CASE STUDY

UV Water Treatment
Hydro-Optic™ Technology

Aquapolo Tests Hydro-Optic™ UV Technology for Non-chemical Biofouling Control in Water Reuse Facility

The Aquapolo Ambiental water reuse project, designed for a peak capacity of 1,000 liters per second of reuse water, provides industrial quality reuse water in São Paulo, Brazil. In order to meet the stringent industrial water reuse water quality requirements, Aquapolo processes influent wastewater in a conventional wastewater treatment plant followed by tertiary membrane bioreactors and partial reverse osmosis (RO) treatment. The facility has been using chemical biocides to protect their RO membrane elements from biofilm due to biological growth. In 2016 they decided to pilot and test the efficacy of the Hydro-Optic™ ultraviolet (HOD UV) technology as a non-chemical biofouling control method. The HOD UV technology was compared in a side-by-side study with chemical biocides.

Background

The Aquapolo facility, built on the grounds of the ABC Sewage Treatment Plant (SP WWTP), uses effluent from the sewage treatment plant as their influent. Given the stringent industrial water reuse standard requirements (Table 1), a multi-process treatment scheme is used by Aquapolo to ensure production of high quality reuse water (Figure 1).

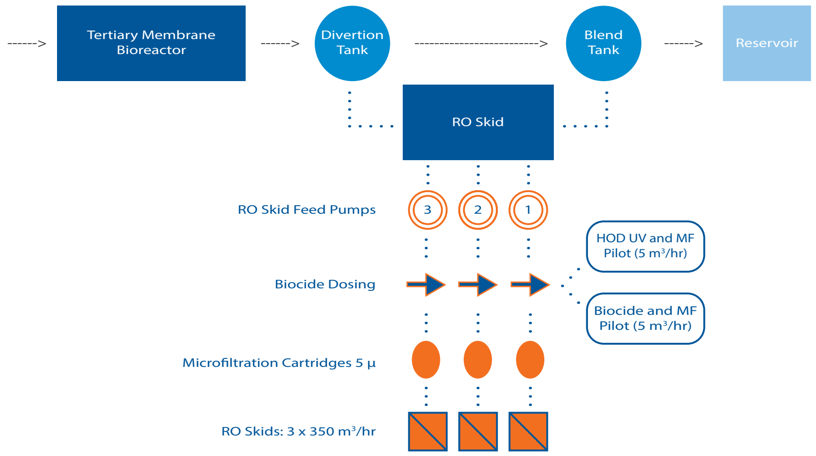

Figure 1: Aquapolo Industrial Water Treatment Plant

Table 1: Aquapolo Water Quality Parameters

Parameter	Influent	Industrial Water Reuse Standard
COD	100	25
BOD	30	10
Ammonia	20	1
Phosphorous	5	0.5
TSS	40	2
Turbidity	15	1
Conductivity	900	720

Effluent from the tertiary membrane bioreactor is 1) Either sent directly to a reservoir for storage and use or 2) Diverted to the RO skid for more advanced treatment. Aquapolo uses three RO skids with a total flow capacity of 1,000 m^3/hr in order to reduce conductivity at the final mixed water and meet the goals for industrial water reuse.

The RO membrane elements are susceptible to biological fouling due to the high organic load (biological and non-biological) in water reuse plants. Protecting the RO membrane elements from fouling is essential to minimizing the operational impacts of biological contamination on operating costs; which include increased membrane element and microfiltration cartridges replacement costs, decreased water quality production and/or increased operating pressure.

Biocides have been used at the facility to control biofouling and protect the membrane elements. Chemical consumption is a key performance indicator for Aquapolo. They are continuously looking to improve their performance and minimize the use of chemicals and associated handling. In 2016 Aquapolo installed a HOD UV pilot system to evaluate its ability to protect RO membranes/cartridges from biological fouling.

HOD UV Technology

The HOD UV technology is a physical process for disinfection that exposes bacteria, viruses and protozoa to germicidal wavelengths of UV light, measured in nanometers (nm), to render them incapable of reproducing and excreting extra-cellular polymeric substances that are responsible for biofilm creation.

The HOD UV technology measures four critical parameters including percent ultraviolet transmittance (%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. 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.

Evaluation Study

Atlantium Technologies, Inc. provided one RZ104-12 HOD UV system to Aquapolo for the pilot study. The pilot study was undertaken at RO Skid 1 feed pipeline. Two side streams of 22 gpm (5 m^3/hr) with 65-70 %UVT were diverted to two newly installed treatment trains in parallel. Each treatment train contained a set of six 5-micron filter cartridges 10" in height (Figure 2). The microfiltration cartridges used in the pilot study matched the supplier specifications for cartridges used at RO Skid 1 and Skid 2. One treatment train was used as a reference for biocide treatment while the other installed the HOD UV unit for non-chemical biofouling treatment and testing.

The objectives of the pilot study were to 1.) Evaluate the disinfection efficacy and performance of HOD UV compared to biocide treatment, 2.) Undertake a feasibility study to verify UV dose required for full-scale treatment.

Pressure drop was selected as the variable for comparison between the biocide and HOD UV treated microfiltration cartridges. A maximum of 2.0 kg/cm^2 was determined as the end of cartridge life.

The pilot study was commissioned 14 July 2016 and was completed in April 2017. The disinfection efficacy of the HOD UV system was assessed during four test runs.

