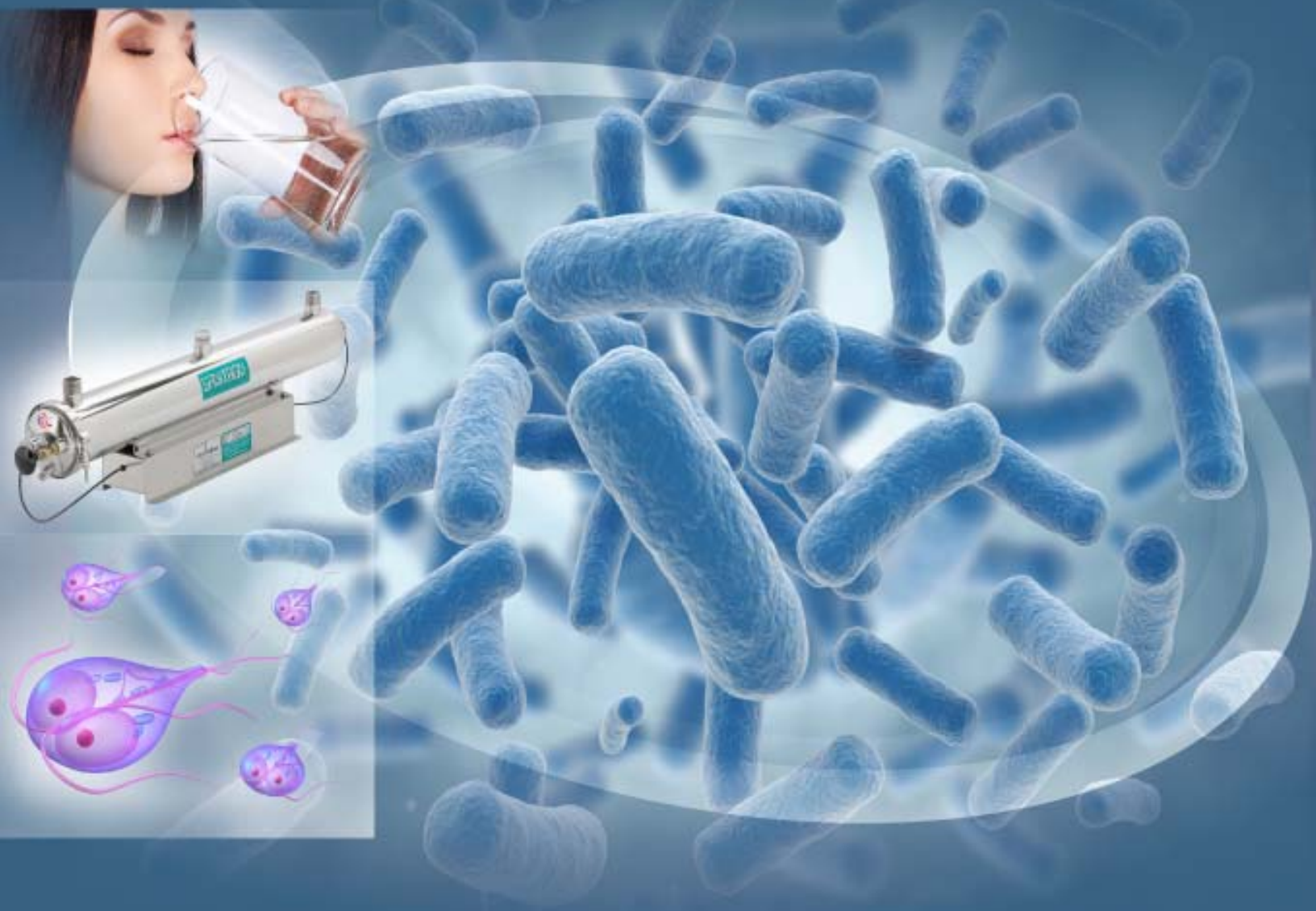
The Practical Guide to Ultraviolet Sterilizers



