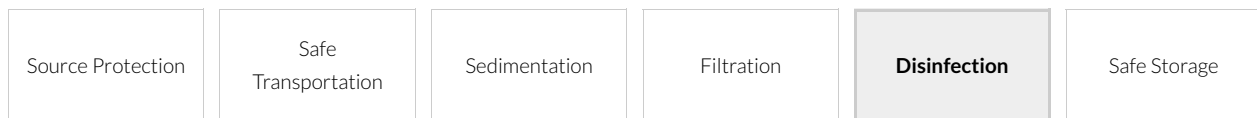


Chlorine (Sodium Hypochlorite)

Technical Information

Chlorine (Sodium Hypochlorite)

Multi-Barrier Approach



Effectiveness

Parameter	Effectiveness	Laboratory Efficiency	Field Efficiency
Bacteria	Very Effective (>99%)	99.99% (Escherichia coli) ¹	80% ² ; 99.4% ³
Viruses	Very Effective (>99%)	99.99% (Noroviruses, Rotavirus) ^{4, 5}	
* All laboratory and field efficiency values shown are from independent testing only.			



Chlorine is a popular chemical used to disinfect drinking water. It forms hypochlorous acid when added to water. This acid reacts with microorganisms, inactivating them. Chlorine began to be widely used as a disinfectant in the early 1900s. It revolutionized drinking water treatment and dramatically reduced the incidence of waterborne diseases. Different brands of liquid chlorine products are manufactured locally, specifically for household water treatment.

Sodium hypochlorite is one form of chlorine used for water disinfection. It can be manufactured locally with salt, water, and electricity, using equipment such as the WATA technology developed by Antenna (<http://www.antenna.ch/en/water-hygiene/range-wata/>) and the MSR SE200 Community Chlorine Maker (<http://sites.path.org/water/water/technology-se200/>). Many manufacturers sell bottles of sodium hypochlorite in various sizes for household water treatment. Chlorine concentrations in these products range from 0.5% to 10%, and each product should have its own instructions for correct dosing of contaminated water. Liquid household bleach also contains sodium hypochlorite and is widely available.

How Does it Remove Contamination?

When added to water, chlorine forms hydrochlorous acid, which reacts through oxidization with microorganisms and kills them. Three things can happen when chlorine is added to water:

1. Some chlorine reacts through oxidization with organic matter and the pathogens in the water to kill them. This portion is called consumed chlorine.
2. Some chlorine reacts with other organic matter, ammonia, and iron and forms new chlorine compounds. This is called combined chlorine.

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3. Excess chlorine that is not consumed or combined remains in the water. This portion is called free chlorine residual (FCR). The FCR is the most effective form of chlorine for disinfection (particularly for viruses) and helps prevent recontamination of the treated water.

Limitations:

- Cryptosporidium oocysts⁶ and ascaris eggs^{7 8} are resistant to inactivation by chlorine.
- The effect of chlorine on the viability of Giardia lamblia cysts varies depending on temperature, pH, chlorine concentration and contact time.⁹

Operation

Many different brands of chlorine products are manufactured specifically for household water treatment. Each product should have its own instructions for correct dosing and contact time. Liquid household bleach products are also commonly used to disinfect drinking water. The strength of the product must be known to calculate how much bleach is needed to disinfect a given volume of water. See CAWST's Technical Brief on Chlorine Disinfection of Drinking Water for information on how to determine the chlorine dose and contact time using household bleach.

The effectiveness of chlorine is affected by turbidity, organic matter, ammonia, temperature, and pH. Use a 30-minute minimum contact time, and increase this for high pH water (>9)¹⁰

The contact time should be increased to one hour when the temperature is between 10° and 18°C. It should be increased to two or more hours when the temperature falls below 10°C. Turbid water should be sedimented or filtered before adding chlorine. These processes will remove some of the suspended particles and improve the reaction between the chlorine and pathogens.

Source Water Requirements

- Low turbidity
- pH between 5.5 and 7.5; disinfection is unreliable above a pH of 9

Maintenance

- Chlorine should be stored in a cool, dark place in a closed container
- Chlorine should be stored away from children

Other Information

- Chlorine reacts with organic matter naturally present in water to form by-products such as trihalomethanes (THMs), which are potentially cancer-causing.
- THM levels produced during household chlorination may fall below World Health Organization (WHO) guideline values.¹¹¹²

Batch Volume

Varies, follow instructions.

Dosage Rate

Varies, follow instructions.