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Industry:
 Wastewater Treatment

Project type:
 Nutrient Recovery

Project goal:
 Reduce the phosphorus content of water used for irrigation and produce renewable fertilizer product.

Study Prepared by:
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Date of Case Study:
 January 19, 2016

Trident Processes Nutrient Recovery Prairie’s Edge Dairy, Fair Oaks, IN

OVERVIEW

Nearly a decade ago, Prairie’s Edge Dairy Farm, LLC in Fair Oaks, Indiana, began looking at manure as more than a by-product of milk production. The owners decided to install an anaerobic digester to harvest the biogas and begin monetizing the energy value of the farm’s manure.

Not only did the digester produce biogas used to fuel the farm’s tanker trucks, as well as generate electricity, it started the farm on a path to explore manure’s full potential as a farm commodity.

BACKGROUND

Prairie’s Edge Dairy on the path toward producing manure-based commercial fertilizer.

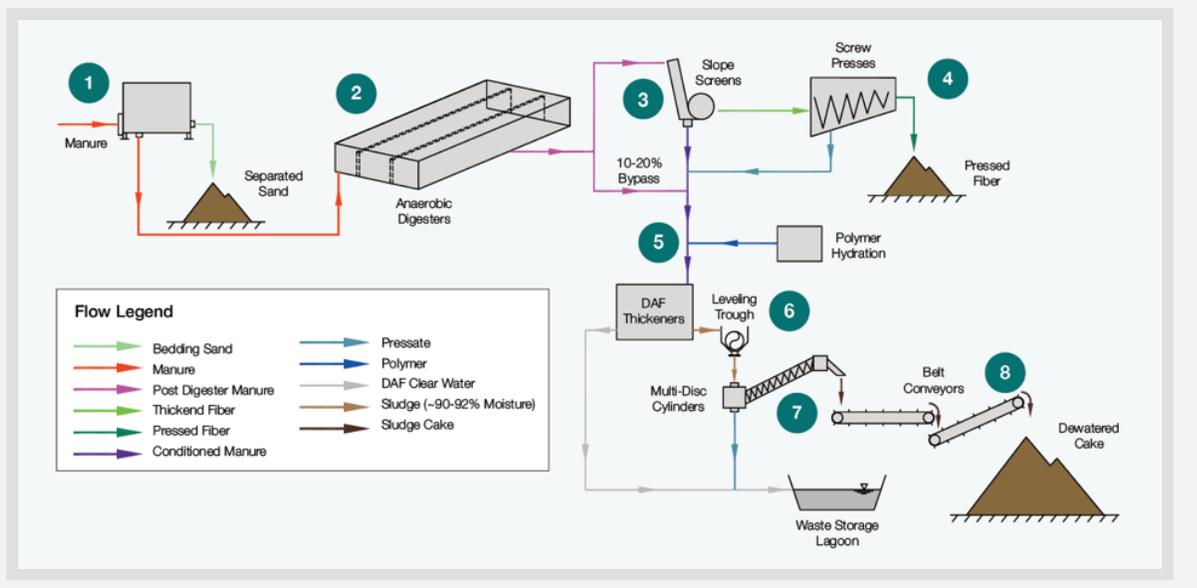
Fair Oaks Dairy Farms was established in 1999. The operation is in Northwest Indiana and consists of five, 3,500 cow dairy units located on 15,000 acres. The dairies are freestall barns with sand bedding that have approximately 3,000 milking cows and 500 dry cows at each unit.

When originally built, the first four units were designed so that scraped manure from the freestall barns was directly field applied. Parlor water was

discharged to one-million-gallon capacity lagoons that were located on each unit and was used for irrigation on nearby fields. This work was done by a crew of 12 employees and one full time manager.

In 2003, Fair Oaks Dairy built its first anaerobic digester that was designed to take all the manure and parlour water from one dairy unit. This digester was considered a vertical plugged flow system with a specialized sand removal and solids recovery system. The performance of this system was very poor initially and was modified significantly over the next three years. The sand removal system was improved until it was removing 98% of the

Trident Flow Diagram



sand (when using sand that meets the established specification) and the solids removal system was completely redesigned as a continuously operating dissolved air floatation (DAF) system. The system did a fair job separating the suspended solids but there was no effective dewatering system available for producing a dry cake that would allow for the handling of the high phosphorus solids.

In 2006, Fair Oaks Dairy built a second digester (DVO Two Stage Linear Vortex Flow), centrally located to the four other dairy units, and processing the manure from 14,500 cows. When built, this system incorporated the design improvements from the first unit. Prior to the digester, the system includes a three-phase sand removal system that includes McLanahan Sand Manure Separators, and hydro cyclones as well as a sand settling lane. After the digester, the system had coarse solids separation and included a series of DAF units for solids recovery and a centrifuge for dewatering this system was decommissioned and removed in 2008. In 2014 the Trident Processes Nutrient Recovery system was successfully demonstrated and in early 2015 a Trident system designed for the entire operation was installed.

KEY LEARNINGS

Nutrient Recovery creating a value-added product is now a proven concept.

