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Illumination using Bio-Gas and it's Applications

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Abstract - *Due to the meagerness of non-renewable resources, it threatens the supply of energy obtained from this form of source. Non-renewable energy is diminishing and also it has some inimical effects on the environment which leads to use the of alternate sources of energy, like renewable energy resources. So it is better to use a renewable form of energy. Renewable energy includes solar, hydro, geothermal, tidal, and biogas forms of energy. In these, all kinds of energy, the use of biogas is very convenient and reliable. Biogas production is an anaerobic reaction that converts the waste into serviceable energy. It does not require any fuels and the entire operation is pollution-free and simple in structure. Biogas is eco-friendly and pure gas. Deposited biogas can give a clean, renewable source of energy. We can transform the biogas into various forms, electricity is one of them. We have divided the outline into two phases. In the second stage, we made a setup to convert this gas into electricity. The process is very efficient for generation, the higher the size of the plant, the production of electricity will be higher. This paper focuses on application of biogas in lighting system, its specifications, properties and its outcomes. Biogas is a solution to existing waste management and pollution problems that solve problems and give better results.*

Key Words: **Mantle lamp, Illumination, Bio-gas, Renewable energy.**

1. INTRODUCTION:

In villages without electricity, lighting is a basic need. The biogas lamp's bright light is the outcome of incandescence. Biogas Technology, the production of a combustible gas from anaerobic biomass digestion, is a renowned technology. There are already so many biogas plants in operation throughout the world. Use of this biogas for direct combustion in household stoves and gas lamps is very common for everyone, but producing electricity from biogas is still very rare in most of the developing countries. The main purpose of biogas plants is conversion of biogas to electricity has become a standard technology.

About 85 to 90% of the population lives in the rural parts of the country, this segment of the population is totally dependent on the use of biomass consisting of firewood, charcoal, twigs, crop residue and cow dung to make to meet its energy demands for cooking and other domestic means it is estimated that the domestic biomass consumption for fuel is as high as 94% with very little use of modern sources of energy such as electricity and liquefied petroleum gas (LPG). The light is one the important source of energy and has become important component of life. Before the use of electricity became sufficiently widespread and economical, the gas was the most popular method of lighting. Main concern in rural and remote areas is that electricity is not reachable and the fuels like CNG & LPG are not affordable. The light is produced either directly by the flame or indirectly with other components such as the gas mantle or the limelight, where the gas is primary source which works as a fuel. So biogas can play an important role for illumination purposes rural areas has vast reserves of biomass which can be used to produce biogas also it will lead to resourceful use of bio-waste.

1.1 Technical Process:

Biogas Formation:

The biogas is created when bacteria degrade biological material in an anaerobic state, or the absence of oxygen. Anaerobic treatment also has the advantage over aerobic treatment of a smaller emission of greenhouse gases. Therefore, biogas is a renewable green energy source.

In the absence of air, organic matter decomposed in the presence of bacteria. These bacterial decomposition of organic matter takes place in three phases namely hydrolysis, acid phase and methane phase. In a hydrolysis phase, the heavier hydrocarbons are broken into a smaller molecules, which are then converted into organic acids by the acid forming bacteria. And finally in the methane phase, fermentation of acids, hydrogen and CO produces methane.

1.Slurry (mixture of equal quantities of biomass and water) is prepared in the mixing tank. Then this prepared slurry is fed in the inlet chamber of digester using the inlet pipe.

2. The plant is left unused for about two months and introduction of more slurry is stopped. During this time period, fermentation of biomass takes place in the presence of water and produces biogas in the digester.

3. Biogas being lighter rises up and starts collecting the gas holder, the gas holder now starts moving up. The gas folder cannot rise up on a certain level, as more and more gas starts connecting, more pressure begins to be exerted on the slurry.

4. The spent slurry is now forced into the outlet chamber from the top of the inlet chamber. When this outlet chamber is totally filled with the spent slurry, the excess amount of slurry is forced out via the outlet pipe into a overflow tank. This is later used as manure for plants.

5. The gas valve of the gas outlet is opened to get a supply of biogas. Once the biogas is ready, a continuous supply of gas can be ensured by regular removal of spent slurry and introduction of fresh slurry.

