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Comparison of extraction of bio gas from various wastes

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ABSTRACT

A Comparative Study of extraction of Bio gas from poultry waste, paper waste& food waste is carried out. The three types of waste are subjected to an aerobic digestion under 40 days' retention period & mesophilic temperature range of 27˚c to 42˚c. The volume of gas produced by each waste is then determined and they are compared with one another by using a graphical representation. As a result of this comparison, generation of biogas from poultry waste is found to be larger than the other two wastes.

Keywords: *Extract, Energy, Waste, Volume, Bio gas*

1. INTRODUCTION

In the current world energy scenario, power is produced with the help of resources like crude oil, nuclear fuel, coal, but they are non-renewable resources and also give importance to renewable resources like hydro energy, wind energy, solar energy &biogas because they are pollution-free energy. Biogas has globally remained a renewable energy source derived from plants that use solar energy during the process of photosynthesis. Biogas is the product of fermentation of waste &biological products. Raw materials for biogas fermentation such as cow dung, poultry waste, water hyacinth, straw, weeds, leaf, human and animal excrement, domestic rubbish and industrial solid and liquid wastes.

2. PROPERTIES OF BIOGAS

Bio gas is a colourless, flammable gas produced from a various waste product like cow dung, plant waste, animal waste, and industrial waste. It is smokeless, hygienic and more convenient to use than other solid fuels. Biogas is a mixture of methane and co_2 and small quantities of other gases like H_2, N, H_2S, and water vapour

50 to 70% of CH_4
30 to 40% of CO_2
2% of H_2
Traces of (N, NH_3, H_2S, Water vapour)
The compression ratio of biogas is 15 to 20

3. PROCESS

Biogas is produced from organic wastes using an anaerobic digestion method. This method is carried out in three phases like Hydrolysis, Acetogenesis, and Methanogenesis.

Hydrolysis

$$(C_6H_{10}O_5)n + nH_2O \rightarrow n\,(C_6H_{12}O_6)$$

Acetogenesis/Acidogenesis

$$n(C_6H_{12}O_6) \rightarrow n\,CH_3COOH$$

Methanogenesis

$$3nCH_3COOH \rightarrow n\,CH_4 + CO_2$$

Biogas technology amongst other processes (including thermal, pyrolysis, combustion and gasification) has in recent times also been viewed as a very good source of sustainable waste treatment/management, as disposal of wastes, has become a major problem especially to the third world countries. The effluent of this process is a residue rich in essential inorganic elements like nitrogen and phosphorus needed for healthy plant growth known as bio fertilizer which when applied to the soil enriches it with no detrimental effects on the environment.

3.1 Hydrolysis

Fermentative bacteria convert the insoluble complex organic matter (cellulose) into soluble molecules such as sugar amino acids and fatty acids. The complex polymeric matter is hydrolysed to the monomer.

Lipids $\rightarrow$ Fatty Acids
Polysaccharides $\rightarrow$ Monosaccharides
Protein $\rightarrow$ Amino acids
Nucleic acids $\rightarrow$ Purines and pyrimidines

3.2 Acetogenesis

In the second stage acetogenic bacteria also known as acid formers convert the products of the first phase to simple organic acids carbon di oxide and hydrogen, the principal acids produced are acetic acid **(CH_3COOH),** propionic acid **(CH_3CH_2COOH)** butyric acid **($CH_3CH_2CH_2COOH$)** and ethanol**(C_2H_5OH)**. The product formed during acetogenesis is due to a number of different microbes.

3.3 Methanogenesis

In third stage methane is produced by bacteria called methane formers (also known as methanogers) in two ways either by means of cleavage of acetic acid molecules to generate carbon di oxide and methane production is higher from reduction of carbon di oxide with hydrogen methane production is higher from reduction of carbon di oxide but limited hydrogen concentration in digesters results in that the acetate reaction is the primary producer of methane

$$\underset{\text{(Acetic acid)}}{CH_3\,COOH} \rightarrow \underset{\text{(Methane)}}{CH_4} + \underset{\text{(Carbon dioxide)}}{CO_2}$$

$$CO_2 + \underset{\text{(Hydrogen)}}{4H_2} \rightarrow CH_4 + \underset{\text{(Water)}}{2H_2O}$$

4. EXPERIMENTAL PROCEDURE

The fixed dome type bio gas plant consists of a closed underground digester tank made up of bricks which has a dome shaped roof also made up of bricks. This dome shape roof of the digester tank functions as a gas holder and has an outlet pipe at the top to supply gas to homes.

