NEWTRIENT
INNOVATIVE SOLUTIONS IN RESOURCE RECOVERY

CASE STUDY

Vendor:
GEA/Houle
1880 Country Farm Dr.
Naperville, IL 60563 USA
www.gea.com/en/products/2-stage-separator.jsp

Industry:
Manure Separation

Project type:
Post Anaerobic Digestion Solids Separation

Project goal:
Screen and dewatering system for separation of fibrous solids for use as bedding

Study Prepared by:
Craig Frear

Date of Case Study:
September 21, 2017

GEA/Houle Two Stage Slope Screen Manure Separator

Edaleen Dairy, Lynden, WA

OVERVIEW

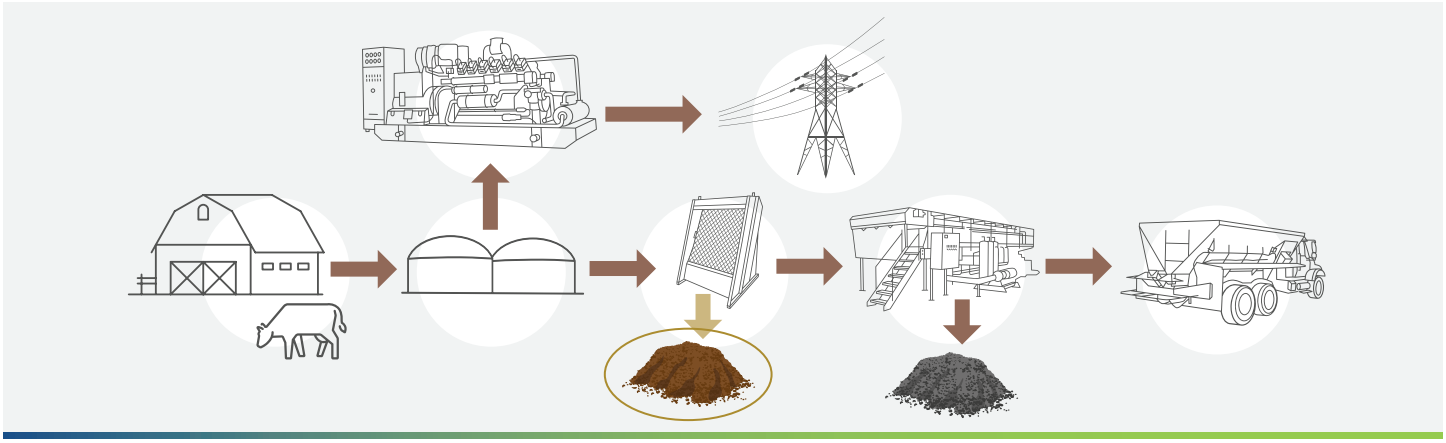
Edaleen dairy is a 1,800 cow dairy in Northwest Washington State which uses alley scrapers to scrape free-stall manure to a pit for mixing with wash water. This manure wastewater is then pumped to a DVO mesophilic mixed plug-flow anaerobic digester that practices limited co-digestion with off-farm organics (<5% volume). Effluent from the digester is then sent to the GEA/Houle two-stage, slope-screen solids separator for separation of fibrous, coarse solids, which the dairy uses as animal bedding and as a soil amendment. While additional post-separator treatment occurs, this case study is focused on the costs and performance of the GEA/Houle two-stage, slope-screen solids separator for treatment of digested dairy manure.

BACKGROUND

The GEA/Houle slope screen separator is an integral component of the Edaleen dairy manure management system.

Edaleen dairy is a family-owned producer/processor located in Lynden Washington, presently milking approximately 1,800 cows. Edaleen dairy aims to be an excellent steward to the local environment, with installation and operation of advanced manure management technologies being a main effort in that overall goal. Presently, Edaleen dairy has one of the more complete, modern manure management systems in the US, which they have phased into place since 2012. The system starts with alley cable-scrapers placed in the free-stalls as well as a flush system within their maternity barn. The combined scrape and flush manure are mixed with farm wash water in intermittently mixed and pumped manure pits. The manure wastewater from these pits is sent to a DVO mesophilic mixed plug-flow anaerobic digester for treatment and production of renewable electricity and carbon credits. Effluent from the digester is passed across the GEA/Houle two-stage, slope-screen separator, producing a high-quality fibrous solid used as both an internal animal bedding and sold off-farm as a soil amendment ingredient to a commercial retail product. The solids are processed in a covered storage building for protection from the local precipitation. Liquid effluent from the screen is

FIGURE 1. MANURE MANAGEMENT SYSTEM FLOWCHART — GEA/HOULE TWO STAGE SLOP SCREEN MANURE SEPARATOR (FIBROUS SOLID PRODUCT CIRCLED).



sent to an equalization pit for control of flows and timing, with dispersal to a DVO Phosphorus Recovery, modified dissolved air flotation (DAF) system for recovery of fine solids for use internally and externally as a soil fertilizer. Final liquid effluent is stored in clay-lined lagoons until ultimate use as fertilizer for nearby fields/forage crops.

