King George County WWTP incorporates new technologies and process optimization for effective phosphorus and nitrogen removal

Background

The Chesapeake Bay Agreement, signed by Maryland, Virginia, Pennsylvania and the District of Columbia, requires the controlling of nitrogen and phosphorus levels to protect the resources and quality of life in the Chesapeake Bay area. In Virginia, new Chesapeake Bay Nutrient Regulations require wastewater treatment plants classified as "significant dischargers" (such as the King George County WWTP in Dahlgren, Virginia) to meet annual nutrient poundage caps. Typically, these nutrient discharge allocations translate to 3 mg/L total nitrogen (TN) and 0.3 mg/L total phosphorus (TP) in the effluent at design flow.

Challenge

The King George County WWTP in Dahlgren, Virginia, discharges into a tributary of the Potomac River that eventually empties into the Chesapeake Bay. In anticipation of ever-increasing ENR discharge limits, the King George Service Authority recognized the need to further optimize its total nitrogen (TN) and total phosphorus (TP) removal to meet "significant discharger" nutrient poundage caps. Its annual nutrient discharge poundage allocation is 12 mg/L TN and 0.3 mg/L TP in effluent at current flow. While the plant was meeting the acceptable 12 mg/L limit, lower discharge levels were desired. Additionally, the plant was losing process efficiency due to over-aerating the reactor.

Solution

In the early 1990s, Siemens Water Technologies provided the WWTP with a three-channel Orbal® system for effective biological nutrient removal (BNR). In 2004, the plant added a SIM-PRE® MLSS recycle pump and a fourth Orbal channel to assist with discharge requirements, as well as a SmartBNR™ control system for increased process efficiency.

Although the plant was meeting its discharge requirements of 12 mg/L, the design engineer wanted to further increase plant performance without requiring a major capital-intensive upgrade. In 2007, Siemens Water Technologies, in conjunction with Timmons Group, created a process optimization program for the Dahlgren plant.

Key process recommendations included:

- Reducing oxygen delivered to the first two channels
- Automating aerators in the same two channels and allowing the controls to determine appropriate oxygen delivery based on oxidation reduction potential (ORP) measurements
- Running the SIM-PRE® MLSS recycle pump at twice the influent flow rate
- Reducing holding and aeration time in the flow equalization basin to increase influent biological oxygen demand

Enhanced Nutrient Removal Case Study

Water Technologies

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Results

One month into the program, the plant experienced cost and energy savings, as well as a considerable reduction in total nitrogen. The upgraded Orbal® system significantly reduced effluent TN from 12 mg/L to less than 4 mg/L. The SmartBNR™ controls allowed for improved process performance and lower operating costs. Power usage for aeration was reduced by approximately 25 percent, and chemical costs for phosphorus precipitation and supplemental alkalinity were cut in half.

Looking to the Future

While the plant has shown considerable improvements in ENR, with current limits below 3 mg/L TN on a regular basis, its ultimate goal is a constant effluent TN below this level. To ensure this, a supplemental carbon delivery system with secondary anoxic and re-aeration zones has been recommended as part of a future plant upgrade.

Project Profile

- **Goal**
  Increase treatment capacity and effluent quality with few modifications
- **Application**
  Wastewater treatment to minimize effluent total nitrogen and total phosphorus levels
- **Capacity**
  Designed to accommodate 1 MGD, though it is currently treating 0.25 MGD
- **Commissioned**
  2007
- **Key Technologies Selected**
  - Orbal® System
  - Smart BNR™ Controls
  - SIM-PRE® MLSS Recycle Pump

The SENRgy℠ Solution

The SENRgy℠ Solution combines advanced and innovative biological and filtration processes with the expertise of SENRgy Specialists to create a customized solution for your ENR needs.

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