How to Select A UV Sterilizer for Well, Spring, and Rainwater Disinfection

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Ultraviolet Sterilizers

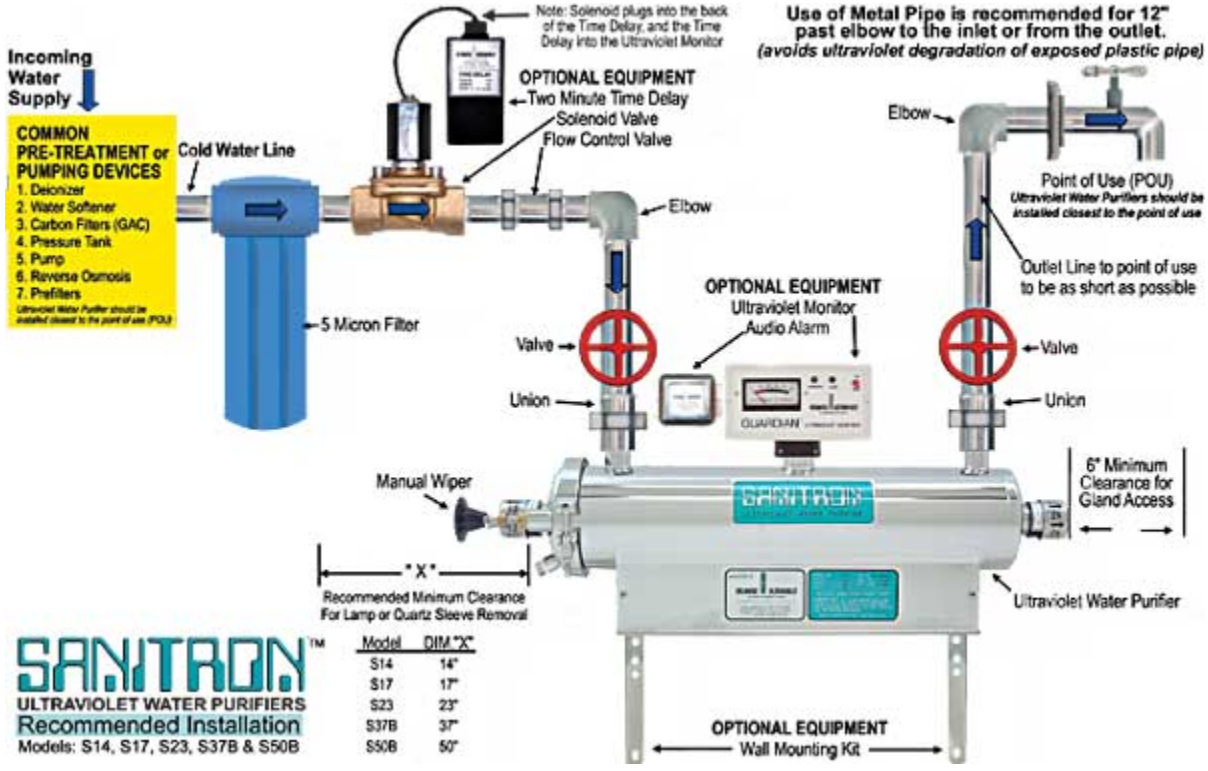
Harmful bacteria can be present in many water supplies. Proper disinfection of drinking water is essential if bacteria, viruses or parasites are present. Ultraviolet sterilizers can be an alternative method of disinfection under the right conditions.

Ultraviolet sterilizers work by exposing the cell walls of organism to intense UV light which disrupts the genetic material and prevents the organism from reproducing.

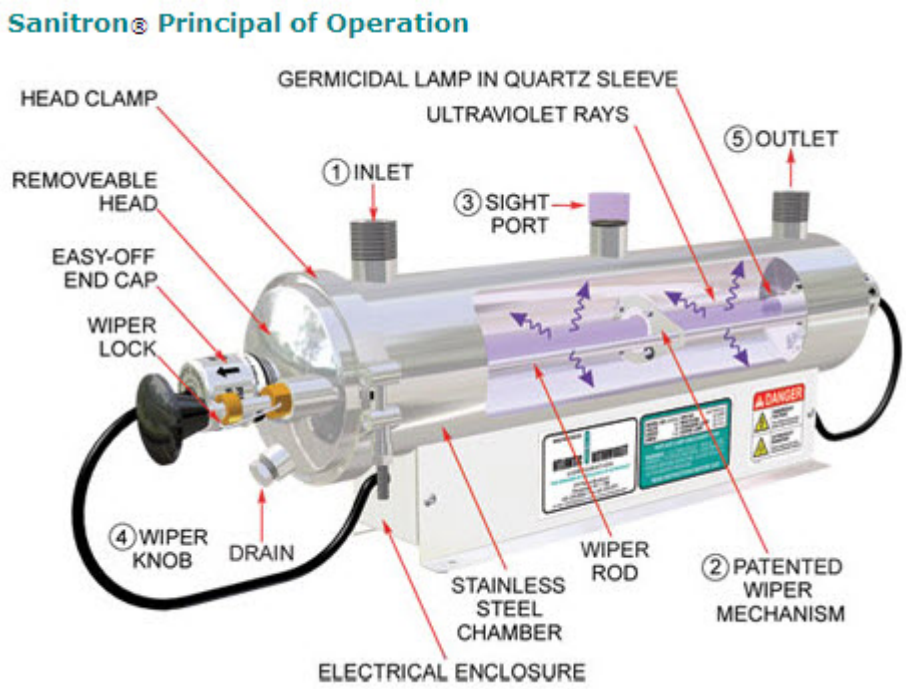
UV effectively destroys bacteria and viruses but is limited by the clarity of the water. UV only works on water that is clear and has a high UV transmission rate. Unlike chlorine there is no downstream residual disinfection. Pretreatment for iron, sediment and excessive hardness minerals is recommended.

