CASE STUDY

DENVER-AREA WWTP MIGRATES FROM METHANOL TO EOSI'S MICROC® 2000

A Denver-area wastewater treatment plant migrates their methanol-fed tertiary filter to using non-hazardous MicroC® 2000 to validate using alternative carbon sources in a tertiary effluent deep-bed biological denitrification process.

Client: Wastewater Treatment Facility

Location: Central Colorado

Flow Design/Actual: 50 MGD/21 MGD

Treatment Technology: Tetra® Deepbed® Denite® System with individual TETRAPace® Control System

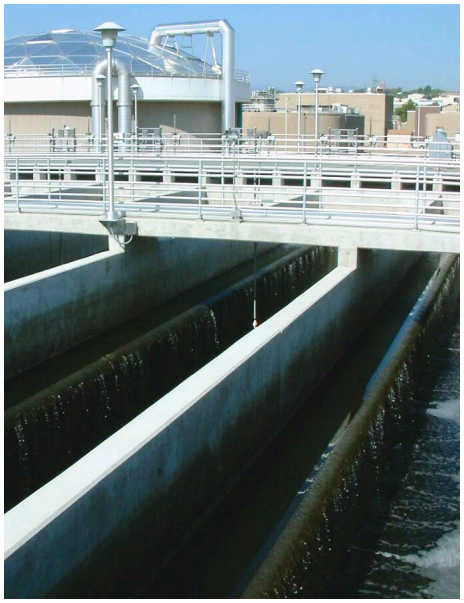
Study Period: August -January

Background: Methanol Risk Concerns

A central Colorado wastewater treatment facility concerned with their continued use of methanol as a supplementary carbon source embarked on a test program to investigate using non-hazardous and less costly alternatives.

In addition to methanol's inherent safety and toxicity risks and unstable price-fluctuation issues, using methanol as a supplementary carbon source also typically involves expensive infrastructure and equipment investment, strict regulatory requirements, significant environmental impact, unique bioengineering challenges, lower carbon efficiency, and more.

Research indicated many previous attempts to use non-methanol carbon sources in downflow denitrification filters similar to that used at the Colorado facility failed to consider the downflow filter operation itself may require modification because of differences in yield and kinetic characteristics of alternative carbon sources relative to methanol.



Tetra® Denite® Filter System in Central Colorado

EOSi's MicroC® 2000 Carbon Sources

The trial was specifically aimed at determining the effect of using alternative carbon sources on the operations of a tertiary effluent deep-bed biological denitrification process. The trial also evaluated operational parameters that could be optimized to enhance the capacity of deep-bed filters to handle non-methanol carbon sources. EOSi's MicroC® 2000 was selected as the supplementary carbon source for the trial.

EOSi's MicroC 2000 series products are widely used in denitrification applications, enhanced biological phosphorus removal (EBPR), and biochemical oxygen demand (BOD) addition applications. Glycerin-based and non-hazardous, MicroC 2000 eliminates methanol's flammability and toxicity concerns, along with methanol's costly flammable liquid storage and feed systems, enabling rapid and flexible deployment of carbon augmentation solutions.

The Colorado wastewater treatment facility's flow rate was 21 MGD at the time of the study, with approximately 2.6 MGD flow through each of the facility's eight filters. Six filters were operated in denitrification mode with carbon feed, while the other two filters were operated in filter-only mode. The backwash scheme to each filter could be individually controlled. One of the six filters in denitrification mode was fed with MicroC 2000, while the other five methanol-fed filters provided a comparative basis for evaluating the results. Table 1 shows the resulting influent and effluent data.

Migrating from Methanol to MicroC®

Different carbon sources deliver correspondingly different yields associated with their usage. The most critical metric determining how much carbon is used for denitrification is the COD:N ratio. The solids yield measures the quantities of solids (measured as VSS or COD) formed per unit of COD consumed for nitrate removal.

