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 Parker Dam

Parker Dam is a hydroelectric facility with a nameplate capacity of approximately 200 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 Parker Dam.

Parker Dam has four main turbines, each with eight heat exchangers (thirty-two heat exchangers in total), requiring protection from mussels. Biofouling protection was also required for the raw water supply of the onsite water treatment facility. In December 2015, two of five Hydro-Optic UV systems were installed at Parker 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 remaining three HOD UV systems were installed and commissioned in the Spring of 2016. The proprietary medium pressure UV systems were supplied with a deposit control mechanism, %UVT monitor, UV dose monitor, and flow switch. To confirm water was flowing limit switches on cooling water valves were used instead of installing a flow meter on each system. As a result, some of the features of the HOD UV system to flow pace and control dose were not used.

Excessive corrosion in the existing raw water piping and strainer required replacement prior to the installation of the UV systems. Therefore, welded stainless steel piping and new self-cleaning strainers were also part of the cooling water improvements. Due to space constraints the HOD UV units could not be installed immediately after the strainer of the raw water, cooling water supply. The 14" piping was extended and looped back providing the additional footprint needed to accommodate each UV system. By extending the piping the UV systems were placed horizontally with adequate spacing for maintenance (30" on each side for ease of UV bulb removal and located 3–4' above the floor). Additionally, a bypass was installed so each unit could be taken out of service for annual maintenance while ensuring adequate flow to the cooling water for the generators. The slightly longer length of the inlet pipe as compared to the outlet pipe allows for laminar flow so that air bubbles are not created inside the UV chamber. Limit switches are used to detect when to signal the UV bulbs to shut down when no flow exists or fluid has drained out of the UV chamber. All electrical components are located in a weather-proof room, dry area, that does not exceed 100˚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.

Following the full-scale installation of the Hydro-Optic UV technology at Parker dam, the facility reduced their annual heat exchanger inspection frequency by 75% in year one, from 16 to 4, and then 100% in year two. The facility is saving $80K annually based on the reduction in man hours to undertake inspections, clean and re-install the heat exchangers; as well as savings with associated material costs used during the inspections. Scaling on the heat exchangers has noticeably reduced with the use of the HOD UV technology.

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.

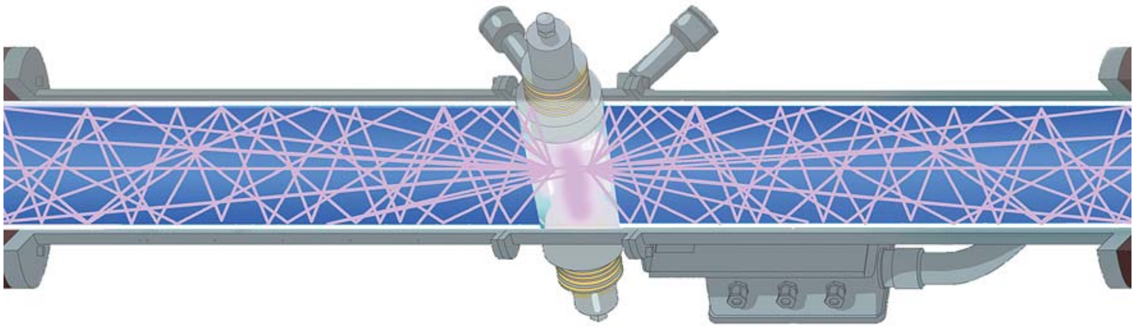

Figure 1: Atlantium Hydro-Optic™ UV Lamp and Chamber

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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