International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 11 Issue: 12 | Dec 2024 www.irjet.net p-ISSN: 2395-0072

PRODUCTION OF BIOGAS FROM VARIOUS ORGANIC MATTER.

Sharadreddy Patil[1], Almaas Bagwan[2], Manjunath[3], Murtuza[4], Ramesh[5], Ravikant Guttedar[6]

[1]Assistant Professor, Dept. of Civil Engg, Veerappa Nisty Engineering College, Shorapur, Yadgir, Karnatak, India
[2,3,4,5,6]UG Student Department of Civil Engineering, Veerappa Nisty Engineering College, Shorapur

---

Abstract - Biogas is a renewable and alternative energy source produced through anaerobic digestion of organic matter. The experiment utilized a closed-loop system. In this process kitchen waste, cow dung and sewage water is used. The combination of all these organic matter produce gases like methane, carbon dioxide etc., the gas is collected and used for various purposes.

***Key Words*: Anaerobic Digestion, Biogas, Kitchen waste, Cow dung, Sewage water, Methane.**

1 INTRODUCTION

Biogas is produced in many ways such as by using kitchen waste, food, cattle waste, agricultural waste etc. These wastes are used as raw material for production of biogas ,because of easy availability in large amount and continuous generation of these wastes.

1.1 MICROBIOLOGY OF ANAEROBIC DIGESTION

The biochemistry and kinetics of anaerobic process are complicated and the biological conversion of organic matter into methane is brought about by a group of specific micro organisms. The schematics of the process as described by Gujer, Zehnder (1983) involving the hydrolysis of biopolymers such as carbohydrates, lipids and proteins, oxidation and fermentation of amino acids and sugars, fatty acids, alcohol's and intermediates and the conversion of acetate and hydrogen into methane are schematically represented in the following figure 1 [2]

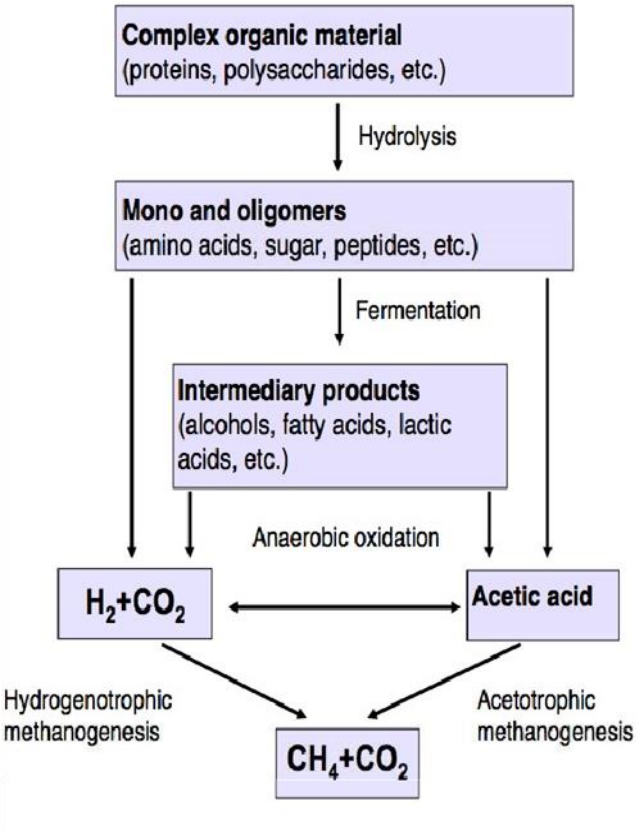

Figure 1: Breakdown of organic polymers in anaerobic digestion.

1.2 OBJECTIVES OF THE STUDY

1. To generate energy from waste.
2. To study the different physical and chemical parameters
3. of food waste, cow dung and sewage water.
4. Comparison of Bio Gas from conventional resources.
5. To improve the properties of the soil through the high quality organic fertilizer.
6. To find ecofriendly disposal method.
7. To generate revenue from the manure produced from digested sludge.

