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PRO-DAIRY

Manure Management at Fessenden Dairy: Case Study

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Covered Manure Storage at Fessenden Dairy

Manure Management System Summary

Number of cows	650 lactating cows, 600 heifers
Covered Manure Storage Dimensions	First Stage: 82' x 175' x 14' Earthen Berm Second Stage: 365' x 175' x 14' Earthen Berm
Cover material	60 mil HDPE, Environmental Fabrics Inc.
Estimated total loading rate	16,000 gallons per day
Covered Storage Volume (total)	7,000,000 gallons
Solid-liquid separator	2 systems in Parallel, DODA™ and FAN™ Separators
Biogas utilization	Flare
Carbon credits sold/accumulated	Not Being Collected[1]
Stall bedding material	Separated Manure Solids
Year installed (cover)	2007

[1]*Originally retained by Environmental Credit Corporation*

Farm Overview

- Fessenden Dairy is a 650-cow dairy operation located in the village of King Ferry, Cayuga County, NY.
- The farm is owned and operated by Tim and Ronda Fessenden, and has been in the family since 1863.
- Currently 50% of the recovered manure solids are recycled as bedding, with the other 50% composted and sold as a soil amendment.
- Separated manure liquids are stored in a 7 million gallon earthen storage (divided into two stages) and spread on the adjacent cropland using drag line application.

Why the Covered Storage system?

The covered manure effluent storage system was installed in 2007 through a partnership with Environmental Credit Corporation (ECC). Through this arrangement, ECC secured financing for the system in exchange for the value of the carbon credits collected through collection and flaring of the methane off of the storage. It was thought at the time that the value of carbon credits would appreciate, and provide an income to ECC. The partnership agreement was for 10 years, after which the farm was scheduled to take ownership of the cover and flare system. However, the agreement was terminated permanently and the farm now owns the cover and associated gas handling system.

An additional benefit of the covered storage is improved odor control for the farm. The farm is located immediately adjacent to, and typically upwind of the village of King Ferry.

System Overview

System and Process Description:

The manure management system at Fessenden Dairy is illustrated below in Figure 1.

Raw manure is removed with alley scrapers, collecting the manure in concrete storage tanks located under the two barns. Every second day, the manure under each barn is pumped out and hauled by truck to a concrete storage tank in the covered manure solid-liquid separator and aerated compost pile building.

At this stage the liquid manure is run through one of two solid-liquid separators. Approximately 50% of the liquid manure flow is separated with a FAN™ separator (1 mm, single screen) for use as on-farm bedding. Following separation, the separated solids are 40 to 45% dry matter. Separated liquid effluent is collected in a concrete effluent storage tank within the same building. Solids used for bedding are taken from the building and used both for freestall and bedded pack bedding.

The remaining 50% of the liquid manure flow is run through two DODA™ solid-liquid separators (0.75 mm rear screen and 0.5 mm front screen), which dewaters the solids to 28 to 30% dry matter. Because the composting process requires water the solids do not need to be dried to the same level as the bedding. Solids for composting are moved by an overhead conveyor system to the floor of the building to form static aerated compost piles. Grates are located in the concrete flooring, through which air is forced to provide oxygen for the composting process, and to help moderate temperatures within the pile.

The static piles are left on the aerated floor for approximately 30 to 50 days during which temperatures within the pile reach 120 to 150F. These thermophilic temperatures kill pathogens and weed seeds present in the manure solids.

Following the 30- to 50-day period in the static aerated pile, the immature compost is removed from the building and placed in windrows where it remains for up to an additional 6 months.

The windrows are located either on an outdoor concrete pad, or else under a newly constructed covered concrete pad (Figure 2). The windrows are periodically turned over.

Once the compost is fully mature it is bagged and palletized in preparation for sale (Figure 3).

Separated liquid is gravity assist fed from the intermediate storage tank located within the solid liquid separator building, to the two-stage 7 million gallon covered earthen berm liquid storage.

