DIGESTERS BRING POWER AND INCOME TO WEST COAST DAIRY FARMS

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Payback for biogas system will be within five to seven years, while generating a revenue stream that's not solely reliant on milk checks.

IF DAIRY FARMING on the West Coast is to survive, we need to move ahead with projects like this," says Darryl Vander Haak about the new digester on his farm in Lynden, Washington just south of the U.S.-Canadian border. The state's first commercial dairy anaerobic digester which will use manure from up to 1,500

cows to produce electricity began operating this month. Two neighboring dairies will also supply the digester with manure.

Seventy percent of the $1.2 million project cost will be paid by Vander Haak, with the rest of the money coming from grants and other resources. Payback is expected within five to seven years, possibly sooner. The project won a cost-share grant from USDA's Rural Development Renewable Energy Systems Improvements Program, as well as assistance from Washington State University's Climate Friendly Farming Project. (See article in this section.) In addition, Puget Sound Energy will purchase the digester's electric output as part of the utility's "green power" program.

Looking at the economics, Craig MacConnell — Whatcom County, Washington Extension chairman — pointed out that the digester provides another income stream so a dairy farmer is not solely reliant on milk checks. Marlin Statema, president of Andgar Corporation — which is building and managing the project — explains that when drought pushed power rates up three years ago, his company started looking at methane digesters.

HOW THE SYSTEM WORKS

According to the technical report prepared for the USDA grant application, major problems currently confronting large-scale farming operations include: government regulations on manure disposal, contaminant leaching to underground aquifers, run-off to surface waters, methane generation by livestock to atmosphere, and odor complaints.

The Vander Haak Dairy retained Andgar Corp. of Ferndale, Washington to install the proprietary digester system developed by GHD, Inc. of Chilton, Wisconsin. GHD describes the system performance as follows:

Unprocessed cow manure from the dairy will be collected in a receiving pit. The manure from the dairy barn and parlor holding area, along with the milking parlor wastewater, will be collected throughout the day in the receiving pit and pumped directly into the anaerobic digester (AD) vessel. The unprocessed manure input to the AD system is therefore uniform and has had little time for aerobic degradation. Minimization of aerobic degradation of the raw manure results in more biogas production within the AD system and less manure smell in the barn.

During the first stage in the AD concrete vessel, raw manure from the dairy will be mixed and heated to a temperature of 100°F. Reclaimed waste heat from the electrical cogeneration system will be utilized to raise the temperature of the manure to the optimum growth temperature of the methanogenic bacteria. The first stage of the AD system is designed to facilitate the growth of acid forming bacteria which break down the raw manure input stream into simpler volatile fatty acids and acetic acid. Residuals from the first stage in the AD vessel will gravity flow into the second stage in the AD vessel.

The second stage will be the largest stage, due to the slower growth rate of the methanogenic bacteria that convert the volatile fatty acids into a biogas, which consists primarily of methane and CO2. Reclaimed waste heat from the electrical cogeneration system will also be utilized in the second stage vessel to maintain a 100°F fluid temperature to offset thermal conduction losses through the vessel structure. After the second stage of the AD system, with a designed 20-day hydraulic retention time, the treated residuals will gravity flow into an effluent collection pit where they will be further processed.

The methane biogas will be collected from the first two stages of the AD vessel and will be utilized for fuel in the combined heat and power (CHP) gensets. These gensets are commercially available, natural gas-fueled reciprocating engines modified to burn biogas. No purchased fuel will be utilized in the AD system gensets to produce electricity. Electricity produced will be sold to the electric utility and/or utilized on the farm as a substitute for currently purchased power. Power produced will be 480v, 3 phase.

Waste heat from the electrical generator will be retained and stored at as high an effluent temperature as possible. The waste heat, in the form of hot water, will be collected from both the engine jacket liquid cooling system and from the engine exhaust (air) system. Approximately 30 to 60 percent of this waste heat will be utilized in the AD system. The remaining waste heat can be utilized by the dairy as a replacement for hot water production (reducing the need for natural gas or propane purchases) and for in-floor heating of the dairy and holding areas. Using that heat is not part of this project at the Vander Haak Dairy, but can be used sometime in the future. Additionally, there is sufficient heat to conduct secondary drying of the fiber if a value added market can be established in the future.

About 20 percent of the AD biosolids, rich in methanogenic bacteria, will be recycled from the end of the third digestion zone and reused at the beginning of the second digestion zone of the AD vessel as "seed" stock for the methanogenic bacteria process. The remaining 80 percent of the biosolids will be pumped from the effluent pit at the end of the AD vessel to a manure solids separator. The mechanical manure separator will separate the influent digested waste stream into solid and liquid fractions. The solids will be dewatered to approximately a 35 percent solid material. The separated solids, having the same odor and pathogen reduction characteristics as the liquid stream, will be utilized by the dairy for bedding replacement (an expense reduction). Utilization of the separated solids for bedding typically comprises about 40 to 60 percent of the generated separated solids from a typical dairy. The residual 40 to 60 percent of nonutilized separated solids will be sold (system-generated income) to other dairies for bedding purposes or eventually sold to after-markets, such as nurseries and composters, for soil amendment material once that market is developed.

Liquid from the manure separator, now with the majority of the large solids removed, will gravity flow into the dairy’s storage lagoon. A large advantage of the effluent from the AD treatment process is that the viscosity of the effluent is such, as opposed to the raw manure influent, that the liquid effluent can be pumped much more easily through an irrigation nozzle for field spreading. Of even greater benefit is the fact that the absolute volume of effluent to spread is at least 15 percent less in total volume due to the digestion process and fiber separation that has occurred to this point. Spreading less volume is an expense reduction. A second large advantage of the AD treatment process is that the organic nitrogen and carbon are substantially converted to inorganic nitrogen and carbon-based material in the effluent liquid.

A report on how utility companies such as Puget Sound Energy are using biomass power in their green energy programs appears below. — J.G.

GREEN POWER FROM NORTHWEST UTILITIES

AFTER the Washington state legislature passed a bill three years ago, Puget Sound Energy (PSE) and 15 other regional utilities were required to offer customers a program to invest in renewable energy. The PSE green power plan is a voluntary program that costs an additional $4/month on a subscriber's electricity bill. Under this arrangement, PSE buys energy from renewable sources such as the anaerobic digester on the Vander Haak farm described in the accompanying article.

The Bonneville Environmental Foundation (BEE) administers the PSE green power portfolio which is generated from resources such as wind, solar, geothermal, landfill gas as well as biomass energy from agricultural residues, forests and dedicated energy crops "that do not include wood pieces that have been treated with chemical preservatives." Last month, BEF announced that Puget Sound Energy had committed to an increase in its purchase of Green Tags generated from solar power projects.

"PSE's green power program is one of the region's leading environmental energy programs, providing a great way for people to personally support the benefits of renewable energy," says Rob Harmon, BEF vice president for renewable programs. Adds Mike Richardson, PSE manager: "Participation in our green power program is up more than 50 percent over last year, and customers continue to sign up at a pace of several hundred per week." The utility's green power program has more than 13,000 customers helping to generate approximately 4 million kilowatt hours every month of renewable energy for the Northwest grid. PSE is Washington state's largest energy utility.