CASE STUDY

EOSi'S NITRACK® CARBON SOURCE AUTOMATION MAKE FLORIDA COUNTY WWTPs LOW-NITROGEN COMPLIANT

Two Florida county municipal wastewater processing facilities achieve an ultra-low nitrogen effluent limit of 3mg./L — even with high variability in NOx loading — and lower overall chemical costs using EOSi's automated Nitrack® Program controller dosing MicroC® 2000 carbon sources.

Client: Florida County Municipality

Facility: Two of three county Municipal Wastewater Treatment Facilities

Plant Flow:
(Central/West WWTP): 2.3/2.4 MGD

Treatment Technologies:
(Central/West WWTP): 4-Stage Bardenpho Process / 5-Stage Barenpho Process

Objectives: Central WWTP Facility

The Florida county operates three municipal wastewater treatment facilities, with its West WWTP facility processing an average flow of 2.4 MGD through a 5-stage Bardenpho process, and its Central WWTP processing an average flow of 2.3 MGD through Veolia's proprietary Biodenipho™ biological wastewater treatment (essentially utilizing the principles of a standard 4-stage Bardenpho process for removing carbon, nitrogen, and phosphorus).

The Florida county's Central WWTP had an existing Total Nitrogen (TN) effluent limit of 12 mg/L but was faced with a future TN effluent permit limit of only 3mg./L. The county commissioned an evaluation of EOSi's Nitrack® Program for delivering optimized dosing of EOSi MicroC® 2000 carbon sources. Would the EOSi solution enable the Central WWTP to consistently meet the future effluent TN target of 3mg./L or below — even with the high variability in NOx loading to the secondary anoxic further complicating the situation?

FIGURE 1 Results from the MicroC® evaluation vs. the Nitrack® evaluation

NOx SETPOINT (mg / L)	MicroC® DOSE (gpd)	NOx REMOVED (lb.-NOx/day)	MicroC® USAGE EFFICIENCY (gal/lb.-NOx removed)	EFFLUENT TN (mg/L)
INITIAL MicroC® EVALUATION				
—	75.0	68.4	1.11	4.57
—	100.0	81.6	1.33	3.43
—	150.0	87.2	2.04	3.20
average	108.3	79.1	1.49	3.73
NITRACK® EVALUATION				
2.00	134.0	151.8	0.89	2.76
1.50	132.0	156.4	0.84	2.83
1.25	125.0	161.5	0.77	2.36
average	130.3	156.6	0.83	2.65

