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EXPERIMENTAL STUDY OF AGRICULTURE WASTE BLEND WITH COW DUNG AND THE EFFECT OF DIFFERENT MIXING RATIO

Navneet kumar khambra, Dr. Shailendra Dwivedi Justify Prof Rajeev singh chauhan

[1]Research Scholar, Dept. of Mechanical Engineering, LNCT Bhopal (M.P.),

[2]Professor & Head Department of Mechanical Engineering LNCT Bhopal (M.P.)

[3] Professor & Department of Mechanical Engineering LNCT Bhopal (M.P.)

Abstract

Biogas typically refers to a mixture of different gases produced by the breakdown of organic matter in the absence of oxygen. Biogas can be produced from raw materials such as agricultural waste, manure, municipal waste, plant material, sewage, green waste or food waste. Biogas is a renewable energy source and, in many cases, exerts a very small carbon footprint.In this work an initiative to obtain the biogas using the agricultural waste material is taken for the production of biogas. This plant setup is proposed in LNCT College Bhopal (M.P.) campus so that its economic as well as environmental benefits can be availed by the people living inside the LNCT Campuse.

Keywords

Use Biogas; Agriculture waste; green waste ;methane

1.Introduction

The production of biogas is based on a profound technology whose output is principally used for electricity generation and also for the vaporization of organic residues. Biogas is an output of anaerobic digestion (AD), where various microorganisms, breakdown organic matter through different metabolic processes. Tremendous and novel development in biogas production has led to the creation of advanced bio-energy facilities. As such, the biogas facilities are the basis of an economy concept aimed at nutrients recycling, reduction of greenhouse gas emissions and bio-refinery purposes. This paper presents an overview of state-of-the-art and future viewpoints related to the AD process for biogas production.

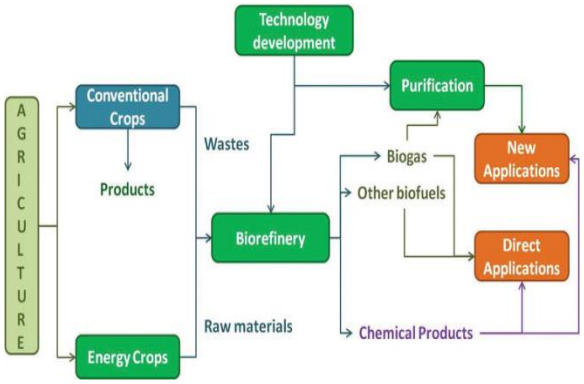


Fig. 1 Biogas generation from agricultural waste

Agricultural wastes are widely available, renewable and virtually free, hence they can be an important resource. They can be converted into heat, steam, charcoal, methanol, ethanol, bio diesel as well as raw materials (animal feed, composting, energy and biogas construction etcetera). However, many of the agricultural wastes are still largely under-utilized, and left to rot or openly burned in the field, especially in developing countries. In Kampala City, over 1000mt of organic waste accumulates daily and only about 30% of this is removed and dumped into a dump fill in Kitezi, yet all these wastes are known to contain high nutrient levels of Nitrogen, Potassium, Phosphorus that would improve soil fertility and increase crop yields such as vegetables, maize that fetch high prices and hence enhance food security. This alternate method of utilisation by farmers for agricultural production has also reduced the rate of accumulation with subsequent reduction on environmental pollution thus improving environmental health.

2. Methodology

Agricultural wastes, especially those derived from plant biomass (e.g. husks, tassels, cobs, straw, shells, peels, amongst others) that can be otherwise discarded usually after harvesting are widely used as precursor

materials for the production of adsorbents. The objectives of our proposed work are:

1. To design and construct the biogas plant in LNCT College campus.
2. To select the agricultural waste material capable of producing the biogas.
3. To present the optimum ratio waste mix to produce the maximum amount of biogas plant.
4. To perform the anova analysis to find the mean and standard deviation for all the ratios used in the present work.
5. To present the application of present work for use in LNCT College campus.

