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PRO-DAIRY

Anaerobic Digestion at Swiss Valley Dairy: Case Study

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Contents:

Anaerobic digestion overview

Digester type	Plug Flow
Digester designer	DVO (Formerly GHD)
Date Commissioned	October 2009
Influent	Raw manure
Stall bedding material	Separated post-digested manure solids
Number of cows	1,450 lactating and replacement animals
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	30,000 gallons per day
Treatment volume	1,100,000 gallons
Estimated hydraulic retention time	30 days
Solid-liquid separator	Yes: Two Doda screw press separators
Biogas utilization	Guascor Engine-Generator Set 300-kW
Carbon credits sold/accumulated	No
Monitoring results to date	N/A

Farm overview

- Swiss Valley Dairy milks about 900 Holstein dairy cows (Figure 1)
- The farm is run by owner, Hubert Wick
- Swiss Valley is located outside the town of Warsaw, NY
- The onsite digester was commissioned in October of 2009

Figure 1. Coverall Barn at Swiss Valley Dairy

Why the digester:

Swiss Valley Dairy decided to pursue the option of building an anaerobic digester for their 900-cow farm for a variety of reasons. With the cost of energy rising, an anaerobic digester can provide a reliable source of on-farm generated electricity. The electricity generated is used to off-set the needs of the farm, as well as to provide some income in months where excess electricity is not needed. The process has the potential to provide a product with significantly reduced odor, which reduces the risk of upsetting neighbors when spreading post-digested manure on fields. The process flow diagram for the Swiss Valley Dairy digester is shown in Figure 2.

Digester System

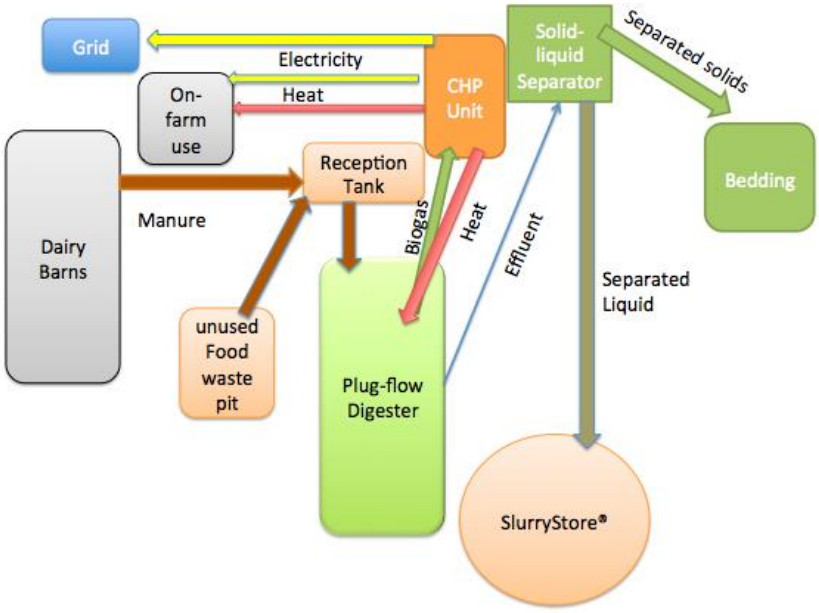

Figure 2. Swiss Valley Digester Flow Diagram

System and Process Description

A skid steer scrapes the barn floors and manure is aggregated in a central pit which gravity flows to the reception tank where it is agitated and mixed with material from the food waste tank. The farm does not currently take in food waste, however they use the tank as storage for manure from replacement animals. The manure blend then gets pumped into the plug-flow digester. The hydraulic retention time is about 30 days. The digester is made of cast-in-place concrete and covered by a pre-cast concrete top. The concrete top and exposed sidewalls are then insulated with spray foam insulation. There is about 14 inches of headspace in the top of the digester to allow for biogas to be collected. Ambient air is pumped into the headspace of the digester to mitigate some of the H_2S before it gets sent to the engine, however, some experts would not recommend H_2S reduction in this manner due to the potential it creates for corrosion in the system. After the effluent comes out of the digester it is then pumped into two Doda screw press solid-liquid separators. The biogas is sent to a 300-kW Guascor engine-generator set.

A 4-inch flare combusts the excess biogas that the engine cannot use or when the engine is receiving maintenance. The effluent is then pumped to the long-term storage Slurrystore® tank, where it remains until it is spread onto the fields. The heat that is produced from the CHP unit is used to heat the digester to about 100 degrees; it is also used to heat water for use in the milking parlor and as a source of heating in the calf barn.

Liquids and Solids Process

The effluent from the digester is pumped to an upstairs room where it is separated by two Doda screw press separators (Figure 3). The separated material falls onto a conveyer belt where it gets stored in a pile. The solids are then used as bedding in the dairy barns. The farm uses about 100 cubic yards of separated solids a day, which is slightly less than they produce on a daily basis. The farm beds the cows everyday, in order to keep the stalls as clean and dry as they can. The liquids that are separated out are pumped to the long-term storage. The effluent also has the capability to be pumped back into the under the-barn manure storage to assist in pumping, making the material more fluid.

Figure 3. Solids separation room

Heat and Electricity Generation

As shown by the farm records, the biogas that is sent to the engine averages 60% CH_4 and 36% CO_2 and the H_2S levels run at about 1000-1400 ppm. As shown in Figure 4, an 8 Cylinder Guascor engine-generator set utilizes the biogas to produce electricity that is supplied to the farm, while the excess is sold to the grid under the NYS Net Metering law. The farm built an engine room that would allow for the addition of a second engine if desired in the future. The second engine would allow for a redundancy if one of the engines were to break down, and would also double their current electrical output.

Figure 4. Engine room

Economics

Swiss Valley Farm had a total initial investment in the AD system of about $1.7 million. They offset this price with a NYSERDA grant, as well as a federal tax credit. The sale of electricity and the avoided expenses also contribute to the economic outlook of the project. One major economic benefit as cited by the farm, has been the avoided cost of bedding. A break out of the costs can be seen in Table 1.

Anaerobic Digester Economic Costs

Digester Constuction	$	500,000.00
Digester Heating system	$	200,600.00
Gas Mixing system	$	44,250.00
Building and Plumbing	$	106,500.00
Electrical Gen-Set	$	350,000.00
Solid SeparationBuilding	$	135,000.00
Engineering/administrative	$	355,000.00
Total		**$1,691,350.00**

Table 1. Economic cost chart

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 • Specific permits may be required to import food waste

Lessons Learned:

- The H_2S level of the biogas is far to high and causes many problems with the engine as well as the pipes that plumb the biogas from the digester to the engine. A scrubber or other means of reducing H_2S, should be carefully considered when building a digester project.
- Plug flow design anaerobic digesters are difficult to open and can be very costly when a system needs to be cleaned out.

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