

Polypropylene covers for biogas generators

A New York dairy farm converts waste to electricity.

Neglect no business concerning a cow, says an old proverb. Owners of the Matlink Dairy in western New York state are following that advice and turning the wastes from 500 Holstein cows into electricity using a biogas generator.

The dairy, one of the largest in the area, had previously disposed of the animal wastes in a large, unlined lagoon. The partially-dried residue was then applied to the fields as fertilizer. However, odors were a recurring nuisance for residents of the downwind village of Clymer. Field application was restricted to the winter months in an attempt to reduce the odor complaints, but snowmelt and rain runoff from the fields caused pollution concerns for the receiving streams.

The farm owners received a \$200,000 grant from the New York State Energy Research and Development Agency (NY-SERDA). The grant enabled them to devise a method for containing and converting the waste into a useable resource. They were assisted by project engineer RCM Digesters

Inc., a specialty firm that has completed more than 35 waste-to-energy digester projects in the United States over the last 20 years.

The basic system

RCM devised a "complete mix" digester system, which uses gravity to convey bovine waste and dairy wash-down water to a drop gutter system and into a 20,000 gal. below-grade concrete mixing tank. There, it is heated and mixed with small amounts of food waste material from local sources, which are held in a second adjacent tank.

After mixing, the resulting slurry is pumped into two adjoining, below-grade, concrete digestion chambers, each with an approximate 300,000 gal. capacity. The 80 ft. (24 m) long chambers are separated by a central concrete beam.

The covers

The digestion chambers are each covered by 45 mil, scrim-reinforced polypropylene geomembranes. The membranes are manufactured in an extrusion process that com-

bines the woven fiber scrim with a reactor-modified polypropylene resin. Polypropylene is preferred for this application because of its resistance to both ultraviolet radiation and the aggressive chemicals in the wastes and resulting gas. It can withstand the extremes of summer heat and winter freezes as well as the high temperatures caused by the anaerobic digestion. With a specific gravity of 0.9, polypropylene's light weight allows larger panels and fewer seams, a plus for a gas-containing application.

Using 78 in. wide material, project fabricator Engineered Textile Products joined 12 panels to make each of the two covers for the digestion chambers, for a total of 24 panels. Panels were hot-wedge welded, with seams reinforced to ensure seam integrity and a gas-tight seal. Covers were fabricated with the light (white) side out and dark side in, to avoid excessive summer heat absorption that could kill the anaerobic bacteria.

In order to maintain a gas-tight system, RCM attached the polypropylene covers to the concrete walls of the digestion chambers with a unique proprietary system that holds the cover edges securely against the gas pressure, normally measuring five inches of water column/0.18 psi, which causes the covers to inflate to a height several feet above the chambers. During a system upset at startup, gas pressure built up in the mixing chambers to such a degree that a buried pipeline leading from the digestion chambers to the generator literally ripped itself out of the ground. Yet, the covers, with a minimum breaking strength of 300 x 250 lbs. (i.e., warp and fill directions), remained intact. In another unintended material test, one of the covers sustained a 5-ft. long tear. The damage was easily repaired by cleaning the surface, applying kerosene to both sides of the tear, then heat-welding a clean piece over the tear.



Photo 1. Beneath the polypropylene covers, waste is digested anaerobically. The dairy owners harvest the methane for energy production, which powers the operation. Excess energy is sold back to the area grid.

Starting the system

Samples of material were taken from the pre-existing waste lagoon and heated to 100° F. This process produced enough anaerobic bacteria to “seed” the newly built system and start the digestion process. The decomposing waste mixture produces methane gas.

The Matlink project is the only digester in the United States that incorporates food-based waste material, including whey from a local ice cream maker and waste from the production of grape juice. The inclusion of the food matter has more than tripled the amount of methane produced by manure alone.

Harvesting methane and by-products

The generated biogas, containing 60% methane, 40% carbon dioxide and a trace of hydrogen sulfide, is piped uphill from the digesters to the generator building. The gas is first compressed, then metered into a 1,905 in.³ Waukesha electrical generator, originally designed to burn natural gas. The generator produces between 130 and 145 kW of electrical power, nearly twice what the farm requires for its own electrical needs. The excess power is sold to the regional elec-



Photo 3. After two or three weeks in the digester, the odorless, dry waste can be used for cow bedding or packaged and sold as soil amendment.

trical grid, operated by Niagara Mohawk Power Corp. According to the dairy managers, the digester system is producing 25% more gas than originally anticipated. Excess gas has to be flared.

The generator provides enough heat to meet all of the facility's hot water needs, including washing and sanitizing of the milking parlor several times a day and heating the calf barn. Excess heat is also used to keep the mixing tanks and the digester at the proper temperature and to dry the food material prior to its introduction into the tank.

Retention time in the digesters ranges from two to three weeks, long enough to allow the bacteria to utilize the majority of the available energy. Decomposed waste is continually pumped out of the digesters, separated with a screw press and dried (using heat from the generator) and stockpiled in an adjacent building. A portion of the dry,

crumbly, now odor-free solid residue is used as bedding material for the cows, and plans are in process for bagging and selling the remainder as soil amendment.

The digested liquid, also odor-free, is piped to a lagoon.

In addition to the initial grant, approximately \$300,000 has been invested in the digester, the generator and the associated equipment. According to RCM, at least 400 animals are needed to create enough waste material to make a digester project economically viable. The dairy's electric bill used to average \$4,500 per month. Now, Matlink sells power for a profit, albeit a small one at present, and is slowly paying off its capital investment. And, perhaps best of all, downwind neighbors are no longer bothered by odors.

Sara R. Black is a freelance writer based in Denver.

Project information

Owner: Matlink Dairy

Project engineer: RCM Digesters Inc.

Fabricator: Engineered Textile Products

Geomembrane: polypropylene from Cooley Engineered Membranes Inc., Pawtucket, R.I.



Photo 2. Each pit cover was fabricated from 12 polypropylene sheets that were hot wedge welded together. The reinforced seams sealed the system and enabled the anaerobic process to begin.