

A Review: Advantages and Disadvantages of Biogas

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Abstract - The present paper gives a complete idea on the prospective technology for the production of clean energy in the form of biogas. Biogas is green and a sustainable energy consisting of methane to a great extent along with other gases. Global warming and greenhouse effect are caused due to the harmful gases which are released into the atmosphere. Emission from automobiles and industries are one of the causes of global warming. Along with global warming the excessive use of fossil fuels shifts the balance of supply of fuels. So in order to save fossil fuels for our future generations alternative fuels play an important role in replacing the fossil fuels. The present paper gives an idea of the production of biogas and their advantages and disadvantages.

Key Words: biogas, methane, global warming, economic impact, anaerobic digestion

1. INTRODUCTION

Biogas is a gaseous fuel, which is produced by the fermentation of organic material. The main component of biogas is Methane gas and other gases like hydrogen sulphides, carbon dioxide, siloxanes and moisture also form a part of biogas. Biogas is generally produced in a closed container where anaerobic digestion takes place efficiently and the closed container is called biogas digester. It is called so since the digestion of organic matter takes place in the presence of bacteria. The bacteria present in the digester need to be fed everyday with food waste and water. Biogas can be compressed and used in motor vehicles the same way natural gas is compressed into CNG. Natural gas and biogas have similar dangers. Biogas usually gets toxic by its own fraction of hydrogen sulphide [1]. The presence of negative pressure can lead to the explosion in the biogas plant. Biogas can be used for various purposes, especially for cooking, fuel in vehicles etc.

So, the basic principle behind the production or generation of biogas is Anaerobic Digestion. As mentioned earlier, anaerobic digestion is simply the degradation or the breakdown of complex substances into simpler substances in the absence of oxygen. Biogas is one of the end products which are obtained as a result of Anaerobic Digestion. It is usually combusted to generate heat and electricity [2].

Table 1. Specific Composition of Biogas

Compound	Formula	Percentage
Methane	CH ₄	50-75
Carbon Dioxide	CO ₂	25-50
Nitrogen	N ₂	0-10
Hydrogen	H ₂	0-1
Hydrogen Sulphide	H ₂ S	0-3
Oxygen	O ₂	0-0.5

There are four stages in which the decomposition of bio-waste takes place: Hydrolysis, Acidogenesis, Acetogenesis and Methanogenesis.

The first step of the digestion process is bacterial hydrolysis (of the input materials). This is done in order to degrade the organic polymers which are insoluble in nature, for example, carbohydrates. The next step is to convert amino acids and sugars into ammonia, carbon dioxide, hydrogen and organic acids [3].

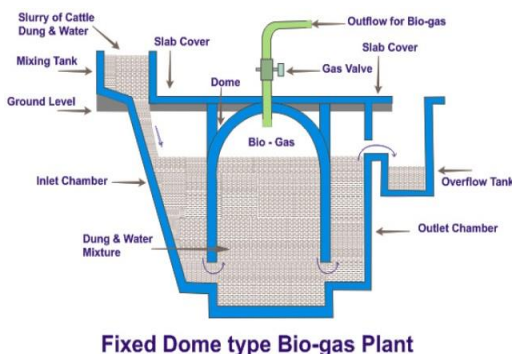


Fig-1 Biogas plant



Fig-2 Stages of anaerobic digestion

This is done by acidogenic bacteria. After which, these resulting organic acids are converted into acetic acid with the help of acetogenic bacteria along with additional hydrogen, ammonia and carbon dioxide. Finally, these resulting products are converted into carbon dioxide and methane. These conversions are done by methanogens.

The process of anaerobic digestion for the production of biogas is usually made to take place in a cylindrical tank that is air tight. These air tight cylindrical tanks are called anaerobic digesters. Concrete bricks or cement or steel are used to build up the digester, which is usually built underground. The mixing tank has an inlet attached to it, this is for feeding in the cow dung. A gas outlet is also present. The slurry or the used cow dung is made to come out of an outlet present in the digester. This slurry which comes out of the digester can be used as manure [4]. When cow dung is used as a substrate, the process takes around 2-3 week.