- The weak point in the system, according to Fair Oaks personnel, is the use of conveyors for the DAF Cake handling. The conveyors that were originally installed were not designed for the weight of the product and were not capable of handling the load. These conveyors were not provided by Trident Processes LLC and have been

replaced by conveyors of heavier design. Ideally the system would discharge directly to a push wall where the solids could be removed using a front loader or similar piece of equipment.

- The low power costs and low maintenance costs of the Trident Nutrient Recovery System is one of the real advantages that this system has over typical dewatering systems such as centrifuges and belt filter presses.
- Like all coagulation or flocculation systems, the need for polymer to flocculate suspended solids and the ongoing cost of polymer is one of the negative aspects of this technology.
- Comparison of Trident’s expected results and the actual results at Fair Oaks indicate that the rotary screens normally supplied with this system, designed to size the coarse solids to maximize the DAF performance, would be expected to increase the phosphorus recovery by approximately 5%. Initially Fair Oaks used existing slope screens but these have been replaced with Trident’s rotary screens resulting in much better performance.

KEY BENEFITS

Reduced Phosphorus in Irrigation Water – This allows the dairy to utilize the irrigation water to satisfy the nitrogen demands of the corn crop without overloading the soils with Phosphorus.

Reduced Solids in the Lagoons – The benefit of the solids reduction is that the dairy can utilize center-pivot irrigation (without clogging of irrigation nozzles) to spread the irrigation water at a significant cost savings to solids application with a drag line.

High Phosphorus Cake – This product is being sold to a third party for production of a manure based slow release fertilizer.

RESULTS

This table is based on the samples gathered by Fair Oaks Dairy personnel immediately following the start-up of the system in September of 2015. As installed, the system was using US Farms slope screens instead of Trident rotary screens.

	Total Solids	Total Kjeldahl Nitrogen	Phosphorus	Potassium
DIGESTER EFFLUENT AVERAGE	4.10%	0.24%	0.05%	0.14%
DAF INFLUENT AVERAGE	2.63%	0.20%	0.04%	0.13%
DAF EFFLUENT AVERAGE	1.09%	0.15%	0.01%	0.12%
DAF CAKE AVERAGE	23.39%	0.87%	0.35%	0.17%
DAF TO DIGESTER EFFLUENT Reduction	73.30%	39.41%	81.00%	13.14%

Key Benefits & Results Summary:

- Reduced phosphorus in irrigation water
- Value added renewable fertilizer
- Lower energy consumption than other nutrient recovery systems
- Reliable operations
- 22 months of proven performance



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CONCLUSION

- Integration of these systems with other advanced nutrient recovery systems like ammonia recovery and energy recovery systems like digesters and gasifiers will lead to more adoption. Newtrient can facilitate the inclusion of this technology in some projects over the next several years.
- Integrating this technology as part of a larger “back-end” system that includes companies like Midwest Bio-Ag and Proteus Environmental Technologies represents a way to increase the value for this manure derived fertilizer product.
- The low RPMs and low energy requirement for the dewatering of the DAF solids is a breakthrough for on-farm manure dewatering systems.

PRAIRIE’S EDGE DAIRY PROJECT BY THE NUMBERS

Location type	Central digester supporting four freestall housing farms
Number of animals	14,000
Type of bedding	Sand
Manure collection	Vacuum Tanker
Daily flow	450,000 gallons per day
System designed by	Trident Nutrient Recovery System
Date operational	Spring 2015
Energy produced/required	Facility produces electricity and renewable natural gas
Installed energy production capacity	1,000 kW Electrical Capacity and 750 MMBTU per day RNG
Products produced	Power, Renewable Natural Gas, Fiber, and High Phosphorus solids
Residual materials	Low nutrient irrigation water
Residual storage	180 days storage
Residual use	Irrigation of dairy forage crops
Electrical utility	Jasper County REMC
Gas utility	Northern Indiana Public Service Company (NIPSCO)
Ownership structure	The project combines many different entities on a family owned farm

PRAIRIE’S EDGE DAIRY FINANCIAL INFORMATION

Capital investment	Approximately \$175 per cow
Annual operating and maintenance cost	Approximately \$0.06 per cow per day
Payback period	Approximately five years



Side by side DAF units



Solids cake at 20% DM

For more information about Trident Processes, LLC or to join our mailing list, email info@newtrientllc.com.

Newtrient’s mission is to help all dairy farmers reduce the environmental footprint of manure while enhancing their economic opportunities and their social license to operate. The information contained in this case study was developed with the cooperation of the organizations involved and Newtrient has endeavoured to make sure it is accurate and complete as possible.

Organizations Involved:

- Prairie’s Edge Dairy
- Jasper County REMC
- Northern Indiana Public Service Company (NIPSCO)
- Steve Dvorak (DVO Renewables, Inc.)
- Kerry Doyle (Trident Processes, LLC)
- Hamstra Builders

Equipment and Technology:

- Vaughn
- McLanahan Sand Manure Separators
- DVO Two-Stage Linear Vortex Flow Digester
- US Farm Systems Slope Screens
- Vincent Fiber Press
- Trident Nutrient Processes
- GE Jenbacher Engine
- Greenlane gas upgrading system



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