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BIOGAS PRODUCTION USING KITCHEN WASTE

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ABSTRACT : *This paper is on the Biogas plant production which is produced from food waste and kitchen waste which includes methane and carbon dioxide which is alternative for LPG. Kitchen waste is the best alternative for production of biogas. Around 55-65% methane and 30-40% carbon dioxide is involved in production of biogas. The gas generated is used in power generation as well as the digested slurry is utilized as organic manure in the garden. The waste material can be disposed off efficiently without any odor or flies. The biogas plant from kitchen waste is installed at Nursery site for environmental friendly disposal. Such biogas plants can process out of waste generated in canteens. Biogas plant works on the principal of traditional gobar gas plant. This system is self-sustainable and effective.*

KEYWORDS- Slurry, Organic manure, methanogen, digester

I. INTRODUCTION

Biogas is produced from organic waste by anaerobic decomposition from various groups of anaerobic bacteria. Anaerobic decomposition includes two stage processes. In first process the acidic bacteria is decompose into different organic molecules like peptides, glycerol, alcohol and sugar. At second stage the bacteria converts this molecules into methane. Day by day there is increase in green house gases like CO_2 in environment. To improve the efficiency alternative fuels are used for the production of energy.

The performance of greenhouse integrated biogas plant was analyzed with their basic aim to reduce thermal loss to ambient in harsh and climate[1].As in cold climate there is low temperature so there is degradation in production of biogas, so to increase the biogas production higher digester temperature is required. It has been suggested that the rate of biogas production and the period to achieve the optimum temperature are the function of temperature of slurry [1]. Biogas is considered to be a kind of efficient and & renewable energy after cleaning Sulphur through physical, chemical and biological methods such as absorption and bioreactor, which can be used to cook, heat, light and generate power and thus reduce dependency of fossil fuel [1]. The slurry and residues from biogas process can be used as an organic fertilizer to replace the use of chemical fertilizer on the farm [2]. In China there is use of biogas in more number.

1.1 Process of producing biogas

The whole process includes anaerobic digestion for production of biogas. In this process acetic acid form bacteria and methane form archea are fed into digester [3]. The organic material is derived from the oxygen source. The intermediate are converted into products of methane, carbon dioxide and trace level of hydrogen. In anaerobic system, the majority of chemical energy is released by methanogenic bacteria as methane [3]. To be fully effective, population of anaerobic microorganisms typically takes some period of time to establish. [3]. so a process known as "Seeding Digester" is introduced by this anaerobic microorganisms.

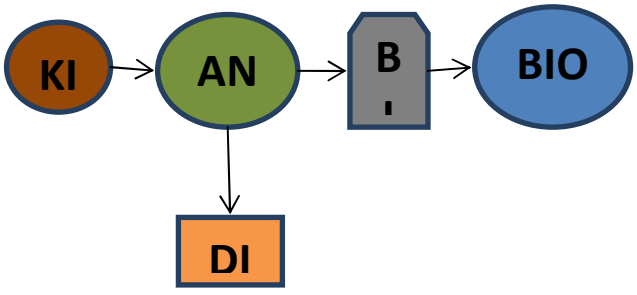

Fig No. 1: Anaerobic Digester

1.2 Production Process

The production includes following components:

1. Manure collection(Kitchen Waste)
2. Anaerobic waste
3. Effluent storage
4. Gas Handling
5. Gas Use

Biogas is renewable form of energy which returns the product of decomposition to environment by degrading organic material.

II. DESIGN :

The dimension of biogas depends on the thermal energy to be produced it is intended to replace a part of LPG gas; the energy equivalent for 1 cylinder of LPG is calculated:
Equivalent with LPG
Caloric value LPG=50 MJ/kg
One cylinder weight=14.2kg
Therefore, net energy of one cylinder=14.2 x 50MJ
The net Energy in 1 cylinder=710MJ
The energy available In 1 m^3 plant in one month
Biogas contains about 60% methane
Density of methane at NTP=0.668 kg/m^3
Therefore, caloric value of methane
=55 x 0.668
=36.74 MJ/m^3
Methane being the only major source of heat
Calorific value of biogas=0.6 x 36.74 MJ/m^3
=36.74MJ/m^3
Methane being the only major source of heat
Calorific value of biogas=0.6 x 36.74 MJ/m^3
= 22.044 MJ/m^3
A Plant of 1 m^3 capacity 0.7 $m^3$of gas per day
Net energy in 0.7 m^3 of biogas= 0.7 x 22MJ
Net energy in 0.7 biogas=15.4mV
Assuming that efficiency of a biogas store & LPG store is the same
Energy provided per month=15.4x 30
Energy provided per month=462 MJ
Therefore Biogas plant of 1 m^3 capacity is equivalent 65% of an LPG cylinder per month.

