

Anaerobic Digestion

What is Anaerobic Digestion?

Anaerobic digestion is a natural, biological process that occurs when bacteria break down biodegradable materials in the absence of oxygen. This creates biogas, a mixture of methane and carbon dioxide with smaller quantities of other gases (e.g., hydrogen sulphide). Most organic waste material can be used including sewage, agricultural residues, animal wastes, grass, paper products and food waste.

Biogas, the main product of this process, can be used to create heat, electricity or automobile fuels. Another by-product of anaerobic digestion is a solid/liquid residue called digestate, which can be used as a fertilizer in agricultural applications.

How Does Anaerobic Digestion Work?

Large-scale anaerobic facilities can process reactions in a controlled environment under optimum conditions.

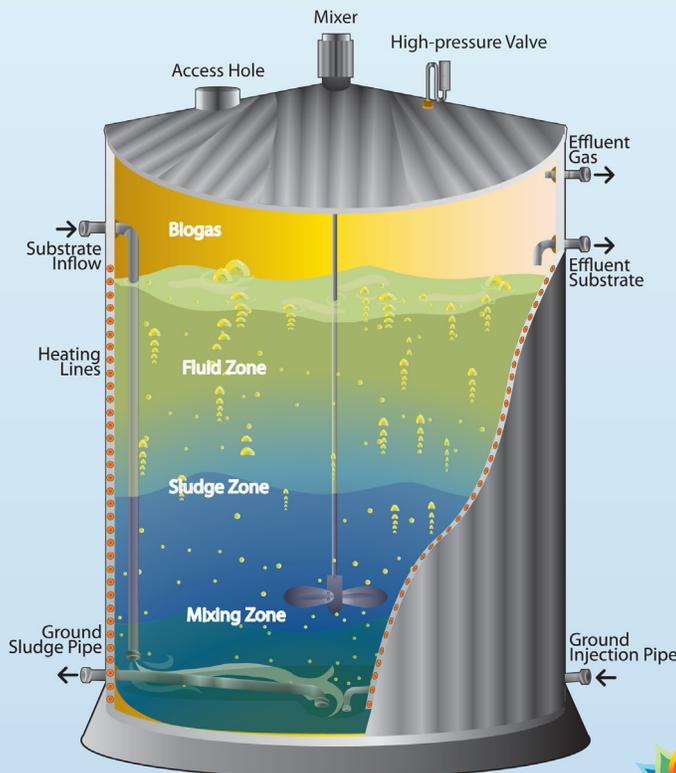
Substrates used in production are usually fermented for about 30 days while being heated and continually stirred in an anaerobic (oxygen starved) environment. With a large enough holding tank to supply a continuous

stream of well mixed organic waste, biogas will form in a matter of days. The different processes that make up anaerobic digestion are:

- Hydrolysis – in a liquid environment, bacteria break down insoluble organic polymers, such as carbohydrates, fats and proteins, into simpler structures and make them available for other bacteria.
- Acidogenesis – acidogenic bacteria convert sugars, fatty acids and amino acids into carbon dioxide, hydrogen, ammonia and organic acids.
- Acetogenesis – acetogenic bacteria convert the resulting organic acids into acetic acid, with additional ammonia, hydrogen, and carbon dioxide.
- Methanogenesis – methanogenic bacteria convert these products into methane, water vapour, hydrogen sulphide and carbon dioxide. At this point the gases are about 70%

Anaerobic Sequencing Batch Reactor Methanogenesis

Methanogenesis is the final step in the anaerobic digestion process. The substrate having been pre-processed has been prepared for methanogenic bacteria in this heated, oxygen deprived reactor to convert it to methane gas.



Adapted from: http://home.comcast.net/~hollywastewater/images/anaerobic_digester_diagram.jpg

methane. Methanogens are archaea class bacteria, which include species that grow in hostile conditions like hydrothermal vents, making them uniquely suited to operating at high temperatures to produce methane gas.

