FOSTER BROTHERS FARM – MIDDLEBURY, VT

A NORTHEASTERN PIONEER IN THE USE OF ANAEROBIC DIGESTER SYSTEMS

BACKGROUND/OVERVIEW

Foster Brothers Farm started out as a small dairy operation of less than 25 cows, back in 1941. Overseen by the Foster family for generations, the farm now has nearly 560 cows and, in addition to dairy products, helps to produce a line of all-natural, composted fertilizers that have developed a loyal customer base.

Back in the late 1970s, America was in the midst of an energy crisis, and Robert Foster was looking for ways to reduce his energy demands from the local utility. He attended a meeting in New Jersey with representatives from Cornell and Penn State Universities who were then at the forefront of anaerobic digester (AD) system technology, and saw how a smaller-scale system could make use of the approximately 6,000 gallons of manure his farm produced each day.

Construction on the AD system began in the fall of 1981. At the time, no grants or other special incentives were available, and Foster Brothers Farm funded the project itself. In working with the electrical utility, Robert Foster was caught off-guard by the ever-changing costs of interconnecting to the local utility at the time. "They quoted me about $12,500 originally," explains Foster, "and during construction, they raised the price to $40,000." Foster ultimately brought the interconnection cost down to $15,000 by splitting up the interconnect into its components and hiring a private contractor, but experienced temporary delays trying to find special, utility-grade, electro-mechanical relays in addition to the commercial solid-state relays required to connect to the grid. The system finally became operational in the spring of 1982.

The anaerobic digester system on Foster Brothers Farm

> *"I think that [installing an AD system] is something farm owners should think seriously about; but the feasibility of the system depends on a balance of scale. If your farm is large enough, you might have staff with enough time to maintain the system. If you are a one- or two-person operation, you might not have that time. Anaerobic digesters are living systems, not just pieces of machinery."*
>
> *—Robert Foster,*
> *Owner, Foster Brothers Farm*

THE ANAEROBIC DIGESTION SYSTEM

The Foster Brothers AD system used a soft-top, horizontal, plug-flow digester fed by a pump system that gathered manure from four collection points. Manure was digested within a below-ground concrete tank that maintained a temperature of about 95°F and had a retention time of 29 days. Recovered biogas was transferred from the digester into another building, where it was fed through a container of marble chips to remove hydrogen sulfide, and then into an 85 kW Caterpillar diesel engine-generator set. The engine-generator was modified to start-up using diesel fuel, and then shift towards biogas. At its peak efficiency, the engine-generator used a fuel mixture of approximately 70 percent biogas and 30 percent diesel. The system generated as much as 1,200 kWh per day, or up to 408,000 kWh annually. Recovered heat from the engine-generator set was used to warm the digester and provide building space heat. The system separated digester effluent into solids and liquids; liquids were piped into a storage lagoon and later applied to growing crops, while solids were used in the soil mixes that Foster Brothers Farm still produces today.

In about 1990, the price of electricity from the grid exceeded the amount the local utility paid the farm for the energy produced by the AD system. As a result, Foster Brothers decided to disconnect from the grid and power the farm (as well as three adjoining residences) through the biogas generator alone. The farm met all of its own electricity needs until the AD system's closure.

Once in the early 1990s and then again in the early 2000s, Foster found that the digester needed to be emptied in order to remove the solids that had settled to the bottom during the preceding 10-year intervals, reducing the capacity of the tank. After the first cleanout, a vertical hydronic heating panel array was installed downstream from the digester inlets. During the second cleanout, some of the heating pipes were found to be corroded and as a trial, one side (half) of the digester was retrofitted with an in-floor hydronic heating arrangement.

REASONS FOR CLOSURE

In 2011 a massive snowstorm struck New England, and the roof of the building housing Foster Brothers' AD system collapsed under the weight of snow. Faced with an estimated cost of $1.1 million to return the system to operation, Foster Brothers chose to return to the local utility for its electricity needs, and the AD system has remained dormant since the storm. The transition back to the utility grid was fairly easy, according to Foster. "We were set up to go back to the grid right away, as the infrastructure was already in place. It took some reconfiguring and communication with the utility, but it wasn't much of a disruption issue." As for returning the AD system to operation, "I'd like to get it up and running again, but we have other priorities right now," Foster explains. "We are looking at newer types of anaerobic digester/biogas systems as well as outside funding sources that might enable us to go online again in the future."

OUTLOOK

Though Foster Brothers currently has no active anaerobic digester system producing biogas, the farm still puts its manure to good use. As early as 1989, Foster Brothers began composting the solids separated through the AD system—as well as separated solids from other farms—to produce organic soil, compost, and assorted fertilizers. In 1992, the farm launched a sister company, Vermont Natural Agricultural Products (VNAP), to market and sell its compost throughout the Northeast region. With a loyal customer base, VNAP now sells more than 750,000 bags of soil mix and more than 10,000 cubic yards of bulk compost every year.

- **Animal Type:** Dairy
- **Population Feeding Digester:** 490
- **Baseline System:** Storage Tank/Pond/Pit
- **Digester Type:** Horizontal Plug Flow
- **Co-Digestion:** Diesel Fuel
- **System Designer:** Hadley and Bennett
- **Former Biogas Use:** Electricity
- **Former Generating Capacity:** 85 kW
- **Dates Operational:** 1982 – 2011

For farmers looking to establish their own AD systems to generate biogas, Foster recommends due diligence to determine economic feasibility. "I think that it is something they should think seriously about; but the feasibility of the system depends on a balance of scale," he explains. "They should do some system modeling based on what other farms already have in place. One of the major challenges is to try and make the system cost-effective, and the utility interconnect fees are now ranging from $70-$100K; more and more `middlemen' have become involved and are making the process [of connecting to the grid for energy return] prohibitively expensive. It's also a matter of time and resources—it goes back to scale. If your farm is large enough, you might have staff with enough time to maintain the system. If you are a one- or two-person operation, you might not have that time. Anaerobic digesters are living systems, not just pieces of machinery."

For more information on anaerobic digester systems, as well as an interactive map on U.S. Farms with AD systems in place, visit EPA's AgSTAR website at www.epa.gov/agstar/. You can also visit VNAP, the company that sells Foster Brothers' compost products, at www.vermontnaturalagproducts.com/.