Advantages of UV Light Sterilizers include:

- Effective - virtually all microorganisms are susceptible to ultraviolet disinfection.
- Economical - hundreds of gallons are purified for each penny of operating cost.
- Safe - no danger of overdosing, no addition of chemicals.
- Fast - water is ready for use as soon as it leaves the purifier
- Easy - simple installation and maintenance. Compact units require minimum space.
- Automatic - provides continuous disinfection without special attention or measurement.



How Ultraviolet Sterilizers Work



(1) The water enters the purifier and flows into the annular space between the quartz sleeve and the chamber wall.

(2) The wiper segments induce turbulence in the flowing liquid to assure uniform exposure of suspended micro-organisms to the lethal ultraviolet rays.

(3) Translucent sight port provides positives indication of germicidal lamp operation.

(4) The wiper assembly facilitates periodic cleaning of the quartz sleeve without any disassembly or interruption of purifier operation.

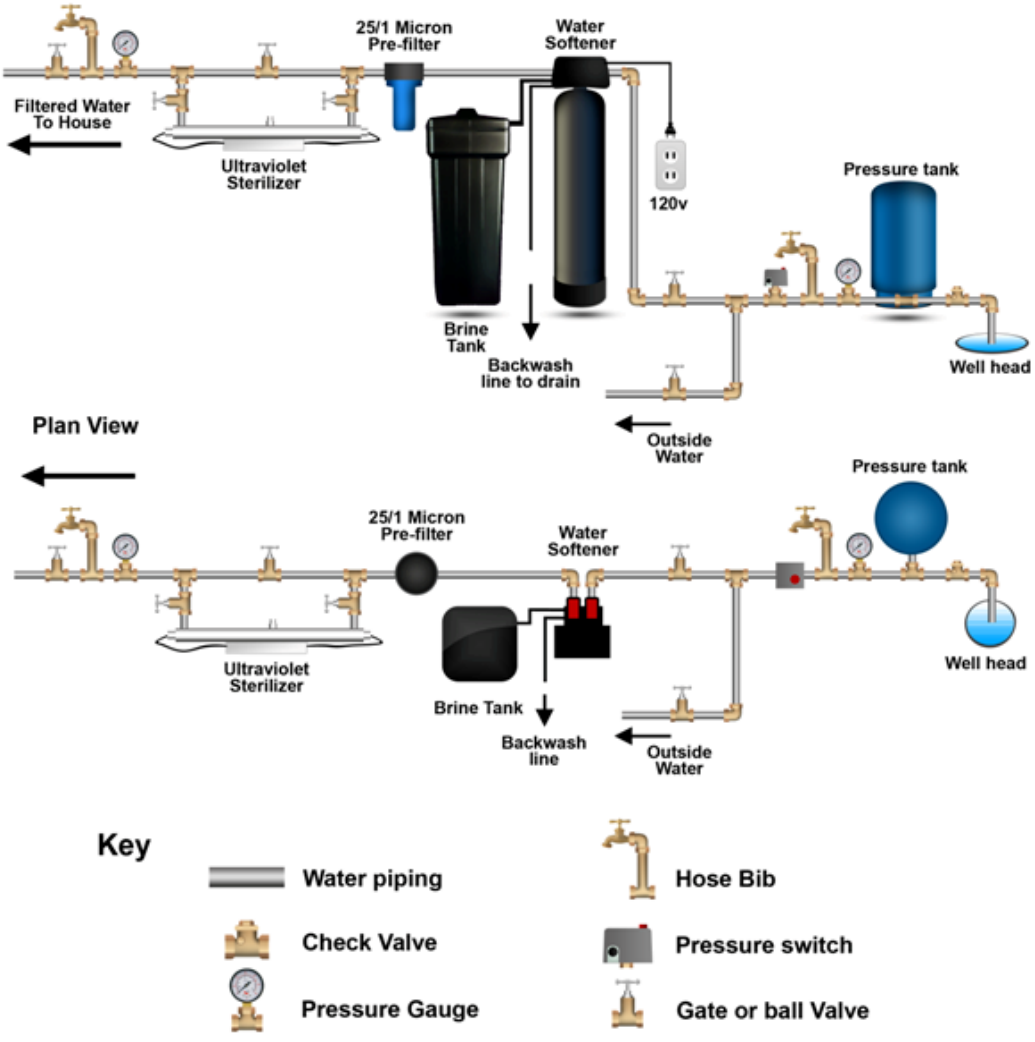
(5) Water leaving the purifier is instantly ready for use.