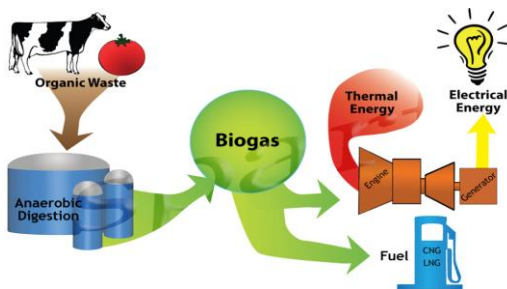


Fig-3 Biogas generation from waste

2. DIFFERENT SOLID WASTES FROM WHICH BIOGAS CAN BE GENERATED

A few solid wastes from which biogas can be generated are:

2.1 . Food wastes or green wastes:

Food that is discarded or left uneaten are called food wastes, basically the wastes that are produced by food items are called food wastes. Food waste, decomposable organic matter and kitchen waste which consist of a little amount of carbon dioxide and of methane, are used to produce biogas, which is then used as an alternative for cooking gas or LPG [5]. Also, the waste materials can be disposed of efficiently without leaving behind any odour or flies. The slurry or the digested slurry obtained can then be used as organic manure in gardens.



Fig-4 Waste organic matter

2.2. MUNICIPAL WASTES AND DOMESTIC SEWAGE

Everyday items that are discarded by the public, also commonly known as garbage or refuse are known as municipal wastes or domestic wastes. They are collected separately from food wastes. Municipal solid wastes can be used to generate energy. Anaerobic digestion of Municipal solid wastes provides a highly controlled and an engineered process of getting methane as compared to capturing methane by the landfill process [6]. The anaerobic digestion system for a municipal solid waste includes: Single-stage wet digesters, dry fermentation and two-stage digesters.



Fig-5 Municipal Solid waste

2.3. ANIMAL WASTES AND MANURE:

The organic matter which is obtained from animal faeces which can be used as natural and organic plant fertilizer is called animal waste or manure. Addition of manure makes the soil more fertile due to the presence of organic matter and nutrients, such as nitrogen. This manure can also be used as a raw material in a biogas plant to produce biogas by the process of anaerobic digestion [7]. On dairy farms, where cows are routinely confined, manure is easily collected at such set ups.

When biogas is directly used for heating it is said to be most efficient, and dairy farms have a year-round demand for hot water.



Fig-6 Cattle waste

2.4. AGRICULTURAL WASTE

Several organic wastes from plants and animals get exploited for biogas production. Some of the plant and agricultural

crops include cassava, corn, sugarcane etc. Most of the agricultural residues are lignocellulosic (plant dry matter) with low nitrogen content, which is the main issue with the anaerobic digestion of crop residues [8]. The digestion of crop residues can be done either in co-digestion with other materials or alone. The digestion may employ wet or dry processes.

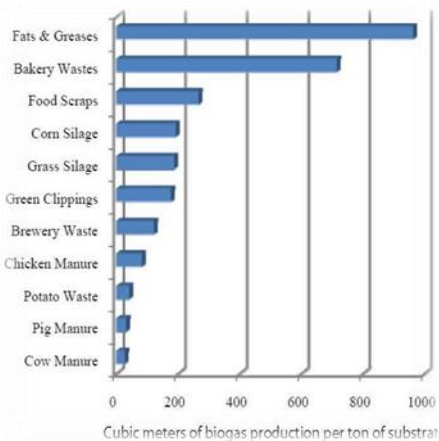


Fig-7 Biogas production from various feedstocks

3. USES OF BIOGAS:

- Biogas is most beneficial in the rural areas since there is no access to any other source of energy, where indoor pollutions and deforestation are an issue.
- Biogas can be used as a source to generate electricity where the wasted heat is used for other purposes. This is done by fuelling an engine-generator which in turn produces electricity.
- In many places, especially rural areas it is used as a medium for cooking and heating purposes.
- Biogas can be used for running water pump-set and tube-well engines [9].
- They can also be used as an illuminant in a metal lantern for domestic and street lighting.
- Biogas can be compressed and used in vehicles as a source of fuel, this fuel is less pollutant and more efficient.