Differences in COD:NO_3-N yields and solid yields imply that, with removal of the same quantity of nitrates, different quantities of carbon (measured as COD) will be required.

MicroC®
Premium Carbon Sources

TABLE 1.

	INFLUENT	EFFLUENT		
		CONTROL FILTER	MicroC® 2000 FILTER	METHANOL FILTER
Flow (MGD)	20.46	2.59	2.50	2.51
Ammonia (mg/L)	0.79	0.10	0.10	0.15
NOX-N (mg/L)	20.04	19.10	2.10	2.00
O-Phosphate (mg/L)	2.89	2.76	2.30	2.70
TOC (mg/L)	2.39	2.16	2.30	2.05
Total Nitrogen (mg/L)	20.83	19.2	2.20	2.15
TN % Removal	——	5.9%	89.2%	89.5%

FIGURE 1

CARBON SOURCE SELECTION	FACTORS TO CONSIDER	PROCESS OPTIMIZATION STEPS
▸ COD:N	▸ VSS Formulation / Solids Accumulation ▸ Filter Capacity ▸ Carbonic Acid Generation, pH changes ▸ Nitrite Accumulation ▸ Assimilatory and Dissimilatory N Removal ▸ Alkalinity Recovery ▸ Phosphorus Requirements	▸ Backwash Scheme ▸ Backwash Frequency ▸ Backwash Duration ▸ Backwash Energy ▸ Upstream Phosphorus Removal

By extension, different quantities of new bacterial cells will be formed during the nitrate removal process. Figure 1 illustrates the factors to consider and process optimization steps that may be required when using different carbon sources in downflow denitrification filters.

Results: MicroC® 2000 Achieves Equal TN Reduction

The accumulation of solids in the MicroC® 2000-fed filter using the same backwash scheme as methanol is demonstrated in Figure 2. Using the same backwash scheme used with a methanol-fed system, nitrite accumulation was observed in addition to the solids accumulation. The result: an overall NOx-N removal of about 60% compared to about 89.5% for the methanol-fed filters.

Investigating the effect of extending the backwash duration on solids accumulation and revealed implementing a strict daily backwash regimen and extending the duration of the backwash by five minutes was sufficient to reach equilibrium with respect to solids removal in the MicroC 2000-fed filter versus the methanol-fed filter. This was determined by measuring the VSS levels in the backwash liquid at given intervals shown in Figure 3.

Optimal filter bed solids control for the MicroC 2000-fed system was established, and total nitrogen removal in the MicroC 2000-fed and methanol-fed filters was equal, demonstrating that alternative carbon sources can be applied as an effective replacement for methanol in biofilter operations (Figure 4).

This study showed that non-methanol carbon sources such as EOSi's MicroC 2000 can achieve equal TN reduction in tertiary deep-bed denitrification filters such as the Tetra® Denite® filter system. A second important finding is the importance of operational modifications to the solids-removal mechanism and backwash scheme to account for the higher yield of non-methanol carbon sources

FIGURE 2 BACKWASH TSS PROFILE

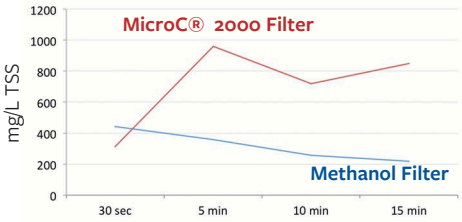


FIGURE 3 TSS PROFILE IN BACKWASH LIQUID

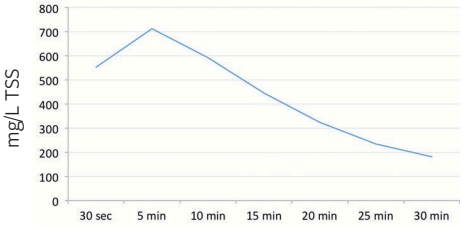


FIGURE 4 TN % REMOVAL POST OPTIMIZATION