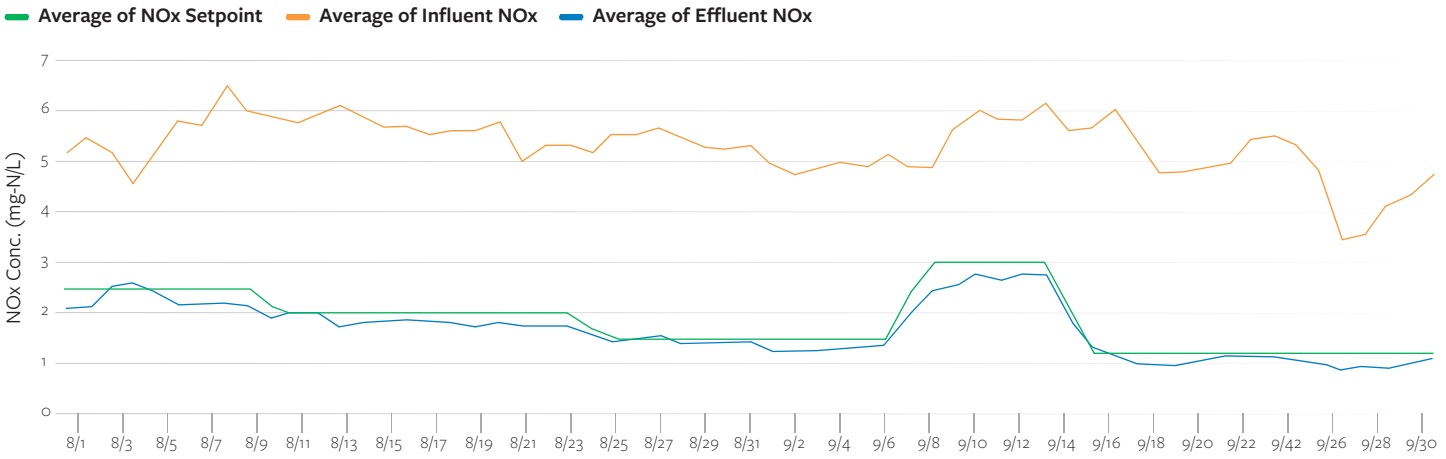
Pilot Project Summary and Results

The goal of the three-phase evaluation: to demonstrate if EOSi's Nitrack controller can optimize the MicroC 2000 dose while maintaining a NOx concentration setpoint to achieve an effluent TN of 3 mg/L for the facility.

Acclimation period: Nitrate monitoring equipment was installed at the facility. Three weeks of nitrate data was collected along

MicroC® Premium Carbon Sources

FIGURE 2 Daily average of influent and effluent NOx data received from nitrate probes across post-anoxic basin during varying NOx setpoints.



with the facilities laboratory and with the performance with and without adding MicroC 2000 carbon sources.

MicroC evaluation: MicroC 2000 dosing into the post-anoxic basin began, and dosing implemented using an incremental manual dosing approach until the product inventory was depleted. During this period, the dosing fluctuated between 25 gpd – 150 gpd, with the dosing remaining consistent for 24 hours per day until the rate was increased.

The manual dosing rate proved the facility could improve the overall denitrification performance by reducing effluent NOx concentration below 3 mg/L with carbon sources such as MicroC 2000. However, the effluent TN target of 3 mg/L was not met on a consistent basis during this evaluation because of highly variable NOx loadings and elevated TKN observed in effluent (as shown in Figure 2 above).

Nitrack evaluation: Real-time data from Hach® Nitratax™ nitrate probe sensors enabled the Nitrack controllers to constantly adjust the MicroC 2000 dosing rate. Implementing an automated dosing approach enabled mitigating periods of overfeeding, underfeeding, and feeding when unnecessary while maintaining compliance. The Nitrack controller was successful in achieving the NOx setpoint (as shown in Figure 2 above) and enabled the facility to consistently achieve an effluent TN of 3 mg/L or below.

Results and Conclusions

The lowest average effluent TN concentration was observed when the Nitrack's effluent NOx target was set to 1.25 mg-NOx/L. During this period, the average MicroC dose was 125 GPD with an average effluent TN of 2.36 mg/L — well below the 3 mg/L TN permit threshold. This period also observed the highest level of MicroC efficiency: 0.77 gal MicroC per pound of NOx removed.

MicroC 2000 dosed manually, shown in Figure 3a, illustrates how both the periods of overfeeding and underfeeding are increasing and decreasing, respectively, with each subsequent increase in manual dosing. Figure 3b, however, demonstrates how the Nitrack controller can mitigate these instances of overfeeding and underfeeding by utilizing real-time process parameters to ensure dosing only the required amount of MicroC 2000. The MicroC 2000 usage efficiency or gallons of MicroC 2000 required per pound of NOx removed was reduced by 44%.

The Nitrack evaluation demonstrated the capability to enable the Central WWTF to consistently meet its effluent TN target of 3 mg/L through the application of MicroC 2000 via EOSi's Nitrack automated dosing control unit. Besides meeting an effluent TN of 3 mg/L with a user-defined effluent NOx setpoint of 2.0 mg/L or lower — both achieved on a consistent and cost-effective basis — the evaluation also revealed potential savings and numerous additional benefits of MicroC 2000 carbon sources dosing optimized by EOSi's Nitrack program, especially compared to manual dosing.

