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BIOGAS: PRODUCTION AND UTILIZATION

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What is Biogas:

Anaerobic digestion, the process by which bacteria break down biological material without oxygen, produces biogas. Biogas, a renewable fuel made from waste treatment, is a mixture of methane (also known as marsh gas or natural gas, CH_4) and carbon dioxide (CO_2). Anaerobic digestion occurs in digestive systems, marshes, garbage dumps, septic tanks, and the Arctic Tundra. It is essentially a simple process carried out in a number of phases by many different bacteria that can use nearly any organic material as a substrate. Humans sometimes strive to outdo nature by creating complex machinery, yet it is still possible to take a straightforward approach. I believe that methane works best as a permanent fuel rather than a mobile fuel because it is so difficult to compress. Compressing the gas requires a lot of energy, which is typically squandered, and there is also the risk of high pressure. In comparison to high-pressure cylinders, regulators, and compressors, variable volume storage is significantly simpler and less expensive to set up. The two primary types are flexible bags and floating drums.

Composition of Biogas

Methane and carbon dioxide are the main gases produced. Biogas has an ignition temperature between 50°C and 750°C and is about 20% lighter than air. It is an odourless, colourless gas with a clear, blue flame that resembles that of LPG gas. A 1 m^3 volume has a calorific value of roughly 22 MJ if it burns at a 60% efficiency. Depending on the raw material utilised, gas composition varies.

Matter	Percentage
Methane (CH_4)	50-75
Carbon dioxide (CO_2)	25-50
Nitrogen (N_2)	0-10
Hydrogen (H_2)	0-1
Hydrogen sulfide (H_2S)	0.1-0.5
Carbon monoxide (CO)	0-0.3
Oxygen (O_2)	0-2

Table 1. Typical composition of biogas

Sources of biogas generation:

Biogas is commonly made from animal slurry, sludge settled from wastewater and at landfills containing organic wastes. However, biogas can also be made from almost any organic waste has the ability to produce biogas: human excreta, slurry, animal slurry, fruit and vegetable waste, slaughterhouse waste, meat packing waste, waste from dairy factories, brewery and distillery waste, etc. Fiber rich wastes like wood, leaves, etc. make poor feed stocks for digesters as they are difficult to digest. Many wastewaters contain organic compounds that may be converted to biogas including municipal wastewater, food processing wastewater and many industrial wastewaters. Biogas can be produced from solid and semi-solid sources, including plant and animal debris.

Biogas Production:

The two stages of the biogas formation process are the methane formation stage and the acid formation stage. A group of acid-producing bacteria found in cow dung activate the biodegradable complex organic molecule found in the waste in the first stage. It is known as the acid generating level because organic acids are the predominant makers at this point. In the second level, organic acids activate methanogenic bacteria, which then releases methane gas. Feces, chicken beets, and agricultural waste are also utilised in biogas facilities, although animal dung is generally thought of as the main raw source.

Component of Biogas Plant:

a. **Mixing tank and inlet** - Mixing tank is used to mix cow dung, kitchen weste or any other waste thoroughly with water. Later this mixture is passed through the digester.
b. **Digester** - A partition wall in the middle divides the digester, which is a crucial component of the biogas plant that is installed underground, into two chambers. This results in the fermentation of the dung and water mixture.
c. **Gas holder or gas storage dome -** The digester's dome is shaped like a steel drum and is fixed to it upside down while being carefully designed to float gently in either an upward or downward orientation. In the dome's top, there is a gas holder that is piped into the stove. When the gas production process begins, it is first collected in the dome before passing through the holder and arriving at the burner.
d. **Over flow tank -** This tank is used to remove the fermented solution in the digester.
e. **Gas main outlet valve, pipeline, gas stove -** It is used to distribute gas at the place of need. Efforts are made that the distribution pipeline should not be too long.

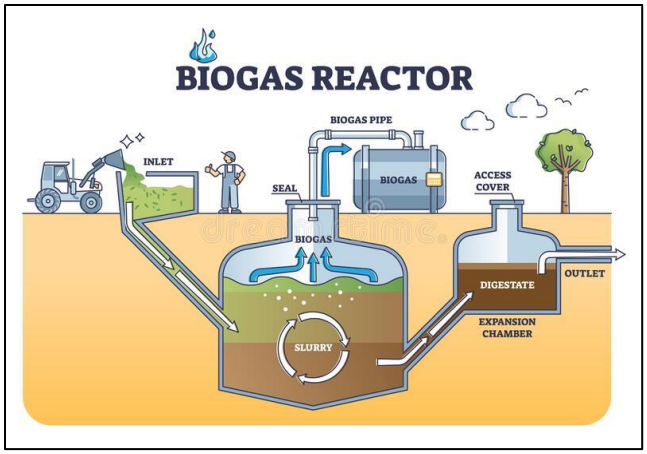

Fig. Biogas plant

Advantage of Biogas:

- It is an eco-friendly fuel.
- Technology cheaper and simpler - than other bio-fuels, and ideal for small scale application.
- Renewable energy - production of methane for use as a fuel.
- Pollution Control-limiting the release of methane, a greenhouse gas directly into the atmosphere.
- Small land area - most of the structure can be built underground.
- Cost effective - can be built and repaired with locally available materials, low operating costs.
- Availability of biogas would reduce the use of firewood and hence trees could be saved.
- Combined treatment - animal, human and solid organic waste treated in the same digester together.
- Long service life - over 20 years.
- Waste management - household and organic solid waste disposed of usefully and in a healthy manner, an effective method to manage the bio-wastes.
- Organic fertilizer - the slurry has a high nutrient content and are ideal fertilizer.
- Prevent deforestation - reduce pressure on fuel wood and self-sufficiency in energy for rural community.

Disadvantage of Biogas:

- At large industrial scale not very attractive economically (as compared to other biofuels)
- Substrates need to contain high amounts of organic matter for biogas production
- Incomplete pathogen removal, the digestate might require further treatment
- Limited gas production below 15°C
- Requires seeding.