



ANALYSIS OF GENERATION OF BIOGAS FROM COW DUNG AND VARIOUS CO-DIGESTION WASTES (MSW) BY ANAEROBIC DIGESTION UNDER MESOPHILIC CONDITION

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Abstract--- All the country in the world mainly dependent on the fossil fuels (coal, petroleum, and natural gas). The fossil fuels such as coal, petroleum (crude oil) and natural gas take thousands of years to form naturally. Biomass is a renewable energy source because plant life renews and adds to itself every year and also biogas is less emission than fossil fuel. So it's also help full for green environmental process. In this Experiment we have planned single phase biogas setups by using 2L bottles. The fermentation time of the anaerobic digestion for the efficient usage of gas as a fuel is about Sixteen days. Our biogas setups are used for all types of anaerobic co-digestion wastes. The primary feedstock is cow dung and the co-substrates such as pasture wastes, fruit wastes, and vegetable waste are used. The pH value as maintained at the range of level 6.5 to 7.2. The output of the biogas yield is 1.6 ml, 1.3 ml, 1 ml, and 0.98 ml around sixteenth days. So the result of cow dung and pasture waste is overall biogas production almost near from experimental setup 1(pure cow dung). The objective of this paper was to study the performance of the anaerobic process used Cow dung waste pasture wastes, fruit wastes, and vegetable waste as substrates in single stage feed batch anaerobic digester for biogas production. The performance of the reactors was evaluated by estimating destruction of total solids, pH and by monitoring daily gas production.

Keywords--- Pasture and vegetable waste, anaerobic co-digestion, Biogas formation, methane.

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 (pasture 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 pasture 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 pasture waste. (ii) By conducting a lab scale study and hence to investigate the biogas yield at an anaerobic digestion of the pasture wastes under ambient temperature conditions [6].

II. MATERIALS AND METHODS

The cow dung was collected from the farm. The fruits wastes were collected from Chennai market and vegetable wastes were collected from kattuppalayam vegetable and farmer's market. The fruit waste and vegetable waste are grinded using wed grinder. Samples were then stored in a separate black polyethylene bags. This anaerobic digestion which is a condition of mesophilic (35 C The daily biogas production was measured by using wet tip gas meter and the biogas components (CH₄,H₂O,CO₂) was measured weekly by using of gas Hatch Carle 400AGC gaschromotograph. The pH value was measured by pH meter. The temperature was measured by digital thermometer.

TABLE I. CHARACTERISTICS OF COW DUNG

| S.no | Properties | Value |
|------|----------------|-------|
| 1. | Total solid | 59.73 |
| 2. | VS/TS (%TS) | 81.55 |
| 3. | TKN (g/l g/kg) | 1.39 |
| 4. | TOC (%TS) | 39.35 |
| 5. | PH | 7.50 |
| 6. | Lipids | 5.50 |

TABLE II. CHARACTERISTICS OF FRUITS WASTE

| Components Fruits | Ph | Fat (gm) | Protein (gm) | Carbohydrate (gm) | Water (gm.) |
|----------------------|---------|----------|-----------------|-------------------|----------------|
| Banana | 4.5-5.2 | 0.33 | 1.03 | 22.24 | 86.32 |
| Grapes | 4.1-4.5 | 0.30 | 0.7-0.8 | 9.3 | 88.12 |
| Apple | 3.3-3.9 | 17.0 | 0.26 | 13.81 | 85.56 |

TABLE III. CHARACTERISTICS OF VEGETABLE WASTE

| Components Vegetables | pH | Fat (gm) | Protein (gm) | Carbohydrate (gm) | Water (gm.) |
|--------------------------|-----------|----------|-----------------|-------------------|----------------|
| Potato | 5.40-5.90 | 0.10 | 2.0 | 17.0 | 75.0 |
| Tomato | 4.30-4.90 | 0.20 | 0.90 | 3.9 | 94.5 |
| Radishes | 6.0 | 0.18 | 0.98 | 5.88 | 25.0 |

TABLE IV. CHARACTERISTICS OF PASTURE WASTE

| Sl. No | Properties | Value[A.S.Nizami][15] |
|--------|--|-----------------------|
| 1 | pH | 4.3 |
| 2 | Volatile Fatty Acids(gkg-1DS) | 5.3 |
| 3 | Ammonia(gkg-1DS) | 46.18 |
| 4 | Volatile solid (VS) (%) | 92 |
| 5 | Dry Solid (DS) (%) | 30.66 |
| 6 | Water soluble carbohydrates (WSC)(g kg-1 DS | 49.83 |

III. EXPERIMENTAL SETUP

This experiment consists of a small scale lab setup with four numbers of two litter bottles which are 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, and Temperature. Nitrogen, Carbon, Phosphorous was measured. The experiment consists of 4 setups.

