

Chloramine Facts

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Definitions and Information

- Chloramine is a combination of chlorine and ammonia.
- Chloramine is used to disinfect water supplies (like the Hetch Hetchy system.)
Water utilities often refer to chloramine as monochloramine.
- In reality, chloramine exists as three different forms or species: monochloramine (NH₂Cl), dichloramine (NHCl₂) and trichloramine (NCl₃). They are chemically related and are easily converted into each other; thus, they are more appropriately called chloramines.
- The three species of chloramine constantly and rapidly shift from one form to another. The species that predominates is dependent on pH, temperature, turbulence, and the chlorine to ammonia ratio.
- Even time plays a factor because after a day or so, with no changes in conditions, monochloramine in a water system will slowly degrade to form dichloramine and some trichloramine.
- Chloramines are all respiratory irritants with trichloramine being the most toxic (order of toxicity: monochloramine < dichloramine < trichloramine-most severe.)
- In contrast to what water utilities claim, it is impossible to have only monochloramine. It is not unusual in water systems for harmful di and trichloramines to occur.
- Disinfection byproducts are chemicals formed when a disinfectant combines with organic matter or other chemicals present in water.
- Trihalomethanes (THMs) are disinfection byproducts that are formed when organic matter in the water combines with chlorine.
- THMs are also formed with chloramine disinfection but at a lower concentration-- (approximately 1/3 less) than chlorine.
- THMs are possible but not proven cancer causing byproducts.

Chloramine Facts

- To reduce THMs, the Environmental Protection Agency (EPA) offers other disinfection methods such as ultraviolet UV light treatment and chlorine dioxide (see the [Alternative Disinfectants and Oxidants Guidance Manual, EPA 815-R-99-014, April 1999](#); the Table of Contents lists disinfection methods, one per chapter.)
- Alternative disinfectants to chlorine, including chloramine, have not been studied for their health effects.
- Chlorine is the only disinfectant that has been extensively studied.
- The safest way to reduce THMs, according to the World Health Organization (WHO), is to remove the organic matter from the water first through prefiltration before disinfection with chlorine (see the WHO's [Guidelines for Drinking Water Quality](#), PDF 950KB).

Characteristics of Chloramine

- Chloramine is a less effective disinfectant than chlorine. The [World Health Organization \(WHO, PDF 950 KB\)](#) says that "monochloramine is about 2,000 and 100,000 times less effective than free chlorine for the inactivation of E. Coli and rotaviruses, respectively."
- Chloramine does not dissipate easily compared to chlorine.
- Chloramine stays in the water distribution system longer than chlorine.
- Chloramine is difficult to remove.
- Chloramine cannot be removed by boiling, distilling, or by standing uncovered.
- Some disinfection byproducts of chloramine are even more toxic than those of chlorine, i.e. iodoacids.
- Chloramine vapors and its disinfection byproducts can accumulate in indoor air and concentrate in an enclosed area such as a shower stall, small bathroom, kitchen, or apartment (see [Toxic Showers and Baths](#) on this website).

Inadequate Studies

- The EPA states that there are NO dermal (skin) and NO inhalant (respiratory) studies on chloramine as used as a disinfectant for drinking water.
- The EPA states that there are INADEQUATE cancer studies on humans or animals.
- In studies that do exist, one shows mononuclear cancer in female rats.
- Another study shows reproductive toxicity and reduced reproductivity in mice and hamsters.
- We are told by the SFPUC that chloraminated water is safe for humans to drink but we do not even know if it can cause cancer.
- Research to date only explores oral (such as drinking tap water) exposure. It leaves out exposure through bathing or inhaling indoor vapors.

Chloramine Facts

- The disinfection byproducts of chloramine have not been studied and may be worse than those of chlorine. Chlorine and its disinfection byproducts have been studied extensively for years.
- The San Mateo County Board of Supervisors, in response to public outcry over health effects, requested on December 7, 2004 that the California Conference of Local Health Officers (CCLHO) evaluate "the potentially harmful effects caused by chloramine." (see Resolution, to be added to this website)
- The CCLHO report of March 8, 2005 did NOT study the health effects of chloramine. It only reviewed previous studies, mostly about chlorine and trihalomethanes (for more information, see [Article Archive and Links](#)).
- The CCLHO report recommends that the exposed public be monitored for health effects caused by chloramine. In other words, we the public are to be used as guinea pigs.

Effects of Chloramine on Human Health

Immune System Problems

- Chloramine cannot kill the pathogens in the water as well as chlorine.
- As a result, people with suppressed immune systems must have their water boiled over TEN minutes BEFORE use to kill pathogens, or they risk becoming ill.
- Those at risk include children under 6 months of age, the elderly, those on or who have had chemotherapy, people with HIV or AIDS, organ transplant patients, and others with a weakened immune system.