2. MATERIALS AND METHODOLOGY

2.1 MATERIALS USED FOR EXPERIMENTAL SETUP

1. 10 L capacity container (Digester)
2. 10 L capacity container (Brine solution)
3. 5 L capacity container (water collector)

4. Solid tape
5. Funnel
6. M-seal
7. Pipe 1/2"
8. Valve
9. Scale (15 CM)
10. Laboratory NaCl salt (brine solution)

2.2 WASTE COLLECTION AND PROCESSING

2.2.1 KITCHEN WASTE

Kitchen waste (KW) sample was collected from house. This kitchen waste constitutes of vegetables, cooked rice, peels and unused parts of vegetables, fruit peels etc.

Plate 2.1 : Kitchen waste

2.2.2 COW DUNG

Cow dung is equine cattle-waste product. Cow manure is indigestible accumulation of plant material that has transversed the gut of the cow. This is minerally rich. The colours vary from greenish to blackish, sometimes darkening shortly after air exposure.

Plate 2.2: Cow dung

2.2.3 WASTE WATER

The domestic waste water was collected from Rangampet nala.

Plate 2.3: collection of waste water

2.3 BIOGAS PRODUCTION

Biogas production was measured daily by water displacement method.

2.4 SAMPLING PROCEDURE

The domestic wastewater was collected in 2 L capacity bottle 12 in numbers. Where there is steady flow, the sample was collected keeping in mind all the precautions. The colour, odour and temperature of the domestic wastewater were observed and noted at the point of collection. After collection of sample, it was brought to Environmental Engineering laboratory of civil engineering department, VNEC, shorapur analysed for various characteristics, such as pH, alkalinity, acidity, total solids, suspended solids, dissolved solids, chlorides, dissolved oxygen, COD and BOD.

2.5 FABRICATION AND SETTING UP OF EXPERIMENTAL SETUP

The schematic diagram of the experimental setup used for the present study. 10 L capacity container was used as digester in the study. The container of 10 L capacity connected with the container of 10 L capacity, which contains the brine solution.

The produced gas will collect in container of 5 L capacity by downward displacement of brine solution. To study the performance of digester the digester effluent withdrawn will be analyse for pH, total alkalinity, per cent COD removal, per cent BOD removal, suspended solids etc.

The daily gas production and temperature under which COD were recorded for effluent. The suspended solid concentration in the reactors was determined in conformity with Standard Methods (2005).

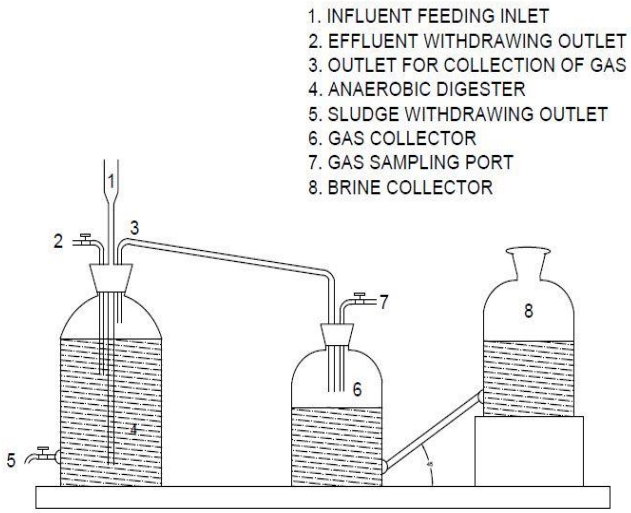

Figure 2.1: Experimental Setup of anaerobic reactor

2.5.1 SET UP -1

800 gram of kitchen waste is mixed with 7.2 litre of sewage water and transferred it to 10 litre capacity container. This is connected to 10 L capacity container which contains the brine solution (800 gram of laboratory NaCl is mixed with 8 L of distilled water) which is again connected to 5 L capacity container to collect the brine solution by water displacement method. In this study the volume of produced gas was measured by water displacement method considering the volume of the generated gas equal to that of expelled water in the water collector.

