EPRI | ELECTRIC POWER RESEARCH INSTITUTE

SUCCESS STORY

SOUTHERN COMPANY DEMONSTRATES ALTERNATIVE TREATMENT FOR DECHLORINATION OF BOILER MAKEUP WATER

In a collaborative project with EPRI, Southern Company and its Georgia Power subsidiary conducted a full-scale field demonstration to evaluate the performance of an alternative treatment system for chemical-free dechlorination of boiler makeup water. The lab-scale testing of Atlantium's Hydro-Optic UV system took place at Georgia Power's Water Research Center, where more than 50 water treatment technologies have been evaluated. The alternative technology, which utilizes photodecomposition via ultraviolet (UV) light, may provide a dechlorination approach that also eliminates the handling, storage, and operational requirements of chemical disinfection solutions.

PROTECTING MEMBRANES AND PREVENTING BIOFOULING

Power plants commonly use reverse osmosis (RO) technology to provide high-purity feedwater for the boiler and steam cycle. However, many plants with RO systems encounter frequent membrane and micron-filter maintenance and replacement as a result of biofouling and fouling by solids. The membrane elements in the RO must be protected from biological fouling and chlorine oxidation. These conditions could lead to operational impacts, which may include more frequent membrane element replacement, loss of clean water production, increased energy usage, compromised product quality, and higher cost of treatment.

Dechlorination is typically achieved in the RO membrane by injecting a sodium bisulfite (SBS) or sodium metabisulfate (SMBS) solution into the feedwater. While these chemical treatments are effective, they may be subject to operational difficulties, such as inconsistent dosage and microbe proliferation of anaerobic bacteria on the membrane. The formation of biofouling layers may also result from bacteria surviving the chlorination stage and reaching the membranes post-dechlorination. The SBS/SMBS neutralization also has additional handling, storage, and operational requirements. Chemical feed systems require an injection pump, piping, and a storage system, and they may have automated control based on oxidation-reduction potential or an oxidant analyzer.

HYDRO-OPTIC ULTRAVIOLET WATER TREATMENT

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. In addition, UV light can also destroy chemical contaminants through a process called UV oxidation. UV light is most commonly produced through medium-pressure (MP) or low-pressure (LP) lamp technologies.

Hydro-Optic UV system on Georgia Power's Plant Bowen reverse osmosis unit

> *"Atlantium's Hydro-Optic UV system has the potential to provide value across Southern Company's generating fleet. This system has been useful in treating boiler makeup water in order to prevent biofouling in the ultra-filtration system downstream."*
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> – **AARON NICKLES**
> *Maintenance Specialist*
> Georgia Power

RELATED EPRI PRODUCTS

Title	Product ID
Boiler Makeup Water Dechlorination Using Advanced Ultraviolet Technology at Plant Bowen Water Research Center	3002002146

The Hydro-Optic (HOD) UV system from Atlantium Technologies, Inc. provided a chemical-free dechlorination treatment approach for boiler makeup water. Through photodecomposition by UV light, the HOD system decomposes the free chlorine oxidant in process water to protect RO membranes. Additionally, the technology provides disinfection to reduce the membrane biofouling potential by eliminating anaerobic and aerobic bacterial growth.

The HOD system uses a proprietary, medium-pressure, high-intensity polychromatic lamp that provides more UV than that of conventional MP lamps and LP lamps.

DEMONSTRATION AT PLANT BOWEN

The HOD UV technology was installed on the full-scale (680 gpm [154 m3/hr]) RO process at Georgia Power's Plant Bowen and was located after the media filters and before the microfiltration and RO system. The technology was evaluated from March 4 through May 30, 2014, and performance is documented in EPRI Report 3002002146.

Results were promising and showed the technology met the treatment objectives. The HOD UV technology effectively removed free and total chlorine from boiler feedwater to undetectable levels, which were above 0.7 mg/L at the inlet. Bacteria levels were also reduced to an average of 3.8 organisms per mL. Overall, the results indicate that the HOD UV system effectively dechlorinated and disinfected the RO feedwater.

Upon completion of the testing at the Water Research Center, Plant Bowen installed a full-scale HOD UV technology to treat the entire RO system. In 2017, after three years of operation, Plant Bowen evaluated RO membrane performance by pressure differential, which is an indication of potentially irreversible fouling (higher differential means more fouling). Plant Bowen found the pressure differential had only increased by 21% since the membranes were first put into service. As a comparison, the prior membranes (which were replaced in 2014) were taken out of service after three years of operation and had a pressure differential increase of 78%. This comparison, lower pressure differential using the HOD UV technology, indicates improved longevity of the membrane elements.

COST SAVINGS FROM HOD UV TECHNOLOGY

At Plant Bowen, the RO membrane elements are generally replaced on five-year cycles. The current elements at Plant Bowen are scheduled for replacement in 2019; however, if performance remains positive, the facility will evaluate the possibility of increasing the life span another year. This delay in replacement would result in an additional cost savings of $100,000.

Performance of the micron filtration system has also been enhanced with the use of the HOD UV technology. In 2015, the four pre-RO micron filters were changed six times, then reduced to four times in 2016, and to two times in 2017. The reduction in cleaning frequency has resulted in a net savings of $160,000. Incorporating the non-chemical HOD UV technology into full-scale operations at Plant Bowen has proven favorable for dechlorination efforts at the facility, mitigating the use of SMBS, resulting in a net savings of $175,000, and providing a two-year return on investment.

Moreover, no reduction in performance to the RO membranes has been reported with use of the HOD UV technology. As a result, Plant Bowen has been able to maintain the integrity of its feedwater for the boiler and steam cycle, ensuring production and quality levels necessary for the facility to operate efficiently.

The application of this technology is not unique to Plant Bowen and could be used at other Southern Company facilities using RO systems for water treatment. Similar installations would possibly lead to significant savings across the Southern fleet.

"Atlantium's Hydro-Optic UV system has the potential to provide value across Southern Company's generating fleet," said Aaron Nickles, Maintenance Specialist, Georgia Power. "This system has been useful in treating boiler makeup water in order to prevent biofouling in the ultra-filtration system downstream."

FOR MORE INFORMATION

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