Questions & Answers

Alternate Disinfectants

Using Disinfectants other than Chlorine

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Are there disinfectants other than chlorine for use in water treatment?

While chlorine is the most commonly used disinfectant in water treatment, it is not the only disinfectant available. Disinfection byproducts (DBPs) form when using chlorine. For this reason, water systems may choose to use alternate disinfectants. These alternate disinfectants for drinking water treatment include:

- Chloramines
- Chlorine dioxide (ClO_2)
- Ozone (O_3)
- Ultraviolet Radiation (UV)

What are some of their advantages and disadvantages?

Each alternate disinfectant has its advantages and disadvantages. The following table shows these advantages and disadvantages. For comparison, chlorine is also shown.

Disinfectant	Principal Advantages	Principal Disadvantages
Chlorine Applied as gas or liquid (hypochlorite)	• Effective for most microorganisms • Can oxidize iron and manganese (makes them easier to remove) • Keeps a residual in distribution system • Technology well understood • Relatively easy to use in hypochlorite form	• Forms DBPs when organic substances are present • Not effective against Cryptosporidium protozoa • Can cause taste and odor problems
Chloramines Formed by combining chlorine and ammonia	• Forms more stable residual than chlorine alone • Forms less DBPs than chlorine • Forms less taste and odor causing compounds in water • Technology well understood	• Less effective than chlorine against microorganisms, especially viruses and protozoa • Poorly oxidizes iron and manganese • Usually requires a more powerful disinfectant for primary disinfection

Chlorine Dioxide Produced by reacting sodium chlorite with chlorine or hydrochloric acid	• More effective than chlorine or chloramines as disinfectant against microorganisms • Controls taste and odor better than chlorine in some cases • Forms less THMs* and HAAs* than chlorine	• Must be produced on site • Forms additional DBPs such as chlorite and chlorate • Requires daily chlorite and chlorine dioxide monitoring • Costs more for equipment and chemicals than chlorine • Takes more technical skill to use
Ozone Produced by electrical discharge through air or oxygen	• Most powerful disinfectant used in drinking water treatment • More effective than chlorine dioxide • Effective against Giardia and Cryptosporidium protozoa	• Must be produced on site • Takes more technical skill to use • Forms bromate and other DBP compounds • Requires bromate monitoring • Does not provide residual protection
Ultraviolet Radiation Non-chemical disinfection by using ultraviolet radiation at certain wavelengths	• Effective against bacteria, Giardia and Cryptosporidium • Does not form DBPs	• Disinfection effectiveness and efficiency are affected by turbidity and dissolved substances • Less effective against certain viruses • Technically complex, requires training to operate equipment • Does not provide residual protection (may need secondary disinfectant) • Does not reduce DBP formation by secondary disinfectant

*THM stands for trihalomethanes and HAA stands for haloacetic acids. Both are forms of DBPs.

Note: Most systems using any type of chemical disinfectant are required to monitor for total THM (TTHM) and five HAAs (HAA5) in addition to those indicated in the above table.

With all these alternatives, what should a small water system do if it needs to disinfect its water?

Most small water systems use only groundwater. Since most groundwaters have low levels of dissolved organic substances, DBP levels are usually not a major concern. If water systems use hypochlorite, they can use inexpensive equipment and widely available chemicals, and they will need no special technical skills to operate and maintain the equipment. Most small systems find that disinfection using chlorine, especially when added in hypochlorite form, to be the best method of disinfection of their water supply.

For more information

Chlorination of Drinking Water (331-253)

Stage One Rule: Disinfectants and Disinfection Byproducts (331-254)

Disinfection Byproducts (331-251)