Town of Vermilion

Science of Chloramination

TOWN OF VERMILION ALBERTA

What is Chloramination?

Chloramination is the process of disinfecting water using chloramines, compounds of chlorine and ammonia.

- Chloramination is a better choice than using chlorine alone because it produces lower levels of disinfectant by-products like trihalomethanes which form when chlorine combines with natural organic substances found in water.

- Chloramination has been widely used in communities across Canada, the United States and Europe for several decades. In Alberta, the cities of Edmonton and Lethbridge treat their water via chloramination.

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Is Chloraminated Water Safe?

Chloraminated water is safe for drinking, cooking, bathing, laundry, gardening and all other general household uses and it is safe for spraying on all lawns, flowers and vegetable gardens as the chloramine readily dissipates with minimal impact on beneficial soil bacteria because of the soil's need for chlorine.

Because chloramine does not accumulate in the body it is safe for:

- women who are pregnant, babies and children alike,
- mixing baby formulas and
- cleansing cuts, scrapes and wounds.

However, just like chlorine, precautions should be taken to neutralize or remove chloramines by these special groups:

- kidney dialysis patients,
- owners of aquariums, reptiles, amphibians or backyard fish ponds,
- restaurants and supermarkets with live seafood tanks,
- photo labs and
- businesses or laboratories requiring high-purity water.

Why is Chloramine Harmful to Dialysis Patients?

Like chlorine, chloramines can harm kidney dialysis patients during the dialysis process if it is not removed from water before in comes into contact with their bloodstream, where it inhibits the ability of their red blood cells to carry oxygen. All dialysis patients can freely drink or bathe in chloraminated water because the body's digestive process neutralizes chloramines.

Patients who perform dialysis at home must check with their health care provider to ensure their own equipment has been properly adapted for use with chloraminated water.

If you are a dialysis patient and have any questions, please call your doctor or the dialysis centre where you are treated.

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Why is Chloramine Harmful to Fish and Amphibians?

Fish and amphibians pass water through their gills directly into their bloodstream for oxygen, chloramine will inhibit the ability of their red blood cells to carry oxygen. Water used for aquariums must be treated in a manner appropriate to remove both the chlorine and ammonia components of the chloramines. In order to do this you must use conditioning chemicals designed to remove chloramines (such as Amquel ® or ChlorOut ®) available at pet stores, fish supply stores, and some variety stores.

Chlorine removal agents that are not specifically designed to also remove chloramines could leave excess ammonia in the water which can be harmful to the fish. To be completely safe, always pre-treat your water before adding it to your aquarium, no matter how little you add. Treatment and test kits are available at most pet and fish supply stores. Chloramine residuals in treated water should be below 0.1 mg per liter.

Treatments which are NOT effective:

- letting the untreated water stand outside for a day or two
- boiling the water first
- using chemicals that remove only chlorine

Free Chlorine vs. Chloramines

Free Chlorine

- Free chlorine is a powerful oxidant and reacts rapidly with organics and inorganics. As a result, the strong disinfectant residual it initially provides may not persist as long as necessary within a distribution system.
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- During it's reaction with organic matter, free chlorine can readily form unwanted disinfection by-products (DPB's) such as trihalomethanes (THM's) and haloacetic acids (HAA's).

Chloramines

- In comparison, chloramines offer a less aggressive disinfectant residual that reacts more slowly and remains longer in the distribution system.
- Given more stringent disinfection by-products regulations, chloramination can be an appealing alternative to the use of free chlorine as a means of limiting DBP formation – especially THMs.
- Also of benefit, fewer taste and odor concerns are reported by consumers of chloraminated water.
- Chlorine is in a water supply system to protect individuals from contaminants and bacteria. Chlorine is tested on a regular basis to ensure levels are high enough to inhibit contaminant growth. Chloramines have longer dissipation times which help ensure a cleaner water system.

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Chloramination Considerations

- To form the preferred chloramine compound, the appropriate weight ratio of chlorine and ammonia must be determined and then carefully managed.
- Free ammonia entering the distribution system must be limited to reduce the potential for nitrification.
- Free chlorine in drinking water can dissipate within a short amount of time or can be removed with relative ease as in our current water treatment process.
- Chloramines are more difficult to remove and generally take over 30 days to dissipate or can be removed with chemicals such as Amquel ®
- The introduction of chloraminated water to unlined cast-iron pipes may result in reddish discoloration. System flushing may be necessary.

Chloramine Compounds?

Chloramine is a general term that describes three related compounds:

- Monochloramine, NH_2Cl
- Dichloramine, $NHCl_2$
- Trichloramine, NCl_3

- The formation of di and trichloramine is minimized by adding a particular weight ratio of chlorine and ammonia to water while maintaining a certain pH range.

- If allowed to develop, di and trichloramines can contribute an objectionable taste and odor to the treated water.

