



# BOD Supplementation with MicroC™ Premium Carbon Sources

The effectiveness of biological wastewater treatment depends on having a healthy, sufficient biomass. Supplementing the biochemical oxygen demand (BOD) of the influent wastewater with a carbon source such as MicroC™ Premium Carbon Sources can help establish or sustain the biomass during periods of low BOD loading. This is an additional application for Environmental Operating Solutions, Inc.'s (EOSi's) products, which are well-known for denitrification.

## What is BOD supplementation?

BOD supplementation is the practice of adding organic compounds to wastewater as needed to establish or sustain a healthy, adequate biomass in the treatment system. The extra carbon and energy promote bacterial growth and reproduction.

## Why consider BOD supplementation?

BOD supplementation helps biological treatment systems avoid two potential problems due to low influent loadings:

- *Loss of active biomass*  
Effective removal of contaminants relies on the presence and maintenance of an adequate biomass. Even during periods of limited or no solids wasting, the biomass inventory will gradually decline due to en-

dogonous decay. If the influent BOD loading is insufficient to support and grow the biomass, the population of bacterial cells can plummet quickly, reducing treatment effectiveness. Depending on influent flow and solids retention time, as much as 10 to 15 percent of the biomass can be lost daily due to endogenous decay alone.

- *Proliferation of filamentous organisms*  
Lower BOD loading reduces the food to microorganism ratio (F/M). At low F/M, filamentous organisms tend to outcompete desirable floc-forming bacteria. Proliferation of filamentous organisms leads to process problems such as foaming, sludge bulking, poor settling, and scum formation.

## When can BOD supplementation help?

BOD supplementation can be useful when a biological treatment system has a:

- *Temporary reduction in BOD loading*  
BOD supplementation will help maintain the biomass until the BOD loading returns to normal.
- *Planned increase in BOD loading*  
BOD supplementation can help build up a treatment system's biomass in preparation for increased BOD loading. This enables the system to handle the increased loading right away.

Facility Type	Consider BOD supplementation for...
Industrial	Seasonal reductions in flows and loadings Changes in processes or production schedules Taking units offline temporarily for maintenance
Domestic	Seasonal reductions in users (domestic or industrial) New plant startup Bringing unused process basins or treatment trains back online

# BOD Supplementation with MicroC™ Premium Carbon Sources

## Selecting an optimal carbon source for BOD supplementation

### • *Provide needed supplemental nutrients*

Nitrogen, phosphorus and trace metals are also critical for biomass growth. The optimal ratios of carbon to nitrogen to phosphorus is between 100:10:1 and 100:10:3. Supplemental carbon sources are often pure carbon compounds, and their usage can produce a C:N:P ratio outside the optimal range. MicroC™ Premium Carbon Sources have a consistent, known carbon composition, and can be custom blended to provide necessary amounts of other nutrients and trace metals.

### • *Match the biodegradability of the usual wastewater substrate*

Two different carbon compounds can have the same chemical oxygen demand (COD) and total organic carbon (TOC), but have different biodegradability patterns. A supplemental carbon source should closely match the biodegradability characteristics of the original carbon source in the wastewater. Evaluating the BOD, readily biodegradable COD (rbCOD), or soluble COD (sCOD) of the wastewater and supplemental carbon sources is helpful in selecting the best match. These parameters are known for MicroC™ Premium Carbon Sources.

### • *Support the specialized and acclimated bacteria in the biomass*

Wastewater treatment systems, particularly industrial systems, tend to develop a specialized biomass capable of metabolizing the wastewater organics unique to a particular system. A supplemental carbon source needs to sustain these specialized and acclimated bacteria. MicroC™ Premium Carbon Sources provide a mixture of different organic compounds to support the existing bacterial population.

Two commonly used carbon sources, methanol and acetate, are poor choices for

BOD supplementation. The portion of bacteria in wastewater influents that can utilize methanol is very small, therefore using methanol as a BOD supplement will reduce diversity. Recent research has shown that acetate may have a similar effect. Instead, a mixture of different organic compounds and/or a carbon source with larger molecules is desirable for BOD supplementation.

### • *Consider inhibition and toxicity*

Knowing the composition and consistency of a carbon source is critical for avoiding potential toxicity and inhibition issues. Although it can be tempting to use existing waste streams or food products as cheap sources of supplemental carbon, trace or unknown compounds in these sources can harm the biomass instead of supporting it. MicroC™ Premium Carbon Sources are specifically designed for use as a carbon source, with no toxic or inhibitory components.

## How EOSi can help

EOSi can help wastewater operators evaluate and implement a BOD supplementation program. EOSi can assist with:

- Biomass maintenance and transition planning, including selecting an appropriate carbon source and estimating the feed rate
- Testing oxygen uptake rates using respirometry to evaluate biodegradability and the ability to support specialized biomass in complex wastewaters
- Nutrient and metals deficiency analyses
- Preparing custom blends as needed

*To learn more about EOSi's products or services, please contact Michael Starr, Manager, at [mstarr@eosenvironmental.com](mailto:mstarr@eosenvironmental.com) or 508.743.8440, ext. 16.*



## Case Study: BOD Supplementation

# MicroCglycerin™ Supports Biomass During Refinery Turnaround

*EOSi's MicroC 2000™ was selected for this BOD supplementation application because of its well-defined kinetic and yield characteristics, and its proven ability to sustain specialized microbial populations. When the system was brought back online, treatment effectiveness was achieved quickly without permit violations.*

MicroC 2000™ was used to supplement biochemical oxygen demand (BOD) loadings at an industrial wastewater treatment facility serving a refinery undergoing turnaround maintenance. The BOD supplementation successfully maintained the facility's highly-specialized biomass during the 3-month turnaround, and the biomass seamlessly transitioned back to treating the original wastewater.

