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Methane production – myth or reality?

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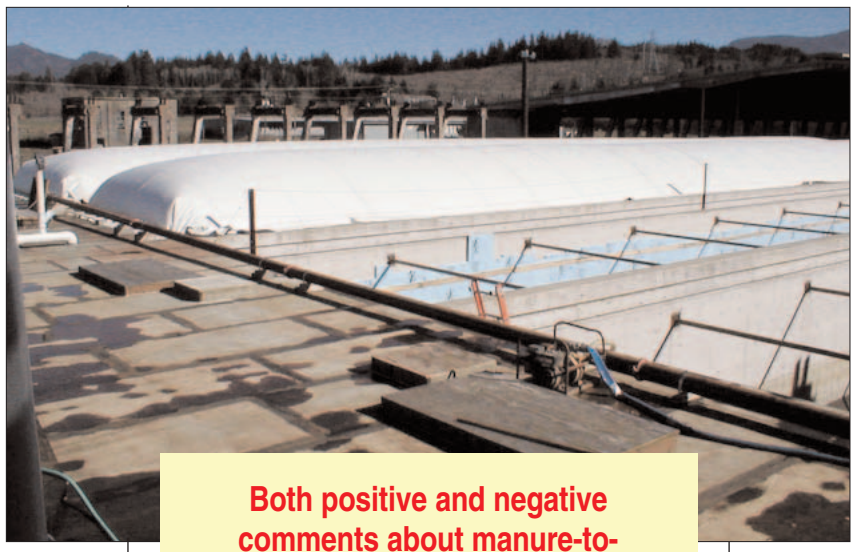
There continues to be a lot of interest by dairy producers in the concept of producing methane from manure. Rising energy costs and increasing talk about control of emissions from dairies have made producers think about anaerobic digestion as a manure handling option. Both positive and negative comments about manure-to-methane technology abound. The fact is that it can be successful, but it must be done correctly and for the right reasons.



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"It is simple to produce methane from manure"

While it's true that manure decomposes naturally and part of this decomposition releases methane and carbon dioxide, this does not mean that it is easy to efficiently create methane from manure.

The solids content of manure is key to producing methane in commercial quantities. It is the solids in the manure that feed the "bugs" making methane. Generally, the higher the solids content of manure, the greater the volume of methane produced. The importance of solids content varies depending on the type of digester used (see the *"All digesters are alike…"* section later in this article).

Proper temperature is equally important. Anaerobic digestion of manure is usually done at 95 to 104 degrees (mesophilic temperature) or 125 to 140 degrees (thermophilic temperature). Once a system is operating, it is important to keep the temperature as constant as possible, because several degrees decrease in operating temperature can diminish methane production by as much as 25 percent. Some systems use both temperatures in sequence (phased temperature) to wring extra methane out of the carbon in manure.

Because solids content and temperature are such critical factors, an anaerobic digester should be monitored frequently. This doesn't mean having a full-time operator, but the owner should record temperatures daily (or even more often) and monitor the amount of gas or electricity produced.

The amount of gas produced daily tells a lot about the health of the biology within the vessel. It is easy to upset the "bugs" doing the work. Avoid using excessive amounts of copper or zinc in footbaths. If using an ionophor to improve feed efficiency, gas production could be reduced. Don't dump lots of waste milk into the collection system. And finally, avoid sand bedding because it will fill the digester with inorganic solids.

"It will solve a dairy's manure headaches"

Be careful getting too excited about this technology solving the pressures for better environmental control of the dairy's manure. Once methane has been generated from the manure, the effluent still contains nitrogen, phosphorus and potassium that must be field-applied responsibly. The major plant nutrients go nowhere during digestion, and can still pollute water if mishandled.

A digester will reduce bacteria remaining in the manure and regulators use bacteria as an indicator of runoff or over-application. Don't believe the folks who tell you that all the bacteria are gone. They are reduced 98 percent, but when you start with millions there are still a lot left, including some pathogens.

Since methane is produced and collected in a closed vessel, there is some odor control built into the system. The technology doesn't do away with odors, however, because cow housing and long term effluent storage can still be sources of gases and particulates.

"It is a great way to make money"

One of the reasons that digesters built in

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the 1970s were eventually abandoned was that wholesale energy rates, while high compared to the 1960s, were not high enough to pay for the investment in equipment and the operating costs of producing electricity.

As energy costs rise, it can be more lucrative to produce energy as long as wholesale rates paid by utility companies to on-farm generation facilities go up as well. Remember, though, that wholesale rates paid to you will only be about half the price of the power you buy from the utility company. The advent of "green power" options where ratepayers choose to pay higher rates for electricity from renewable sources may help the on-farm economics of anaerobic digestion.

It takes an investment per cow of anywhere from $500 to $1,000 to build a digester and generator combination. Ongoing operating costs, like generator maintenance, take another 8 to 10 cents per cow per day. Of the initial investment, about half is in the portion of the system needed for turning methane gas into electricity that can be used on the dairy and/or sold back to local utility companies. This is also the portion of the system that costs the most to operate.

About 80 percent of total operating costs are associated with the electrical generation facilities. A lower cost alternative for some dairies is to burn the methane itself for water and space heating. While this may only use part of the gas collected, it may make a system more affordable and practical to the busy dairy operator.

"All digesters are alike and any of them will work on your dairy"

Actually, there are four general types of anaerobic digesters. Each is more efficient with a particular type of manure and each is has a particular level of operation sophistication. Here is a brief discussion of each:

The covered lagoon requires a temperature or warm climate since there is no supplemental heating of the manure. It will work best with low solids content manure (4 to 8 percent) and manure must be held in the pond for 40 to 60 days to allow breakdown of carbon-bearing materials into methane gas. As you might guess, it takes quite a large cover to collect gas from a pond that can hold 60 days of a dairy's manure.

The complete mix digester is a closed vessel or tank system where manure is constantly fed in at a pre-set rate and is mixed into manure already in the vessel. Manure is heated in the vessel so this digester can be used in any climate. Complete mix digesters will handle manure with medium solids content (8 to 14 percent) and have moderate to good gas production rates. Thermophilic digesters are most often complete mix types because higher temperatures can be maintained more dependably when cooler manure fed in is constantly mixed with heated manure in the tank. Retention rates are usually 20 to 28 days for these digesters.

Plug flow digesters are the cheapest to build and the easiest to operate. Manure with a solids content of 11 to 13 percent is fed into a long narrow tank at one end, while effluent that has been digested comes out the other end. These are also heated and covered, so gas is collected above the manure.

Bio-reactive digesters are generally the most expensive and the most complicated to operate. They can handle manure with low solids content (like flushed manure) and have the shortest retention time to harvest the carbon out of manure. In general, they are designed to create an ideal micro-environment for methane-producing bacteria and to bring the manure to the "bugs." Often the micro-environment will be a film or slime layer within the digester where the most active "bugs" reside and manure flows through, providing carbon that can be made into methane. While these digesters may not require a full-time operator, they do require a lot of attention. They are sort of the "race car" of digesters.

Summary:

The decision to build and operate a digester will have many financial and management impacts for years to follow, so the process should not be taken lightly or done quickly. Digesters can work fine, but they must be designed for each specific dairy operation involved. Extensive research is crucial, including visits to see digesters that are already in operation. Producers must also carefully examine the considerable time, cost, and labor needs that will be required to operate

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