

## **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 (NH<sub>2</sub>Cl), dichloramine (NHCl<sub>2</sub>) and trichloramine (NCl<sub>3</sub>). 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 dichloramine 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.

### ***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).

## ***Effects of Chloramine on Human Health***

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### **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.

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<http://www.chloramine.org> 650 328-0424

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- 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.

### **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."

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### **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. The other option is the use of a large catalytic

carbon tank, one that allows enough contact time to remove both.

- 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.

### ***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.

### ***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.

**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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