Rockaway Valley Regional Sewerage Authority Conducts Enhanced Denitrification Demonstration

By Robert G. Sobeck, P.E.

In October 1999, the DEP retained the firm Rothberg, Tamburini, and Windsor (RTW) to conduct a demonstration at the Rockaway Valley Regional Sewerage Authority (RVRSA) treatment plant located in Parsippany Troy Hills. The demonstration was to determine if a change in operating procedure could lower nitrate concentrations in the treatment plant's effluent. Reducing nitrate concentrations in waters used for public consumption received renewed interest after the occurrence of recent drought events.

Ronald G. Schuyler, P.E., a senior project manager for RTW, who developed a protocol approved by the DEP, was selected to direct the enhanced denitrification demonstration. Denitrification is the anaerobic biological conversion of nitrates to nitrogen gas. The process is based on the principle that the nitrogen compounds found in raw sewage may be converted to the nitrate form in a secondary treatment process (nitrification). These nitrates can be removed by further treatment under anaerobic conditions (denitrification). Under these conditions, nitrogen is released as nitrogen gas, a non-pollutant.

The RVRSA wastewater treatment facility was designed by Elson T. Killam Associates and consists of the following equipment:

- Influent chamber
- Screening and grit removal
- Biological treatment - extended oxidation
- Aeration activated sludge process
- Final clarifiers
- Disinfection and dechlorination facilities
- Effluent aeration facility
- Sludge processing facility

The following demonstration protocol was outlined:

1. Aeration equipment was to be turned on and off at set time intervals
2. Influent and effluent flows, were to be sampled and analyzed for Mlss, ammonia, pH, oxidation reduction potential, and nitrate. Non-certified methods may be used for process control processes.
3. The licensed operator has the authority to end the enhanced denitrification demonstration at any time.

How the Demonstration was Conducted

Prior to the start of the demonstration on October 21, 1999, the plant was achieving a high level of nitrification and good phosphorus removal. The demonstration commenced when one aerator was turned off in oxidation ditch No. 1. Within 2 hours, the nitrate at the ditch's discharge pipe had dropped to 6.0 mg/l and to 5.7 mg/l by 4:20 p.m. The morning of October 22nd, it had dropped to 4.5 mg/l and by October 26th, it was varying between 2 and 4 mg/l, depending on the time of day and ammonia load at the plant. Ammonia values remained constant at less than 0.5 mg/l, while phosphorus levels held at 1.5 mg/l.

During the period from November 1999 and March 2000, aerators 1A and 2A were turned on and off for various lengths of time. When ammonia levels started to rise, all aeration equipment was put back into operation.

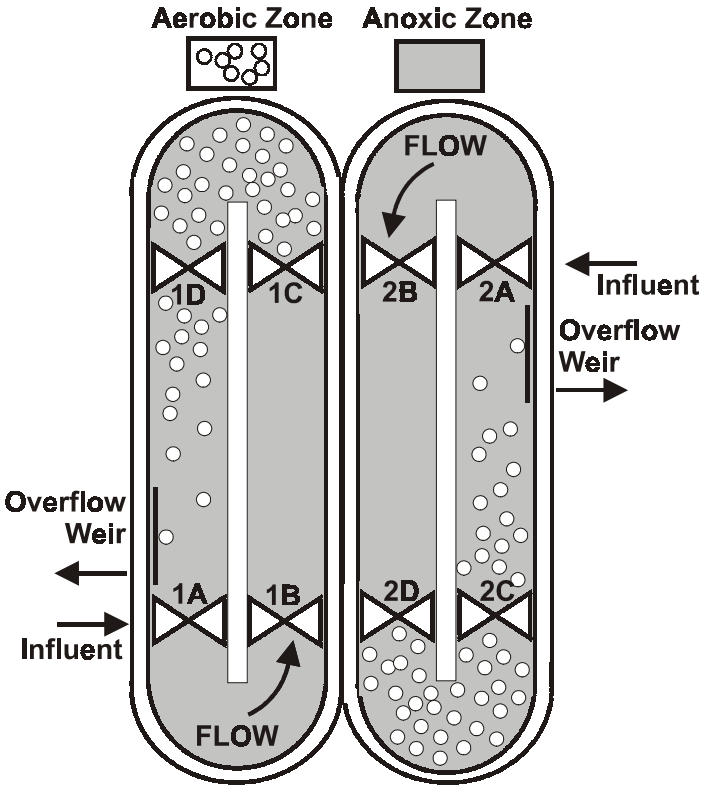
Commencing late summer 2000, aerators 1A, 1B, 2A, and 2B were turned off in an attempt to develop an anoxic zone in the oxidation channels. For a period, there was one area where the dissolved oxygen level was zero. During this time, ammonia effluent levels averaged 0.47 mg/l with phosphorus levels averaging 0.73 mg/l.

In September 2000, effluent ammonia levels started to climb. Upon reviewing the effluent water quality data, it was decided to place all aeration equipment into operation. After three days, operations were again set to the on/off mode. After a number of trial on-off schedules and a review of effluent data, a new schedule was implemented which called for aeration brushes 1A, 1B, 2A, and 2B to be turned off at 7:00 A.M. and back on at midnight. Whenever ammonia levels dropped, these units were turned off. The equipment remained off as long as good nitrification was maintained.

To assess the performance of the activated sludge process, data was collected using a portable monitoring device called a sonde. While a sonde is not used for compliance monitoring, it does provide operators with timely information they can use to make process adjustments when necessary. The sonde was used to measure the following parameters: temperature, pH, ORP, nitrate, ammonia, and ammonium.

It is important to note the denitrification problems that occurred during the demonstration. There is an increase in scum due to floating solids and increased effluent turbidity. Currently, these solids are captured in the chlorine contact tank and removed. Future plans call for a pilot filter unit at the clarifier discharge pipe as well as chemical precipitation.

After a review of the demonstration data, it was concluded that the original goal to lower the concentration of nitrate in RVRSA's effluent was achieved. In addition, a consistent decrease in effluent phosphorus levels was accomplished. Other significant benefits include reduced energy and chemical costs and a 20 percent reduction in disinfection costs due to lower chlorine demand. At the time of this writing, an effluent composite sample analysis showed a nitrate level of 0.6 mg/l and a total phosphorus level of 0.43 mg/l. Although this treatment plant was not specifically designed for enhanced denitrification, this demonstration has shown that changes in equipment operation can produce different levels of treatment.



After successfully operating the RVRSA plant in the enhanced denitrification mode for 14 months, the authority has decided to continue operating the plant in this manner. If you have any questions about this demonstration project, please contact Chris Hoffman, Bureau of Engineering South, at (609) 984-6840.