Hazards/Concerns

Anaerobic digesters are not necessarily a fit for every operation. There are multiple considerations that should be addressed prior to installing these digesters. Some of them are listed below:

- Size
- Initial investment
- Power purchase agreements
- Permitting
- Solids handling
- Design
- Operation/maintenance
- Handling potentially explosive gas
- End use of biogas: for heat or electricity, utility connectivity
- Digester management
  - -High ammonia levels (>1500 ppm) can inhibit methane production.
  - -pH maintenance
  - -Temperature controls
  - -Controlled load (% solids level maintenance)

Benefits of Using a Digester

There are several reasons farm operators might consider an anaerobic digester: manure management, odor control and power generation. Manure treated through the digester is stabilized and can be applied to fields as a soil conditioner that is rich in nutrients including nitrogen, phosphorous, potassium and other trace elements. This fertilizer could serve as an additional revenue stream for the operation. The process helps to control odors associated with manure collection facilities. The methane gas produced by the bacteria can be used to generate heat or electricity, which can in some instances be sold to utility companies.

Economics

Anaerobic digester system costs vary widely. Systems can be put together using off-the-shelf materials or designed and built by companies who specialize in digesters. Factors to consider when building a digester are cost, size, the local climate, and the availability and type of organic feedstock material.

Digesters can be operated utilizing dairy waste, swine manure and poultry litter. However, each of those wastes has different characteristics that affect the viability and economics of a digester.

Anaerobic Digesters

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Methane Digesters

Methane digesters convert organic matter into an energy source known as biogas. This renewable source of energy can be produced without adversely affecting greenhouse gas emissions. Although there are many organic material sources available to produce biogas, this brochure will focus on methane digesters using animal wastes as the fuel source.

Biogas

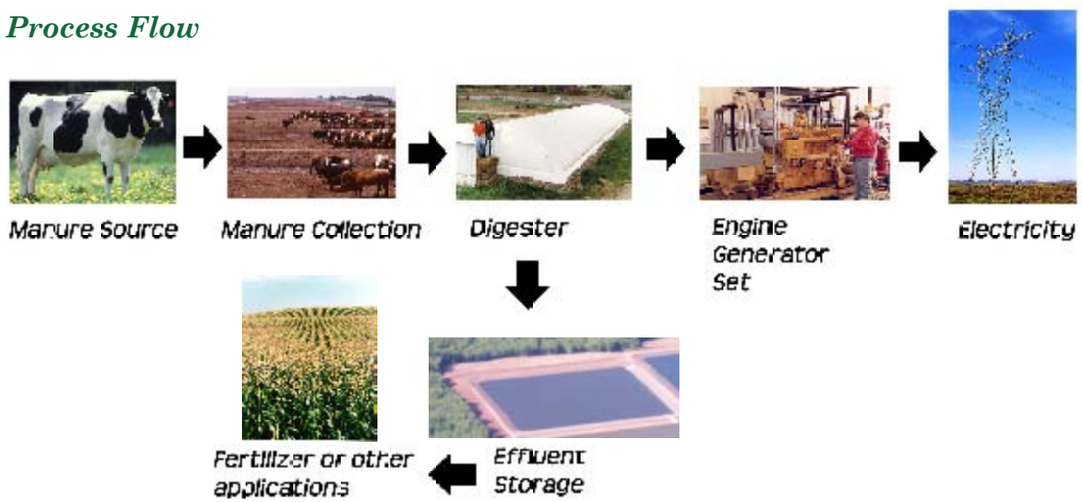
Biogas produced from organic matter typically contains 60-70% methane, 30-40% carbon dioxide and trace amounts of other gases. The heat value of raw biogas is approximately half that of natural gas. Biogas is often used in boilers to produce heat and/or used in a generator to produce electricity and capture excess heat.

The Digester Process

Manure is collected and deposited or scraped into a digester. Pretreatment may include heating, adding water (adjusting solids content), or allowing heavy debris to settle out of the slurry. The conversion from animal waste to biogas occurs through an anaerobic (without oxygen) fermentation process. Over time, and under controlled temperatures, acid forming bacteria convert the waste to organic acids. Methane forming bacteria then convert the acids to methane and carbon dioxide.

Management of the carbon to nitrogen ratio is important for biogas production. The rule of thumb for optimal digester management is 20 parts carbon to 1 part nitrogen. Addition of high carbon/low nitrogen content organic material such as crop residues, leaves, or newsprint can improve digester performance when higher nitrogen levels are detected. These higher carbon materials may be added on a constant basis whenever animal urine (higher ammonia {nitrogen} levels) is included with the manure.

Process Flow



Common Digester Types

Lagoon

Low installation costs
Low maintenance costs
Manure characteristics: liquid (<2% solids)
Not heated
Methane production: Driven by ambient temperatures (fluctuates)
Common installation: Used in warm climates and sites with flush systems

Plug Flow

Medium installation costs
Minimal maintenance costs
Manure is mixed prior to entering the digester
Manure characteristics: 10-14% solids
Methane production: 10-20 days
Common Installation: Dairy farms

Complete Mix

High installation costs
High maintenance costs
Manure characteristics: 3-10% solids
Heated tank required
Mixer required to keep solids in suspension
Common installation: poultry farms

Heating Values Comparison

Heating Values Comparison for Common Fuels	
Fuel	Heating Value/Unit
Natural Gas*	1,028 Btu/ft.^{3}
Propane*	91,333/gallon
Fuel Oil #2*	140,000/gallon
Bituminous Coal	7,300 – 10,000 Btu/lb.
Biogas	600 – 700 Btu/ ft.^{3}
* Published by the Department of Energy	

The heating value from biogas can vary according to the amount of methane produced in the digestion process. Because biogas produced from the digester is 60-70% methane, biogas has a heating value of approximately 600-700 Btu/ft.^{3}. The table shows the heating values comparison between common fuels.