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Mini Biogas Plant Using Kitchen Wastes

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ABSTRACT
In our institute, we have a big Canteen, where daily a large amount of kitchen waste is obtained which can be utilized for better purposes. Biogas production requires anaerobic digestion. The project was to create an Organic Processing Facility to create biogas which will be more cost effective, eco-friendly, cut down on landfill waste, generate a high-quality renewable fuel, and reduce carbon dioxide & methane emissions. Overall by creating biogas reactors on campus in the backyard of our hostels will be beneficial. Kitchen (food waste) was collected from College canteen of D Y Patil Knowledge City, Pune.

Mess as feedstock for our reactor which works as anaerobic digester system to produce biogas energy. The anaerobic digestion of kitchen waste produces biogas, a valuable energy resource anaerobic digestion is a microbial process for the production of biogas, which consists of primarily methane (CH4) & carbon dioxide (CO2). Biogas can be used as energy source and also for numerous purposes. But, any possible applications require knowledge & information about the composition and quantity of constituents in the biogas produced. The continuously-fed digester requires the addition of sodium hydroxide (NaOH) to maintain the alkalinity and ph. to 7. The rate of production can be determined at laboratory scale using the simple digester.

Keywords*: *Anaerobic Digestion, Kitchen Waste, Biogas.

1. INTRODUCTION

Due to the scarcity of petroleum and coal, it threatens supply of fuel throughout the world also problem of their combustion leads to research in different corners to get access the new sources of energy, like renewable energy resources. Solar energy, wind energy, different thermal and 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 does not have any geographical limitations nor does it requires 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, most of the part depends on charcoal and fuel wood for fuel supply which requires cutting of forest. Also, due to deforestation, it leads to decrease the fertility of land by soil erosion. Use of dung, firewood as energy is also harmful to 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 is an organic material having the high calorific value and nutritive value to microbes, that's why the efficiency of methane production can be increased by several orders of magnitude as said earlier. It means higher efficiency and size of reactor and cost of biogas production is reduced. Also in most of cities and places, kitchen waste is disposed in a landfill or discarded which causes the public health hazards and diseases like malaria, cholera, typhoid. Inadequate management of wastes like uncontrolled dumping bears several adverse consequences: It not only leads to polluting surface and groundwater through leachate and further promotes the breeding of flies, mosquitoes, rats and other disease-bearing vectors. Also, it emits unpleasant odor & methane which is a major greenhouse gas contributing to global warming.

Anaerobic digestion is a complex biological process in which microorganisms break down biodegradable organic matter i.e. Cattle manure, kitchen waste, sewage sludge, poultry dropping, agriculture residues and other organic garbage in the absence of oxygen and thus produced biogas. Anaerobic digestion is controlled biological degradation process which allows efficient capturing & utilization of biogas (approx. 60% methane and 40% carbon dioxide) for energy generation. Anaerobic digestion of food waste is achievable but different types, the composition of food waste results in varying degrees of methane yields, and thus the effects of mixing various types of food waste and their proportions should be determined on a case by case basis.

Anaerobic digestion (AD) is a promising method to treat the kitchen wastes. While anaerobic digestion for treatment of animal dung is common in rural parts of developing countries, information on technical and operational feasibilities of the treatment of organic solid waste is limited in those parts. There are many factors affecting the design and performance of anaerobic digestion. Some are related to feedstock characteristics, the design of reactors and operation conditions in real time. Physical and chemical characteristics of the organic wastes are important for designing and operating digesters because they affect the biogas production and process stability during anaerobic digestion. They include moisture content, volatile solids, nutrient

2. OBJECTIVE

1. To increase the renewable energy production from biogas with small-scale concepts for energy self-sufficiency.
2. To reduce greenhouse gas emissions due to the consumption of renewable energy sources and to the adequate waste management.
3. To increase governmental support to biogas technology by new

4. Regulations on energy self-sufficiency with net balance.

3. MATERIAL AND METHODS

A) **Inlet:** This consists of a receptacle for the raw fresh organic waste and pipe of at least 10 cm diameter leading to the digester. The connection between the inlet pipe and the digester must be air tight.

B) **Digester:** This is the reservoir of organic wastes in which the substrate is acted on by anaerobic microorganisms to produce biogas.

