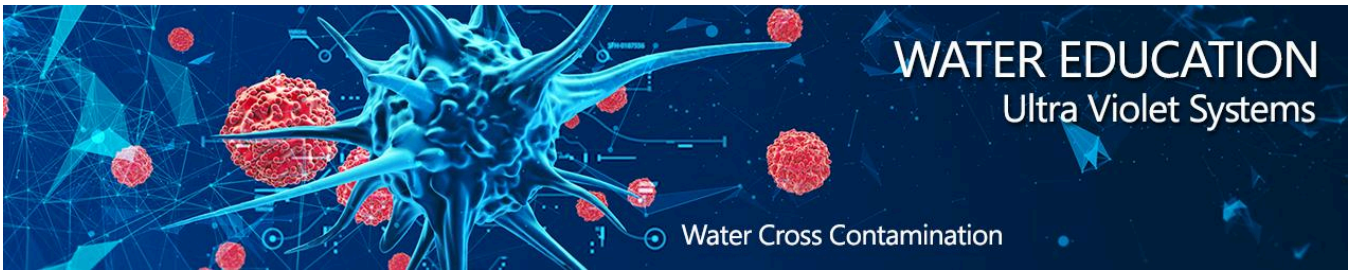

UV - Water Cross Contamination

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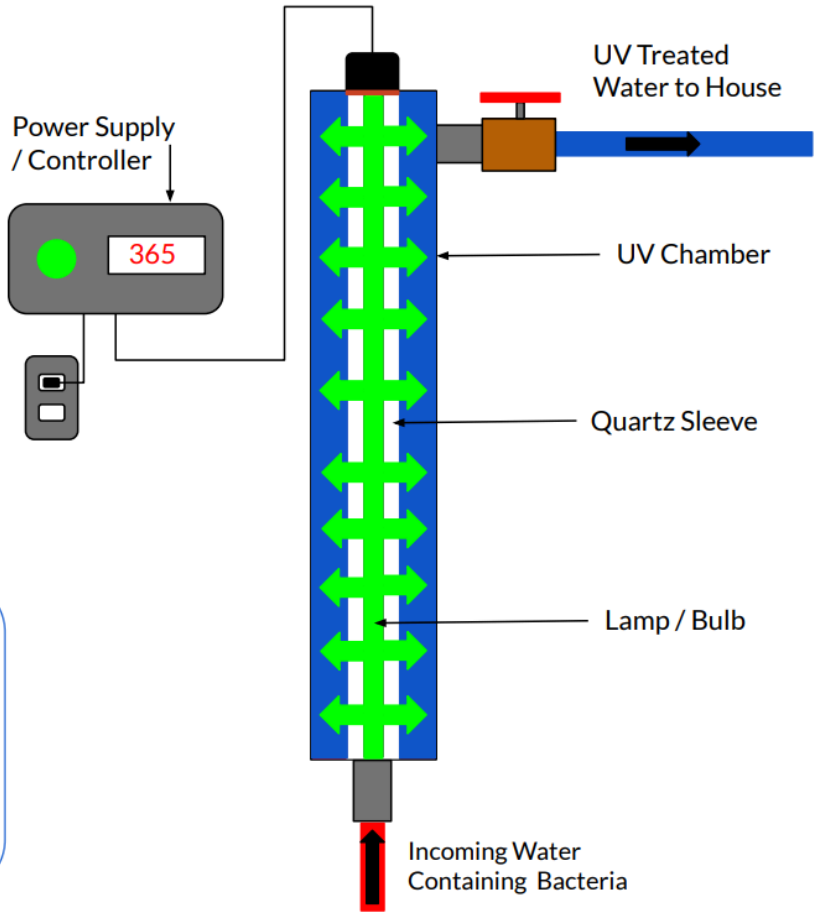
There is a commonly misunderstood or unknown component when an ultraviolet (UV) system is used for bacterial disinfection. Water cross contamination occurs when a water source containing bacteria is allowed to pass through the UV chamber and out into the water piping of an establishment or residence. This can occur through various different scenarios, all of which have the same risks and implications for water quality and safety.

