Water treatment: The Ultraviolet Light (UV) System

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Today's blog will discuss ultraviolet light as a viable option for the treatment of bacteria in drinking water supplies. The focus will be on well water sources but we will also discuss the advantages of UV lighting for municipal and public water supplies.

We will review the following:

- the presence of bacteria in drinking water
- the definition of ultraviolet light for water treatment
- how UV treats bacteria
- the requirements for ultraviolet light treatment
- NSF classifications for UV light systems
- the sizing of the system and,
- the installation and scheduled maintenance of a UV light system

Bacteria, usually referred to as total coliform bacteria, is normally present in water that comes into contact with the open-air, or surface water. There are numerous examples of outbreaks, to include the Legionella bacteria outbreak of the 1970s, but more often as isolated outbreaks of bacteria in water sometimes resulting in death. When testing for bacteria, labs will typically test for the presence of total coliform bacteria. If total coliform is present, the lab will immediately test for E. coli, the more damaging form of bacterial contamination.

Ultraviolet light used for drinking water treatment is one of several proven solutions for the removal or reduction of bacteria. Chlorination is most commonly deployed, particularly at the municipal level as it is very effective, creates a residual treatment and is relatively inexpensive. Reverse Osmosis is also a very common filtration solution for bacteria as is Ultrafiltration. Ultraviolet light treatment is popular because it is effective but also relatively straightforward to install and maintain. Unlike

chlorination, there is no injection tank or contact tank necessary. Once it is installed, assuming a certain microbiologically-correct water supply, it can be left alone for around 12 months. It is not the most inexpensive option but it is somewhere in the middle. When you factor in maintenance costs, it can certainly be quite viable compared to other solutions.

How does UV work? There are three bands of UV light; UVA, UVB and UVC. UVC is utilized in water treatment in order to effectively disrupt the ability of the bacteria cells to replicate. As with UVB in humans, with sunburn for example, UVC damages the outer wall of the bacteria cell not allowing it to adhere and multiply, essentially killing it. One disadvantage of this in comparison to chlorination is that there is no residual once the water passes the UV treatment. Chlorination systems are set up to pass a residual, in most cases to the point of use or at least to the carbon filter that removes the chlorine just prior to use. If a contaminated supply gets through the UV light, on the other hand, it is free to replicate through to the point of use. This is why maintenance, proper sizing and minimal requirements for the point of entry water chemistry are necessary.

The NSF provides two classes of UV lighting; Class A and Class B. Without getting into too much detail, class B provides minimal dosing and protection options and is more appropriate for those seeking an additional layer of protection for municipal water. This might be for a home that has a member who is particularly vulnerable to immune disorders or something else that might compromise his or her ability to come in contact in any way with contaminated water. NSF Class A, on the other hand, allows for optimal dosing, as well as failsafes to ensure contaminated water does not pass through to the point of use. This could include solenoid-based systems to shut off water if it exceeds certain parameters, audible alarms, etc. This type of system would be most appropriate for well water applications and other locations where there was a real fear of bacterial contamination.

It is important to install the proper sized UV unit for your property. If you are attempting to treat a small home with 2 to 4 inhabitants and 1 to 2 bathrooms, a 6 gallon per minute system would be appropriate. If you are a medium-sized home, a 10 to 12 gallon per minute system should be considered. And if you are a small business or a large home, you would now look at systems in excess of 20 GPM. You also need to look at the pipe size at your point of entry to ensure you are purchasing a system that does not constrict the flow into your dwelling.

In terms of minimal water quality requirements, it is important to understand what comprises the UV treatment system. The housing is a stainless steel cylinder with inlets and outlets for untreated and treated water. Inside the housing is a clear quartz sleeve which acts as a shroud for the UV lamp inside. The UV lamp shines a light

within the housing, effectively killing any bacteria that passes through. Understandably, if that light is not allowed to broadcast effectively, the system will fail to operate optimally. And, as mentioned before, any bacteria that is allowed to pass through has the ability to multiply at the point of use. Even if there is a carbon filter just prior to the point of use, these are not designed to treat down to the size of bacteria cells.

The presence of hardness (such calcium or magnesium), iron, turbidity or even cysts such as cryptosporidium or Giardia can reduce the effectiveness of your system. Therefore, they must be treated prior to the UV system. Cysts are typically between 3 and 8 µm, so a 1 µm prefilter should be looked at as a minimal guard to the system. If iron is present, a system should be installed. Hardness can be removed through the installation of a softener. Water should have less than 7 grains per gallon of hardness prior to the UV light system.

The installation should be completed at point of entry rather than point of use. That is to say, all water should be treated within the dwelling. Some properties have holding tanks. If this is the case, the water should be treated after the holding tank as any supply inside the tank should be viewed as surface water and can grow bacteria.

In summary, the installation of the UV system can be completed once the water quality has been achieved, the proper size units has been determined and the location is finalized.

UV lamps are typically rated for 9000 hours which would allow them to last under proper conditions for at least one year. Water should be tested at least annually for bacteria. If there is a concern, the lamp can be disassembled and cleaned with alcohol or purified water. Always use a non-filament cloth and take great care as the bulbs are very sensitive and costly.

In conclusion, we have reviewed bacterial contamination, the effectiveness of ultraviolet sanitation in treating bacteria, the various systems and options, selecting an effective system and finally, maintenance and installation. I hope this is helpful to you in the investigation of water treatment solutions.

Let's get started.