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Anaerobic Digestion at Lawnhurst Farms: Case Study

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Contents:

Anaerobic digestion overview

Digester type	Complete mixed
Digester designer	EnviTec Biogas
Date Commissioned	June 2012
Influent	Raw manure, food waste (whey, vegetable production waste)
Stall bedding material	Post-digested separated manure solids
Number of cows	1,200 lactating cows
Rumensin® usage	Yes
Dimensions (width, length, height)	100-ft Diameter 24-ft high
Cover material	Double layered plastic membrane covers
Design temperature	100 degrees °F
Treatment volume	1.3 million gallons
Estimated hydraulic retention time	30 days
Solid-liquid separator	Yes; screw press solid separator
Biogas utilization	GE Jenbacher engine-generator set (541-kW)
Carbon credits sold/accumulated	No
Monitoring results to date	N/A

FARM OVERVIEW

- Lawnhurst Farms, (Stanly, NY) a family farm for the past three generations, since 1925, is owned and operated by Mr. Don Jensen with his son and daughter, Donny and Kelley.
- Lawnhurst employs about 30 employees to work on the farm.
- The farm has about 1300 dairy cattle.
- The farm raises crops such as corn, alfalfa and beans on 2,300 acres of land for on-farm use.
- Lawnhurst began expanding in 1992, expanding from a 180-cow herd to about 300 head. They then expanded again in 2002, building a freestall barn and a parlor
- The Jensen's first started looking at anaerobic digestion in 2007. After a few year of investigation, they decided to travel to Europe in 2010; where the Jensen's connected with Envitec Biogas. The company was very interested in expanding into the U.S. however, was not able to at that time.
- After receiving a grant from NYSERDA, as well as other grants and funding, and after two years of dealings and planning between Lawnhurst and Envitec, construction began in June of 2012. A diagram of the digester is shown in figure 1.
- Envitec biogas also provided Lawnhurst with operational training. Donny spent four months in Germany touring other biogas plants, as well as receiving hands on training to prepare him to oversee the digester at Lawnhurst.

Why the digester?

Well-designed and operated anaerobic digestion systems can reduce a farm's odor emissions, preserve nutrients in treated manure for use by field crops, and reduce the risk of run-off and leaching of nutrients when properly applied to land with a growing crop in accordance with the governing comprehensive nutrient management plan (CNMP). Combined heat and power generation can offset purchased heating fuels and electrical power. These were the major drivers for constructing the digester along with the desire to continue being a good neighbor. The farm selected a complete mix digester over a plug flow digester due to the flexibility of the mixed digester to handle comparatively low solid concentration influent as well as food waste from outside sources. Food waste generators pay a tipping fee to the farm, which can substantially

improve the economics of on-farm anaerobic digestion. The process flow diagram for the Lawnhurst Farm digester is shown in Figure 1.

