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Biogas Generation through Reused Digested Waste

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1. Introduction

Eco-friendly and renewable energy is a must in today's scenario. There are various cellulosic biomass available in the rural areas of developing countries. Biomass acts as a good potential source to cater to the energy demand. The annual generation of biogas is about 18240 million cubic meters (m cu m) [1]. The increasing number of poultry farms is another source which can generate biogas of 2173 m cu m annually. In country like India itself there is huge amount of biomass available which is a good renewable source of energy [1]. Biogas comprises of 60-65% methane (CH_4), 35-40% carbon dioxide (CO_2), 0.5-1% hydrogen sulphide (H_2S), and the rest is water vapor etc. To meet this ever -increasing demand fossils fuel such as coal ,oil, natural gas have been exploited in an unsustainable manner.
Digestate is the A by-product of methane and heat production in a biogas plant, is digestate which comes from organic wastes [6]. Depending could be a solid or liquid material based on the biogas technology.

In our project we will discuss about the use of digestate or digester output and how to recycle the slurry[2]. Slurry contains a lot of unused resources when it is applied to the field, and some of them end in the environment causing problems when their concentrations rich certain levels, like greenhouse gas emissions (GHG) and eutrophication of ground water.

In our project we will investigate the possibility of taking out some of these resources of biogas plant to produce energy. All the changes will be taken in consideration and analyzed in detail for a final evaluation of the viability of this project.

1.2 Composition of Biogas

In an anaerobic condition when methanogenic bacteria act on biodegradable materials it results into the production of biogas[3]. The Biogas thus produced is generally composed of 50 to 70 percent of methane, 30 to 40 percent of carbon dioxide (CO2) and low amount of other gases as shown in Table.

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Table 1: Compositions of biogas.

Substances	**Symbol**	**Percentage (%)**
Methane	CH_4	50 – 70
Carbon Dioxide	CO_2	30 – 40
Hydrogen	H_2	5 – 10
Nitrogen	N_2	1 - 2
Water Vapour	H_2O	0.3
Hydrogen Sulphide	H_2S	Traces

The composition of slurry is dependent on feeding, age and condition of the cattle and the amount of water added to the dung before feeding it to the biogas plant. When the cattle dung is mixed with an equal amount of water, after digestion/fermentation, the composition of slum' is recorded as - 93 % water, 7 % Dry matter of which 4.5 % is organic matter and 2.5 % is inorganic matter. The percentage of NPK content of slurry on wet basis is 0.25, 0.13 and 0.12 while in dry basis it is 3.6, l.8 and 3.6 respectively[3], in addition to the major plant nutrients, it also provides micro-nutrients such as zinc, iron, manganese and copper that are also essential for plants but required in trace amounts. The fresh dung used for feeding the biogas plant consists of 80 % water and 20 % of dry matter (15 % organic and 5 % inorganic matter). During the process of digestion 40 % of the total organic matter is converted into the methane gas and carbon-di-oxide.

Biogas which is a byproduct of anaerobic digestion is carried out by a consortium of microorganisms and depends on various factors like pH, temperature, HRT, C/N ratio, etc., it is therefore relatively a slow process.

2. MATERIALS & METHODS

List of Instruments used for designing of digester

1] Digester: Two batch type airtight digester. (Capacity - 15 liters)

2] Biogas container: glass type, capacity - 1 liter

3] Plastic tubes: 0.5 inch, 0 .25 inches.

4] Water displacement meter.

5] Digital pH-electrode meter.

6] Gas analyzer Multiwarn II equipment.

In my experiment, I used different type of additives. Such as poultry waste, cultures for example (rhizobium, phosphoculture), with reused digested sludge to enhance the biogas production[4]. Two different samples are made such as poultry waste with slurry, digested dung alone, with cultures. Some positive results are achieved. Output of the digester which maximum plants are just lefted at the open space can be used as a seeding. Washed out microbes can be recirculated with some additives to enhance biogas production[5].

a) **Experimental setup:** A set of 2 containers (each of capacity 15 liters) was used as digesters for this experiment, that is, one digester for each sample. Another set of 2 flasks was used.