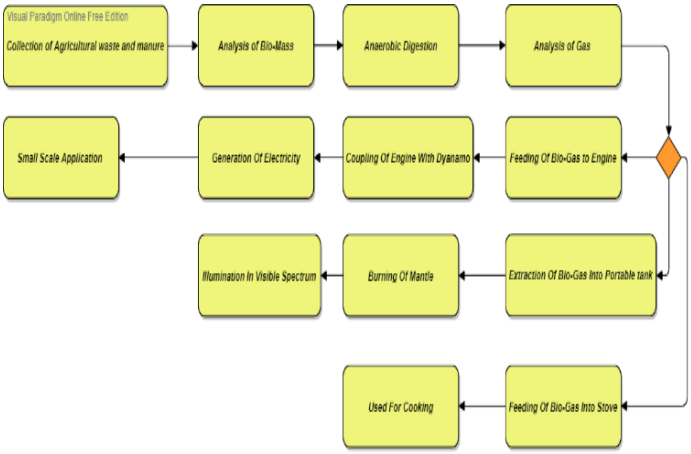


Fig 1: Utilization of Biogas

1.2 Mantle:

The Mantle is like a pear-shaped fabric bag made from fibers of silk ramie-based artificial silk, rayon, cotton or nitrocellulose. To produce mantle made of cotton, it is woven into a bag of net, impregnation done by soluble nitrates of selective metals and then heated, the cotton burns and nitrates are converted to nitrites which results together into a solid mesh. As heating goes on, nitrites decompose into mesh which is fragile in structure having solid oxides of high melting point. The nitrocellulose has extremely fine threads but is converted back to cellulose when immersed into solution of ammonium sulfide before first use since it is highly flammable and can cause explosion.

Lantern:

Most of the lantern's component are made of high grade steel. The lantern's ventilator's hood and faunt are of draw quality that is the steel being flexible will not develop enough crack when pressurized. The fuel delivery system are made of various brass alloys. The grid used for making parts depends on how much heat that part can sustain.

The smaller parts such as bail, pressure and ignition system and collar are made of other steel alloys. In the latest model, standing base and control knob have been made of molded plastic or rubber. While the metal mesh is used to make some globes the most prevalent material for global production is still heat resistance glass of borosilicate. The pyrex brand glass is used to which is formed by combination of boric oxide and silica sand.

2. Mechanism:

The fibres impregnated by metallic salts when heated in flame, the fibres burn out in seconds and metallic solids are converted to solid oxides, leaving brittle shell of ceramic and shape of remains original. The Mantle of lamp glows brightly in visible spectrum while little infrared radiation are emitted.

The combustion process is aided by mantle as flame is kept small and contained inside itself when fuel flows at rates which are higher than in simple lamp.

Since the combustion is concentrated inside the Mantle, the transfer of heat from flame to mantle is improved. When the fabric material has burnt away the mental shrinks and become very fragile after first use.

The rare earth oxides like cerium and actinides like thorium composed in mantle have low emissivity in infrared region when compared to an ideal black body, but emissivity is high in visible spectrum. It is evident that candoluminescence enhances emission, the light emitted from combusted products before reaching thermal equilibrium. This combination results into mantle which when heated by LPG or kerosene flame, it emits radiation which is intense in mostly visible light, with relatively little energy in unwanted infrared region which increases luminous efficiency.

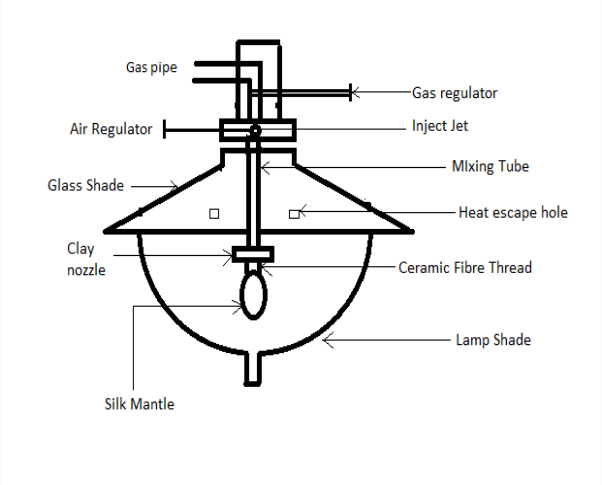
Table -1: Lamp Description

Model name/number	Biogas lamp
Usage / application	Biogas plant
Gas consumption	0.3m³/h
Methane content	20%
Size	465*210*240,100pcs/ctn
Nitrogen content	60%

Biogas Mantle Lamp

The pear-shaped fabric bag, made of silk or rayon is mantle. When the mantle is first heated in a flame, the fibre burns out quickly and impregnated rare earth metallic salt convert in solid oxides and form brittle shell of original fibric shape. Corium and thorium have high

emissivity in visible spectrum but have low emissivity as compare to an ideal black body. The mantle when heated emits intense radiation which is mostly visible light it follows the combination of above two properties. The mental improves heat of transfer of the flame to mantle the size of the mantle reduced after its first use due to material fabric burned away.



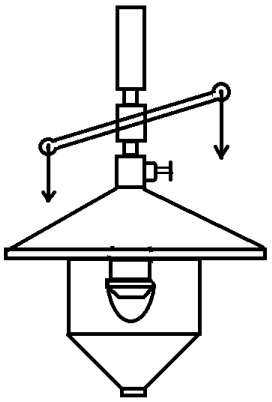
To create a mantle a net bag is woven by knit or cotton it is then impregnated with soluble nitrate and then heated the chosen metal. Then the nitrates are converted to nitrites and cotton burn away, which result in solid mesh. On further heating the nitrites convert into mesh of high melting point solid oxide. To strength the cotton mantle sufficiently it dipped into solution of collodion, which form a layer on outer mantle which burned off when mantle first used. Use a wire or thread of ceramic fibric to tie mantle with lamp.

