

**NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD**

**ANAEROBIC DIGESTER – AMBIENT TEMPERATURE**

(No.)

**CODE 365**

**DEFINITION**

An unheated waste treatment impoundment.

**PURPOSE**

To biologically treat waste as a component of a waste management system to:

- produce biogas and capture for energy
- improve air quality
- reduce greenhouse gas emissions

**CONDITIONS WHERE PRACTICE APPLIES**

This practice applies where:

- Biogas production and capture, possibly for energy recovery, are components of a planned animal waste management system.
- Existing waste impoundment(s) can be modified to the requirements of this standard or for new construction.
- The digester is in conjunction with a separate waste storage facility or where the digester and storage are congruent.
- Manure can be collected fresh and delivered to the digester with a total solids (TS) concentration in the influent waste of less than 2 percent.
- The operator has the interest and training to monitor and maintain processes or contracts with a consultant to provide these services.

**CRITERIA**

**General Criteria Applicable to All Purposes**

**Laws and Regulations.** All planned activities shall comply with all federal, state, and local laws and regulations. The Alabama Department of Environmental Management (ADEM) Rules require owners/operators of animal feeding operations and associated waste management systems to fully implement and regularly maintain effective best management practices (BMP's) that meet or exceed NRCS technical standards and guidelines to prevent discharges and to ensure groundwater and surface water quality.

All construction activities must implement adequate construction BMP's. In addition, to comply with the National Pollutant Discharge Elimination System rules, all construction activities involving one acre or more of land disturbance shall have and follow a construction best management practices plan prepared by a qualified credentialed professional until construction is complete and all disturbed areas are stabilized. All construction activities related to waste contact or containment, including design, installation, modification, and closure are to be certified by a professional engineer licensed in the state of Alabama.

**Cultural Resources.** Ground disturbing activities such as excavation and site preparation for animal waste facilities have the potential to affect significant cultural resources. A cultural resources review shall be completed prior to ground disturbing activities to assure that existing cultural resources will not be adversely impacted.

**Manure Characteristics.** This practice is applicable to manure that is collected fresh, generally less than 7 days old. Manure shall be essentially free of soil, sand, stones, or fibrous bedding material (including clumps of straw), or shall be processed to remove such material.

Ruminant's manure shall be treated with solid separation prior to entry into the digester.

**Rainfall.** Rainfall runoff shall be diverted from the digester. Precipitation accumulating on the cover shall be discharged to suitable grassed or otherwise stabilized areas, unless included in the design volume as for a partially covered digester.

**Anaerobic Digester.** The digester shall meet the criteria in the section "General Criteria for All Lagoons" in Alabama NRCS conservation practice standard Waste Treatment Lagoon, Code 359 as appropriate, and the following additional requirements:

1. **Minimum Treatment (Design Operating) Volume.** The design operating volume shall be based either on the daily volatile solids (VS) loading rate per 1,000 ft<sup>3</sup> or the minimum hydraulic retention time (HRT) adequate for methane production, whichever is greater. The maximum daily VS loading rate shall be selected from the values listed on the map in figure 1. The minimum HRT shall be selected from values listed on the map in figure 2.
2. **Required Total Volume.** The required total volume of the digester shall be equal to the minimum treatment volume except where waste storage is included in the design, in which case the volume shall meet the additional criteria in the section "Required Storage Volume" in Alabama NRCS conservation practice standard Waste Storage Facility, Code 313 as appropriate.  
  
The digester storage volume does not need to account for rainfall except for partially covered digesters.
3. **Freeboard.** A minimum of 2 feet of freeboard above the digester design water surface shall be provided, except for a design including rainfall in the operating volume that will require only 1 foot of freeboard.
4. **Length to Width Ratio.** The ratio of length to width of the digester is limited to 4:1 or less.

5. **Operating Depth.** The operating depth of the digester shall be at least 12 feet over 50 percent or more of the bottom area.
6. **Interior Slopes.** Interior slopes shall be as steep as permitted by soil properties and construction techniques.
7. **Waste Inlet and Outlet Location.** The inlet and outlet devices shall be located as far apart as practical to minimize "short circuiting."
8. **Inlet.** The inlet shall discharge a minimum of 12 inches below the digester water surface.
9. **Outlet.** The digester shall be equipped with an outflow device that maintains the digester water surface at its operating level. Except where the digester is designed to include storage, the outlet shall release directly to the waste storage facility without release of trapped gas.
10. **Digester Cover.** The digester cover, materials, anchorage, and all appurtenances, such as weights and floats, shall be designed to capture and convey biogas to the gas collection system. Covers shall meet the requirements of Alabama NRCS conservation practice standard Waste Facility Cover, Code 367.

