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New Life

San Antonio shows how to install cost savings without disrupting water recycling service

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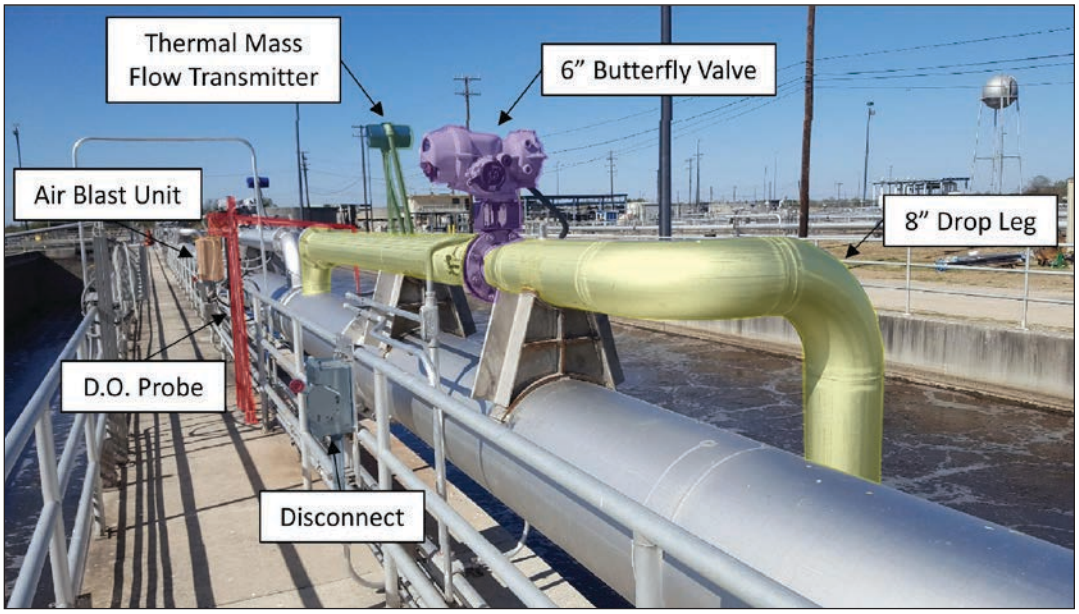
The San Antonio Water System (SAWS) serves more than 1.2 million customers in and around San Antonio, Texas, one of the fastest-growing areas of the U.S. To keep pace with demand, SAWS has committed to building the nation's largest recycled water delivery system. However, the Leon Creek Water Recycling Center (WRC), one of the critical components of the recycled water system, showed clear signs of stress and aging. Additionally, inefficient manual aeration and disinfection processes used in everyday operations were straining the operating budget of the facility.

By investing $11.5 million in innovative rehabilitations and aeration and disinfection process improvements over 4 years, SAWS updated Leon Creek WRC's treatment equipment, improved operations with automation, and saved substantially on costs for electricity, chemicals, and labor. Specially designed operator training on this project also contributed significantly to the successful adoption and integration of a considerably new and different system.

The Leon Creek Water Recycling Center is a key facility for serving San Antonio Water System's more than 1.2 million customers in one of the fastest-growing areas of the U.S.
Courtesy Freese and Nichols Inc.



Automating the aeration system for the 15 basins at the Leon Creek Recycling Center corrected imbalanced air distribution, improved operations, and provided substantial cost savings for the San Antonio Water System. Courtesy Freese and Nichols Inc.

SAWS' experience in working with its consultant partners, Freese and Nichols (San Antonio, Texas), to rehab the facility provides valuable lessons for utility operators and managers in how to pursue the dual goals of

- showing leadership in water management, and
- accomplishing renovations without disrupting normal wastewater operations and service to customers.

The Challenge

The Leon Creek WRC is a conventional activated-sludge facility permitted for a peak flow of 348.26 ML/d (92 mgd). The facility can provide up to 109.78 ML/d (29 mgd) of highly treated effluent to industrial and commercial customers, golf courses, and parks. Permits from the State of Texas and the U.S. Environmental Protection Agency closely govern the facility's operational standards.

Aging equipment at Leon Creek WRC was wasting energy. Old, clogged, or broken diffusers, corroded air piping, and imbalanced air distribution all posed challenges. The old system also lacked process controls within the different zones of the 15 aeration basins, so the amount of air reaching each zone could not be monitored or controlled remotely.