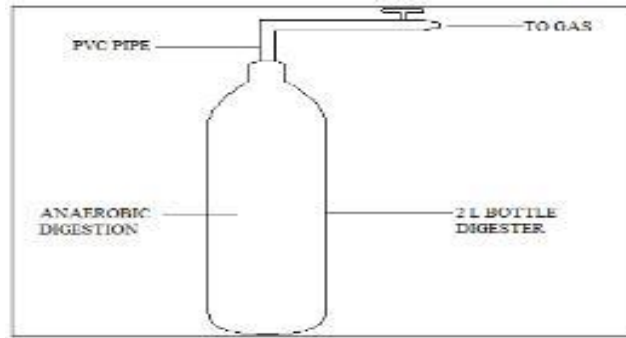


Fig.1. Outline Diagram of Single Phase Biogas Digester Setup



Fig.2. Continuous type single phase Biogas digester setup

A. Experimental setup 1

It consists of a 2 liter bottle containing 50% of cow dung and 50% of water.

B. Experimental setup 2

It consists of a 2 liter bottle containing 50% of (cow dung + pasture) and 50% of water.

C. Experimental setup 3

It consists of a 2 liter bottle containing 50% (cow dung + fruits waste) and 50% of water.

D. Experimental setup 4

It consists of a 2 liter bottle containing 50% (cow dung + vegetable waste) and 50% of water.

VI. EXPERIMENTAL RESULTS AND DISCUSSION

TABLE V. BIOGAS PRODUCTION IN ML

| Experimental setup Days | Experimental Setup 1 | Experimental Setup 2 | Experimental Setup 3 | Experimental Setup 4 |
|----------------------------|----------------------|----------------------|----------------------|----------------------|
| 2 th | 0.86 | 0.38 | 0.29 | 0.27 |
| 4 th | 0.81 | 0.87 | 0.59 | 0.49 |
| 6 th | 0.83 | 0.62 | 0.43 | 0.39 |
| 8 th | 0.94 | 0.68 | 0.58 | 0.46 |
| 10 th | 1.51 | 1.41 | 1.12 | 0.97 |
| 12 th | 1.85 | 1.50 | 1.38 | 1.33 |
| 14 th | 2.68 | 2.04 | 1.58 | 1.56 |
| 16 th | 2.83 | 2.49 | 1.56 | 1.97 |
| Average | 1.53 | 1.24 | 0.97 | 0.93 |

TABLE VI. pH AND TOTAL SOLID CONCENTRATION

| Days | Experimental Setup 1 | | Experimental Setup 2 | | Experimental Setup 3 | | Experimental Setup 4 | |
|------------------|----------------------|--------------|----------------------|--------------|----------------------|--------------|----------------------|--------------|
| | pH | TS% | Ph | TS% | pH | TS% | pH | TS% |
| 2 nd | 7.13 | 0.412 | 6.03 | 0.452 | 6 | 0.325 | 6.1 | 0.325 |
| 4 th | 7.01 | 0.432 | 6.1 | 0.251 | 6.05 | 0.253 | 6.25 | 0.235 |
| 6 th | 7.32 | 0.653 | 6.01 | 0.251 | 5.6 | 0.475 | 7.4 | 0.215 |
| 8 th | 5.03 | 0.225 | 7.4 | 0.426 | 5.01 | 0.442 | 5.3 | 0.421 |
| 10 th | 6.1 | 0.441 | 6.35 | 0.494 | 6.53 | 0.371 | 6.12 | 0.214 |
| 12 th | 6.2 | 0.532 | 6.5 | 0.622 | 6.23 | 0.521 | 6.35 | 0.241 |
| 14 th | 6.2 | 0.654 | 7.00 | 0.691 | 6.35 | 0.311 | 6.25 | 0.484 |
| 16 th | 6.32 | .685 | 6.3 | 0.674 | 6.65 | 0.65 | 6.7 | 0.412 |
| Average | 6.41 | 0.504 | 6.42 | 0.489 | 6.41 | 0.401 | 6.43 | 0.356 |

Graph analysis:

The graph Fig.3 clearly says that the gas production in Setup 1 increases when comparing to each other's. The next highest gas production involves the Setup 2 containing cow dung and co-substrate grass wastes.

