STUDY OF EFFECT OF TEMPERATURE AND STIRRER ON BIOGAS PRODUCTION RATE BY USING SOLAR ENERGY

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Abstract: In view of the factors affecting fermentation with the mixture of duck manure and straw, and the cumulative gas production from raw material mixed in different proportions, optimum temperature for mixed anaerobic fermentation is about 40 °C and the optimum proportion of raw materials is 2.8:1. By maintaining the parameters influencing biogas production to the optimum level highly efficient biogas production rate can be obtained.

***Keywords*–Biogas, Production Rate, temperature, parameters**

I. INTRODUCTION

Biogas 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, plant material, Sewage, Green waste or Food waste. Biogas is renewable energy source. A high performance of the Digester will require complete mixing of organic waste and precise temperature control. This will allow for the Methane producing bacteria to have optimal conditions. A key factor in an optimized Biogas plant is the digester tank to have an optimal design. Therefore, careful consideration of the net energy balance between the increased heating energy demands and improved additional methane production at higher operating temperatures must be simultaneously taken into account when deciding the economical digesting temperature. The current use of fossil fuels and the impact of greenhouse gases on the environment are driving research into renewable energy production from organic resources and waste. The global energy demand is high, and most of this energy is produced from fossil resources. Recent studies report that anaerobic digestion (AD) is an efficient alternative technology that combines bio-fuel production with sustainable waste management, and various technological trends exist in the biogas industry that enhance the production and quality of biogas. Further investments in AD are expected to meet with increasing success due to the low cost of available feedstock and the wide range of uses for biogas (i.e., for heating, electricity, and fuel). The objective is to achieve an efficient installation, which allows optimal use of the available resources and a progressive impact on the natural and social environment of the plant. The digestion unit is the heart of a biogas plant; this is where microbial activity takes place and organic matter is transformed to biogas. The digestion unit is composed of one or several digesters, including feeding, agitation and heating systems. A pre-digestion tank and a post-digester may complete the unit. The technological possibilities are vast, with choices depending mainly on feedstock characteristics such as dry matter content, degradation rate, and contaminant and inhibition risks. It gives an introduction to the technological options, choice parameters and engineering rules concerning biogas plant design. This chapter also looks at process control technology, used to manage and track the operations of a biogas plant. The main factors influencing each step of plant design are the composition and the amount of material that will be dealt with.

II. Problem Statement

Taking into accounts variations in the elements of climate that is change in air temperature, rainfall, etc. the climate in India classified as summer, winter and rainy. Temperature range in India during these seasons lies between 5^0C to 40^0C. Biogas generation in the biogas plant is highly depending on temperature. The effect of temperature on biogas yield from food waste was investigated experimentally in batch anaerobic reactors.. The experimental results were compared with the predicted values. The best performance was observed in digester operating at a temperature of 35-40 °C. so it is necessary to maintain the temperature in this range. Normally in Maharashtra biogas production rate decreases up to 50% in winter season and up to 35% in rainy season. Slow moving stirrer also necessary to mix the fresh waste in entire old waste. by above two problems biogas production rate can be increases at certain amount. Searching of additives is necessary to enhance the rate of fermentation.