Working:

- Selection of site for the construction of Biogas plant for performing the experimental procedure.
- Construction of biogas plant and installing the required equipment for the measurement of biogas produced.
- Selection of biogas material.
- Calculate the effect of different mixing ratio in production of biogas
- Performed ANOVA and calculate F-value

For performing the experimental work and construction of biogas plant LNCT Campus was finalised. The experimental work comprised of three different mixtures of biomass materials for performing the experimental work. Concerning the aim of this work that is to check the effect of different ratio of vegetable waste and fruit waste on the performance and generation of biogas. The construction took around 15 days for the completion and for 2 days continuous reading were observed and noted for the evaluation procedure.

Table 1: Raw materials with quantity used in biogas plant installation

Material	Quantity	Price
Sand	As per requirement	800
Cement	12 PKT	2600
Steel rod		1000
Bricks	650	3900
Stone	As per requirement	1000
Labour Cost	15 days	11250
Miscellaneous (pressure gauge, pipes etc.)		1000
Total		21,550

Above table illustrates different materials with cost used in the construction of biogas plant in LNCT Campus.

In the initial stage of this experimental process a design layout of biogas plant was prepared to have an overall idea and calculation of the space required for the construction of biogas plant. For the Design process AutoCAD drafting and modelling software was utilised and further the drawing obtained were used in the construction of biogas plant. Below in fig.2 detailed dimensions used in the construction of biogas plant are illustrated using the 3d model.

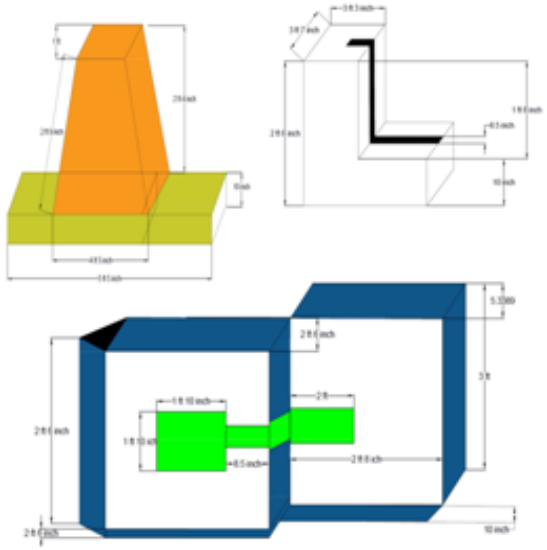


Fig. 2 Dimensions used the biogas plant construction

The waste materials were hand-picked and utmost care was taken to ensure that just a particular type of waste was used. Below Table 2 show the agriculture waste quantity.

Table 2 Agriculture waste quantity

Agriculture Waste	**Type**	**Quantity**
Vegetable Waste	Potato	1 Kg
	cabbage	1 Kg
	Tomato	1 Kg

	Spinach	1 Kg
	Onion	1 Kg
Fruit Waste	Orange	1 Kg
	Pineapple	1 Kg
	Sugarcane	1 Kg
	Banana	1 Kg
	Watermelon	1 Kg
Mixed fruits and vegetable Leaves wastes	Leaves	2 Kg
	Total Quantity	12 Kg

The project was conducted experimentally by constructing a biogas plant for assessing the variation of methane and carbon dioxide yield with time, where three replicates were carried out for each sample. Below Table 3 show the ratio of each components.

Table 3 Design of case

	Vegetable Parentage	**Fruit Waste percentage**	**Cow dung**	**Water Ratio**
Case 1	40	60	1:1	1:1
Case 2	50	50	1:1	1:1
Case 3	60	40	1:1	1:1

