CASE STUDY

MIDWEST RECLAMATION EBPR EVALUATION: ASSESSING MICROC® 2000 FOR AMPLE PHOSPHORUS REDUCTION

A midwestern-U.S. water reclamation facility unable to significantly reduce phosphorus with their upgraded activated-sludge process engaged EOSi's MicroC® evaluation & application support (MEAS) services to test and evaluate whether adding MicroC 2000 carbon sources could boost phosphorus-removal performance and achieve permit compliance — without requiring expensive plant upgrades.

Client: Midwestern Municipality

Facility: Municipal Water Reclamation Plant

Flow Design/Actual: 354 MGD/250 MGD

Treatment Technology: Activated Sludge

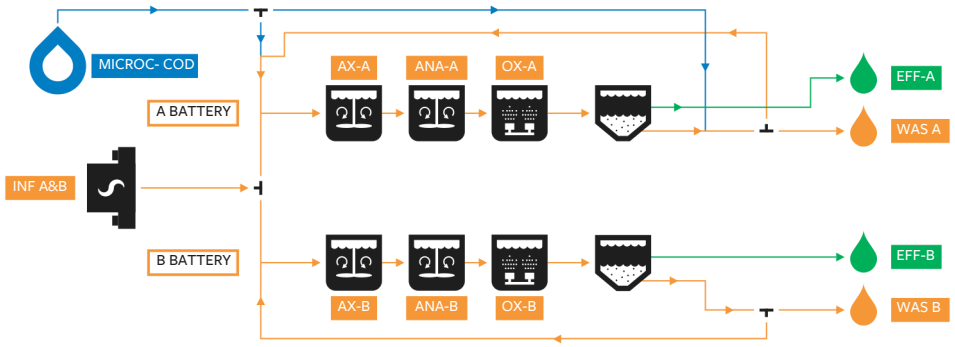
Study Period: October–December

Objective: Boost Phosphorus-Removal Performance

The 354 MGD water reclamation facility serving 1.1 million people within an area of 300 square miles had converted two of the plant's five wastewater-treatment batteries to an anoxic-anaerobic-oxic (A2O) configuration to improve the plant's phosphorus-removal performance.

However, preliminary testing conducted by the facility's maintenance, operations, engineering and research teams determined that the plant's activated-sludge process readings of BOD:P of 15 (biochemical oxygen demand-phosphorus ratio) indicated a significant carbon deficiency to sustain the proper microorganisms necessary for waste reduction.

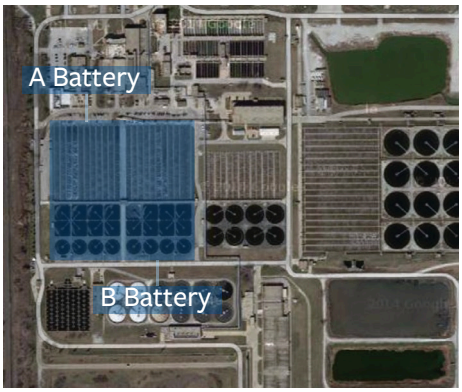
Two of the plant's five batteries (A Battery and B Battery) were reconfigured to provide a suitable environment for enhanced biological phosphorus removal (EBPR). The two batteries were converted to an anoxic-anaerobic-oxic (A2O) configuration by modifying the diffused air flow along the 415-foot length of each of the eleven trains within each battery.



Bench-scale SBR (sequencing batch reactor) evaluations simulating the plant's full-scale characteristics were performed to determine if 1) external carbon addition stimulated EBPR, and 2) determine the external carbon requirements for a full-scale evaluation.

The results of these efforts:

- Reconfiguration of A and B batteries to stimulate EBPR in the absence of external carbon did not significantly reduce phosphorus.
- The SBR study verified that sustainable EBPR was established with the appropriate dose of external carbon.

