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Power Generation by Using Animal Waste

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Abstract*:* Animal manure and food processing waste are examples of biomass with a high moisture content that may be used to create biogas through a biological process known as anaerobic digestion. Due to its high methane concentration, biogas is an excellent source of renewable energy to replace natural gas and other fossil fuels. Methane typically comprises 40% to 60% of biogas. Typically, biogas is utilised to generate energy and heat in manufacturing boilers and engine generator sets. The facility can utilise the electricity produced by the internal combustion engines running on biogas or export it to the power grid.

Keywords: Biogas, Methane, power.

I. INTRODUCTION

Energy crisis! Energy crisis a word we very often hear in our day to day life .we all know that we prefer to use energy for our various purpose. Due to the advancement in technology and industrial activities there has been a large demand for energy or specifically power. Currently the main source of power is from fossil fuels, this fossil fuels are limited in nature and are going to deploy one day.as a result the idea of using non-conventional source of energy comes into the picture. Anaerobic digestion, or "biogas production," is a process where putrefactive bacteria break down organic material in the absence of oxygen to create energy and fertiliser while also enhancing sanitation and protecting the environment.

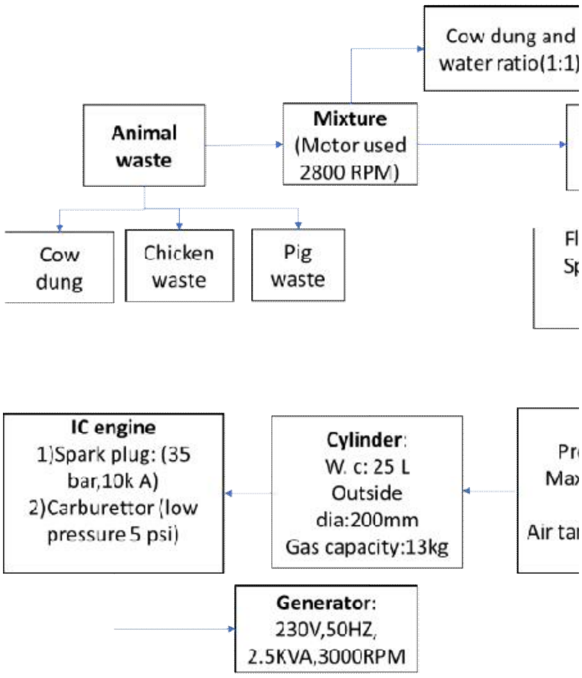

Fig: Block diagram of biogas gas production system

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All feed materials consist of organic solids, inorganic solids and water. The waste of much feed materials can be used for biogas generation. Biogas consists of about 60% methane and 40% carbon dioxide. Biogas digester can decompose a number of organic wastes. Usually, for better gas production the following percentage of organic wastes are mixed together.

Cattle manure (65%), Poultry manure (55%), Straw (59%), Grass (70%), Leaves (58%), Kitchen waste (50%), Algae (63%), Water hyacinth (52%). Methane levels are too low in the initial gas produced by a freshly filled biogas plant. Therefore, it is necessary to evacuate the gas that generated during the first 3 to 5 days. Gaseous nitrogen (N2) is transformed into ammonia (NH3) during digestion. The nitrogen is accessible to the plant as a nutrient in this waste soluble form.

Biogas plant:

Biogas is a gaseous fuel obtained from Biogas by process of anaerobic fermentation.

The raw materials to the Biogas plant includes-

- Urban waste
- Human waste
- Ruler, agricultural waste.
- Cow dung
- Animal waste

All these materials are mixed with water forming slurry to assist anaerobic fermentation presses.

The biogas includes methane (CH) 60%, Carbon-dioxide (CO) 30%and other gasses.

II. WORKING PRINCIPLE:

The feed slurry fed into the Digester (Reactor) for fermentation. Seeding mater (bacteria rich substance) may be added to slurry to start & accelerate the presses of anaerobic fermentation. The biomass the slurry is retained in digester for several days (i.e. 39 to 60 days) to allow anaerobic fermentation. This time is called retention time.

This time vary with size of biogas plant, type of infeed, ambient temperature & rate of infeed etc.

The temp. in the digester is kept between 25 °c to 63 °c. In winter warm water may be added. The Biogas is obtained from the outlet pipe on the digester tank.

Various types of Biogas plant are-

- Continuous type
- Batch type
- Fixed dome type
- Floating dome collector type

SCRUBBING OF RAW BIOGAS:

Need for the purification of raw biogas:

- Biogas is produced by the process of anaerobic digestion of organic matter by bacteria. The raw biogas contains various constituents in it such as Methane (CH4), Carbon-dioxide (CO2), Hydrogen Sulphide(H2S) and also water vapours and other gases but in small proportion
- The presence of CO2 in raw biogas reduces the density and decreases the calorific value of biogas
- Similarly the presence of H2S is very harmful as it corrodes the metallic parts of engine, pumps, storage tanks etc. . Hence these gases need to be removed to get the final product Bio methane which is composed of about 95-99% methane content.