S.N.	Application	Consumption
1.	Cooking	0.25m^3 /person/day
2.	Lighting	0.13 m^3 /hour/lamp
3.	Engine Operation	0.5 m^3 /hour/horse power

MODEL DESCRIPTION:

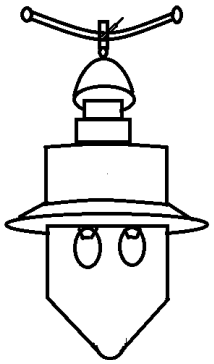
➢ According to Construction:

1. Single Mantle Lamp: Single mantle gas lantern with storage pouch, very convenient to carry. Easy to connect to your flat tank. High strength stainless steel construction, durable to use. Piezoelectric ignition system ensures successful and easy lighting. Intensified thin lamp and high temperature resistant. Specifications: Stainless steel + Brass.



Single Mantle Lamp

2. Double Mantle Lamp: Powered by 2 pints of unleaded gas, 7 hours burn time on high, 14 hours on low porcelain coated ventilators won't rust adjustable light, two different levels of brightness. Camping Lantern that is easy to use Rust free body makes it ideal for use in the outdoor. Specification: Stainless steel + brass.

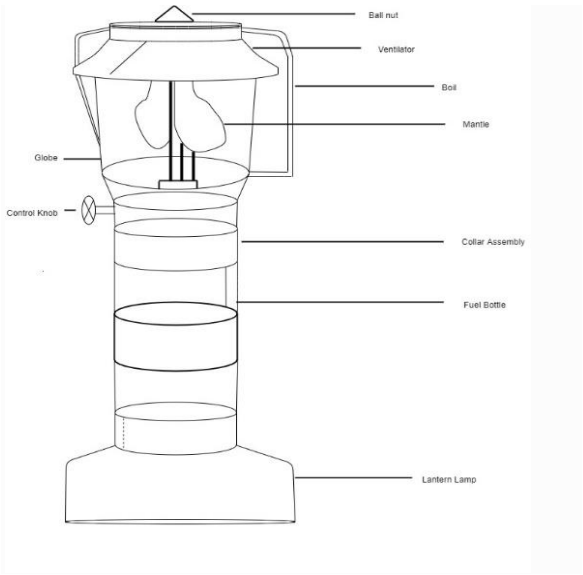


Double Mantle lamp

➢ According to Mobility:

1. Fixed Lamp: The mantle lamp is directly connected to the digester nozzle through a pipe with a T-joint and can be illuminated. In this case a continuous supply of gas is maintained and the lamp can be illuminated for longer duration.

2. Portable Lamp: The gas can be extracted from the biogas plant through extractor and can be store in a plastic tank (size can be varied). The lamp is connected to the plastic tank from which the gas can be fed to the lamp through a pipe. Now this whole assembly becomes portable and can be used anywhere according to our requirements. Due to size constraint the volume of gas is less so the lamp is illuminated for a smaller duration.



SOME POINTS RELATED TO LAMP:

1. Will fulfill a demand for good quality light.
2. Difficult to be made by small scale workshops.
3. Cheap large scale production in China and India.
4. Need a good service infrastructure (regular need to spare parts).
5. Need quality user training for operation and maintenance.
6. Capacity comparable with 60-75 Watt incandescent lamp.

Capacity comparable with 60-75 W incandescent lamp.

Convenience:

1. Backup to unreliable electricity grid
2. Replacement for- costly- batteries, candles, kerosene, etc.
3. Gives light where is used to be dark.
4. Low gas use, 80-100 litres per hour.

Safer:

1. Reduces the risk of fire in the house when well positioned and care is taken when the mantle needs to be replaced.

However:

1. Poor efficiency of only 3% (kerosene lamp 6%).
2. Very high temperature is needed to glow 1000-1500 C.
3. Frequent change of mantle.

3. CONCLUSIONS

- With continuing attention to the use of renewable energy, particularly in the electric power sector, an assessment of the potential for expansion of the use of waste biomass for electricity generation provides a basis for evaluating policies designed to encourage this energy source.
- With the enlarging stipulation of energy, need for scrutinizing new sources of energy which are renewable as well as eco-friendly is a must. Hence biogas become one of the relevant source of energy.
- In comparison of biogas and kerosene as a fuel, it can be inferred that the cost of illumination is highest for kerosene litted lamps and it is lowest for biomass gasifier and biogas electric system.
- Switching over from kerosene based lighting to biogas lighting will lead to better illumination and avoidance of such fossil fuel will lead reduction in CO_2 emission and improve air quality.

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REFERENCES

[1] Gas mantle technology https://patents.google.com/patent/US4877553

[2] Incandescent lamp lighting https://www.britannica.com/technology#ref197925

[3] Brits, R.J. Measurement of The content of gas mantles. Health Phys. 1985, 48, 124.

[4] Ohia, H., Kudryavsev, V.V. and Semenova, S.I., 1997, “Polyimide membranes: applications, fabrications and properties.”, Chapter 5, p. 180.Paper.

[5] Biogas – renewable energy source: optimization of production and application. International Research Journal of Engineering and Technology(IRJET)Volume: 03 Issue: 06 | June-2016