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Each contained water and was connected to a particular digester by means of a connecting tube and also, on the other side, connected to a measuring cylinder by means of a connecting tube. The gas collecting apparatus was used to run-off and measure water displaced by the collected gas. Water displacement method is responsible for the collection of gas. This was carried out by measuring and recording the quantity of water displaced daily using a 100mL measuring cylinder.

i)Experimental setup 1

All three digester filled with digested slurry. In First sample, I used slurry and poultry waste mixture. Ratio with water and the whole waste then loaded to about 3/4 of the digester volume. Ratio of water and waste is 1:1.

ii) Experimental setup 2

In second sample, the mixture of digested slurry and rhizobium culture is used. About 250 gm of substrate is used. Ratio with water and the whole waste then loaded to about 3/4 of the digester volume. Ratio of water and waste is 1:1.
Following table shows the gas generation at regular interval of different samples. Gas generation is in (ml) , as we can seen initially it takes time for generation but after few day generation increases gradually.

3. Results And Discussion:

3.1 Experimental Setup 1: (Digested Slurry: Poultry waste Mixture)

Daily biogas production for first sample is shown in the fig.2. after feeding anaerobic digestion starts and it takes about 15 to 20 days to produce biogas. In this sample gas generation starts from 10th day. pH for this sample is 7.6, ambient temperature is maintained. Then as the day's progresses biogas generation increases gradually. Maximum gas generation is recorded in 55th day i.e. about (89ml). After 70th the biogas generation gradually deceases that because of the complete digestion of feed material in the digester takes place the digestion process has stopped. Following graph shows the daily basis gas generation for first sample.

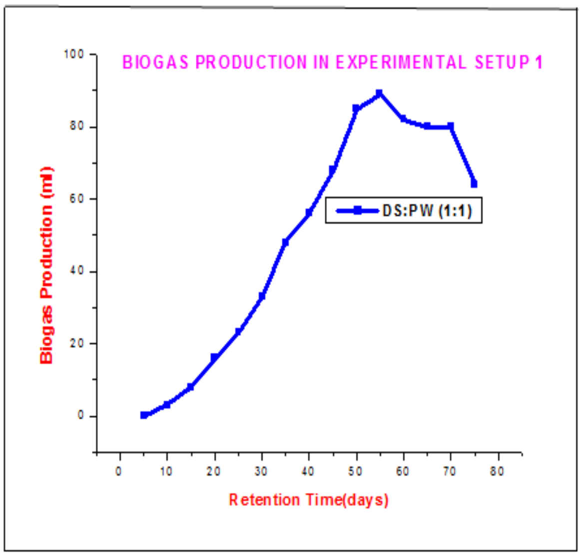

Figure-1 Daily biogas production of Experimental setup 1

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3.2 Experimental Setup 2: (Digested Slurry: Rhizobium Culture Mixture)

Daily biogas production for Second sample is shown in the figure. 15 days are required to generate biogas after feeding anaerobic digestion. In this sample gas generation starts from 20th day. pH for this sample is 7.7; ambient temperature is maintained then as the day's progresses biogas generation increases gradually. Maximum gas generation is recorded in between 50 to 60 day i.e. about (63 ml). After that because of the complete digestion of feed material in the digester takes place the digestion process has stopped. Following graph shows the daily basis gas generation for second sample.