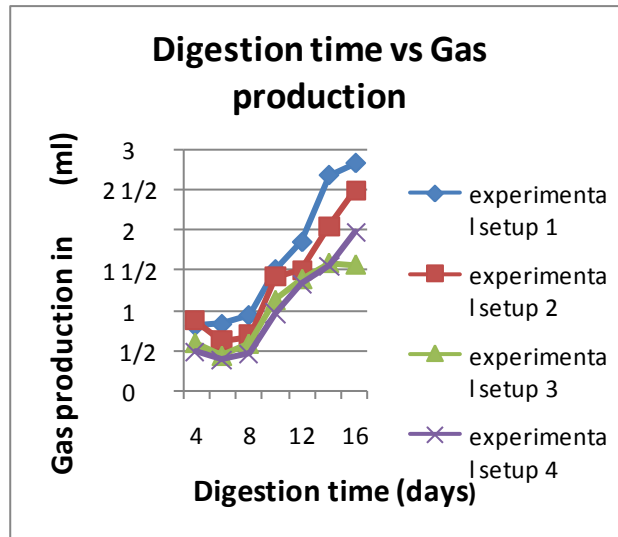


Fig.3 Amount of Gas production (ml) for various experimental Setups Vs. Digestion Time (Days)

This graph Fig.4 shows that the pH is on higher side, as reaction inside the bottles continues. It starts decreasing and after the day 8, it becomes acidic. Then the shaking the bottle and thus pH increases. The production rate of biogas depends on the pH maintained.

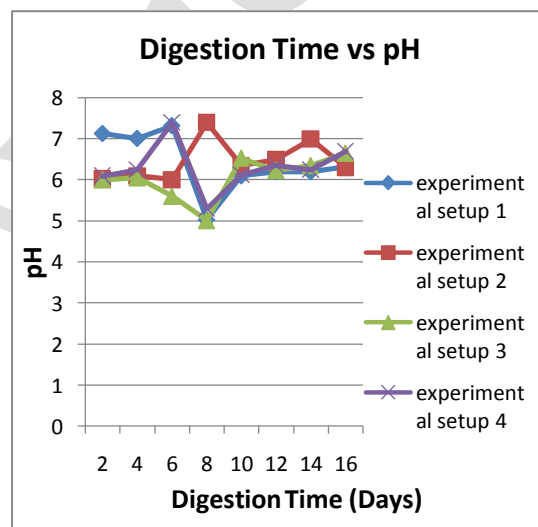


Fig.4. pH value obtained for various Experimental Setups Vs. Digestion Time (Days)

This graph Fig.5 explained about difference between total solid concentration and digestion time. So I have understood above this graph variation of Total Solid concentration in each day.

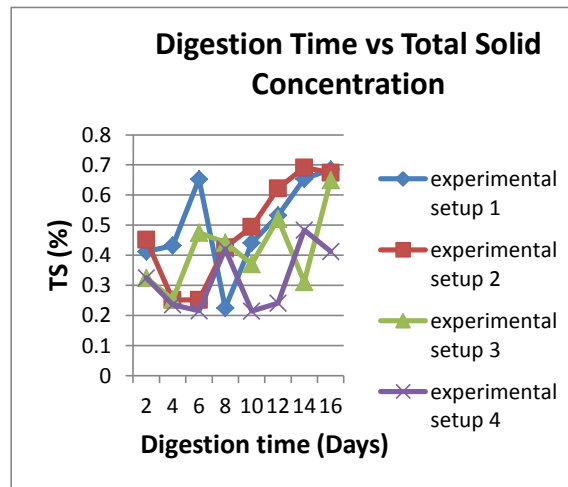


Fig.5. TS value obtained for various Experimental Setups Vs. Digestion Time (Days)

V. CONCLUSION

From the results obtained , it can be concluded that, the pasture wastes containing high carbohydrates are amenable to anaerobic digestion process and the maximum gas production was observed during 5-10 days of digestion. Through the successful anaerobic processing inside the reactor, methanogen gradually converts the organic acids into methane gas and carbon dioxide. The biogas production range from the anaerobic digestion of pure cow dung is 1.6ml, cow dung with the co substrate pasture wastes produces 1.3ml, with fruit wastes and vegetable wastes are 1.00ml and 0.98ml. The amount of methane increases after seventh day from the digester. The pH was maintained as 6.5-7.2 to increase the biogas generation. Thus the study concludes that anaerobic digestion of pure cow dung produces highest amount of biogas and the cow dung along with the co substrate pasture waste produces the next higher amount when compared to the other co substrates used in the study. So the future thought of the study is to perform the biogas production using cow dung and pasture wastes less than two phase method on a large scale.

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