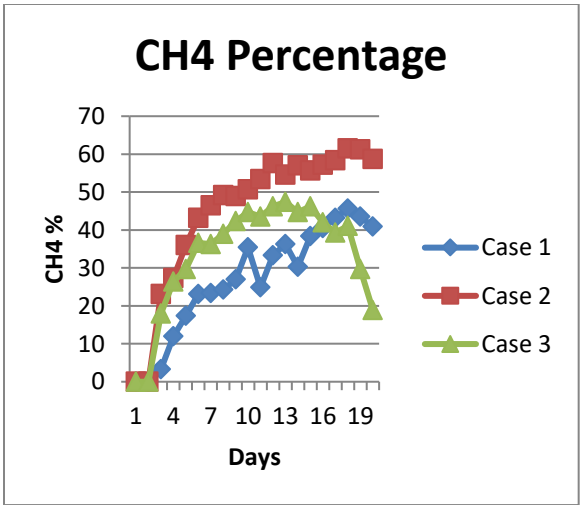
3. Results

The results that are presented in Figures and Tables were the mean of the three replicates for each sample. For all the three different cases simultaneously different reading for methane gas obtained and co2 obtained were recorded. These readings will be utilised in other sections for identifying the best performance of biogas plant with the three different cases or mix substate selected for the study. The reading of the digester (container) was noted every day.

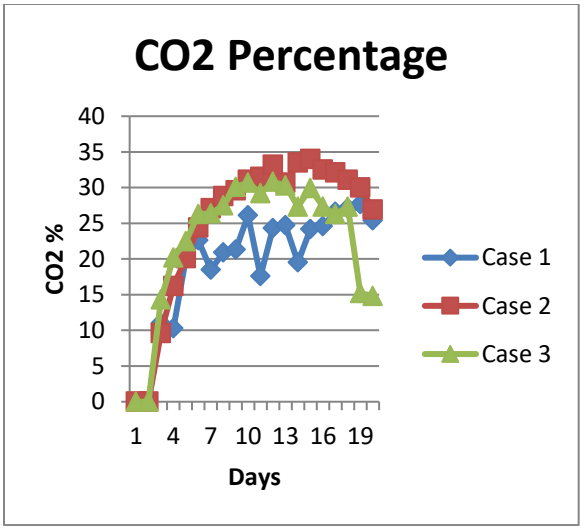
Table 4 Reading of Methane and CO_2 Production in per day

Substrates	**Case 1**		**Case 2**		**Case 3**	
Time (Days)	**CH4 (%)**	**CO2 (%)**	**CH4 (%)**	**CO2 (%)**	**CH4 (%)**	**CO2 (%)**
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	3.3	11	23.1	9.6	18	14.3
4	12	10.3	27.3	16.2	26.4	20.2
5	17.4	20.1	36	20.1	29.7	22.5
6	23.1	22.6	43.2	24.4	36.6	26.3
7	23.4	18.5	46.5	27.1	36.3	26.4
8	24.3	20.9	49.2	28.8	39	27.5
9	27	21.3	48.9	29.6	42.3	30.1

10	35.4	26.1	50.7	31.1	44.7	30.7
11	24.9	17.6	53.4	31.5	43.5	29.2
12	33.3	24.3	57.6	33.2	46.2	30.8
13	36.3	24.7	54.6	30.7	47.4	30.3
14	30.3	19.5	57	33.5	44.7	27.3
15	38.4	24.2	55.7	34	46.2	29.9
16	40.5	24.6	57.2	32.5	42	27.3
17	43.2	26.6	58.4	32.1	39.3	26.3
18	45.6	27.1	61.5	31.1	41.1	27.3
19	43.5	27.7	61.2	30	29.7	15.2
20	40.9	25.4	58.7	26.9	18.9	14.8



Graph 1Amount of methane produced with respect to no. of days

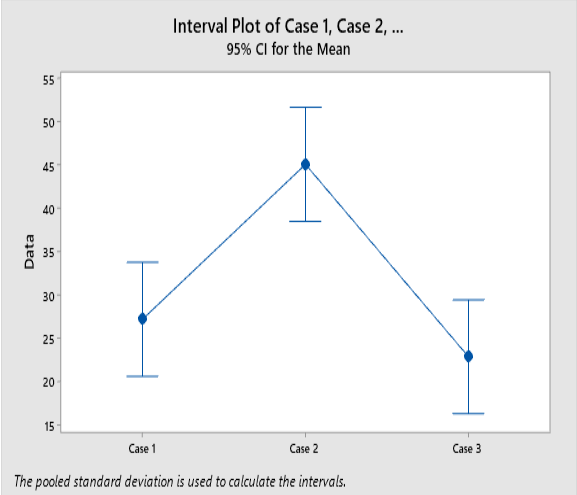


Graph 2Amount of CO_2 produced with respect to no. of days

Means

Factor	N	Mean	StDev	95% CI
Case 1	20	27.14	14.46	(20.57, 33.71)
Case 2	20	45.01	18.67	(38.44, 51.58)

