Atlantium
Illuminating Water Technologies

APPLICATION BRIEF

Hydro-Optic™ Technology
MACRO/MICRO BIOFOULING CONTROL

Bureau of Reclamation Installs Hydro-Optic™ UV System for Mussel Control at Hoover Dam

Hoover Dam is a hydroelectric facility with a nameplate capacity of approximately 2,080 megawatts that is managed by the Bureau of Reclamation (Reclamation) Lower Colorado Dam Office. Following the spread of quagga mussels to Lake Mead, Reclamation began a feasibility study in 2007 to identify control options that could protect their facilities (Hoover, Davis, and Parker Dams) while having little to no environmental or ecological impact. Following the evaluation of various chemical and non-chemical control methodologies, the Hydro-Optic™ (HOD) UV treatment system was selected as the preferred treatment to supplement operational and mechanical activities already in place at Hoover Dam.

Hoover Dam has seventeen cooling water systems for turbines requiring protection from mussels; nine on the Arizona wing and eight on the Nevada wing. In January 2018, the first of seventeen Hydro-Optic UV systems were installed at Hoover Dam. Each UV system (Model RZB300-11 with DPM) accommodates a flow rate of 454 m^3/hr (1,600 gpm) for water quality conditions with percent UV transmittance as low as 85 %UVT. The proprietary medium pressure UV systems are supplied with a deposit control mechanism, %UVT monitor, UV dose monitor, and flow control values.

The HOD UV unit was installed on the existing 10" piping immediately after the strainer of the raw water cooling water supply from the tailrace, in a vertical configuration with upward flow. Water is delivered from the tailrace, to the strainer, and then the HOD UV unit before supplying cooling water to the turbine. The flow meter was incorporated into the raw water supply to use the features of the HOD UV system to flow pace and control dose. The vertical installation eliminates air bubbles from entering the inside of the UV chamber. To ensure adequate spacing for system maintenance, 30" spacing was left on either side of the unit to easily remove the bulbs and the base mounting bracket allowed for 6–12" of space behind the UV system. All electrical components are located in a weatherproof room, dry area, which does not exceed 70˚F. The system's communication is accomplished by MODBUS and signals are taken to a central location for monitoring the system alarms and operating parameters.

The Hydro-Optic UV system is an environmentally friendly, non-chemical disinfection method to minimize the risk of mussel fouling by preventing invasion and infestation at Hoover Dam.

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.

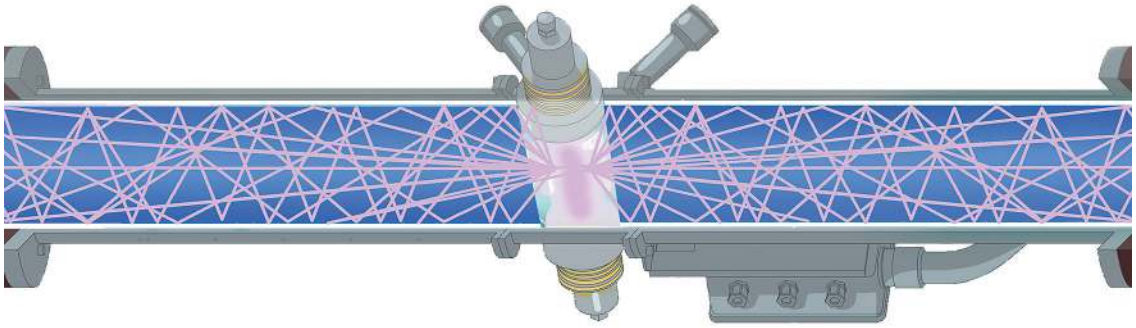

Figure 1: Atlantium Hydro-Optic™ UV Lamp and Chamber

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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