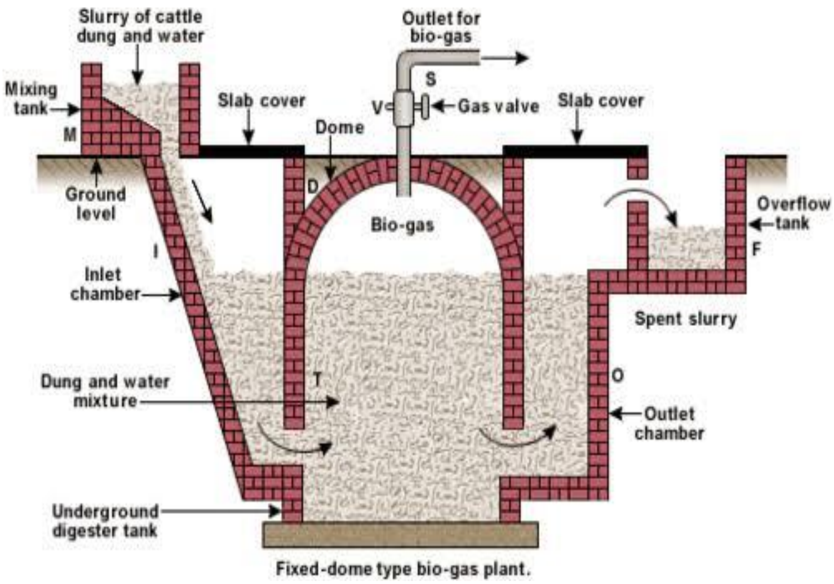

Fig. 1: Experimental setup

The slurry is prepared by mixing water in cattle dung in equal proportion in mixing tank. The slurry is then sent into the digester tank with the help of the inlet chamber. It should be noted that slurry is fed into the digester tank up to the point where the dome of the roof starts. Inside the digester tank, the complex carbon compounds present in the cattle dung breaks into simpler substances by the action of anaerobic microorganisms in the presence of water. This anaerobic decomposition of complex carbon compounds present in cattle dung produces bio gas and gets completed in about 60 days. The bio gas so produced starts to collect in dome shaped roof of bio gas plant and is supplied to homes through pipes. The spent slurry is replaced from time to time with the fresh slurry to continue the production of bio gas. The volume of the gas was measured by formula:

$$V=pr^2h$$

Where,
r: Radius of the cylinder pot
h: Height of the pot from the water surface

5. DISCUSSION ON GAS PRODUCTION

5.1 Poultry waste

Figure 2 shows the gas production from poultry waste in four slots of hydraulic retention time. In the first slot from 0-10 day's maximum amount of gas about 25% is produced. From 1120 days gas production decreases to about 22%. In the third slot from 21-30 days, the gas production is about 18%. From 31-40days gas production increases slightly to about 21%. From 41-50 days gas production decreases to about 12%. Finally, from 51-54 days gas production reduces to about 1.8% and gas production almost ceases after the 54th day.

