Anaerobic Digester at Spring Valley Dairy: Case Study

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Who Should Consider a System Like This?

- Farms in need of odor control.
- Farms where manure can be collected easily.
- Farms with capital available for initial start up costs.
- Farms with technical interest and skills for the system operation and maintenance.
- Farm with adequate cropland for the nutrients.

Farm Information

Edward Swartz, Jr operates Spring Valley Dairy, located in the town of Schodack, in Rensselaer County. There are 236 animals including 150 milkers, 50 heifers, and 36 calves on the 1800-acre farm. To address a variety of issues including odor control, nutrient planning, and potentially increasing revenue, Spring Valley Dairy looked into anaerobic digestion technology for a solution.

Why the Digester?

Traditionally, manure generated at Spring Valley Dairy was stored in a concrete manure storage pit and spread on crop fields. However, this manure management practice can potentially cause pollution to water and air, including water quality problems, dust, smog, greenhouse gases (methane), and odors. The odor from dairy manure handling and spreading on the farm had seriously affected the local community. Faced with the potential of increasing federal and state regulations on animal waste, Spring Valley Dairy looked for alternative practices. The search quickly landed on anaerobic digestion technology.

Due to the high capital costs and operating costs, there have been very few farms installing anaerobic digesters in New York State. To address this issue, dubara company Inc. has developed a new type of anaerobic seeding process, known as the 'Manure Activation System', which has the potential of dramatically reducing capital costs. Receiving funding from the New York State Department of Agriculture and Markets and the New York State Energy Research and Development Authority, Spring Valley Dairy installed a manure activation system, covered storage and gas collection and utilization systems designed by Stephen Hoyt, dubara company Inc.

Digester System

System and Process Description

The digester system at Spring Valley Dairy is composed of several subsystems (See Figure 1):

- Manure collection
- Activation system
- Covered manure storage
- Engine generator set
- Flare

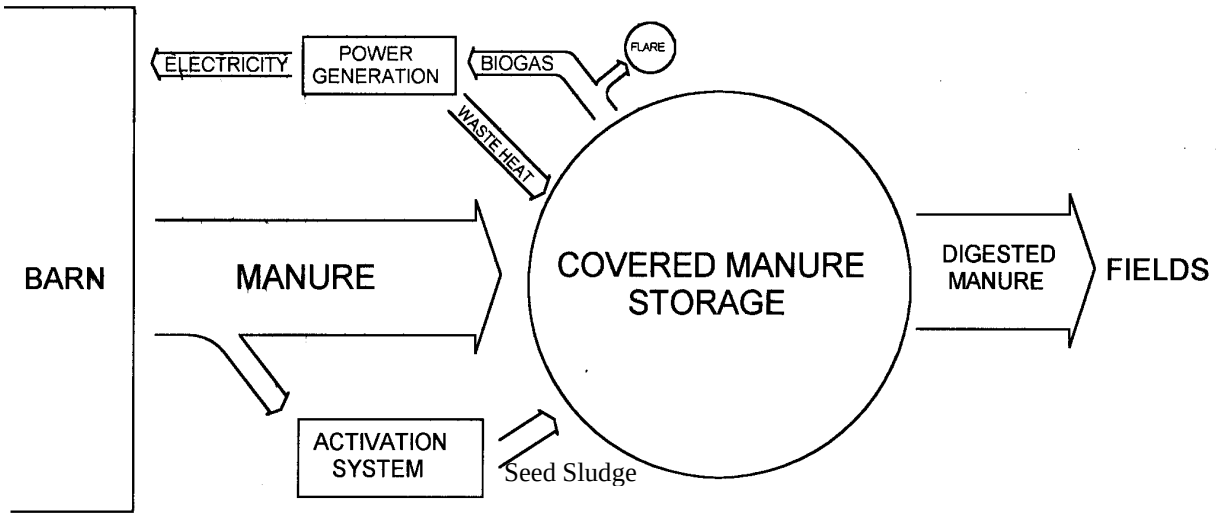

Figure 1. Schematic of the manure activation and covered storage on Spring Valley Dairy (by Stephen Hoyt)

Unlike other anaerobic digester systems, which have a single "tank" that holds and processes manure for biogas production, this system has two "tanks". One is the activation system that uses special small-scale reactors designed to provide sufficient seed sludge to effectively activate the storage pit for biogas production. The continuous seed process helps maintain high levels of methanogenic organisms in order to facilitate the bacterial population growth in the storage despite varying quantities of manure substrate. Another much bigger tank, the covered manure storage pit, holds and processes manure for biogas production with a much longer retention time (2–12 mo.)