Solvent Scrubbing:

Solvent scrubbing is a process that uses either a chemical (eg : AMINE) or physical (eg : CA(OH)2) solvent to remove CO2 and H2S from the biogas , allowing the methane component to pass through. The most effective ways are as follows:

a) Removal Of H2s From Raw Biogas:

Hydrogen sulphide must be oxidised with oxygen from the atmosphere in order to be removed from biogas. Directly into a bioreactor containing digested materials can be added a little amount of air (3-6% volume of generated biogas). Pumps that provide the appropriate air pressure can do this. The following chemical reaction may be used to explain this oxidation process:

$2H_2S + O_2 \rightarrow 2S + 2\,H_2O$

Using catalyst iron oxide in the form of oxidised steel wool or iron shavings from any workshop's lathe operation, hydrogen sulphide may be eliminated. Iron oxide transforms into elemental sulphur when raw biogas comes into contact with steel wool or chips. Here is the chemical formula for this process:

$Fe_2O_3 + 3H_2S \rightarrow Fe_2S_3 + 3\,H_2O$.

ii) $2Fe_2S_3 + 3O_2 \rightarrow 2Fe_2O_3 + 6S$.

b) Removal Of CO2 From Raw Biogas:

- The most easiest and effective way of removing CO_2 from biogas is by using limewater . Solution of solid calcium hydroxide ($Ca(OH)_2$) and water can be mixed together to prepare limewater.
- As a result, a tremendous quantity of heat will be produced, which will cause an exothermic reaction. Raw biogas can be allowed to flow through the solution once the heat has dissipated. This will lessen the amount of carbon dioxide in the biogas.

$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$.

- It was discovered that the effectiveness of CO_2 removal is significantly influenced by the limewater content.
- The results show that over 71% removal efficiency could be attained with a limewater solution concentration of 14%, producing enhanced CH_4 gas with a purity of roughly 21.2%.
- This could be because larger concentrations produce more active hydroxide ions that can diffuse to the gas-liquid interface and interact with CO_2. This ultimately leads to an increase in the rate of absorption, which results in a better CO_2 removal efficiency.

Storage of Biogas:

The effectiveness and safety of a biogas plant are significantly impacted by the choice of an adequate methane storage system.

Storage for later on-site use and storage before and/or after transit to off-site distribution stations or systems are the two main reasons for storing biogas. A biogas storage system also makes up for variations in biogas production and consumption as well as volume variations caused by changes in temperature.

Balloon:

Factors	Fixed dome	Floatin
Gas storage	Internal Gas storage up to 20 m^3 (large)	Internal Gas size (
Gas pressure	Between 60 and 120 mbar	Upto 2
Skills of contractor	High; masonry, plumbing	High; mason wel
Availability of Material	yes	y
Durability	Very high >20 years	High; drum
Agitation	Self agitated by Biogas pressure	Manual
Sizing	6 to 124 m^3 digester vol	Up to
Methane emission	High	Me

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A 'balloon plant' is a digester and gas holding enclosed in a heat-sealed plastic or rubber bag. The gas is retained at the top of the balloon. The intake and outflow are directly coupled to the skin of the balloon. The balloon's weight may be increased to increase the gas pressure.

If the gas pressure is more than what the balloon can bear, the skin might be damaged. Therefore, safety valves are required. If higher gas pressures are required, a gas pump is required. Synthetic caoutchouc or specifically stabilized, reinforced plastic are employed since the material must be UV and weather resistant.

Biogas Generator :

Technical Specificatio

Sr no.	Item
1	Maximum
2	Rated ou
3	Rated cu
4	Rated vo
5	Rated frec
6	Voltage reg
7	Fuel consu
8	Continuous c

Technical specification : Engin

Sr no.		Ite
1		Maximu
2		Rated
3		Ideal
4		Operating
5		Ignition
6		Engine oi

III. RESULTS AND DISCUSSION:

The study's data showed that biogas generation was really slow at the beginning and finish of the process. As development rate of gas is directly inversely proportional to the particular growth of methanogenic bacteria, this result was caused by the methanogenic bacteria's low level of activity. 40kg of cow manure was utilised for this project. After a retention time of 30 days, the biogas production and filtration system produced 1.565 m3 of purified biogas, which was compressed into a 3 kilogramme gas cylinder using a refrigerator compressor given a mass of 1.8 kg and a total mass of 4.8 kg. The power generation system was powered by the generated biogas.

Electricity Production from Biogas:

Biogas used to Produce Electricity: 1.565 m3 of pure biogas were produced by the biogas production and purification system. The volume of the biogas was first translated into mega joules, then from mega joules to kilowatt-hour and multiplied by its percentage useable energy to establish the rate at which the biogas was turned into electricity.

Rate of biogas production: 1.565 m3

Converting the amount of generated biogas to mega joules

1m3 of biogas = 19 mega joules 1.565m3 of biogas

= 1.565m3 × 19 mega joules

= 29.7 mega joules

Kilowatt-hour conversion: 8.26 kWh = 29.7 mega joules / 3.6.

65% of the energy lost during the conversion of biogas into electrical energy was used by the power generator as heat and other mechanical losses.

As a result, 35% of a kilowatt-hour's electrical energy is utilised to generate electricity.

35% of 8.26 kWh = 0.35 × 8.26 kWh

= 2.88 kWh.

2.88 kWh of power were produced utilising 1.565 m3 of biogas, according to the aforementioned result.

IV. CONCLUSION:

The potential of biogas for generating electricity is examined in the article. A compact biogas producing system was created and put into operation. The internal combustion engine was successfully adjusted, and it now runs without any hints of loud banging during the whole experiment. Comparatively, our results reveal that 1 litre of gasoline operates on the power producing system with a load input of 1400 Watts for 127 minutes whereas 1.8 kg of biogas runs for the same amount of time with a load capacity of 1400 Watts.The power producing system used 1 litre of gasoline for a total of 42 minutes before shutting down since all of the fuel had been used up. Aside from the fact that 1.8 kg of biogas costs far less than 1 litre of fuel, the adoption of this technology may help with waste management and give a better sustainable answer to energy self-sufficiency and economic growth.

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