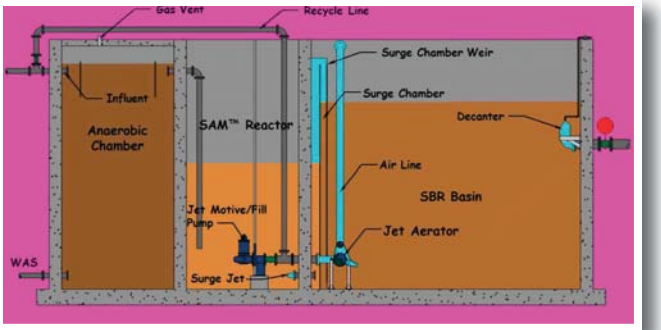
Low cost installation and operation of a modified SBR system with potential for effluent reuse

By John Seguire and Albert Wakim

Norwood Water Pollution Control Plant.



ISAM SBR system.

The Norwood Water Pollution Control Plant in Peterborough County, Ontario, required a treatment capacity upgrade from an average day flow of 727 m^3/d to 1,200 m^3/d. In addition to increased flow, the effluent limits were required to be lower than for the original plant, to meet revised discharge permit conditions and to allow for the potential reuse of effluent for irrigation at a local golf course.

The original WPCP included screening, grit separation, secondary treatment with a carousel-type extended aeration (EA) plant, and chlorine disinfection. After an assessment by AECOM, the preferred upgrade option was to install a second headworks screen, a Fluidyne ISAM™ (Integrated Surge Anoxic Mix) sequencing batch reactor (SBR) for secondary treatment.

Aluminum sulphate would be injected into the SBR to chemically precipitate phosphorus not removed biologically. Total secondary effluent would be polished in a DynaSand deep bed filter, followed by UV disinfection, before being discharged to the Ouse River. A septage receiving station was also required, as part of the upgrade.

The ISAM SBR was selected as the preferred upgrade for the secondary treatment process, on the basis of its performance, simple design and costs. In addition, there was limited space available at the site for new construction and the ISAM SBR had a smaller footprint than the alternatives reviewed.

The SBR process incorporates primary treatment, aeration, settlement and sludge wasting in one reactor, and each of these phases operates on a time-based process cycle. The combination of these phases in the SBR tanks is known as a cycle. Because the SBR process can be adjusted to suit site-specific wastewater conditions, it has very flexible phase and cycle times.

In addition to process flexibility, operating all phases of treatment in one reactor has the advantage of lower capital and O&M costs compared to other biological treatment systems. This is due to less tankage, interconnecting pipework and process equipment usage.

The ISAM SBR system was chosen

Table I. Average influent and effluent data for 2010 to 2012 at the Norwood WPCP.

Parameter	Influent	Effluent	Effluent Objectives
Flow (m^3/d ADF)	544	N/A[a]	N/A[a]
$CBOD_5$ (mg/L)	182	< 2.1	5
TSS (mg/L)	182	<3	5
TKN (mg/L)	32.4	N/A[a]	N/A[a]
Ammonia-N (mg/L)	N/A[a]	< 0.7	0.9
Total P (mg/L)	3.9	0.08	0.2
E. coli (MPN[b]/100 mL)	N/A[a]	< 2	100

Note: a. Not applicable b. Most probable number

for the Norwood WPCP as it has the flexibility and lower costs of an SBR process, with the following additional advantages:

- It incorporates an anaerobic stage (ISAM), where primary solids and waste biological sludge from the SBR are stored and digested. This reduces sludge production and provides a sludge storage capacity of about 180 days. It also allows conditions for biological phosphorus removal.
- There is an anoxic surge tank (SAM™) which acts as a balancing tank and denitrification area, reducing energy consumption for secondary aeration. During periods of higher influent flow and when the SBR tank is full, the SBR contents overflow into the SAM tank.
- The aeration and mixing system uses a jet aerator, which incorporates a venturi nozzle. This results in very efficient aeration, which is not significantly reduced in dirty water.
- The mechanical design is very simple, which results in a robust process that is easy to operate and maintain. The main reasons for this are the uncomplicated designs of two main mechanical components: the jet motive pump and the decanter.
- A jet motive pump is used to transfer mixed liquor into the SBR, to mix the SBR during the anoxic phase, and to provide aeration (with supplemental blowers) during the aeration phase. The decanter is used to discharge secondary effluent from the SBR tank after the settling phase. The patented decanter system uses a simple air-lock created with a solenoid valve, as well as a configuration that decants large volumes at a low weir-overflow velocity.

