlers), will have to take measures to take the chloramine out of their water. In formation about special filters can be obtained trough organizations such as NSF international (national sanitation foundation) and more information can also be acquired through drinking water providers.

Advantages and Drawbacks

The advantage of chloramine over chlorine is that less harmful by-products are created. The most important by-products with chlorination are trihalomethanes (THMs). THMs are the products obtained when organic compounds react with the chloride in water. They are found in drinking water in very low concentrations. At the moment, little is known about these compounds, but some are believed to be carcinogenic and several are also suspected to have influences on the reproductive system. Therefore the EPA (Environmental Protection Agency) has issued maximum concentration levels for these contaminants. At the moment this level is set at 0.080 mg/L or 80 parts per billion (ppb) as is enforced since December 2003. As a result, more chloramine is used in disinfection instead of chlorine. Examples of cities that recently switched are Washington DC and San Francisco.

Several drawbacks are known for using chloramine as a disinfectant.

- Elastomeric materials (rubber-like compounds) that are used in plumbing fixtures and other distribution features can be affected to become more brittle.
- It can enhance the nitrification process which would remove ammonia from the water. Nitrification is the biochemical oxidation of ammonium to nitrite and nitrite to nitrate. This process is carried out by specialized bacteria.
- The potential to form by-products that are specific for chloramine.

Most of these drawbacks have remedies. Alternatives for the elastomers can be bought at hardware stores and by reducing the detention time of water in the distribution system the chance of nitrification will be decreased.

A lot of research is done to pin-point the risks involved with chloramine related by-products. Chloramine will just like chlorine enhance the forming of chlorinated by-products (eg. THMs). But, because of its low react ability less will be formed, and consequently the concentrations of these byproducts are lower. A recent study showed that chloramine can, under certain circumstances, enhance the formation of a potentially toxic by-product. In drinking water containing high concentrations of bromide and iodide, iodo and bromo acetic acids can be formed. Chloramine favors the formation of the iodo acetic acids more than chloride.

The toxicology of iodo- and bromo acetic acids is not currently known, but it seems that they are more toxic than chloro acetic acids, although a lot more research is needed to further substantiate these claims. It should be noted that it is highly unlikely these compounds will pose a significant health risk, because the particular circumstances for their forming are rare and no significant quantities are produced. In the nationwide study on drinking water quality these compounds were only found in one site which has the above mentioned specifics. It is however something for drinking water providers to keep in mind before changing to chloramine.

Removal of Chloramines

Chloramine is a more persistent disinfectant than chlorine. As a result it is retained in the water for a longer period of time. The advantage is that in this way it can function much longer as a disinfectant than chlorine. However, it cannot be removed by letting the water stand for a couple of days as with chloride. The best way to remove chloramine is to use a water conditioner that contains a de-chlorination chemical or by using high quality granular activated carbon which will absorb the chloramine. Nevertheless, there are only a few circumstances when complete removal is mandatory.

Taste

Tests have been done to review the taste of chloramine in drinking water versus chloride. It seemed that chloramine has a less offensive taste than chlorine. Most panels were not able to identify chloramine in concentrations even higher than the normal dosage used for disinfection. Consequently, most people will probably not need a device for removal of chloramine just because of taste and odor issues.

Washington lead scare

In February 2004 the first reports came about the possibility of high lead levels in Washington DC. By several researchers it was discovered that the lead values in drinking water were over six times the maximum allowed concentration and sometimes substantially higher and this situation continued until August 2004. In January 2001 the Washington Aqueduct and Sewer Authority (WASA) switched from using chlorine to chloramine to reduce the amount of chlorinated organic by-products in their drinking water.

The lead peak coincided with the chloramination of the water and after extensive research was proven to be the culprit. The result of high lead levels can be very severe. Lead can have serious impact on health issues (for more information see factsheet #2). The conditions of the DC water supply were of such a nature that chloramination accelerated lead leaching. The amount of lead lines used, brass fixtures and lead containing water meters were the lead source contributors. This case is unique. The availability of lead and the presence of other chemicals in the water (sulfite, phosphate etc.) combined with the chloramine caused the leaching, something that otherwise would not have happened. The fact remains that this could happen to other towns that have the same water composition and use extensive lead plumbing. Although Washington DC has a distinctive situation, in future use of chloramines in stead of chloride it is of importance that drinking water companies should consider the water composition and the lead plumbing in their area. San Francisco, another big urban area that recently made the switch is currently investigating the effect of chloramine of the lead levels in their drinking water.

Quick facts about Chloramine

Chloramine…

- does not change the pH of water
- is safe to use for watering plants and the beneficial soil bacteria will not be harmed
- will not affect swimming pools
- cannot be removed by reverse osmosis or boiling
- will not be found in cow's milk, when they would drink chloraminated water
- does not cause asthma
- is not associated with heart failure
- is not a carcinogen
- in drinking water is safe for babies and pregnant women
- does not bio-accumulate (either in fish, animals or humans)

Summary

Chloramine seems a very good alternative to chloride. The taste is less offensive than chloride; it releases less harmful by-products and has no adverse health properties. Though, it should be noted that in two unrelated unique cases chloramine is the probable culprit in increasing lead levels and iodo acetic acid levels. As long as the exact reason for these contaminations is not resolved, drinking water companies should be careful in switching from chlorine to chloramine. The risk for high lead levels can have a serious health impact and should not be something to take lightly. The WASA has already announced to take drastic measures to decrease the quantity of lead lines in the next years. The development of this case will be an interesting example for the enhancement of understanding what chloramine can affect. However, the risks posed by the iodo and bromo acetic acids are very low and should not be considered a threat. Drinking water companies will know about the special circumstances for both the lead and the acetic acid occurrences and change their procedures accordingly.

Except for the above mentioned cases, it seems that the popularity of switching from chlorine to chloramine is correct and will help to lower the amount of THMs so our drinking water is healthier.

For in-depth information about your local disinfectant situation ask your drinking water provider.

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