# CASE STUDY



# Vendor:

Regenis

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## Industry:

Engineering, Procurement, Construction, Fabrication and Operation

## Project type:

Dairy Anaerobic Digestion and Solids/Nutrient Recovery Systems

## Project goal:

Provide construction management as well as operations at dairy-based renewable energy and solids/nutrient project

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**Date of Case Study:** February 5, 2018

# **Regenis Construction Management** and Operations Services

Edaleen Dairy, Lynden, WA

# **OVERVIEW**

Edaleen Dairy is an 1,800 wet-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, Linear Vortex, anaerobic digester that practices limited co-digestion with offfarm organics (<5% volume). Effluent from the digester is then sent to a GEA/Houle two-stage, slope-screen separator and DVO Phosphorus Recovery modified DAF separator for recovery of coarse and fine solids and production of a thin tea-liquid waste for lagoon storage and eventual field application. Biogas is utilized in a Dresser-Rand Guascor SFGLD 560 engine/generator set packaged by Martin Energy Group for production of electricity interconnected to the grid and recovered heat for use in digester operations. The focus of this case study is the consultation, construction, and operations completed on all aspects of the Edaleen postmanure collection treatment system during the period 2012-present.

# BACKGROUND

Edaleen Dairy is a family-owned producer/ processor located in Lynden Washington, presently milking approximately 1,800 Holstein wet 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 combined with small amounts of off-farm substrates delivered to a substrate receiving pit and sent to a raised, in-ground, insulated DVO two-phase, mixed-plug



flow, Linear Vortex, mesophilic anaerobic digester for treatment. Raw biogas from the digester is sent through a gas blower to raise gas pressure and then through a two-stage plate exchanger to cool the gas and drop out moisture prior to entry to the engine.

Renewable electricity is produced and sent to the grid using a Dresser-Rand Guascor SFGLD 560 engine/generator set packaged by Martin Energy Group. Heat from the engine coolant and exhaust is recovered for subsequent storage and re-utilization within the digester internal heat exchange system. Excess heat is dumped to the environment through a radiator. Mixing of the digester is accomplished through internal use of biogas sent to specific mixing zones via a patented mixed plug-flow design allowing for axial mixing of the digester contents that does not interfere with the forward plugflow movement of the contents for an assured residence time.

Effluent from the digester is periodically pumped from the digester using float valves and is passed across a GEA/Houle two-stage, slope-screen separator, producing a high-quality fibrous solid used as both an internal animal bedding and a soil amendment ingredient to a commercial retail product. Liquid effluent from the screen is 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. Starting in 2012 Regenis has been contracted to provide consultation, design, construction and full operations and maintenance services for the entire installation. The focus of this case study is the performance of these contractual services.

# **KEY LEARNINGS**

"Regenis consulting, construction management and operations services has been instrumental in providing a well-designed system capable of meeting our unique manure management needs, while also providing service that has led directly to high levels of upkeep, runtime and performance."

# – Mitch Moorlag, General Manager, Edaleen Dairy

Within a large project are specific unit operations, in this case: the anaerobic digester, the engine/ generator set, the solids/liquid screens, and the fine solids separation. Each unit operation requires business case/Pro Forma analyses, design, engineering, grant writing, mechanical/ electrical/biological integrations, vendor supply and procurement, construction management, co-product offtakes/handling, and effective daily operations and maintenance. From a larger picture, each unit operation must integrate seamlessly with each other as well as within the larger dairy operations, while being adaptive to a constantly changing farm environment, weather-induced flow changes, changing seasonal temperature and weather conditions, and changes in technology and markets. As the case with many dairies, Edaleen's expertise and time is limited, preferring to focus on the needs of the cows and their milk production-turning to Regenis as an expert partner for these above aspects, assisting them in developing, realizing and operating a modern manure management system aimed at valued added products and enhanced environmental sustainability.

"While at first take, an additional farm expense, use of Regenis as a third-party partner in consultation, design, construction and operations has been a blessing—allowing us to do what we do best and educating us in the best, most modern and available technology and approaches that has allowed us to be better stewards and neighbours, while achieving excellence in runtime and maintenance upkeep that from a larger picture has led to significant long-term savings to the dairy."

