CASE STUDY

METHANOL TO MICROC: WASHINGTON WWTP REDUCES COST & RISK WITH NON-HAZARDOUS EOSI MicroC® 2000.

When a Washington wastewater treatment and reclamation plant using methanol year-round as a supplemental carbon source evaluated safer non-flammable and non-toxic alternatives to maintain adequate denitrification, they discovered more pounds of NOx were removed per gallon of MicroC® 2000 used compared to using methanol — even with influent NOx loading measuring twice as high when treated with MicroC 2000.

Client: Washington Puget Sound-Area Municipality

Facility: Municipal Water Redemption Plant

Flow Design / Actual: 10.75 MGD

Treatment Technology: 4-stage Bardenpho

Study Period: March - June

Product: MicroC® 2000 + Nitrack®

Methanol Risks and Costs

The Washington municipal wastewater treatment plant (WWTP) operating with a daily average flow of 10.75 MGD through a 4-stage Bardenpho configuration was meeting its seasonal TN permit requirements consistently using methanol as a supplemental carbon source. The facility dosed methanol year-round using a feed-forward automation control to maintain the necessary population of methylotrophic bacteria required for denitrification during their critical 7-month permit season.

The facility was considering upgrading their existing methanol storage and feed system but also evaluating potentially safer, cheaper, more efficient, and more environmentally sustainable alternatives to using methanol as a supplementary carbon source. Highly flammable and toxic, methanol as a supplemental carbon source poses storage and handling safety risks to personnel and the surrounding environment, and involves strict safety protocols, careful monitoring and dosage controls, and costly regulatory compliance challenges. Given the overall high expense of storage and feed systems for flammable and toxic chemicals, the facility was facing a large capital investment if they continued with methanol.

Non-flammable and Non-toxic Carbon Source Alternative

The facility decided to conduct an evaluation using EOSi's MicroC 2000 as the supplemental carbon. The main objectives of this evaluation were to eliminate an onsite hazardous chemical — methanol — with its associated safety concerns, significantly reduce the capital cost to move or upgrade a flammable carbon feed system and eliminate a required supplemental carbon maintenance dose during the off season.

The evaluation was to be considered successful if the daily average target NOx concentration of 3 mg/L leaving the post-anoxic basins was achieved with less than 1.5 times the typical methanol dose, and the need for dosing during the off-season acclimation period was eliminated.

MicroC 2000 Evaluation Trial

EOSi was contracted to supply a turnkey Nitrack® full-service program installation, including a peristaltic pump skid with an integrated Nitrack automation and monitoring system, 6,900-gallon upright poly storage tank, and ongoing technical and maintenance service support (see Figure 1).

The temporary feed system was installed so that the MicroC 2000 was dosed in the existing methanol dosing location channel prior to entering the post-anoxic basin. One facility-owned





FIGURE 1 Equipment used for a temporary MicroC 2000 chemical feed system. Figure 1a (left): Pump Skid. Figure 1b (right) 6,900-gallon poly tank and skid.

Nitratax™ UV nitrate sensor probe was located at the influent of the post anoxic basin, and a second probe was installed in the channel, leaving the re-aeration basin. The MicroC 2000 dosage was calculated using the real-time NOx data from the probes with the plant's flow data.

Baseline data was collected between March 2nd – March 7th before MicroC 2000 was dosed at a manual rate of 75 gpd between March 8th-12th. The flow signals were connected to the Nitrack equations on March 13th and automation commenced. The Nitrack algorithm was fine-tuned during the first few weeks of operation prior to the start of the seasonal effluent permit.

EOSi MicroC 2000 Control Strategy

In previous years, the facility used an internallydeveloped control strategy to dose methanol. For the evaluation, an EOSi Nitrack controller was employed to automate the MicroC 2000 dosing. The Nitrack utilized the plant influent flow, RAS rate, and two Nitratax probes to calculate the amount of MicroC 2000 dosed.

The Nitrack algorithms are a unique combination of a feedforward and feedback control. Feed-forward (FF) control actively adjusts the dose to changes in the influent and feedback (FB) control actively adjusts dose based on system performance and the effluent NOx concentration. The combination of FF and FB control ensures that the effluent NOx limit is achieved consistently and as cost-effectively as possible.

MicroC Dosing Results

MicroC 2000 vs. MeOH Dosing rate: An average of 85 gallons of MicroC 2000 was dosed per day between April 1st and June 18th — which was less than 1.5 times the methanol dosed during the same days in the previous BNR season (an average of 60 gpd methanol). Moreover, the influent NOx loading was twice as high during the following BNR season. ***Thus, the year 2 BNR season MicroC 2000 consumption rate was 0.120 gallons of MicroC/lb. NOx removed, compared to the year 1 BNR season methanol consumption rate of 0.164 gallons of methanol/lb. NOx removed.***

More pounds of NOx were removed per gallon of MicroC 2000 compared to methanol, based on the year of year data from April 1st – June 18th (as shown in Table 1).

