



E³A: Anaerobic Digester Applications for the Farm or Ranch

Steps in the Anaerobic Digester Series

Understanding Technical Feasibility

Estimate Potential

Economics

Selection

Maintenance

Selecting a technology provider for anaerobic digestion

Some companies specializing in anaerobic digester installation are new, and others have been around for more than 30 years. Recent technological improvements have made anaerobic digesters more successful on farms, however it is still a buyer-beware market. Providers often offer one anaerobic digestion technology, and you should know what is and is not a good fit for your site. Educate yourself about anaerobic digester technologies and their fit to your facility before contacting a provider.

Guidance for anaerobic digestion technology selection

Several different technologies are available for anaerobic digestion including; covered lagoons, plug flows, complete mixes, upflow sludge blankets and fixed film reactors. Technology selection is highly dependent on solids content of the waste being used (Table 1). Swine waste generally comes in the form of a slurry, which is less than 15 percent solids, and is therefore amenable to conventional anaerobic digester technology. On the other hand, cattle waste collected from dry lots can be high in solids content — with some as high as 50 percent. Dairy cattle manure collected on concrete generally has a solids content between 10 and 16 percent, whereas flushed manure can have a solids content less than 3 percent, but can vary substantially depending on the amount of water used for flushing manure. Use the online decision support tool for additional guidance on technology selection based on your current waste management methods.

Table 1. Recommended waste solids content for anaerobic digestion technologies.

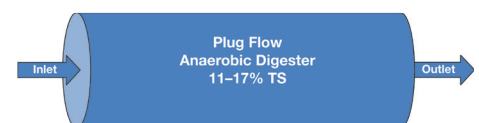
Technology	Recommended waste solids content
Plug flow	11–17 percent
Complete mix	5–10 percent
Upflow sludge blanket	1–5 percent
Covered lagoon	Less than 3 percent
Fixed film	Less than 1 percent

Covered lagoons

Covered lagoons are one of the cheapest and simplest anaerobic digestion technologies available. Anaerobic digestion and subsequent production of methane takes place naturally in lagoons that contain animal wastewater. A synthetic cover, typically made of plastic or rubber, traps and stores the biogas. Covered lagoons are difficult to heat, so they are only recommended in warm climates where freezing temperatures are rarely observed. Too little methane is generated by covered lagoons during cold winter months to justify installation of biogas capture and use equipment. Insulated covers for lagoons could make them more feasible in colder climates.

Plug flow

Plug flow digesters are a low-tech anaerobic digestion technology for treatment of high-solids-content waste (Table 1). The thick, high-solids-content waste travels down the digester in a “plug,” as a continuous mass. Plug flow digesters can be a good fit with the high-solids-content waste generated by animal feeding operations.

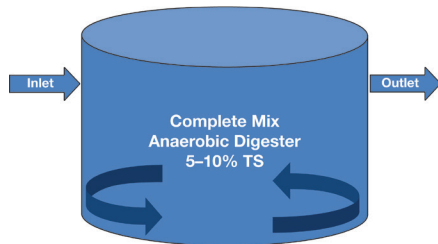


Credit: Colorado State University
Illustration developed by Lucas Loetscher
Plug flow anaerobic digester

Complete mix

Complete mix reactors are large tanks with stirring mechanisms, such as injected biogas or motorized paddles, to keep the reactor circulating.

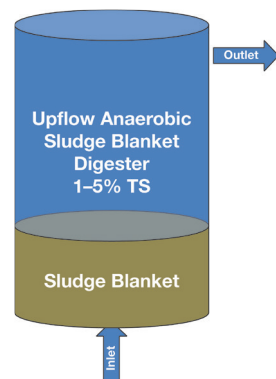
Mixing produces an ideal environment for anaerobic microorganisms by spreading the nutrients evenly throughout the reactor, while simultaneously dampening the shock loads of toxins that may enter the system. Complete mix reactors operate best when solids content is between 5 and 10 percent (Table 1).



Credit: Colorado State University
Illustration developed by Lucas Loetscher
Complete mix anaerobic digester

Upflow sludge blanket

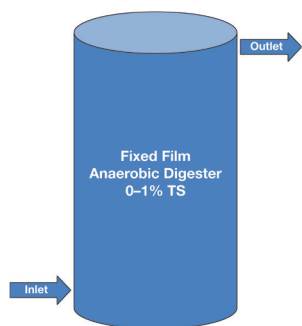
Upflow sludge blanket reactors are similar in design to complete mix reactors, except that there is no integrated mechanism for homogenizing the waste. Instead, settling of solids is encouraged so that a sludge blanket is formed, maintaining biomass within the system and reducing the required holding time. These reactors are highly efficient and have been successfully scaled up to accommodate commercial use.



