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BIOGAS: A RENEWABLE ENERGY FOR FUTURE

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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 a sustainable energy constituting methane to a maximum amount along with some other gases. Methane is the major cause for the global warming. Global warming and greenhouse effect are the major predicaments faced by the human beings these days. However, the causes for the global warming are the haphazard activities caused by humans. So, there is desperate need to use non-conventional sources of energy which have the capability of replacing the fossil fuels. Biogas can fulfill the need to a great extent. It is clean and eco-friendly which has the power of substituting the present conventional sources that are responsible for the devastation of the environment. A famous saying, "With the use of biogas we can see light at the end of tunnel". Moreover, if we don't think for our future generations then we will be stucked in dire straits. The paper reviews different stages of anaerobic digestion, properties of biogas, impact on environment and the production rate through various techniques and utilizing different feedstock's. It also depicts the economic impact of biogas on society and it's usage for a better and bright future.

Keywords: Biogas, methane, global warming, economic impact, anaerobic digestion

1. INTRODUCTION

Our mother Earth is under an immense threat due to indiscriminate activities carried out by human beings. It is the responsibility of everyone to redefine our Earth once again. The only way we can help out is by finding the alternative means which is disturbing the ecosystem. One of the ways is to use renewable energy in all possible means. Fuels like petrol and diesel should be replaced by Bio-diesel, Hydrogen gas and Bio-gas. Biogas is a by result of the anaerobic (without oxygen) breakdown of natural matter [1] It can be delivered from crude materials, for example, horticulture waste, manure ,municipal waste, plant material, sewage, green [2].The

most essential part in biogas is Methane which is a combustible gas utilized as a part of furnaces for cooking even as a motor fuel.However,biogas additionally contains carbon dioxide and little measures of hydrogen, hydrogen sulphide,nitrogen and water vapour.Biogas can be utilized for the creation of warmth and power. The composition of biogas is given below:-

Table: 1 Specific Composition of Biogas

Compound	Formulae	Percentage
Methane	CH4	50-75
Carbon Dioxide	CO2	25-50
Nitrogen	N2	0-10
Hydrogen	H2	0-1
Hydrogen Sulphide	H2S	0-3
Oxygen	O2	0-0.5

2. DIFFERENT STAGES OF ANAEROBIC DIGESTION

Anaerobic digestion is a process in which the biodegradable material gets broken down by micro-organisms without the presence of oxygen. This is the frequently used process for producing biogas. There are four stages of anaerobic digestion namely Hydrolysis, Acid genesis and Methanogenesis [3].The complete process can be illustrated by a simple chemical reaction:-

$$C6H12O6 \rightarrow 3CO2 + 3CH4 \quad (1)$$

In this chemical reaction, carbon dioxide and methane were obtained as products when Glucose was digested anaerobical by the micro-organisms.

2.1. Hydrolysis

Mostly, large natural polymers constitute Biomass. For getting to the vitality possibilities of the substance, the microbes introduce in the digesters need to separate the extensive polymers into littler constituents. Polymers like proteins, carbohydrates and fats are transformed to amino acids, fatty acids and monosaccharide respectively [4]. The condition beneath plainly portrays the change of natural waste into basic sugar:-

$$C6H10O5 + 2H2O \rightarrow C6H12O6 + 2H2 \quad (2)$$

So the procedure of breaking and dissolving the expansive polymers into arrangement is called Hydrolysis. This is the main phase of anaerobic digestion.

2.2. Acidogenesis

This is the second phase of anaerobic absorption in which the results of first response get changed into short chain unpredictable acids, alcohols, ketenes, carbon dioxide and hydrogen by acidogenic bacteria. The items acquired in the essential acid genesis stage are prop ionic acid, butyric acid, acetic acid, formic acid, lactic acid, ethanol and methanol, along with other. Out of these products, carbon dioxide, hydrogen and acidic corrosive won't experience the third phase of the digestion process [5].They are straightforwardly used by the methanogenic microbes in the last stage. The conditions beneath obviously delineate the change of glucose into ethanol, propionate and acidic acid, respectively

$$C6H12O6+2CH3 \longrightarrow CH2OH + 2CO2 \quad (3)$$

$$C_6H_{12}O_6 + H_2 2CH_3 \longrightarrow CH_2COOH + 2H_20 \quad 4$$

$$C_6H_{12}O_6 3CH_3 \longrightarrow COOH \quad 5$$

2.3. Acetogenesis

This is the third stage of anaerobic digestion in which the acid genesis products like prop ionic acid, alcohols and butyric acid get transformed into hydrogen, carbon dioxide and acetic acid, by the acetogenic bacteria. This process will take place only if the partial pressure of hydrogen is low enough to allow the conversion of all acids thermodynamically hence; hydrogen plays a vital intermediary role in this acetogenesis process. The equations below clearly depict the transfiguration of acid genesis products into acetates

