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DESIGN AND DEVELOPMENT OF SMALL SCALE BALLOON BIOGAS DIGESTER FOR HOUSE HOLD

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Abstract - The generation of the cooking gas in from the natural resources are available in the market from quiet a long time. But the major problem with these are it chambers are get damaged easily due to low quality material and to construction of which usually requires skilled labor intense and high-quality materials. To address these problems in the present work a balloon type biogas has been designed and developed which is cheap, weather resistance, and thermophilic (i.e it can operate in temperature as high as (50°-55°), which helps in digest the bacteria mesophilic bacteria range (40°-50°), it generates the gas. The problem with this digester tearing of the bag digester because of the stress caused due feeding of the slurry. So this problem designed another digester support for the bag whenever stress caused by the feeding of the slurry it can be distributed equally.

***Key Words*:** Gas production rate, Balloon Biogas Digester Performance analysis, Cow dung, Methane

1.INTRODUCTION

It is observe that environmental pollution is rising more quickly over the globe, contributing to both global warming and the ozone layer's depletion. The atmosphere's CO2 emissions have grown to be a significant problem. Biogas is a byproduct of the anaerobic digestion of cow manure such as animal manure in the absence of oxygen. In many states, biogas is used for cooking of the food and electricity generation. The flammable gas mixture known as biogas is created when organic material decomposes through microbial activity at warm temperatures (30°C to 40°C or 50°C to 60°C) in an anaerobic environment. It contains around 60% methane and 40% carbon dioxide. Karnataka ranked in the second with 513 thousands biogas plant.

The digestion process takes place inside a balloon or plastic bag in a balloon type biogas plant, which has a relatively simple design. The high-quality fertilizers made from digested waste sludge is used in agricultural. The biogas is operated using a mesophilic (35°C) single-stage method that relies on wet fermentation. The fermentation chamber is horizontally positioned, and a balloon is placed over the digester to collect biogas. This plant is more efficient than fixed and floating biogas plants. The plant has a capacity of 500 litres per day and is also known as ‘Gobar gas’.

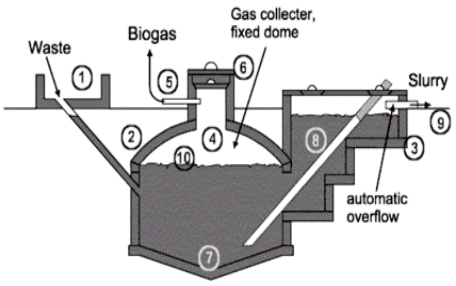
2. REVIEW OF LITERATURE

1. Design and analysis of a digester in biogas plant:- In this research we read that analysis of the biogas digester using stress analysis software like ansys, creo, catia.

2. Economic analysis of biogas production via biogas digester made from composite material:- This technology mainly focused on composite material and brick, cement, HDPE.
3. Design and analysis of biogas digester:-In this research paper they focused only on the technical aspects of the fixed dome biogas digester. The paper offers integrated review on the renewable energy sources and they used combined-heat and power system.
4. Design and fabrication of a plastic biogas for the production of biogas from cow dung:- In this research paper focused on the design and fabrication. The objective of the study is to analysis of plastic digester and the equation. Result is obtained in this process 54.50% methane gas and 44.25% carbon dioxide.
5. Development and implementation of small-scale biogas balloon biodigester:- The first biodigester balloon prototype's technical concerns with regard to installation, usability, biogas output, material, and design be evaluated and understood through a pilot test. In particular, the biogas generation was examined to determine the system's ideal HRT and biogas yield depending on the local circumstances.

3. BIOGAS DIGESTER TYPES

- Fixed Dome Type:- The most popular design is a fixed dome digester. The digester's four main parts-gas collector, fermentation for the digestion process, a hydraulic tank, and intake tanks are all included in a single construction (Fig.1). Its major advantages
- constructed entirely of concrete; therefore, a durable and long-lasting investment. basic in design. minimal cost.
- Because it has no moving parts or metal parts, it is simple easy to maintain.
- Higher gas pressure may be produced (on average 10 times greater than floating biogas digester and no floating digester is used.
- Entirely underground, saving land space, allowing for easy input material flow into the digester by the gravity, simple operation.