The UV Process

A UV system disinfects water inside of a stainless-steel chamber by passing a UV ray that is emitted from a UV lamp (bulb) through a protective quartz sleeve (dome) and into the water, rendering the bacteria incapable of replication.

Put in simple terms, this is a light passing through “glass” into the water and “scrambling” it’s DNA making it unable to cause harm.



Important

Disinfection occurs when the UV ray is able to properly come in contact with the water at a high enough dosage rate to ensure proper disinfection.

UV Disinfection Does Not Remove Anything from Water

Understanding the Role of the Quartz Sleeve
Critical to the disinfection process is the UV rays ability to pass through the quartz sleeve into the water. Water quality can have a significant impact on the quartz sleeve and result in it becoming fouled by dirt, stains, scratches and surface coating.

Coarse sediment can result in pitting or etching of the quartz sleeve's exterior surface. Fouling and etching can refract the UV rays and prevent them from reaching the water in the proper strength to disinfect properly. In some cases, the sleeve is severely fouled by iron, hardness or sulphur and the rays do not reach the water flowing through the UV chamber at all.

Water Quality
Elements present in ground or surface water can have an impact on the UV's ability to "see" through the water or quartz sleeve with a high enough dosage to ensure disinfection.

Most elements result in the adherence to the exterior surface of the quartz sleeve and can accumulate over time completely "coating" it, causing bacteria to pass through the UV system. This sets off with no alarm or indication from the UV system.

Other elements impede the UV ray from properly passing through the water within the UV chamber with no alarm or indication from the UV system as well.

Heavy Sulphur Coating
This is a photo of a sleeve heavily coated with sulphur This sleeve resulted in no UV dosage at all.

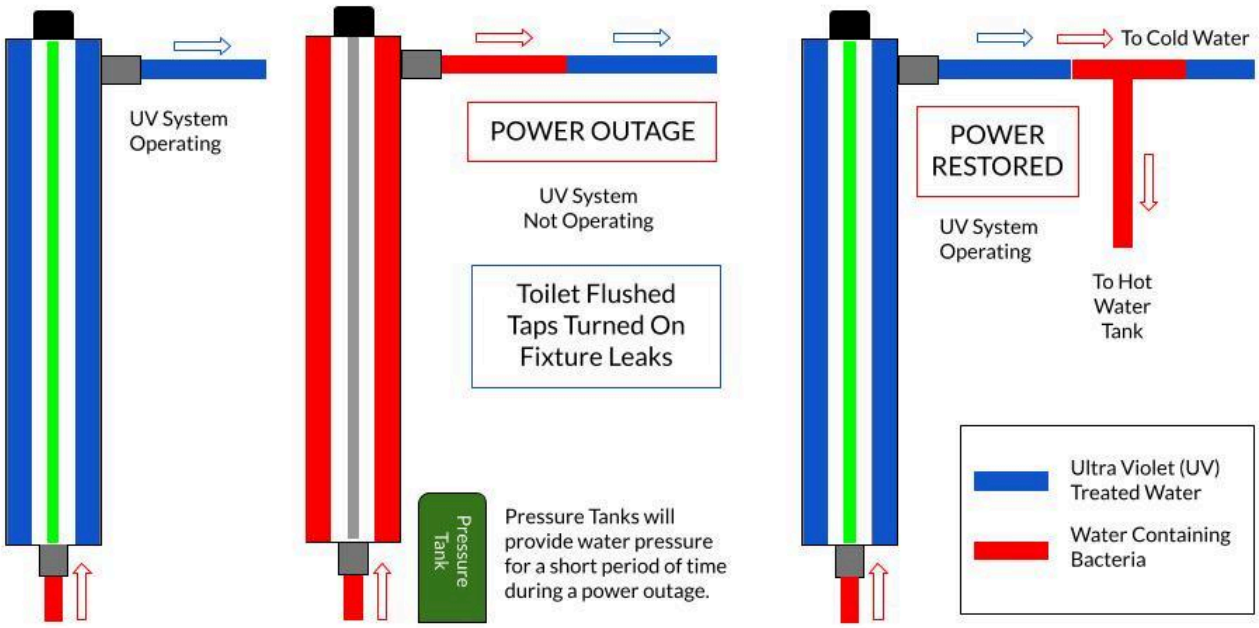
Water Quality Elements Affecting UV System Operation