Background and Objectives: West WWTP Facility

Like the Florida county's East WWTP, the West WWTP facility has an average flow of 2.4 MGD, but instead uses a standard 5-stage Bardenpho process. The West WWTP operators also explored using

FIGURE 3A Overfeeding and underfeeding MicroC® compared to meeting desired NOx conc.

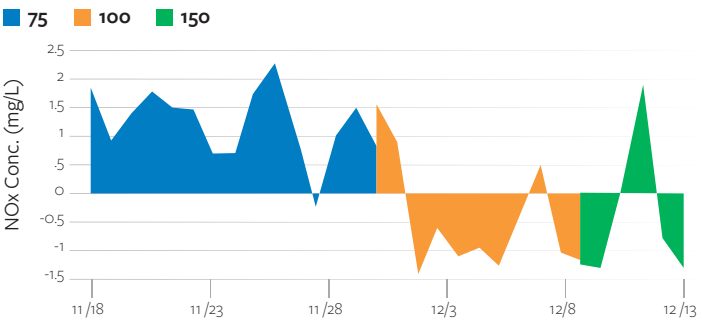


FIGURE 3B Overfeeding and underfeeding MicroC® compared to meeting desired NOx conc.

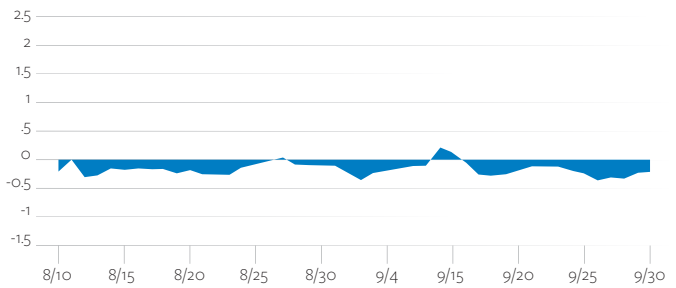
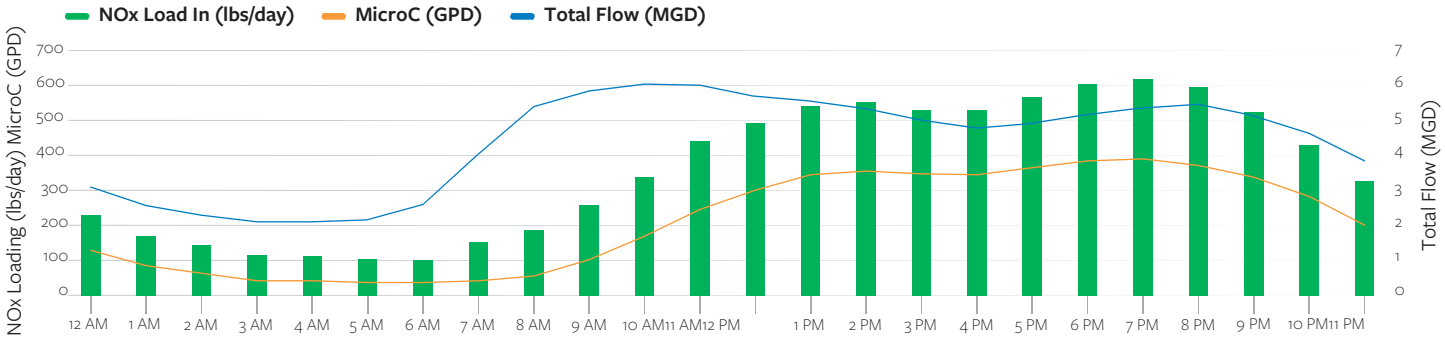


FIGURE 4 Typical diurnal loading pattern at facility for a day



MicroC 2000 as a carbon source to consistently achieve an effluent TN permit target of 6mg/L or below. However, the West WWTP facility utilized a flow-paced control strategy that relied on the variations of flow in the process and did not account for changes in NOx loading.