ISAM SBR system components

The upgraded plant was commissioned and began operating in October 2009. A summary of how the Norwood WPCP has performed over the last three years is shown in *Table 1*. As the data shows, the plant has met all effluent quality requirements over this time period. Measurements have consistently placed well below discharge limits since the plant became operational. Effluent quality is acceptable for reuse as golf course irrigation water, but unfortu-

nately the cost of piping the effluent has made this unfeasible.

There has been a significant reduction in O&M costs, as a result of the upgrade. Site visits have been reduced from five times to three times per week and the estimated cost saving in labour is $10,000 per annum. Although the new process has increased the amount of equipment requiring maintenance, the automation lends itself to improved maintenance procedures. Additionally, the ability to remotely monitor the facility reduces the need to be on-site and allows for improved operational planning.

As well as maintaining the blowers which provide air to the jet aeration system, other routine maintenance for the ISAM SBR includes greasing the decanter and inspection of the jet pumps.

Sludge disposal costs have also decreased, with estimated cost savings of $6,000 per year. This is based on an approximately 30 per cent reduction in sludge, compared to the old plant. Lower sludge production has also been reported for other facilities operating an ISAM SBR system.

There is also an energy saving associated with the transfer and digestion of sludge. Since the primary and waste activated sludge are stored and digested within the ISAM SBR, O&M costs for settling, pumping and digesting it in separate processes are removed.

The significantly lower sludge production with this process also reduces energy associated with sludge management. Energy savings also result from the use of a separate anoxic zone (SAM) and with the anoxic conditions created in the SBR tank during the settling and idle phases. This is due to nitrate being used in place of oxygen during anoxic conditions. This reduces aeration demands during the aerobic treatment stage.

The ISAM SBR does not require the construction of a primary or secondary clarifier or a sludge digester. Therefore, costs associated with construction - interconnecting pipe work, pipes and valves, which are part of having separate tanks for these processes - are eliminated.

The upgraded plant at Norwood had lower capital costs than originally estimated. Estimated project cost was $7.2 million, while the actual cost was $6.28 million. Some of the savings were due to lower than estimated construction contract costs, but a significant fraction of the saving was due to lower project management and design consulting fees.

It is felt that this was primarily due to the use of a package secondary treatment system and having a significant amount of the engineering supplied by the SBR equipment provider.

Although the upgrade essentially doubled the size of the facility, along with increased capacity, the operating authority has been able to realize cost savings in operator time, biosolids hauling and improved effluent quality during high flow periods such as spring run-off.

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Delcan celebrates its 60th anniversary

Delcan Corporation, an award winning, multi-disciplinary engineering, planning, management and technology firm, is celebrating its 60th anniversary. The firm began in Toronto, Ontario, in 1953 as a small, five person consultancy. Quickly and steadily, Delcan expanded to a company with now more than 800 employees in multiple offices world-wide.

Delcan has many employees who have invested more than 25 years of their careers to the firm. In fact, Delcan has been the home to three generations of the Riggs family. The first Riggs family member, Jack Riggs, joined Delcan in 1964.

Following in his father's footsteps, John Riggs joined Delcan in 1967. John now serves as a vice president, managing Delcan's London, Ontario office. John and his father Jack had the opportunity to work on a project together, an opportunity that John valued immensely and is now an experience that he is able to share with his son, Rob Riggs, who joined Delcan in 2004.

Whether through providing transit systems, stream naturalization and green buildings or through projects like traffic management, water efficiency measures and urban planning, Delcan has delivered solutions that conserve resources and enhance the natural environment.

The firm's commitment to corporate responsibility, outside of contracted work and daily operations, includes active participation in community organizations, both at the employee and corporate level. Delcan has been a long-standing participant in various annual fundraising programs including the United Way, Water For People, Canadian Cancer Society's daffodil campaign, local food drives and many more not-for-profit organizations, as identified by local offices.

Three generations of the Riggs family have worked at Delcan.

Delcan employees have been extremely generous and readily donated monies toward these charities, as well as fundraisers for natural disaster relief, including the Haitian earthquake and both the Japan earthquake and tsunami relief efforts and, most recently, the Calgary, Alberta floods.

In addition to supporting local charities in the communities in which its employees live and work, Delcan also contributes $50,000 every year in scholarships for post-secondary education.

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