Respiratory Problems

- Chloramine can cause and/or aggravate respiratory problems.
- Chloramine fumes can cause an individual to become congested and cause sneezing, sinus congestion, coughing, choking, wheezing, shortness of breath, and asthma (see the [Hazardous Substances Fact Sheet for Chloramine](#), PDF, 98 KB), by the New Jersey Department of Health and Senior Services).
- An increase in asthma due to exposure from chloramine in indoor swimming pool areas was shown in a [Belgium study from the Catholic University of Louvain](#) (PDF, 707 KB).
- Chloramine damages mucous membranes. The lung damage in those exposed to chloramine in indoor pool air is similar to that seen in regular smokers (see [Health24 News](#) article).
- Chloraminated vapor from showers, baths, hot tubs, dishwashers, and other household appliances contains volatilized chemicals that can be inhaled and cause irritation to the respiratory tract.

Chloramine Facts

- Inhaled chloraminated vapor can enter the bloodstream directly through the lungs. It bypasses the digestive tract where the SFPUC says it is broken down and excreted (questions 35 and 36 in their Chloramination Questions and Answers).
- The SFPUC says that, "if monochloramine enters the bloodstream directly, it combines with hemoglobin (red blood cells) so it can no longer carry oxygen" (question 37).
- The toxic exposure to chemicals (like chloramine) in water is greater from taking a shower than from drinking the same water (see [Toxic Showers and Baths](#)).
- An individual can experience long term effects from repeated exposures to a chemical (like chloramine) at levels not high enough to make them immediately sick (see the [Hazardous Substances Fact Sheet for Chloramine](#), page 3, PDF, 98 KB).
- The likelihood of becoming sick from a chemical increases with exposure time and concentration (see the [Hazardous Substances Fact Sheet for Chloramine](#), page 3, PDF, 98 KB).
- In a study by Zierler, et al, it was found that there was an increase in deaths from influenza and pneumonia in the communities that used chloramine. (Communities in Massachusetts that used chlorine for disinfection were compared to those that used chloramine).
 - 1) Chloramine exposure damages lung mucosa, making the lungs more susceptible to allergens and infections.
 - 2) Chloramine is a less effective disinfectant and therefore people are exposed to more pathogens.

Skin Problems

- Chloramine tap water can cause severe skin reactions:
 - rashing dry skin
 - itching flaking
 - welting blistering
 - chapping burning sensation
 - cracking scarring
 - bleeding pigmentation
- Chloramine can aggravate other skin conditions such as eczema and psoriasis.
- Chloramine can cause bleeding lips, dry mouth and dry throat.
- Chloramine can cause burning, red, and dry eyes.
- Skin exposure to ammonia "breaks down cell structural proteins, extracts water from the cells and initiates an inflammatory response, which further damages the surrounding tissues."

Chloramine Facts

Digestive and Gastric Problems

- Chloramine damages digestive mucosa.
- Chloramine can aggravate digestive disorders.
- It is suggested that monochloramine is responsible for gastric cancer. (Journal of Gastroenterology, 1997, "Enhancement by Monochloramine of the Development of Gastric Cancers in Rats; a possible mechanism of Helicobacter, pylori-associated gastric carcinogenesis. [Click here](#) for a PDF, 2.87 MB.)

Kidney and Blood Problems

- Persons with liver or kidney disease and those with hereditary urea cycle disorders are at increased risk for ammonia toxicity from the consumption of chloraminated water.
- Kidney dialysis patients cannot use chloraminated water in their dialysis machines because it will cause hemolytic anemia.
- Chloramine must be completely removed from the water in dialysis treatment using extensive carbon filtration and a reverse osmosis or Cation filtering system to remove both chlorine and ammonia from the water.
- There are populations that are unusually susceptible to ammonia reactivity or toxicity due to factors such as genetic makeup, age, health status, etc.

Filtration

- Filtration for chloramine is very expensive compared to filtration for chlorine.
- To remove chloramine, an extensive carbon filter (to remove the chlorine part of the chloramine molecule) followed by a reverse osmosis or cation filter (to remove the ammonia) is necessary.
- There is NO certified showerhead filter to remove chloramine. The high flow rate and large volume of water passing through a showerhead renders the showerhead filter useless.
- Sink water filters for chloramine handle low flow, cold water conditions only.
- For high flow uses like showering and bathing, a whole house filtration system would be needed to effectively remove chloramine and ammonia.
- A whole house filtration system could cost between \$10,000 to \$15,000 with \$1,200 maintenance per year.
- For a 5-unit apartment building, the cost could be as high as \$80,000 to \$120,000 plus yearly maintenance.
- Even with a comprehensive filtration system, no filtration system engineer will guarantee complete removal of chloramine. Chlorine is by far easier to remove with inexpensive carbon filtration.