The liquid storage system is covered with a 60 mil High Density Polyethylene (HDPE) floating cover which serves both to collect the biogas produced, and to keep rain and snow out of the pond. It is conservatively estimated that preventing the dilution of the pond results in savings of over $4,000 on an average year in reduced spreading costs. In years of high rain or snowfall, the savings could be even greater.

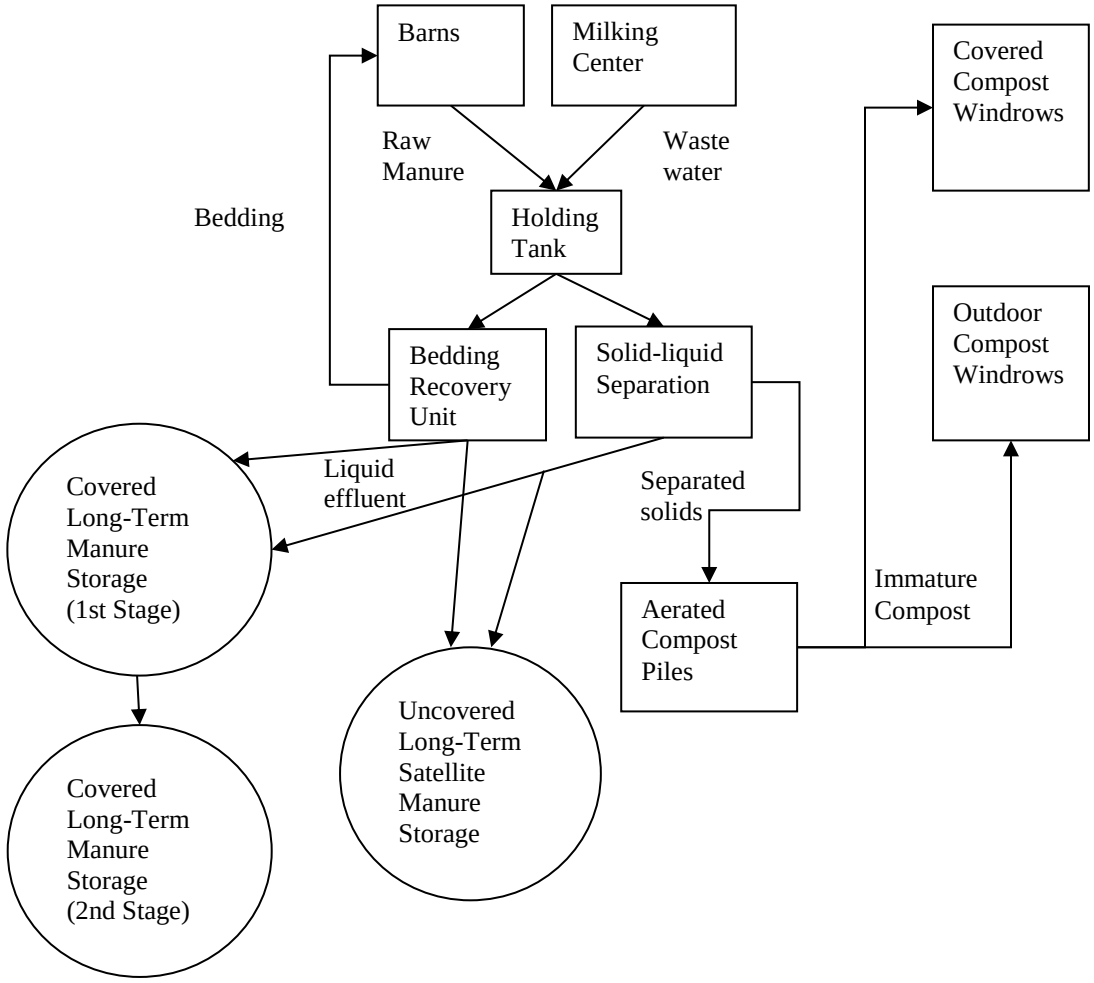

Figure 1: Fessenden Dairy Manure Management System Process Flow Diagram.