With 236 animals on the farm, the manure production is about 3,400 gallons per day. The manure utilizes gravity to flow from the barn collection system to the manure pit, from which it is pumped into the activation system. These consist of two seed digesters with a capacity of 1,000 gallons each. The converted manure storage pit has a capacity of 300,000 gallons. A flexible, impermeable cover added to the top of the pit traps the biogas. The retention time is 20 days for the activation digesters and 90 days for the manure storage pit.

Heat and Electricity Generation

Biogas production is projected to be about 6,000 cubic feet per day, which has a methane (CH_4) content of 60%, 40% CO_2, 0.3% H_2S and other trace gases. The biogas will be collected and fed

into an Isuzu diesel engine attached to a 25 kW generator. Because of the corrosive hydrogen sulfide in the biogas, engine oil will be changed regularly.

This engine-generator set has a projected electricity production of roughly 219,000 kWh/year, which can potentially supply all the electrical needs of the farm, or another flexible use system such as an absorption chiller for cooling milk. Moreover, the recovered heat from the generator will be used to help facilitate anaerobic digestion activity in the existing manure storage, and at same time provides hot water for other uses on the farm.

Economic Information

	Items	Cost/Benefit *
Capital Costs	Digester	
	- Digester Construction and Materials	$38,000
	- Pumps	$2,300
	Subtotal	$40,300
	Engine-Generator Set	
	- Engine Generator	$20,000
	- Switching Equipment	$5,000
	- Engine Building	$2,000
	Subtotal	$27,000
	Manure Storage (Existing)	$35,000
	Cover for Manure Storage Pit	$18,000
	Sand Removal System	$8,000
	Others	$15,350
	Total Capital Cost	$143,650
	Total Annual Capital Cost **	$14,961
Annual Operating Costs	Maintenance, Repairs, Labor, Fuel, Insurance, etc. ***	$8,022
Annual Benefits	Savings on Electricity and Heat	-$13,500
	Savings on Reduced Rainwater	-$3,750
	Total Annual Benefits	-$17,250
Annual Net Cost Per Cow ($/cow/year)		$22.93

Note: * The operating costs (maintenance and repairs) and revenues are projected numbers as of August 19, 2003. An updated analysis will be provided with real data once the system is operated for one year.
** Total Annual Capital Costs = Annual interest charge of 5% plus depreciation.
*** Spreading Costs are not included on this system. They are not materially different with the treatment system.

Based on the cost-benefit analysis, the annual net cost is about $22.93/cow/year for odor control and waste stabilization. The capital cost for this system is $143,650. This is low for a farm that can't take advantage of the economies of scale that typical 500-1,000 cow farms with conventional digesters have. This system also includes the storage, while the typical capital costs for plug-flow digesters, which range from $500 to $800/cow, do not include the storage.

Environment Benefits

Since the installation of the anaerobic digester system on Spring Valley Dairy, the odor from manure handling and spreading has been greatly reduced. The nutrients in manure are also controlled and the pathogens are likely also reduced.

Advantages and Disadvantages

Advantages	Disadvantages
- Odor Control	- Adding Complexity to Farming
- Energy Production	- Dedication to Digester System Management (i.e.

- Fuel Saving - Energy Saving - Nutrient Management Ease - Pathogen Reduction - Potentially Low Capital Costs	labor and maintenance)

Lessons Learned

Inoculation of the manure in a long-term storage can reduce the odors of the manure. Originally discovered serendipitously, the system treating only a small portion of the manure in a controlled temperature digester can reduce the odor of all the manure given time. This means that for a low capital cost odor control can be achieved.

Incremental improvements of the system to match the capital expenditures with benefits provided can be part of the system. By first building the small digester to achieve odor reduction. Then adding a cover to collect the gas emissions from the manure storage to flare. Then adding an engine to utilize the gas for on-farm power production. Finally adding heat recovery to provide more than ambient temperatures to the main manure storage to facilitate digestion. Each of these components can be added incrementally.

Retrofitting a fabric cover on an existing concrete manure storage allowed the gas produced in the storage to be collected. Reinforced fiber strips supported by a center pole support the cover when the gas pressure is too low.

Sand laden dairy manure (SLDM) can be removed with a retrofitted gutter cleaner running at the heated inlet. As sand is dropped out the chain driven gutter cleaner is turned on coming out of the digester though air lock to load a manure spreader with SLDM. A ramp still exists to be able to drive down into the storage to remove any solid manure or sand that is not removed by the gutter cleaner.

Who to Contact

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