Atlantium
Illuminating Water Technologies

APPLICATION BRIEF

Hydro-Optic™ Technology
MACRO/MICRO BIOFOULING CONTROL

Salt River Project Mormon Flat Dam Installs Hydro-Optic™ UV System for Mussel Control

The Morman Flat Dam is a hydroelectric station with a nameplate capacity of approximately 61 megawatts that is managed by the Salt River Project (SRP) Office in Phoenix, Arizona. Following the spread of quagga mussels in the Colorado River SRP began monitoring their facilities as early as 2008 to identify control options that could protect their facilities 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 the Mormon Flat Dam.

The Mormon Flat Dam has two main turbines requiring protection of the service and cooling water lines from invasive mussels. In May 2018 SRP installed three Hydro-Optic UV systems, one on the cooling water line (Model RZB300-11 with DPM, 204 m^3/hr (900 gpm)) and two (Model RZ163-12HP, 102 m^3/hr (450 gpm) and Model RZ300-12 with DPM, 272 m^3/hr (1,200 gpm)) on the service water lines to treat 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 units were installed as close to the penstock take off as possible, the cooling water system was installed using existing 6" piping and the two service water systems were installed using existing 10" piping. The existing raw water piping was protected with a strainer for debris mussel control. Thankfully the existing piping provided adequate spacing for 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 below the UV system. The inlet pipe is slightly longer than the outlet pipe to allow for laminar flow so that air bubbles are not created inside the UV chamber. Additionally, a bypass was installed to allow the HOD UV systems to be taken out of service annually for maintenance while still ensuring adequate flow to the cooling water for the generators.

All electrical components use 480V 3-phase power with one system located in a weather-proof room, dry area, that does not exceed 100˚F. The other two HOD UV systems are installed outside without a weather-proof room despite the manufacturer's recommendation for a protective cover from direct sunlight and rain. A flow meter was incorporated into the raw water supply to use the features of the HOD UV system to flow pace and control UV dose in real time. The flow meter also protects HOD UV from operating with no water flow to signal the UV bulbs to shut down when no flow exists or fluid has drained out of the UV chamber. 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 the Mormon Flat Dam, the facility is effectively targeting macro/micro biofouling from mussels in service and cooling water lines. 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 Mormon Flat 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.

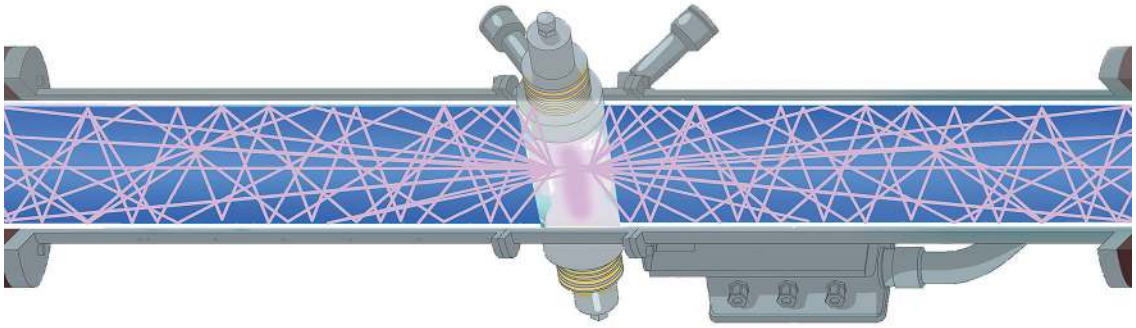

Figure 1: Atlantium Hydro-Optic™ UV Lamp and Chamber

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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