Figure 2 shows the MicroC 2000 consumption rate compared to the NOx influent loading during the year 2 BNR season. The consumption rate was the highest while the automation algorithm was being

TABLE 1 MicroC 2000 vs methanol during the BNR seasons (Year 2 vs Year 1)

	Influent NOx mg/L	Influent NOx lbs/day	Effluent NOx mg/L	Effluent NOx lbs/day	NOx Removed lbs/day	Total Dose gpd	Consumption Rate gal/lb NOx removed
MicroC Dosing April 1st - June 18th Year 2	7.34	**1028**	2.23	323	708	85	**0.12**
Methanol Dosing April 1st - June 18th Year 1	3.19	**514**	0.91	147	366	60	**0.164**

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FIGURE 2 MicroC consumptive rate vs. influent NOx loading during the year 2 BNR season. in Yellow-highlighted area shows the period where the algorithm was being fine-tuned, and the blue highlighted section shows when the MicroC 2000 dosing was turned off on March 27th-28th.

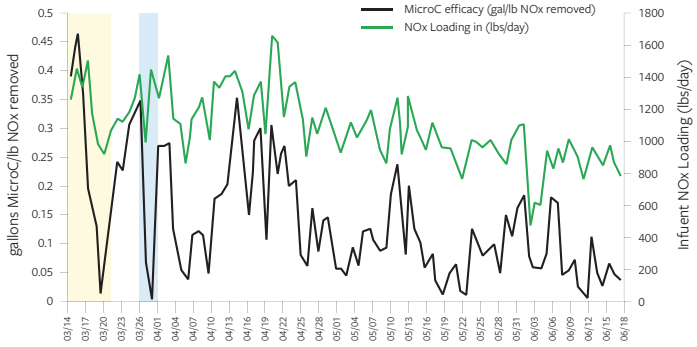
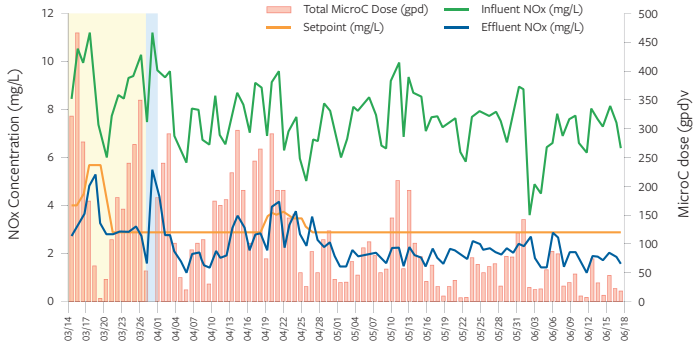


FIGURE 3 Nitrack NOx setpoint (mg/L) vs. the effluent and influent NOx (mg/L) during the year 2 BNR season.



fine-tuned (highlighted in yellow). Overall, the consumption rate was less desirable when the NOx influent loading exceeded 1,000 lbs./day.

Effluent of 3 mg/L NOx during MicroC 2000 dosing: The majority of the BNR season in year 2 the average daily effluent NOx concentration was below 3 mg/L. During April, the Nitrack setpoint was increased temporarily. The NOx setpoint vs. the effluent NOx concentration during the year 2 BNR season is show below in Figure 3 above.

Acclimation Period: Due to complexity and high degradability, MicroC 2000 is utilized by a large diversity of microorganisms. MicroC 2000 can be utilized by non-acclimated sludge at a high rate. Diverse populations developed by MicroC 2000 are robust in cold temperatures, considerably reducing the risk of denitrifier washout. When the MicroC 2000 dosing commenced in mid-March, removal was seen within hours.

Conclusion: MicroC 2000 Replacing Methanol

The evaluation demonstrated that MicroC 2000 combined with a Nitrack automation system can match methanol performance at relative consumptive rates much lower than might be expected. A nitrate concentration of 3 mg/L or below was consistently met throughout the duration of the evaluation with a lower consumptive rate than with methanol. The lack of acclimation required will allow the facility to eliminate their maintenance dose during non-permit periods.

As a result of the evaluation, the facility decided to move forward with implementing a permanent feed system for MicroC 2000, effectively achieving three goals: eliminating the need for a maintenance dose during times without a permit, removing a hazardous chemical from site, and avoiding costly upgrades to their existing methanol dosing system.