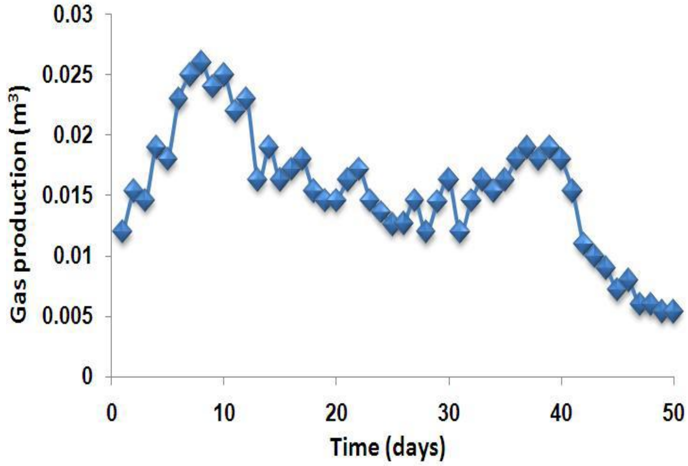

Fig. 2: Gas production from poultry waste

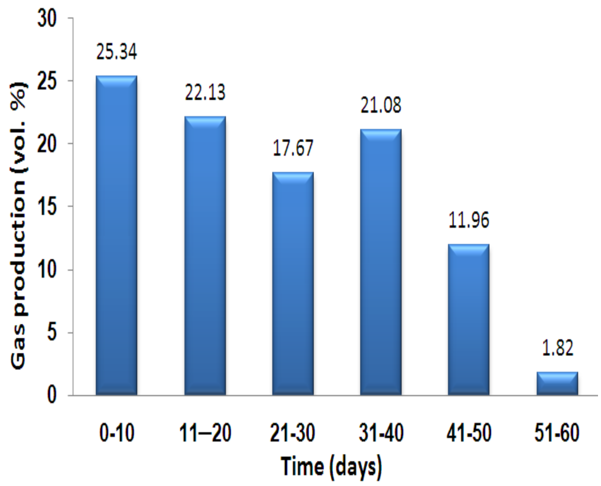

Fig. 3: Gas production from poultry waste in different time slots

5.2 Paper waste alone

The experiments are carried out under the ambient temperature range of 26˚c to 36˚c and the inlet temperature of 32˚c to 42˚c with in a retention period of 45 days. The paper waste system becomes flammable with 24 hours of charging the digester. Even though gas production is reduced drastically and flammability is also discontinued only to resume after 14 days.

From figure 5, Biogas production starts within 24hrs. It produces 5 litres of biogas on the 2nd day and decreases its production and increase its production after the 14th day. It produces 8 litres on the 20th day and it produces a maximum of 10 litres on the 25th & 40th day.

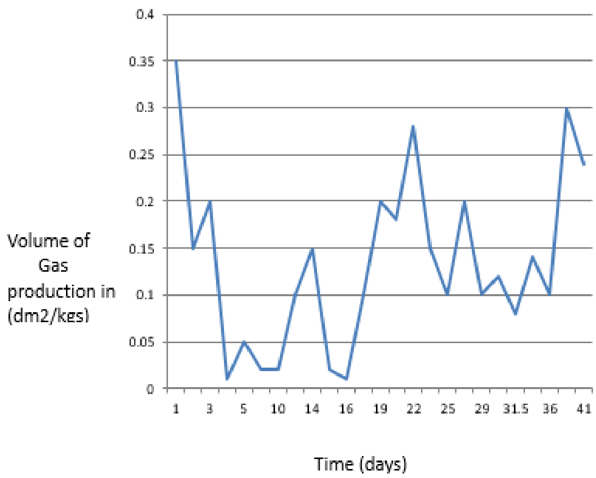

Fig. 4: Gas production from paper waste

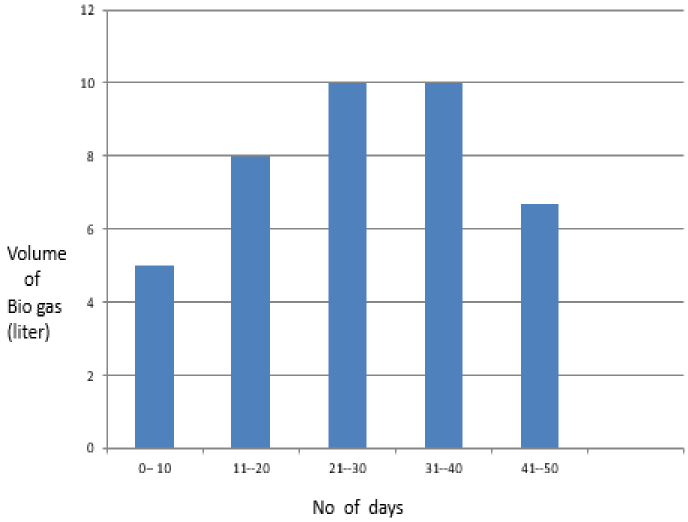

Fig. 5: Gas production from the paper waste in different time slots

5.3 Food waste

Food waste is rich in organic matter and these release methane, a greenhouse gas, feed stock characterizes reactor design and condition of operation play the major role in biogas production and process stability in the anaerobic digestion process. Food waste treatment and its conversion into biogas are carried out in single phase & high rate. Two phase anaerobic digestion process were microorganisms break down bio degradable material in the absence of oxygen.

