

Meeting Strict TN Limits: ANITA™ Mox

Biological Treatment | Case Study

South Durham Water Reclamation Facility

The Client

The City of Durham is located in the Research Triangle Region of North Carolina. The City operates two wastewater treatment plants – the North Durham Water Reclamation Facility and the South Durham Water Reclamation Facility, both permitted to treat 20 million gallons per day (MGD).



Design Flow: 0.08 MGD;
Peak Design Flow: 0.16 MGD
Effluent Criteria:
≥75% NH₄-N Removal
≥65% TN Removal

The Client's Needs

In 2011, the City of Durham completed a comprehensive wastewater master plan that evaluated different treatment techniques for meeting strict total nitrogen (TN) limits at the South Durham Water Reclamation Facility (SDWRF). The SDWRF will need to meet a TN limit of 3 mg/L at its design flow to comply with the total maximum daily load (TMDL) in the Jordan Lake Watershed, which serves as a source of drinking water in the region. The SDWRF uses anaerobic digesters to break down the plant's sludge. Downstream of the digesters, the plant uses belt filter presses for dewatering. The resulting liquid – the pressate from dewatering, or what is referred to as “sidestream” flow – historically accounted for about 20 percent of the nitrogen load in the plant's biological nutrient removal (BNR) process. While this sidestream nitrogen contribution sounds high, it is typical for many plants with anaerobic digestion.

The Solution

As a result of the evaluation, Durham selected Veolia's ANITA™ Mox sidestream deammonification system for ammonia and total nitrogen removal. The City studied mainstream and sidestream treatment alternatives to meet its TN limits. In its cost comparisons, ANITA™ Mox was calculated to be three times lower in cost per pound of nitrogen removed when capital and operating costs were considered. ANITA™ Mox was estimated to cost \$0.93 per pound of nitrogen removed (\$/lb N), while the most cost-effective mainstream BNR solution was estimated at \$2.66/lb N. The City thus selected ANITA™ Mox as the most cost-effective nitrogen removal alternative.

Process Description

ANITA™ Mox is Veolia’s sidestream deammonification technology for short-cut nitrogen removal. When compared to conventional mainstream nitrification/denitrification, ANITA™ Mox uses about 60% less oxygen, requires no external carbon source, and produces less sludge.

ANITA™ Mox is offered in both Moving Bed Biofilm Reactor (MBBR) and Integrated Fixed Film Activated Sludge (IFAS) configurations, depending on site conditions. As such, the system consists of engineered polyethylene carriers – in this case AnoxKaldnes™ K5 media – to provide ample protected surface area for biofilm to thrive. The K5 media (approximately the diameter of a quarter) host two types of bacteria in the same reactor. The outer layer consists primarily of ammonia oxidizing bacteria (AOBs) which convert about half of the ammonia to nitrite. The inner layer consists mainly of anammox (anaerobic autotrophic ammonia oxidizer) bacteria. These bacteria utilize the resulting nitrite and much of the remaining residual ammonia and convert them to nitrogen gas, which is released harmlessly to the atmosphere.

Since ANITA™ Mox has a high removal rate and treats the smaller sidestream flow at a wastewater plant, it has a compact treatment footprint. At many plants, the system can fit into a spare or abandoned tank on site. At the SDWRF, for example, the MBBR system was constructed in an abandoned aerobic digester.

SDWRF – Nitrogen Returned to the Influent Pump Station Requiring Additional Treatment			
Parameter	With ANITA™ Mox (pounds per year)*	Before ANITA™ Mox (pounds per year)*	Guaranteed Removal by ANITA™ Mox
Ammonia Nitrogen	< 61,000	244,000	≥ 75%
Total Nitrogen	< 94,000	268,000	≥ 65%
* Values based on Design Flow and Loads for 365 days per year.			

ANITA™ Mox Removes Nitrogen Efficiently – Requiring Less Aeration Energy, Chemical Usage, and Sludge Management than Conventional Nitrogen Removal			
Parameter	ANITA™ Mox	Conventional Nitrogen Removal	Sidestream Savings with ANITA™ Mox
Oxygen Requirement (lb O ₂ / lb N)	1.9	4.6	60%
Methanol Consumption (lb / lb N)	0	3.0	100%
Sludge Production (lb VSS / lb N)	0.1	0.5 – 1.0	80% to 90%

Results

At the SDWRF, the ANITA™ Mox MBBR system was started up in 12 weeks – an efficient time given the slow growth of anammox bacteria. Now operating full-scale, the system is achieving greater than 80% ammonia removal and 70% total inorganic nitrogen (TIN) removal – both exceeding guaranteed values. The ANITA™ Mox system is thus helping the SDWRF meet its strict effluent nitrogen limits using the most cost-effective solution.

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