

UV Lights for Drinking Water

The presence of pathogens in drinking water can be the result of recent contamination from human or animal waste, e.g. improperly treated septic discharges, leaching of livestock manure or from wildlife. Following a heavy rainfall event, bacteria, e.g. total coliform and *E. coli*, and other harmful microorganisms from these and other sources, may be washed into rivers, lakes and water supplies. Surface water supplies are often more susceptible to contamination than groundwater sources. Proper well construction, routine maintenance and maintaining adequate separation distances will all help to protect drinking water supplies. However, in some cases, bacterial issues may persist and water treatment is needed prior to consumption. One option for treatment of bacteria is the installation of an ultraviolet (UV) light.

How does a UV light work?

Most UV lights consist of a stainless steel cylindrical chamber with a cylindrical mercury arc lamp located inside (Figure 1). Water enters the chamber, flows around the lamp and exits the other end within a few seconds. The light penetrates disease causing microorganisms, such as coliform bacteria (including *E. coli*), viruses and parasitic cysts, making them unable to reproduce and rendering them harmless and no longer capable of causing illness. It is important to continue regular water testing following installation to ensure the system is working properly.



Figure 1. UV light and filter.

Pros

- *Low installation and operating cost compared to other water disinfection systems*
- *Low maintenance requirements compared to other water disinfection systems*
- *Mounts on wall and requires minimal space*
- *Adds no taste, odour or chemicals to the water*

Cons

- *Effectiveness limited by water quality (and may require additional pre-treatment)*
- *No disinfection residual after UV light treatment such as with a chlorine injection system*

Installation

Installation should be performed by a qualified installer. The installer ensures that the light is sized according to the water use and flow rates needed. Some UV lights include a UV intensity monitor that sounds an alarm when the UV dosage is inadequate. A UV light requires electricity to operate and therefore will not operate during a power failure. A dedicated circuit is recommended for the system.

Maintenance

Maintenance must be performed as per manufacturer recommendations. Most manufacturers recommend the light bulb be changed once per year as the amount of UV dosage emitted by the bulb can diminish with time. Some UV lights include a transparent bulb sleeve that houses the bulb. In these systems, the water never comes in direct contact with the bulb. Regular cleaning of the sleeve is recommended to remove any deposits that may have collected on the sleeve surface.

Compatibility with Water Quality

To be effective as a disinfection treatment, all bacteria in the water must be exposed to sufficient UV energy. The thinner the water layer and the slower the water flows around the UV bulb, the more effective the system will be. Anything that blocks the light will lessen the UV light effectiveness.

The water supply must have minimal turbidity (i.e. cloudiness), suspended soil particles and organic matter. Excessive hardness, iron and manganese tend to create a film on the sleeve or bulb, rendering the UV light ineffective. UV lights are therefore not compatible with water that has high levels of these minerals. To ensure effectiveness, the water quality should meet the minimum limits as set by the manufacturer. Typical quality parameter limits are listed in *Table 1*.

Pre-treatment and increased maintenance

If the water quality parameters in *Table 1* are exceeded, pre-treatment is recommended to address the identified parameters. Water hardness greater than 120 mg/L, for example, may require a water softener to reduce the hardness prior to the UV light. Other parameters, such as manganese and iron, may be addressed using other pre-treatment such as an oxidizing (greensand) filter.

Total suspended solids and turbidity require filtration. Cartridge filters, media filters and other filter technology can be used. A cartridge filter should be installed just in front of the UV unit to remove any large particles that might be in the water.

If the parameters are only slightly exceeded, pre-treatment may not be required, provided the UV light maintenance schedule is adjusted to ensure effective operation. It is recommended that a UV light with a bulb sleeve be installed to allow the sleeve to be cleaned rather than replacing the bulb at shorter intervals.

For more information, contact a qualified water treatment supplier in your area or visit the Nova Scotia Environment website: <https://novascotia.ca/nse/water/uvdisinfect.asp>.

Table 1. Common operating parameters.

Parameter	Limit
Hardness	< 120 mg/L
Iron	< 0.3 mg/L
Hydrogen sulphide	< 0.05 mg/L
Manganese	< 0.05 mg/L
Tannins	< 0.1 mg/L
Total suspended solids (TSS)	< 5.0 mg/L
Turbidity	< 1.0 NTU
UV transmittance	> 75%



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