C) **Gas Storage /Reservoir:** Depending on the proposed design, this may be simply an empty but enclosed space above the slurry in the digester

D) **Exhaust outlet:** This consists of a pipe connected to the digester at an a\ lower level than the inlet pipe to facilitate outflow of the exhausted slurry.

Fig-1: Model of biogas Digester

3.1 Methods

Biogas can be obtained from any organic material after anaerobic fermentation by four main phases. The fermentation of organic wastes under anaerobic conditions to produce biogas occurs in the following four stages as illustrated in Figure

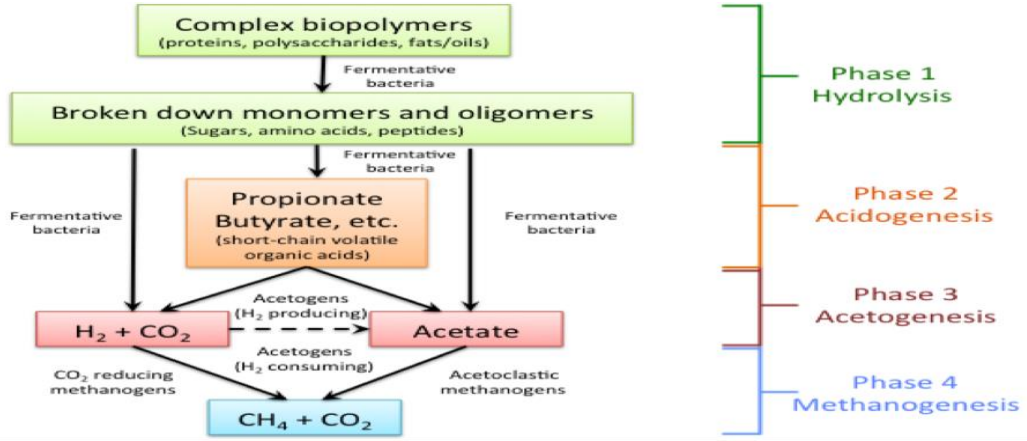

Fig no.2: Fermentation of organic wastes under anaerobic conditions

3.1.1 Hydrolysis

In the first step, the organic matter is enzymolysed externally by extracellular enzymes, cellulose, amylase, protease & lipase, of microorganisms. Bacteria decompose long chains of complex carbohydrates, proteins, & lipids into small chains. For example, Polysaccharides are converted into monosaccharide. Proteins are split into peptides and amino acids.

3.1.2 Acidification

Acid-producing bacteria involved in this step, convert the intermediates of fermenting bacteria into acetic acid, hydrogen and carbon dioxide. These bacteria are anaerobic and can grow under acidic conditions. To produce acetic acid, they need oxygen and carbon. For this, they use dissolved O2 or bounded-oxygen. Hereby, the acid-producing bacterium creates an anaerobic condition which is essential for the methane producing microorganisms. Also, they reduce the compounds with low molecular weights into alcohols, organic acids, amino acids, carbon dioxide, hydrogen sulfide and traces of methane. From a chemical point, this process is partially endergonic (i.e. only possible with energy input), since bacteria alone are not capable of sustaining that type of reaction.

3.2.3 Methanogens

(Methane formation) Methane-producing bacteria, which were involved in the third step, decompose compounds having low molecular weight. They utilize hydrogen, carbon dioxide and acetic acid to form methane and carbon dioxide. Under natural conditions, CH4 producing microorganisms occur to the extent that anaerobic conditions are provided, e.g. under water (for example in marine sediments), and in marshes. They are basically anaerobic and very sensitive to environmental changes if any occurs. The methanogen bacterium belongs to the archaebacteria genus, i.e. to a group of bacteria with heterogeneous morphology and lot of common biochemical and molecular-biological properties that distinguishes them from other bacteria. The main difference lies in the makeup of the bacteria's cell walls

5. COMPOSITION OF WASTE IN DR D Y PATIL SOET COLLEGE CANTEEN

Table-1: **Composition of kitchen Waste**

(A) Uncooked fruits & vegetables	(51%)
(B) Cooked meat	(16%)
(C) Uncooked meat	(15%)
(D) Bread	(2%)
(E) Tea waste	(5%)
(F) Eggs	(6%)
(G) Cheese	(3%)
(h) Paper	(2%)

