Complete Water Services, LLC

System Upgrade:

Conventional AS System to MBR at a Poultry Processing Plant

Jim L. Lewis
President
Complete Water Services, LLC

Anticipating increases to production, the Wayne Farms, LLC, Pendergrass facility, wanted an upgrade to their existing Sequencing Batch Reactor (SBR), aerated lagoon, and Land Application (LAS) wastewater treatment system. The single tank SBR and the LAS system had reached capacity and could not handle significant additional flow. Wayne Farms applied for and was issued a National Pollutant Discharge Elimination System (NPDES) permit from the Georgia Environmental Protection Division (GaEPD) for direct discharge to Allen Creek, a tributary to the Middle Oconee River watershed.

To meet the NPDES discharge limits, the existing wastewater treatment plant would have to be upgraded to provide higher removal efficiency. Also, looking ahead at potential water/drought issues within Georgia and wanting to reduce their water footprint, Wayne Farms requested the ability to recycle and reuse the treated effluent in non-food contact areas within the production plant.

Objectives of Upgraded System

Wayne Farms requested an upgraded wastewater treatment system that would:

- Utilize as much of the existing wastewater treatment equipment as possible due to limited budget
- Meet or exceed the NPDES discharge limits

- Produce water of sufficient quality for recycling

Former Wastewater Treatment System

The Wayne Farms Pendergrass facility's wastewater treatment system was an activated sludge (AS) system that used a 1.6 million gallon SBR and an aerated lagoon. Effluent from the production facility was screened then had limited

equalization (EQ). From the EQ, the wastewater flowed to a dissolved air flotation (DAF) unit, to an aerated lagoon, to the SBR, and then on to a series of lagoons for further treatment and storage. Treated effluent would flow through the lagoons and be discharged through an LAS system. Waste activated sludge (WAS) was stored in the sludge lagoon.

Basis for Design

As part of the new system design, Wayne Farms instituted a multiple-polymer system for the existing DAF. Therefore, the following table shows the "influent" design parameters following the DAF:

PARAMETER	INFLUENT	EFFLUENT LIMIT
Flow (MGD)	0.8	
BOD (mg/L)	450	<16
TSS (mg/L)	100	<10
NH_3 (mg/L)	22.1	<4
Total Nitrogen (mg/L)	100	<103
P (mg/L)	24.3	<1.2
Fecal Coliform (counts/100 mL)	TNTC	<200

System Design Alternative

In order to meet the three main objectives for the wastewater treatment system upgrade, Complete Water Services, LLC, (CWS) recommended a membrane bioreactor (MBR) system with denitrification, phosphorous removal and ultraviolet (UV) sanitation. Because MBRs do not rely on conventional settling and clarification, the concentration of biomass can be increased, thus decreasing the overall size of the system while increasing the amount of loading the system could handle. Ultrafilters (UF) would be used to separate the mixed liquor suspended solids (MLSS) which gives a high quality effluent as permeate.

With an MBR, the existing SBR tank could be converted to the bioreactor, and the existing blowers were of sufficient size to maintain the biomass. The wastewater would be intercepted after the existing DAF, thus keeping the existing screen, limited EQ and DAF in service.

Denitrification and phosphorus removal further added to the recyclability of the treated wastewater, meeting and exceeding the USDA Food Safety and Inspection Service (FSIS) requirements for reuse water in poultry plants.

Design and Construction of System

Wastewater at a flow of 0.8 MGD from the existing DAF was intercepted and rerouted to flow by gravity to a new Reaction Tank, located inside the new Wastewater Building, where a coagulant is dosed to remove phosphorus. The tight total phosphorus limit was achieved by feeding an aluminum-based inorganic coagulant into the Reactor tank following the DAF thereby chemically precipitating the phosphates in one of two "phosphate ponds" prior to entering the activated sludge process. The former Sludge Holding Pond was subdivided into two Phosphorus Settling Ponds, one Anoxic Pond for denitrification, and one WAS storage pond.

After flow through the phosphorous ponds and the Anoxic pond, the water is pumped at a rate four times the influent flow rate to the Bioreactor (converted SBR tank). The mixed liquor from the Bioreactor is then pumped up to the new wastewater building that house the UF membrane skids.

There are two UF skids, with two units each. The four unit UF system utilizes 10-inch diameter by 4 meter tubular ultrafilter membranes with 8 mm tubes. Each unit contains 6 modules and each module has 575.12 ft^2.

