

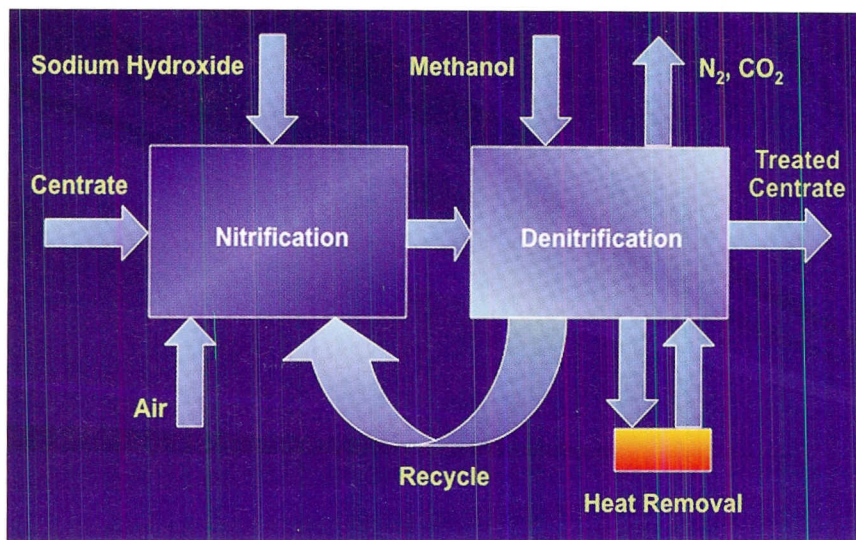
## WASTEWATER

### *New York City Begins Operating Largest Nitrogen Removal System of Its Kind*

**T**HIS PAST NOVEMBER, New York City's Department of Environmental Protection (DEP) began employing a relatively new process for removing nitrogen from wastewater at its Ward's Island Water Pollution Control Plant. Known as the single reactor system for high-activity ammonium removal over nitrite, or SHARON, the process had not previously been tried at full scale in North America. However, the installation at the Ward's Island facility is not only the first large-scale effort on the continent but also the largest in the world.

The 275 mgd Ward's Island plant discharges to the upper portion of the East River, which connects to Long Island Sound. To address the problem of hypoxia in the sound, in 2001 the states of New York and Connecticut established a total maximum daily load of nitrogen that could be released into the river. This quantity stipulates how much of a particular pollutant a water body may receive without violating water quality standards. To comply with the limit, the DEP began investigating methods for reducing nitrogen discharges from its wastewater plants.

The Ward's Island facility was a key target for these efforts. Because it accepts and processes solids from four other wastewater facilities owned by the city, Ward's Island generates more nitrogen than does a typical wastewater plant of comparable size. Using high-speed centrifuges, the facility dewateres approximately 260,000 cu ft of solids on an average day. The water removed from the solids by this process is referred to as centrate, and it "contains quite a bit of nitrogen," says Keith Beckmann, P.E., the chief of the process



#### SHARON PROCESS CONFIGURATION

planning section within the DEP's Bureau of Wastewater Treatment. Previously, the centrate was simply sent back untreated to the main treatment process, thereby returning the nitrogen to the wastewater stream.

The DEP tested a variety of approaches for reducing nitrogen concentrations in centrate before selecting the SHARON process. In addition to seeking a method that would be relatively inexpensive to operate and maintain, the city was particularly interested in options that would require a "small footprint," says Vincent Sapienza, the Bureau of Wastewater Treatment's deputy commissioner. "Our sewage treatment plants are essentially landlocked," he says. "We don't have much space to grow."

Besides providing a relatively compact solution, the new process was found to cost significantly less than conventional methods for reducing nitrogen concentrations in such high-strength streams as centrate from centrifuges. Developed by researchers in the Netherlands at the Delft University of Technology (TU Delft), the SHARON process creates conditions that facilitate the growth of certain bacteria capable of removing nitrogen more efficiently than is the case in conventional approaches to nitrification and denitrification. Known as ammonia oxidizing bacteria, the bacteria thrive in the warm temperatures and minimal sludge retention times maintained in the process.

Traditionally, nitrification is a two-

step process: bacteria first convert ammonia to nitrite, and the nitrite is then converted to nitrate. During denitrification, bacteria convert the nitrate to nitrogen gas, which enters the atmosphere. To facilitate these processes, oxygen and methanol or some other carbon source must be added to promote biological activity.

The advantage offered by the SHARON process is that it can achieve nitrification and denitrification in fewer steps. In particular, the ammonia-oxidizing bacteria that predominate in the process convert ammonia to nitrite before changing the nitrite directly to nitrogen gas. In effect, the process involves a "short-circuiting" of the conventional approach to removing nitrogen from wastewater, Beckmann explains. As a result, the new process requires approximately 25 percent less oxygen and 40 percent less methanol than do traditional methods of nitrification and denitrification, he says, resulting in "substantial savings" in electricity and methanol costs.

At the Ward's Island facility, the SHARON process comprises two identical trains, each with two stages. Before entering the system, centrate from the dewatering operations is split into two streams, one for each train. The first stage features a tank 95 ft wide, 86 ft long, and 23 ft deep. Here fine bubble diffusers introduce oxygen, enabling bacteria to convert ammonia to nitrite. Caustic soda also is added to maintain a pH between 7.0 and 7.5. The second stage also has a tank, this one 95 ft wide, 44 ft long, and 23 ft deep. Here

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anoxic conditions obtain, facilitating the conversion of nitrite to nitrogen gas. Methanol is added during the second stage. After undergoing this two-step process, treated water is returned to the main treatment process at Ward's Island. What is more, a heat exchanger system was constructed to cool the new reactor by transferring its heat to the effluent from the main plant, which has a lower temperature.

Approximately 95 percent of the ammonia in the centrate is removed by the new process, says Al Warakomski, a partner with Mixing and Mass Transfer Technologies LLC, of State College, Pennsylvania. The firm is part of a joint venture that includes Grontmij NV, of De Bilt, the Netherlands. The latter supplied the SHARON process to the DEP. As the licensor of the process's patent in North America, Mixing and Mass Transfer Technologies provided project management services for the installation at Ward's Island. Grontmij provided process design and is providing operational assistance.

The SHARON system at the Ward's Island facility is designed to treat an average daily flow of 1.85 mgd and a peak flow of 2.31 mgd of centrate containing an average daily ammonia load of 10,797 lb. For systems that treat centrate only, such loads are "huge," Warakomski says. By comparison, the SHARON reactor closest in size to the one at Ward's Island, a facility in the Dutch city of Groningen, is designed to treat an average daily ammonia load of roughly 6,170 lb.

Thus far construction of the SHARON system has cost nearly \$69 million, and some minor construction is yet to be completed. Silverite Construction, of Hicksville, New York, is the general contractor for the project, the overall design of which was provided by AECOM, of Los Angeles. As mentioned above, the SHARON system began operating in November, but it has run only at a reduced capacity. However, the process is expected to be fully operational by this summer, Sapienza says. —JAY LANDERS

### BUSINESS BRIEF

STV, a 1,700-employee engineering, architecture, planning, and environmental services firm based in Douglassville, Pennsylvania, has acquired Civil Structures, Inc., a Dallas-based bridge and highway design firm. The acquired firm will operate as STV/Civil Structures and will form part of STV's transportation and infrastructure division.