PRODUCTION OF BIOGAS THROUGH SMART WASTE MANAGEMENT BY CHEMICAL DIGESTERS

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Abstract: The conversion of kitchen waste into naturel energy by adding some chemical digesters. In kitchen waste the organic material of high nutritive and calorific values, the composting or other reuse of bio-degradable waste such as food or garden waste is also considered for recycling. Keep the kitchen waste in, crush containers, and recycle.The digestion of the kitchen waste produces biogas, anaerobic digestion is a microbial process for production of biogas, and Biogas consists of gases like methane and carbon dioxide. And With the help of bio-gas we produce heat and electricity and it can be used as fuel. Biogas can be produced from raw material such as agricultural waste, manure, municipal waste, plant material, sewage, green waste or food source. It can also be used in a gas engine to convert the energy in the gas into electricity and heat. This process is economically cheaper.

Index Terms **- Anaerobic digestion; Biogas; chemical digester; kitchen waste**

I. INTRODUCTION

In our college of engineering there are two individual canteens and both having their own individual mess, our project is to create a biogas which will be eco-friendly, more cost effective. Daily large amount of kitchen waste is obtained from our mess, it can be utilised for better purpose of producing biogas, Biogas can be used as high quality renewable fuel, by placing a biogas reactor on campus, and it will be beneficial. Kitchen waste will be collected from individual messes for the reactor to produce biogas energy. The digestion of the kitchen waste produces biogas, anaerobic digestion is a microbial process for production of biogas, Biogas consists of gases like methane and carbon dioxide, and it can be used as energy source. In kitchen waste the organic material consist of high nutritive value and high calorific value, so the efficiency of methane is high. So the cost of the biogas production is low.

In our country deforestation and pollution was very big problem, most of the people uses charcoal and wood as fuel or to produce energy. It leads to deforestation, it also damages soil erosion, dung and fire wood also leads to pollution by producing smoke, Coal and petrol are also used to produce energy, but they are non-renewable and damages the environment, Renewable energy sources like solar energy, wind energy, thermal energy, hydro source and biogas are all renewable energy resources.

In most cities and places, Kitchen waste is disposed in landfills or discorded which causes the health hazards and diseases like malaria, typhoid. It not only leads to polluting surface and ground water, it further leads to breeding of flies and mosquitoes, rats and other diseases. From this it emits bad smell and methane. It is a major greenhouse gas.

By using cattle dung, municipal solid waste (MSW) or sewage in biogas plants, we can make this system very efficient by using kitchen waste or food waste. Biogas has different characteristics, at the same time organic waste can be used as fertilizer and water for use in Agriculture irrigation. It does not require any advance technology to produce energy, it is very simple to use. We need eco-friendly energy.

1. BIOGAS

BIOGAS: Biogas is a renewable source, like wind energy, solar energy, thermal energy, hydro energy. It is eco-friendly and clean. It is used to produce lighting, heating and generation of electricity and also used as fuel for cooking. Biogas is formed under the condition of anaerobic, this process is known as anaerobic digestion, and the digester would produce fertilizer and methane, biogas consist of some gases like methane (CH4), carbon dioxide (CO2), water (H2O), hydrogen sulphide (H2S), ammonia, nitrogen, oxygen, hydrogen. Biogas can be formed by using the cow manure, buffalo manure, pig manure, kitchen waste, municipal waste, agriculture waste. Biogas is produced under the absence of oxygen.

1.1 Composition of biogas

Compound	Formula	Percentage (%)
Methane	CH4	50-75
Carbon dioxide	CO2	25-50
Nitrogen	N2	0-10
Hydrogen	H2	0-1
Hydrogen sulphide	H2S	0.1-0.5
Ammonia	NH3	0-0.05

1.2 Applications of Biogas:

- Biogas can be used for production of electricity.
- It also used for cooking and heating purpose.
- It can be replace compressed natural gas for use in vehicles.

1.3 Characteristics of biogas:

- Biogas characteristics are depends upon the temperature and pressure.
- Change in volume and calorific value as a function of temperature and pressure.
- Change in calorific value also depends upon water content.
- Change in the value of temperature and pressure, it differs the water vapour content.