Element	Operating Value	Information	Impact on UV System
Iron (Fe)	<0.3 ppm / mg/L	Three types: Ferric, Ferrous or bacterial	Coats the outside of the sleeve with orange particulate or scaling.
Hydrogen Sulphide Gas (H_2S)	<0.3 ppm / mg/L	Two types: Gas or Bacteria	Coats the outside of the quartz sleeve with grey to black or slimy adherence.
Water Hardness	< 7 GPG / ppm	Dissolved Calcium & Magnesium in Water	Coats the outside of the quartz sleeve with white scale deposits.
Tannin / Lignin	<0.1 ppm mg/L	Yellow, Reddish or Brown coloured water from	Interfere with UV's ability to penetrate into the water due

		vegetation sources	to the tannins absorption capabilities.
Manganese	<0.5 ppm mg/L	Mineral found naturally in the environment	Coats the outside of the quartz sleeve with a dark brown or black adherence.
Turbidity	< 1 NTU	Refers to how clear the water is. Total suspended solids (TSS)	Interfere with UV's ability to penetrate into the water due to water clarity

Cross contamination can occur any time that the UV quartz sleeve is fouled or the water quality does not allow for proper disinfection rates. It is important to understand that as the quartz sleeve becomes fouled, the level of disinfection reduces and the risk for cross contamination increases.

Pre-Treatment of the Water is Important



Power Outages

Rural areas experience power outages on a more frequent basis than their urban counterparts. Often people will turn on taps or flush toilets during an outage and inadvertently cross contaminate their water piping without ever knowing it. This action can result in water cross contamination with very little water

passing through the UV. As water passess through a non-operational UV, the bacteria does as well. When power is restored, most homeowners assume that everything is okay because the UV continues to function. This may not be the case, as bacteria have the opportunity to replicate on the other side of the operating UV light. Simply turning the UV system back on does not guarantee the water is bacteria free, as there is no residual disinfecting occurring in the pipes. Once cross contamination has occurred, a proper pipe disinfection including the hot water tank should be performed.

This scenario is plausible as the pressure tank associated with many rural water sources will provide 4 to 20 gallons of water after the power goes out and allow water to pass through the UV System untreated. While not as common in rural areas close to larger cities, it can be a common occurrence in rural areas with minimal development and large areas for power lines to travel before entering homes.

There is another scenario involving power which is seen many times in the field of water treatment. Many people simply turn on the UV system when they feel bacteria may be present in the water and turn it off again when they feel there is no bacteria. It is not possible to know without proper testing. Bacteria can be present in a water source through all of the seasons, 365 days a year.

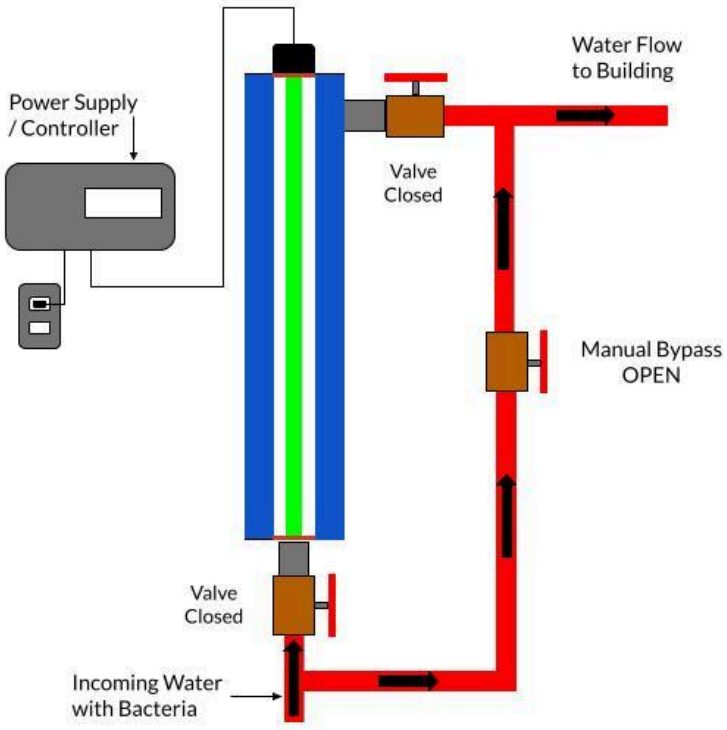
When the Power Goes Out - Do Not Use the Water

