Crystal IS
High Performance UVC LEDs

CASE STUDY:

Sensorex

Sensorex is a market-leading manufacturer of quality sensors for water applications.

CHALLENGE

Water treatment facilities are increasing their use of UV light for drinking water disinfection. Radiation in the UVC range of 250-280 nm deactivates bacteria, viruses, and other microbes by attacking their DNA. The microorganisms, in turn, lose their reproductive capability and are destroyed, rendering them inactive and no longer harmful. Unlike chlorine disinfection, UV disinfection is a physical process that introduces no toxic disinfection by-products (DBPs). Most conventional UV disinfection systems use low pressure mercury lamps that emit UVC light at 254nm.

Effective disinfection requires significant reduction in the concentration of bacteria, viruses and other microorganisms in water, and is typically denoted by 2, 4 or 6 log reduction in concentration. To achieve log reductions in the concentration of microorganisms, UV doses (a product of UV light intensity and time) above critical thresholds are required.

Understanding the UV transmittance of water (UVT) is key to ensuring that the UV light dose is sufficient to inactivate pathogenic microorganisms. UVT is a measure of water quality and indicates the percentage of the incident light that is able to pass through water. The higher the UVT, the better the water quality. A UVT of 100% indicates that all the light is able to pass through water with no interference from dissolved organics or other particulate matter.

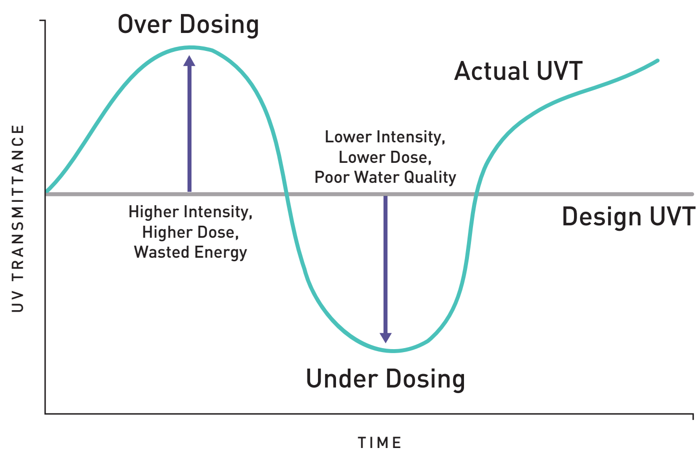
Environmental changes such as sudden weather events, seasonal changes in source water composition, or unplanned changes in upstream treatment processes can affect UVT. UVT monitoring can detect organic events upstream of the UV disinfection process and may help reduce chemical consumption in coagulation, prevent membrane fouling, and extend the life of the carbon used in filtration.

A UV disinfection system is designed around an expected UV transmittance (UVT). This value is often based on historical information or periodic testing. In reality, the actual UVT of the water will fluctuate. The more variables that affect the quality of the source water, the more frequently these fluctuations will occur.

In periods where the actual UVT is higher than the expected (or designed for) UVT, the UV system will deliver more than enough UV intensity to disinfect the water, which translates

"THE SMALL FOOTPRINT, LONG LIFETIME AND LOW POWER CONSUMPTION OF CRYSTAL IS DEEP UV LEDS IS IDEAL FOR THE UVT-LED PRODUCT," SAID DAN SHAVER, NEW BUSINESS DEVELOPMENT MANAGER AT SENSOREX.

FIGURE 1



Over dosing and under dosing have consequences for plant operations and the community. UVT monitoring can help avoid these consequences and achieve optimal dosing.

into unnecessarily high energy consumption. In periods where the actual UVT is lower than the expected UVT, the UV system will not be able to deliver enough UV intensity to meet disinfection requirements and therefore water quality will suffer, presenting an immediate health risk. UVT monitoring can help eliminate the consequences of under and over dosing.

Traditional UVT monitors used mercury lamp light sources. Mercury lamps require a longer warm-up time to achieve stable measurement results and so they are typically left on continuously, resulting in frequent lamp replacements. Due to the variability in lamp output, several measurement techniques involving different path lengths, multiple lamps and sensors or other methods of compensation have been used. These features often require more moving parts, resulting in a much larger product with a higher level of maintenance required to continue reliable operation.

In contrast, UVC LEDs achieve full intensity instantly, which allows them to be used for measurement on demand and then turned off to preserve the overall life of the LED.

SOLUTION

The introduction of brighter, long lifetime UVC LEDs from Crystal IS has created new opportunities for the use of LEDs for UVT measurements. Sensorex evaluated the Crystal IS 255 nm UVC LED in their UVT-LED transmittance monitor. Replacing a traditional mercury lamp with the LED enabled a smaller footprint for UVT-LED, making it easy to use across multiple water treatment environments: directly in a pipe, in an open channel, or used offline as a battery operated handheld instrument.

The Sensorex UVT-LED was deployed to monitor UVT in a water treatment plant with three different size systems to understand the effect that accurate UVT information can have on energy consumption (Figure 2).

THE POTENTIAL YEAR ONE SAVINGS THAT COULD BE REALIZED BY IMPLEMENTING A UVT MONITORING SOLUTION ARE OFTEN GREATER THAN THE ONE-TIME COST OF PURCHASING A UVT MONITOR.

FIGURE 2: ANNUAL POWER CONSUMPTION FOR DIFFERENT LEVELS OF UVT IN THREE DIFFERENT SIZE SYSTEMS

Source: Aquionics, Inc. 2014

MGD refers to water supply of million gallons per day.

An expected dose of 30 mJ/cm^2 was used for all scenarios. It can be seen from the data that in order to achieve an effective UV dose, more power (more UV intensity) was required for the lower levels of transmittance than for the higher levels of transmittance. This is because when UVT is lower, more energy is required for the UV light to penetrate the water and provide adequate disinfection.

This extraneous energy usage can be quantified in energy costs.

For example, a small UV system (0.5 MGD) operating at 60% UVT would cost approximately $1,700 more annually to operate than the same UV system operating at 70% UVT. By comparison, the same UVT ranges would yield an energy consumption difference of approximately $8,400 per year for a 3 MGD capacity system and over $23,000 annually for a 5 MGD system.

This study confirmed that small changes in water quality throughout the year (from 5-10% UVT) have the potential to directly affect a facility's operating costs. The potential year one savings that could be realized by implementing a UVT monitoring solution are often greater than the one-time cost of purchasing a UVT monitor.

"The small footprint, long lifetime and low power consumption of Crystal IS deep UV LEDs is ideal for the UVT-LED product," said Dan Shaver, New Business Development Manager at Sensorex. "This makes for a versatile product with extremely stable readings in all conditions, over an extended lifetime."

Crystal IS ADVANTAGE

LEDs offer light stability, instantaneous response and design freedom over traditional light sources. In addition, Crystal IS deep UV LEDs provide:

- **High spectral quality for measurement linearity over a wide range**
- **Long lifetime and simple drive electronics that enable maintenance-free, continuous, remote operation**

Crystal IS™
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