

MANURE DIGESTERS FOR ENERGY – WHAT’S HAPPENING ON VERMONT FARMS?

Dan Scruton, Agency of Agriculture & Onan Whitcomb, Williston

A new national initiative, “25 x ‘25” envisions U.S. farms supplying 25% of the U.S. energy needs by 2025. Dan Scruton, from the Agency of Agriculture, gave a brief overview of different farm energy sources in the context of this 25% goal.

Vermont needs to determine which on-farm energy sources fit our agricultural systems best. For example, although ethanol production from corn has reached a positive energy equation (1 Joule expended gains 1.67 Joules), Vermont cannot provide the same per/ acre corn yield as other states that might supply ethanol plants. The Agency of Agriculture is looking into other high-energy crops to grow in Vermont. Wind is another option. Jack Lazor and Ken Smith both relate their wind experiences in other presentations. Anaerobic digestion is another part of the picture. Dan is working on several demonstration projects around the state.

The Methane Project at the Agency of Agriculture studies anaerobic digester system feasibility on Vermont farms. Digesters are not a new technology. In the early 1980’s, many pilot projects appeared on farms in response to oil shortages in the 1970’s. 80% of these digesters failed. Foster Brothers Farm in Middlebury is one of the 20% of digesters from that generation that continues in operation. Studying this farm has suggested changes to make in the newest digester designs. The Audet family’s Blue Spruce Farm is one location where a new digester features some of these adjustments.

➤ *Heating:* Foster Brothers uses a plug flow system where manure moves as a plug through an underground anaerobic digester and heating pipes inside the pit keeps the manure warm. Unfortunately, the heating pipes also mean that there is room only for a person with a shovel to clean out the digester. Blue Spruce Farm uses steam injection external to the pit for manure heating.

➤ *Cleaning:* Sediment build-up forces the Fosters to clean (by shovel) their digester approximately every five years. Blue Spruce Farm, on the other hand, has installed a digester

where manure moved through tubes shaped as a U with agitation perpendicular to the flow to prevent settling/ build up.

➤ *Storing Gas*: The Foster Brothers placed a soft top over their digester to collect unused gas during low demand times, which was a complication in the system. Net metering now allows all extra gas to go to electricity on the grid then be pulled back in when needed.

➤ *Solids Use*: Foster Brothers runs an extensive retail business for digested, composted solids. Blue Spruce Farm will not establish a new branch of business dedicated to marketing soil amendments. It is using the separated, composted solids as bedding. This bedding replaces sawdust imported from off-farm. Preliminary experiments suggest that the manure provides a safe bedding (UVM Extension will conduct a more in-depth study).

One change in Vermont policy that supports the economics behind anaerobic digesters is a more progressive net metering system for farms. While the net metering only works on credit (i.e. you can't earn money – only offset electric bills), farms have the option of putting electricity on the grid at one building, then drawing an equivalent amount off at any other building considered part of the farming operation.

Net metering often presents the best option for generation under 150 kW (the net metering limit). Larger farms, like Blue Spruce Farm, have set up contracts to sell all of the electricity from their anaerobic digester for CVPS at wholesale rates plus a \$0.04 renewable energy premium.

Onan Whitcomb is experimenting with a new anaerobic digester design on his 250-cow farm in Williston. Some parts of it function like conventional digesters– he scrapes manure from his barn, separates it, then uses a heat exchanger and boiler to heat the liquid portion for digestion (the solids go to bedding in cold months or field application).

The major innovation comes in the biological processes that BioProcess, a Rhode Island company, has installed within the digester tanks. The liquid drips over a medium seeded with bacteria to harvest the nutrients, yielding a N-rich sludge, a P-rich sludge and clean water. The sludges can be pumped for irrigation.

The BioProcess design reduces retention time from 21 days to 2 ½ days. The company believes that it can break volatile solids down at a rate that is twice as efficient as a plug flow digester (80% Volatile Solid destruction vs. 40%). Because the liquid portion of manure contains about half the total solids of non-separated manure this efficiency does not mean twice the energy output.

Onan has held off on purchasing a generator for his biogas while he waits to measure how much biogas this new technology produces so that he can size the equipment accordingly. In the meantime, he is saving money on manure management. His crop fields are located on the opposite side of 5 corners from his dairy, so trucking liquid manure has become infeasible. Now he transports only the solids. Soon he will be able to use the biogas for heat as well.

The Whitcomb system cost approximately \$300,000. This price includes extra monitoring costs for the demonstration stages. If this system is successful and Bioprocess increases production, the price tag should come down significantly. Unlike the standard digesters, which are built permanently within a specific site, this new design can be mass produced and trucked in to any farm.

Reference Papers

Scruton, Daniel L., Dr. Stanley A. Weeks, Robert S. Achilles. *Strategic Hurdles to Widespread Adoption of On-Farm Anaerobic Digesters*. Paper presented at the 2004 Dairy Manure Management Systems conference, Ottawa, Canada. August 4, 2004. (ASAE – 044164)

Scruton, Daniel L., Dr. Stanley A. Weeks, Robert S. Achilles. *Net Metering's Effect on On-Farm Electrical Generation*. Paper presented at the 2004 Renewable and Distributed Power Generation: Wind Solar and Other Sources Conference, Ottawa, Canada. August 3, 2004. (ASAE – 044136)