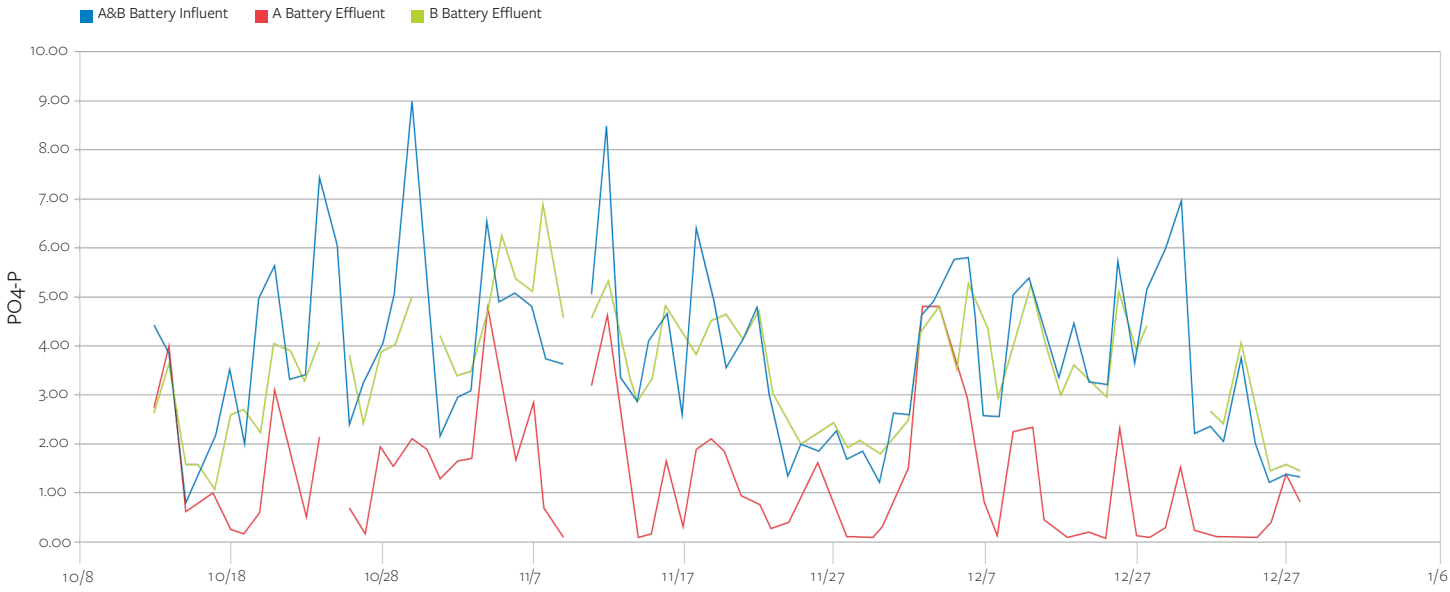


MicroC® 2000 Evaluation & Selection

A feasibility evaluation of using EOSi's MicroC® carbon sources was approved and initiated by the municipality.

MicroC® Premium Carbon Sources

Figure 1



The plant engaged EOSi's MicroC evaluation & application support (ME&AS) services to review and assess the plant's processes and perform field testing to evaluate whether MicroC carbon sources can help boost performance of the plant's biological treatment systems and achieve more cost-effective permit compliance.

EOSi's MicroC 2000, a nonhazardous glycerin-based carbon source with a COD concentration of 1.04 kg COD/L, was selected as the external carbon source to be added. MicroC carbon sources provide a consistent and readily available source of food and energy to support microbial populations needed for biological treatment of nitrate, nitrite, and selenium in FGD (flue gas desulfurization) wastewater.

Prior demonstrations demonstrated MicroC 2000 to be an effective substrate for EBPR in the proper environment, including BOD augmentation to sustain the biomass during periods of low flows or loadings due to seasonal variations or maintenance shutdowns, and for establishing an acclimated biomass during start-up of new or upgraded biological treatment systems.

Carbon Source Storage & Feed System

A 20,000-gallon temporary storage tank with remote tank-level telemetry was deployed to support the trial. Additionally, four peristaltic pumps were tied into a more than 1000-foot length of PVC piping to deliver approximately 3000 gpd of MicroC® 2000 for the duration of the trial.



MicroC® Testing Design

The project objectives: reduce PO4-P by 2-3 mg/L and maintain an effluent PO4-P of 0.75-1 mg/L in A Battery. Two batteries were monitored during the study, A Battery was dosed with MicroC® , and B Battery was used as a control. Primary effluent flow rate and RAS flow rate were fixed at 45 MGD to A Battery for a portion of the trial to maintain fixed HRT and SRT. MicroC was manually dosed to two points, the RAS return channel and the influent splitter box of A Battery. Plant data collection included daily 24 hr composite samples, inline instrumentation for DO, NH4, NOX-N, weekly nutrient profiles along A and B batteries, and microbiological analysis for PHB and PolyP in the MLVSS from both batteries.

MicroC® Success Metrics

Phosphorus removal with the addition of MicroC® 2000 occurred immediately, indicating an initial PAO population was present. Phosphorus removal averaged 2.54 mg/L over the 70-day evaluation period.

The MicroC feed rate (2991 gpd) to achieve this reduction was within 5% of the estimated stoichiometric requirements. Influent PO4-P averaged 3.93 mg/L during the trial but varied greatly, from as low as 1 mg/L to as high as 9 mg/L. (see Figure 1).

The MicroC program achieved a 2.5 mg/L reduction in phosphorus in A Battery over the 70-day evaluation period. However, the desired effluent concentration of 0.75-1.0 mg/L was not achieved 100% of the time due to the variable influent PO4-P concentration and the manually administered MicroC feed strategy. During the period of highest feed (3428 gpd) to A Battery at the end of the evaluation, 3.30 mg/L of PO4-P was removed (81% removal), maintaining an effluent PO4-P of 0.79 mg/L, and successfully meeting the project's objectives.

Recognizing an automated MicroC feed is required to consistently meet the desired effluent PO4-P of 0.75 mg/L due to the variable influent conditions, EOSi developed a Biowin simulation model assuming the use of an automated controller like EOSi's Nitrack® advanced automation technology, process controls for biological nutrient removal applications enabling plant operators to continuously monitor and optimize their unique treatment processes. Managing vital aspects of the treatment process remotely to achieve nutrient performance goals and permit compliance, the model predicted an average feed rate of 3666 gpd to maintain a 24hr flow weighted composite PO4-P of <0.75 mg/L over a 30-day simulation — enabling the plant to reliability achieve nutrient performance goals and future permit compliance.