- Monochloramines are effective biocides that contribute least to taste and odor problems.

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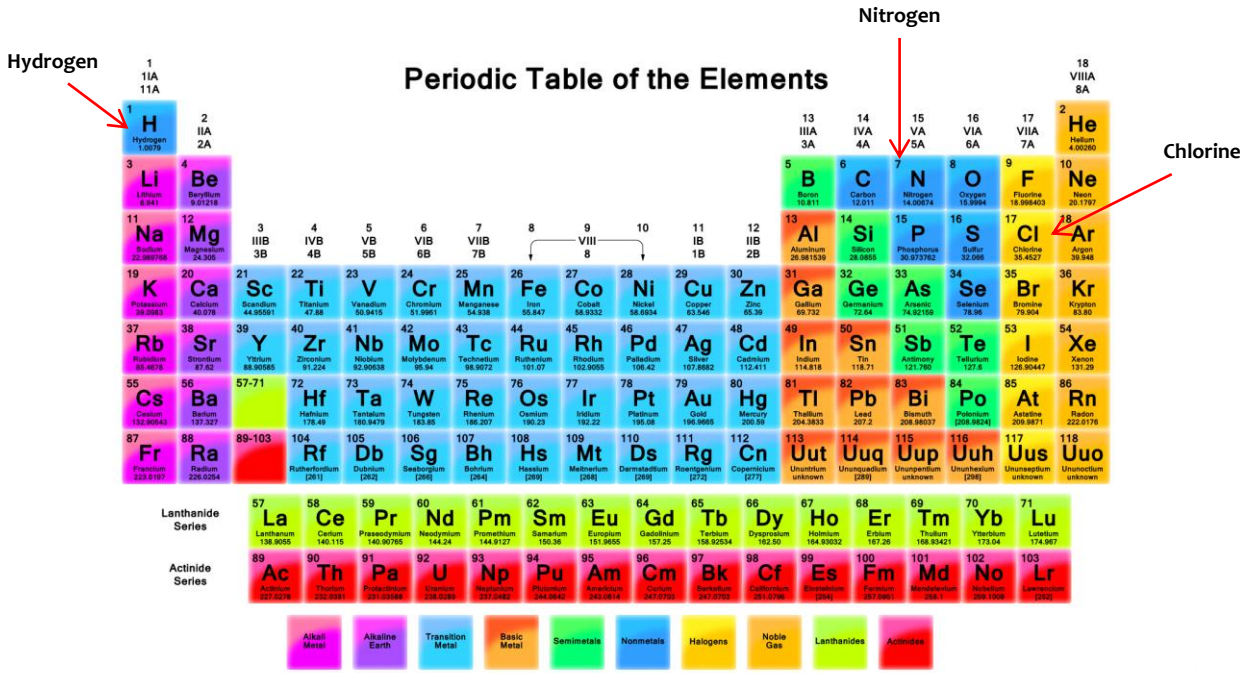
Chemistry of Chloramination

To fully understand the chemistry involved with chloramination, it is helpful to start with the basics;



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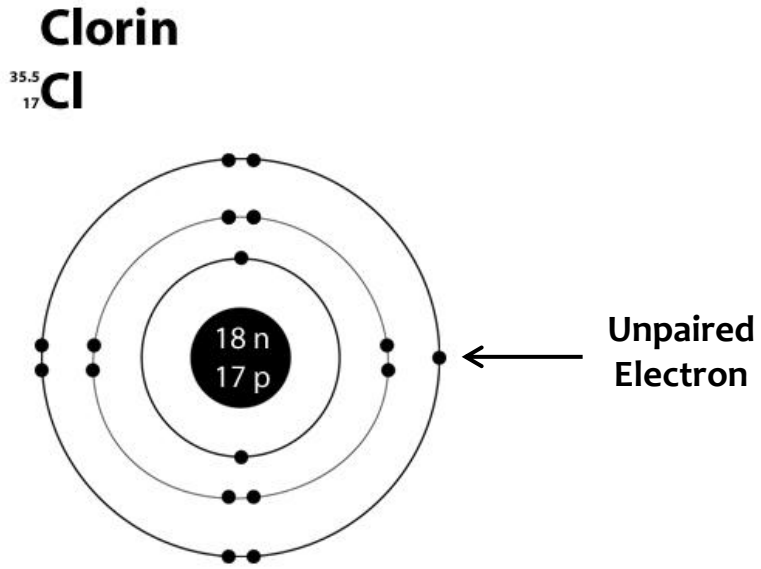
Chlorine

Chlorine, an element in the halogen family, is represented by the symbol Cl. It has one unpaired electron in its outer valence shell making it highly reactive.



