PLANT **PROFILE**

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Stratford Water Pollution Control Facility

Gary R. Johnson and Peter Stallings

Location: Stratford, Conn.
Startup date: March 2009
Service population: 47,000
Number of employees: 16
Design flow: 43,500 m³/d (11.5 mgd)
Average daily flow: 30,300 m³/d (8 mgd)
Peak flow: 147,700 m³/d (39 mgd)
Annual operating budget: $4,500,000

▲ **The Stratford (Conn.) Water Pollution Control Facility recently completed an upgrade that enables it to reduce total nitrogen concentrations in its effluent and better protect Long Island Sound.** Morgan Kaolian

During the past 2 years, the Stratford (Conn.) Water Pollution Control Facility has gone from spending more than $1 million to buy nitrogen credits to earning $185,000 from selling them. In 2009, the facility completed a $55 million biological nitrogen removal upgrade that included a supplemental carbon feed system and on-line nitrate analyzers. Both additions help the facility optimize denitrification and reduce the amount of total nitrogen (TN) in its effluent.

The 43,500-m³/d (11.5-mgd) facility discharges its effluent into Long Island Sound at the confluence with the Housatonic River. All wastewater treatment facilities in Connecticut are covered under a general permit for nitrogen discharges, where they are allowed to buy and sell nitrogen credits to achieve the specific annual mass-based limit for each facility's permit. Facilities that remove nitrogen in excess of their permit limits can sell credits to the system, and facilities that fall short must buy them.

Stratford's total nitrogen limit is mass-based and will drop annually until 2014. For 2010, the limit was 184 kg/d (406 lb/d); in 2014 the limit will be 162 kg/d (356 lb/d). That translates to about 6 mg TN for 2010 and 5.3 mg/L TN for 2014 at the current average flow of 30,300 m³/d (8 mgd).

Process improvements

Following the 2009 upgrade, treatment processes at the facility include influent screening, grit removal, primary settling, activated sludge biological nutrient removal, reaeration, secondary clarification, and ultraviolet disinfection. The activated sludge process uses a Modified Ludzack–Ettinger suspended growth configuration with a post-anoxic zone that includes supplemental carbon addition.

The upgraded Stratford facility was designed with a methanol supplemental

carbon feed system. However, the Stratford operators did not want to utilize methanol; they wanted to remove all hazardous chemicals from the treatment facility. Instead, they chose a nonflammable and nonhazardous proprietary supplemental carbon source based on glycerin.

Carbon dosing

The facility achieved substantial completion in early 2009 and stable nitrification–denitrification in the second half of 2009. During this period, supplemental carbon was not added to the second anoxic zones, and the facility averaged 5.5 mg/L total nitrogen.

In January 2010, operators began adding supplemental carbon. They wanted to test the carbon's effect, especially during the winter's cold-weather operating conditions in New England. Winter wastewater temperatures in Connecticut can drop as low as 10°C.

The results from this cold-weather operating period were excellent. When carbon was fed to the system for 22 days, total nitrogen concentrations in the effluent averaged 3.5 mg/L despite water temperatures around 11°C. When the supplemental carbon was turned off for 6 days, the total nitrogen concentration quickly rose to about 5.7 mg/L. Effluent nitrate values from the plant's West train went from 1.3 to 3.7 mg/L (See figure, p. 56). The higher nitrogen levels remained constant until the supplemental carbon feed system was turned back on.

A chilling effect

In addition to the biological process concerns, starting up the supplemental carbon feed system in the middle of the winter in New England presented operational problems. Particularly in cold-weather operating conditions, the glycerin-based product has a higher viscosity than methanol. The hydraulic diaphragm feed pumps installed at the facility had difficulty maintaining suction lift as the storage tank is a top-feed tank and requires a lift of approximately 2.5 m. This led to intermittent pumping of supplemental carbon.

To resolve this, Stratford added an additional peristaltic feed pump to maintain constant pumping feed rates. Piping changes were made from the bulk storage tank to supplemental carbon feed pumps in late January, which resolved the suction lift problems. The glycerin-based product was stored in an outside bulk storage tank where temperatures dropped as low as −15°C during the night with no observed pumping problems.

The supplemental carbon was fed as a concentrated solution without dilution water added during the entire evaluation period. The supplemental carbon feed system had the capability to add dilution water, but it was not operational in the winter, when plant water pipes could freeze.

