CASE STUDY

Vendor:
Vaughan Company, Inc.
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http://www.chopperpumps.com

Industry:
Pumping systems for livestock manure.

Project Type:
Vaughan non-clogging chopper pumps supply the dairy's full daily manure stream to energy and nutrient recovery technologies.

Project Goal:
Harvest the full value of manure by reliably pumping the farm's daily manure stream through a series of advanced treatment technologies.

Study Prepared by:
Mark Stoermann, Newtrient Technology Advancement Team

Date of Case Study:
May 2019

Vaughan Chopper Pumps Help Harvest the Full Value of Manure as a Farm Commodity

Prairie's Edge Dairy Farm, Fair Oaks, Indiana

OVERVIEW

Prairie's Edge Dairy Farm, LLC, located in Fair Oaks, Indiana (formerly Fair Oaks Dairy) developed a fully integrated system of advanced energy and nutrient recovery technologies to process the daily volume of freestall manure from 18,000 cows mixed with milking parlor wastewater into value-added products. Integral to the system is a series of Vaughan pumps strategically selected and located to ensure the manure stream is continuously circulated through the treatment processes, with no interruptions. High pump reliability ensures the daily manure slurry is processed to produce recycled sand bedding, irrigation water, crop fertilizer, soil amendments, renewable energy (electricity and RNG), carbon emission reductions and reduced odor from the manure.

BACKGROUND

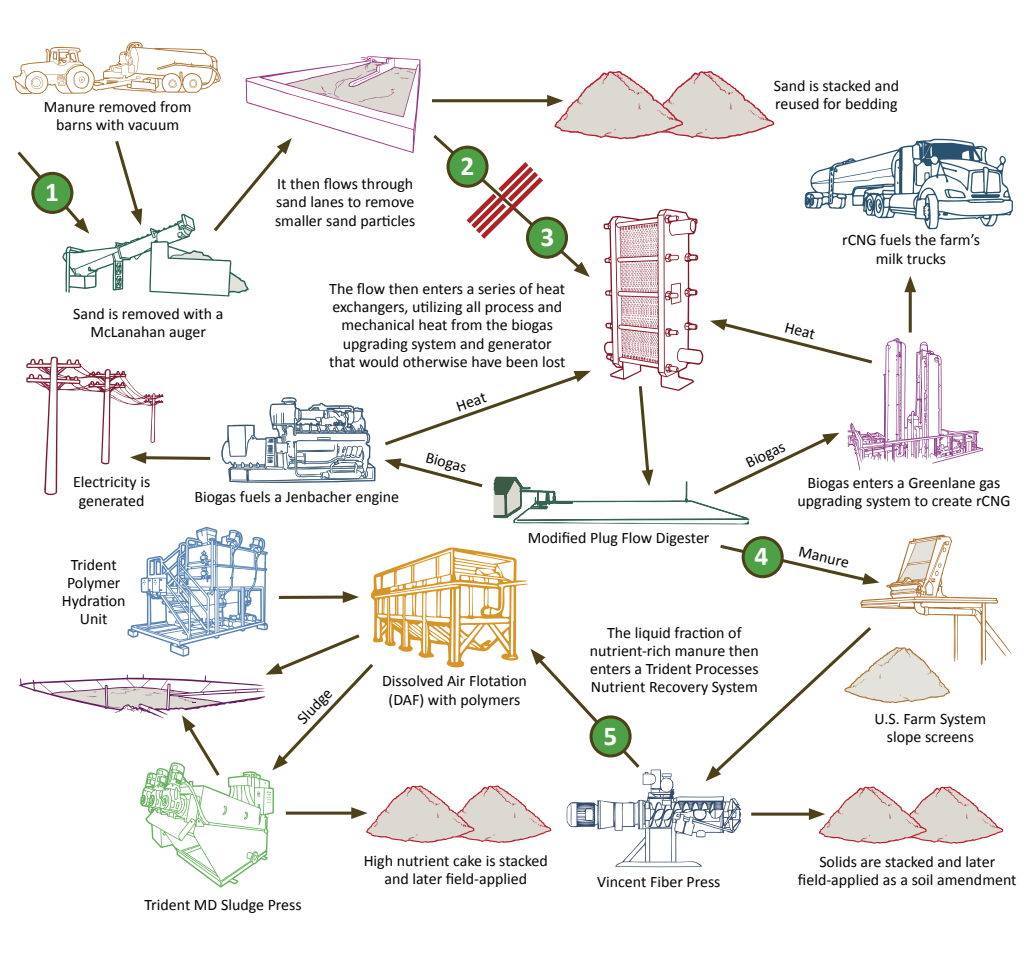
Vaughan Chopper Pumps reliably supply 645,000 gallon per day of manure slurry to on-farm energy and nutrient recovery technologies.

Prairie's Edge (formerly Fair Oaks Farms) is located on I-65 between Chicago and Indianapolis. The farm is known for its leading role in the industry implementing sustainable manure management technologies with the goal of harvesting the full economic and environmental value of manure. The journey began in 2003 with the installation of an anaerobic digester and solids recovery system designed to process manure from 3,500 cows. Over the next three years modifications were made to improve the sand removal system until 98% of the sand was being captured.

By 2008, the dairy had three digesters in operation and began the next step — to design a fully integrated manure nutrient and energy recovery system. Carl Ramsey, Operations Manager at Prairie's Edge Farms, is tasked with managing all the manure for the farm and strongly advocates for advanced nutrient recovery. A key challenge was designing and developing a reliable pumping system to continuously pump thousands of gallons every day of livestock waste at five to eight percent solids through multiple stages of nutrient recovery, with no interruptions. To meet the challenge the dairy teamed with Vaughan Chopper Pumps to engineer and install a highly reliable, non-clogging pumping system that began with installing over thirty chopper pumps suppling the digesters and associated nutrient recovery systems.