The figure 6 shows the Biogas production for a period of days. It produces a maximum of 7742.5ml of biogas on the 30 days. Production is in gradual growth and increases its volume.

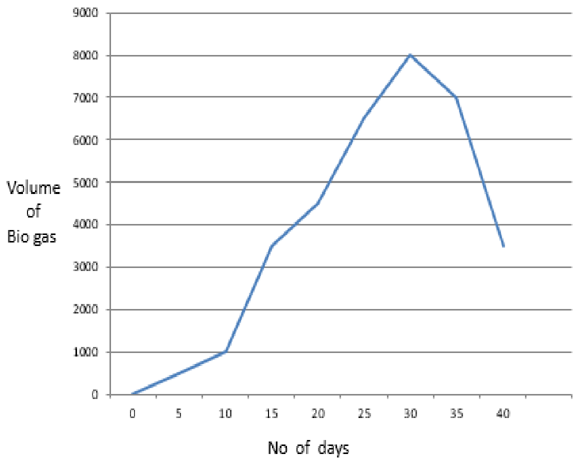

Fig. 6: Gas production from paper waste

6. COMPARISON OF RESULTS

Figure 7 shows Gas production (vol. %) from different materials in different time slots and also shows the total gas production from different fermentable materials. The average digester temperature for different fermentable materials is a little bit different, although constant digester temperature is desirable for proper comparison. This is due to the seasonal changes during the investigation procedure. It shows that the total gas production from poultry waste is almost twice that of food waste. Total gas production from paper waste is equivalent to the food waste. This means that less amount of poultry waste is needed for the same amount of biogas production in comparison to paper waste and food waste. The biogas production was different for different substrates because the bacteria responsible for the breakdown of the substrate were different.

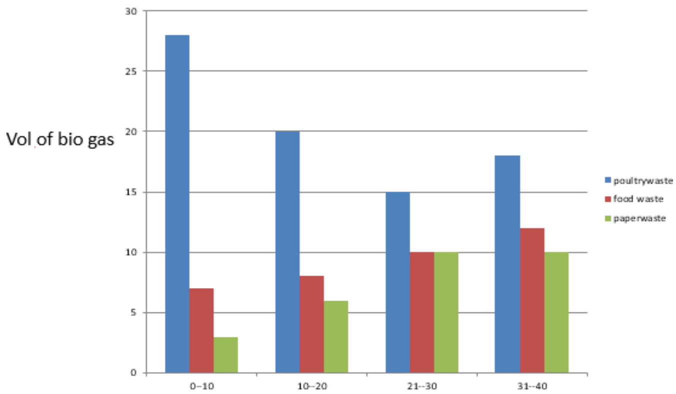

Fig. 7: comparison of the volume of gas produced by various waste

7. CONCLUSION

The anaerobic digestion process offers the possibility of combining the treatment of waste and the production of renewable energy is biogas rich in methane CH_4. The biogas produced in the two substrates is flammable, especially since the second day of the digestion of the substrate sludge Biogas production systems have several benefits, such as (a) eliminating greenhouse gas, (b) reduction of odour, (c) betterment of fertilizer, (d) production of heat and power. Usually, the efficiency of biogas plant varies with the type of digester, the operating conditions, and the type of material loaded into the digester. Operating temperature is an important factor influencing digester efficiency. And the result of this research on the comparison of production of biogas from poultry waste, paper waste, food waste has shown that the flammable biogas can be produce from these wastes through anaerobic digestion for biogas generation. Based on my research, poultry waste is found to produce more volume of biogas than paper waste & food waste. Biogas technology can be adopted as a successful development option for developing countries for energy production & substitution if properly managed and marked.

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