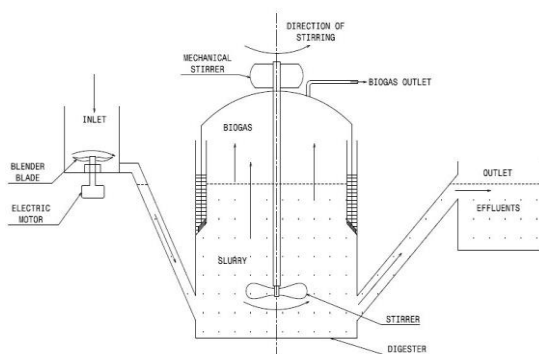


Fig -8. Conventional Biogas Reactor [1]

4. ADVANTAGES OF BIOGAS

4. 1. It is a renewable source of energy: The only time when biogas will be depleted is when the production of any kind of waste is stopped. Also it is a free source of energy.

4. 2. Non-polluting: Biogas is considered to being non-polluting in nature. The resources are conserved by not consuming any further fuel since the production of biogas does not require any oxygen. It also reduces deforestation and any sort of indoor air pollution.

4. 3. It reduces landfills: There is a decrease in soil and water pollution since it uses up the waste in landfills and in dumps as well.

4. 4. There is use of cheaper technology: The technology to utilize biogas is getting better and hence the applications for biogas are also increasing. Biogas can be used for the purpose of heating as well as producing electricity. One type of biogas, Compressed Natural Gas (CNG), is also used as fuel in vehicles, this is done by compressing it.

4. 5. A large number of jobs are obtained: Due to the biogas plant setups, a major number of work opportunities get created for thousands of people. For the people in the rural areas, these jobs turn out to be a blessing.

4. 6. There is very little capital investment: The setup of a biogas plant requires little capital investment and is also easy when set up in a small scale. The waste material that is produced in farms by their livestock can be used to produce biogas in a farm itself and farmers can make themselves self-sufficient [1].

4. 7. It reduces greenhouse effect: Production of biogas takes place by utilizing the gases which are produced by the landfills and hence the greenhouse effect is reduced. This is utilized as a form of energy. It works on simple technology and it also recycles most forms of biodegradable or organic wastes and hence biogas has started becoming an important resource.

5. DISADVANTAGES OF BIOGAS

5. 1. Little Technology Advancements: Very little technological advancements have been made or introduced for streamlining and making the process cost effective and hence the systems that are currently used are not efficient enough. Hence, even the large scale industrial production of biogas is not shown or isn't visible on the energy map [3]. Most investors are not willing to put in their capital investments in the production of biogas, although investments could be a possible solution to the problems being faced.

2. It consists of impurities: Biogas goes through many refining processes and yet contains a number of impurities.

The metals in an engine can start corroding if this biogas full of impurities is used as a fuel after compressing the biogas.

5. 3. Biogas is not attractive on large scale: Large scale usage of biogas is not economically viable. Enhancing the efficiency of biogas systems is very difficult as well.

5. 4. Biogas is unstable in nature: When methane comes in contact with oxygen, biogas tends to become flammable in nature. This happens because biogas is unstable and hence it is vulnerable to explosions [5].

6. CONCLUSION

“The future is green energy, sustainability and renewable energy. To make life possible without a hitch, alternative sources of energy should be used. Utilization of biogas reduces global warming and also prevents harmful diseases. From a zero value of waste lot of energy and income is generated. Setting up biogas plants will help in the generation of different jobs thereby reducing unemployment. Waste is generated in large amounts and thus the input for biogas plant is available all-round the year without any scarcity.

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