$$CH_3CH_2COO^- + 3H^-_20 \longrightarrow CH_3COO^- + H^+ + HCO_3^- + 3H_2 \quad 6$$

$$C_6H_{12}0_6 + 2H_20 \longrightarrow 2CH_3COOH + 2CO_2 + 4H_2 \quad 7$$

$$CH_3CH_2OH + 2H_20 \longrightarrow CH_3COO^- + 2H_2 + H^+ \quad 8$$

2.4. Methanogenesis

This is the last phase of anaerobic digestion. During this stage, hydrogen and acidic corrosive shaped by the corrosive formers get changed over to methane gas and carbon dioxide by the Methanogens are the microscopic organisms in charge of this conversion [7].Waste adjustment is capable when carbon dioxide and methane gas are yielded out. The conversion is shown below:-

$$CO_2 + 4H_2 \quad CH_4 + 2H_20 \quad 9$$

$$2C_2H_5OH + CO_2 \quad CH_4 + 2CH_3COOH \quad 10$$

$$CH_3COOH \quad CH_4 + C0_2 \quad 11$$

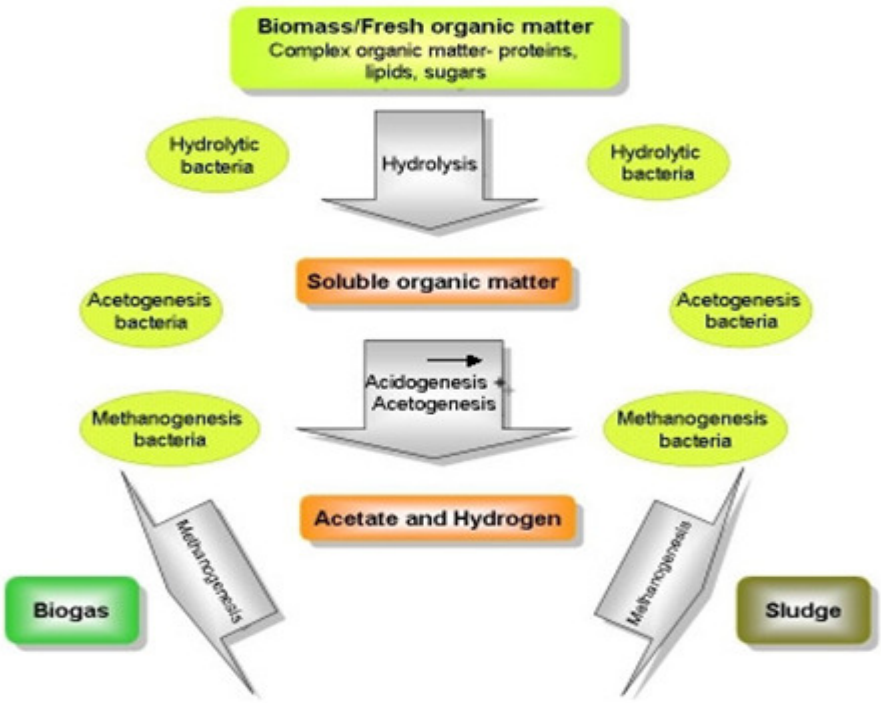

Figure 1 Stages of anaerobic digestion

3. PROPERTIES OF BIOGAS

Biogas consists of methane to a major extent along with carbon dioxide and other gases and their proportions depend on the production environment and techniques adopted. Few traces of hydrogen sulphide, ammonia and nitrogen gas may also be present. Biogas is normally drenched with water vapour. The energy value of pure methane is 9.81 KWh/Nm^3 [8].Taking into consideration, the relative amounts of methane, carbon dioxide and other gases, the energy value of biogas varies between 4.5 to 8.5 KWh/Nm^3 .The presence of sulphur compounds is responsible for the stench of biogas. Biogas may ignite at concentrations of

Table: 2.Comparison of properties of three gases

Property	Unit	LPG	Biogas	Natural Gas
CalorificValue, lower	MJ/Kg	46.1	20.2	48
Density	Kg/m^3	0.525	1.2	0.83
Odour	-	Faint smell	Low odour	Garlic-like
Ignition Temperature	Fahrenheit	770-1076	1200 to 1380	1163
Hydrogen Sulphide	Ppm	Absent	<500	3

4. PARAMETERS AFFECTING THE PRODUCTION OF BIOGAS

4.1. Temperature

Increase in temperature results in the slight change in the efficiency of production. Firstly it can build dissolvability of natural mixes and then increases chemical and biological response rates. It also enhance the diffusivity of solvent substrate and increments the demise rate of pathogenic microscopic organisms, particularly under hemophilic condition [5]. The only drawback of increase in temperature can be that it diminishes pKa of smelling salts, in this way builds the part of free-alkali which is inhibitory to microorganisms.

