Digesters bring energy and fertilizer to dairy farms
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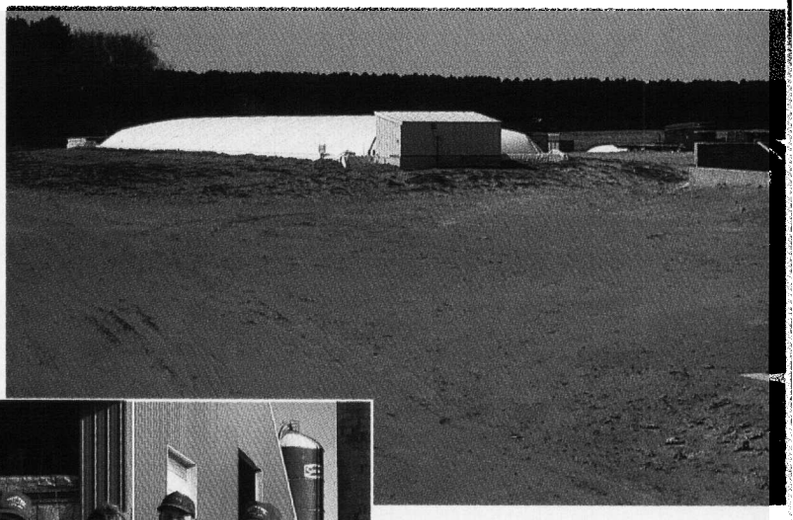
INTEGRATED TECHNOLOGY

DIGESTERS BRING ENERGY AND FERTILIZER TO DAIRY FARMS

Plug flow operation at Minnesota farm becomes major part of strategy to increase herd size and handle manure economically as well as environmentally.



To make the dairy farm economically viable, the Haubenschilds — Tom, Marsha, Bryan and Dennis (from left to right) — needed to enlarge the operation to 1,000 cows. The expansion, and related environmental issues, led to installation of an anaerobic digester (above).

THREE YEARS AGO, the two sons of Dennis and Marsha Haubenschild joined the family dairy farm in Princeton, Minnesota. Along with their wives and children, Tom and Bryan represent the third generation to be part of Haubenschild Farm Inc, which dates back to 1952, when their grandfather established a dairy herd of 100 milking cows. In order to support each family, a decision was made to enlarge the operation. Currently, 500 cows are milked, and facilities are being built to accommodate an additional 500 cows.

With the expansion, the families needed to address a wide range of other issues, including manure management, in a way that maintained herd health and environmental quality. Their analysis led to a decision to install an anaerobic digester for odor control, energy production and soil enrichment for the dairy feed crops grown on their 900 acres.

According to Carl Nelson and John Lamb of The Minnesota Project, which has assisted the farm's digester program, Dennis Haubenschild has been interested in alternative energy technology since the 1970s, but rejected the idea as too risky and costly. Instead, he installed solar collectors for heating water used in the dairy operation, but never gave up on the digester idea. "I had no doubt it would work; it just took quite a few years to tie everything together," says Dennis. Once the family decided to expand, Dennis pursued anaerobic digestion again.

Table 1. Summary of digester performance — September, 1999 to March, 2000

Month	kWh Generated	Farm Use	Excess kWh	Generator Credit* ($)
Sept./Oct., 1999	31,200	21,440	9,760	707.60
November, 1999	30,320	27,640	2,680	194.30
December, 1999	35,920	30,640	5,280	382.80
January, 2000	58,880	34,680	24,200	1,754.50
February, 2000	62,240	31,080	31,160	2,259.10
March, 2000	86,240	37,350	48,890	3,544.53
Total	304,800	182,830	121,970	8,842.83

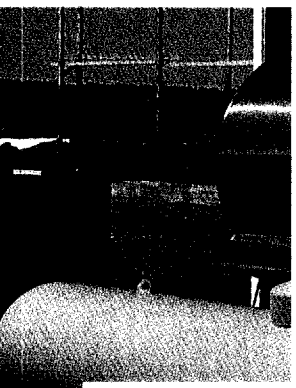
**ECE generator credit paid to Haubenschild Farms, excluding sales tax and basic service charges. Compiled by East Central Energy, Cambridge, Minnesota.*

When traditional lenders rejected the idea, the Haubenschilds sought grants and loans from nontraditional sources.

A new zero interest loan program for the technology had been recently established at the Minnesota Department of Agriculture. After qualifying for a loan as well as for additional grants from other sources, they were able to procure the $250,000 required for the digester and manure handling system. The federal AgSTar program — a joint project between the Environmental Protection Agency, Department of Energy, and the Department of Agriculture — provided technical and engineering support for planning, design and construction of the digester and energy conversion system. The Haubenschild project is one of 13 charter demonstration farms in the AgSTar program.