2. Literature Review:

Oliveira.F, Doell.k conduct an experiment on production of biogas, and they observed that in the United States, more than 40% of food is wasted during the crop, production. Oliveira experiment is to digest the food waste and recover the energy. The important factors to be consider is loading rate, temperature, time, gas ratios. He found that biogas is formed from the organic matters like agriculture crops, wastes, plants, municipal waste, and kitchen waste. From these some gases like methane, hydrogen and carbon dioxide are released due to anaerobic digestion process. He observed that food waste is highly desirable feedstock for anaerobic digestion, due to its nutrient content and methane yield.

Xiguangchen, ruihong zhang they investigated five types of feedstock for a potential anaerobic digester system, they are soup processing plant, a cafeteria, a commercial kitchen, a fish farm, and grease trap collection service. They mix the food waste individually and conduct a mesophilic (35%) and thermophilic (50%) temperature and two foods to microorganism ratios of 0.5

and 1.0 for 28ndays. In this test they found fish and grease trap wastes required longer time and produce high biogas than other wastes. They mixes sodium hydroxide to maintain PH level constant. It is necessary to use to maintain PH level.

H.Bouallagui makes an experiment on mesophilic biogas production from fruit and vegetable waste in a tubular digester. He tested for the conversion of fruit and vegetable waste into biogas. He varies the hydraulic retention time between 12 and 20 days, but he found that no effect on fermentation stability and PH remained between 6.8 -7.6. But he observed bacteria below 12 days. After completion of 20 days in tubular digester 75% of fruit and vegetable waste is converted into biogas and 64% of methane content was achieved.

Salma a Iqbal made an experiment on the kitchen waste to produce biogas, he observed that kitchen waste consist of high biodegradability, calorific value and co-digestion of cow manure. He took three digesters and they were prepared to observe the individual degration rate of kitchen waste and cow manure and co-digested kitchen waste with cow manure at room temperature 37°c. He observed that mixture of kitchen waste and cow manure are higher than kitchen waste and cow manure alone. The prime object of this work was to investigate the prospect of kitchen waste for biogas production.

3. Types ofdigestion process:

There are two types of digestion process,

- Aerobic digestion
- Anaerobic digestion

Aerobic digestion: The digestion process occurring in the presence of oxygen is called Aerobic digestion.

Anaerobic digestion: The digestion process occurring in the absence of oxygen is called anaerobic digestion.

3. Methods and calculations

Analytical methods and calculations:

1) Total Solids (Ts %) - It is the amount of solid present in the sample after the water present in it is evaporised.

The sample, approximately 10 gm. is taken and poured in foil plate and dried to a constant weight at about 1050C in furnace.

TS % = (Final weight/Initial weight) *

2) Volatile Solids (Vs %) – Dried residue from Total Solid analysis weighed and heated in crucible for 2hrs at 500 0C in furnace. After cooling crucible residue weighed.

VS % = [100-(V3-V1/V2-V1)] * 100

V1= Weight of crucible.

V2= Weight of dry residue & crucible.

V3= Weight of ash & crucible (after cooling)

3) Volatile Fatty Acid (VFA) - Volatile fatty acids (VFA's) are fatty acids with carbon chain of six carbons or fewer. They can be created through fermentation in the intestine. Examples include: acetate, propionate, and butyrate. There are many titration method for VFA measurement. Here two methods are used for VFA measurement.

Method 1

1. Take 100 ml sample in beaker

2. Filter the sample.

3. Check pH of filtrate.

4. Take 20 ml of filtrate and add 0.1M HCl until pH reaches 4

5. Heat in the hot plate for 3 mins

6. After cooling titrate with 0.01M NaOH to take pH from 4 to 7.

7. Amount of HCl & NaOH recorded

Total VFA content in mg/l acetic acid = (Volume of NaOH titrated) * 87.5

4. EXPERIMENT:

Software

1. Arduino board
2. Relay
3. Ultrasonic sensor

4. Ribbon wires

Hardware

1. 750watt DC motor
2. 12v DC geared motor
3. 20liters water tin
4. Upvc pipes
5. Tubes and tyre

Chemical - bioharz digester

6. Result and Conclusions:

In our daily life we are wasting so much of food or kitchen waste, which can be used in other way to produce energy like biogas. Our project is designed with new ideology, it consist of three sections made up of iron tins and 750watt DC motor and upvc pipes, and it also consists of software parts like relay, ultrasonic sensor, Arduino board.