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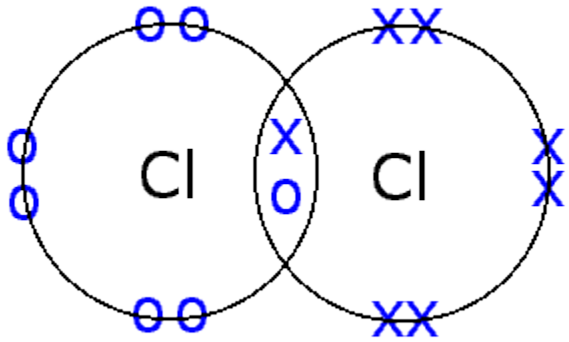
Chlorine

Elemental chlorine exists as a two-atom molecule with the symbol Cl_2. In this arrangement, each atom has 8 valence electrons in its outer shell.

The molecular weight of this diatomic molecule is 70.92.

The bonding between the two atoms is relatively weak and keeps the Cl_2 molecule highly reactive.



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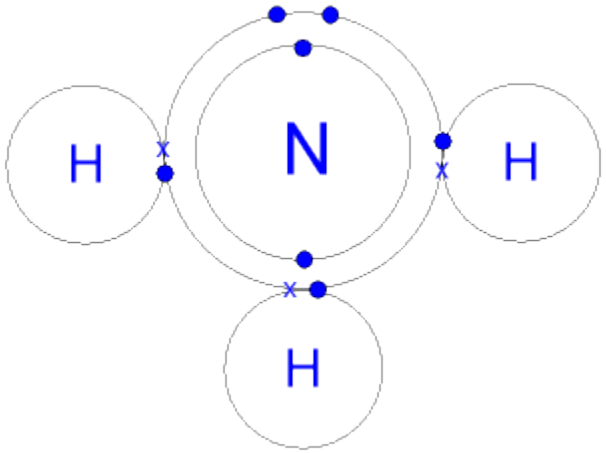
Ammonia

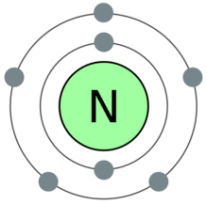
Ammonia, NH_3, is a compound made up of one nitrogen atom and three hydrogen atoms. The nitrogen atom has an atomic mass of 14 and each hydrogen atom has an atomic mass of 1 giving ammonia a total molecular weight of 17.

Ammonia



Hydrogen **1**

Nitrogen **2,5**



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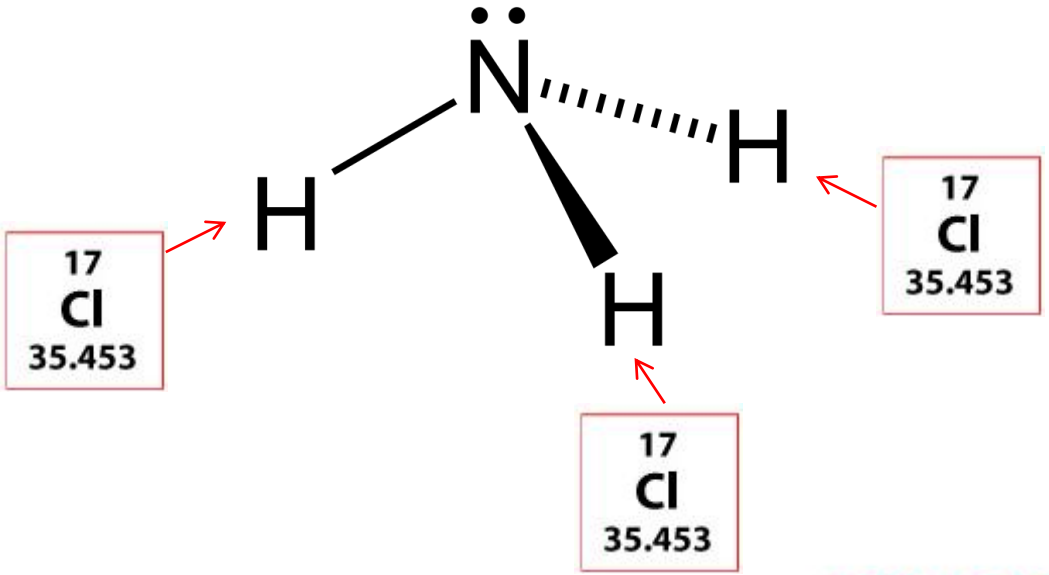
Chloramine Structure

The molecular structure of all three chloramine compounds resembles the structure of ammonia.

A chlorine atom will replace one, two, and three hydrogen atoms respectively for the formation of mono, di, and trichloramines.



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Chlorine and Water

During hydrolysis, chlorine reacts rapidly with water to form hypochlorous acid (HOCl) and hydrochloric acid (HCl)…

$Cl_2 + H_2O \leftrightarrows HOCl + HCl$

Of the two compounds, hypochlorous acid is more important in the water treatment process. It contains the active form of chlorine that will be used to disinfect organisms.

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Still have questions?

Please contact us at…

Town of Vermilion

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