In 2015 the dairy commissioned a highly successful wastewater treatment for removal of phosphorous. The Trident system is currently processing dairy waste from 18,000 cows to recover NPK nutrients from the manure. Today the dairy operates three anaerobic digestors, a Renewable Natural Gas upgrade system, electrical generation with grid interconnection and multiple nutrient recovery technologies. The manure is supplied to these systems by an integrated system of over 17 chopper pumps at five strategically located pumping stations, ensuring a reliable manure supply to the advanced nutrient recovery technologies.

Vaughan Chopper Pump System Integrated with Manure Nutrient and Energy Recovery



Prairie's Edge Dairy installed five primary pumping stations (green dots) with a total of seventeen Vaughan Chopper Pumps suppling 645,000 gallons per day of manure slurry to an integrated system of eleven on-farm energy and nutrient recovery technologies.

1. Milking parlor wastewater is pumped to sand separator
2. Liquid manure pumped through a low temperature heat exchanger
3. Liquid manure pumped through three high temperature heat exchangers and to the digester
4. Digestate supplied to Solids Separators
5. Separated liquids pumped to Dissolved Air Flotation (DAF) phosphorus recovery unit

Key Benefits & Results:

- Vaughan Chopper Pumps have provided reliable performance at the dairy since 2003.
- Downstream pipe clogging problems are significantly reduced because chopper pumps eliminate large fiber and clogging solids in the manure stream.
- Vaughan provides support designing the entire system and evaluating the most efficient pump for each individual application.
- It is imperative that backup pumps are always available 24/7 and ready to run to ensure the system does not shut down.

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KEY LEARNINGS

Prairie's Edge dairy pumping system successfully supports state-of-the-art mature processing technologies.

Continuous Operation – The dairy's pumping system requires continuous 24/7 operation. It is imperative that backup pumps are always available and ready to run to ensure the system does not shut down.

Non-Clogging – One of the main reasons the dairy decided to use Vaughan Chopper Pumps is chopper pumps effectively reduce or eliminate fibrous material in the manure stream that can cause downstream problems such as pipe clogging.

Top Quality – Vaughan Chopper Pumps are higher in cost but a better-quality, properly engineered and sized pumps that provide efficient and reliable performance.

Power Consumption – Chopper pump impellers have been redesigned, along with some of the casings. The pumps now use less energy for the same performance against a fabricated manure pump. Performances are approaching some clean water pumps.

Wide Variety of Pumps – The pumps come in a wide variety of sizes and configurations and can be used in areas and applications where other pumps are not well suited. The horizontal pumps used for pumping digestate from the digester are very large pumps that have demonstrated many years of excellent performance with minimal downtime.

KEY BENEFITS

Reliability – The key benefit is a reliable pumping system to continuously supply the manure slurry to the nutrient and energy recovery technologies with essentially no unscheduled downtime.

Design Support – Vaughan Company provides support designing the system and identifying the best pump for each individual application.

Performance – Downstream pumping problems are eliminated or reduced because the chopper pumps reduce the quantity of material that can plug other parts of the system.

RESULTS

Vaughan Chopper Pumps have provided reliable performance as part of this renewable energy and nutrient recovery system since 2003. Originally over thirty chopper pumps supplied the systems digesters and nutrient recovery systems.

Design changes and efficiency improvements streamlined that number to seventeen primary and backup pumps that continuously supply the daily manure slurry to the nutrient and energy recovery system. This greatly improved overall system performance and reduced costly downtime while saving uncountable man hours unclogging pipelines and downstream equipment.

CONCLUSION

"Vaughan Chopper Pumps have proved to be reliable and we are satisfied with their performance to consistently pump a slurry of manure solids with minimum clogging to our nutrient and energy recovery technologies."

– Carl Ramsey, Prairie's Edge Dairy

Vaughan Influent Pumps to heat exchanger and the digester.

Two Vaughan Effluent Pumps from digester to solids separator.

Organizations Involved:

Farm or facility

Prairie's Edge Dairy

Distributor

Contact Vaughan Company, Inc. for the location of a regional agricultural representative

Equipment and Technology:

Manure collection

Vacuumed manure

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PRAIRIE'S EDGE DAIRY PROJECT BY THE NUMBERS

Location type	Prairie's Edge Dairy is a registered dairy operation located in Fair Oaks, Indiana
Number of animals	18,000 milking cows
Type of bedding	Sand
Manure collection	Vacuum Tanker
Daily flow	645,000 gallons per day of manure slurry mixed with milking parlor wastewater
System designed by	Vaughan Company, Inc.
Date operational	First chopper pumps commissioned in 2003
Energy produced/required	Chopper pumps power requirements range from 10 HP to 40 HP
Ownership structure	Farmer owned

FINANCIAL INFORMATION

Capital investment	• For a small farm a typical pump is a V4K x 8 ft. long with a 10 HP motor running at 1800 RPM and a budgetary price of $9,500. • For a medium sized dairy a typical pump is a V6U x 10 ft. long with a 20 HP motor running at 1170 RPM motor and a budgetary price of $16,000. • For larger sized dairies a typical pump is a V8N x 14 ft. long with a 40 HP at 1170 motor running RPM and a budgetary price of $30,000. • Final price with installation is dealer specific. Typical dairy pipe size is 4 to 10 inch.
Revenue	Chopper pumps were installed to continuously pump thousands of gallons/day of manure slurry through multiple stages of nutrient recovery with high reliability to ensure the farm's investment in nutrient recovery technologies meets annual revenue projections. Chopper pumps are meeting the performance requirements.
Payback period	Six years due to direct cost savings and reduced manure management expenses and labor requirements.

For more information contact:

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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.

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