Chloramine Facts

Misleading Statements from the SFPUC

- Contrary to SFPUC's website (Q 18), the NSF DOES NOT certify showerhead filters for chloramine. It only certifies cold-water, low-flow filters for drinking water.
- Contrary to what the SFPUC says (Q 14), there IS a Material Safety Data Sheet (MSDS) on monochloramine, available at <http://ptcl.chem.ox.ac.uk/MSDS/CH/chloramine.html>.
- The SFPUC says that chloramine DOES NOT bioaccumulate in the body (Q 39) Then it contradicts itself (Q 30). See SFPUC Questions and Answers.
- In Q 41, the SFPUC claims that chloraminated water is safe for the general public and for people with suppressed immune systems. However, since chloramine is a much weaker disinfectant, those with suppressed immune systems are at increased risk.
- In Q 31 and Q 32, the SFPUC claims chloramine does not cause dry skin, skin rashes, or asthma. Yet no studies have been done to date on the skin or respiratory effects of chloramine as used as a water disinfectant.

Business Effects

- It is costly and time consuming for businesses that must filter out chloramine from their water for their use and processing needs. They include:
 - chip manufacturers
 - medical suppliers
 - Pharmaceutical companies
 - dialysis machine technicians
 - pet stores with fish, amphibians, reptiles
 - food businesses that use water (fresh or saltwater)
 - breweries
 - photo labs
 - biotech companies
- The cost is often passed on to the consumer and the public at large.

Plumbing Problems and Some Implications for Health

- Chloramine can cause leaching of lead from lead pipes, lead soldering and from so called "lead free" brass plumbing parts.
- Lead leached by chloramine can cause lead poisoning. Lead poisoning can cause neurological damage, health problems and even death in young children.
- Chloramine can cause pinhole pitting in copper pipes. Leaks from the pinholes can cause mold to grow. Some molds are highly toxic to humans and can endanger the health of individuals, often permanently.

Chloramine Facts

- Insurance companies do not cover damage from mold. As a result, some homeowners lose their homes.
- Chloramine can cause rubber corrosion of rubber plumbing parts like toilet flappers and rubber casings.
- Rubber corroded parts need to be replaced with chloramine resistant parts such as synthetic polymer.
- Rubber corrosion can be spotted as early as 6 months after chloramine has been added to the water supply. Signs of corrosion can be seen when little black specks appear in the water from plumbing parts.
- The thousands to tens of thousands of dollars in plumbing repair costs caused by chloramine are passed on to property owners.

Environmental Effects

- Canadian EPA ruled chloramine "toxic" as defined in Section 64 of the Canadian Environmental Protection Act, 1999, as a result of a study assessing the impact of high volume chloraminated water discharges entering the environment, particularly on fish.
- Chloramine is toxic to fish, amphibians, and water-based reptiles and marine invertebrates. Chloramine enters directly into the bloodstream of fish, and amphibians through gills and skin, respectively.
- Chloramine must be removed from the water with a GAC (granular activated carbon) filter followed by a reverse osmosis or Cation filter. Note: The GAC filtration filters out only the chlorine from the chloramine molecule leaving the ammonia behind.
- Chloramine run-off from water hydrants or broken mains that enter storm drains, streams, lakes, rivers, and creeks, endangers the lives of fish, amphibians, water invertebrates, and other sensitive marine animals.
- Chloramine must be filtered out BEFORE it reaches bodies of water. This includes wastewater released into the environment from wastewater treatment plants.

CCAC Recommendations

- CCAC recommends that chloramine be removed from the water supply. The SFPUC should discontinue the use of chloramine as a water disinfectant until the appropriate scientific studies are done to test the safety of chloramine as a water treatment option.
- CCAC supports the use of prefiltration of organic matter before disinfection that the World Health Organization (WHO) recommends to control trihalomethanes (THMs). The use of prefiltration will allow us to continue to use chlorine as our water disinfectant thus eliminating all the harmful effects that chloramine is causing.

Chloramine Facts

Note: Organic matter is a precursor to the formation of trihalomethanes, a possible but not proven carcinogen. Removing organic matter prevents the formation of trihalomethanes in the first place. This allows the use of chlorine and takes best advantage of its superior disinfection capabilities. Chlorine is much more effective at killing disease causing organisms than chloramine. Chlorine has been well tolerated for decades, is easily and inexpensively filtered out, and has been studied extensively. For a more complete explanation, see the WHO report, "[Guidelines for Drinking Water Quality](#)."

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