### Project Description

The treatment facility used a two-stage activated sludge process to remove hydrocarbons from the refinery wastewater. The first and second stages both consisted of aeration tanks followed by two clarifiers.

Mixed liquor suspended solids (MLSS) concentrations of 2,400 milligrams per liter (mg/L) and 2,000 mg/L were maintained in the first and second stages, respectively. The endogenous decay rate ( $k_d$ ) for the process was estimated to be 0.1/day, implying that as much as 10 percent of the existing biomass could be lost daily due to endogenous decay.

### Need for BOD supplementation

The wastewater operators believed that the biomass was highly acclimated to the refinery's wastewater. Based on observations from past maintenance turnarounds, loss of these highly specialized bacteria during the maintenance turnaround made the wastewater treatment facility slow to regain treatment effectiveness after resuming normal operations. For this maintenance turnaround, the treatment facility opted for BOD supplementation.

### Carbon source selection

The wastewater manager selected EOSi's MicroC 2000™ as the carbon source for the BOD supplementation. MicroC 2000™ offered well-defined kinetic and yield characteristics, and a proven ability to sustain specialized microbial populations. Respirometry studies confirmed that MicroC 2000™ would be able to sustain the refinery's highly acclimated biomass so it could smoothly transition back to the original wastewater.

### Success with MicroC 2000™

When the maintenance turnaround began, half of the first stage and the entire second stage of the wastewater treatment process were taken offline to minimize the quantity of biomass to be sustained. Operators fed MicroC 2000™ to match the total organic carbon (TOC) shortfall in the wastewater influent. Daily checks on TOC concentrations, the sludge volume index, and mixed liquor volatile suspended solids concentrations were used to verify the biomass was being sustained. Stored wastewater rich in hydrocarbons was periodically fed to the treatment system to ensure the biology could still utilize the original wastewater constituents.

When the treatment system was brought back online, it quickly regained treatment effectiveness and regulatory compliance.



## Case Study: BOD Supplementation

# MicroCglycerin™ Establishes Biomass for Casino Treatment Plant Startup

*EOSi's technical team worked with plant operators to calculate proper MicroC 2000™ feed rates, recommended operational adjustments, and provided guidance on a process monitoring program to establish a biomass. The biomass was able to meet all permit requirements during construction and during the casino's grand opening weekend, when the system received significantly higher flows.*

MicroC 2000™ was successfully used for biochemical oxygen demand (BOD) supplementation at a wastewater treatment plant for a new 83,000-square-foot casino complex in central Michigan. MicroC 2000™ helped maintain the treatment plant biomass during casino construction despite wastewater flows far below design specifications. MicroC 2000™ was used to establish a biomass capable of handling significantly higher flows and loadings in time for the casino's grand opening weekend.

### Project Description

The wastewater treatment plant was completed before the casino complex and was operational during construction. The plant utilized a membrane bioreactor (MBR) with a capacity of 100,000 gallons per day (gpd) for biological treatment.

### Need for BOD supplementation

Wastewater flows during construction ranged from 5,000 to 10,000 gpd. The low organic loading relative to the MBR capacity made it impossible to maintain high mixed liquor volatile suspended solids (MLVSS) concentrations in the wastewater. The operations firm opted to use BOD supplementation to maintain a high level of treatment during the 10-week construction period, and to prepare the biomass for a 10- to 20-fold increase in flow and organic loading when the casino opened.

### Carbon source selection

The operations firm selected EOSi's MicroC 2000™ as the carbon source for the BOD supplementation. MicroC 2000™ offered:

- High BOD and readily biodegradable chemical oxygen demand content
- Well-defined kinetic and yield characteristics
- Ability to support a broad microbial community and provide a seamless transition from the carbon source to the actual organics in the wastewater influent
- Non-hazardous, economical material available in totes

### Success with MicroC 2000™

Initial MicroC 2000™ feed rates were calculated based on the difference between the actual and desired BOD loading to the MBR. During this period, no biosolids were wasted from the system. MLVSS concentrations were monitored as the feed rate was optimized.

Ultimately, it was determined that 25 gpd of MicroC 2000™ were sufficient to maintain a mixed liquor suspended solids concentration of 6,500 milligrams per liter with 75 percent volatile suspended solids. With these parameters, the treatment system was able to meet all permit discharge requirements during construction.

The system successfully handled the increase in flows and loads when the casino opened. Influent flow increased to 75,000 gpd during opening weekend. The biology responded immediately to the increased organic and nutrient loads. MicroC 2000™ is inventoried as a supplemental BOD source until the loading patterns are better understood.