NRCS
Natural Resources Conservation Service
State Template

ANAEROBIC DIGESTER - 366

Conservation Practice Information Sheet

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Definition

An anaerobic digester is a component of a waste management system that provides biological treatment in the absence of oxygen. For a complete version of the national practice standard, see the web site: http://www.nrcs.usda.gov/technical/efotg/.

Purpose

The purposes of this practice may include capturing biogas for energy production, managing odors, reducing the net effect of greenhouse gas emissions, and reducing pathogens.

Where Used

When byproducts are generated from livestock or other agricultural operations, a digester can be part of the management system. The operator must also have the technical support, interest, time and technical skill to operate and maintain the system.

Conservation Management System

The anaerobic digester practice is part of a planned manure management and/or comprehensive nutrient management system. Anaerobic digesters may entail other conservation practices such as structures, pipelines, pumps, or even delivery trucks. Additional information including design criteria and specifications are in the local NRCS Field Office Technical Guide.

Digester Types

1. Plug Flow - Typically used for scraped collection systems where the solids content is 11 - 14%. Retention time is usually more than 20 days.
2. Complete Mix – Typically used with flushed collection systems, where the solids content are less than 10%. Retention times are more than 17 days.
3. Ambient Temperature – Typically an unheated, covered lagoon or tank where the solids content is less than

2%. Retention times are often more than 60 days.

4. Alternative Designs – Advanced systems such as fixed-film, induced blanket, or thermophilic digesters with specific design and operating characteristics not discussed above.

Biogas Production

Livestock manure contains volatile solids that can be used by anaerobic microbes to produce methane. Biogas is a byproduct of digestion that contains 60 – 70% methane and 30 – 40% carbon dioxide, with the remainder as water vapor and trace gases.

Table1 - Estimated Biogas Production

Animal Type (weight)	CF / animal-day
Dairy (1400 lb)	**66**
Beef (1000 lb)	**14**
Swine (300 lb)	**5.6**
Poultry (4 lb)	**0.3**

Biogas Collection and Transfer

After the biogas is produced by the digester, the gas must be collected and transferred for storage or utilization. Since the biogas is saturated with moisture, frost buildup may be a problem. Biogas is also flammable, highly toxic, and potentially explosive; therefore, safety considerations are very important.

Biogas Utilization

Biogas can be flared, burned to power natural gas boilers, used to fuel turbines and internal combustion engines, or processed to produce pipeline-quality natural gas. Potential uses include fuel cells and hydrogen generation.

Design Considerations

The digester must be designed by a professional engineer to meet local and state regulations and permitting requirements. A 12-month energy budget will help with determining long-term economic viability of the digester. Detailed operating procedures are required for the manager/operator.

Management Considerations

Digester operation and management require a time commitment from the operator. Complex equipment must be replaced in a timely manner. Variations in temperature, retention time, and feedstock directly affect biogas production. Nutrients in the feedstock must be considered in the farm's nutrient management plan. Provisions must be made for flaring biogas if other uses are not possible.

Table 2 - Estimated O&M Costs

Component	Estimated Cost
Digester	1.75 – 2.25% of total cost
Engine/Generator	1.25¢ - 1.50¢ / kWh
Turbine	1.5¢ - 2.50¢ / kWh
Heating	1 BTU / lb_storage-º F
Labor	0.25 FTE (minimum)

ADDITIONAL INFORMATION

Technical Note 1, An Analysis of Energy Production Costs from Anaerobic Digestion Systems on U.S. Livestock Production Facilities, USDA NRCS, October, 2007.

Guide to Anaerobic Digesters, US EPA AgSTAR Program, April 2008.

Methane Recovery from Animal Manures: The Current Opportunities Casebook, P. Lusk, Resource Development Associates Washington, DC, September 1998, NREL/SR-580-25145