Pretreatment Important Consideration

Water to be treated by UV light should be clear and relatively low in minerals. If the water is hard (over 5 – 10 grains per gallon of hardness) a water softener which will remove the hardness is recommended. If the water is high in turbidity or cloudy, it is essential to treat the water prior to treating with UV light. The UVT or UV Transmission level should be low enough to allow the UV rays to penetrate the water. A 5 micron filter for pretreatment is recommended as a minimum precaution.

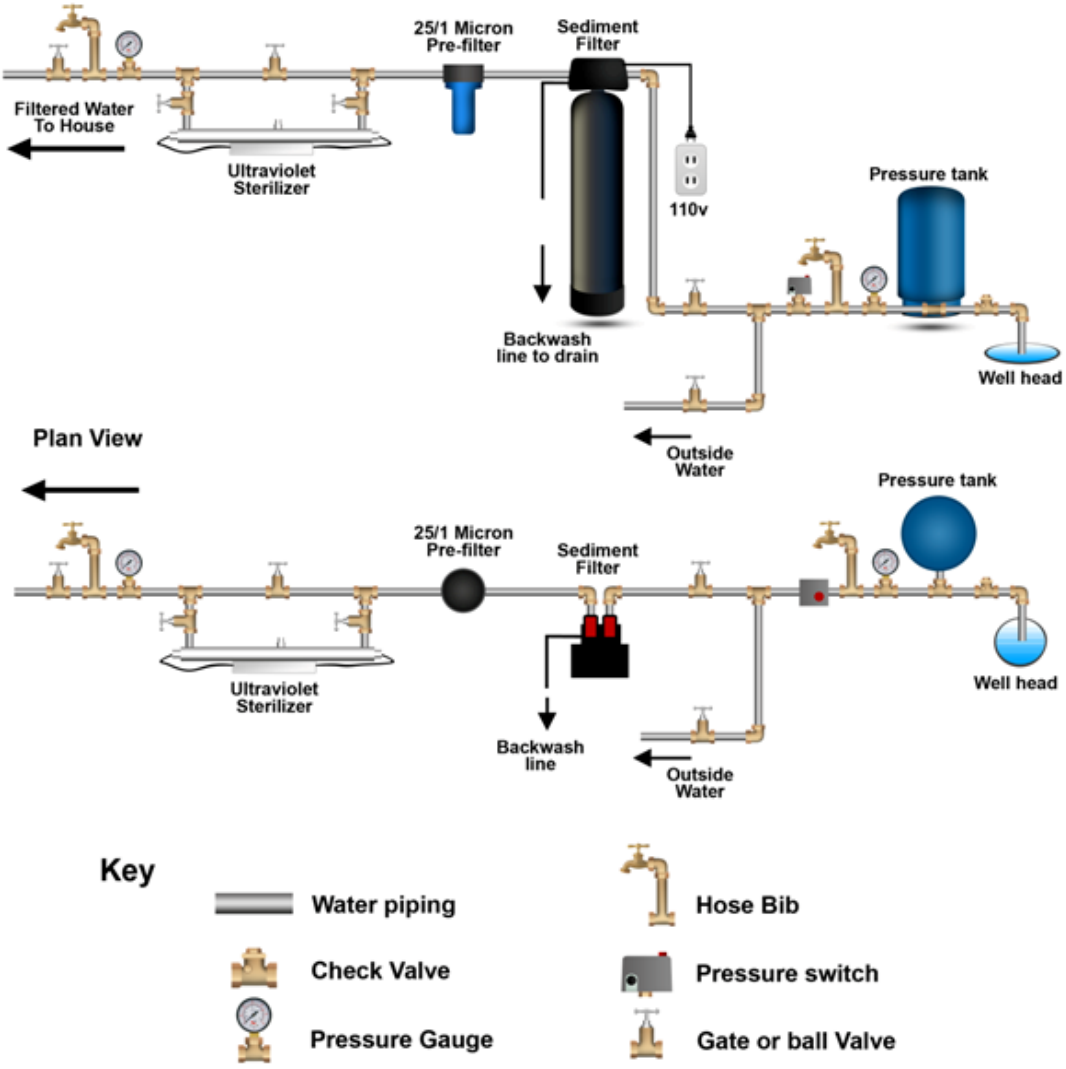
Pretreatment System for Hard Water

Softener > 25/1 Dual-Grade Filter > UV Sterilizer



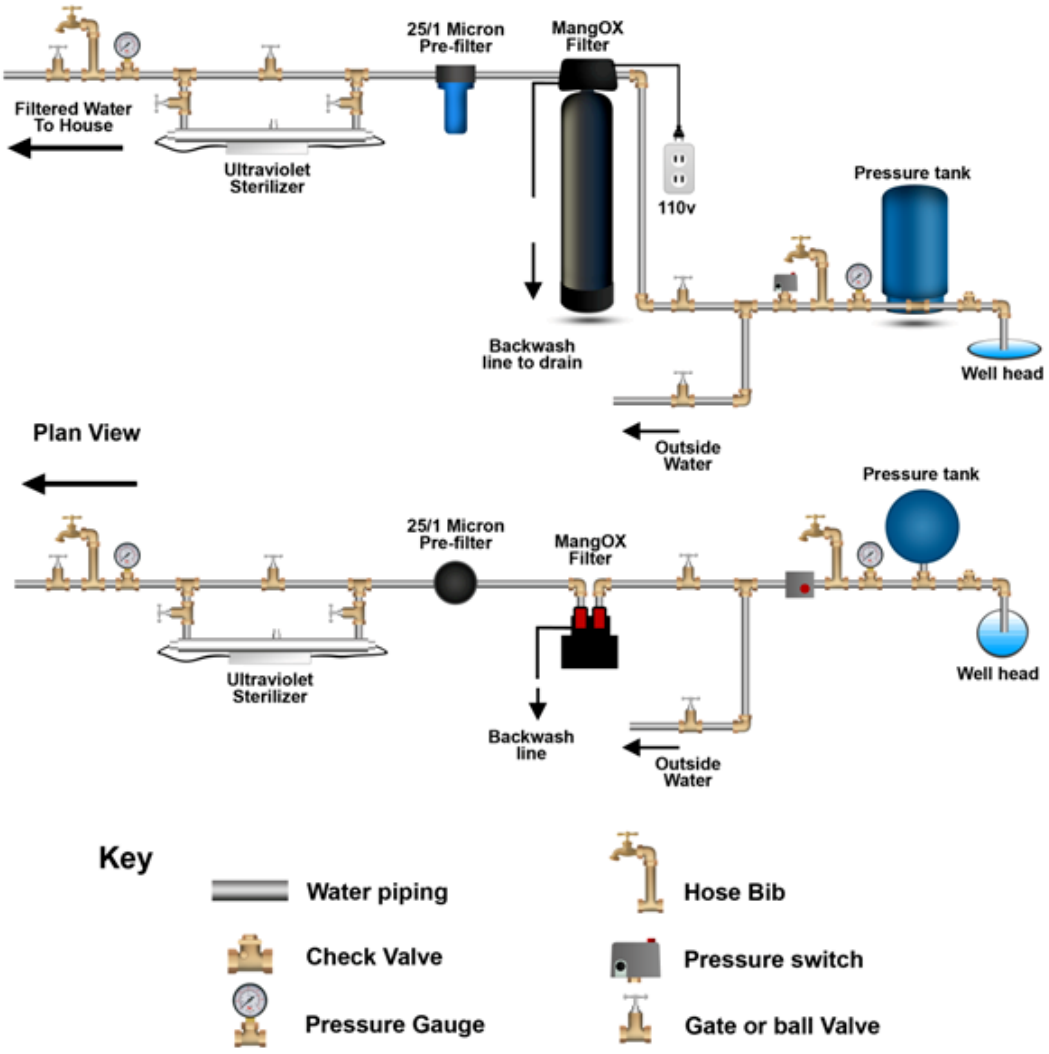
Pretreatment for Sediment

Sediment Backwash Filter > 25/1 Dual-Grade Filter > UV

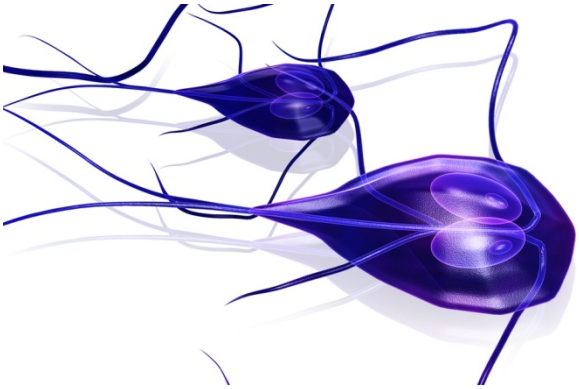


Pretreatment for Iron in Well Water

Iron Filter > 25/1 Dual Grade Filter > UV Sterilizer



Ultraviolet Sterilizers and Giardia


Giardia Protozoa

