PRODUCTION OF BIOGAS FROM KITCHEN WASTE

[1]S. Sharada, [2]Mr. G. Surendra Babu, [3]K.Hema Latha

Chemical Engineering
JNTUA College of Engineering, Ananthapuramu

***ABSTRACT*: Due to the increasing demand for fossil fuels and environmental threat, a number of renewable sources of energy have been studied. Considering the present scenario there is a peak demand for energy in our country. An attempt is made to assess the suitability alternate fuel like Biogas production from kitchen waste by anaerobic digestion was investigated.In our JNTUA College, we have 7 hostels and the problem of kitchen waste management is highly inefficient. The problems can be met with a residual clean energy output in the form of biogas through a portable digester which can be installed from minimum resources. An original digester design is adopted in building a lab scale 20 L biogas plant. The digester consists of inclusions like inlet, outlet, gasline. Initially cow dung (inoculum) was added. After initial gas production, cow dung was co digested with food waste. Main ingredients of the food waste included rice, vegetables, banana peels etc., The kitchen waste had slightly higher solids and volatile solids (9.3% and 94.9%) content compared to cowdung (8.5% and 93.1%).**

***Key Words*: Anaerobic Digestion, small scale digester design, kitchen Waste, Biogas yield.**

1. 0 INTRODUCTION

India is world’s eleventh largest energy producer currently and accounts for nearly 2.4% of the world’s total energy production . Due to scarcity of petroleum and coal it threatens supply of fuel throughout the world also problem of their combustion leads to research in the new sources of energy, like renewable energy resources. Solar energy, wind energy, different thermal, hydro sources of energy and biogas are all renewable energy resources.[1]

1.1 BIO GAS

The origin of biogas starts from l0th century in Assyria for heating bath water. In 17th century that flammable gases could evolve from decaying organic matter. The first digestion plant was built at a leper colony in Bombay, India in 1859. [2] Biogas typically refers to a gas produced by the biological breakdown of organic matter in the absence of oxygen. Biogas can be produced from different sources like cattle dung, agricultural waste, sewage sludge, kitchen waste, biomass etc.

Fig.1: Different sources for biogas production[5]

Table.1: composition of biogas [1]

Type of gas	% in the mixture by volume
Methane	50–80
Carbon dioxide	15–45
Water	5
Other gases including hydrogen	0–1
Hydrogen sulphide	0–3

1.2 PROPERTIES OF BIOGAS:

1. Change in volume as a function of temperature and pressure.
2. Change in calorific value as function of temperature ,pressure and water vapour content.
3. Change in water vapour as a function of temperature and pressure[7]

1.3 KITCHEN WASTE

Kitchen waste is organic materials having the high calorific value and nutritive value to microbes, which increases the efficiency of methane production. Food waste is any food substance raw (or) cooked , which is discarded in the hotels. Food waste ia an untapped energy source that mostly ends up rotting in land fills , there by releasing green house gases in to atmosphere which causes diseaseslike Cholera, Malaria, Typhoid. Hence a proper kitchenwaste management strategy needs to be devised to ensure its eco-friendly and sustainable disposal.[6]

2.0 ANAEROBIC DIGESTION

Anaerobic digestion is a process where bacteria breakdown organic matter, such as manure, in the absence of oxygen. The anaerobic digestion process generates biogas that is composed mostly of methane, which can be used as an energy source (e.g., heat or electricity generation). A wide range of micro-organisms are involved in the anaerobic process which has two main end products : biogas and digestate. Digestate is the decomposed substrate ,rich in macro and micro nutrients and therefore suitable to be used as plant fertiliser.[3]

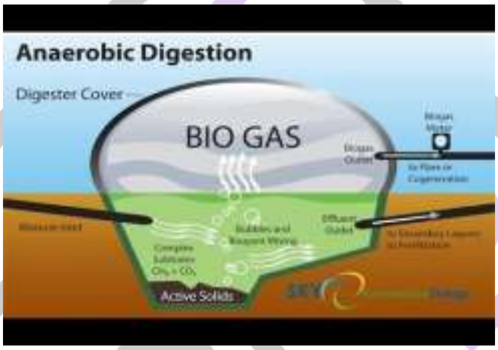

Fig.2: Anaerobic digestion

This anaerobic digestion broadly consists of three phases:[4]