- Mitch Moorlag, General Manager, Edaleen Dairy

## Key Benefits & Results Summary:

- 98%+ runtime for all main technologies in the manure management system.
- Effective payback and positive economic return for all key components except the new fine solids separators which will need time for markets to develop.
- Combination of consultation, construction management and operations that has led to a modern manure management system for effective control and mitigation of key environmental concerns.



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## **KEY BENEFITS**

## Anaerobic digester, providing multiple

environmental benefits—The anaerobic digester produces a variety of revenues beyond its main product of electricity provided by the engine/ generator set. These include tipping fees and green tags, and carbon credits. From an environmental perspective the digester is instrumental in reducing solids loading, pathogens, greenhouse gases, volatile organics that lead to odour. The revenues exceed costs of this unit operation and has met anticipated finance payback for a positive return to the dairy.

Engine/Generator system, providing valued renewable electrical power to the grid as well as process heat for the anaerobic digester—Biogas

produced by the anaerobic digester is utilized in the engine/generator set, producing electrical power to the grid as revenues to the project. Engine heat is collected and used internally to heat the manure and maintain desired temperature for the process. The revenues exceed costs for this unit operation, meeting anticipated finance payback for a positive return to the dairy.

Solids/liquid Separator, providing value-added

fibrous solids—Post-digestion, effluent is passed over the solids/liquid separator for production of value-added fibrous solids. The solids are nearly pathogen-free, often meeting Class-A pathogen targets even without required time and temperature treatment. Additionally, the solids are greatly stabilized while containing unique properties unique to the digested fiber, namely air and water holding capacity, porosity, bulk density and nutrients. As a result, the solids make both an ideal bedding, allowing for offset of external bedding procurement costs, and a soil amendment, providing unique properties to a blend for commercial products. Offset bedding costs alone, but additionally with value-added revenue from the soil amendment sales, allows for revenues to exceed costs for this unit operation, meeting anticipated finance payback for a positive return to the dairy.

Fine Solids Separator, providing low-solids, low nutrient irrigation tea water and stackable nutrient-rich solids— Post solids/liquid separation, additional solids and nutrient partitioning was desired. The installed modified DAF unit, provides this capability, producing a nearly suspended solids-free, tea-coloured liquid more suitable for improved storage and field application, especially via irrigation systems. The preferred liquid results from the separation of solids, dewatered to a nice stackable pile, that is comprised of most of the organic-N and total P in the effluent. Partitioning of these specific nutrients provides increased flexibility in how to best and more efficiently manage nutrients on their farm, i.e. hauling more concentrated solids more economically to distant fields, targeting specific crops with products either focused on inorganic ammonia-N, or organic-N, while also better managing P on all fields. With immature and unrealized markets for the solids and the higher operating costs of the polymersupplied system, the system to date is not producing hard revenues above costs, yielding a negative return on payback, although soft costs in manure management enhancements is a driver for the dairy to continue its operation.

# Overall positive environmental impact with minimal to even positive financial return to

**dairy**—The Pacific Northwest area where this dairy is located is experiencing concerns with high nitrates in local groundwater, high phosphorus levels in agricultural soils, and transfer of pathogens to surface waters, ultimately impacting shellfish beds in the Puget Sound. Within the Puget Sound area is a population specifically concerned with growing concerns in climate change and the need for greenhouse gas mitigation as well as an overall desire for green technologies and green energy. Additionally, agricultural lands are being encroached by new housing developments, intensifying a need for control of odours. Edaleen Dairies' manure management system and its list of environmental control benefits positively targets these environmental concerns, as delineated above. With some co-products leading to realized revenues, many others do not have hard economic returns, but do allow the dairy to address local and regional concerns, allowing them to be better stewards to both the environment and the local populace—a fact that is particularly advantageous and important to a producer/processor.

