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REVIEW ARTICLE

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INVESTIGATIONOF BIOGAS PRODUCTION FROM MESS WASTE THROUGH ANAEROBIC DIGESTION

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ABSTRACT

The present day's research interests on bioenergy have been expanded rapidly due to oil crisis of 1980s. This bio energy should be available in locally and it's purer than the fossil fuels. The field of bio energy is important for governments, scientists and business people in worldwide because of its available in nature and renewable resource. Today's the most important renewable energy is Biomass. The biological conversion of biomass to methane has become rapidly increasing in present days. All types of organic wastes can be converted to methane. In this study the installed plant is a sintex floating type biogas plant. The cubic capacity of plant is about 1000 liter. The pH range is maintained in the level of 6.85 to 7.4. The fermentation time of the anaerobic digestion for the efficient usage of gas as a fuel is about 35 days. Our biogas plant is used for all types of anaerobic respiration wastes such as cow dung manure, kitchen wastes etc. The input feed of kitchen waste is about 10 kg per day. The output of the biogas yield is about 0.688 m^3/kg. The composition of biogas is 50% to 60% of methane and rather than remaining 30% to 40% CO_2 and small amount of water about 2% to 5%. The performance characteristics of biogas plant are studied in this paper. To evaluate the performance of biogas production and pH variation throughout this study.

Keywords: Organic waste, Methane, Anaerobic digestion, Biogas Production

I. INTRODUCTION

One of the worldwide problems faced today is management of handling the wastes and energy crisis. This happens due to population growth and uncontrolled urbanization which has created serious problems of energy requirement. So there are lot of renewable energy resources namely solar energy, wind energy, different thermal and hydro resources of energy, biogas etc. But, in this energy resource, organic waste is simply converted to biodegradable waste and produces an alternate fuel source. Organic waste is an inseparable element of human existence and activity. Among this waste, important one is household food waste. India produces around 3000 million tons of organic waste annually [1]. To utilize this waste material for productivity process is important for both economic and environmental reasons and having a great potential for reducing landfill issues,/ and to minimize the risk of the environment and human health. In this study,food waste is used as a source of organic waste. A plan to turn this organic waste (kitchen waste) into energy, different technologies is possible; however, maximum energy recovery and less discharge are possible through *anaerobic digestion*. Anaerobic digestion (AD) is historically

one of the oldest processing technologies used by mankind [2]. It is a matured technology with simple process, and a cost effective way to manage biodegradable waste, because it produces biogas and digestate. The use or sale of both can provide great financial incomes with low energy requirement. The organic waste is digested from anaerobic digester contains many nutrients and thus it is used as plant fertilizer and soil amendment [3]. Biogas is one of the excellent energy sources. It is a mixture of about 60% methane and 40% carbon dioxide. In this biogas production *methane* is the main component of natural gas. It is relatively clean burning, colourless and odourless gas. This gas can be captured and burned for cooking and heating purposes [4]. The main objective of this study is to use anaerobic digestion process as a sustainable technology for digesting the kitchen wastes and to provide the renewable source of energy as well as to reduce the potential greenhouse gas emission [5]. The specific objectives of this research are, (i) to optimize the methane gas evolution from the kitchen waste. (ii) by conducting a lab scale study and hence to investigate the biogas yield at an anaerobic digestion of the kitchen wastes under ambient temperature conditions [6].

II. MATERIALS AND METHODS

A. Sources of mess waste

Biodegradable wastes are collected from sources such as domestic waste, street waste and market waste. The waste such as older mess wastes (rice waste, chapatti, dhalls, vegetables and cooked vegetables). Animal bodywaste such as (fish, meat stock) can also feed into the digester. Flours such as (wheat, rice, and cornflowers) and nonfood waste such as (neem flour, jatropha) will also produce biogas in the digester. The processing of chemicals used for food waste products give hazardous to environment. In this biogas production processmess waste has high methane production potential than cattle manure& biosolids. So the kitchen waste is being selected as a major source of this study.

