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Study and Analysis of Biogas Plant

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ABSTRACT-

Biogas is a renewable source of energy that convert the raw material like municipal waste, agriculture waste, animal waste etc. Into energy. As we know that the major environmental problem of our society is to continuously increasing the production of waste material or organic waste where dumping of waste and controlled landfill disposal is not acceptable today. so, we can use this waste as a raw material and convert into useful energy that why we can easily reduce increasing of waste material and pollution and also save money by implementing of biogas plant. [1] This research paper is based on the estimation of biogas production composition and its type. The main aims of this paper are to identification of hazard posed by biogas plant in India and assessment of critical zones around failed biogas plant facilities and also find why biogas failed in India?

Introduction

Biogas is also known as "GOBAR" gas. Biogas is a mixture of different gases that are producing by the decomposition of organic matter in absence of oxygen by feeding substrate or waste material such as kitchen waste, municipal waste, animal waste, agriculture waste etc. It produces mixture of mainly different types such as methane and carbon dioxide and but it also contains slight number of gases are oxygen, nitrogen and hydrogen sulphide that has been originated from post consumers, industrial and other kind of waste [2]. Biogas can also be used to produce heat, electricity generation or as an engine fuel and also used as a feed source for syngas and methanol production. [3]

Anaerobic digestion process: -

Anaerobic digestion us a process that take place in absence of oxygen firstly we collect the waste material from different sources for the production of biogas where we separateout plastic bag aur polythene, wood from collecting waste**.** Now, add chemical to enhance the digestionprocess ofbiogas this process is known as"prior treatment". Afterthat mixing in proper functioning to increasetheefficiency of the digestion process. Now, the rawmaterial that are coming from different source is thenfed into the digester for the production of biogas. Thesubstrate should not include wood or plastic bag because bacteria can't decompose. So, we can say that anaerobic digestion is a process ofbiological in different kind of waste into biogasand inorganic substance that can be used as fertilizers. [4][5]

There are various stages of anaerobic digestion: -

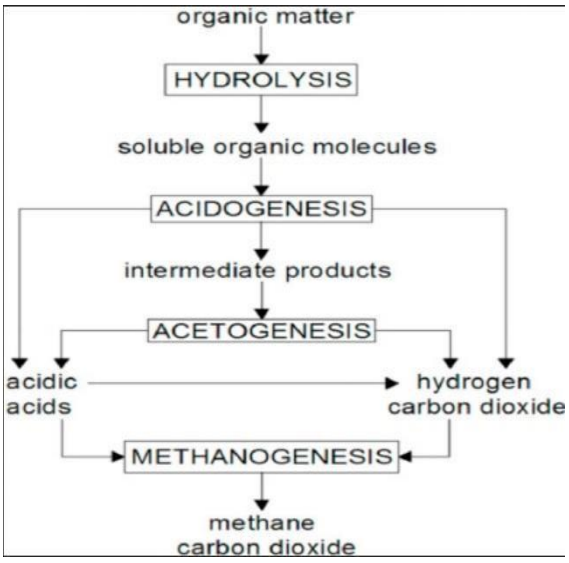


Figure 1 Anaerobic digestion process

1 Hydrolysis

In the first stage, hydrolytic bacteria decompose or breakdown of complex compound into simple compounds such as protein break down into amino acid, fat into fatty acid and carbohydrates breakdown into monosaccharides.

2 Acidogenesis

The bacteria utilize the product of first stage to produce acid. it produces propanoic acid,butanoic acid and acetic acid. *Acidogenesis* that produce the carbon dioxide and hydrogen by converting volatile fatty acid and small amount of alcohol

3 Methanogenesis

This is the final stage of anaerobic digestion process where bacteria utilize acid which are formed in acidogenesis process to produce methane and carbon dioxide.[5]

4 Biogas composition

Biogas mainly produced different types of gases such as methane, carbon dioxide, but it also consists small amount of oxygen,carbon monoxide,ammonia and other gases. the content of methane has an impact on the biogas combustion process.[6] The content hydrogen sulphide and carbon dioxide make biogas more corrosive. Biogas composition depend on the feeding substrate,organic waste charge and the rate at which the gas is fed into digester.[6][7][8]

Main components of biogas plant:

Inlet pipe: the waste material is fed into the digester through inlet pipe.