4.2. Volatile Fatty Acids

FAs are the absolute most essential intermediates in the anaerobic biogas handle. The transformation from VFA into methane and carbon dioxide is the most imperative phenomenon [7]. The expansion of VFA focus in the biogas procedure is well known, as an aftereffect of process disparity. In this way, it has been normally recommended as an indicator in the anaerobic digester.

4.3. Nutrients

Proper nutrients are essential for the growth of microbial cells. Macro supplements for example, carbon, nitrogen, potassium phosphorus, sulphur and miniaturized supplements, for example, iron, Nickel, Zinc and Cobalt in lesser amount are required for ideal anaerobic microbial development [6].

4.4. pH

Many groups of micro-organisms have the same optimal pH range, while each group has a specific pH region for optimal growth in anaerobic degradation. Buffering capacity is a vital factor for process stability, in terms of resistance to pH change. Bicarbonate arises to be the main buffer with a pKa of 6.3 when anaerobic digesters are concerned and the main generated acids are VFAs with a pKa of 4.8 [5]. Other compounds such as hydrogen sulphide (pKa 7.1), dehydrogenate phosphate (pKa 7.2), and ammonium ion (pKa 9.3) are generally found in the digester. They have an adverse impact on the pH balance if found in higher concentrations [6]

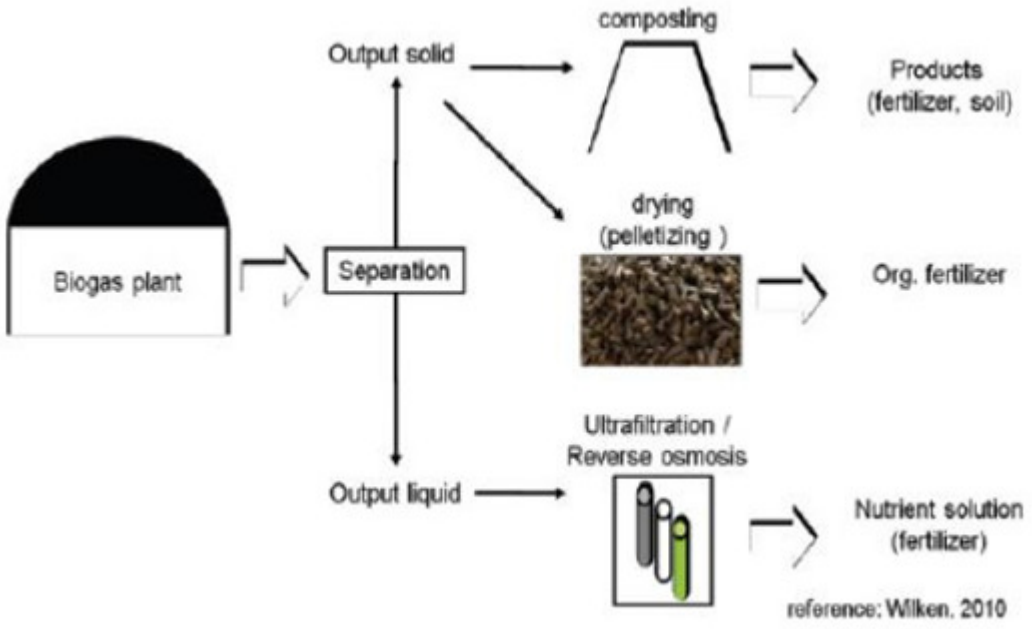

Figure 2 Treatment options of fermentation residue emiss ions

5. AMOUNT OF BIOGAS PRODUCED FROM DIFFERENT MATERIALS

Biogas is produced from diff erent materials like fats &greases, food scra ps, green clippings, chicken manure, potato waste, pig manure and cow manure etc. Fats , oils and greases generate more amount of biogas as compared to the other materials. Hence, in many dairy farms local food scrap is add ed to the manure in digester to produce mor e amount of biogas. Large quantities of biogas can be produced by using all these materials to a greater extent [9].The data is shown below:

