Better Through Biology

A BIOELECTRODE SENSOR PLATFORM SOLVES A COMPILATION OF CHALLENGES FOR A WASTEWATER TREATMENT PLANT ON PRINCE EDWARD ISLAND

By Scottie Dayton

Periodic foaming in an aerated digester and a drop in dissolved oxygen were affecting the performance of the Montague Wastewater Treatment Facility in Three Rivers, Prince Edward Island.

"We knew something was upsetting the biology, but not what it was because the digester returned to normal in a day or two," says Tommy MacLeod, operator. "The situation was exacerbated by our dewatering problems. We occasionally lacked the storage capacity to waste."

The Montague Sewage and Water Collection and Treatment Corp. authorized the installation of variable-speed drives on the digester blowers to handle fluctuations in dissolved oxygen. That helped but didn't address the root of the problem, which turned out to be the addition of two microbreweries to the collections system.

Proving they were responsible required evidence. "We needed scientific data to persuade the owners to work with us toward an amicable solution," MacLeod says.

Fortunately, the town had been in partnership with Island Water Technologies since 2014. The agreement enabled Island Water Technologies to use the Montague plant as a working laboratory. In May 2018, the company began a 12-month pilot of its Sentry technology. Its bioelectrode sensors gave MacLeod real-time insights to variable biological conditions, the necessary irrefutable data and some surprises.

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> **TOMMY MACLEOD**

PACKAGE PLANT

Installed in the 1970s, the 400,000-gpd (design) activated sludge package plant averages 200,000 gpd from 2,000 residents and some small industries. It originally had the clarifier in the center of its round structure and the activated sludge process in the outside ring. In 2002, an upgrade changed the clarifier to an aerated digester for more storage, and a contractor built a new clarifier and 10,000-gallon storage tank.

In 2016, two 40-by-60-foot Geotube containers (TenCate Geosynthetics) were installed on outdoor concrete dewatering pads. "Each step was an improvement, but the sludge still freezes in winter," McLeod says. "We can't waste from early to mid-December until the spring thaw. Residents complain of the odor associated with aging sludge for 21 days or longer because we can't dewater."

Each container holds wasting from one season. In 2018, dewatering produced 27.5 cubic yards of cake for land application. "We're breaking ground in spring 2020 to install a 120,000-gallon two-compartment aerated precast tank," MacLeod says. "It should give us more control over everything in the plant."

PHOTOS COURTESY OF ISLAND WATER TECHNOLOGIES

Influent arrives at the Montague return activated sludge package plant.

HOW IT WORKS

The Sentry sensors amplify that control. According to Island Water Technologies, the technology monitors biological activity in wastewater streams. Every living organism releases electrons during respiration (breathing), and the sensors measure how many electrons are generated by those organisms to ascertain their health.

The sensors arrive inoculated with bacteria, which need one to three days to acclimate to the environment. Once a robust biofilm is established, a bioelectric current passed through the sensors enables them to measure electron transfer. This value is displayed on an online dashboard, updated every 60 seconds. Typically, shock loads cause a drop in activity, while increased organics accelerate metabolic activity, producing a significant spike in respiration and electrons.

FAR LEFT: Bryce Stewart, engineer in training with Island Water Technologies, installs an in-line Sentry sensor in the influent channel using a PVC rail mount. NEAR LEFT: The Sentry sensor in the influent channel is attached to PVC pipe with U-bolts and fixed to a rail. The sensor connects to an online dashboard, enabling operators to monitor remotely for shock loads and other events affecting the plant.

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The subscription-based bioelectrode sensor platform monitors influent wastewater organic loading and fluctuation, providing correlations to BOD to help optimize aeration. The units are installed like pH or dissolved oxygen probes, with the difference that sensors need surface biofilm growth and do not need regular cleaning.

QUICK INSTALLATION

Patrick Kiely, Ph.D., founder and CEO of Island Water Technologies, and Bryce Stewart, engineer in training and project manager, consulted with MacLeod on the best locations for the sensors. They chose the influent channel, the third chamber of the aerated digester, and the Montague River outfall. The first two are in-line sensors attached to PVC pipe with U-bolts and fixed to a rail. The two drop-in sensors at the outfall use standard industry fittings.

Island Water Technologies installed everything in less than two days. "If there is a problem with the control panel or sensors, they repair it," MacLeod says. "Except for checking that nothing has caught on the influent sensor, the system is maintenance-free, and the technology is great."

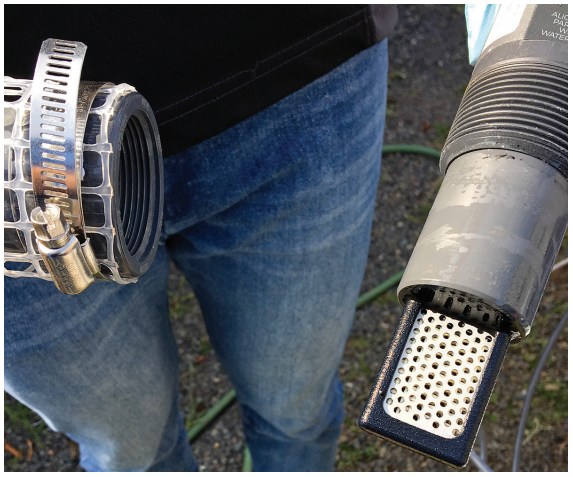
Stewart trained town and plant personnel on how to use the dashboard. "It's simple to learn and navigate," MacLeod says. "Data is presented with options to view on hourly, daily, weekly, monthly or customized intervals. Spotting changes in the normal pattern is easy, and when those spikes are consistent, it's time to investigate."

LEARNING THE FACTS

At first the plant team tested CBOD every second Wednesday, and the results were always less than 10 mg/L. Then the sensor data showed huge spikes on Thursdays, indicating a biological feeding frenzy. Testing on Thursdays revealed 240,000 mg/L BOD in the waste stream. "We traced it to one brewery dumping trub — sediment including hops debris, spent yeast or yeast slurry," MacLeod says. "Our provincial discharge limit is 300 mg/L BOD."

Town officials talked to the brewery owner, who agreed to drain off the water, dispose of the yeast elsewhere and handle spent hops more carefully. Conditions at the plant improved, but the spikes continued.

One spike surprised MacLeod. It revealed that just an inch of rain upset the microbiology significantly. "We always saw the result of inflow and infiltration when it rained, but we didn't have a clue how much it took to affect the plant," he says. "Now we have an advantage. If heavy rains are forecast, there is a nine-hour delay before the water arrives. If the solids are high in the clarifier, we have time to waste enough to reduce the risk of a hydraulic overflow."



Protective screen meshes are available for sensors installed in high-strength waste streams.

That brings MacLeod back to the worst-case scenario of heavy rains and tanks full of stabilizing biosolids. "The sensors pointed out we were playing with fire, because we're upstream from a food fishery," he says. "We hope this knowledge will help accelerate funding for the new 120,000-gallon storage tank."

FINDING A REMEDY

More online research into brewing convinced MacLeod that the still-visible spikes on Thursdays were due to the breweries washing the yeast and hop fermentation vessels. He confirmed that by visiting the breweries and spying spent hops outside the doors.

Three months of collected data gave MacLeod his evidence. "The records show that what they are dumping is too strong for the plant," he says. "I plan to visit the owners on a Thursday, share the information and ask them to work with me to remedy the situation. All it would take is for them to discharge on different days and at times when plant flows are quieter." **tpo**