Mixing tank: organic matter like dung, food is gathered in the mixing tank using sufficient amount of water. the material is thoroughly mixed till homogeneous mixing slurry is formed.

Digester: waste material which is supplied from inlet pipe is fermented where biogas is produced Bacteria action.

Gas holder: the biogas produced which is collected in gas holder.

Outline pipe: where waste is discharged through outlet tank.

Gas pipeline: it carries the gas to the utilization point like stove.[9]

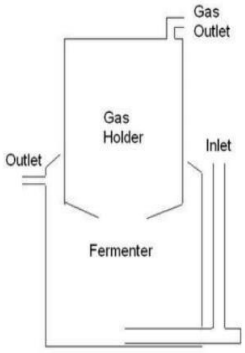


Figure 3 component of biogas plant

Types of biogas plants

1. Fixed dome biogas plant

The digester consists of underground pit lined made up of concrete and bricks where inlet pipe is used to supply waste to digester and gas is produced under pressure and stored at top of dome having gas pipe to supply biogas to the stove or lamp. Slurry is pushed out from digester to through outlet pipe. Design construction of fixed dome is different in countries such as Chinese dome plant consist of cylindrical digester with round top and flat or curved at bottom where Deenbandhu 2000 model plant developed in India having dome shaped at top and curved at bottom. [10]

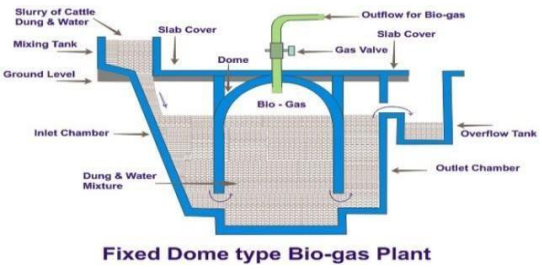
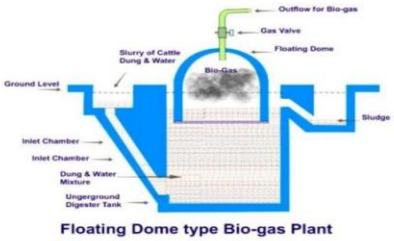


Figure 4:fixed dome biogas plant

2 Floating drum biogas plant

The popular design of this plant is KVIC (khadi and village industries commission). The drum is typically made up of steel. It consists of an underground digester and a moving gas holder.

Water and waste material are combined in mixing pit supply to the digester through inlet pipe where gas is produced and collected in the drum which move up and down depending on the amount of gas is being stored. this gas is held under pressure from weight of drum. [11] When we added more waste material to the digester then slurry come out through outlet pipe.



3 Balloon / bag digester biogas plant

The balloon is heat sealed plastic or rubber bag that combining the digester and gas holder parts. The inlet and outlet pipe are attached directly to the body of balloon where slurry can be fed through inlet and removed through outlet. A gas produced at the upper part of balloon where gas pressure can be increased by adding the weight on the balloon but if gas pressure exceeds a limit, then it may damage the balloon bag then safety valve is required. So, the material of this bag is weather, UV resistant specially reinforced plastic. The life of this bag may be 2 to 5 years.[10]

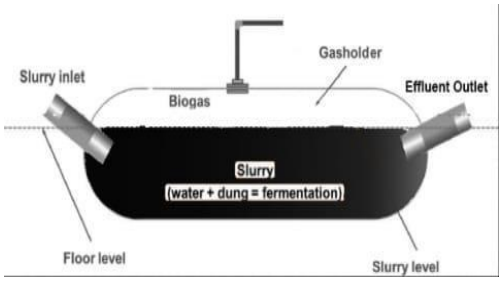


Figure 6: balloon biogas plant

Hazard of biogas plant due to failure:

1) Fire and explosion:

It can be occurring due to leakage of gases, creation of explosives zone, welding or frozen pipes.