# Organizations Involved:

Farm or facility Edaleen Dairy

**Electrical Utility** Puget Sound Energy

**Engineers** GEA/Houle

**Contractor** Regenis

Developers

Edaleen Dairy



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# RESULTS

Each unit operation has its own costs as well as environmental benefits, with **Figure 2** (below) highlighting and quantifying these costs as well as key performances allowed for by both the technologies and the Regenis operations. **Figure 3** (below) is a summary of the transformation in manure quality and nutrient content across the different unit operations and entire system.

# CONCLUSION

Any capital investment and its operation are only as good as its upkeep, runtime and resulting performance. A black-eye to the anaerobic digester and nutrient management technology industry within agricultural-placed projects has been and continues to be a record with too many failures related to performance and/or early infrastructural decay and negative financial return. Cited reasons for these failures point to an immature industry with non-vetted developers, consultants, and technology providers without the experience and wherefore-all to provide suitable solutions and business plans, as well as farm-run operations, that leads to premature infrastructure decay, delayed high maintenance costs and poor runtimes. While by no means perfect, the Edaleen Dairy project does point to a five-year record of impressive runtimes, scheduled maintenance upkeep, and delivery of projected technology performances. Correspondingly, this success can in part be attributed to the experienced professionalism of a third-party specialist for all aspects related to consultation, design, grant-writing, construction management, and full-system operations and maintenance.



FIGURE 2. INFOGRAPHIC OF SPECIFIC UNIT OPERATION COSTS AND KEY PERFORMANCE INDICATORS

% Runtime 📃 Various Pe

Various Performance Indicators 🛛 🛑 Installed Capital and Operating Costs (2017 dollars)

### FIGURE 3. CHANGES IN MANURE CONSISTENCY AND NUTRIENT CONTENT.

Pictogram of full-Edaleen system including DVO Phosphorus Recovery System (a) liquid samples at various stages of process; (b) liquid-poured samples at various stages of process; (c) NPK fertilizer values along various stages of process.



# 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 consultation, grant writing, design/integration, construction management, and operation/maintenance



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Anaerobic Digester — DVO Two-Phase, Mixed-Plug Flow, Linear Vortex



Fine Solids Separator — DVO Phosphorus Recovery Unit and Nutrient-Rich Solids



Solids/Liquid Separator — GEA/Houle Separator and Fiber Processing Building



Engine/Generator Set — Dresser Rand Guascor SFGLD 560



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# **REGENIS AT EDALEEN DAIRY PROJECT BY THE NUMBERS**

Location type	Dairy
Number of animals	Approximately 1,800 wet cow equivalents
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	<ul> <li>DVO Two Stage Mixed Plug-Flow Anaerobic Digester</li> <li>Dresser-Rand Guascor Engine with Martin Machinery Package</li> <li>GEA Houle Two stage slope screen manure separator</li> <li>DVO Phosphorus Recovery system</li> </ul>
Date operational	Fall 2012
Energy produced/required	<ul> <li>DVO Anaerobic digester approximately 40-45 KW parasitic load</li> <li>GEA/Houle Separator approximately 2 KW parasitic load</li> <li>DVO Phosphorus Recovery system approximately 40 KW parasitic load</li> </ul>
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
Contracted prices	Project proprietary information
Residual materials	<ul><li>Digested, separated liquid manure wastewater</li><li>Fine Solids Soil Amendment</li></ul>
Residual storage	<ul> <li>Lagoon storage for digested, separated liquid manure wastewater</li> <li>On-site storage for fibrous solids prior to use/sales</li> <li>On-site storage for fine solids prior to use/sales</li> </ul>
Residual use	<ul> <li>Wastewater residual fate as fertilizer for local fields/forage crops</li> <li>Fibrous solids recycled internally as bedding and sold as ingredient to retail soil amendment</li> <li>Fine solids as fertilizer to local fields/forage crops or sold as fertilizer/soil amendment to fields undergoing crop rotation</li> </ul>
Electrical utility	Electrical power purchase agreement with Puget Sound Electric
Ownership structure	Family owned dairy

For more information about Regenis, 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.



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