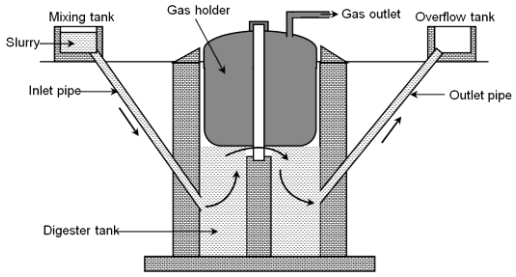


(Fig.1)

Disadvantages of the Fixed dome plant:- The biggest drawbacks are the recurrent issues with the brick gas holder's gas-tightness (a small crack in the upper part of the brick can cause heavy loss of methane gas). Therefore, fixed-dome palnt should be used in situations where skilled biogas specialists can oversee construction.

1. Floating Type:- The tank feature it is made of stainless steel cylindrical dome that floats on the collection of the slurry and collects the gas produced. As a result, this type of plant is known as a floating type biogas plant. The slurry is allowed to ferment for approximately 45 days. The anerobic digestion produces more gas, increasing the pressure inside the gas collecting

floating digester. An decomposed matter expands and overflows into the next small another tank (Fig.2).



(Fig.2)

Advantage:- Floating-drum plants are simple design easy to understand and manipulate. It provide gas at a constant pressure, and the stored gas volume is immediately visible by the position of the floating dome. Gas-tightness is not an issue as long as the floating digester can not be de-rusted and painted on a regular basis.

Disadvantage:- The floating drum's high construction cost, more steel parts suspected to corrosion, resulting in a short life approximately 15 years; in tropical coastal regions, about five years for the dome), and ongoing maintenance costs due to painting.

2. Balloon or Bag Type Digester:- The design was created in Taiwan during the 1960s. It is made up of a long cylinder type made of fiber glass plastic or red mud plastic. The bag digester was designed to address issues with brick and metal digesters. GGC was tested a PVC bag digester in Butwal, Nepal between April and June 1986. This study found that the performance of the fiber glass palstic depended on the availability of FRP bags, higher internal pressure, and welding facilities. In the majority of rural communities in developing nations, these requirements are challenging to achieve.

The digester is typically situated in a trench to prevent damage to the bag, and the trench is somewhat deeper at the slurry exit so that the slurry will settle there.

The top of the bag expands as gas is produced, and the gas can be out through an outlet pipe in the top of the bag. You can be raise the gas pressure by putting weights on top of the bag. It is demonstrate Fig.3.

Advantages of the balloon biogas digester:-

- Low-cost standardized prefabrication.
- High temperature digesters in warm climates.
- Thin placement suitable for use in areas where the water level is high.

(Fig.3)

3. DESIGN OF BALLOON BIOGAS DIGESTER

- Volume = $\pi r^2 h$
- (Height)Length = 6m
- Radius = 1.15m
- Volume = 24.92m^3
- For Semi Cylinder Volume divided by 2
- Volume = 24.92/2 = 12.46m^3

(Fig.4)

- Capacity of the digester is 12000 liters.
- In the beginning of the process feeding rate will be 1:1 that's means equal amount of cow dung and water.
- After 30 days per day feeding rate will be 200kg cow dung and 200L of water.
- After that it will produce 4 litres of for 1 kg of cow dung per day of gas.

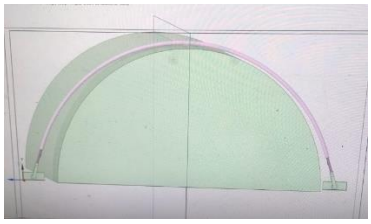
4. PROBLEMS WITH THE DIGESTER

In this biogas digester faced the problem tearing or the damaging of the digester at the support due to stress developed by the feeding of the slurry.