Digester System

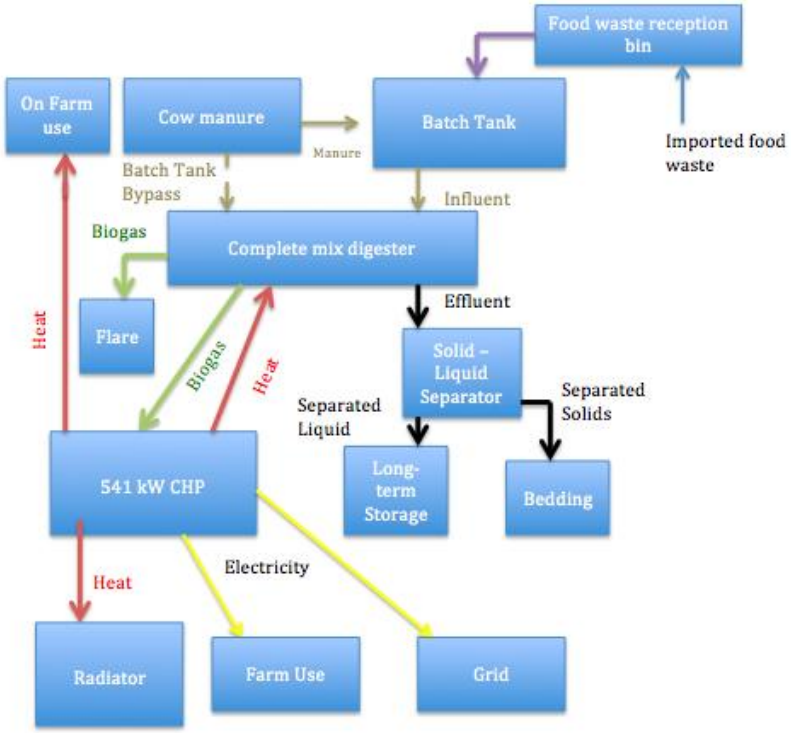

Figure 1. Lawnhurst Farm AD system flow diagram

System and process description

A 1.3 million-gallon mixed digester with a designed hydraulic retention time of approximately 30 days, based on manure from 1,300 dairy animals (1,200 lactating and dry cows and approximately 125 heifers) plus the addition of raw food waste, was designed by Envitec Biogas. Hired contractors assembled the pre-cast concrete digester vessel and constructed the pre-digestion batch tank and support buildings. Food waste from vegetable production is being sourced from local farmers and processing centers in the area. The food waste will be received in a reception bin and fed into the digester after being mixed in a 26,000-gallon batch tank. Cow and heifer barn manure alleys are cleaned with alley scrapers. Alley scrapers deposit collected

manure in under-the-barn storages where it is subsequently pumped to the batch tank then the digester. Contents of the food waste reception bin would be added to the batch tank as well, and mixed for one hour before being fed into the digester.

Initially the farm will only be digesting raw manure, however they are currently looking for vegetable production waste and other food wastes to add into the influent. Several years before the digester was built the farm started separating raw manure and used the solids for bedding while sending the liquids to long-term storage. With the digester in commission the liquid-solid separator now separates the effluent after the digestion process.

The digester vessel is made from pre-cast concrete, which was cast in Canada. The concrete is insulated using styrofoam insulation as well as fiberglass insulation. The biogas is contained by a flexible, two layered dome top. There are three vertical agitators located around the digester vessel that can be adjusted in angle and depth to keep solids suspended and assist in the release of biogas. Air is infused into the gas chamber for H_2S control at the top of the vessel. Electric blowers are used to transfer biogas from the digester through underground pipes, which cool the biogas, then through condensation traps, which drain the moisture. From there it is then transferred to the biogas utilization building (shown in Figure 2) where it is used to fire a 541-kW GE Jenbacher engine-generator set. In the case of a generator shut down for an extended period of time, a flare has been installed to mitigate high-pressure safety risks. The flare is only operational if the generator is not in operation.

Figure 2. Lawnhurst farm biogas utilization building

Liquids and solids process description

Mechanical liquid-solid separation is achieved by using a FAN screw-press separator. Raw manure is now pumped from the cow and heifer barns to the underground temporary storage then into the batch tank. After the digestion process the effluent is pumped into the solid-liquid separator where separated liquids are transferred into a long-term storage lagoon and separated solids are used for freestall bedding.

Heat and electricity generation

Biogas is then utilized by a J 312 GS Jenbacher engine generator set made by GE. Generated power is used on-farm and excess is sold to the grid under the provisions of the New York State net metering law (see Fact Sheet No. NM-1) The heat that is generated is first used to heat the digester vessel then it is piped to the milking facility where it is used as a heat source in the winter, as well as a hot water source for the farm.

Benefits and Considerations

Benefits	Considerations
• Odor control • Potential revenue from: 1) Value-added products 2) Reduction of purchased energy 3) Sale of excess energy 4) Food waste tipping fees 5) Efficient use of biogas production 6) Carbon credit sales • Nutrient conversion, allowing use by plants as a natural fertilizer, if effluent is spread at an appropriate time • Pathogen reduction	• Possible high initial capital and/or high operating costs • Long and tedious contracts with the local utility; may require special equipment for interconnection • Dedicated management of the digestion system is required • Careful attention to equipment maintenance and safety issues due to the characteristics of raw biogas • Increased land base may be required to handle the imported food waste nutrients • Specialized permits may be required to import food waste

Lessons Learned

The farm reported that the following lessons were learned as a result of building and operating their anaerobic digester.

- The construction of the system began in June of 2012 with the initial operations date being in the end of December. However, both the farmer, as well as the system designer said that the amount of energy it takes to heat the digester vessel was unbelievable when the manure is as cold as it is in December. The recommendation being to plan the construction making the initial operation date to occur in the summer.
- Working with a company based in Germany, they had conflicts with shipping into the U.S. from Europe. This being the first system of its kind in the United States, Envitec said that they would like to source more of the equipment and building supplies out of the U.S. instead of shipping from Germany.
- Communication is very important; Continuity is important to keep the constant communication between Envitec and the farm.
- Communication between the farm and the utility service; working with the utility has been one of the toughest parts for Lawnhurst, they recommend keeping a constant dialog with the utility service to keep the ball rolling on the project.

WHO TO CONTACT

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