Case 3	20	22.82	9.43	(16.25, 29.39)



Graph 2CI Level for the mean values of all the 3 cases considered

Table 2 C/N ratio for specific fruits and vegetable waste

Days	**% C**	**% N**	**C/N Ratio**
1	46.19	2.874	16.07:1
2	41.8	3.902	10.71:1
3	46.19	4.331	10.66:1
4	46.99	1.306	35.98:1
5	48.58	1.247	38.96:1
6	43	3.314	12.98:1
7	45.39	1.247	36.40:1
8	37.41	1.706	21.93:1
9	47.78	1.211	39.45:1
10	40.6	1.16	35.00:1
11	41.89	1.974	21.22:1
12	37.5	3.002	12.49:1
13	41.89	3.431	12.21:1
14	42.69	2.41	17.71:1
15	44.28	3.64	12.16:1

16	38.7	2.414	16.03:1
17	41.09	1.6	25.68:1
18	33.11	0.806	41.08:1
19	43.48	1.4	31.06:1
20	36.3	1.23	29.51:1

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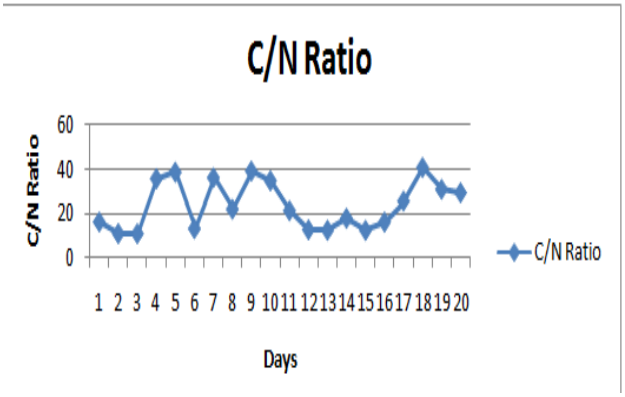

Graph 3C/N Ratio for 20 days of working for case 2

4. Conclusion and future work

Over all conclusion obtained from the complete experimental work performed in this present study on biogas plant using three different ratios of vegetable waste and fruit wastes. Also, the future scope of current work are discussed in the below sections. Following conclusions can be drawn from this work:

1. From the three cases having different ratios, the case 2 having 50:50 Ratio of vegetable waste and fruit waste showed the maximum amount of methane produced during the 20days of working.
2. Maximum Methane produced in the case 2 with 50:50 ratio was 61.5 m3 which was obtained on the 18th day of working. Which also stated that 50:50 ratio is the optimum ratio to obtain the maximum efficiency from the biogas plant for complete 20 days, where as in cases with different ratios showed gradual decrement in biogas production after 10-12 days of working.
3. Anova analysis performed using the readings obtained for the three cases during 20 days of working also revealed the maximum mean for case 2 having 50 : 50 ratio of vegetable waste and fruit waste with comparatively lower standard deviation then other cases used in the present study. Therefore it can be clearly seen in the case 2 that optimum gas can be produced for 20 days with better performance than the two other ratios.
4. Maximum C/N ratio was obtained on the 18th day of working in case 2.

Future Scope

1. Further a study using large data set can be performed using bio gas plant.
2. Taguachi or GRA method further can be implemented in similar studies to optimize the performance of biogas plant.
3. Some new ratio of waste materials can be utilized for the use in biogas plant.
4. In future a numerical or simulation-based study can also be carried out on biogas plant for obtaining different affecting parameters.

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