Credit: Colorado State University
Illustration developed by Lucas Loetscher
Upflow sludge blanket anaerobic digester

Fixed-film digesters

In a fixed-film digester, bacteria colonize a provided support structure within the reactor. This support structure is a high surface area material suitable for colonization, such as PVC pipe or shredded plastic. Fixed-film reactors have successfully been implemented with low solids content (less than 3 percent) dairy cattle manure wastewaters. The waste must be diluted effectively and inexpensively for these digesters to perform correctly.



Credit: Colorado State University
Illustration developed by Lucas Loetscher
Fixed-film anaerobic digester

operation, you are ready to contact technology providers. You may choose to hire a consultant to guide you through the process of technology provider selection, but make sure they are not tied to a specific technology provider. Some technology providers may assist you with project financing, but it is also important to consider all financing options. Consider asking these questions of a technology provider:

- How many on-farm anaerobic digesters does your company currently have in operation and where are they located? The advantage of choosing a company with many successfully operating projects is lower risk. Some newer companies offer novel systems that can be advantageous compared to conventional systems, but there is more risk. Newer technology providers should be considered, but make sure that technologies have been successfully demonstrated on-farm on a large scale. Ask to speak with producers who have been involved in demonstrations. Many companies will also have published case studies, which they can provide.
- Of the operating digesters, how many are applied to manure management in an animal feeding operation? A company that specializes in anaerobic digestion of manure may be a good choice. Several companies have emerged that specialize in anaerobic digestion of food and yard wastes collected in urban areas. Manure differs greatly from these urban wastes, and technologies developed for food and yard waste may not work well for anaerobic digestion of manure.
- Where are successfully operating anaerobic digesters located? Are you willing to take on projects in the Midwest region? Many technology providers have regions where they have had a lot of success and may not be willing to move outside of their current service area.
- What types of anaerobic digestion technologies does your company provide? Some companies may offer only one type — complete mix, plug flow, upflow sludge blanket or fixed film. Make sure you work with a company that offers technologies suited to the waste generated at your farm.
- What services does your company provide? Determine what services a company does and does not provide, and whether you will need additional support for other services.
- Are there case studies of your technology that you can share? Many technology providers have published case studies of their technology. Review any such publications if they are available. This will help you compare performance of various technologies. Check to see if case studies show the system lifetime, contacts of farmers using the system or insurance policy details.
- Is pretreatment required? Some technologies require

Technology provider selection

With some knowledge of appropriate anaerobic digestion technologies for your

pretreatment of waste, which can add substantial capital and maintenance costs to the operation of an anaerobic digester. For example, some pretreatment of waste is to remove inorganics (rocks, soil or sand).

- How long are your project design, construction and system timelines on average? Find out how long it will take to install the system and what its expected lifetime is.
- Does your company provide a performance guarantee or warranty? If so, what are the details? Different technology providers will provide different guarantees or warranties and you should understand the details of those so that you can make comparisons between different companies.
- Does your company provide support and guidance for handling end products? The end product of anaerobic digestion is a slurry, which can be applied to land or must be otherwise disposed of (learn more about handling end products in the *Understanding Technical Feasibility* guide). Some technology providers do not support handling of end products, so you need to consider how you will handle the end product. The costs and maintenance of handling end products must be considered in the project feasibility study. Determine how much support your technology provider or consultants can provide in this area.
- Will your company hire any subcontractors to complete portions of the project design and construction? Make sure you understand who will comprise the project team and that you are comfortable with the process.

- What kind of training does the client receive from the technology provider? Installation of an anaerobic digester will require more maintenance for animal waste management than composting or lagoon management (see the *Maintenance* guide). Make sure your technology provider is clear about maintenance activities that will be required after operation begins. Anaerobic digester operation will be more successful if the technology provider provides a clear plan and training for maintenance activities.
- Will the technology provider help coordinate project financing? As with any large capital investment, it pays to research financing options. Numerous federal and state funding programs provide grants, reduced interest loans or tax credits for anaerobic digesters. A good place to start your research is the U.S. Environmental Protection Agency's AgSTAR website. Look online for information on the funding programs at <http://www.epa.gov/agstar/tools/funding/index.html>.

Several technology providers offer loans directly for anaerobic digestion projects. The technology provider may also help you to navigate through the numerous federal and state grants or loan programs that are available. The technology provider might be able to connect you with privately funded niche programs, including greenhouse gas mitigation programs.

Your local agriculture lender may be your best financial resource. While the technology provider might be able to help coordinate project financing, be sure that you fully understand the project financing package offered.



