Sensorex

UV DISINFECTION PERFORMANCE

INTRODUCTION

Waterborne pathogens must be properly inactivated prior to entering the distribution system en route to consumers. Ultraviolet (UV) disinfection for drinking water has proven to be most effective process for inactivation of Cryptosporidium and Giardia. This treatment process is complemented with chlorination for a residual in the distirbution system. Continuous monitoring of data to ensure UV treatment effectiveness is imperative for public human health and safety.

UV TRANSMITTANCE

UV Transmittance (UVT) is the measure of UV light at the 254nm wavelength that is transmitted through a sample of water, and is expressed as a percentage (%) transmission. The measurement provides valuable insight to the suspended solids and organics content in the water sample, and is a parameter used in the dose calculation for UV disinfection systems. Monitoring UV Transmittance provides critical data for delivering the required dose of UV light to reach target log inactivation. Dose is calculated using UVT (UVT %), UV light intensity (I mW/cm2), and contact time (t seconds):

$$\text{UV Dose} = I/UVT \times t$$

While the light intensity of the UV disinfection system is important to monitor, UV dose is truly related to the amount of UV light that penetrates the water sample to achieve a log reduction of a pathogen. Suspended solids and other content present in the water that absorb or scatter UV light at the 254nm wavelength can lower the amount of UV light transmitted for pathogen inactivation.

SYSTEM DESIGN & SIZING

It's critical to understand design requirements and constraints when designing and sizing a UV system. Generally, UV disinfection system manufacturers and/or engineering consulting firms can assist in the design to meet treatment targets. Mathematical models, such as Point Source Summation (PSS), can be used to design the system, though this method does not account for the microbiological data of the water at the site. Bioassays are an alternative method, which involves laboratory bench scale testing and a UV reactor field test using site-specific water quality data.

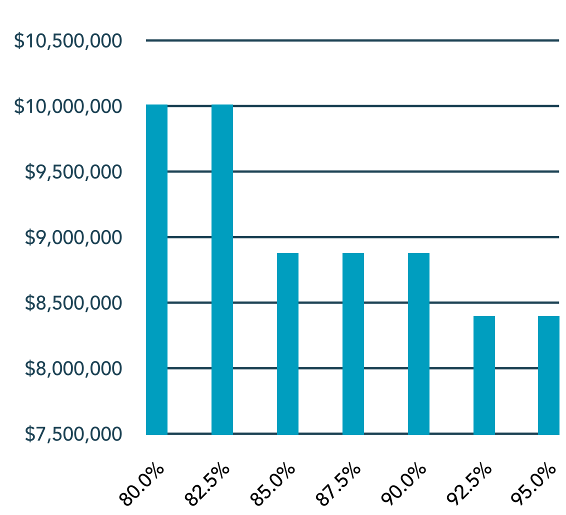
Key parameters in the design of UV disinfection systems include:

- Flow rate / reactor volume
- Headloss / water level
- Lamp output / power setting
- Lamp age
- Quartz sleeve transmittance (coating/fouling)
- Water quality (UV Transmittance)

While all of these parameters are important for proper system design, the site-specific water quality is especially critical. Monitoring UVT over an extended period of time (3-12 months) prior to system design can provide insights into seasonal water quality changes that will impact treatment effectiveness. This can result in significant capital cost savings by correctly sizing a system for site-specific water quality data and treatment objectives.

Very small changes in the UVT value used in the system design can have significant impacts on the capital costs. For example, a plant with design flow of 60 mgd (45 mgd average flow) could save greater than $1M with an 2.5% increase in the UVT value used in design.

UV Capital Costs for 2.5 log Crypto Inactivation



© Sensorex Corporation. All rights reserved. In the interest of improving and updating its equipment, Sensorex reserves the right to alter specifications to equipment at any time.

SYSTEM CONTROL & OPERATION

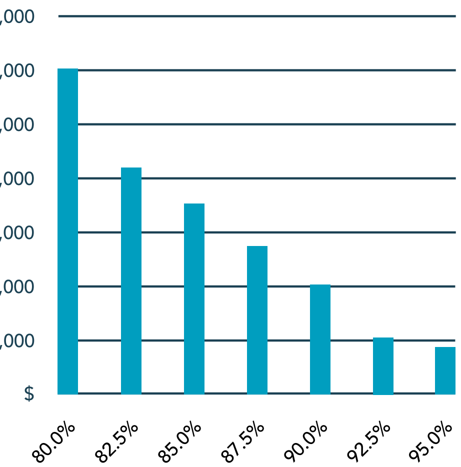
UV disinfection systems can account for a large portion of the operational budget for a water plant. With budgets tightening, there's an opportunity to generate significant cost savings by optimizing the UV disinfection process through sensing, control, and automation.