III. CONSTRUCTION OF MINI-BIOGAS PLANT

Biogas Plant-

- The Biogas plant consists of digester tank in which the organic material is stored and microorganisms work on them and released the gas.
- The gas is collected in gas collector.
- A guide pipe is used to move slurry up and down from gas collector to inside the digester tank.
- The digested slurry is drained out of the pipe which is further used as fertilizer for plants.
- The gas is utilized for cooking and lighting which is passed by gas pipeline from gas collector.[4]

Step 1: Selection of Tank
Before selecting any tank you need to consider how much amount of kitchen waste is produced daily for feeding the tank.
If you collect around 3.5 to 4 kg wastes daily then 700 to 800 liter capacity tank is sufficient to use as a digester tank.
For mini biogas plant you need to build floating type gasholder tank that means gas will move up and down based on the amount of gas inside. So the gas holder tank should fit inside the digester and should have minimum difference between their widths as this will reduce loss of gas through the sides.
Step 2: Other material required
Following PVC parts are used:

- PVC door elbow 120mm dia one number for feeding waste.
- PVC pipe 50mm dia 300mm long fitted with digester for slurry outlet.
- PVC pipe 32mm dia 250mm long 4 pieces to be fitted with digester for guide system.
- PVC pipes 32mm dia 1000 mm long 4 pieces for guide system.
- PVC pipes120mm dia one piece to be used for guide system and stabilizing gas tank.
- PVC pipes 120m dia one piece to be used for waste feeding.
- PVC cap 120mm dia for waste feed pipe
- PVC pipe 50mm dia about 5 meters for slurry outlet system.
- PVC 32mm dia threaded couplers 4 pieces to be fitted with gas tank for guide system
- PVC 32mm dia plain couplers 4 pieces to be fitted with digester for guide system
- PVC elbow reducer32 mm to 12mm 4 pieces for the guide system [4].

Step 3: Adhesive used
For joining gas plant parts following adhesives are used:
Araldite Epoxy Adhesive
M-Seal Epoxy compound
PVC Solvent Cement.
Step 4: Tools required
A hacksaw with frame
A single sided hacksaw blade
A sharp knife
A medium size hammer
Set of spanners to tighten the gas pipe connectors.

Step 5: Preparation of gas Holder tank
The 500 liter capacity tank is cut at the top.
Step 6: Preparation if Digester Tank
The top of the digester tank also needs to be cut and while its width needs to be considered for free movement of gas tank.
Step 7: Fixing the feed pipe to the digester tank
The 1220mm dia elbow is fixed at the bottom of the digester tank.
Step 8: Fixing slurry outlet pipe with the digester tank
The 50mm dia 300mm long pipe is used to fit at the top of digester for slurry outlet.
Step 9: Fixing the guides over the digester for the movement of gas holder tank.
Some sort of guide movement should be provided for easy up-down movement of gas holder tank. For this purpose 250mm long 32mm dia pipes are used.

Step 10: Providing guide support on the gas holder tank
In order to keep gas holder tank in alignment, we will provide a guide system on the side of gas tanks, so we use 40mm dia threaded couplers for this.
Step 11: Preparation of gas pipes
From gas holder tank to the link pipe mounted on the wall.
Link pipe between gas holder tank pipe and kitchen.
From the link pipe to biogas stove.

IV. PREAUTIONS WHILECOLLECING SAMPLE

4.1 Kitchen waste:
A separate container for coconut shells, egg shells, peels and chicken mutton bones will be crushed separately by mixer grinder
Different containers of volumes are collected for wet waste, stale cooked food, waste milk products. The vegetables refuse like peels, rotten potatoes, coriander leaves are collected in bags.
4.2 Installations:
Avoid choking of plant and make the plant run smoother. Convert solid waste into liquid slurry, so mixer can be used for this purpose.

CONCLUSION

Kitchen waste is the best substitute for production of renewable energy like LPG. The waste slurry can be used as fertilizer for plants.
The regular feeding of biogas can produces consistent amount of gas. The payback period is small and is adorable in school canteens. The local hotels and plants have daily food waste which can be used in biogas and reduce the environmental hazards. Biogas plant made from metal like aluminum absorbs more sunlight heat for the production of energy than biogas plant made from plastic because plastic has more environmental problems as it is non biodegradable.

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