Generation of Electricity Using Campus Food Waste

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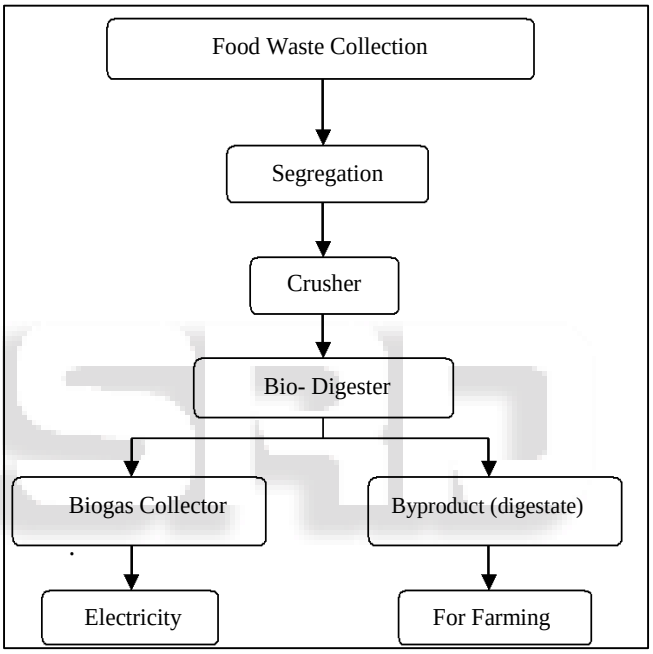
Abstract— In our institution we have one food court having there are three messes and international school have two messes. These all mess are produce large amount of kitchen waste which can be used for biogas production. Anaerobic digestion is used for biogas production. Our Project is to create an Organic Processing Facility to produce biogas which will be more cost effective, eco-friendly. It will generate renewable fuel. Kitchen waste is collect from different messes of Sanjay Ghodawat Institute. The anaerobic digestion of kitchen waste produces biogas, which consist of primary methane (CH4) & Carbon dioxide (CO2). Biogas can be used as energy source & also for numerous purposes. But, any possible applications require knowledge & information about the composition & quality of constituents in the biogas produced. For this we have made experiment on food waste potential for production of biogas & study its economical feasibility. With our calculation of 84kg, 0.84 cubic meter production of biogas is possible. With this equation electrical power of KW is possible for generation.

Key words: Biogas, Economic Evaluation, Electricity Generation, Food Waste, Methane, Solid Waste Management, Technical Evaluation

I. INTRODUCTION

Due to limited storage of petroleum & coal it threatens supply of fuel throughout the world also problem of their combustion led to research in different corners to get access the new sources of energy, like renewable energy resources. Solar energy, wind energy, different thermal & hydro sources of energy, biogas are all renewable energy resources. But, biogas is distinct from other renewable energies because of its characteristics of using, controlling and collecting organic wastes and at the same time producing fertilizer and water for use in agricultural irrigation. Biogas has not any geographical limitations. Although it does not require advanced technology for producing energy, also it is very simple to use and apply. Deforestation is a very big problem in developing countries like India. The most of the part depends on charcoal and fuel-wood for fuel supply which requires cutting of forest. Deforestation causes soil erosion due to this fertility of soil decreases. By using dung, firewood as energy is also harmful for the health of the masses due to the smoke arising from them causing air pollution. We need an eco-friendly substitute for energy. Kitchen waste having the higher calorific value and nutritive value to microbes, due to this efficiency of methane production can be increased by several orders of magnitude. It means higher efficiency and size of reactor and cost of biogas production is reduced. The disposal of food waste in an open space not only poor sanitation but also contributes to green house gases such as methane which is higher heating factor of 21 times than carbon-dioxide.[1] Biogas production of anaerobic digestion is a renewable energy source with reducing carbon emission.[2]Our campus generates about 365kg of food waste per day but for our small plant we take 84kg of food waste. To calculate the sizing of digester, the waste would require a fixed form of digester and the study assumed consists, 80% as digester capacity factor. Biogas is used in several ways such as cooking, heating and electricity generation. The plant was estimated to work for 24 hours and 365 days, considering that food waste production per day is 2kg. The power production will be around 1.55KW as per calculations.