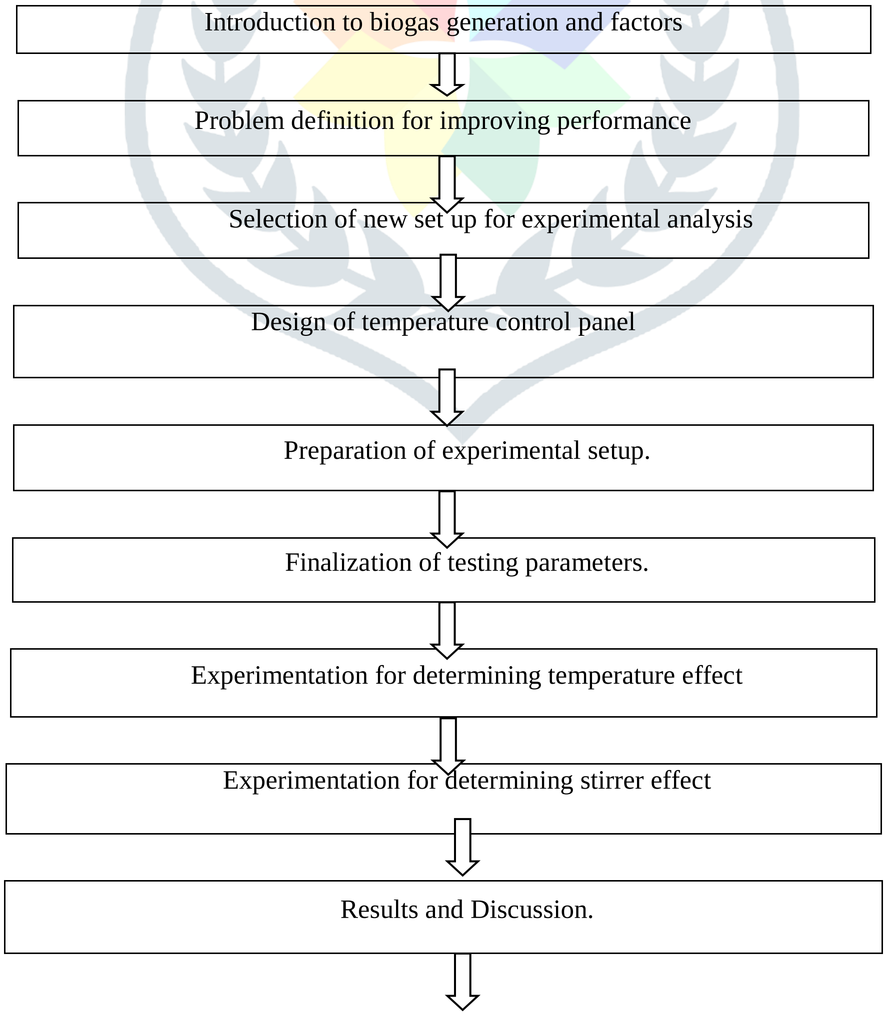
III. Objectives

Objective of solving above three problems is to develop efficient biogas plant which uses solar energy as an input. Above problems are to be solved by using renewable energy. In India at winter season many states feels the temperature below 10^0C. At such low temperature use of exist biogas plant become highly costly. So objective of this experimentation is to develop the new model of biogas plant which can be equally efficient at any environmental condition by using solar energy and additives which promote the fermentation process. So as peoples who live in cold regions like Himalayas can be preferred biogas as a source of energy.

IV. Scope

Biogas has been found to be an eco-friendly fuel which can cater all the requirements of the present scenario in India. From being an easily producible fuel to an eco-friendly one, it can be used for cooking, heating, lighting and running small I.C engines. This is eligible in fulfilling the basic needs of an Indian household to managing waste from society. Biogas is a gaseous fuel which is obtained from biomass by means of fermentation of wet organic matters. Biogas is clean as it does not release additional carbon into the atmosphere on burning and reduces greenhouse effect. Therefore it is eco-friendly and less polluting. All these factors effectively convey how biogas can become a sustainable source of energy in India. Still there are a large number of villages devoid of electricity due reasons like remote lands, rugged terrains and various other geographical reasons. The environment is also at stake as greenhouse gases, pollutants and other by-products critically impair the nature's wealth causing climate changes. Also due to population rise there is an increased demand for energy resources for national development needs stated that biomass is still being depended upon as a solid fuel for cooking (thermal efficiency 5-15%) by about 30% of total Indian population .The strategy must target on the principal seven goals to fulfill the energy demand of the population in India which are minimization of cost, maximization of efficiency, employment generation, reliability of the system, minimization of petroleum product, maximize the usage of local resource and minimization of emissions. The renewable energy sources are one of the essential for the sustainability of the globe. India is the sixth largest fossil fuel consumer. The dependence of other countries for fossil fuels creates barriers in implementing unbiased political strategies. So biogas and other renewable energy sources have their relevance. The cost factor is one of the advantages of biogas. The government is in right direction for the implementation of biogas as fuels. But India has an infinitely extensible canvas synchronizing with agricultural sector. The paper proposes the future strategies to be adopted by India for empowerment of biogas as a fuel.

1. RESEARCH METHODOLOGY



Conclusion

2. EXPERIMENTAL SETUP

A fixed-dome plant consists of an enclosed digester with a fixed, non-movable gas space. The gas is stored in the upper part of the digester. When gas production commences, the slurry is displaced into the compensating tank. Gas pressure increases with the volume of gas stored; therefore the volume of the digester should not exceed much more. If there is little gas in the holder, the gas pressure is low.