On-line analyzers

The Stratford operators, working in conjunction with the supplemental carbon supplier, sought to use their new on-line nitrate analyzers to fine-tune carbon additions.

Stratford is one of the first wastewater facilities in Connecticut to use on-line nitrate analyzers to monitor and control nitrate levels in the influent and effluent of each process train in the second anoxic zone and final effluent. Prior to the upgrade, Stratford had relied on twice-weekly monitoring of 24-h effluent composite samples to provide nitrogen removal data.

The on-line nitrate analyzers have provided operators with the ability to monitor in real-time removal efficiencies

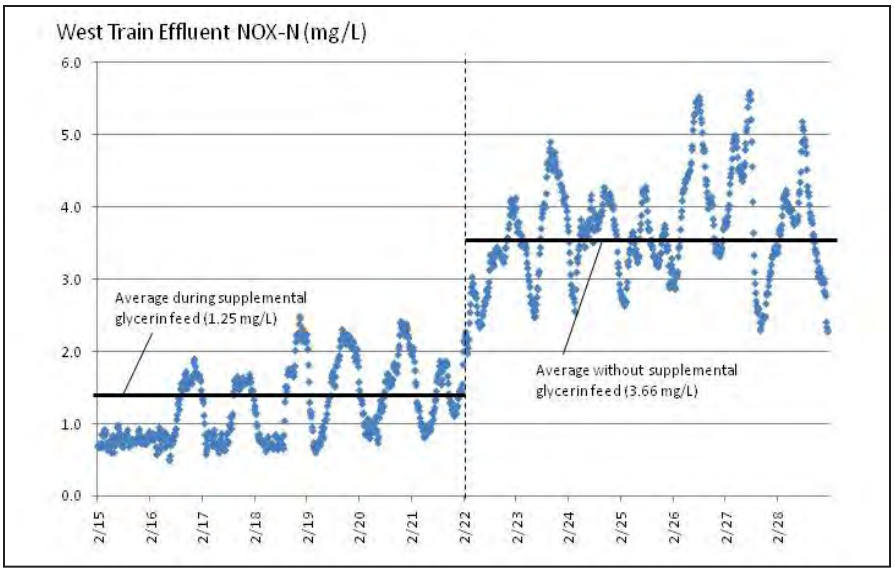
Facility staff added a peristaltic pump to the supplement carbon delivery system to overcome the glycerin-based product's higher viscosity during cold weather. Environmental Operating Solutions Inc.

in the second anoxic zone and control supplemental carbon additions, enhance denitrification, and reduce total nitrogen discharged from the facility.

Using the analyzers, Stratford's operators worked to lower the daily peak levels of nitrate in the anoxic basin. Typically, these nitrate levels follow a plant's diurnal flow patterns. (Other factors, such as biosolids processing and septage treatment, also can affect the magnitude and duration of the peak loading to the anoxic zone. This is especially true for treatment facilities that process biosolids and septage only during the day shift

Superintendent Peter Stallings, wastewater operator Bill Marcucio, and lead operator Jim Makraus from the Stratford (Conn.) Water Pollution Control Facility helped to implement the installation and use of the facility's new on-line nitrate analyzers. Environmental Operating Solutions Inc.

West train effluent nitrate concentration



Mondays through Fridays.)

At Stratford, the on-line analyzers revealed that influent and effluent nitrate can vary as much as 3 mg/L during a 24-h period. Operators created a two-level carbon pumping routine to optimize dosing. More carbon is delivered during peak loading periods and less during low loading periods.

In June, Stratford tested this idea. Operators set the feed rate at 4 gal/h per process train from 7 a.m. to 9 p.m., and 2 gal/h from 9 p.m. to 7 a.m. The total nitrogen concentration dropped to 2.8 mg/L from 4.1 mg/L the month before.

The next project for Stratford has been to create a feed forward control loop, which will automatically adjust carbon dosing based on real-time measurements utilizing the on-line analyzers. Supplemental carbon pumping rates will vary in real-time with readings from the influent and effluent analyzers in the anoxic zone controlling the feed rates.

As the nitrogen limits in Connecticut's general permit for nitrogen become more stringent in future years, higher doses of supplemental carbon will be necessary to achieve the required limits. By developing more accurate and efficient dosing systems, the Stratford facility will be better able to maximize nitrogen removal and, therefore, the number of nitrogen credits it can sell.

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