**Separate Waste Storage Facility.** Separate waste storage facilities shall meet the minimum storage requirements of Alabama NRCS conservation practice standard Waste Storage Facility, Code 313. No storage credit shall be attributed to the digester in meeting the minimum storage requirements, except for sludge volume reduction based on expected TS removed or destroyed.

**Gas Collection, Transfer, and Control System.**

The biogas collection, transfer, and control system shall be designed to convey captured gas from the digester to the gas utilization equipment or device (flare, boiler, engine, etc.).

1. **Gas Collection and Transfer.** Pipe and/or appurtenances shall meet the following:
  - Perforated pipe and other components under the digester cover shall be designed to exclude floating debris and waste residue and shall have a service life consistent with the expected cover life, but not less than 10 years.
  - Pipe and components under the cover shall be securely anchored to prevent displacement from normal cover forces.

- The collection and transfer pipe shall be designed for wet biogas. In colder climates, the pipe shall be protected as necessary to prevent frost buildup. In no case shall the pipe size be less than 3 inch diameter.
- Pipe used for transfer of gas shall be leak-proof and can be buried or installed above ground and must include provisions for drainage of condensate, pressure and vacuum relief, and flame traps.

2. **Gas Control.** Equipment for gas control shall meet the following:

- Gas control equipment and components shall be conveniently located and sheltered from the elements. A minimum distance of 30 feet shall separate the control facility from the digester.
- Gas control equipment and components shall have a service life of not less than 2 years and shall be readily accessible for replacement or repair.
- The size of equipment and connecting pipe shall be based on head loss, cost of energy, cost of components, and manufacturers' recommendations.
- Where electrical service is required at the control facility, the installation and all electrical wire, fixtures and equipment shall meet the National Electrical Code and local and state requirements and shall be certified in writing by a qualified licensed electrician.

**Gas Utilization.** Gas utilization equipment shall be designed and installed in accordance with standard engineering practice and the manufacturer's recommendations.

As a minimum, the installation will include a flare to burn collected gas. The flare shall be equipped with automatic ignition and powered by battery/solar or direct connection to electrical service. The flare shall have a minimum capacity equal to the anticipated maximum biogas production.

Gas-fired boilers, turbines, and internal combustion engines, when a component of the system, shall be designed for burning biogas directly or shall include equipment for removing H<sub>2</sub>S and other contaminants from the biogas.

**Monitoring.** When the purpose is to produce and capture biogas for energy, equipment needed to properly monitor the digester and gas production shall be installed as part of the system. As a minimum, the following equipment is required:

- A temperature sensor and readout device to measure internal temperature of digester.
- Gas meter suitable for measuring biogas.

**Safety.** The digester shall be fenced and warning signs posted to prevent children and others from using it for purposes other than intended.

The effect of earthquake loads on the digester and biogas system shall be considered and appropriate protective measures incorporated into the design.

Biogas is flammable and highly toxic. The gas collection, control, and utilization system shall be designed in accordance with standard engineering practice for handling a flammable gas and to prevent undue safety hazards associated with normal O&M. As a minimum:

- "Warning Flammable Gas" and "No Smoking" signs shall be posted on each side of the digester and at other locations where gas is utilized.
- Flares shall be located a minimum distance of 95 feet from the biogas source and grounded or otherwise protected to minimize the chance of lightning strikes.
- A flame trap device shall be provided in the gas line between the digester and points of use (flare, boiler, engine, etc.).
- The location of underground gas pipe shall be marked with signs to prevent accidental disturbance or rupture. Mark exposed pipe to indicate whether gas line or other.

## CONSIDERATIONS

**Location.** In determining the location of the digester facility, consider elevation and distance from the covered digester to take advantage of gravity flow.

The covered digester should be located as near the source of manure as practicable and as far from neighboring dwellings or public areas as possible. It is highly recommended that digester facilities meet the minimum distance requirement from public or private facilities as shown in Table 1.

These distances should be increased wherever possible in order to minimize any negative impacts of the digester. In no case shall the facility siting distances be less than the minimum distance requirements as required by the ADEM Administrative Code Chapter 335-6-7, as amended. ADEM's regulatory minimum distances are summarized in the ADEM/NRCS Buffer Distance Summary for Animal Feeding Operations.

<b>Table 1. Minimum Distance Requirement for Digester Facilities</b>	
<b>Public or Private Use Facilities</b>	<b>Minimum Distance from Digester</b>
Any public use area or DCSHP <sup>1/</sup>	700 feet
Well, up-gradient	150 feet
Well, down-gradient	300 feet
Natural Water Courses, Lakes	200 feet
Milking Parlor	100 feet
Drainage Ditches	100 feet
Area specified by state or local ordinance	Greater of state or local distance or distance shown above

<sup>1/</sup> DCSHP: Non-owner existing occupied Dwelling, Church, School, Hospital, or Park

A flare or other utilization device that could release untreated biogas shall be considered part of the digester facility when determining siting distances. Pipelines, power generation equipment, or other utilization equipment that will not release untreated biogas may not be required to meet these siting distances.