Cryptosporidium and *Giardia* protozoa are present in many drinking water supplies across the world. The occurrence of *Cryptosporidium parvum* in drinking water sources is recognized as a significant threat to private and public water supplies throughout the world (Rose *et al.*, 1991; Lisle and Rose, 1995; Messner and Wolpert, 2000).

Water treatment plants usually cannot guarantee the removal of all *Cryptosporidium* because these tiny parasites are formed as cysts, called oocysts and are very small (four to five micrometers in diameter). They are resistant to chlorine and most other disinfectants. It is for this reason that many municipal treatment plants are installing UV systems.

A report published by the US EPA2 indicates that,"…*Cryptosporidium* is not only a surface water problem." In Canada and the US, 60.2 percent of surface water samples contained oocysts in a study done by LeChevallier and Norton in 1995.

The same report also cites a study done by Hancock *et al.* (1998), reporting a study of 199 ground water samples tested for *Cryptosporidium*. They found that five percent of vertical wells, 20 percent of springs, 50 percent of infiltration galleries, and 45 percent of horizontal wells contained *Cryptosporidium* oocysts. The significance of this is that normal water testing does not test groundwaters for oocysts.

An absolute 1 micron filter, combined with UV is very effective at removing the oocsysts and disinfecting surface and ground water supplies. When UV is used for surface water disinfection or in wells under the influence of surface water, a pre-filter system consisting of 5 micron and then 1 micron absolute filtration is recommended.

Ultraviolet disinfection of water consists of a purely physical, chemical-free process. UV-C radiation in particular, with a wavelength in the 240 nm to 280 nanometers range, attacks the vital DNA of the bacteria directly.

The radiation initiates a photochemical reaction that destroys the genetic information contained in the DNA. The bacteria lose their reproductive capability and are destroyed. Even parasites such as *Cryptosporidia* or *Giardia*, which are extremely resistant to chemical disinfectants, are efficiently reduced.[12] UV can also be used to remove chlorine and chloramine species from water ; this process is called photolysis, and requires a higher dose than normal disinfection.