Plate 2.4: Experimental setup 1

2.5.2 SET UP -2

800 gram of cow-dung is mixed with 7.2 litre of sewage water and transferred it to 10 litre capacity container. Connection is same as the setup 1.

Plate 2.5: Experimental setup 2

2.5.3 SET UP-3

800 gram of kitchen waste and 800 gram of cow-dung is mixed with 6.4 litre of sewage water and transferred it to 10 litre capacity container. Connection is same as the setup 1.

Plate 2.6: Experimental setup 3

2.6 EXPERIMENTS CONDUCTED

- pH
- Total alkalinity
- Acidity
- Total solids
- Dissolved solids (ds)
- Suspended solids (ss)
- Chlorides
- Biological oxygen demand
- Dissolved oxygen

3 RESULTS AND DISCUSSION

3.1 GENERAL

The laboratory bench scale experiments were carried for production of Biogas in container of 10 Lts working volume. In laboratory the following physical and chemical characteristics of the samples were analysed for pH, BOD, alkalinity, acidity, total solids, suspended solids, dissolved solids, and chlorides.

The study was conducted at laboratory temperature varying from 25 – 30 ˚C. The results obtained during the study has been presented and discussed in the following sections.

3.2 CHARACTERISTICS OF DOMESTIC WASTEWATER

This section deals with the characteristics of domestic wastewater. The fresh domestic wastewater sample was brought to laboratory for period of 10 days to analyse the typical characteristics of domestic waste water. The physical characteristics of domestic wastewater shown in table 3.1

Table 3.1: Physical characteristics of domestic wastewater

SI No.	Parameters	Unit	Observance
01	Colour	--	Dark grey
02	Odour	--	Foul smell
03	Temperature	°C	22 to 28

Table 3.2 : Characteristics of domestic wastewater

SI. NO.	Parameters	Unit	Values
3	pH	--	6.9-6.43
2	Alkalinity as $CaCO_3$	mg/l	186-176
3	Acidity	mg/l	134-129
4	Total solids	mg/l	1173-1121
5	Dissolved solids	mg/l	1074-997
6	Suspended solids	mg/l	142-86
7	Chlorides as Cl_2	mg/l	492.1-478.4
8	BOD at 20°C	mg/l	550-480
9	Dissolved Oxygen	mg/l	12.5-11

3.3 SET UP OF REACTOR

The setup is operated for 30 days. The results of pH, BOD for Setup 1, 2, 3 are shown in table 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, respectively and figure 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, respectively.