Reject (concentrate) from the membranes flows back to the Anoxic Pond as return activated sludge (RAS). Permeate (treated effluent) flows from the membranes at the system influent rate, through a UV system for disinfection and into a stainless steel Reuse Storage Tank. Overflow from the Reuse Storage Tank flows through the flume/monitoring station, down the cascade aeration, and on to Allen Creek.

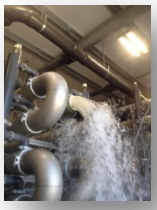
Start-up of System

A system start-up was attempted in July 2013. Several issues immediately became apparent:

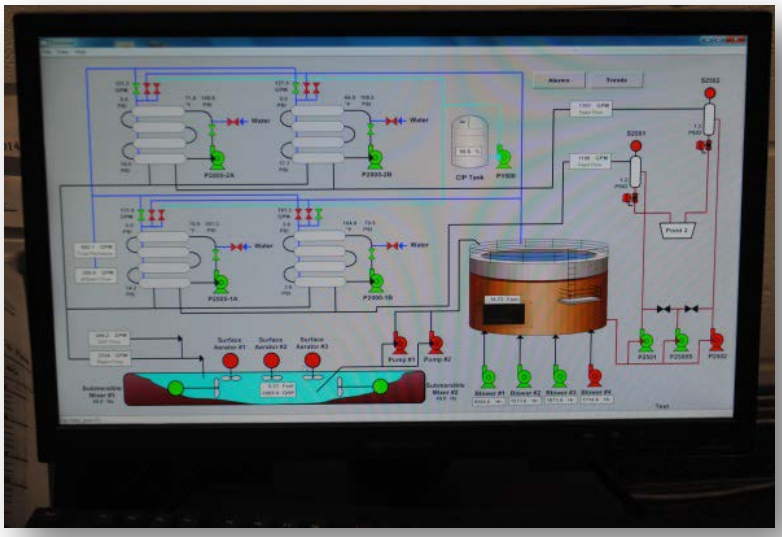
- Mineral scale deposition due to high hardness from the production well water

- The membranes and screens plugged and fouled due to the vegetative growth (leaves and grass) in the Anoxic Basin
- The membranes and screens plugged and fouled from feathers due to periodic bypasses from the existing DAF
- There was excessive FOG and phosphorus due to partial treatment during DAF surges
- There was significant debris inside the existing SBR tank that caused plugged of the inline screens/strainers on the membrane feed pumps



- There were some instances of piping breakage on the membrane skids
- The tank fitting for the membrane feed pumps was too small. This was an existing fitting that was shown incorrectly on the older system drawings and could not be visually verified because it was below grade.



Operation of System

Each of these issues was systematically addressed and the treatment system was fully operational in August 2013. It was determined that there were several long-term operational considerations:

- It was found that there was a balance between membrane flushes and cleaning. Cleaning of the membranes is of major importance. The type of cleaning solution, the temperature of the solution, and the frequency of cleaning are all issues that are somewhat unique to the system.
- Due to the high hardness present in the well water used to supply the facility, a more intensive acid cleaning regime was required.
- The membranes had considerably better performance with established biomass than with young sludge.

- Wayne Farms previously had been using a limited amount of DAF effluent for reuse. With the high effluent quality of the new system, Wayne Farms is now reusing up to 120,000 gpd for pump seal flush, screen flush, etc.

- Due to the specific wastewater characteristics, in February 2014, it became apparent that additional membranes were required
  - The sizes of the pressurization pumps impellers were increased to accommodate the additional membranes.
  - Additional structural supports were added to the membrane skids to eliminate the pipe breakages

  - The UF skids were originally installed with 5 modules per unit. Two additional membrane modules were installed to each skid for a total of 6 modules per unit.

Conclusion

Treated wastewater from the MBR system consistently meets or exceeds the NPDES discharge limits. It also exceeds the USDA FSIS requirements for reuse water at poultry plants. The high quality effluent from Wayne Farms permitted discharge has improved the overall water quality in Allen Creek.

Wayne Farms Pendergrass is fully committed to ensuring that the system is operated well, including adding qualified personnel on all shifts, continuous training of wastewater operations personnel, and performing significant in-house process testing.

Brian A. Rindt, PE
Rindt-McDuff Associates, Inc.

Karen J. Niebuhr, PE
Complete Water Services, LLC