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PRO-DAIRY

Anaerobic Digestion at Wagner Farms: Case Study

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Contents:

Anaerobic digestion overview

Digester type	Complete mixed
Digester designer	CH Four Biogas, Inc. (formerly Genesys)
Date Commissioned`	October 2010
Influent	Raw manure
Stall bedding material	Separated manure solids (switched from sand)
Number of cows	390 dairy cows
Rumensin® usage	No
Dimensions (diameter, height)	52'-5" x 19'-10"
Cover material	Flexible
Design temperature	100°F
Estimated total loading rate	6,300 gallons per day
Treatment volume	264,200 gallons
Estimated hydraulic retention time	28 days
Solid-liquid separator	Yes; separated manure solids used for bedding
Biogas utilization	MAN 100-kW engine generator set
Carbon credits sold/accumulated	Plans to in future
Monitoring results to date	Currently being monitored using ASERTTI protocol

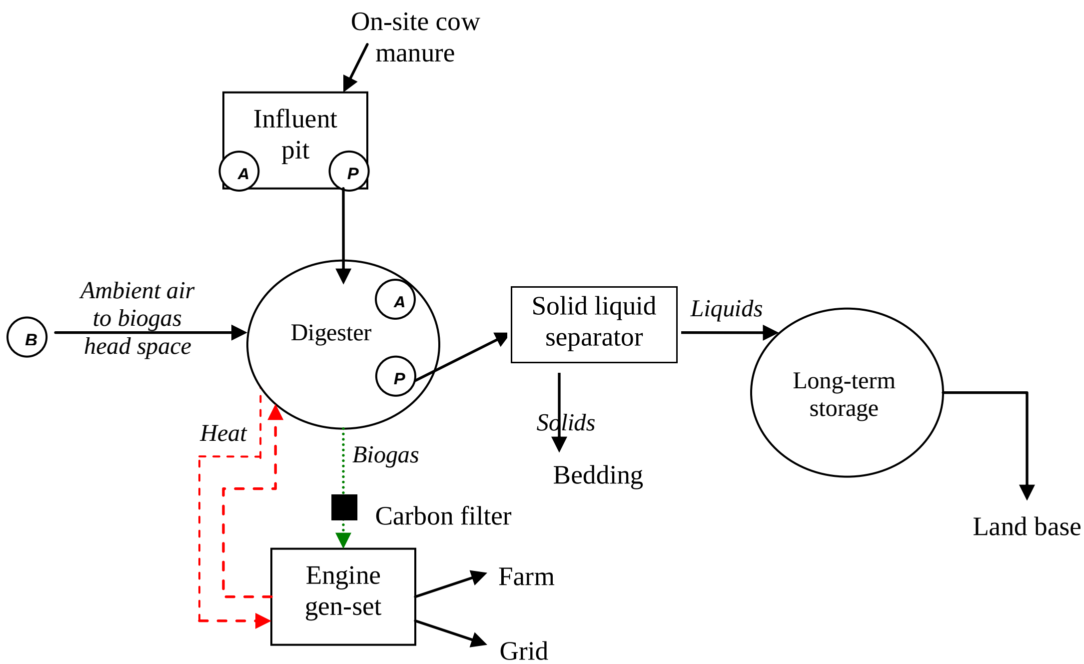
Farm overview

- Wagner Farms (Poestenkill, NY) is located in Rensselaer County
- The farm is owned and operated by Pete and Bobby Wagner
- The farm has 390 milking cows
- The farm raises forage crops on 1000 acres of land
- Digester was commissioned in October 2010

Why the digester?

The farm decided to install the digester system for several reasons, one of which was to reduce odor emissions from some fields when manure was land-applied. In addition, the farm feels that dairies are going to transition to anaerobic digestion as a typical manure management strategy. The farm expects to realize savings on bedding and electricity costs, and to position the digester as an income source for the farm. The farm also sells excess electricity, as well as post digested manure solids as compost.