II. FLOWCHART OF PLANT:



III. PROBLEM STATEMENT

- For steam power plant large amount of coal is required. The amount of coal available is limited in nature so these plants are not beneficial for operation & utilization all the time.
- For hydro power plants, capital cost is very high also due to short period of rainfall; they cannot be utilized all the time.
- Along with generation our social duty is survival and protection of environment.
- In urban areas we find that waste food is dumped in open place which produces methane gas. The methane gas is harmful to human health so disposal of food waste is a prime issue, which also requires transportation cost.

IV. OWN EXPERIMENT:

Our final year project group has done one experiment on our own which consist of 2kg food waste, two bottles, two balloons and water. In this we took food waste of 1kg each in two plastic water bottles, added some amount of water in it with ratio 1:1.

The food waste consisted of curry, chapatti, rice, etc. and the top of bottles were covered with the mouth of balloon. This structure was kept for 6 days without disturbing it. After 6 days we found that balloons were expanded due to gas in it.

From this experiment we came to know that gas production is possible from food waste of 2 kg and also observed the volume of gas according to the size of the balloon.

Fig. 1: First Day

Fig. 2: After Six Days

V. METHODOLOGY

A. Crusher

First we can collect the waste food from all mess which is available in our campus. The total food waste available from all mess is near about 365 KG/day, but for our small plant we take 2kg/day. The food waste is then put into crusher. As the organic waste is in various sizes, it is shredded in the crusher to form fine slurry and water is added to this shredded waste in the proportion 1:1. The fine slurry helps the bacteria to consume the organic matter efficiently and in a short period. Apart from this the fine slurry of waste is easier to digest as compared to the regular waste particles.

B. Design of Crusher

Equipments used for crusher design-

1) Stainless steel pot
2) 1phase induction motor for crushing
3) Crusher Blades

Rating of induction motor:-

1HP, single phase induction motor ,Speed- 2880rpm Stainless steel pot:-Capacity of pot- 2kg Crusher Blades:-

We used 4 blades of galvanized plating.

C. Digester:

In the absence of oxygen anaerobic digestion is a process in which microorganismbreakdown biodegradable material[3]. For energy production the methane biogas produced is suitable therefore anaerobic digestion process is considered as a renewable energy sources. The biogas is burned to produce heat and electricity.

This requires specific temperature & is done in between 14 to 40 days depending upon feedstock, number of organisms, temperature and pH value. There are many types of anaerobic digestion, but for food waste mesophilic (35^0 C) is the most suitable[4][5].Thermophilic digestion allows for faster methane extraction.

Now we can see simple construction of digester. Here the food waste from crusher is feed in digester which is mesophillic and fixed dome and kept for 21days under the temperature of 35°C to 55°C. Then the biogas is produced which contains 60% of methane, 35% of CO2 and 5% of water and hydrogen sulphide. This gas is supplied to IC engine. And the remaining from digester is given to digestate.

D. Process in anaerobic digestion:

1) Hydrolysis:-A chemical reaction where particulates are solubilized and large polymers converted into simpler monomers;
2) Acidgenesis:-A biological reaction where simple monomers are converted into volatile fatty acids;
3) Acetogenesis:- A biological reaction where volatile fatty acids are converted into acetic acid and carbon dioxide and hydrogen.
4) Methanogenesis:- A biological reaction where acetates are converted into methane and carbon dioxide, while hydrogen is consumed[6].

E. Design of Digester:

Calculations for biogas production:

1) 1KG of kitchen produces 0.1 cubic meter biogas according to experiment
2) For available kitchen waste gas production
   0.1*10 kg = 1 cubic meter
3) Active slurry volume (Vs) = HRT * 2W/100 =(21*10 * 2)/100=4.2 cubic meter

According to calculations the final dimensions of digester will be:

Height of digester = 90cm.

Diameter of digester = 60cm.

VI. ELECTRICITY PRODUCTION

1 * 19 MJ = 19 MJ

MJ to KWH = 19/3.6 = 5.277 KWH

Electricity generation = (5.277* *35) / 100= 1.846 KWH*

So total electricity generation about 1.846 KWH.

VII. CONCLUSION

From our college campus 84kg per day of food waste KW of electricity is generated. Its physical and chemical composition makes it a suitable substrate for biogas production. When conducting the AD, food waste needs to be crushed in small particles to achieve maximum biogas production. It has several benefits such as organic manure and carbon credits. Besides this, the project has other benefits which could not be calculated in this evaluation such as reduction in air, land and water pollution.

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