CASE STUDY

Freund's Farm, East Canaan, CT

Manure Digester to Generate On-farm Heat

Matt Freund manages 200 milking cows and 600 crop acres in northwest Connecticut. The cows are pastured 5.5 months per year, and largely confined for the other 6.5 months. A methane digester and liquid manure system was installed in 1997 to help with manure management during the non-grazing period and to generate on-farm energy.

The original digester was designed and engineered by AgStar. Matt has made numerous modifications to that design over the years. The digester only uses biomass from the dairy: manure and sawdust bedding. Matt may try changing the bedding to paper to see if more available carbon helps the digester perform better.

Manure is collected by scraping twice daily into an 8,000 gallon tank where it is mixed before entering the digester, which is a 60,000 gallon, 20-day tank. The pre-tank is heated with an added heat rack that was installed in 2000. After the digester tank is another 8,000 gallon tank. A pump moves the manure from there to a screw press separator. The solids go to compost and the liquid is stored in an 800,000-gallon lined lagoon.

The biogas from the digester tank is trapped in a plastic-covered greenhouse with metal supports. The original cover was a liquid seal, created by contact between the plastic and the manure and was very dangerous to remove, so Matt re-designed the cover to seal above the level of the manure with a dry seal.

The cost for installation was about $150,000, including two grants from the Connecticut Department of Agriculture. One grant was for $80,000 for the original construction and the other for $40,000 for modifications. Upkeep is $6,000 - $8,000 dollars per year. This includes cost of replacement motors, mixers, pumps, controller parts, energy, and labor.

When the digester is clean, there is a 20-day retention time of the manure in the tank. The retention time increases as sand and grit accumulate, until the digester fails and has to be cleaned out, after 2 to 3 years of operation.

In early spring and fall the lagoon is emptied and liquid manure applied to the fields. A pump stationed at the pit pumps 800 gallons per minute through a six-inch main line for up to one mile. At the field, application is through a drag line and a homemade injector. The pump tractor uses about 144 gallons of fuel in a little over 16 hours and the drag tractor runs at just above ideal, taking less than 40 gallons for the whole job of moving 800,000 gallons of manure.

The system produces about 15,000 cu. ft. of biogas per day for 6.5 months of the year. The rest of the year it produces about 8,000 cu. ft. per day. Assuming the biogas is 60% methane and 40% CO2, it contains about 600 btu of energy per cu. ft., so approximately 9 million btu/day are generated on-farm daily.

The gas is used for heating hot water for the dairy farm operation and to heat the farm house. The water is heated in a boiler that runs 24 hours per day. The hot water is pumped through insulated pipe lines. When it gets very cold, all the energy is needed to maintain the digester temperature so there is no energy benefit to the farm.

It takes less than 30 minutes per day to manage the system, making minor adjustments to the flame as gas quality changes, and checking system temperatures. However, a number of major problems can occur and these take a lot more time to address and can be a big hassle during weekends and holidays. Pumps go down, motors burn up, screens break, pipe lines break, foaming occurs and manure flows into alleys, holes in the cover develop or seals break.

If all costs are considered, overall the system only results in about $1,000 per year in savings compared to conventional hot water heating. That's because there are a lot of labor and maintenance costs associated with the digester, and the energy it generates cannot be used very effectively. In the summer, there is an excess of heat energy, so it is 'dumped' at no value to the farm, and in the winter 40 to 50 percent of the energy produced goes back to the digester for maintenance. On the coldest winter days, it even takes additional energy from an oil furnace to maintain the digester temperature. Being located in a cold barn is very challenging for winter management of the digester. It takes 135 Btu to bring a pound of manure from 31 to 33 degrees.

Despite these extra costs, the on-farm energy produced by the system does significantly reduce the need for off-farm energy required to heat hot water for the farm and in the farm house.

The main benefit from Matt's point of view is being able to move manure very efficiently and in an environmentally sound manner because of separation of solids from liquids. The manure is now always liquid even in the winter. It used to take two weeks with two men to spread the manure in the late spring – if the fields were dry. Now it takes one man just three days, including set up and clean up. This system of manure management is also a lot more neighbor friendly.

"Biogas is very corrosive and dangerous and needs to be taken seriously," Matt advises. "You must know what your goals are and if a digester will help you achieve them. If you're looking to make money from manure as an energy source, without some type of subsidy there may not be a payback, so you need to have other goals in mind. You also must be dedicated to running the system. It will not work without someone on the farm checking and adjusting it 365 days per year. You are farming living 'bugs' that can get sick, and when they do it's very frustrating to make them happy again."

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