

ANAEROBIC DIGESTION AT KEEWAYDIN DAIRY FARM



Stowe, Vermont, is known for its picturesque beauty & year-round tourism activities that range from performing arts to antique car rallies, top-notch skiing & hiking. Situated just outside this New England mecca is the Keewaydin Dairy Farm, owned and operated by Leslie, Claire & Suzi Pike. The site has been under increasing pressure to reduce farm-related manure odors.

Enter Avatar Energy LLC, a renewable-energy company with offices in VT, CA & NV that designs & installs economically viable, state-of-the-art anaerobic digester systems for small to mid-sized dairy farms in the U.S. & Canada. Eliminating these odors was one of many factors in the Pikes' decision to install Avatar's AnD 1B22 anaerobic digester, equipped to handle 22,472 gal. of waste. Currently there are 90 jersey cows producing milk in the Keewaydin main barn, with another 80 dry cows and heifers in a secondary barn. The AnD 1B22 has the ability to handle the bio-waste from roughly 75 mature milking cows, and produces at minimum 4.18cu.ft. of biogas/gal. of waste introduced into the system.

Anaerobic digester systems are unique in that their benefits extend beyond the renewable nature of the energy produced: They have significant positive impact on existing farm manure management practices. Traditionally, digesters have been scaled only for large dairy herds, are in-ground, causing a host of economic and environmental issues. Avatar Energy's digester system uniquely addresses 5 hot-button issues in the industry:

1. modularity (its pre-engineered, scalable and modular design allows for maximum configuration flexibility, providing an easily



deployable & replicable technology at minimal capital expense while producing heat, power, bedding and fertilizer to the farm);

2. scalability (*hulls can adapt to variable herd sizes*);
3. above ground (fiberglass hulls resist corrosion from inside, so risk of groundwater contamination is eliminated).
4. economics (minimal waste, easy to clean and maintain, renewable form of clean energy, increased farm self-sufficiency)
5. environmental (methane, a potent greenhouse gas, is prevented from entering the atmosphere and is used as fuel, reducing need for other less-clean energy sources)

The Keewaydin project is Avatar's first commercial scale digester demonstration site in the United States. It not only shows the feasibility of a small-scale digester, it also represents a dairy farm's ability to coexist within a small tourist community. The end-result is a more self-sustainable dairy farm that preserves Vermont's agricultural traditions and is compatible with current pressures in developing tourist areas.

Digester process flow is as follows:

- Manure is extracted from barn floor and short-term storage receptacle, delivered to preheat tank.
- Manure is preheated in 375-500 gallon batches to 105°F four times per day.
- Manure is fed into digester via hydraulic injector pumps.
- Manure passes through digester in slow plug-flow for 18-21 days, during which time 99% of pathogens and 90% of odors are destroyed. By controlling odor, the system also controls flies and other pests that can plague animal operations.
- Biogas is produced (60% CH₄, 40% CO₂, 1% water vapor, less than 2000ppm H₂S) and utilized to run a combined heat and power generation unit. More than 10kW of electricity are generated continuously.

- Digested manure is processed through a separator (liquids from solids).

- Solids are utilized as bedding replacement; excess are sold off farm.

- Nitrate-rich liquid can be spread on crops, reducing fertilizer costs.

- In order to fund this system, Avatar Energy collaborated with the Pike family to acquire grants on both state & federal levels. Because Avatar's digester system is a modular, non-fixed asset, banks are able to finance it as farm equipment. ♻️

ANAEROBIC DIGESTION OVERVIEW

Farm Name:	The Keewaydin Dairy Farm
Location:	Stowe, VT
Date Operational:	Summer 2011
Digester Type:	Plug-Flow
Digester Model:	AnD 1B22
Digester Designer:	Avatar Energy, LLC
Influent:	Dairy Manure
Current Bedding Material:	Sawdust from Vermont supplier
Number of Cows (design):	75 milking cows
Hull Components:	(1) 60' long x 8' diameter & (1) 20' long x 8' diameter
Hull Dimensions:	8' diameter x 60' long
Cover Material:	P2000 Insulation - dual layers for optimal intertization
Design Temperature:	105 degrees Fahrenheit
Estimated Total Loading Rate:	1,124 gallons per day
System Capacity:	22,472 Gallons
Plug-Flow Retention Time:	20 Days
Solid-liquid Separator:	Screw Press separator
Solid Use:	Bedding
Liquid Use:	Fertilizer
Biogas Utilization:	CHP Generator - electricity, heat.
Monitoring of Results:	Automated PLC unit designed into system.