Control of the system is commonly either flow-paced control or dose-paced control. Flow-paced is the simplest strategy, with the number of banks, lamps and channels based strictly on influent flow rate. Dose-pacing uses several parameters to ensure proper UV dosing through online monitoring of:

- Flow rate
- UV Transmittance
- Lamp power (including lamp age and on-line output intensity data)

Dose-paced control optimizes efficiency of the UV disinfection process by modulating lamp output power based on real-time data. For instance, if UVT increases in the incoming water to the UV disinfection system, control mechanisms are in place to turn off unneeded lamps or lower lamp output power. This results in lower energy consumption while still meeting disinfection objectives.

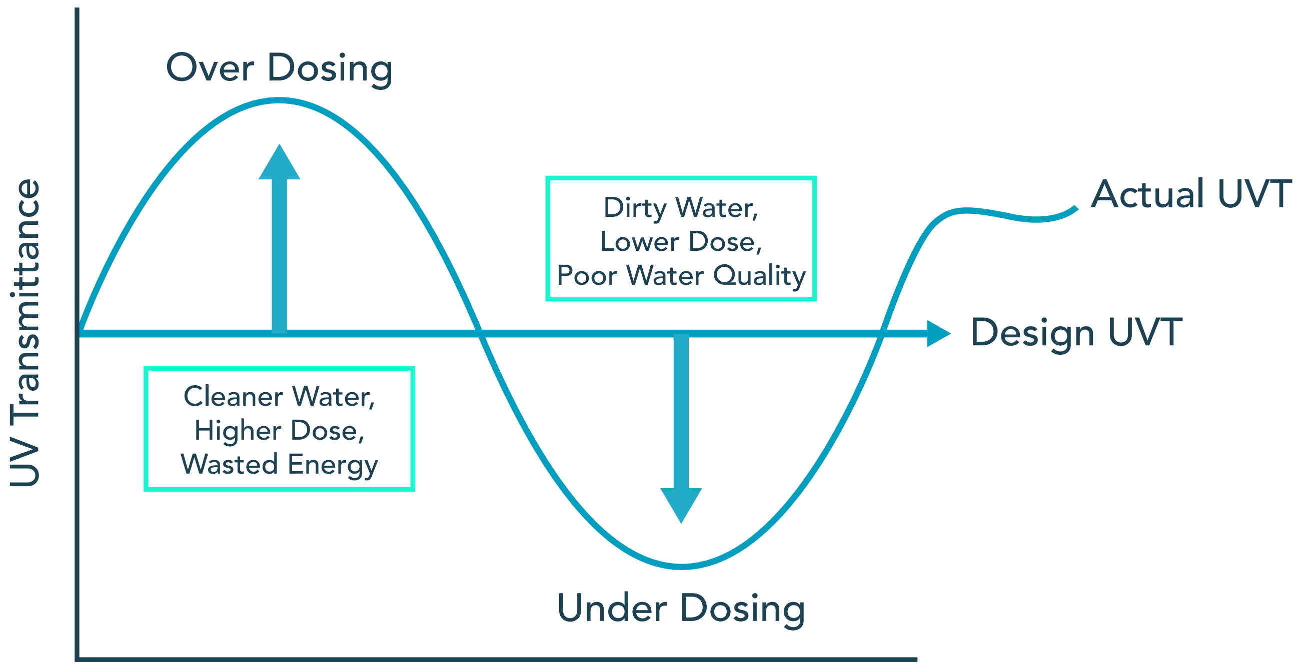
UV Annual Operating Costs for 2.5 log Crypto Inactivation



Similar to capital costs, small changes in UVT can have a powerful impact on annual operating costs of the UV disinfection system. For example, the same plant from the previous example with design flow of 60 mgd (45 mgd average flow) could realize over $100k with a 5.0% increase in the average UVT of the water entering the UV disinfection stage.

CONCLUSION

Online UVT monitoring ensures that energy isn't wasted through over-dosing ,and that water is properly disinfection using the target UV dose. This data is critical to proper system design and operation to reduce capital costs and operating costs, respectively.



DESIGNED AND ASSEMBLED IN CALIFORNIA, USA

11751 MARKON DRIVE • GARDEN GROVE, CA 92841 • 714.895.4344 • WWW.SENSOREX.COM

© Sensorex Corporation. All rights reserved. In the interest of improving and updating its equipment, Sensorex reserves the right to alter specifications to equipment at any time.