Table 3.3: pH during every 5 days of interval for Setup 1

S. No.	Experimental period in days	pH
1	5	6.78
2	10	6.3
3	15	5.8
4	20	5.1
5	25	4.75
6	30	4.5

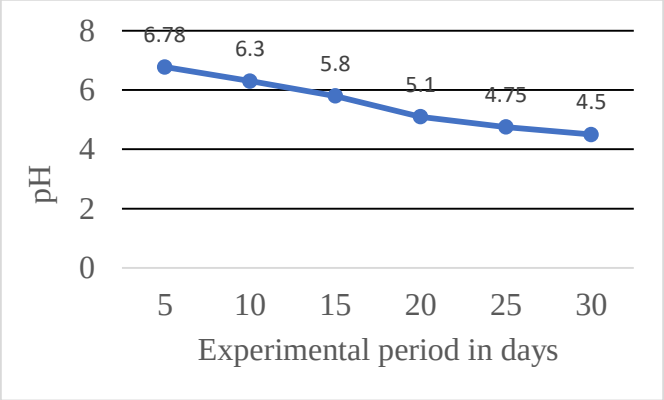

Figure 3.1: pH during every 5 days of interval for Setup 1

Table 3.4: pH during every 5 days of interval for Setup 2

S. No.	Experimental period in days	pH
1	5	6.82
2	10	6.1
3	15	5.64
4	20	5.19
5	25	4.59
6	30	4.47

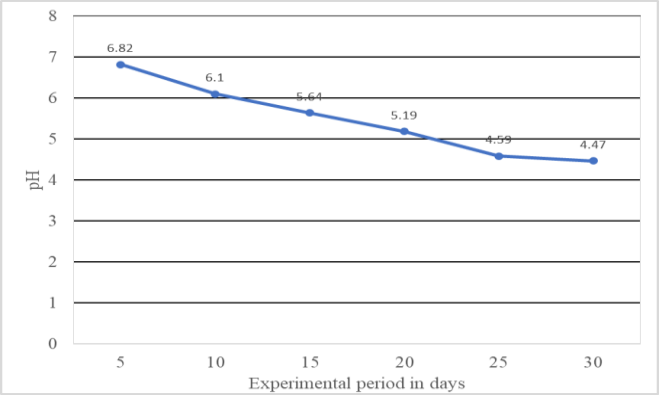

Figure 3.2: pH during every 5 days of interval for Setup 2

Table 3.5: pH during every 5 days of interval for Setup 3

S. No.	Experimental period in days	pH
1	5	6.73
2	10	6.35
3	15	5.79
4	20	5.23
5	25	4.46
6	30	4.2

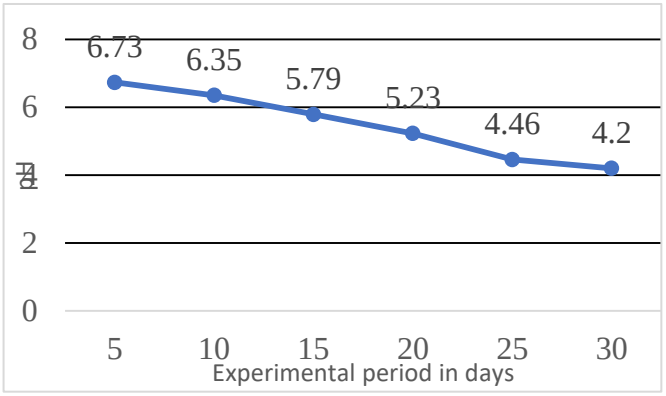

Figure 3.3: pH during every 5 days of interval for Setup 3

The figure 4.1, 4.2, 4.3 showing the variation in pH value of domestic wastewater during day 3 to day 30. This indicates decrease in pH of wastewater during day 03 to day 30. This because releases of volatile fatty acids during digestion process. This leads pH value to come down day by day.