B. Equipments and collection

Equipment's used in the study include a weighing scale of 50.00kg capacity and up to 5L capacity of water bottles used as anaerobic digesters and hand gloves which will be used to prevent direct contact with the waste respectively. The mixed mess wastes are collected about 10kg and waste water is mixed with that which forms semi solid state for this experiment.

C. Characterization of mess waste

The study is conducted on a mixed mess waste sample that is collected from leftovers at households and markets. The particle size of the wastes has been reduced in the range of 0.2 -1mm to grind in a kitchen grinder. The FW slurry concentration is 50%, made after diluting with tap water and later fed to the reactor. The characteristics of FW used in this experiment are compared with literature and the comparison is shown in table 1.

Table: 1 Characteristics of mess waste

S. No	Parameter Of Mess Waste	Value	Value [Zhang et al., 2006]
1	pH	6.88	7.57
2	TS(g/L)	94	309
3	TVS(g/L)	93	263
4	COD(g/L)	8	-
5	Moisture content	47	70

III. EXPERIMENTAL SETUPS

This experiment consists of a small scale lab setup with 1liter, 2liter& 20liter bottles, used as digesters. Here different concentration & combination of wastes are used. Different parameters of input and effluent like total solid, volatile solid, volatile fatty acid, pH, Temperature, Nitrogen, Carbon, Phosphorous will be measured. This experiment consists of two setups.

Setup 1

It consists of a 2 liter bottle, 50gm kitchen waste + cow dung, remaining water (1.5 liter)

Result: Gas production is found but not measured.

Fig.1 Different bottling setups

Fig.2 1000 liter Digester setup

Setup 2

It consists ofdifferent sets of 1 liter& 2 liters bottles with different compositions are installed. They are given as

1. 200gm cow dung is mixed with water to make 1liter slurry which is poured in 1liter bottle.
2. 50gm grinded kitchen is mixed with 150gm cow dung and water is added to make 1liter solution which is poured in 1liter bottle.
3. 400gm cow dung is mixed with water to make 2liter slurry which is poured in 2liter bottle.

RESULTS

In all of the 3 sets, gas production occurs and the gas burns with blue flame. The process continues, volatile fatty acids (VFA) are produced which causes the decrease in pH of solution.

A. Inoculum and methodology

Initially Cow dung slurry is used as a source of inoculums because of the microbial digestion process. After the processing of methogenic bacteria for about 5 to 6 days, the vegetable and kitchen wastes can be feed as input for digester. The composition of cow dung and water should be in the ratio of 1:1. So the cow dung is taken nearby 150kg and it is diluted with 150 liter water and sieved to remove coarse particles. Now digester comes to reaction process. The total solids (TS) concentration of the mix was 9000 ml/L with volatile fraction of 86 %. The FW slurry through the reactor which transfers the phases such as hydrolysis, acidogenesis and methanogenesis. After this reaction gas will produced but the gas valve has to be closed for first 3 to 4 days and then it has to be opened at 5th day to avoid unpleasant gas odour. To put 5kg input of anaerobic wastes for 1cubic meter digester.For efficient results, the waste can be feed into two partitions for a single day.Thevarious testing methods has been checked such as chemical analysis of COD, TSS, VSS, nutrient contents and pH valuesat beginning and end of each biodegradabilitery tests are checked.

IV.EXPERIMENTAL RESULTS AND DISCUSSION

Table: 2 biogas production in ml

Set no. /day	1st day	2nd day	3rd day	4th day	5th day	6th day	7th day	8th day	Average
Set 1	27	38	24	13	-	43	28	09	24.50
Set 2	83	156	117	45	-	65	85	119	90.58
Set 3	84	77	54	33	-	16	69	97	58.23

From the result it has been seen that, set 2 which contains kitchen waste produces more gas when comparedto other two set. In set 2 the kitchen waste produces average 252.50% more gas than set 1 (with 200gm cow dung) and 65.2% more gas than set 3 (with 400gm cow dung). Kitchen waste produces more gas than cow dung because the kitchen waste contains more nutrient values. The efficient method for produce biogas is to use kitchen waste.

