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Why the Interest in Methane Generation?

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Bio-gas or methane production for energy use is not a new technique, but with increasing power costs nationwide, livestock producers have developed a keen interest in this technology as a means to use accumulated manure. For years sewage treatment plants have recovered methane for heating and electrical generation. In the 1970's rising oil prices triggered an interest in developing "commercial farm-scale" bio-gas systems in the United States. Since then approximately 70 bio-gas facilities have been installed at commercial swine, dairy, and caged layer farms and another 70 digesters were installed as university research and demonstration projects. For more than 20 years Mason-Dixon Farms, a dairy in southern Pennsylvania, have digested manure to generate electrical power.

Most digesters are relatively simple tanks or pits that hold manure and bedding for about two weeks under anaerobic conditions. A cap or top allows accumulated gases to collect and these gases are used for generation of energy. Most digesters are "thermophilic", or heated, to stimulate growth of microorganisms. It is these microbes that generate gases from the organic matter in manure. Methane accounts for 65% of the gas type generated by manure digestors. The accumulated gas also contains carbon dioxide (30%) and small amounts of hydrogen sulfide (<5%).

The gas can be burned without processing to heat buildings or water for use on the dairy, saving the dairy producer money in water or space heating bills. The greatest savings is derived when gas is run through a generator to produce electricity.

Other benefits of bio-gas production include:

Reduced Odors. Bio-gas systems reduce offensive odors that impair air quality and may be a nuisance to nearby communities. The volatile organic acids that cause the odor are consumed by bio-gas producing bacteria.

More Readily Available Nitrogen for Fertilizer. In the process of anaerobic digestion, the organic nitrogen in the manure is largely converted to ammonium, the primary constituent of commercial fertilizer, which is readily available and taken up by plants.

Reduced Surface and Groundwater Contamination. Digester effluent is a more uniform and predictable product than untreated manure. The higher ammonium content allows better crop uptake and the physical properties allow easier land application. Properly applied, digester effluent can reduce the likelihood of surface or groundwater pollution.

Pathogen Reduction. Heated digesters reduce pathogen populations dramatically. Lagoon digesters isolate pathogens and promote pathogen die-off prior to entering storage for land application.

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Methane Generation

Part II: Is it for you?

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The benefits of methane generation are intriguing but the system may not be appropriate for every farm. Let's examine the effort required to reap the benefits and why there are not more dairies equipped with digesters.

Facilities

The type of methane generation unit is based on the system of manure management at your dairy. A covered lagoon is a small earthen lagoon that holds mixed manure and is heated. It has a floating cover which collects the gases. The plug flow digester is designed for manure to enter one end of the digester vessel, move through as new manure enters the system, and out the opposite end. Manure is held in the digester for 10 to 20 days depending on the design capacity. In a complete mix digester, manure enters at one place. All the material is mixed together and an amount equal to the volume pumped in is drawn out each day.

Start Up Cost

The digester, manure handling and preparation facilities, and generator will cost roughly $250,000 for a typical system that would generate electricity from 300 to 500 cows. This estimate will vary widely depending on whether the dairy uses a covered lagoon, a plug flow digester, or a complete mix digester.

Of the investment in an anaerobic digester/generation system, the digester accounts for 40%, the generator 30%, and the remaining 30% on equipment to prepare the manure and to handle the effluent from the digester. In other words, half of the investment is in the digester and half is in the post-digester functions. Once the system is operating, about 80% of the operation and maintenance cost is in the post-digester facilities which generate electricity and handle the effluent from the system. A crucial aspect of maintenance is removing the small percentage of hydrogen sulfide from the methane containing gases before burning them in an internal combustion engine. If not removed, the gas becomes highly-corrosive sulfuric acid and will ruin the generator engine and any metal-clad building nearby.

Potential Income

Most economic analyses show that a dairy needs to be at least 300 cows in a high power cost area to make on-farm power generation profitable. Most states have laws that require electrical supply companies to buy power from local generation sites for the average price they pay for power from other sources. If you're in an area where hydroelectric power is a primary source, you will receive about 3 to 4 cents per kilowatt hour, usually less than half the retail rate. So you offset the power you use at the retail rate and sell the rest at wholesale.

In order to reduce the cost of building a methane generation facility and the time to payback of the investment, state and federal tax credits for creating new power sources are available. Additionally, some states offer loans for the development of new energy sources.

Inconsistent Results

Despite the seeming simplicity of methane generators, many bio-gas systems have failed. These failures have led to improvements in existing technologies and newer, more practical systems. Thus, the success rate of bio-gas systems built after 1982 is greater than that of digesters built before 1982. Following a retrospective study of bio-gas recovery projects, the U.S. Environmental Protection Agency suggests that there are predictable conditions associated with the success or failure of bio-gas recovery projects.

Conditions Associated with Success of
Biogas Technology

1. The owner/operator was committed to bio-gas technology and wanted to make it work.
2. The owner/operator had some mechanical knowledge and ability and had access to technical support.
3. The designer/builder built systems that were compatible with farm operation.
4. The owner/operator increased the profitability of bio-gas systems through the sale of manure byproducts. One facility operator generates more revenues from the sale of electricity and other manure byproducts than from the sale of milk.

