CASE STUDY

NC RECLAMATION FACILITY BOOSTS DENITRIFICATION & COMPLIANCE WHILE REDUCING MICROC® 2000 COST

A North Carolina water reclamation facility engages EOSi's MicroC® process assessment and optimization services and achieves reduced energy consumption, reduced carbon dosing rate, and high denitrification efficiency for consistent permit compliance.

Client: North Carolina Municipality

Facility: Water Reclamation Plant

Flow Design/Actual: 3.6 MGD/3.5 MGD

Treatment Technology: **MLE facility**
Consisting of Two Oxidation Ditches and One Anoxic Ditch

Total Nitrogen Discharge Limit:
40,457 LBS/YEAR (~4 mg/L)

Study Period: April-May

Background: Modified Process

The North Carolina water reclamation facility is designed for a maximum flow of 3.6 MGD, consisting of one anoxic ditch and two oxidation ditches configured as an MLE — a Modified Ludzack-Ettinger process using nitrate produced in the aeration zone as a source of oxygen for treatment bacteria needed in the event of the breakdown of raw wastewater in the anoxic pan.

Historically, the plant treated approximately 3.5 MGD of municipal wastewater and discharged the treated effluent to a surface waterway, with a TN (total nitrogen) limit of 40,457 lbs./year, corresponding to 4.0 mgN/L at full design flow. The plant has been using EOSi's MicroC® 2000 as a supplemental carbon source for several years,



with RAS (return activated sludge) and nitrate recirculation flows averaging 3.5 MGD and 35-42 MGD, respectively.

EOSi's MicroC® 2000 Usage

EOSi's MicroC® non-hazardous carbon sources are widely used in denitrification, enhanced biological phosphorus removal (EBPR), biochemical oxygen demand (BOD) addition applications, and biological treatment of nitrate, nitrite, and selenium in FGD (flue gas desulfurization) wastewater.

The municipality experimented with several supplemental carbon dosing locations and operational strategies in attempts to optimize dosing rates and achieve lower effluent TN. This evolved into a standard practice of dosing MicroC 2000 at a rate of 85 to 88 gpd at the plant's headworks. As a result, the effluent TN was typically around 4 mg/L — but with higher than desired MicroC 2000 usage.



Adjustable-Speed Brush Aerators in the Aeration Tanks.

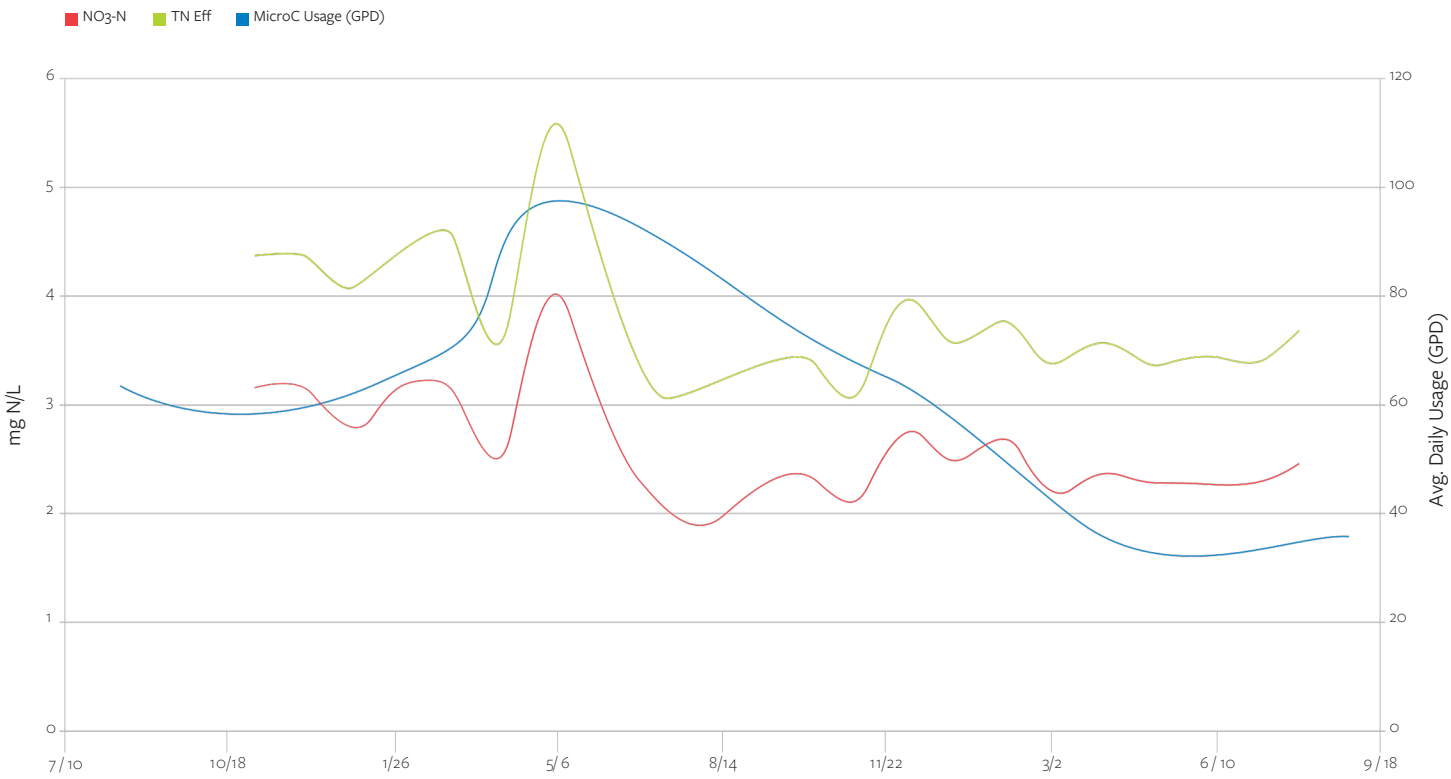
Two-Phase Approach: Assessment & Optimization