Manual Plumbing Bypass

A plumbing bypass is often installed to allow water to “go around” the UV system. It is usually installed for emergency purposes, such as the UV system leaking.

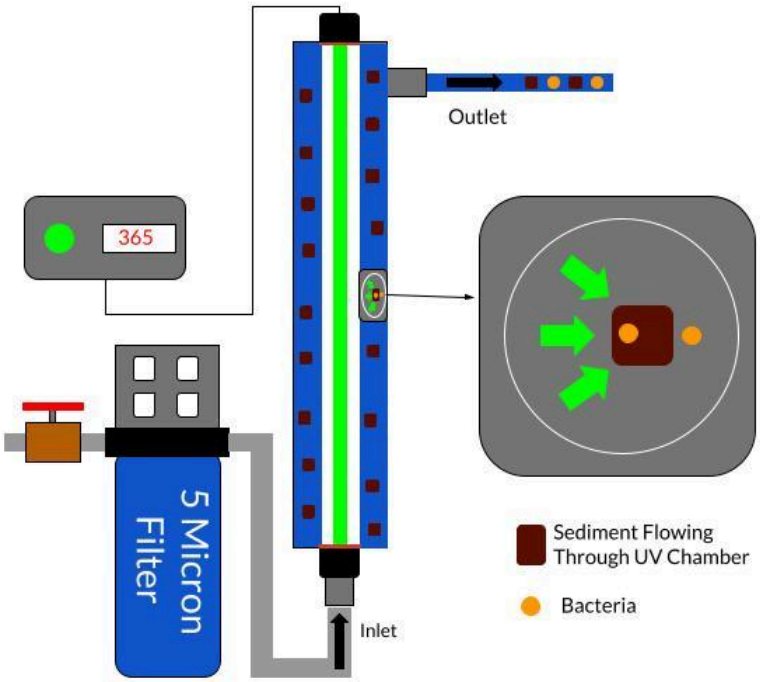
It is also installed to allow for uninterrupted water usage during routine maintenance of the UV system when service is required to replace the ultra violet lamp and quartz sleeve.

The use of a bypass can lead to water cross contamination as bacteria makes its way into the plumbing system. Once power is restored and the bypass closed, there is the potential for bacteria to be present in the hot or cold water piping located after the UV system.



Caution when Using a Bypass Valve

Sometimes a bypass valve can be left in the open position resulting in water never entering the UV chamber at all despite the system being on and functioning properly.



Sediment Shadowing
All manufacturers recommend achieving 5 micron sediment filtration.

When particles of sediment are larger than 5 microns in size they can act as a “shield” and prevent the UV Ray from coming into contact with microbes.

Once sediment is removed, the UV ray can “see” the bacteria in the water properly and disinfection can occur.

Comparing Common Micron Sizes

Bacteria 0.1 - 2.0
Viruses 0.02 - 0.4
Human Hair 80 - 90
Beach Sand 62 - 500
Table Salt 100

The human eye can see down to approximately 25 microns in size.

Pre-Treatment of the Water is Important

If you are using a UV light for bacterial disinfection, it is important to understand how it operates and properly pre treat the incoming water source. If you are unsure about your water quality or have questions, consult a certified water treatment professional who can provide you with the necessary information to ensure that your UV system is capable of disinfecting the water in your home or cottage.