Conditions Associated with Failure of
Biogas Technology

1. Operators did not have the skills or the time required to keep a marginal system operating.
2. Producers selected digester systems that were not compatible with their manure handling methods or layout of their farms.
3. Some designer/builders sold "cookie cutter" designs to farms. For example, of the 30 plug flow digesters built, 19 were built by one designer and 90% failed.
4. The designer/builders installed the wrong type of equipment, such as incorrectly sized engine-generators, gas transmission equipment, and electrical relays.
5. The systems became too expensive to maintain and repair because of poor system design.
6. Farmers did not receive adequate training and technical support for their systems.
7. There were no financial returns of the system or returns diminished over time.
8. Farms went out of business.

Bio-gas can be a successful small enterprise on today's dairy, but it pays to plan the project carefully and to get some good technical advice along the way.

Importance of Biosecurity:
Now More Than Ever

After the September 11th attacks, the media has spread the alarm that our nation's agricultural industry and, thus, our food supply, is at risk of a bioterrorist attack. The message is repeated on the television, radio, newsprint or internet: "Agroterrorism, as it has been named, is a threat and action must be taken!"

Where have these journalists been hiding for the last several years while government agencies and livestock producers institute biosecurity protocols and quality assurance management programs in order to guarantee the safety of US food supply? Globalization of trade spurred the agricultural industry to implement biosecurity protocols and HAACP principles years ago. The hysterical coverage of agroterrorism might sell advertising but it should not alarm those diligent livestock producers and processing plants that are on task in their efforts to guarantee animal health and food safety. The food production industry has been applying HAACP principles, the management protocols that check each step of production in order to eliminate areas that are susceptible to problems. As livestock operations increase in size and animals congregate from many points of origin, biosecurity protocols are being applied to minimize the introduction and spread of endemic diseases diseases such as Johne's disease and mycoplasma mastitis, as well as protect against the introduction of foreign animal diseases such as foot and mouth disease and bovine spongiform encephalopathy. For instance, Anthrax is not a new disease to livestock producers. This summer Texas reported cases of anthrax in deer and livestock. Vigilant producers and veterinarians recognized the signs. In anticipation of periodic outbreaks, state animal health commissions developed detailed protocols to control the size and impact of an outbreak.

This current hoopla in the media does serve to remind producers of the importance of vigilant attention to signs of infectious disease outbreaks in herds but there are constant reminders in our industry, such as the outbreak of BSE and Foot and Mouth Disease in the United Kingdom and abroad. Once again it is time to review biosecurity measures and quality assurance protocols for your operation. Outbreaks of infectious disease will attract the attention of authorities concerned with agroterrorism and will be difficult to differentiate from naturally occurring disease. Review these protocols with your management team and your team of workers on the dairy. This periodic review of protocols with consultants and workers will improve effectiveness.

If biosecurity protocols have not been instituted on your operation, it is very important to develop some. Proactive action will minimize chances of disease entry, improve response to disease outbreak, and reduce financial losses if an outbreak does occur. The goal of biosecurity protocols is to eliminate the introduction of disease and contain quickly that which may occur. The September issue of the Western Dairy News contained specific recommendations for importation biosecurity. To be successful these recommendations must be tailored to the operation and their importance appreciated by each worker. Periodic review is necessary to evaluate the success and efficiency of biosecurity protocols.

Further information can be found on the following web sites:
Food Safety: United States Department of Agriculture: http://www.usda.gov/
USDA/FDA HACCP Training Programs and Resources Database:
http://www.nal.usda.gov/fnic/foodborne/haccp/haccpfly.html
What is USDA doing to ensure well-being of America's agriculture?
http://www.usda.gov/special/biosecurity/anthraxq&a.htm

Center for Animal Health Monitoring:
http://www.aphis.usda.gov/vs/ceah/cahm/index.htm

Dairy Biosecurity: USDA
http://www.usda.gov/special/biosecurity/safeguard.htm
http://www.aphis.usda.gov/vs/ceah/cahm/Dairy_Cattle/dairy.htm

Importation Biosecurity Protocol:
http://www.cvmbs.colostate.edu/ilm/CDN

Infectious Disease Information:
Anthrax: www.aphis.usda.govoa/pubs/anhrax.html;
http://www.cdc.gov/mmwr/indexbt.html
Foot and Mouth Disease: http://www.aphis.usda.gov/oa/fmd/informwp.html
BSE: http://www.aphis.usda.gov/oa/bse/

National Biosecurity Resource Center for Animal Health Emergencies:
http://www.biosecuritycenter.org/nbrctoc.htm

National Association of State Departments of Agriculture:
http://www.nasda-hq.org/

Public Health Emergency Preparedness:
Center for Disease Control:
http://www.bt.cdc.gov/

Western Dairy News *is published as a service to the people interested in the health and welfare of the western dairy industry.*

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