2) Chemical hazard:

Due to their toxicological properties like ammonia, hydrogen sulphide and carbon dioxide expose operator to safety hazards. To reduce the risk, it's essential to main thresholds limit value.

3) Biological hazard:

organic matter of animals, human origin, agriculture waste used as a anaerobic digestion feedstock contain various bacteria, fungi, parasites, and viruses.

4) Mechanical hazard:

This includes Hazard related to the operation of turbo machine example pump and compressor etc. These accidents are most likely to occur during maintenance work of biogas plant.

5) hazards related to gas pressure:

if the failure occurs and the tank become unsealed, the gas or liquid stored in pressure tank can be released under high pressure creating hazard in biogas plant. [12]

So, accident in biogas sector is caused by failure of equipment and components, design error, inappropriate operation or maintenance and other action.

For ex: - in 1994 - 2015, the number of accidents in biogas plant or sector totalled 169 which occurs in Europe mostly in Germany because of inappropriate maintenance and design error. [13]

Mostly in India biogas plant was failed due to these accidents and its barriers. So, this accident that occur in biogas sector can be easily eliminate when we ensure safety and minimize risk with proper design considerations and maintenance work, plant design, project construction and biogas plant consideration.

Why biogas failed in India?

In India, the estimate for the production of biogas is about 20757 lakh cubic meter in 2014- 2015. this is also equivalent to 5% of the total LPG consumption in the country today. But today only 4 to 5 % of the total population utilizes biogas technology. The main reason behind failure of biogas plant in India are, the initial capital for establishing a biogas plant and associates' dissemination is usually high for the poor rural population. The upfront cost such as construction, labour and equipment cost of installing a biogas plant are quite high for rural households. The total installation cost of family biogas plant varies with sizes, location and model. The average cost of installing a family size biogas plant capacity 1 cubic meter of biogas per day is around $348. The government provide subsidy around $123 - $200 for family biogas plant depending upon plant capacity range from 1 to 6 cubic meter

i.e., 20 -40% of total installation of cost.

This indicates that the upfront install cost of biogas plant is significantly higher than the monthly household's expenditure of low income in rural areas. The second reason we can say that barriers which may be market barrier, financial and economical barrier, social and cultural barrier, regulatory and installation barrier, technical and infrastructure barrier .so these barriers are the main reason to failed biogas plant in India.[14]

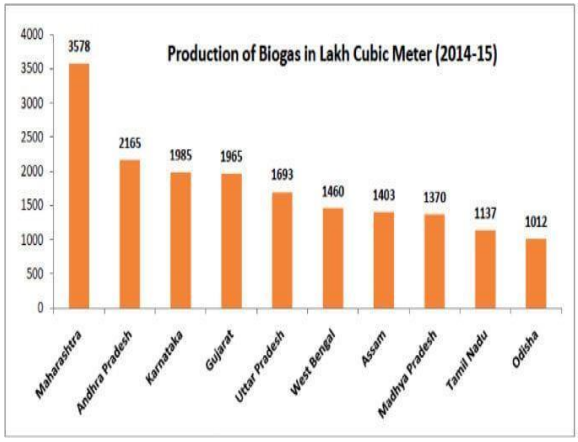


Figure:production of biogas in India

Application of biogas

- electricity generation.
- cooking fuel as a sustainable energy source.
- waste management in agriculture. ~ biogas is used in silk mental lamp for lighting purpose.
- if compressed, it can be replaced compressed natural gas for use in vehicle.
- heat of biogas is used to heat ammonia of refrigeration plant.
- waste material to that is coming out from outlet slurry used as a fertilizer

Conclusion

biogas is a clean source of energy. biogas technology has significantly potential to eliminate several problems related to improving hygiene and health, minimizing crucial fuel demand. Thus, resulting in an overall improvement in quality of life in rural or urban areas. For this improvement, the research organization should focus on newer efficient low-cost design. but the government of India can play important role in biogas sector by introducing education scheme and the availability of technology and creating more awareness and providing more subsidy to rural and urban areas.

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