KEY LEARNINGS

The GEA/Houle slope screen separator has an excellent runtime, maintenance record, and solids separation performance.

The GEA/Houle slope screen separator is placed on an elevated stand with catwalk and with separated solids falling onto a concrete pad inside a three-walled and covered solid handling building. Manure from the digester is periodically pumped at an approximate 150 gallons per minute flow rate to the screen via float sensors. Depending upon the float level demand, manure is fed for approximately 10-20 minutes. At cessation of flow, the screen undergoes an automated washing cycle to clean the screen and system.

The system is a two-stage process, using the slope screen to separate solid/liquid fractions while a set of roller presses dewaters the solids. Regular operations/maintenance is a daily 10-minute check, weekly power-wash cleanings, bi-weekly acid wash as part of the power-wash, and scheduled maintenance/repair of parts.

KEY BENEFITS

Simple, reliable mechanical separation process— Over its 5-year operational record, the system has shown excellent uptime and only limited need for maintenance, removing significant amounts of solids with a desired total solids content.

Production of a valued fibrous solid—The produced fibrous solids via combined actions of the digester and screen are of a high quality, producing nearly 11 cubic yards per cow per year with 50% used internally as animal bedding and the other 50% sold off-farm as an ingredient to a retail soil amendment product. The dairy is very pleased with the quality of the bedding material, seeing no negative impact and perhaps even a positive impact on cow udder health, while also saving considerable dollars by not needing to purchase outside bedding.

Table 1 (below) is a summary of the performance of the GEA/Houle screen as monitored by Washington State University across a two-week testing protocol. Approximately 27% of total solids in the digested wastewater were removed by the screen, producing 11 cubic yards of fibrous solids per cow per year with a bulk density of roughly 750 lbs./cubic yards.

Solids separation performance is related to screen mesh size as well as total solids content of the incoming manure slurry, so results can vary from site to site. Separation led to a significant reduction in volatile solids or organic matter remaining in the separated liquid but relatively speaking did little in reducing the NPK within the effluent. As such, the separator can be viewed not so much as a nutrient control device but a solids and fiber/organic matter control device for the specific production of a valued solid to the dairy. Importantly, the removal of these large, fibrous particles is an important step in any further downstream processing.

RESULTS

The GEA/Houle separator was installed in the fall of 2012 and now with a 5-year operational record. Capital costs at the time of purchase/installation from a third-party construction company were

Key Benefits & Results Summary:

- Production of 11 cubic yards of separated fibrous solids per cow per year at 26% total solids
- 27% reduction of total solids in liquid wastewater
- 10%, 4%, and 4% N, P, K reduction in liquid wastewater
- Third party purchase/ installation capital costs $108 per cow, for total installed system

TABLE 1. SCREEN PERFORMANCE AND SOLIDS INFORMATION

	TS (%)	VS (% DM)	N (%L)	P (mg/L)	K (mg/L)
Influent to Screen	4.04 +/ 0.15	72.53 +/- 1.25	0.23 +/- 0.01	321.9 +/- 21.73	1869 +/- 24.8
Efffluent from Screen[1]	2.96 +/- 0.06	63.11 +/- 0.56	0.21 +/- 0.03	309.9 +/- 29.7	1804 +/- 39.7
Reductions	26.7%	13.0%	10.1%	3.7%	3.4%
	Flow Rate (yd^3/cow/year)		TS (%)	NPK (% DW)	
Separated Solids	11		25.67 +/- 0.47	2.6%, 1.1%, 0.9%	

[1] Effluent samples adjusted for volumetric loss estimated at 6%. *NPK is reported as percent total nitrogen, phosphorus as P_2O_5, and potassium as K_2O, in dry weight values. Approximate bulk density of solids is 750 lbs./cubic yards; volatile solids content of solids is 89.3 +/- 7.4%. Data from Exact Scientific Laboratories, Ferndale WA, as reported to Yorgey et al., (2017), Washington State University Center for Sustaining Agriculture and Natural Resources.