Table 3.6: BOD during every 5 days of interval for Setup 1

S. No.	Experimental period in days	BOD
1	5	320
2	10	275
3	15	226
4	20	195
5	25	170
6	30	135

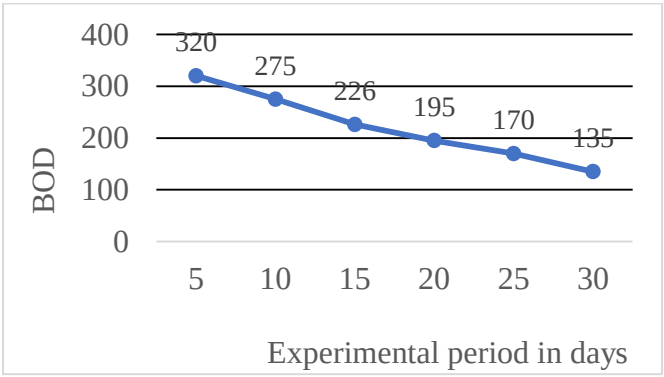

Figure 3.4: BOD during every 5 days of interval for Setup 1

Table 3.7: BOD during every 5 days of interval for Setup 2

S. No.	Experimental period in days	BOD
1	5	515
2	10	486
3	15	435
4	20	382
5	25	347
6	30	312

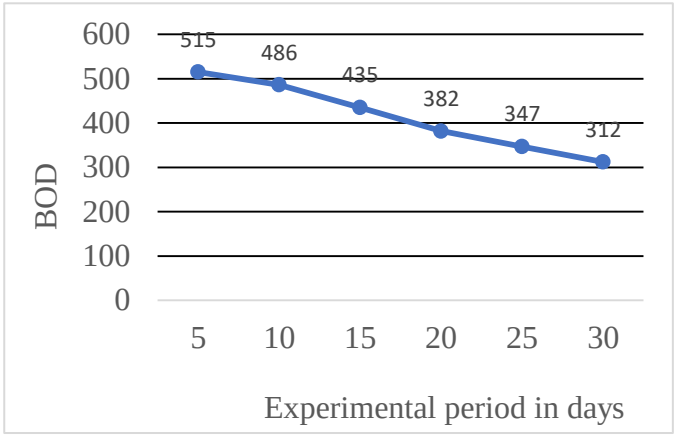

Fig 3.5: BOD during every 5 days of interval for Setup 2

Table 3.8: BOD during every 5 days of interval for Setup 3

S. No.	Experimental period in days	BOD
1	5	542
2	10	518
3	15	473
4	20	428
5	25	386
6	30	345

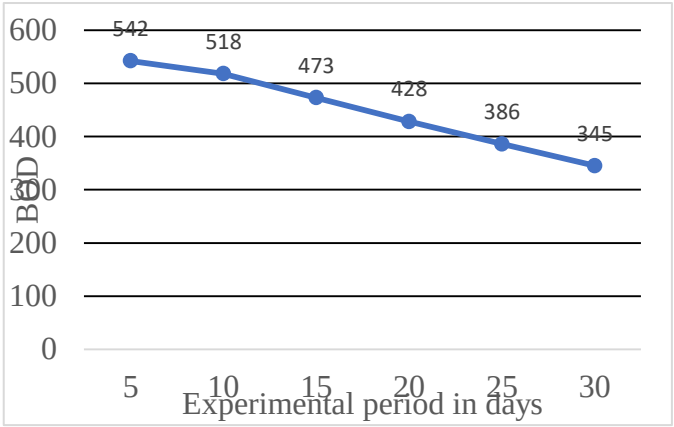

Fig 3.6: BOD during every 5 days of interval for Setup 3

The figure 3.4, 3.5, 3.6 showing the variation in the value of BOD of domestic wastewater during day 03 to day 30. This indicates decrease in BOD of wastewater during day 03 to day 30. This because decrease in bacterial growth during digestion process.

3.4 BIOGAS PRODUCTION

The production of biogas from day 3 to day 30 shown in table 3.9, 3.10, 3.11 respectively and figure 3.7, 3.8, 3.9 respectively.

Table 3.9: Biogas production during day 3 to day 30 for Setup 1

S. No.	Experimental period in days	Biogas produced in Ltr.
1	3	0.0034
2	5	0.0076
3	10	0.029
4	15	0.041
5	20	0.051
6	25	0.068
7	30	0.081

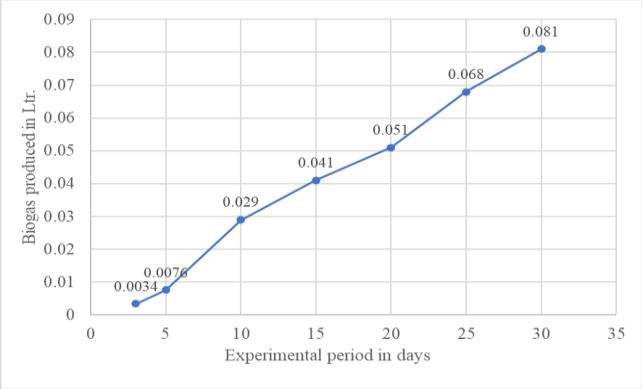

Fig 3.7 : Biogas production during day 3 to day 30 for Setup 1

Table 3.10: Biogas production during day 3 to day 30 for Setup 2

S. No.	Experimental period in days	Biogas produced in Ltr.
1	3	0.28
2	5	0.46
3	10	0.88
4	15	1.32
5	20	1.7
6	25	2.12
7	30	2.5

