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## FILMTEC™ Membranes Dechlorinating Feedwater

### Introduction

Chlorine (Cl<sub>2</sub>) has been used for many years to treat municipal and industrial water and wastewaters as a disinfectant because of its capacity to inactivate most pathogenic microorganisms quickly. The effectiveness of Cl<sub>2</sub> is dependent on the Cl<sub>2</sub> concentration, time of exposure, and the pH of the water. Chlorine is used for the disinfection of potable water where a residual chlorine concentration near 0.5 mg/L is commonly used. In a water treatment scheme, fouling of water intake lines, heat exchangers, sand filters, etc., may be prevented by maintaining a free Cl<sub>2</sub> residual of 0.5-1.0 mg/L.

When FILMTEC™ FT30 thin-film composite membrane is used in the reverse osmosis (RO) process, the RO feed must be dechlorinated to prevent oxidation of the membrane. FT30 membrane has a chlorine tolerance of up to 1,000 ppm-hours before noticeable loss of salt rejection is observed. If dechlorination upsets occur and if corrected in a timely manner, membrane damage can be minimized.

### Definitions and Chemistry



#### Residual chlorine.

Refers to the total amount of chlorine ("combined" and "free available" chlorine) remaining in the water at the time of measurement.

#### Combined available chlorine.

Refers to one or more of the family of chlorine-ammonia compounds, called chloramines, resulting from the reaction of chlorine with ammonia compounds present in the water.

#### Free available chlorine.

This form is actually hypochlorous acid, hypochlorite ion or a mixture of the two, depending on pH and temperature. Free chlorine is usually present after sufficient chlorine has been added to satisfy the demand of ammonium ions present.

### Engineering Considerations

Chlorine is most commonly available as hypochlorites of calcium and sodium or chlorine gas. Capital cost, operating cost and water chemistry will be the predominate factors in deciding which type of system to use.

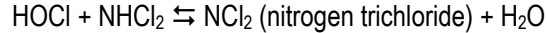
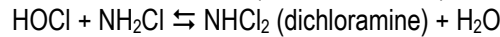
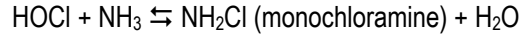
If the product water from an RO system is chlorinated, care must be exercised to insure that the chlorine does not diffuse back into the membrane. Air breaks, check valves, etc., should be employed appropriately.

### Chloramines

Studies have demonstrated that chlorine reacts with organic compounds present in drinking water to produce a variety of trihalomethanes (THMs). Toxicological investigations have implicated certain THMs as carcinogens. The EPA has established a maximum THM contaminate level of 100 ppb for drinking water. To meet this requirement, many water facilities have sought to reduce levels of THMs. This can be done by using chloramine as a disinfectant. Chloramine does not generate THMs. However, considerable controversy has arisen concerning the efficiency of chloramine disinfection and its potential health effects.

## Chloramines (cont.)

In aqueous solution, HOCl reacts with ammonia to form inorganic chloramines in a series of stepwise reactions.



These reactions are governed primarily by pH and chlorine-to-nitrogen weight ratio.

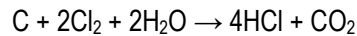
FILMTEC™ FT30 membrane has a 300,000 ppm-hour tolerance for chloramine, which implies that dechlorination is not required. However, since chloramines are formed by adding ammonia to chlorine, it is possible that free chlorine will be present. Since this free chlorine can be damaging to the membrane, dechlorination should still be considered.

## Dechlorination

Residual chlorine can be reduced to harmless chlorides by chemical reducing agents. Discussion follows on two of the most common proven techniques.

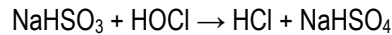
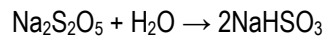
### Activated carbon.

Chlorine reacts with activated carbon as follows:



The activated carbon should be replaced or regenerated periodically.

### Sodium metabisulfite.



In theory, 1.37 lb of sodium metabisulfite will remove 1.0 lb of free chlorine. In practice, however, 3.0 lb of sodium metabisulfite are normally used to remove 1.0 lb of chlorine from brackish water. For seawater, more sodium metabisulfite may be required when dissolved oxygen is present. Sodium metabisulfite has a usual shelf life of 4-6 months under cool, dry storage conditions. The solution life, however, varies with concentration as follows:

Solution (wt %)	Maximum Solution Life
2	3 days
10	1 week
20	1 month
30	6 months

The dechlorination reaction requires mixing to ensure completion. Therefore, static mixers should be utilized and the sodium metabisulfite injected prior to the cartridge filters.

Notice: The use of this product in and of itself does not necessarily guarantee the removal of cysts and pathogens from water. Effective cyst and pathogen reduction is dependent on the complete system design and on the operation and maintenance of the system.

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