Proper location should consider slope, distance of manure transmission, vehicle access, wind direction, neighboring dwellings, proximity of streams and flood plains, and visibility.

The covered digester should be located near a suitable site for energy utilization equipment. Short

distances for the transmission of methane through buried pipe are preferable.

**Gas Utilization.** Using available gas to heat the digester can improve TS destruction and further reduce greenhouse gas emissions.

**Waste Transfer Pipe.** The standard practice is to locate a cleanout immediately upstream of the digester. Influent from the waste collection pit discharges below the digester operating level, and depending on the installation, solids tend to accumulate in the inlet pipe. The cleanout is also a good location for venting any gas that accumulates in the transfer pipe.

**Visual Screening.** Analyze the visual impact of the digester within the overall landscape context or viewshed. Screening with vegetative plantings, landforms, or other measures may be implemented to alleviate a negative impact or enhance the view.

**Depth of Digester.** Improved digester performance and reduced cover cost (less area for given volume) can be realized with deeper digesters.

**Rainfall.** Consider a system to divert uncontaminated rainfall from the surface of an impermeable cover. In locations subject to high rainfall events (thunderstorms and hurricanes), a ported riser on the outflow pipe should be considered to provide temporary storage and reduce the outflow rate.

**Gas Transfer Pipe.** Exposed pipe conveying flammable gas is generally painted orange.

**PLANS AND SPECIFICATIONS**

Plans and specifications shall be prepared in accordance with the criteria of this standard and good engineering practice. The plans and specifications shall include all details necessary for construction and completion of the work.

As a minimum, the plans and specifications shall provide the following:

- Layout of livestock facilities, waste collection points, waste transfer pipe, digester, and storage pond
- Location of all digester influent and effluent pipes and devices
- Details of pipe material, size, and grade

- All digester and storage facility dimensions, type of lining material, and other parameters as appropriate
- Digester cover material and dimensions of covered surface. Means of rainfall removal or details of drainage
- Details of digester cover anchorage (ex: location and width of trench, depth, backfill material, and compaction of fill)
- Details of the gas collection system, including type of pipe, devices, sizes, location, material, and grades
- Details of gas control facility, piping layout, components, electrical service if required, and protection from the elements
- Appropriate gas safety equipment or protective measures
- A process flow diagram
- Alternative operating procedures in the event of equipment failure
- Instructions for safe use and/or flaring of biogas
- Cover and gas collection system maintenance
- Daily inspection of the following:
  - Check cover material for cracks, tears, or points of distress around perimeter
  - Check for excessive ballooning of cover or presence of odor
  - Check for excess rainwater on cover
  - Check gas control panel, regulators, pressure gages, electrical power, flowmeter, flare igniter, and flare operation
- Frequency of measuring and recording digester inflow, operating temperatures, biogas yield, and/or other information as appropriate

#### OPERATION AND MAINTENANCE

An operation and maintenance (O&M) plan shall be developed and reviewed with the owner prior to construction. The O&M plan shall be consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design. The plan shall list O&M requirements including but not limited to:

- Proper loading rate of the digester and total solids content of influent
- Proper operating level of the digester
- Estimates of biogas production, methane content, and potential energy recovery
- A description of the planned startup procedures, normal operation, safety issues, and normal maintenance items

#### REFERENCES

ADEM Administrative Code, Chapter 335-6-7, as amended

[ADEM/NRCS Buffer Distance Summary for Animal Feeding Operations](#)

Alabama NRCS Conservation Practice Standards:  
[Waste Facility Cover, Code 367](#)  
[Waste Storage Facility, Code 313](#)  
[Waste Treatment Lagoon, Code 359](#)

National Electric Code

[NRCS Cultural Resources Handbook](#)