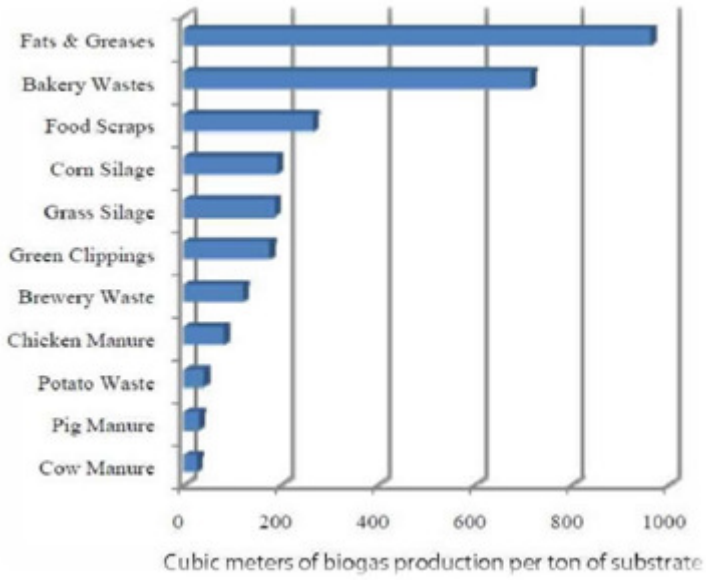

Figure 3 Biogas productions from various feedstocks

6. ECONOMIC IMPACT OF BIOGAS

Bio-Gas has a positive impact on the society. It is beneficial to Humans in many ways. Few of its benefits are:-

6.1. Production of heat and electricity

Due to the presence of methane, Biogas can be used as a fuel substituting the existing fuels like kerosene, petrol etc.The complete consumption of firewood in rural areas can also be substituted by the use of biogas in large quantities. Communal units in forest areas produce biogas in large quantities to run engines and generators for power generation.

6.2. Transformation of organic wastes into useful organic fertilizer

If the organic wastes like cow dung slurry is put in the biogas digester then it results out into an organic fertilizer which can be used by the farmers who cannot afford to buy chemical fertilizers. This bio-fertilizer is highly nutritious and it secretes hormones, amino-acids and vitamins. Hence it plays a vital role in improving the seed germination and growth of the root [6-9].On a whole, we can say that bio-gas plant is the best fertilizer making machine which produces the eco-friendly and economical fertilizers which are helpful for the establishment of the plants.

6.3. Curtailment of workload

If a biogas plant is installed at home, there will be reduction of workload especially for women. In most of the rural areas, women go in search of firewood for the cooking purpose which causes pollution. It is not worth time saving.So,Biogas plant installed at home can save their time and they can spend their useful time with their families. Biogas plants also improve the health conditions at homes. It increases the hygienic conditions and cooking with gas takes less time than with wood [3-5].Since biogas burns clean, homes do not fill with smoke and ash which in turn reduces the bronchial problems and can be expected to live longer. As the cutting of wood is reduced, there is an efficacious impact on the environment.

7. BIOGAS FOR THE BETTER FUTURE

There is a need in our nation to improve conditions to let biogas production flourish. With the shortage of energy, increasing global warming and increasing indiscriminate activities of humans, there is a need to find out an alternative source of energy to make our life possible. Why do the people run after the sources which will be extinct after a while? They are not aware of the alternative energy prevailing in and around them. We must look into the depth and find out a solution [6].Every useless material is proficient in some or the other way. The cow dung, human wastes, animal wastes and etc. can be used to produce biogas which gives us a hope for our future generations. Biogas is the best alternative source which can be used to produce energy and is also useful in reducing the pollution. By converting the organic waste into useful fertilizers, global warming can also be used up to some extent. Our future generation can lead a very happy and pollution free life if we use the alternative sources of energy [7].Finding out a new solution is equivalent to finding out a new means of life. We need to think higher and build up ourselves always to find out a new means of energy to get rid of the present predicaments and to lead a prosperous life.

8. ADVANTAGES OF BIOGAS

1. It invokes a pollution free and renewable source of energy.
2. Productive way of energy conversion.
3. Produces effective and eco-friendly fertilizers.
4. Helps in making out a hygienic environment.
5. It is also used in power generation.
6. Technology is cheaper and simpler and economic.
7. Helps in reducing greenhouse effect and global warming.

9. DISADVANTAGES OF BIOGAS

1. Biogas plant is not accomplishable in all locations.
2. It is arduous to intensify the efficiency of biogas plant.
3. Smell can also be considered as a disadvantage.
4. It is ideal only for a small scale application.

9. CONCLUSION

It was rightly said by Arnold Schwarzenegger that “The future is green energy, sustainability and renewable energy. To make life possible without a hitch, alternative sources of energy should be used. We will have to face an uphill battle if we go on degrading the energy sources. The scarcity of resources can be vanquished only by the use of renewable sources of energy. The fossil fuels should be superseded by biogas or biodiesel etc. The Government should also encourage the use of alternative sources by conducting awareness programmes. It needs to proactively help by facilitating to fabricate productive biogas plants and by adjusting the vitality preservation charge, which is gone for supplanting old machines and apparatus to the rural cultivating groups with new mechanical devices. We should provoke the set out to think in transit forward, to discover more natural sources of energy for vitality protection and ideal vitality generation for our potential future, to remain a prosperous one. Finding out a new solution is equivalent to finding out a new means of life.

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