(Fig.5)

5. ALTERNATE DESIGN

So, developed another design whenever the stress or the feeding rate is increased it can be displaced at one side or the equally distributed.



(Fig.6)

6. GAS PRODUCTION

- Production of the manure = 400 kg.
- Percentage of total Solid and volatile solid.
- Total solid =19.38%*200 = 3876 kg/day.
- % Volatile solid = 15.06%*200 = 3012 kg/day.
- Biogas volume (BP) Production = 0.04 m^3/kg*3876 kg/day = 155.04m^3/day.
- The rate of gas production m^3/day is R = 65%*155.04
  R = 10077.6m^3/day.

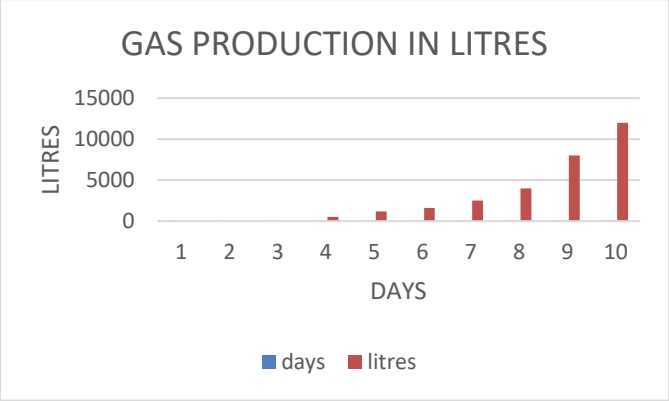
6. GAS PRODUCTION CHART

i. Biogas production chart (Days vs Litres):- Production of the biogas has been increases rapidly in the duration of the 55-70 days. It is producing 12000 litres methane gases chart 1.

Table-1: Gas production values

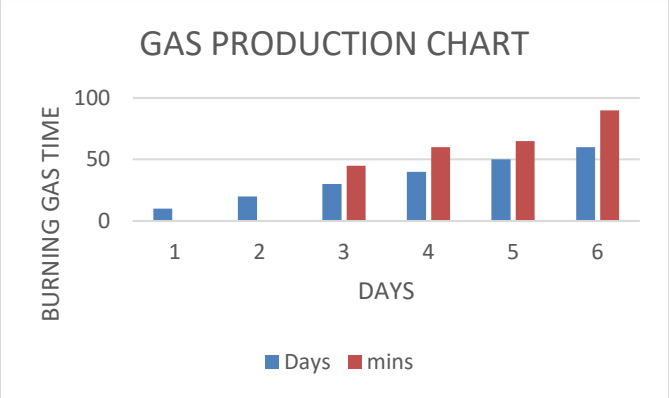
Sr.no	Days	4m^3(4000litres)
01	5	0
02	10	0
03	15	0
04	20	500
05	25	1200
06	30	1600
07	40	2500
08	50	4000
09	60	8000
10	70	12000

Chart 1



ii. Biogas production chart (Days vs cooking time):- Cooking time also increasing with respect to production of the methane gas chart 2.

Chart 2



CONCLUSION

Biogas technology has the capability to considerably improve the quality of life in ruralconsumption of the fossil fuels, maximising hygiene, and discussing a number of ecological imbalance related problems. Anaerobic digestion is a type of bacteria of the cow manure decomposition of organic materials that takes place without oxygen and predominantly yields methane and carbon dioxide as biogas. The discussion above makes it clear that the effectiveness of anaerobic process primarily depends on the level of bacteria activity, which is affected by a number of variables including the ambient temperature, the material's temperature, the loading rate, the hydraulic retention time, the pH of the digester content, etc. The purpose of this paper to design and development of the balloon biogas for the household because digester should approximately 20 to 25 years so design a digester with movable supports. And also it is good for cooking purpose and reduction of the fossils fuel that are highly impact to the environment. This balloon biogas will portable it doesn't require highly fabricated material and slurry after biogas production will used in used farms for the fertilizer of the crops.

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