The controls were manual, and the 15 basins span the area of almost three American football fields (approximately 13,000 m^2). This led to operators spending considerable time traveling among the basins to adjust valves manually to maintain proper airflows. After each adjustment, a 30-minute wait was required to verify that the change satisfied the dissolved oxygen (DO) concentration levels before operators decided whether to make another change. Before the rehabilitation, all 15 basins were served process air from a bank of four single-stage blowers through a common header. Each basin had two DO sensors. However, the sensors weren't readily accessible for maintenance, nor were they working properly. To reach the sensors, operators had to lean over hot process air lines to remove some of the DO sensors, posing a danger.

Automating the Aeration System

Fully automating the aeration system for the activated sludge process involved replacing aged air piping and diffusers. It also meant installing modulating valves, dissolved oxygen analyzers, and air flow metering in each of 15 aeration basins. Basins were configured with three DO zones (A, B, and C). Each zone has its own drop leg with a thermal mass air flow meter and air flow control valve. This enables measurement and control by zone instead of by basin.

Now, in total, there are 45 sets of air flow control valves and flow meters for the aeration basin system. Two additional flow meters and air flow control valves were added to provide this control in the influent mixing box and influent channel.

When installed, each flow meter and valve was tuned in place to provide the most optimal control for its respective purpose. The number of diffusers fed by each drop leg helped to determine the minimum and maximum limits for the flow meter and valve sizes.

This tuning improved air control for an optimized treatment process. It reduced the facility's blower electric bill more than 25%. This reduction compared the first 22 months after the upgrade with the 16 prior months prior to it.

The modifications also made accessing process monitoring sensors more manageable and saved numerous hours of trying to balance air flow to each basin manually.

Achieving this result posed multiple challenges. The team needed to understand the operators' desired controls, integrate the blower and sensor–control technologies, tune the system prior to start-up, test the system (while training staff on its use), and train all shifts of operators.

The two technology vendors spent numerous hours sharing the transfer of information to ensure a seamless connection between the two systems.

During the design phase, operators indicated their preference of aeration basin air flow controls (automated and manual), which this system delivered. But the operators also needed to be comfortable with the human–machine interface layout and control parameters. They needed to be comfortable knowing that the process control programming provides set points, alarms, and different control schemes for full control of the process.

Automating the Chlorination/ Dechlorination System

The Leon Creek WRC also upgraded and automated its disinfection system. The chlorine feed system consists of three chlorine evaporators, eight chlorinators, and three chlorine contact basins.

Before the upgrade, the process was cumbersome and inefficient. Facility personnel would take multiple grab samples throughout the day, analyze them and then, modify dosing levels to meet Texas Commission on Environmental Quality (TCEQ) and U.S. EPA standards.

To ensure permitting compliance, a properly working system or process is critical. But, because this was a manual process and flows changed throughout the day, chemicals were being overfed. This wasted money both on chemicals and on added labor.

Automation made the disinfection process and controls more effective, simple, flexible, and robust. Operators can still control the system manually when necessary.

The new system uses DPD (N,N-diethyl-p-phenylenediamine) colorimetric chlorine analyzers to monitor the chorine residual in the contact basins. This reading, in conjunction with a facility flowmeter reading, is used to automatically adjust the dose of chlorine. This change improved the facility's environmental footprint by significantly reducing chemical use. It also saved hours of manually monitoring and adjusting concentration levels.

Keeping the Facility Running

One of the project's most significant challenges was keeping the facility running at capacity 24 hours a day throughout the extensive repair and replacement of equipment. Construction had to be sequenced carefully to accommodate all the special requirements. For

Rehabilitation of the San Antonio Water System Leon Creek Water Recycling Center involved multiple components, including automation of the aeration system and chlorination/ dechlorination system, plus repairs to the clarifiers and construction of a blower enclosure. Courtesy Freese and Nichols Inc.

To keep the Leon Creek Water Recycling Center operating at full capacity during the rehabilitation, the engineering team designed and oversaw construction of a 100% bypass pumping installation that could handle seasonal peak flows.
Courtesy Freese and Nichols Inc.

instance, only two of the 15 aeration basins could be taken out of service at a time for repairs (with one exception). Also, because of connections under the water surface, certain basin pairs had to be taken out of service together.

