LOCKING UP LEACHATE

By William J. Cunningham

Charlotte County, Fla., treats leachate on site

For decades, Charlotte County, Fla., has drawn a growing number of retirees from northern climates seeking sunshine, lower taxes and a slower pace of living. With nearly 180,000 residents, the county government has kept pace with population growth by investing in the infrastructure needed to support the delivery of citizen services.

One capital investment made in 1992 continues to yield substantial annual dividends in the form of more than $3.4 million per year in cost avoidance, freeing funds that the county could invest elsewhere. It is the Charlotte County Solid Waste Department’s 90,000-gallon-per-day (gpd) Leachate Treatment Facility at its 640-acre site, which includes the county’s 108-acre permitted solid waste landfill.

Leachate is the liquid that forms as water, mostly from rainfall, percolates through a solid waste landfill, picking up toxic chemicals as well as suspended and dissolved solids as it moves through the mass of disposed materials. Those compounds can include organics that can drive biochemical oxygen demand (BOD) and chemical oxygen demand (COD) levels beyond permitted limits, plus dissolved solids, heavy metals, ammonia compounds and hydrocarbons.

As the landfill ages, the leachate gets more difficult to treat. However, left untreated, it could contaminate groundwater supplies. While few of more than 2,400 municipal landfills across the U.S. treat their leachate on site like Charlotte County, that may be changing. A recent comprehensive survey of U.S. landfills found that only 6% have onsite leachate treatment and 62% choose to send their leachate to publicly owned treatment works (POTWs)—20,800 gpd, on average. Among the latter, 38% must haul their leachate to the POTWs at an average cost of $2,300 per day.

While many municipalities might consider onsite treatment expensive and complex, this $2,300 daily cost would be more than what Charlotte County’s onsite treatment
and disposal costs. That makes the county’s decision to invest in onsite treatment decades ago a wise one.

The Challenge

Due to its subtropical climate, Charlotte County gets approximately 54 in. of rain each year, mainly in the summer wet-weather season. This rainfall—a third more than the annual U.S. average of 39 in.—is the primary driver behind the landfill’s generation of one of the largest leachate flows in the nation, between 80,000 and 100,000 gpd of leachate, 4 to 5 times the national average.

Like most Florida landfills, the leachate needs to be carefully handled, especially because the state’s primary source of drinking water is drawn from just below its thin layers of sandy soil; the 100,000-sq-mile Floridan Aquifer that spans all of Florida and parts of Mississippi, Alabama, Georgia, and South Carolina. While most landfills in Florida choose to truck their leachate to POTWs, Charlotte County decided that a more cost-effective approach would be onsite treatment with deep-well injection below the Floridan Aquifer.

Richard Allen, the county’s solid waste operations manager, said that the landfill has a vertical bentonite (clay soil) slurry wall that blends with the natural confining layer of soil surrounding the landfill below ground.

“This slurry wall separates the interior landfill leachate, groundwater, and lakes from the groundwater outside of our landfill that surrounds the entire site,” Allen said. “Leachate seeps down through the landfill to a French-drain type collection system and is pumped to the treatment facility for biophysical treatment.”

In effect, the landfill’s collection system acts as a dewatering system. As such, it helps keep a consistent groundwater gradient across the slurry wall around the landfill’s outside perimeter. This further dilutes the landfill’s leachate before treatment.

Allen also noted that, in 2010, the county opened a large composting facility across the road from the landfill. While this environmentally friendly addition reduces solid waste going to the landfill, this also adds to the leachate load needing treatment.

“For our composting processing, we take in biosolids and mix them with ground-up yard waste to make an AA-grade compost material, the best there is,” Allen said. “The composting facility has an open containment area, and when it rains, the rain water is collected, with any excess liquids needing treatment as leachate, too. In addition, we started treating condensate from our gas collection system in 2010.”

The Solution

To address its onsite leachate treatment requirements, especially for deep-well discharge, Charlotte County installed a Siemens Powdered Activated Carbon Treatment (PACT) system with sequencing batch reactor (SBR) operational capabilities. It also installed a companion Hydro-Clear rapid sand filter system for post-treatment polishing and suspended solids removal.

“Despite our additions to the leachate treatment facility’s load over its 25 years of operation, we haven’t had to look at other systems or spend money on operational improvements,” Allen said. “The system has scaled to handle the additional loads quite well.”

One of powdered activated carbon’s advantages is how it can enhance the settling characteristics of a biological treatment system. For example, it can reduce the typical settling time compared to a conventional activated sludge batch reactor.

Not only does the carbon absorb compounds in the waste stream, but many microorganisms will attach to it. Together they settle and compact in the tank to lower levels than a conventional system, enabling a larger volume of decant to be processed with each batch in a shorter period of time.

The county’s PACT system is the largest in the U.S. and consists of three, 48,000-gal SBR units, each about 48 ft long by 12 ft wide and 12 ft high resulting in a treatment capacity of 150,000 gpd. As in most biological treatment systems, before leachate reaches the units, it enters a flow equalization storage tank which enables the facility to process seasonal variations in leachate levels.

Kirk Kettler, the Leachate Treatment Facility’s chief operator, said the water treatment system uses a combination of powdered activated carbon and aerobic bacteria in the form of sludge to simultaneously adsorb and metabolize the leachate contaminants in a single stage. The SBR process helps the facility handle variability in leachate flows, typically the result of seasonal rainfall, with cycle durations depending on both hydraulic and organic loading in the reactor.

“The PACT tank goes through an aeration cycle and then we shut off the aeration, so the sludge can settle,” Kettler said. “When settling is done, we decant the clear water effluent, pumping it to the Hydro-Clear sand filter for final polishing. Then we refill the PACT tank with raw leachate and restart the aeration blower to repeat the process all over again.”

After the biophysically treated effluent passes through the sand filter, it gets pumped into the deep well injection system to a level that is 2,710 ft below ground in a confined saltwater aquifer.

The Results

Kettler said the water treatment system achieves effluent quality levels that fall far below its permit maximums, even as the landfill has aged. For example, COD averages 33 mg/L, while BOD averages less than 6 mg/L and total suspended solids averages just 3 mg/L.

As solid waste operations manager, Allen welcomes the cost-effectiveness of the treatment solution. He estimates that all-in costs for onsite leachate treatment is $5.40 per 1,000 gal or $177,000 annually. That is 95% less than the average $110 cost per 1,000 gal reported elsewhere in the U.S. to haul and treat leachate at POTWs.

If Charlotte County were paying those higher rates, its annual leachate treatment costs would be $3.6 million. Over the 25 years that the leachate treatment systems have been in place, the county has avoided nearly $86 million in cost, money that has been better spent improving the quality of living for its citizens.

William J. Cunningham, P.E., is manager of integrated solutions for Siemens Water Solutions. Cunningham can be reached at williamj.cunningham@siemens.com.