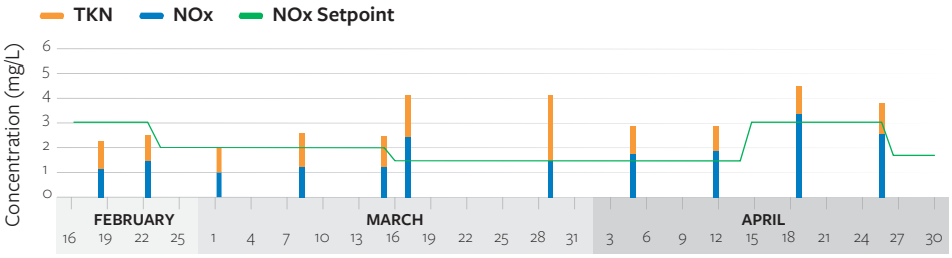
The West WWTP's MicroC 2000 carbon source dosing was automated to optimize the feed rate while meeting the effluent objectives due to the large variability in the NOx loading. EOSi's Nitrack Program controller analyzes fluctuations in loading and desired effluent limits and predicts the precise chemical dosing dynamically. The Nitrack controller can minimize the effect of influent disturbances on process effluent, while also considering any error by making dosing adjustments reactively.

Pilot Project Summary and Results

Flow-Paced MicroC Evaluation MicroC 2000 was dosed into the post-anoxic basin with a flow-paced control to establish a baseline. The dosing rate fluctuated with the flow going into the plant. During this period, the average MicroC 2000 usage was 331 gpd, with an average NOx removal of 208 lbs./day, and an average MicroC 2000 efficiency of 1.59 gal./lb.-N removed. Data gathered showed the variations in flow do not always correspond to the variation in NOx loading. In addition, on an average day the influent NOx loading can fluctuate from 100 – 600 lbs./day with peak loadings hours as high as 1000 lbs./day (see Figure 4 above).

Nitrack Evaluation The MicroC 2000 dosing was automated using the probes previously deployed and utilizing a controller to automate the dose of MicroC 2000. The controller optimized chemical addition during changing loadings in the system and was able to maintain a designated NOx setpoint in the anoxic basin of the process. When the NOx setpoint was 1.5 mg/L, high loading and pump limitations led to some higher NOx values than the setpoint (see Figure 5 above).

FIGURE 5 Effluent TN concentration and its TKN and NOx speciation (based on facility-provided laboratory data).



Conclusions

The Nitrack evaluation demonstrated the capability to enable the West WWTF to meet an effluent TN target of 6 mg/L while also reducing overall use of MicroC 2000. Using the Nitrack automated dosing control and maintaining a NOx setpoint of 3 mg/L or less, an average TN of less than 6 mg/L can easily be achieved.

Depending on the facility's goals, a NOx setpoint of 3 mg/L or 2 mg/L delivers the best results. A NOx setpoint of 2 mg/L was the most efficient with a utilization rate of 0.69 gallons of MicroC per pound NOx removed, also removing a significant amount of NOx loading per day (see results in Figure 6 below).

This setpoint will also allow the facility a larger buffer for achieving the target TN of 6 mg/L. A setpoint of 3 mg/L would use less MicroC 2000 on average since less NOx would need to be removed and had a utilization rate of 0.74 gallons of MicroC per pound NOx removed. The overall improvements noted from the flow-paced control to the Nitrack taking control were a 37% reduction in MicroC 2000 usage, 32% improved NOx removal, and an overall 57% improved MicroC efficiency.

FIGURE 6 Process performance comparison between setpoints.

NOx SETPOINT (mg / L)	MicroC® DOSE (gpd)	NOx REMOVED (lb.-NOx/day)	MicroC® USAGE EFFICIENCY (gal/lb.-NOx removed)	EFFLUENT TN (mg/L)
NITRACK® EVALUATION				
—	331	208	1.59	3.94
3	203	274	0.74	3.30
2	210	304	0.69	2.37
1.5	224	284	0.79	3.18*