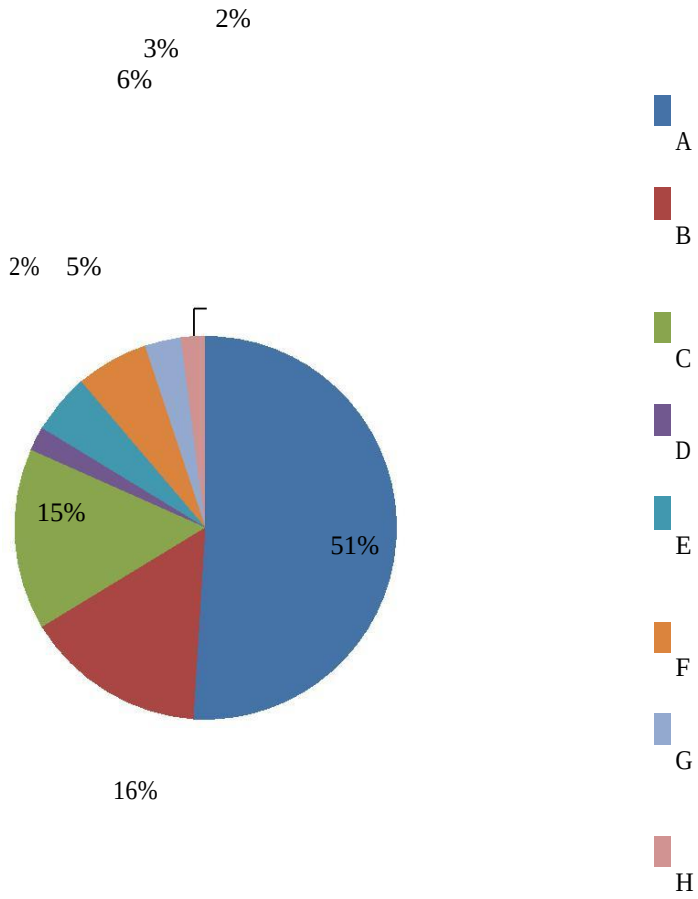

Fig-3: Composition of kitchen waste

6. METHODOLOGY FOR BIOGAS SYSTEM

A typical biogas system consists of the following components:

1.Manure collection

Fig-4: **Manure Collection**

2. Anaerobic digester

Fig-5: **Anaerobic Digester**

3. Effluent storage

Fig-6: Effluent Storage

4. Gas handling

Fig-7: **Effluent storage**

5. Gas use

Biogas is a renewable form of energy Methanogens (methane producing bacteria) are the last link in a chain of microorganisms which degrade the organic material and returns the product of decomposition to the environment.

RESULT AND DISCUSSION

- **Results Obtained For Total Solids**

Table-2

Wt. of crucible	Wt. of crucible after 105º C (In gm.)	Wt. of crucible after 500º C (In gm.)
34	34.07	34.026
38	38.07	38.056

Table-3

Total solids (in mg/lit)	Total dissolved solids (in mg/lit)	Total volatile solids (in mg/lit)
1470	900	560
1470	540	800

- Total solids found in test samples are 1470 mg/lit.
- Total dissolved solids found in test samples are 900mg/lit and 540mg/lit.
- Hence average dissolved solids found in samples are 720mg/lit.
- Total volatile solids found in test samples are 560mg/lit and 800mg/lit.
- Hence average volatile solids sound in test samples are 680mg/lit.

- **Results Obtained For Alkalinity**

Table-4

Sample 1 (in mg/lit)	Sample 2 (in mg/lit)
600	560

Hence average alkalinity is 580 mg/lit.

- **pH of the sample**

The average pH of the sample found is to be 5.5

8. CONCLUSION

India's energy problems have made the need to turn towards waste-to-energy technologies extremely important, especially because landfills in India's urban centers are fast nearing the limits of their capacity. Kitchen waste based biogas plants will actually help in improving rural health and Environment. In addition, these plants will play an important role as a source of bio-energy and a safe, desirable organic manure of very high quality
The characterization of kitchen waste collected from two canteens in the Dr. D Y Patil School of engineering and technology campus will help to produce biogas i.e methane which is further used by the college canteen for the preparation of food.

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