Table: 3 pH and total solid concentration

Day	Set 1		Set 2		Set 3	
	pH	Ts%	pH	TS%	pH	Ts%
1	7.13	7.1	7.43	7.4	7.12	8.21
4	6.54	8.3	6.12	5.74	6.9	8.1
5	6.75	8.4	6.29	5.25	7.23	7.9
8	6.83	6.96	4.86	5.13	6.9	6.81

From this results, it has been seen that pH reduces as the process going on (bacteria produces fatty acids). Here methanogens bacteria which utilize the fatty acids are slow reaction compared to other. So it is rate limiting step in reaction. In set 2 which contains kitchen waste, pH decreases highly. So the reaction is fast because hydrolysis and acid genesis reaction is fast as organism utilize the waste more speedily than dung and total solid concentration decreases more in set 2.

Graph analysis (i):The graph clearly says that the gas production increases up to day-3. But as the acid concentration increases in the bottles and the values of pH starts decreasing below 7. Soto increase the pH values in the bottles we need to add water to dilute after 5 to 6 days of pH decreasing, then the gas production starts again increasing. Therefore, the acid concentration greatly affects the biogas production.

Graph Analysis (ii): This graph shows that the pH is on higher side, as reaction inside the bottles continues. It starts decreasing and after the day 3, it becomes acidic. Then water is added to dilute and thus pH increases. The production rate of biogas depends on the pH maintained.

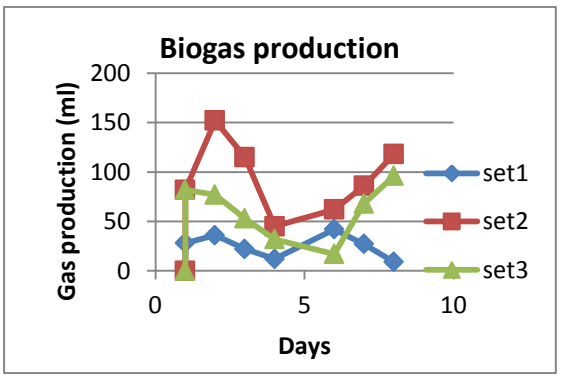

Fig.3 Graph (i)

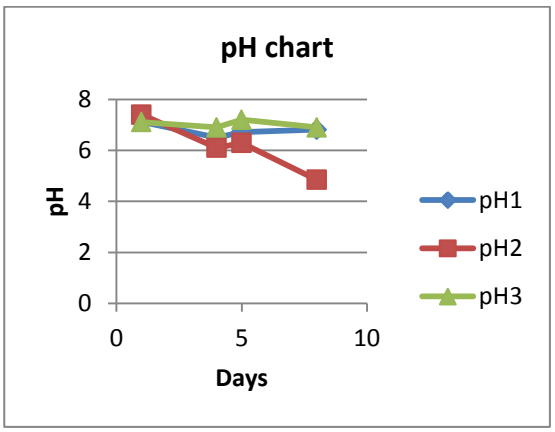

Fig.4 Graph (ii)

5. CONCLUSION

This study investigated the effectiveness of kitchen waste for biogas production and presented the performance characteristics of the anaerobic digestion, As a result from this research the amount of kitchen waste is 10kg added with 15liter water. The inoculum has been created in 7lt slurry and the total biogas yield for 1000liter digester is 0.688 m^3/kg.The maximum methane fraction in the range of 46% and duration of methane fraction production is 19-30 days. The number of methane fraction present in digester is 6 days. The pH value maintain in this study as 7.5 to increase the biogas generation. Through the successful anaerobic processing inside the reactor, methanogen gradually converts the organic acids into methane gas and carbon dioxide. The digestion of organic waste with animal manure reduces the emission of greenhouse gases by approximately 0.3 and 0.6 kg CO_2. Thus biogas production achieves a waste of resource utilization and reduction of greenhouse emissions and to produce a renewable energy source.

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