Digester System



System and process description

A 264,200-gallon, mixed, mesophilic digester with a design hydraulic retention time of approximately 28 days, was designed by CH Four Biogas, Inc. based in Ontario, Canada. Manure from 390 on-farm milking cows is aggregated in the influent pit and heated prior to being pumped to the digester. The digester vessel is a circular above-ground concrete tank 52'-5" in diameter and 19'-10" in height with the liquid level at 17'. The digester tank has an in-wall heating system and 4" of extruded foam insulation surrounding the tank. One impeller agitator is inserted through the side of the digester tank, and a second port is available, should the decision be made in the future to install a second mixer. The impeller agitator is a Doda 15-kW (20 Hp) mixer that runs intermittently on a pre-determined schedule. The above-ground concrete effluent storage tank is 80' in diameter.

Compared to other New York State on-farm digesters, one unique feature of the Wagner Farms' digester is the in-vessel hydrogen sulfide (H_2S) reduction system consisting of a series of untreated Hemlock telephone poles laid horizontally on the top of the digester head space, below the cover and provides a medium for biological H_2S reduction. Hydrogen sulfide reduction begins by treating biogas with 3%-5% of ambient air pumped into the headspace of the digester to precipitate out the sulfur from H_2S. In addition to the ambient air, 1-8 gallons (based on daily H_2S levels) of liquid Ferric Chloride is added to the manure influent everyday to help with H2S reduction. Then the gas is condensed in a passive earth-cooling field, then passes through a fine mesh stainless steel particle separator before entering a gas pressure booster/blower prior to the engine.

Liquids and solids process description

Manure is collected pre-digestion in a digester influent holding pit, and transferred to the digester using a chopper pump located in the influent pit. After digestion, the effluent is separated using a solid-liquid separator (SLS) and liquids are transferred to an above-ground cast-in-place concrete long-term storage and then subsequently land applied; the solids are used for stall bedding and a small amount are sold as compost.

The farm formerly used sand bedding, but has switched to post-digested separated solids since the digester has been operating and producing solids. The farm also plans to add substrates in the future as the digester operation stabilizes and a reliable source of organic substrates can be located.

Heat and electricity generation

The farm has installed a 100-kW MAN engine procured from Martin Machinery that has a base rate of 112-kW. The threshold for the engine is 800 ppm H_2S, if the levels are higher, the engine maintenance required increases; this is the reason so many pre-engine H_2S removal steps are taken at the farm. The engine receives oil changes about once every 380 hours and a complete engine rebuild once every 23000 hours. The interval for oil changes is increasing as time goes on due to the better control of H_2S. The farms utility provider – National Grid – ran 3-phase power to the farm to allow for net metering. Generated power is used on-farm and excess is sold to the grid under the provisions of the New York State net metering law.

The digester uses a series of 5/8" Pex tubing to provide in-vessel hydronic heat. Exhaust heat is recovered from the engine and sent through the hydronic heating system to heat the influent pit, and to keep the digester at operating temperature. The farm is explored the possibility of utilizing excess heat to heat the nearby farm house and milking parlor as well, however they found that not enough heat was produced just from the engine during the winter. The farm installed a boiler to supplement digester heating in the winter.

Economics

The farm applied and was accepted to participate in the NYSERDA Renewable Portfolio Standard (RPS) program, which provides a performance based incentive of 10 cents per kWh produced by the engine over 3 years. The farm also plans to trade carbon credits and hopes to receive some revenue in doing so.

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

- Carefully assess the qualifications of the system designer you choose.
- A boiler can be useful in the winter months when more energy is needed for heating the digester.
- H_2S has been observed to be higher when the digester contents are cooler, so a consistent temperature is desirable.
- Dependable flares are important, the farm has replaced the new flares and selected flares made from stainless steel to prevent weathering and corrosion.

Who to Contact

- Keith Wagner, AD operator for Wagner Farms
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- CH Four representative contact: Benjamin Strehler, CH-Four Biogas, Inc.
- Curt Gooch, Dairy Housing and Waste Treatment Engineer, PRO-DAIRY Program, Cornell University. Phone: 607-255-2088, E-mail: cag26@cornell.edu

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