The cassettes at the Rubes Creek Water Reclamation Facility show minimal solids accumulation after eight months of operation.

Replacing Membranes

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Georgia water reclamation facility upgrades its membrane system

Woodstock is a city in northern Georgia's Cherokee County and is a part of the Atlanta metropolitan area. The Rubes Creek Water Reclamation Facility (WRF) in Woodstock, with its conventional system, was challenged by more stringent effluent quality permit requirements on its discharge into Rubes Creek. Furthermore, growth in the community increased the demand for wastewater treatment. In 2002, the city council started planning for a retrofit and plant expansion. In a competitive bid, the ZeeWeed membrane system was selected and commissioned in three phases between December 2004 and June 2005.

Following poor screen performance, which resulted in significant solids and trash accumulation in the membrane bundles, new headworks screening and a grit removal system were added to the plant in 2012 and 2013.

The city had planned for a membrane life expectancy of approximately eight years. In April 2014, the city, with competitive bids in hand, selected to upgrade and expand the plant with new cassette frames equipped with the LEAPmbr aeration system using the larger LEAPmbr module. Commissioning was completed in July 2014, confirming a final weighted average life of the original modules of more than nine years, exceeding customer expectations.

Current System Configuration

Influent to the plant is typical municipal waste with no extraordinary industrial influence.

Headworks:

- Two bar screens, which run in parallel. If one of the bar screens fails and the other bar screen cannot keep up with capacity, then influent is diverted to the center channel with a manual screen.
- Vortex grit removal. A rotating vessel with paddles settles the grit.
- Rotary drum fine screens. The influent is passed through a rotary drum fine screen running at any one time without a bypass provision. The screens are pressure washed every two weeks. Installation of the new screen was an essential precondition to be met before installation of the LEAPmbr system at this plant.

Biological and sludge treatment units: There is an equalization tank followed by anoxic and aerobic tanks. Wasted sludge is sent to the sludge holding tank before it is processed by the centrifuge. Centrate is sent back to the headworks.

Membrane tanks: Rubes Creek WRF uses a GE membrane filtration system to process and treat city wastewater. Ferric chloride is dosed just before the water enters the membrane tank for phosphorus removal.

Post treatment: Effluent is passed through an ultraviolet disinfection unit before discharging to the nearby Rubes Creek.

The System

Four objectives were identified during the membrane replacement planning process:

- Elimination of high-maintenance cyclic valves;
- Energy savings;
- Best available technology with enhanced redundancy and flexibility; and
- Reduced aeration rate contributing to extending membrane life.

GE's design solution allowed Woodstock to:

- Eliminate cyclic aeration valves, which simplifies maintenance and reduces downtime;
- Increase reliability through the design of the 500d LEAPmbr; and
- Match existing flow using one fewer cassette per train, providing an economical design and creating spare membrane space for future expansion in the plant.

Upgrading from the ZeeWeed 500d 340 module to ZeeWeed 500d 370 module offered the following advantages:

- An 8.8% increase in membrane module surface area;
- Increased membrane module surface area without any changes to the overall dimensions of the module;
- No increase in chemicals for maintenance or recovery cleans due to increased surface area;
- Improved membrane chemistry that allows for greater permeate productivity per square foot of membrane area without impacting water quality; and
- Lower aeration requirement due to fewer modules.

MLSS Rescreening & Control

Mixed-liquor suspended solids (MLSS) from all biological treatment units, including the equalization tank, were rescreened through the new 1-mm screens to get rid of the trash accumulated in the system due to the previous absence of a properly sized screen and previous screen shortcomings. This was an important step for the successful implementation of LEAPmbr aeration. This is typically not required if a plant is already operating with a GE-approved 2-mm screen. MLSS concentration was maintained between 8,000 and 10,000 mg/L for efficient application of the aeration system.

Simple & Efficient Aeration Upgrade

The aeration technology incorporates a simplified, more efficient membrane aeration system offering operating cost savings. Due to its aerator design, larger air bubbles are formed intermittently, which increases the shear along the membrane surface, resulting in more effective cleaning of the membranes.

The aeration technology was pre-installed in each of the cassettes. GE supplied all materials for the aeration upgrade.

Air is delivered on a continuous basis and it accumulates in the aeration mechanism at the base of the cassette. As accumulated air reaches the fixed target volume, it burps out to provide large-bubble scouring of the membrane. This eliminates the need for maintenance of high-frequency cyclic aeration valves.

For new plants, only one air header and one automated valve are required per train. However, to minimize changes to the existing trains, one cyclic valve is left in place in the closed position and one air header with the cyclic valve on it is utilized. The cyclic valve now operates as an actuated valve and only closes when the train is not being aerated (i.e., shutdown, specific cleaning steps or in standby). After the new aeration system was installed, the programmable logic controller program was modified to operate the cyclic valve as a normal open/closed isolation valve (i.e., they will cycle far less, thereby reducing wear and maintenance needs). New cassettes were installed in all four trains in a single stage. GE was able to complete the installation in approximately seven days of working closely with the customer.

Energy & Maintenance Savings

The plant currently has five blowers—four duty and one standby—for membrane aeration. The blowers all were resheaved to provide a lower flow based on the aeration rate and reduced module counts, saving significant energy in the process. The aeration rate requirement is about 30% lower than that of cyclic aeration. Because there was about a 30% reduction in the number of modules, Rubes Creek has achieved up to a 49% reduction in membrane aeration energy consumption. Also, because the aeration system eliminates the requirement for high-frequency cyclic valves, it saves maintenance costs associated with them. It reduces the amount of aeration needed by the valves, thus reducing compressed air requirement.

Current Performance

Permit requirements for the plant's effluent fecal count are 200/100 mL (monthly average); after installation of the new membranes, the effluent fecal count averages 1/100 mL.

The new membrane replacement design provided a cost-effective solution due to less surface area, eliminated cost due to cyclic valve maintenance and resulted in significant energy savings with better plant performance. Due to the unique, gentle nature of the aeration, it is expected that membrane life will exceed the common expectation of 10 years, providing further economic benefit to the customer.

Upgrading the facility to the LEAPmbr system transformed a wastewater treatment facility with a few challenges to a smoothly operating plant meeting demand and all the water quality requirements with much lower membrane surface area. W&WD

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