Anaerobic Digestion at Sunny Side Dairy, Inc.: Case Study

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Anaerobic digestion overview

Digester type	Plug-flow with biogas recirculation
Digester designer	GHD
Date Commissioned	May 2009
Influent	Raw manure
Stall bedding material	Separated manure solids
Number of cows	2,900 lactating cows + 1,400 heifers (designed for 4,400 cow equivalents)
Rumensin® usage	Yes; used on all dairy cows and all heifers
Dimensions (width, length, height)	144’ x 240’ x 16’
Cover material	Pre-cast concrete, spray foam insulation, spray sealer
Design temperature	100°F
Estimated total loading rate	80,000 gallons per day
Treatment volume	3.76×10^6 gallons
Estimated hydraulic retention time	57 days
Solid-liquid separator	Yes; separated manure solids used for bedding
Biogas utilization	Guascor engine with 500-kW generator
Carbon credits sold/accumulated	No
Monitoring results to date	None available

Farm overview

- Sunny Side Dairy, Inc. (Venice Center, NY) has been a family farm for three generations, currently operated by the managing partners Greg and Neil Rejman
- The farm has 3,300 total milking age cows + 1,400 800 to 1,200 lbs heifers
- The farm raises forage crops on 5,000 acres of land
- Digester construction started in April 2008 with commissioning in May 2009.

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), and provide an offset of purchased power and heating fuels. The digester is also an integral component of an overall manure treatment system and allows the farm to be well positioned for future opportunities in manure treatment and renewable energy. These were the major drivers for constructing the digester along with the desire to continue being a good neighbor.

Digester System

System and process description

The digestion system was designed by GHD. A detailed flow diagram of the system is provided on the following page. There are two parallel constructed and operated anaerobic digestion vessels, each 72' wide by 240' long by 16' deep with a 1.5' biogas head space above the manure surface. Total processing capacity of the two units is 3.76 million gallons. Overall the digester vessels are designed to process manure from 4,400 cow equivalents with a design retention time of 20 days. Based on the current loading rate of 2,900 lactating cows and most of the farm's heifers, the daily influent volume is 65,000 gallons with resulting hydraulic retention time of 57 days.

The digester is designed to co-digest liquid substrates and this may be pursued in the future. The concrete digester vessel and pre-digestion holding tanks and support buildings were constructed by contractors.

Liquids and solids process description

Cow and heifer barn manure alleys are cleaned with alley scrapers. Alley scrapers deposit collected manure in barn pump pits where it is subsequently pumped to a 75,000-gallon influent pit located adjacent to the digester. Digester feeding and mixing is performed automatically 24 times per day by a Pro-Logic controller. A Vaughn 10-Hp pump is used to transfer material from the influent pit to the digester.

The digester solid top, constructed with pre-cast concrete insulated with spray foam, followed by a sealer, is used to contain the produced biogas. A portion of the collected biogas is re-circulated with a 40-Hp blower back into the digester vessel with the goal of providing in-vessel agitation.

Digester effluent is processed with one of three FAN screw-press solid-liquid separators. Separated solids are used for freestall bedding and excess is either sold or land-applied. The screen size used is 0.75 mm. Separated liquid flows by gravity to an intermediate long-term storage where it is stored or subsequently pumped to one of the farm's satellite storages. Stored effluent is recycled to the farm's cropland, following their comprehensive nutrient management plan (CNMP), using either liquid tankers or drag hose equipment, depending on the field location and time of year.

Heat and electricity generation

Electric blowers are used to pressurize the biogas before it is used primarily to fire the Guascor engine driving a 500-kW generator unit procured from Martin Machinery. 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). A 1.8-MW engine-generator set was initially ordered but the order had to be cancelled after the farm learned that the local utility lines were not sized sufficiently to carry the extra power.

A duel-fuel Columbia boiler (Pottstown, PA), with a 1.8 mmBtu/hr output rating, can be fired with biogas when the system calls for more heat than is reclaimed from the engine water jacket and exhaust. Excess biogas, which represents a significant portion of the overall amount, is flared thru one or two 12" power flares.

A biogas hydrogen sulfide (H_2S) scrubber was added in September, 2009 by Energy Cube, LLC to remove the majority of the H_2S prior to utilization by the engine-generator set (see Figure 1). A lower biogas H_2S concentration reduces maintenance needs and resulting maintenance costs, therefore likely increasing the capacity factor. Based on a few measurements, biogas H_2S concentrations before scrubbing were on average 4,000 ppm and post scrubbing were dropped to 40 ppm.

Figure1. Hydrogen Sulfide scrubber at Sunny Side Dairy.

Economics

The initial overall anaerobic digester system had a capital cost of $4.5 million or $1,023 per lactating cow equivalent (LCE).

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) 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 constructing and operating their anaerobic digester for 9 months.

Baby Steps: Compared to other on-farm capital construction projects, constructing an anaerobic digester took significantly more time from project conception to completion. Digester projects involve entities outside of a dairy producer's normal working circles that added considerable time to the project. For a significant part of the project, overall progress needs to be viewed on what is different this month than last and not what progress was made on a daily basis.

Utility: Be sure to get all information in writing from the utility and have papers signed as needed. It is important to engage the utility early in the digester consideration stage as significant time is needed for the utility to work thru the steps they have to do in order for an interconnection to take place.

Engine-generator set sizing: In addition to working with the digester designer and engine-generator set supplier be sure to discuss engine-generator set sizing with the proper utility contact person. In our case, and at some other AD projects in the state as well, the size of the engine-generator set was ultimately limited by the size of the utility's electrical distribution system equipment and wiring.

Patience and Perseverance are keys to success: The abnormally long period experienced with the digester project required patience and perseverance but the effort so far has been worth it. At

this point, overall we would do the project again. Five-finger waves from the neighbors when we spread digested manure on hay ground this summer was more welcome than fewer finger gestures we received in years past.

Who to Contact

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