Figure 2: Fessenden Dairy Covered Compost Windrows.

Figure 3: Compost bagging system, Fessenden Farm.

Economics:

The $183,000 capital cost of the long-term storage cover and flare system was borne by ECC in 2007, with assistance from a USDA CIG grant that covered 50% of the cost. At that time, the agreement was that in return for installing this equipment on the Fessenden Farm, ECC retained ownership of the Carbon Credits generated by the project. After 10 years, the project equipment ownership will revert to the Fessenden Farm. During the 10-year life of the project, Fessenden Dairy would also be paid an annual fee of $3,000 from ECC. As of 2014, the agreement between Fessenden Dairy and ECC ended and the farm retains full ownership of the cover system.

The estimated annualized cost of the covered manure storage system, had the farm been the sole investor in the project, is shown below in Table 1. The estimated total annualized cost is about $19,000. This includes ownership costs, such as initial capital investment, depreciation, and lost opportunity cost of the investment, and operating costs including maintenance, repairs, and electrical costs.

Table 1: Estimated Annualized Cost of Covered Manure Storage System[1]

Ownership Costs		**Notes**
Initial Capital Investment	$183,000	Includes materials and installation for cover, gas collection system, and flare
Useful Life (years)	20	Expected lifespan of the cover
Salvage Value	$0	-
Annual Depreciation	$9,150	Assumed to be straight-line
Lost Opportunity Cost of Investment	$6,405	Based on an interest rate of 7.00%
Total Ownership Cost, Annual	**$15,555**	-
Operating Costs		
Annual Maintenance/Repairs	$3,000	Estimated by the farm
Annual Electrical Cost	$524	Average actual electrical cost over past 2 years
Total Operating Cost, Annual	**$3,524**	-
Total Annualized Cost		
Total Cost, Annual	**$19,079**	Cost to remove/recycle cover at the end of its useful life was not included in this analysis

[1] *This work was supported in part by Hatch and Smith Lever funding provided by the USDA National Institute of Food and Agriculture. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the National Institute of Food and Agriculture (NIFA) or the United States Department of Agriculture (USDA).*

The cost of a covered storage system like this can be somewhat offset by cost benefits such as reduced manure spreading costs and increased nitrogen value of the manure. Manure spreading costs can be reduced due to the preclusion of precipitation from the storage location. The nitrogen value of the manure could be increased by minimizing volatilization loss by reducing interactions of the storage surface with air and wind.

The covered compost building was partially funded through Round XVII of the Environmental Protection Fund handled by the NYS Soil and Water Conservation Committee. The capital cost of this project was $235,500 of which 65% was State funding and 35% from Fessenden Dairy.

Benefits and Considerations

Benefits	Considerations
• Revenue from: Off-farm sales of composted manure solids • Odor control (on-farm benefit) • Recovered manure solids used as bedding • Approximately 35 to 40% reduction in required storage volume through separation of solids and keeping rain and snow out of the long-term manure storage. • $4,000 Annual savings through reduced spreading costs.	• Agreement with ECC was made during a time when Carbon Credits were thought to be appreciating in value. Would not happen with current values of Carbon Credits. • Value of manure solids as bedding must be weighed against value of manure solids composted.

Lessons Learned

The overall system is made up of several individual components. This component design provides flexibility and options in deciding how to process and handle the separated manure solids. The design also has some redundancy built into it. The two DODA solid liquid separators do not need to run constantly to provide enough solids for the composting operation; either one of them could handle this separation task.

The covered manure storage can result in real savings through preventing rain and snow from diluting the effluent. Locating the storage centrally on the farm's land base allows the collected effluent to be applied to the crops through draglines.

Additional Information

- Steinberg, Sam, Curt Gooch, and Karl Czymmek. "Covered manure storage systems: Tangible and non-tangible benefits." *DairyBusiness East* Jan. 2015. 23.

Contact Information

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