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PRO-DAIRY

Anaerobic Digester at Zuber Farms: Case Study

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Figure 1. Anaerobic digester at Zuber Farms

Anaerobic digestion overview

Digester type	Complete mix
Digester designer	RCM
Date Commissioned	February 2010
Influent	Raw manure, permeate, waste milk
Stall bedding material	Separated manure post-digested solids
Number of cows	2,000 lactating cows
Rumensin® usage	No
Dimensions (width, length, height)	108-ft in diameter X 16-ft in depth (Figure 1.)
Cover material	Flexible polyethylene membrane
Design temperature	96-100 degrees F
Treatment volume	1,500,000 gallons
Estimated hydraulic retention time	17 days
Solid-liquid separator	Two screw press solid-liquid separators
Biogas utilization	Guascor Engine 380-kW Generator
Carbon credits sold/accumulated	No
Monitoring results to date	N/A

Farm overview:

- Zuber Farms milk about 2,000 Holstein dairy cows (Figure 2.)
- The farm is located outside of the town of Byron, NY
- The on-site digester was commissioned in February of 2010
- Zubers work about 3,600 acres of land

Figure 2. Cows at Zuber Farms

Why the digester:

Zuber Farms decided to build an anaerobic digester when new grants became available to assist with funding capital costs. They had been looking for a way to reduce the cost of their electric bill while at the same time reduce dependency on receiving bedding from other non-reliable sources.

Digester System:

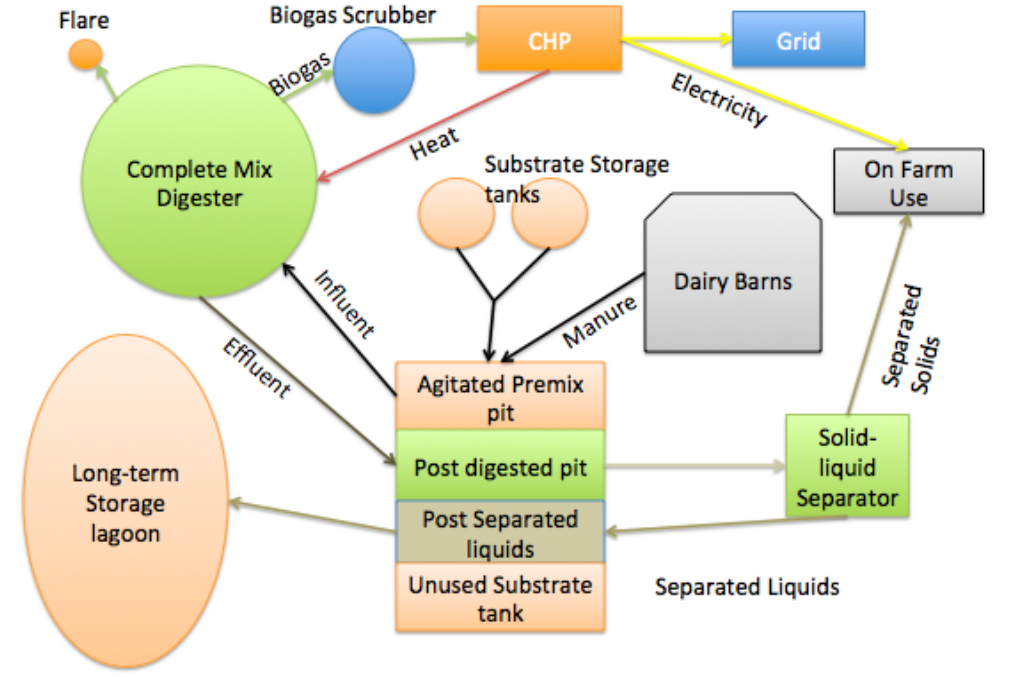

Figure 3. Digester flow diagram

System and Process Description

Figure 3 demonstrates the flow of material and biogas at Zuber Farms. The manure from several dairy barns at Zuber Farms is collected with both skid steer scrapers as well as alley scrapers (depending on the barn). The manure then gravity flows into a common pit that is agitated. The contents of the pit are a combination of the manure and material from the substrate storage tanks, which contain waste milk, and whey permeate. When the digester was first built, there was another storage tank built for substrates, however currently it is not used due to the inconvenience of its location in regards to truck traffic. The contents of the influent pit get mixed to assure a consistent quality. The influent from the pit gets pumped into the digester about every 2 hours. The digester is a complete mix digester that is 108 feet in diameter and 16 feet deep. The heating racks on the inside of the digester make a half-moon shape around each half. The digester is insulated from the ground up using rubber from old sneakers. The biogas from the digester is then sent through an Energy Cube biogas scrubber (Figure 4). The Scrubber contains plastic latticework inside meant to increase surface area; it is fed with a nutrient provided by Energy Cube. As the biogas flows through the scrubber the nutrient reacts with the H_2S and Elemental sulfur begins to buildup on the lattice surface area. After the scrubbing process a 380-kW Guascor CHP unit utilizes the biogas to generate electricity, which is used on the farm and excess is sold to National Grid. The excess biogas and the biogas that is produced when the engine is under maintenance are flared.

Figure 4. Gas scrubber at Zuber farms

Liquids and Solids Process

The effluent from the digester is pumped to a storage pit that acts as a balancing tank for the solid-liquid separators. Zuber Farms has two solid-liquid separators, one Doda screw press separator and one Fan screw press separator. The solids from the separation process are dropped into a plastic tube with a fan at one end that blows the solids out into the solids storage building. This fan helps dry the solids further and is lower maintenance than other systems, such as a conveyer belt. The liquids then get pumped back to a holding tank where it is subsequently used on fields for fertilizer or pumped to a storage

lagoon for longer-term storage. The solids from the process get used as bedding for the dairy animals.

Heat and Electricity Generation

A Guascor 380-kW CHP unit utilizes the biogas produced by the digester (figure 5.). The engine is a 12 cylinder engine, and oil changes are performed about once every 13 days. Using the NYS Net Metering law, Zuber's Farm uses the electricity that they generate to power the farm as well as several houses where employees live. The excess electricity is sold to National Grid utility. The heat from the engine is used to maintain the temperature in the digester at about 99 degrees Fahrenheit.

Figure 5. Guascor CHP unit

Economics:

The entire digester project cost about $1.1 million dollars. The costs were separated into three different categorizes: (1) biogas production, (2) electricity generation, and (3) solid-liquid separation. Of the total cost each category was split almost evenly. Zuber farms has been very happy with the bedding product that has come from the solid-liquid separators and are currently looking into selling it to garden stores to increase the income of the system. To help with the high capital costs of the project, Zubers Farm received a NYSERDA grant as well as a grant from the USDA. After the initial project was finished Zubers then added the Energy Cube BioGas scrubber, which cost an additional $165,000.

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

Benefits and Considerations:

Lessons Learned:

- When building a digester it is important to allow for future growth and a potential increase in biogas production and utilization.
- The slope of the biogas line is important to keep in mind. Moisture can condense within the line and accumulate in the engine.
- When a digester project is finished, time is needed to adjust the feeding rates and "recipes" for substrates that are loaded into the digester to allow for maximum biogas production.

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