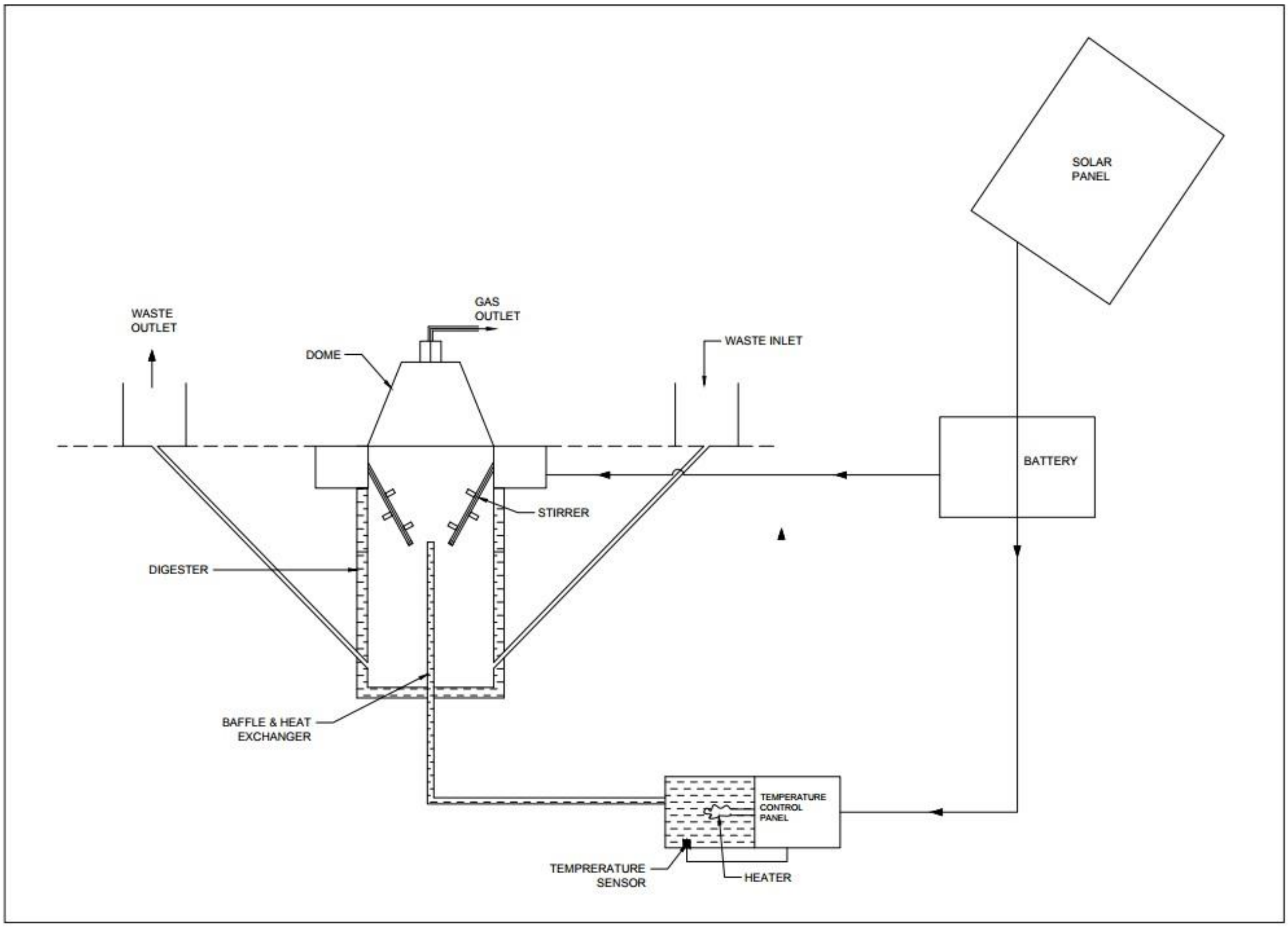


Fig2.1experimental setup

3. EXPERIMENTAL PROCEDURE FOR CALCULATIONS

When setup is ready the experimental results will be obtained after 15 days of retention period. At first day the waste material of 5 Kg feed inside the digester with standard proportion of water. After 15 days biogas formed is taken out through gas outlet. After that reading will be taken out for each day of 24 hours. Energy of biogas will be used to heat the water and amount of heat liberated through combustion of biogas can be measured by measuring the enthalpy of heated water. Consider initial temperature of water is T_1 and final temperature after heating is T_2 then heat liberated is given by,