Microorganisms That Are Treated By UV

Bacteria	UV Dose	Bacteria	UV Dose
Agrobacterium lumefaciens 5	8,500	*Pseudomonas aeruginosa* (Environ.Strain)	10,500
Bacillus anthracis 1,4,5,7,9 (anthrax veg.)	8,700	*Pseudomonas aeruginosa* (Lab. Strain) 5,7	3,900
Bacillus anthracis Spores (anthrax spores)*	46,200	*Pseudomonas fluorescens* 4,9	6,600
Bacillus megatherium Sp. (veg) 4,5,9	2,500	*Rhodospirillum rubrum* 5	6,200
Bacillus megatherium Sp. (spores) 4,9	5,200	*Salmonella enteritidis* 3,4,5,9	7,600
Bacillus paratyphosus 4,9	6,100	*Salmonella paratyphi* (Enteric Fever) 5,7	6,100
Bacillus subtilis 3,4,5,6,9	11,000	*Salmonella Species* 4,7,9	15,200
Bacillus subtilis Spores 2,3,4,6,9	22,000	*Salmonella typhimurium* 4,5,9	15,200
Clostridium tetani	23,100	*Salmonella typhi* (Typhoid Fever) 7	7,000
Clostridium botulinum	11,200	Salmonella	10,500
Corynebacterium diphtheriae 1,4,5,7,8,9	6,500	*Sarcina lutea* 1,4,5,6,9	26,400
Dysentery bacilli 3,4,7,9	4,200	*Serratia marcescens* 1,4,6,9	6,160
Eberthella typhosa 1,4,9	4,100	*Shigella dysenteriae* - Dysentery 1,5,7,9	4,200
Escherichia coli 1,2,3,4,9	6,600	*Shigella flexneri* - Dysentery 5,7	3,400
Legionella bozemanii 5	3,500	*Shigella paradysenteriae* 4,9	3,400
Legionella dumoffill 5	5,500	*Shigella sonnei* 5	7,000
Legionella gormanil 5	4,900	*Spirillum rubrum* 1,4,6,9	6,160
Legionella micdadei 5	3,100	*Staphylococcus albus* 1,6,9	5,720
Legionella pneumophila (Legionnaire's Disease)	12,300	*Staphylococcus epidermidis* 5,7	5,800
Leptospira canicola-Infectious Jaundice 1,9	6,000	*Streptococcus faecaila* 5,7,8	10,000
Leptospira interrogans 1,5,9	6,000	*Streptococcus hemolyticus* 1,3,4,5,6,9	5,500

Micrococcus candidus 4,9	12,300	*Streptococcus lactis* 1,3,4,5,6	8,800
Micrococcus sphaeroides 1,4,6,9	15,400	*Streptococcus pyrogenes*	4,200
Mycobacterium tuberculosis 1,3,4,5,7,8,9	10,000	*Streptococcus salivarius*	4,200
Neisseria catarrhalis 1,4,5,9	8,500	*Streptococcus viridans* 3,4,5,9	3,800
Phytomonas tumefaciens 1,4,9	8,500	*Vibrio comma* (Cholera) 3,7	6,500
Proteus vulgaris 1,4,5,9	6,600	*Vibrio cholerae* 1,5,8,9	6,500
Molds	**UV Dose**	**Molds**	**UV Dose**
Aspergillus amstelodami	77,000	*Oospora lactis* 1,3,4,6,9	11,000
Aspergillus flavus 1,4,5,6,9	99,000	*Penicillium chrysogenum*	56,000
Aspergillus glaucus 4,5,6,9	88,000	*Penicillium digitatum* 4,5,6,9	88,000
Aspergillus niger (breed mold) 2,3,4,5,6,9	330,000	*Penicillium expansum* 1,4,5,6,9	22,000
Mucor mucedo	77,000	*Penicillium roqueforti* 1,2,3,4,5,6	26,400
Mucor racemosus (A & B) 1,3,4,6,9	35,200	*Rhizopus nigricans* (cheese mold) 3,4,5,6,9	220,000
Protozoa	**UV Dose**	**Protozoa**	**UV Dose**
Chlorella vulgaris (algae) 1,2,3,4,5,9	22,000	*Giardia lamblia* (cysts) 3	100,000
Blue-green Algae	420,000	Nematode Eggs 6	40,000
E. hystolytica	84,000	Paramecium 1,2,3,4,5,6,9	200,000
Virus	**UV Dose**	**Virus**	**UV Dose**
Adeno Virus Type III 3	4,500	Influenza 1,2,3,4,5,7,9	6,600
Bacteriophage 1,3,4,5,6,9	6,600	Rotavirus 5	24,000
Coxsackie	6,300	Tobacco Mosaic 2,4,5,6,9	440,000
Infectious Hepatitis 1,5,7,9	8,000		
Yeasts	**UV Dose**	**Yeasts**	**UV Dose**
Baker's Yeast 1,3,4,5,6,7,9	8,800	*Saccharomyces cerevisiae* 4,6,9	13,200
Brewer's Yeast 1,2,3,4,5,6,9	6,600	*Saccharomyces ellipsoideus* 4,5,6,9	13,200
Common Yeast Cake 1,4,5,6,9	13,200	*Saccharomyces sp.* 2,3,4,5,6,9	17,600