

UV Disinfection 101

Water is a resource that all of us tend to take for granted. We turn on the shower, the kitchen faucet, and the garden hose and out pours an endless supply of fresh, clean water. What many of us may not realize, though, is that our water supply is not a never end supply and it is not as clean as it may appear. Chlorine is a popular disinfectant that can provide an effective disinfectant residual but it is unable to effectively treat some pathogens. Exposure to certain chlorine-resistant pathogens can cause severe gastrointestinal illness and even death among people with compromised immune systems.

Ultraviolet (UV) technology is more effective than chemicals in destroying certain waterborne contaminants without altering the taste of water. This makes it a practical process for treating water used for drinking and food preparation.

How does it work?

Ultraviolet light (UV) destroys bacteria and viruses by altering DNA. This natural and non-chemical method of treatment penetrates and permanently alters the DNA of the microorganisms in a process called *thymine dimerization*. The microorganisms are “inactivated” and rendered unable to reproduce or infect.

UV light advantages:

Treating our water supply by the use of UV disinfection is not only more effective than traditional treatments, but it is also an environmental responsible way of treating our water. There are no disinfection by-products with the use of UV which is safe and chemical free. Plus, by using UV disinfection rather than chemicals, we have also removed the need to handle and dispose of hazardous materials. Plus, UV does not alter water chemistry and its constituents, such as pH, taste, odor, or colour.

Purchasing a UV disinfection system for your home or even a light commercial application, such as a community centre, school, retirement facility or a hospital, has a capital low cost as well as a low operational cost. The energy used by a UV disinfection system in an average size home is comparable to the same energy used by a 40-watt bulb!

UV disinfection systems can be used in conjunction with other water treatment methods such as softeners and require very little maintenance as long as the water has been properly pre-treated.

Installation and Operation of UV disinfection systems:

UV disinfection systems are extremely user friendly and are easy to install and operate. There are no moving parts to wear out over time – only a UV lamp to replace on an annual basis for optimal disinfection. They have a compact design making them easy to fit into any plumbing layout.

Determining Dosages

The UV disinfection process is quick, but different germs require different amounts of UV energy, or dosages to be destroyed. By definition, dosage is a function of intensity multiplied by time. Intensity is the magnitude (amount) of UV energy that lamps generate at a given distance from the lamp per centimeter square of surface area (expressed in microwatts per centimeter squared). The lamp's intensity is measured at different distances from its surface. The intensity decreases by the square of the distance from its source - as the distance from the lamp increases, the intensity

decreases. Usually, in UV system design, the level of intensity is usually measured at the farther point in the UV chamber, or the distance from the lamp's surface to the chamber's inside wall. Time is the period it takes water to travel from the inlet port to the outlet port of the UV chamber. This is expressed in seconds and is calculated at a given flow rate, taking into consideration the dimensions of the chamber.

Factors Affecting UV Performance:

UV is only effective if it hits its target so it is important to be aware of the factors that could affect the performance of your UV disinfection.

Flow rate: To achieve successful UV disinfection the UV equipment capacity must match the target microorganism's UV dose requirement. In other words; the microorganism must be held in direct contact with the UV-C light for a specific amount of time (UV Exposure uWs/cm²), enough to irradiate it.

UV Absorption: Dissolved substances such as iron and manganese and certain organic substances will absorb UV energy and leave little for disinfection.

Suspended solids. Contaminants can be shielded from UV by suspended solids, which act like an umbrella covering organisms from the germicidal light.

Water Quality (Hardness and Iron). Water temperature will affect the UV energy produced. Quartz sleeves can minimize the temperature fluctuation effect and regulate UV dosage levels transmitted into the water. Depending on its level, the water's hardness can also affect the performance of the UV system as the hardness of water can cause scale to form around the lamp's sleeve. This can reduce UV light transmission and the germs-kill ratio.

Try on the Right Size

Follow these guidelines to accurately size and install an ultraviolet (UV) treatment system: Consider the following parameters: capacity (flow) required, feed water quality, the pre-treatment used and the purpose of treatment.

If in doubt, always oversize the UV unit instead of under-sizing it to save on cost. Often the cost of a larger unit is only a few dollars more. Usually an 8-gallons-per-minute (gpm) UV unit is adequate for an average size home. UV units should be placed as close to the point-of-use (POU) as possible. Pre-sterilize all pipes and tanks by chemical shock treatment and flush thoroughly prior to using a UV unit for the first time. Install the system on the cold water line before any branch lines. The UV unit should be installed after all other treatment processes except microfiltration. To insure the safe operation of a UV system, test the water periodically for bacteria and other contaminants

Our understanding of water and the contaminants that thrive in water has expanded over the last few decades. The technology that has gone into treating our water to provide our community members with safe, clean drinking water should also be expanding. The use of UV disinfection is a proven and trusted way of reaching our goals for safer and cleaner water. It is a technology that has been embraced worldwide in many different application types.

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