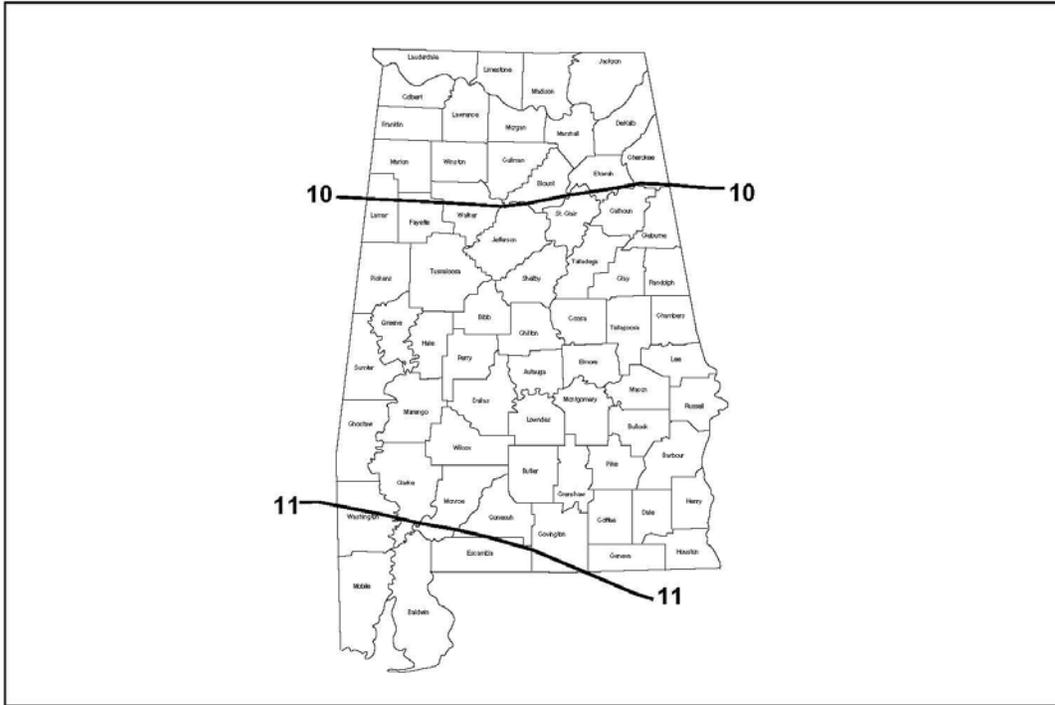


Figure 1. Covered anaerobic digester maximum loading rate (lb. VS/1,000 ft<sup>3</sup>/day)

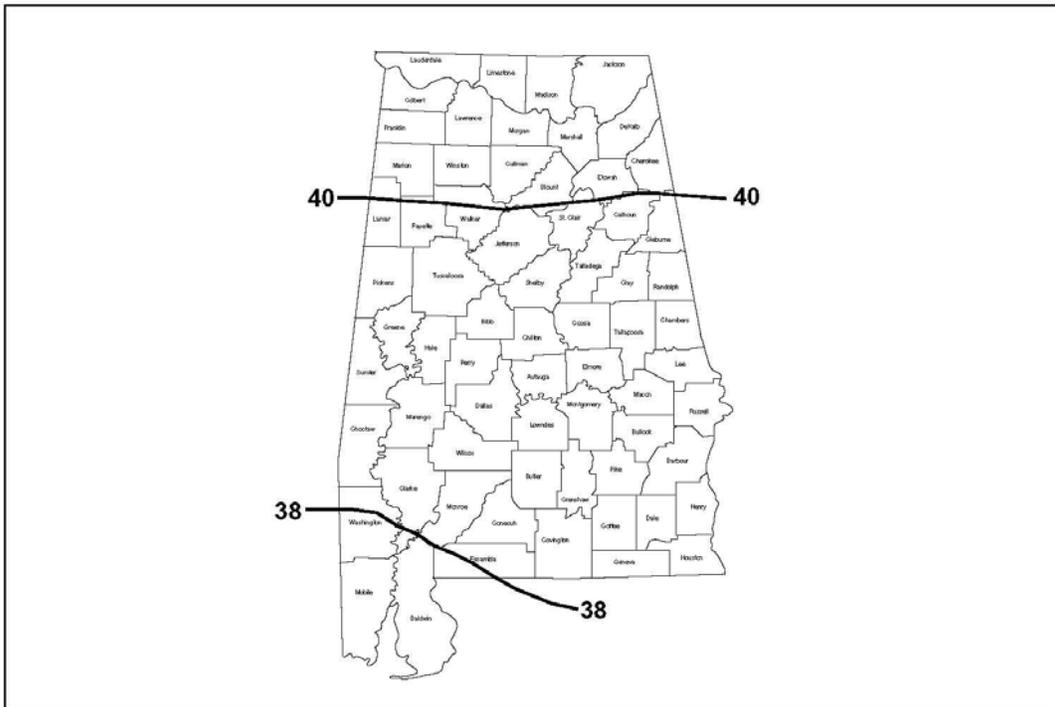


Figure 2. Covered anaerobic digester minimum hydraulic retention times (MINHRT), in days (minimum HRT if minimum treatment volume is < minimum HRT to achieve ~60% VS destruction)