- Hydolysis
- Acetogenesis
- Methanogenes(Shefali & Themelis)

3.0 MATERIALS AND EXPERIMENTAL SETUP

3.1 MATERIALS REQUIRED

- Empty water can 20 L capacity-1(Digester)
- M-seal
- Gas collecting tube
- Pvc pipes of ¾ in -3
- T- shape valve
- Level pipe(4 m)

3.2 DESIGN PROCEDURE

- A plastic can of 20 L capacity coated with black paint is used as a digester.
- A PVC pipe of 50 cm length was joined with one of the hole made on the top of the digester, which acts as an inlet system.
- A slurry outlet pipe of 15 cm length was connected at one of the side of a digester.
- A level pipe was attached on the top of the digester containing provision, and other end is connected to gas collecting tube.

Fig.3. Experimental Setup

3.3 PREPARATION OF INOCULUM

The inoculum was made on 4th March 2016. Fresh cow dung was used to inoculate. 5 kg of cow dung was weighed and was taken in a tub. 8 litres of tap water were added and homogenized nicely to make fine slurry. The slurry was dumped in to digester and the digester was kept aside for a week. The temperature was kept at a range of 40-45°c.

4.0 EXPERIMENTAL PROCEDURE

Kitchen waste from the hostel was brought on 11th March 2016. The waste was brought in a plastic container. The food waste was physically assessed and was found to consist of the following mixture : cooked rice , vegetables like tomoto, carrot, onion ,banana peels. The food waste was mixed with water used for rice washing to make fine slurry. Fresh sample was taken for physico chemical analysis. The slurry was poured in to the digester and it is kept air tight. Care was taken to prevent any leaks.

5.0 FLAMMABILITY TEST:

The Biogas produced experimentally is measured carefully. After the measurement of gas produced it undergoes the Flammability test. If we kept the lightening match stick near the ball valve in which gas is coming out, it burns vigorously with high flame . This indicates that the produced gas contains high amount of methane

Fig .5: Vigorous burning of flame

5.0. BIOGAS YIELD

After the digester was operated for several weeks after the initial filling, the pH value had reached the stable value that remained constant during the period of sampling. The temperature is constant between 38-45°c during the day and 35-40°c during the night. Therefore, those two parameters were considered as the constants with respect to the model development.

TABLE.5 : % OF TYPES OF SOLIDS PRESENT IN THE FEED.[8]

Type of feed	Total solids (%)	Volatile solids(% of Ts)	Amount of slurry
Cow dung	5	70	13 kgs
Kitchen waste	4.75	80	0.2 kgs

5.1.1TOTAL 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 a crucible and dried to a constant weight at about 105 0C in Hot air oven.

TS % = (Final weight/Initial weight) * 100

5.1.2.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)

5.1.3.Biogas produced Experimentally

The biogas produced experimentally is given by the difference between the final weight of the gas collecting tube and the Initial weight of the gas collecting tube.

The Biogas produced experimentally is about 0.462 m^3.Therefore the biogas produced from kitchen waste is given by the difference between the total biogas produced to the gas produced from cow dung. Thus, the biogas yield is 0.101 m^3/kg volatile solids from kitchen Waste slurry.

6.0 CONCLUSIONS

The study evaluates biogas production from food (rice,vegetable peelings, banana peelings) waste through an anaerobic digestion of 20L capacity designed and built in the lab. In the duration of 30 days, biogas production started from the 10th day. The total amount of gas production recorded up to 30 days.

Food waste getting converted into biogas not only becomes an alternative source of energy but also burning the biogas helps in reducing the methane production from organic waste which is one of the green house gases. From our study it is evident that food waste can become a good feedstock for the biogas production. Food waste contains more biodegradable solids (9.3%), with higher volatile solids (94.9%) than cow dung. Increase in moisture content of the digestive was 4.75%. 12% decrease in VS was observed after 30 days. Since food waste contains 83.7% VS, it thus has a great potential of biogas production and can be used easily and potentially as a raw material for biogas production. The volatile solids finally reduced to 80%.

Thus Biogas produced from the kitchen waste is higher than the biogas produced from the cow dung.

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