Detecting Hazardous Gases at Wastewater Treatment Plant

By Paul Nesdore

A score of "electronics bloodhounds" are monitoring dangerous levels of toxic and explosive —and noisome—gases at the Seneca wastewater treatment plant in suburban Minneapolis. The bloodhounds are actually sensitive gas detectors from Sensor Electronics that keep a watchful eye out for hazardous methane, chlorine, hydrogen sulfide and sulfur dioxide throughout the plant.

Seneca gulps in some 28 million gallons a day of sewage from four communities in the Twin Cities' south suburban ring, plus the nearby Mall of America shopping center—"almost a small city in itself," groans Seneca operations chief Ted Stein.

Dating back a half-century, Seneca is the fourth largest treatment plant in the state. Regular expansions and updates have made it one of the top ten in the nation in terms of efficiency, efficacy and operating economy, Stein says.

"We recycle and reuse wherever we can," he says. "We recycle our bacteria, we send indigestible solids to a landfill. We wring excess water out of the remaining sludge, and sell that to an eastern fertilizer plant. We treat the remaining water until it's clear and clean, then feed it into the nearby Minnesota river. "And that water—18 million gallons a day— is cleaner than the upstream river water. In fact, you can see the clarity difference at our discharge outlet in the river," Stein says.

By closely monitoring operations and operating costs, Seneca treats the 55 gallons of daily sewage from each of its 300,000 "customers" for a nickel a day. "And we've held to that nickel a day rate for the past decade in spite of higher costs for almost everything. We've done it by streamlining our treatment methods, by automation, by using computers wherever possible, and by cutting expenses in unusual ways."

"Take those gas detectors, for example. Depending on the location here, we'll change the sensor every one, maybe two years. But because these sensors are factory-calibrated for each specific gas, we don't have to bother with on-site calibration. So we can change the sensor in two minutes or so, in contrast to the half-hour it used to take, what with fussy checking and calibration.

"Here's another one," Stein continues. "We're spraying water into our incinerator chimney, keeping the stack temperature down to around 1600 degrees. This does two things: It helps make the waste particles more slippery, so they don't clump into large chunks, making the ash easier to handle. And it keeps the chimney cleaner.

"We used to shut down, three, four times a year for chimney cleaning, an expensive proposition when you figure the down time lasting days. Now we shut down just once a year, mainly to check the chimney. Cleaning is a thing of the past. (In passing, the lower temperatures mean the firebrick lasts longer.)"

In the main, Seneca operations parallel conventional waste treatment plants. Incoming effluent to screened to sieve out rocks, plastics, other indigestible materials. The heavy sludge is pumped to twin clarifiers where anaerobic bacteria begin digesting the sewage, creating clouds of methane and hydrogen sulfide.

The indigestible solids go to a landfill; the remaining material goes to aeration basins, together the size of six football fields. Here oxygen bubbles up through the bacteria–laden liquid to speed the decomposition. Heavier materials sink to the bottom, are shunted to a centrifuge to wring out remaining water, then to the incinerator. Meanwhile the bacteria-rich sludge is skimmed off and fed back to the clarifiers, where the bacteria go back to work.

"In effect, this is a self-selection process for the bacteria," muses Stein. "They screen themselves out, with only the strongest and most vigorous going through the cycles. Hopefully this will be giving us bigger and better bacteria that will eat more and eat faster, meaning we can move sewage faster and thereby keep up with population growth without expanding our plant and our budget. In a sense we're genetically engineering better bacteria."

Depending on temperature which can reach -30°F on a Minnesota winter day, it takes up to 16 hours for incoming sewage to move through the primary clarifiers and aeration basins. Increasing bacteria efficiencies could shave an hour or more from these times, effectively increasing plant throughout.

The liquid goes to six final clarifiers, treated with chlorine, then cascades down a double-weir waterfall to aerate the water; oxygen-enriched air is also fed into the now-clear water. From there it flushes into the Minnesota river.

The gas detectors look for dangerous explosive/toxic gas levels at the initial separation stage; at the clarifiers and aeration basins; and the chlorine feed units. In addition, detectors are at critical points in the four-block-long tunnel underneath the plant. Digital readout panels on each detector show exact gas levels at that point. LEDs change from green/amber/red as gas levels increase; At red alarms go to a central control panel, and warning signals alert personnel. The detectors even keep an eye on themselves, spelling out what's wrong where in case of any troubles in the system.

Savings from these long-lived gas detectors, from spraying water in the incinerator chimney, by recycling better bacteria, by automating, by using computers have helped Stein cut his operating budget by 30 per cent compared to what it would have been what with inflation and booming population growth.

"We're running lean and clean—just like our wastewater."

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