TS = total solids; **VS** = volatile solids, **N** = nitrogen, **P** = phosphorus, **K** = potassium, **DW** = dry weight. Values reported as mean and standard deviation of n = 12 samples averaged across duplicates.

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$91,000 for the GEA/Houle two-stage, slope-screen separator and $180,000 for installed system including stand, automated washing system, piping/electrical connections, and three-walled, covered solids handling building (2017 inflation adjustment: $97,000 and $193,000). On a per cow basis for this case study dairy, these 2017 costs are $54/cow, equipment only and $108/cow for installed system. Operations and maintenance (O/M) costs result from electricity, acid cleaning chemicals, replacement parts, and labour. Average O/M costs across the 5-years of operation have been $16,477 per year broken down into 69% labour, 26% parts, 4% electrical, and 1% acid chemical. Major replacement parts over the 5 years have been repair of steel frame from ammonia decay and a new screen roller. On a per cow basis, the O/M costs average at $9/cow/year.

Both capital and O/M costs can vary according to scale, flow rate, quality/type of manure, and location of dairy.

CONCLUSION

The GEA/Houle two stage slope screen solids separator is an integral part of the Edaleen Dairy manure management system, positioned after anaerobic digestion for separation of fibrous solids. The produced solids are significant revenue savings for the dairy both in its use and subsequent offset for purchase of animal bedding and in its sales as a valued soil amendment ingredient to a retail supplier. The separator has had an excellent track record with runtime, low operations cost and simplicity of use. Operations are improved with regular washing/cleaning as well as maintenance of key replacement parts at regularly scheduled intervals.

GEA/HOULE AT EDALEEN DAIRY PROJECT BY THE NUMBERS

Location type	Dairy
Number of animals	1,800 milking cows
Type of bedding	Digested, separated fibrous solids
Manure collection	Alley cable scraper with one maternity barn flush
Daily flow	90,000 to 95,000 gallons per day
System designed by	• DVO Two Stage Mixed Plug-Flow Anaerobic Digester • Dresser-Rand Guascor Engine with Martin Machinery Package • GEA Houle Two stage slope screen manure separator • DVO Phosphorus Recovery system
Date operational	Fall 2012
Energy produced/ required	• DVO Anaerobic digester approximately 40-45 KW parasitic load • GEA/Houle Separator approximately 2 KW parasitic load • DVO Phosphorus Recovery system approximately 40 KW parasitic load
Installed energy production capacity	Averaging 544 KW of electrical generation to the grid from the anaerobic digester
Products produced	Electrical Power, Green Tags, Carbon Credits, Tipping Fees, Fibrous Solids Bedding Offset, Fibrous Solids Soil Amendment Ingredient, Fine Solids Soil Amendment
Residual materials	• Digested, separated liquid manure wastewater • Fine Solids Soil Amendment
Residual storage	• Lagoon storage for digested, separated liquid manure wastewater • On-site storage for fibrous solids prior to use/sales • On-site storage for fine solids prior to use/sales
Residual use	• Wastewater residual fate as fertilizer for local fields/forage crops • Fibrous solids recycled internally as bedding and sold as ingredient to retail soil amendment • Fine solids as fertilizer to local fields/forage crops or sold as fertilizer/soil amendment to fields undergoing crop rotation
Electrical utility	Electrical power purchase agreement with Puget Sound Electric
Ownership structure	Family owned dairy

Organizations Involved:

Farm or facility
Edaleen Dairy

Electrical Utility
Puget Sound Energy

Engineers
GEA/Houle

Contractor
Regenis

Developers
Edaleen Dairy

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GEA/Houle Separator **First Stage** Slope Screen

GEA/Houle Separator First and Second Stages

GEA/Houle Separator **Second Stage** Roller Dewatering

Separated Fibrous Solids for use as Bedding and/or Soil Amendment

For more information about GEA/Houle, 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.

Equipment and Technology:

Manure collection
GEA/Houle Alley Scrapers, GEA/Houle mixers/pumps

Primary treatment
DVO Two-Stage Mixed Plug-Flow Mesophilic Anaerobic Digester

Secondary treatment
GEA/Houle Two-Stage Slope Screen Solids Separator

Tertiary treatment
DVO Phosphorus Recovery Modified Dissolved Air Flotation (DAF) System

Energy systems
Dresser-Rand Guascor SFGLD 560 engine/generator set, heat recovery and interconnect packaged by Martin Energy Group

Other
Regenis construction, installation and operation/ maintenance

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