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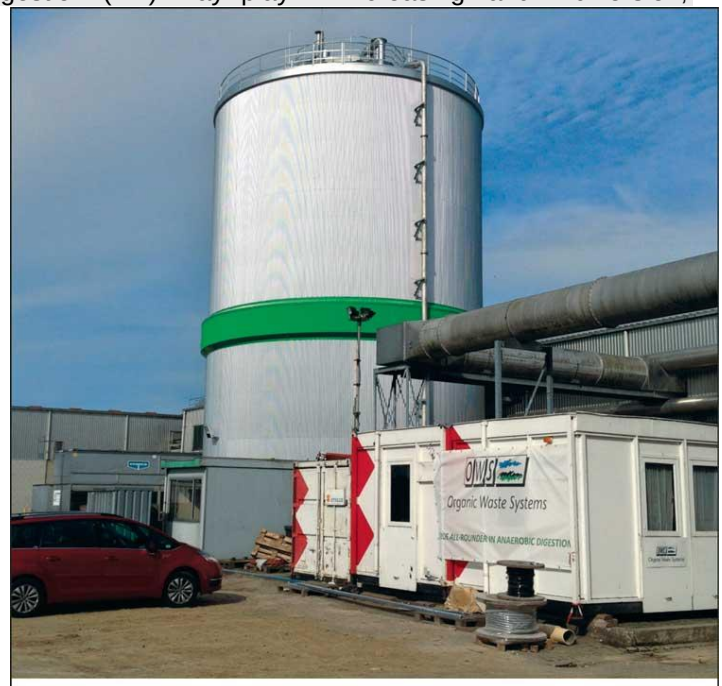
Anaerobic Digestion: The last frontier for municipal solid waste

Europe could help give an impression of what the U.S. waste disposal industry can become and what future role anaerobic digestion (AD) may play in increasing landfill diversion, producing biogas, nutrient-rich products and compost for municipalities.



Organic Waste Systems' second plant in Wijster, Netherlands. It processes 44,000 tons per year of biowaste, including food waste, yard waste, soiled papers and compostable packaging. Plant started up in May 2013, the second OWS digester at the site owned by Attero BV.

The Landfill Directive established by the European Union in 1999 is now firmly established and is on track to reduce the landfilling of biodegradable municipal waste to 35 percent of 1995 levels by 2016. Part of that diversion progress can be attributed to the wide adoption of anaerobic digestion technology to make biogas. Europe now has over 10,000 operating digesters with some communities essentially fossil-fuel-free because of them.

A digester vessel is an air-tight tank that can be of nearly any size or shape. Depending on the type of system employed, with intermittent mixing, digestion time varies depending on the composition of the material being digested, up to a month in some cases. It can be batch-to-batch or continuous process. The technology and economics of the various processes have been established over decades in thousands of installations worldwide, primarily for wastewater and agricultural applications. Now, it looks as though AD is on the verge of breaking through into North American MSW operations.

Norma McDonald, sales manager for Organic Waste Systems (OWS), a Belgium-based company has 30 of its DRy-ANaerobic-Composting systems installed around the world, 27 of which handle municipal solid waste (MSW). These systems are located predominately in Europe with some in Japan and Korea.

“Since 2005 we’ve been building agricultural systems in the U.S. and have installed 13. Like others in our industry, we are hoping that this is the year that we win some U.S. projects on the MSW side. We are a finalist on several MSW projects and hopefully we will have an AD plant up and running in the U.S. within the next two years.” McDonald said.

McDonald continued, “All of our facilities produce biogas. We have facilities that are predominately food waste. Some handle 90 percent food waste from homes, restaurants and stores. We have other facilities where the feedstock is yard waste, up to 85 percent. The main thing that makes MSW really attractive is that it will produce 10 to 35 times more biogas than manure, or sludge coming out of wastewater treatment facilities.”

“After digestion, our SorDiSep process can be used if you want to achieve pristine compost even after you have processed MSW without source separation. The advantage of this process is that after digestion, a closed-loop dilution step uses the same water to continuously cycle. The material that comes from the digester is about 22 or 25 percent total solids and we dilute further to 5 to 7 percent total solids. This makes the heavy material sink and things like light plastics float. The advantage after digestion is that this closed-loop process reuses the water, and you don’t have to worry about salt or ammonia accumulation, or worry about losing biogas potential. The result is separated clean sand, fresh compost, inerts and light fractions.”

Patrick Serfass, executive director of the American Biogas Council said, “As a society if we want to increase our recycling rates above about one-quarter of our trash we have to recycle our organics. There are two main ways to recycle organic waste, composting and anaerobic digestion, but only anaerobic digestion allows you to produce energy while also creating the nutrient-rich soil products like compost.”

Currently, there are nearly 1,500 AD systems operating on U.S. farms and wastewater treatment plants producing biogas, compost and fertilizer. “The potential for U.S. growth is huge. We count almost 12,000 sites ripe for development, not only farms and wastewater treatment plants, but also 540 landfill projects which could support a digester today and an unknown number of industrial sites like food and beverage processors beyond that,” Serfass added.