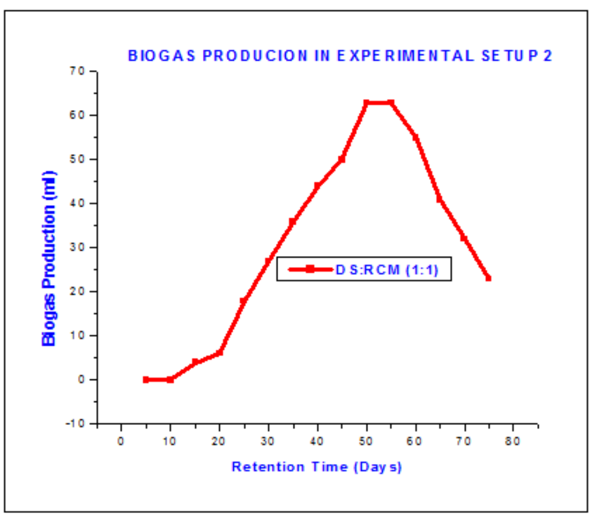

Fig.2 Daily biogas production of case-2

3.3 Comparison of Biogas Production two Experimental Setup: The Biogas Production of two different substrates is show in following fig. 4. The increasing the biogas production in Experimental Setup 1.

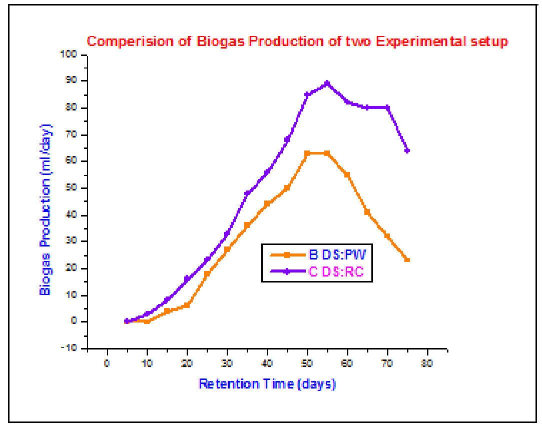

Figure 3-Comperision of Biogas Production of two Experimental Setup

3.4 Comparison between these two Experimental setup on the basis of Cumulative biogas generation

Following graph shows the biogas production for the above samples. For analyzing the composition of the biogas, I used Gas analyzer Multiwarn II equipment.

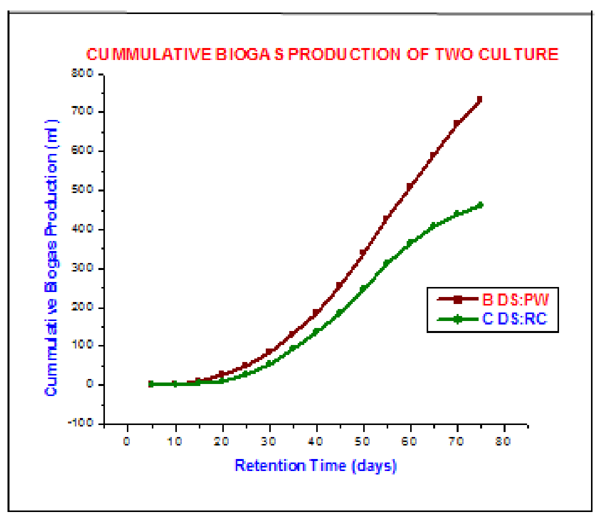

Fig. 4-Comparative Cumulative Biogas production of different two experimental setup

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4. Conclusion

In the present investigation it has been found that waste generated in the biogas power plant is harmful not as economic point of view but it is highly polluting and hazardous a for human beings. However this waste can be further an aerobically digested and that will not only eco-friendly but also it will generate biogas as high quality manure. For rapid digestion it has been found that slurry with PW (DS: PW) leads high gas yield comparison of other slurry mixture with Rhizobium Culture (DS: RC). Methane content in the generated biogas is also more than 50 % which is sufficient to run gas engines in power plant. The digested waste obtained after the digestion is nutrient rich substance and also used for additional biogas production. The absence of nutrients for necessary for anaerobic digestion fulfills to and another carbon and nitrogen rich organic substance likes poultry waste, Rhizobium Culture, Phosphor Culture. We find poultry waste substance is best for biogas generation.

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