EOSi

Supplementing Biochemical Oxygen Demand

Establish and Sustain Biomass 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, also referred to as BOD Augmentation and BOD Addition, 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 endogenous 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.

MicroC®
Premium Carbon Sources

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

When Can BOD 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.

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 ratio 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 influent 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

SERVICES

Bench Scale Testing

EOSi often uses bench-scale studies to guide the design of full-scale MicroC® evaluations and programs. EOSi has laboratory facilities capable of simulating full-scale operations of biological treatment systems to remove nitrogen, phosphorus, and other contaminants. Bench-scale evaluations are useful for feasibility studies, selecting the appropriate MicroC® product, and assessing sludge microbial activity.

Custom Formulations

The MicroC®4000 product series includes custom formulations for industrial treatment systems that need additional macro- or micronutrients to support their unique biomasses. EOSi works with our customers to develop the appropriate ratio of these constituents for each specific application. Providing everything the biomass needs in a single product is convenient for our customers and allows them to forgo capital expenses for multiple storage and feed systems.

Department of Engineering & Automation

EOSi has built a team of experts in biological wastewater processes to complement our advanced technology. We are a solutions-oriented company seeking to build long-term partnerships with our customers. We are dedicated to providing the best technical and most cost-effective approach for biological contaminant removal programs in various industries and applications.

Refinery

- A refinery preparing for turnaround maintenance investigated using BOD Addition to maintain the highly acclimated biomass in its wastewater treatment system. During past turnarounds, loss of these specialized bacteria had made the treatment system slow to regain effectiveness when refinery operations resumed.
- MicroC® 2000 was selected for BOD Supplementation because of its well-defined kinetic and yield characteristics, and a proven ability to sustain specialized microbial populations. MicroC® successfully maintained the biomass during the 3-month turnaround, and enabled it to seamlessly transition back to treating refinery wastewater.

Pharmaceuticals

- A wastewater treatment system at a pharmaceuticals plant needed a different strategy to help its biomass recover from annual maintenance shutdowns. Historically, when production resumed, seed sludge was added in an attempt to re-establish the biomass. This method took too long to return the wastewater treatment system to full capacity, negatively impacting production.
- The plant opted to try BOD Addition with MicroC® 2000. EOSi provided temporary equipment for the study. MicroC® successfully sustained the biomass during shutdown. The wastewater treatment system was able to treat normal flows and loadings as soon as production resumed.

Industrial Leachate

- As part of decommissioning a polyester manufacturing plant, the existing wastewater treatment system was repurposed to treat leachate. Supplemental BOD was needed to establish and maintain a specialized biomass capable of treating the chemical compounds in the industrial leachate.
- MicroC® 2000 was selected for BOD Addition. With MicroC®, the biomass is effectively treating the leachate to meet disposal requirements.

Municipal Startup

- BOD Supplementation was used during startup of a new 32 MGD municipal wastewater treatment plant. The engineering company had to demonstrate successful treatment of specified BOD loads to comply with performance testing requirements and finalize project delivery. However, there was insufficient BOD loading in the plant influent to complete the testing.
- MicroC® 2000 was used to achieve the required BOD loads during the testing period. The engineering company was able to complete the performance testing and deliver the project on schedule.

Municipal Underload

- A 28 MGD wastewater treatment plant has successfully used BOD Addition to manage large variations in influent flows and loadings. Approximately 80 percent of the influent is from industrial dischargers, including paper mills and electronics and chemical plants. These discharges are highly variable due to process changes, production problems, and planned (or unplanned) maintenance shutdowns. Despite these challenges, effective treatment is critical because effluent is discharged to the ecologically-sensitive James River and Chesapeake Bay.
- The treatment plant uses MicroC® 2000 whenever BOD Supplementation is needed. When an industrial discharger had a process problem that resulted in abnormally high ammonia and TKN loadings, additional BOD was used to achieve proper C:N ratios for effective nitrogen removal. And when a lengthy shutdown at a paper mill greatly reduced BOD loading, MicroC® maintained the treatment plant's biomass until production at the paper mill resumed.

Package Plant Startup

- The package plant serving a new casino was required to meet effluent discharge requirements on opening day. BOD Addition was needed to establish a healthy biomass while the casino was still under construction.
- EOSi worked with the design engineer and operations company to develop a BOD Supplementation program to establish the biomass in the membrane bioreactor (MBR). MicroC® 2000 was fed to the package plant for 10 weeks prior to the casino opening. During opening weekend, flows to the package plant increased from 5,000 gpd to 75,000 gpd. The package plant achieved regulatory compliance from day one despite this sharp increase in flows.

Chemical Manufacturing

- A large chemical manufacturer uses BOD Addition as needed to manage variable loadings to the wastewater treatment plant. The highly specialized biomass needs consistent COD loading for effective treatment, but the COD loading can drop quickly and precipitously as the manufacturing plant commissions and decommissions production processes.
- EOSi supplies this customer with MicroC® 4200, a custom blend that provides COD in a form readily usable by this unique biomass. The plant supplies consistent COD loads to the biomass by adding MicroC® when needed.

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