Anaergia, Inc. headquartered in Burlington, Ontario, claims to extract over 95 percent organics from mixed waste streams and highly contaminated source separated organics.

Organics are cleaned and digested in AD systems that produce a high purity biogas that can be used to generate renewable energy or fuel. After organics are recovered from waste streams, roughly 70 percent of the waste typically remains in the dry fraction of MSW. From this stream, recyclables such as plastics, papers, glass and metals are recovered. The remaining dry residuals can be gasified to maximize diversion and energy recovery. Residuals from source separated organics and other food wastes can be composted and used as fertilizer on farms. This diverts nearly 100 percent of source separated organics and provides an alternative to chemical fertilizers.

Bernie Sheff, vice president of agriculture at Anaergia offered his opinion on the possibilities of AD for municipal waste. “For MSW operations in the U.S. today anaerobic digestion is really in its infancy. You have a number of cities that are beginning to see the opportunities and realize there’s power production there. California is leading the curve right now. There are a number of companies that are building facilities in California, including our project in Anaheim, which is an excellent example.”

“They are building facilities that will bring in materials that go through separation to recover conventional recyclables, and then the rest goes to a digester to make biogas and then upgrade it to renewable natural gas to fuel the trucks coming in,” Sheff reported. “So there’s complete energy recycling at transfer stations that are starting to come to light. I have projects on the east coast that are just starting to take off. There are a number of site-separated organic projects that are currently in place in Massachusetts that are bringing in food waste, sending it to a digester to make biogas, making power and putting it on the grid.”

“I suspect with the switch-over of municipalities from diesel to methane and with Renewable Identification Numbers in place you are going to see a huge shift in the AD industry. And, as more landfill bans on organics occur, we will begin to switch over to AD as they have in Europe,” Sheff concluded.

In August, Anaergia commissioned a new anaerobic digester facility at Michigan State University in East Lansing to serve the 48,000 students and 5,000 faculty. “This system is the largest on a college campus in the United States,” said Dana Kirk, a specialist from MSU’s Department of Biosystems and Agricultural Engineering. “It’s the largest in volume and in energy output. The digester will utilize about 17,000 tons of organic waste to generate 2.8 million kilowatt hours of electricity per year. Only about 20 percent of the energy we produce is being used to sustain the process,” Kirk said. “The other 80 percent is available for other uses on campus.”

The organic material the system uses includes cow manure from the MSU Dairy Teaching and Research Center; food waste from several campus dining halls; fruit and vegetable waste

and fat, oils and grease from local restaurants. Manure, food waste and other organic matter are placed in an airtight tank, which holds about 450,000 gallons of material. The tank contents are maintained at roughly 100 degrees Fahrenheit for 20 to 30 days. The organic material is decomposed by a group of naturally occurring microorganisms found in livestock manure. The result is biogas and a slurry of partially decomposed organic matter, water and nutrients. Total project cost was about $5 million and is expected to pay for itself in less than 15 years.

The county of Maui in Hawaii recently announced that Anaergia was awarded the integrated waste conversion and energy project for the Central Maui Landfill. Anaergia will privately finance, design, build, own and operate the renewable fuel facility that converts Maui's waste streams including municipal solid waste, food waste, sewage sludge, oils and grease into renewable liquefied natural gas and solid fuel from residue. The two renewable fuels may be used for on-site energy generation, or locally as a replacement to imported fossil fuels. In addition to generating renewable fuel from local waste without the combustion of solid wastes, the project will divert roughly 85 percent of County's waste from landfill, reduce over 100,000 tons of greenhouse gases per year and create permanent, local jobs.

David Schneider, Anaergia's director of business development commented on the Maui project, "Maui wanted a system that was commercially proven and we were the winner among over 20 proposals. We will be taking in up to 450 tons per day of municipal solid waste and extracting the organic fraction for digestion. We are using our organic extrusion press technology to remove the organic fraction and create the feedstock for digestion. It's a fully integrated waste management system that will be located at the central Maui landfill. The intent is to recycle first, handle standard recyclables like cans and bottles, and from those residuals extract the organic fraction for digestion to create renewable natural gas. With permitting, design and engineering it will be a two to three year project."

Anaergia was also recently awarded a contract to finance, build, own and operate an anaerobic digestion facility for the City of Anaheim; a suburb of Los Angeles with population of 336,265 and the 10th largest city in California. The project has the potential to recycle approximately 300 tons per day of food waste that was previously landfilled. It will feature Anaergia's organics extraction process to remove a clean organic fraction from the municipal solid waste stream and be anaerobically digested for power production. The annual 4.5 MW of power produced will be purchased by the City to help reach its 33 percent renewable portfolio standard target by 2020. In September, the City of Anaheim approved a renewable power purchase agreement.

Schneider speculated about the future of anaerobic digestion for MSW applications in North America: "I think in the next several years you'll see in California taking a much more

aggressive approach to AB 341 for mandatory commercial recycling addressing organics going to landfills. In the near term, the places I see AD making the most sense are in the Northeast, the western part of the United States and in Canada.”