At first kitchen waste is dumped into the first section when it is filled up to 75% the ultrasonic sensor detects the distance and transfer the signal to Arduino board, In Arduino board the program has developed to work the sensor. Relay receives the signals from the mother board and acts like switch to pass the signals for the motor, Then motor stars working. The motor was connected to the plate under the first section, when the sensor passes the signal the motor rotates and plate moves to downwards. All the kitchen waste that dumped in the first section falls into the second section. The plate will open till 1 minute, after one minute the plate will close automatically.

In second section, after dumping the waste from first section the plate will close back. In second section the motor is placed and a small water inlet is allowed to mix the water with the kitchen waste. After closing the plate motor starts automatically, on the other side water is allowed. Then kitchen waste and water mixes each other. Water helps us in fast digestion of waste. After grinding of waste it is passed to third section through small valves. In third section, the waste pit is collected. Again the liquid waste is passed to the small container of 20 liter tin through pipes.

A 20 liter tin is coated with black colour so it can observe the sun light, it is helpful in the digestion process. To the waste pit we added a chemical called Bioharz which helps us in the fast digestion of kitchen waste, to the tin a small inlet and outlets are fixed to pass the waste and to collect the waste after completion of the process. At the top of the tin a small hole is made to fix the tube, to pass the gas through it. To that tube a three way valve is fixed, one side of the valve is fixed to the outlet valve where we collect the biogas, on the other side of the valve a pipe is fixed to the storage tube, where we want to store the gas for some days.

At first day of the biogas production 80 ml of gas is formed, on the second day of the production 150 ml is formed. On the increasing days the production also increases for some level, but after reaching maximum level production of gas decreases. On the third day 120 ml of gas is produced, on the fourth day 50 ml of gas has formed and it is constant to sixth day. Then pass little amount of water through the valve it helps in the digestion process and makes the PH level of gases constant. On the sixth day 60 ml of gas is formed, on seventh day 90 ml of gas had formed, on eighth day 115 ml of gas had formed. Out of 100% of the process, only 70% of the gases is retrieved.From my experiment I am able to produce around 10 lit of biogas daily in a 20 liter digester.

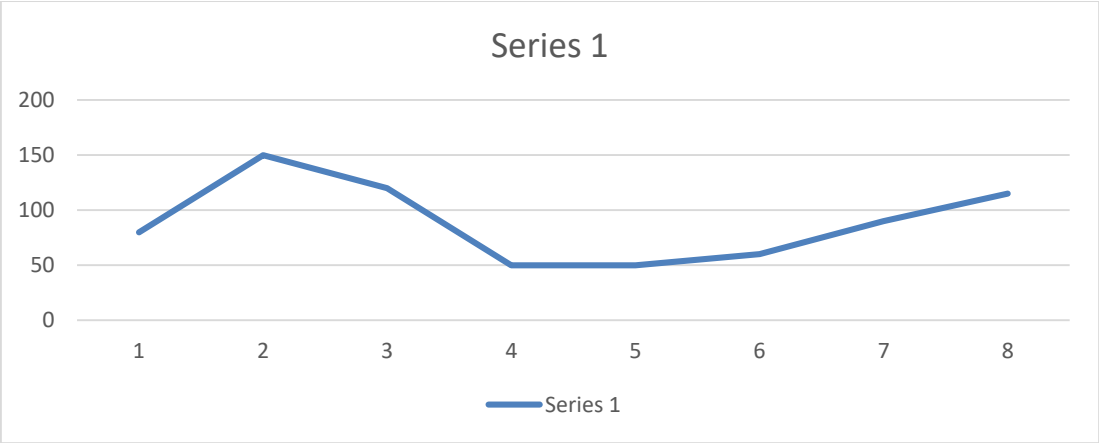

Fig. 6.1. Production of biogas in ml/day

Future scope:

According to our purpose of our project we can design a big reactor and produces high amount of biogas and use as a fuel in industries to run the machines, and also produces the electricity.

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