The municipality commissioned EOSi to perform a process assessment and optimization in collaboration with the plant's operators. The objectives: optimize MicroC® 2000 usage while maintaining the effluent discharge quality. A two-phased approach involved first conducting a process assessment, then based on the assessment findings determine what was needed to optimize the process.

The phase-one assessment included creating a nutrient profile of the anoxic ditch. The parameters measured, included BOD (biochemical oxygen demand), COD (chemical oxygen demand), NH_4 (ammonia nitrogen), NO_3 (nitrate), and NO_2 (nitrite).

MicroC®
Premium Carbon Sources

Figure 1



Samples were taken for analysis from four different locations within the anoxic ditch. Nitrate/nitrite concentrations were found to be nearly zero in all sections of the anoxic ditch. BOD was typically found to be less than 5 mg/L, suggesting that the process reached the denitrification capacity in the anoxic zone and suggesting MicroC 2000 was being fed in excess. This information was essential to determine how to proceed with phase two optimization.

In phase two, EOSi investigated if denitrification could be enhanced within the oxidation ditches by adding MicroC 2000 to the ditches (versus the headworks) during air-off (anoxic) intervals. To facilitate this evaluation, cBOD (carbonaceous biochemical oxygen demand), DO (dissolved oxygen), and NO_3 (nitrate) were profiled in the oxidation ditches during the air-off intervals.

Based on the profile, EOSi recommended cycling the adjustable-speed brush aerators in the two oxidation ditches at 100% speed for three hours and at 35% speed (anoxic) for one hour. The 3-hour/1-hour cycle was repeated with the MicroC 2000 injection during the anoxic periods. Simultaneous nitrification/denitrification (SND) was promoted during the reduced aeration (anoxic) periods, enhancing denitrification throughout the system.

The result: the enhanced denitrification operational strategy enabled reducing the MicroC 2000 dosing from 100% in the headworks to 70% in the headworks and 30% in the aeration ditches. These improved process efficiencies reduced the carbon requirement by approximately 50%.

Low MicroC®, Maximum Efficiency

Denitrification efficiency improved by promoting SND (simultaneous nitrification and denitrification) in the aeration zones, resulting in achieving TN (total nitrogen) levels consistently below 4 mg/L, and complete oxidation of ammonia in the aeration ditches. As depicted in Figure 1, the treatment plant's newly implemented operational strategy resulted in zero loss of nitrification efficiency and a considerable reduction in supplemental carbon use.

EOSi's process optimization also enabled a reduced carbon dosing rate by approximately 50% consistently (shown in Figure 1), reduced energy consumption by 15% (with brush aerators), and consistent permit compliance with an average effluent TN of <4 mg/L.