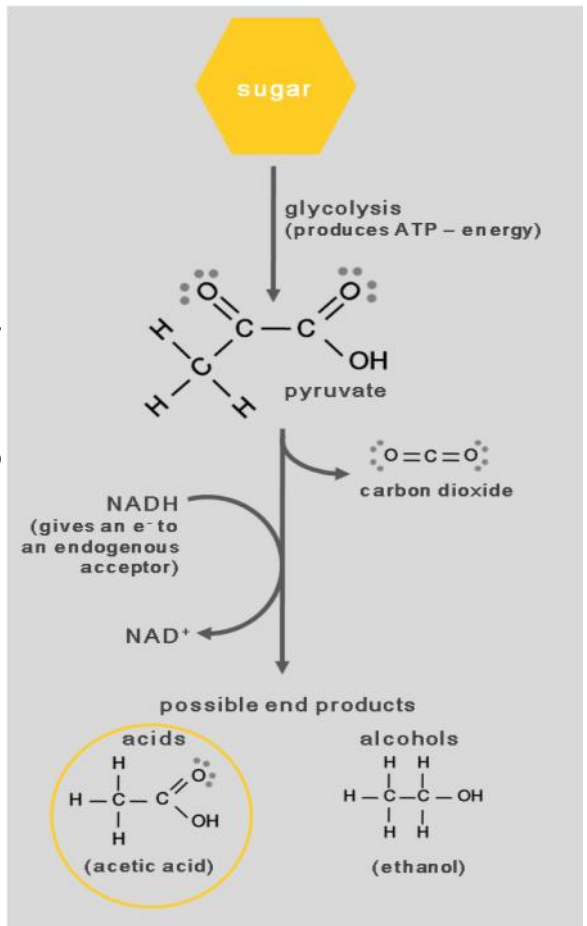


## Dry Fermentation vs. Wet Fermentation

Anaerobic digesters induce the processes of fermentation and anaerobic digestion and provide a mechanism for capturing the released by-product, biogas. Traditional digesters are classified as “wet” fermentation systems. They typically use high moisture waste streams, like manure, as input and add large amounts of liquid to facilitate movement required by this system. BIOFerm™ Energy Systems offers industrial scale “dry” fermentation technology that uses numerous waste streams, such as municipal solid waste and industrial food processing waste. Our specialized system eliminates the need for movement of input and the addition of liquid. BIOFerm™ dry fermentation technology has specific advantages over “wet” fermentation systems in many situations and provides customers with increased flexibility and profitability.

<b>Anaerobic Digestion:</b>	A biological process in which organic material is broken down by microorganisms resulting in the release of biogas. Biogas can be used to generate heat, electricity and as a natural gas substitute.
<b>Dry Fermentation:</b>	Anaerobic digestion using input material that has moisture content less than 75%. BIOFerm™ dry fermentation systems require no movement of organic matter or addition of liquid. No pre-treatment of biomass or organic waste is required.
<b>Wet Fermentation:</b>	Anaerobic digestion using input material that has moisture content greater than 75% and a system that requires the addition of liquid for the movement of organic material. Wet fermentation systems require that biomass and organic waste input undergo multiple treatment steps prior to entering digester system. Steps often include: separation of non-organic material, liquefaction, sand separation and sanitization.

Diagram of Simplified Fermentation Process



### Fermentation Process:

The term fermentation is often used interchangeably with anaerobic digestion when describing the physical decomposition of organic material (typically when discussing foods and beverages). In reality, fermentation is a distinct biological reaction that makes up one step in the greater process of anaerobic digestion. It is responsible for acidogenesis, the forming of acids.

Fermentation is a metabolic pathway for certain microbial organisms in anoxic environments. During fermentation, larger organic molecules, like sugars, are converted into a mixture of reduced end products (products that have gained electrons). The process occurs in two steps (see diagram). First, energy (in the form of ATP molecules) is produced by the reactions of glycolysis, a process that breaks down sugars and converts them into pyruvate molecules. NAD<sup>+</sup> molecules are used up in this step and are transformed into NADH. In the second step, NAD<sup>+</sup> is recreated from NADH via oxidation and reduction reactions (which involve repositioning electrons). NADH molecules donate an electron to an acceptor. Because a typical substance that normally receives the electron, like oxygen, is not available, endogenous electron acceptors are utilized in this cycle. Pyruvate molecules, (created during glycolysis) accept the electron and are subsequently converted into substances such as acids and alcohols through further molecular rearrangement. Specific fermentation reactions differ according to the microorganism performing the process as well as the original substrates (sugars) being used. The result is the creation of varying end products. In the case of fermentation within anaerobic digestion, the production of a mixture of organic acids drive the decomposition process to create biogas.





### BIOFerm™ Dry Fermentation

- Organic input remains stationary throughout process, eliminating moving parts and resulting in low system maintenance and repair costs
- Batch process and stationary system allow precise control over input removal ensuring maximum energy yield
- Closed loop liquid cycle — no additional liquid required following start-up, eliminating post-process waste water treatment needs
- No pre-treatment or sorting of inputs required prior to system loading, saving time and money for system operators
- Almost no limitations to inputs—over 3,000 inputs have been identified and researched
- BIOFerm™ system has low energy consumption, using only 5% of the energy generated for plant operation
- Organic input volume reduced by minimum of 40%, a significant additional cost benefit, and waste water is eliminated, removing risk of groundwater contamination



### Wet Fermentation

- System requires mechanical parts to circulate biomass in liquid holding tank, leading to increased maintenance and repair costs
- Liquid mixture causes premature removal of input before all organic matter has been digested, resulting in a loss of energy
- System requires additional liquid to allow fermentation, greatly increasing the amount of system waste water and costly post-process treatments
- Inputs require pre-treatment to prevent breakdown of mechanical parts as input is agitated and moved through system
- Input limited to “wet” waste streams
- Typical systems consume 10-30% of the energy generated for plant operation, and treatment of waste water requires additional energy
- Waste water volume increased up to 70%, requiring high energy input for treatment and increasing risk of groundwater contamination