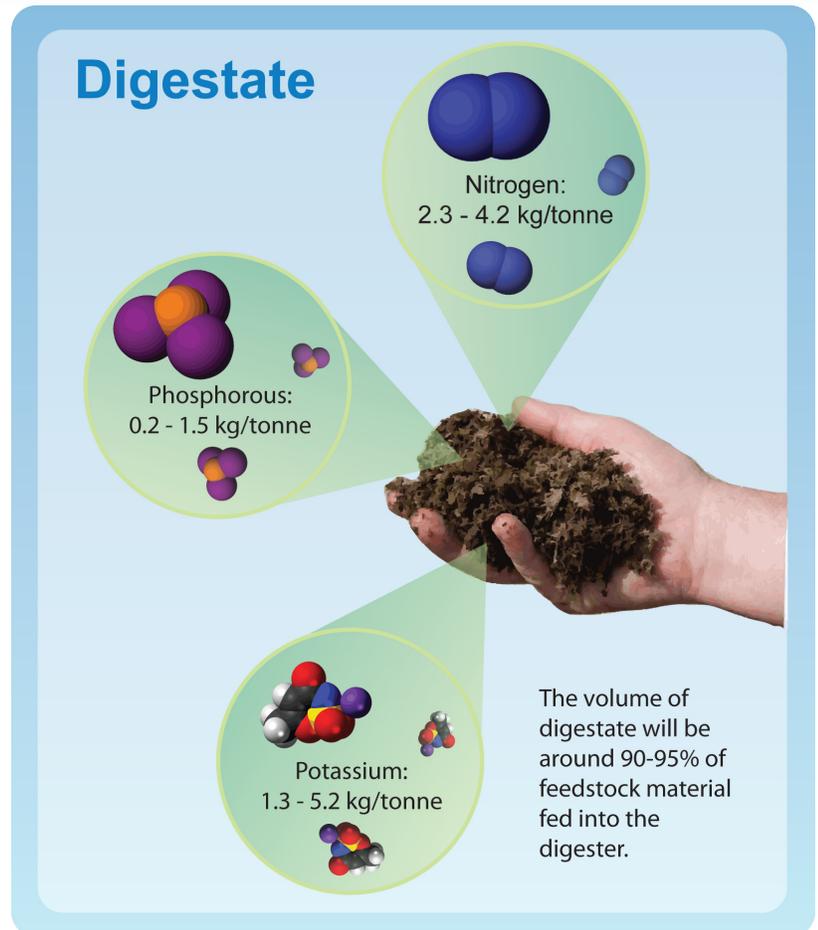
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- The gas is then treated by sending it through a condensation unit to remove water vapour.
- Hydrogen sulphide is extracted from the biogas in a biological desulfurization plant. Oxygen is added to the gas mixture in the presence of microbial cultures, which utilize the sulphur in the gas through biomechanical process.
- What remains of the biogas is sent through a pressurizer, and washing and drying unit before it is ready for final use.

There are many different configurations of anaerobic digesters including Batch Digester, Plug-Flow Digester, Covered Lagoon, Completely Stirred Tank Reactor, Upflow Anaerobic Sludge Blanket and Anaerobic Sequencing Batch Reactor.

Benefits of Anaerobic Digestion

- Solid/liquid digestate residue is not harmful to the environment. Digestate makes a good fertilizer as nutrients contained within it are easily available to plants, yet the organic acids and bacteria, which could cause illness and unpleasant smells, are no longer present.
- Biogas plants can be remotely operated, meaning that multiple locations can be monitored in one central office. Many small farms can run digesters and mutually profit by sharing operating costs.
- Anaerobic digestion is a stabilization process as it reduces odour, pathogens and the total mass of organic wastes. This reduces health risks and saves companies from having to pay for waste management.
- Many sources of biomass used are usually landfilled. If left to degrade naturally, they release greenhouse gases into the atmosphere. Low grade organic wastes that do not have a meaningful end use can be transformed into useful biogas.



Information Sources:

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