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PRO-DAIRY

Anaerobic Digester at Lamb Farms: Case Study

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Anaerobic digestion overview

Digester type	Plug Flow
Digester designer	DVO (Formerly GHD)
Date Commissioned	2010
Influent	Raw manure, whey permeate
Stall bedding material	Post-digested separated manure solids
Number of cows	2,300 lactating cows
Rumensin® usage	Yes
Dimensions (width, length, height)	72-ft X 150-ft X 16-ft
Cover material	Pre-cast concrete
Design temperature	96-100 degrees °F
Estimated total loading rate	40,000 gallons per day
Estimated hydraulic retention time	24 days
Solid-liquid separator	Two EYS; screw press solid separators
Biogas utilization	476-kW Guascor Engine Generator
Carbon credits sold/accumulated	No
Monitoring results to date	N/A

Farm overview

- Lamb Farms milks about 2,300 Holstein dairy cows (Figure 1)
- The farm is located outside the town of Oakfield, NY
- The onsite digester was commissioned in the beginning of 2010
- Lambs milk on a Westfalia Surge 60-cow rotary parlor 3 times a day

Figure 1. Freestall barn at Lamb Farms

Why the digester:

Lamb Farms chose to build a digester as a way to mitigate the rising cost of both electricity and bedding. The anaerobic process has the potential to greatly reduce the odor emitted from manure storages, which in the case of Lamb farms, is located near a local school. Being so close to a town center, Lambs must be proactive in dealing with odor issues.

Digester System:

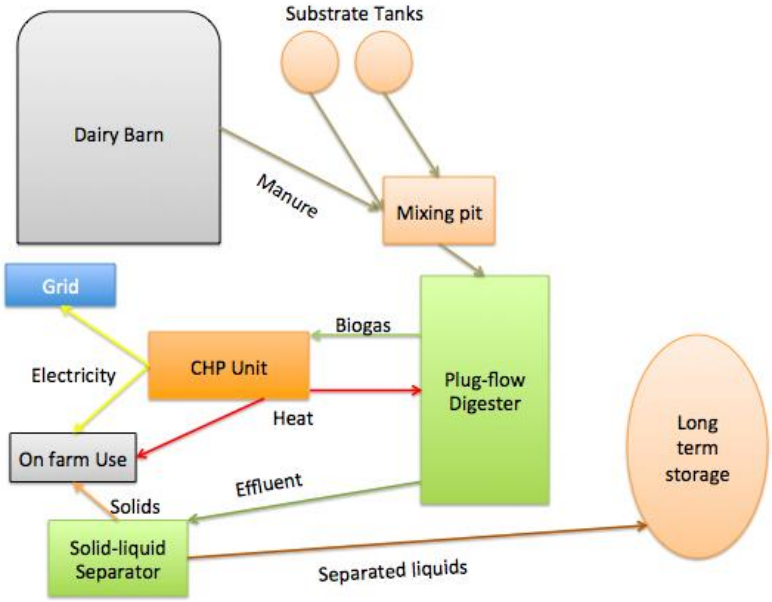

Figure 2. Lamb Farms digester flow diagram

System and Process Description

The process flow diagram for the Lamb Farm digester is shown in Figure 2. Of the 2,300 dairy animals milked on-site at Lamb Farms, only about 1,050 of them provide manure that is utilized by the digester. The farm decided to only send manure from one of the freestall barns so that they could continue to use sand bedding in the other barns. The

farm has two different manure systems; the anaerobic digester, which serves one barn, and a sand separation system, which serves the barns that, are bedded with sand. The sand-laden manure from the portion of the farm that houses cows bedded with sand, is sent to a Mc Lanahan sand-manure separator. The farm not only processes the manure from the dairy cows but also takes in other substrates including 8,000 gallons a day of whey Permeate. The substrates are unloaded into two 5,000-gallon fiberglass tanks. The manure and substrates are first pumped into a mixing pit, and then transferred into the digester. The digester is made from cast-in-place concrete with a pre-cast top, which is covered in spray foam insulation. A portion of the biogas taken from the headspace of the digester is then recirculated back into the digester acting as a form of mixing. After about 24 days in the digester the influent then gets pumped up to two solid-liquid separators. From the separators the liquid effluent gets pumped to a long-term earthen storage. A CHP unit that produces electricity and heat for the farm utilizes the biogas that is harvested from the process.

Liquids and Solids Process

The manure is collected from the barn by alley scrapers. The scrapers collect the manure into a central pit, where it is then pumped into the mixing pit. After effluent exits the digester it gets pumped to two solid liquid separators (Figure 3). The material is then separated as it drops down into a commodity shed where it is stored for later use. The solids that are produced are used to make bedding, which is only used in the barn that provides manure for the digester. Additionally, the separated solids bedding is applied three and a half times per a week. Currently more solids are produced than is needed for bedding purposes.

Figure 3. Solid-liquid separator

Heat and Electricity Generation

The biogas is collected from the 24-inch headspace at the top of the digester. A portion of the biogas is then recirculated back through the influent by way of pipes near the heating racks on the center wall within the digester. This facilitates the mixing of the influent. The biogas is utilized by a Guascor SFGLD 360 CHP; a 12-cylinder engine that powers a 476-kW generator. Heat from the energy conversion process is then used to heat and maintain the temperature of the digester. Excess heat is also used to heat some barns, the

milking parlor, and milking center wash water. The CHP unit runs at about 350-kW consistently. The farm uses the majority of the electricity generated but does sell the excess power under the NYS Net Metering law to National Grid. The farm preforms oil changes on the engine every 600 to 700 hours of run time and the engine heads must be rebuilt every 14,000 hours.

Economics:

The entire project, from engineering costs to equipment and construction costs, was roughly $1.6 million. The farm received several grants including one from NYSERDA. All of the grants totaled about $1.4 million. The savings in bedding and electricity, as well as the tipping fees received, have proven to offset the initial capital costs at Lamb Farms.

Benefits and Considerations:

Benefits

- 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

Considerations

- 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
- Specific permits may be required to import food waste

Lessons Learned:

- H_2S levels should not be ignored and a system to control the levels should be well thought out from the beginning of a digester process.
- Plug-flow style digesters are prone to build up of solids at the bottom and eventually need to be cleaned out, which can be costly and disruptive to typical farm duties.
- A company that provides full service anaerobic digester planning, including technical and business consulting, as well as other resources as related to anaerobic digesters, is in high demand for farms that have anaerobic digesters.

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