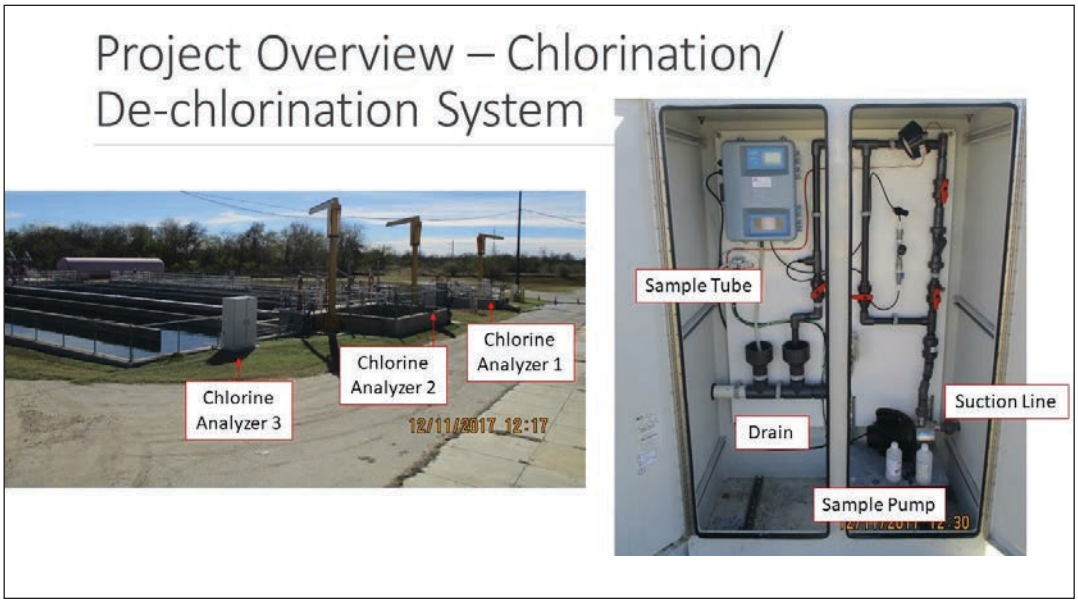
To accomplish this, the engineering team designed and oversaw construction of a bypass pumping installation to allow for 100% bypass of facility flows around a flow distribution structure that needed complete rehabilitation. The bypass pumping installation was sized to handle flows up to 295.26 ML/d (78 mgd), which is the seasonal peak facility flow including return activated sludge. The bypass distributed these flows evenly into 13 separate basins to maintain treatment process.

Because keeping the same aeration capacity and flows was vital to the operation of the facility, the bypass installation had to be equipped with fully redundant pumps. These pumps were manned continuously in case any of the installed pumps went out of service. The bypass pumping operation and flow distribution structure rehabilitation went smoothly, and it was brought back online without affecting the facility's processes.

Good Practices

Throughout this process, the project team paid attention to what worked. Some choices helped to move the project smoothly.

Build Operator Confidence Through Training. Training operators about the system



Automating the disinfection process at the Leon Creek Water Recycling Center reduced the facility's chemical use and saved operators many hours of manually monitoring and adjusting concentration levels. Courtesy Freese and Nichols Inc.

can contribute to the success of a project. For this project, SAWS allowed operators to use new equipment enough to get a feel for the system prior to classroom training. Operating the system prior to the classroom component provided them enough experience to know what questions to ask during the classroom sessions. The programmer was onsite during the training and encouraged operators to touch any button or operate in any scenario so they would not fear that they might "break" the new system while onsite. This exercise built confidence, which led to greater trust in automation and less fear in making process changes. They knew they could switch operations to manual mode if necessary.

Involve Operators Early. Keeping operators involved during design helps manage expectations and ensure buy-in for the designed system. In this case, implementing operators' feedback and talking about their expectations demonstrated this system was designed and built to meet their needs.

Use Design To Anticipate Coordination Issues. Involving technology integrators during design helps define the scope of work required by each integrator. This also leads to more concrete contractual obligations.

Conclusion

The Leon Creek WRC provides essential — though perhaps largely taken for granted — services to more than a million SAWS customers every day. Close and continuous coordination between SAWS and Freese and Nichols throughout this project resulted in completion of innovative and cost-saving improvements that serve the public interest. Large savings in electricity and operational costs through automation of the aeration system enable SAWS to continue as a national leader in recycled water delivery. Cutting excess chemical and energy use for chlorination and dechlorination reduces the facility's environmental and financial footprint. And accomplishing the renovations without disrupting normal treatment allowed SAWS to continue providing vital services without harming public health or welfare, while setting up the facility for the future.

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Other key members of the teams who were instrumental in completing this project were Daniel Rodriguez, Leon Creek WRC Manager from 2011 to 2019; Joe Daggs, SAWS Construction Inspections; and Mike Villegas, Leon Creek WRC Superintendent.