Figure 2: Pilot system, two treatment trains with 5 micron-filters installed

Study Results

The first test run took place on 14 July 2016 to 21 August 2016. Initial microbial sampling was analyzed by an external authorized laboratory for heterotrophic plate count (HPC). Samples were collected aseptically in sterilized PP jars. Sampling and testing was done according to the standard method 9215 A e B- 22ª edition, incubated at 30°C during 48 hours.

Results were very promising and showed the HOD UV was more effective compared to biocides: the use of the HOD UV produced results that were better than results from using biocides.

In terms of performance, the HOD UV treatment train operated for 412 hours before the microfiltration cartridges reached the end of their life, while the biocide treatment train operated for 352 hours. The HOD UV treatment train operated 17% longer than the biocide train (Figure 3).

The second second test run took place during 7 October to 30 October 2016. In terms of performance, the HOD UV treatment train operated for 499 hours before the microfiltration cartridges reached the end of their life, while the biocide treatment train operated for 384 hours. The HOD UV treatment train operated 30% longer than the biocide train (Figure 4).

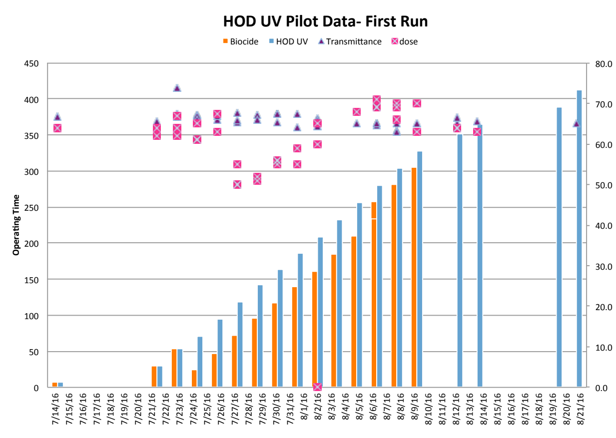

Figure 3: Data from first run 14 July 2016 to 21 August 2016

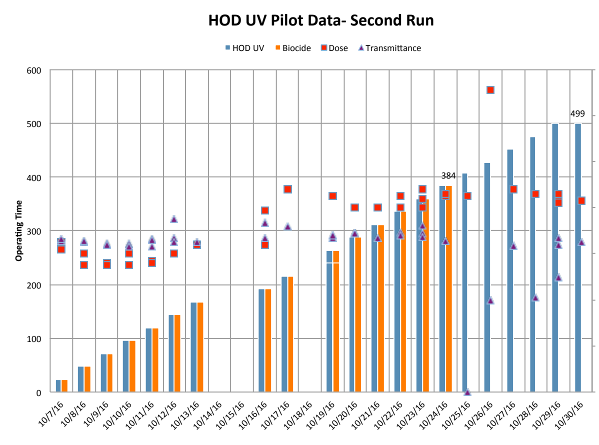

Figure 4: Data from second run 7 October to 30 October 2016

The third and final test run, initiated 14 March 2017 and completed on 3 April 2017. Microbial analysis showed the HOD UV was performing better than biocides.

The HPC counts for UV disinfection ranged from 1.3 x 10^2 cfu/ml to < 1 cfu/ml, while the biocide train remained 1.6 x 10^2 cfu/ml.

In terms of performance, the HOD UV treatment train operated for 425 hours before the microfiltration cartridges reached the end of their life, while the biocide treatment train operated for 323 hours. The HOD UV treatment train operated 35% longer than the biocide train (Figure 5).

Conclusion

The pilot evaluation of the HOD UV system determined that the technology provided better biological fouling control than biocide treatment. The HOD UV system positively affected performance of the microfiltration cartridges, increasing the life of the elements between 30-35%. The HOD UV system also provided a greater reduction in bacteria levels compared to biocides; the HOD system averaged a 3-log reduction (99.9% removal).

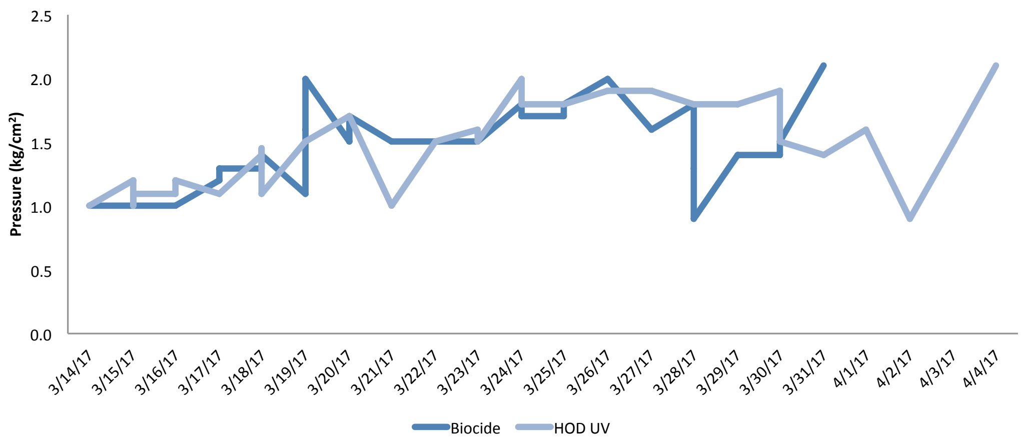

Figure 5: Microfiltration filters pressure drop
(kg/cm²) during third test run

Atlantium Technologies Ltd.
Har Tuv Industrial Park, POB 11071, Israel 99100
Tel: +972 2 992 5001 Fax: +972 2 992 5005

www.atlantium.com
info@atlantium.com

For more information, contact your Atlantium representative