ORBAL® BIOLOGICAL NUTRIENT REMOVAL (BNR) SYSTEM

Town of Elkton, MD WWTP

Envirex® energy efficient activated sludge process meets stringent regulations while minimizing costs

ORBAL® BNR SYSTEM — ENHANCED BIOLOGICAL NUTRIENT REMOVAL FOR AN ENVIRONMENTALLY CONSCIOUS COMMUNITY.

Adapting to change

The Town of Elkton, Maryland, located in Cecil County near the head of the Chesapeake Bay, has a population of approximately 15,000 and an average elevation of 9.1 m (30 ft). Elkton is an economically strong, stable community that is very conscientious about environmental issues. In an effort to protect the Chesapeake Bay aquatic life, new stringent wastewater effluent regulations were implemented requiring very low nutrient levels in wastewater treatment plant discharge.

Maximizing efficiency and gaining control with the Orbal® BNR system and SmartBNR™ process controls

In 2005, Elkton found itself out of compliance with the new, lower nutrient level removal requirements for wastewater treatment effluent. The existing system at the Elkton WWTP consisted of fine bubble air diffusers, which failed to provide consistent nitrification and sufficient denitrification to meet the new stringent effluent requirements. The variability of treatment conditions caused by diurnal flow and load changes was solved by incorporating the SmartBNR™ electrical control system in the design.

To ensure compliance, the town selected the proven Orbal® BNR system from Evoqua. The Orbal system is a suspended growth activated sludge process that consists of a series of concentric oxidation ditch channels operating in series. The design of this system provides a higher overall kinetic reaction rate allowing for treatment at higher organic loadings, the reduction in the size of the basins, and lower construction costs.

INDUSTRY
MUNICIPAL WASTEWATER

Business Challenges
Meet new stringent effluent requirements
Satisfy the demands of a conscientious community

Keys to Success
Identify a BNR solution that provides constant nitrification and sufficient denitrification
Minimize implementation and operating costs

Results
Exceptional effluent quality
- Flow 1.80 MGD
- Power 1,930 kWh/MG, 0.97 kWh/lb BOD
- $\text{BOD}_5$ 4.06 mg/L
- TSS 3.41 mg/L
- TP 0.07 mg/L with chemical addition
- TN 1.95 mg/L

Energy consumption reduced by 40%

The Orbal® BNR system was the ideal solution for stringent nutrient requirements at the Elkton, MD WWTP.
Analyzing the process

The suspended growth activated sludge process begins when screened and de-grittted wastewater is directed to the outer channel of the basin and mixed with RAS from the clarifiers to form the system’s mixed liquor. The combined mixed liquor passes progressively through the Orbal® BNR system’s channels before passing on to the final clarifiers. The outer channel is operated as an aerated anoxic reactor with dissolved oxygen levels near 0 mg/L. Simultaneous nitrification/denitrification and phosphorus release occurs in this zone.

Oxidation/reduction potential (ORP) is used to monitor the condition of the outer channel. The middle channel is a transition zone between the outer anoxic channel and the inner aerobic channel. Its condition may vary depending on the load coming into the plant. The inner channel is maintained in an aerobic state with dissolved oxygen levels at or above 2.0 mg/L. This supports the final nitrification required to complete treatment. Each channel is physically separated so the environment within each channel can be controlled precisely to produce consistent treatment results.

The SmartBNR™ PLC based control system measures the ORP and dissolved oxygen (DO) conditions within each treatment zone in the system.

Elkton’s Orbal® BNR system basin was designed with a 16-day solids retention time (SRT) to assure nitrification during cold weather operation. Other design parameters were a MLSS of 4,000 mg/L and an organic loading rate of 16 lb BOD/day /1000 ft³.

For enhanced denitrification, an internal recycle wall pump with a maximum capacity of 12.8 MGD was included in the design to recycle nitrates in the nitrified MLSS from the inner channel to the anoxic outer channel. A second anoxic zone was followed by a re-aeration zone downstream of the Orbal® BNR system basin was also included in the design to achieve greater than 95% total nitrogen removal. The second anoxic zone was designed to have carbon provided by endogenous respiration. This environment allows for maximum denitrification without the need for supplemental carbon addition, which results in additional daily operational cost savings.

Exceeding expectations while conserving energy

The new Elkton Orbal® BNR system was commissioned in December 2008 and quasi steady-state operation was achieved by April 2009. The plant has been producing outstanding effluent quality (performance data summarized on the front). Additionally, the operational staff was able to optimize energy usage to reduce power consumption by approximately 40% compared to their prior system.

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