$$Q= MC_{Pc}\,(T_2-T_1)$$

Where, T_1 = initial temperature of water.
T_2= final temperature of water.
m= total mass of water.
c_{pw}= specific heat of water.
By following this procedure for different conditions we can compare the performance of biogas plant under different conditions. Depending upon conditions readings will take out in following three steps.

3.1 When heater is off.

In these step readings is taken out when stirrer and heater is in off condition. The time given for gas generation is 24 hours and after that gas is burned to heat the water. By measuring initial and final temperature of water by using thermometer heat output will be calculated by

$$Q= MC_{Pc} (T_2-T_1)$$

Table 3.1.1 results

Sr. No.	Temperature	Time	Output value in KJ	Mass of water
1	25	24 hours	8000	50 litre

3.2 When heater is on.

In these step readings of temperature is taken out when stirrer is in off condition and heater is in on condition. The time given for gas generation is 24 hours and after that gas is burned to heat the water. By measuring initial and final temperature of water by using thermometer heat output will be calculated by

$$Q= MC_{Pc} (T_2-T_1)$$

In this step different readings will be taken at different temperature conditions of digester. By taking successive readings following observations are to be record

Table 3.2.1 results

Sr. No.	Temperature	Time	Output value in KJ	Mass of water
1	25	24 hours	8000	50 litre
2	30	24 hours	9000	50 litre
3	35	24 hours	9825	50 litre
4	40	24 hours	9970	50 litre
5	45	24 hours	9995	50 litre
6	50	24 hours	9915	50 litre

3.3 When both stirrer and heater are ON

In these step readings of temperature is taken out when stirrer and heater is in on condition. Waste feed rate for each day is keeping constant. The time given for gas generation is 24 hours and after that gas is burned to heat the water. By measuring initial and final temperature of water by using thermometer heat output will be calculated by

$$Q= MC_{Pc} (T_2-T_1)$$

Different readings will be taken at different temperature conditions of digester. By taking successive readings following observations are to be record

Table 3.3.1 results

Sr. No.	Temperature	Time	Output value in KJ	Mass of water
1	25	24 hours	8500	50 litre
2	30	24 hours	9425	50 litre
3	35	24 hours	9970	50 litre
4	40	24 hours	10070	50 litre
5	45	24 hours	10095	50 litre
6	50	24 hours	9950	50 litre

4. CONCLUSION

The results shows that as the temperature was increased the Biogas Production and Methane Was also increased, however the highest amount of Biogas Production rate and Methane Content was observed in the digester when operated between the temperature range of 35^0C to 45^0C.Mixing also plays an important role in Maintaining uniform environmental conditions for biological processes.

REFERENCES

[1]Dong-Hyun Kimetet al. Past, current and future of biomass energy research: a bibliometric analysis. Renew Sustain Energy Rev 2015;52:1823–33
[2] Chunlan Mao et al A comparative study of anaerobic digestion of acid cheese whey and dairy manure in a two-stage reactor. Bioresour Techno 1996;58:61–72.
[3] V. Siva Subramanian et alHistory and future of domestic biogas plants in the developing world. Energy Sustain Dev. 2011;15:347–54.
[4]Elvin Lobo et al Anaerobic digestion of municipal solid waste: a modern waste disposal option on the verge of breakthrough. Biomass- Bioenergy 1995;9(4):365–76.
[5] Martina Pöschl et alproduction from crop residues on a farm-scale level: is it economically feasible under conditions in Sweden. Bioprocess Biopsy's Eng. 2005;15(2):57–61.
[6] Philip Owende et al. Codigestion of manure and organic wastes in centralized biogas plants-status and future trends.ApplBiochemBiotechnol 2003;109(33):95–105.
[7] Nygaard Ivan, DembeléFilifing, DaouIbrahima, et al. Lignocellulosic residues for production of electricity, biogas or second generation biofuel: a case study of technical and sustainable potential of rice straw in Mali. Renew Sustain Energy Rev 2016; 61:202–12.