Atlantium
Illuminating Water Technologies

APPLICATION BRIEF

Hydro-Optic™ Technology
MACRO/MICRO BIOFOULING CONTROL

Ontario Power Generation DeCew II Generating Station Installs Hydro-Optic™ UV System to Mitigate Invasive Mussels

The Ontario Power Generation (OPG) DeCew II Generating Station (NF23) is a hydroelectric facility with a nameplate capacity of 144 megawatts. Following the spread of zebra mussels to the Great Lakes in 1988, OPG installed chlorination systems in the early 1990s to mitigate their threat. However, new organizational environmental policies resulted in OPG's evaluation of environmentally friendly methods of controlling invasive mussels that do not expose fish, plants and other aquatic life to hazardous chemicals. Additionally, OPG wanted to reduce the hazards of chemical exposure to its staff.

In May 2017 OPG installed and commissioned the Hydro-Optic™ (HOD) ultraviolet (UV) system for full-scale demonstration as an environmentally friendly, non-chemical disinfection method to inhibit invasive mussels at DeCew II. The treatment objective of the HOD UV system was to achieve 95% control of settlement under varying %UVT conditions. The system was used for seasonal operations from May through November 2017, at which point ambient water temperature fell below 10° C and the UV system was powered off.

Atlantium provided a RZB300-13 HOD UV unit to accommodate a flow rate of 430 m^3/hr (1,893 gpm). The proprietary medium pressure UV system contained three lamp sections, each with two lamps, for a total of six (4.2 kW) lamps in the system. The system was supplied with a deposit control mechanism, %UVT monitor, UV dose monitor, and flow control values.

The HOD UV unit was installed at the Cooling Loop, #1 penstock. Due to space constraints the unit could not be installed immediately after the strainer of the raw water, cooling water supply. The 14" piping immediately after the strainer was extended around the wall to the other side and looped back providing the additional footprint needed to accommodate the UV system. By extending the piping the UV system was placed horizontally with adequate spacing for maintenance (30" on each side for ease of UV bulb removal and located 3–4' above the floor). Water was diverted from the strainer through to the HOD UV unit and then returned back to the treatment line.

During the six months of operation of the Hydro-Optic UV system, no viable individual mussels have settled in the test biobox while settlement was recorded in the control. It can be concluded from these results that the HOD UV system is providing settlement control within DeCew II generating station and that the system met and exceeded the treatment objective of achieving 95% control of settlement. This result was achieved under varying %UVT conditions ranging as low as 49.79 %UVT and as high as 98.99 %UVT.

The pilot study proved the Hydro-Optic UV system to be an environmentally friendly, non-chemical disinfection method to mitigate invasive mussels at DeCew II. OPG will be using the technology in full-scale operation going forward.

Hydro-Optic™ UV Technology: Principles of Operation

Unlike chemical treatment approaches, UV systems employ a physical process for disinfection. When bacteria, viruses and protozoa are exposed to the germicidal wavelengths of UV light, they are rendered incapable of reproducing.

Medium pressure (MP) UV lamps provide polychromatic UV light (200–415nm), while low pressure (LP) lamps provide monochromatic light (254nm). MP lamps produce a high-density broad-spectrum UV light inclusive of wavelengths responsible for disinfecting certain resistant viruses.

Since different microorganisms are sensitive to different UV wavelengths, MP lamps can easily inactivate more microorganisms, such as algae, adenovirus, and IPN, through their broad UV germicidal spectrum.

When a microorganism has been inactivated by a LP UV system, it can still repair using its own cell-repair mechanism or by summoning host repair mechanisms. In a MP UV system, the various wavelengths work together to disable cell repair mechanisms. MP lamps disable the proteins and enzymes needed to trigger repair, achieving permanent microbial inactivation at a lower dose than LP systems.

The Hydro-Optic UV technology measures four critical parameters including %UVT, flow rate, UV lamp intensity (kW) and UV apparatus (consisting of Total Internal Reflection and Dose Pacing) in real time to maintain the minimum required UV dose.

The system uses a proprietary Total Internal Reflection (TIR) based design that when coupled with the comprehensive monitoring of critical parameters allows the system to achieve and maintain the specified UV dose.

The system's patented TIR technology, which is similar to fiber optic science, recycles UV light energy within the HOD UV chamber. The core of the technology is its water disinfection chamber made of high-quality quartz surrounded by an air block instead of traditional stainless steel (Figure 1). This is especially important given that in traditional UV systems metal adsorbs or "detracts" the UV dose the closer it gets to metal, whereas the TIR enhances the UV dose.

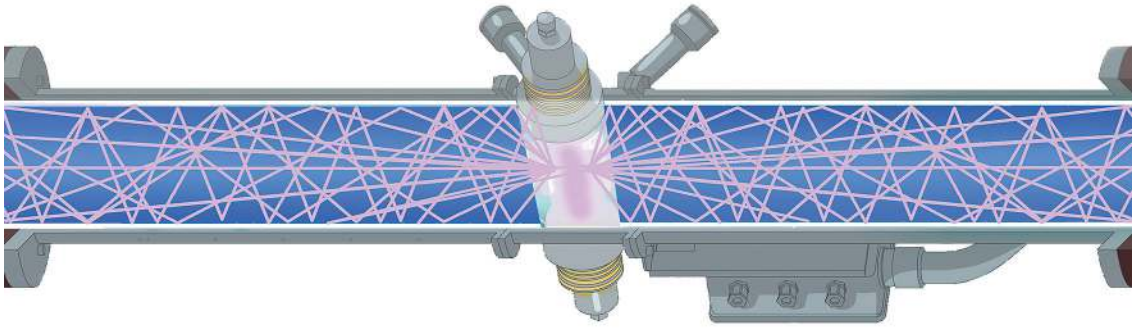

Figure 1: Atlantium Hydro-Optic™ UV Lamp and Chamber

This configuration uses fiber optic principles to trap the UV light photons and recycle their light energy. The photons repeatedly bounce through the quartz surface back into the chamber, effectively increasing their paths and their opportunities to inactivate microbes.

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