HOW THE DIGESTER WORKS

The plug flow digester seemed the best fit for the Haubenschilds' dairy operation. One reason is that they use recycled newspaper bedding. According to Dennis, the bedding adds fiber to the manure, provides clean and comfortable rest areas for the cows and is low cost. Barns are scraped and new bedding is shredded and put down three times a day. As explained in a report in *The Voice of Agriculture,* published by the Minnesota Farm Bureau, the Haubenschilds' plug flow digester started to work in September, 1999. To operate the digester, manure is scraped into an alleyway pit; from the pit, manure is gravity fed through a 24-inch pipe to the mixing pit. There it is tested for consistency to feed the digester the optimal mix of volatile solids and liquid.



The digester itself is a concrete pit in the ground capped with heavy reinforced cloth and plumbed for heating and gas capture. It is 30 feet wide, 150 feet long and 14 feet deep. The manure is pumped into the digester. Hot water pipes running through the center of the digester are used to heat and keep the manure at 100°F for the most efficient and balanced microbial action and hot water use. This is also the most manageable temperature for Minnesota, since it would be difficult to maintain higher temperatures in winter months.

Another pipe system collects the methane gas and sends it through a meter and onto a CAT 3406 150 kilowatt engine and generator unit. In the first seven months, the digester has created over eight million cubic feet of biogas and 305,000 kWh of electricity. The generator creates enough power to fulfill the electric needs of the dairy and heat the manure in the digester as well as over 9,000 square feet of floor space in the dairy facilities. In addition, the Haubenschilds partner with their local utility, East Central Energy Coop, to sell excess energy to the coop that is used to power at least 30 homes.

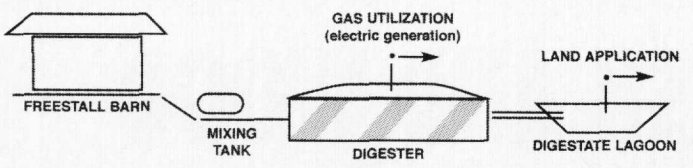
It is taking from 35 to 40 days to push a slug of manure through the digester. When the dairy operation expansion is completed, the time will be reduced to about 20 days. After manure is pushed through the digester, the biologically sta-

Energy And Savings Produced By Haubenschild Digester

- Over 50,000 cubic feet of biogas/day
- 2,000 kilowatt hours/day of electricity (80 kW)
- Saving approximately $400/month in winter heating costs to heat 9,000 square feet of barn space
- Saving over $20,000/year in electricity bills
- Selling additional electricity to East Central Energy

Based on preliminary data compiled by staff of The Minnesota Project

Figure 1. How a digester works



bilized effluent (digestate) flows into a storage pond, where it will remain until land application. Most offensive odors are removed by the digestion process, and digestate analyses suggest the product will be used more readily by growing plants than untreated manure. The heat of digestion also kills weed seeds and up to 90 percent of pathogens. Manure is tested at least monthly, in addition to soil testing, to help maintain optimal land application rates. "It's too valuable just to (randomly) put it on the field," Dennis emphasizes. "We are able to significantly cut back on commercial fertilizer by using digestate from the storage pond."

"So far, results look promising," report Nelson and Lamb of The Minnesota Project based on statistics being compiled. "When the farm grows to 1,000 cows as planned, the expected electrical output will be enough to power the farm and about 60 other households. The local electric cooperative, East Central Energy, has agreed to buy the excess electricity at full retail price around the clock." A summary of the digester's performance from September, 1999 through March, 2000 — compiled by East Central Energy — appears in Table 1. Dennis Haubenschild expects that the initial investment in the digester will be paid back in five years or less.

OUTLOOK FOR DIGESTERS

According to John Lamb of The Minnesota Project, it is too early to determine the cost-effectiveness of the digester. "So far, we don't know whether the technology is cost-effective, although it appears to be so for this project," says Lamb. "We don't know whether or not and at what level subsidies (grants, loans, cost-sharing) may be required to support building digesters. We also don't know if the full technology (manure to methane to electricity) can be effectively or efficiently applied on other size dairies or on swine operations as they exist in Minnesota today. We do know that digestion may be a good method for reducing odor, decreasing pathogens, killing weed seeds and producing gas that can be burned."

Environmental issues were an important factor in the Haubenschild family decision to install the digester. As reported in *Agri News*, they wanted to reduce dairy-generated odors, while keeping manure as a usable by-product to apply to their fields. Another factor was reducing the state's reliance on coal as an energy source. "We've always tried to be an environmentally sound farm," comments Marsha Haubenschild. Sums up her husband Dennis: "Manure is a natural renewable energy resource, and we weren't using it to its fullest potential. There is a need to show that manure is a commodity ... The whole theory (behind the digester) is to be as environmentally friendly as possible." ■

This report on the anaerobic digester at the Haubenschild Farm has been developed from material supplied by Carl Nelson and John Lamb of The Minnesota Project as well as reports in The Voice of Agriculture and AgriNews. Based in St. Paul, The Minnesota Project staff have been documenting digester performance to determine its implications for energy policy, environmental impacts, manure management, costs and benefits. For additional information, contact John Lamb, The Minnesota Project, (651) 645-6159, e-mail: jlamb@mnproject.org; or contact AgSTar, (800) 645-6159, www.epa.gov/agstar.