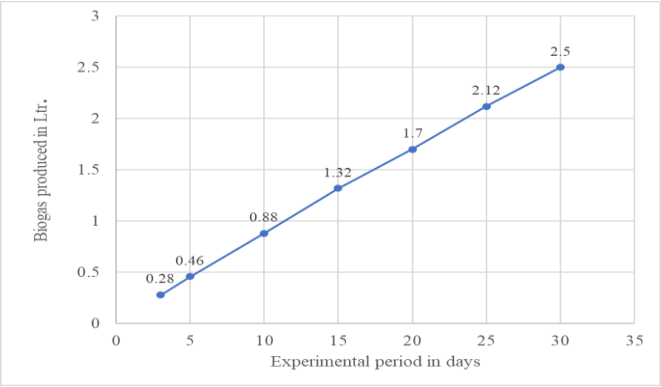

Figure 3.8 : Biogas production during day 3 to day 30 for Setup 2

Table 3.11: Biogas production during day 3 to day 30 for Setup 3

S. No.	Experimental period in days	Biogas produced in Ltr.
1	3	0.317
2	5	0.78
3	10	1.34
4	15	1.9
5	20	2.36
6	25	2.82
7	30	3.2

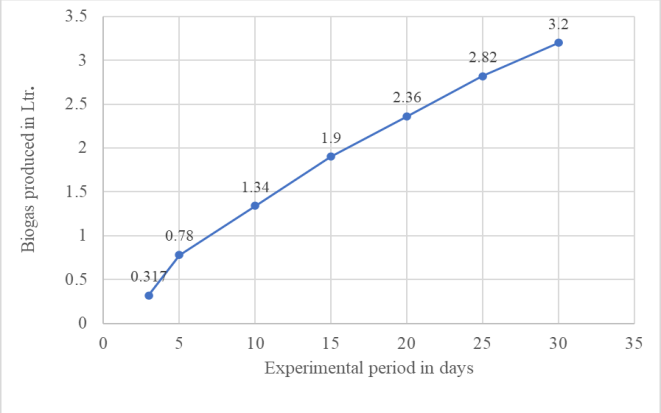

Figure 3.9 : Biogas production during day 3 to day 30 for Setup 3.

3.5 Manure

After completion of digestion process, the digestate is separated into two phases that is liquid and solid. The sludge has been dried and used as manure to improve soil fertility.

Plate 3.1 : Dried sludge

Plate 3.2 : Dried sludge used as a manure.

4 CONCLUSIONS

Based on the experimental study following conclusions can be drawn

1. The degradation of the organic matter is achieved more than 90%
2. The maximum biogas produced in Setup 1 is 0.081 Lts on the 30th day
3. The maximum biogas produced in Setup 2 is 2.5 Lts on the 30th day
4. The maximum biogas produced in Setup 3 is 3.2 Lts on the 30th day
5. After completion of the digestion process, the sludge has been taken out and dried. After drying the sludge has been used as manure to improve fertility of soil.

REFERENCES

[1] Aditya Dalvi, Atul Bhosale, prof. Santosh Ingel: "The production of biogas from food waste". Volume:05 Issue:04/April-2013. International Research Journal of modernization in Engineering, Technology & science P.P. 4960-4964.

[2] B. G. Mahendra , Sharadreddy Patil. "Anaerobic digestion of domestic wastewater". International journal of research in engineering & technology. P.P. 283-284.

[3] Umapathy H, D P Nagarajappa, Dr. P. Shiva Keshava kumar. "Biogas Production from Kitchen waste". Volume 07, Issue:08/August 2020. International Research Journal of Engineering and Technology. P.P. 1777.

[4] Azza A. Mostafa, A. Elbanna, Fathy Elbehiry and Heba Elbasiouny. "Biogas Production from Kitchen wastes: Special focus on Kitchen and Household wastes in Egypt". P.No.132-141.