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BIOGAS POWER GENERATION FROM ORGANIC WASTES ON SMALL SCALE

Sam Daniel Fenny A[1], Mohanakrishnan M[2], Harish Kumar S[3], Naveen Kumar K[4]
Department of Mechanical and Automation Engineering, Agni College of Technology, Chennai

Abstract-
Due to the situation of our country's need for fuel and energy requirement has become a major problem due to the over pricing of the fossil fuels like coal, petrol, diesel, etc. So it is very much important to find an alternative source of fuel to satisfy the need of our countries fuel requirement. This work is based on those factors. The capability of biogas in power generation is substantial and is definitely a field that deserves a lot of awareness. This work has fully described the method of production and uses of Biogas. It has also gone a step further to filter and remove the traces of H2S gas from the raw Biogas. This work is about using the Biogas as a fuel to run a boiler and to utilize that energy to generate electricity. As the Biogas is prepared from organic waste, It's price is very much lower than any other fuels like petrol, diesel, LPG, etc. The digestate produced from the Biogas plant is a very good organic fertilizer which increases the fertility of the soil, it can be used in agriculture. By executing Biogas plant the domestic waste generated in our country can be reduced and can be converted into a useful source of energy.
Keywords: Organic wastes, Bio gas, electricity power generation

1.0 INTRODUCTION

Energy is not considered as a basic need, but it is a basic ingredient in the successful satisfaction of most basic human needs. The level and intensity of commercial energy use is a key indicator of economic growth in a country. About 65% of the electricity consumed in India is generated by thermal power plans, 22% by hydroelectric power plants, 3% by nuclear power plants and the rest by 10% by the alternate source like solar, wind, biomass etc. This report will deal more on biomass and in particular biodegradable material being used to produce Biogas that will be used to generation of electric power.

This work provides a process for the production of electric power, using a biogas as a fuel in an electric power producing turbine, wherein the biogas produced from a biomass in a gas generator, and the biogas after treatment according to the process, may be directly charged to an electric power producing combustion turbine. Biogas is a combustible gas mixture produced during the anaerobic digestion of organic matter in an anaerobic biogas reactor (small digester, digestion of organic waste, anaerobic baffled reactor, etc,.). During anaerobic digestion, wastes are treated and degraded and biogas is produced which is a renewable green energy source. Anil kumar, (2014) [1] et al A review on biomass energy resource, potential, conversions, policy, and statistical analysis of various sources of biomass resources in India. This paper deals with knowing the available source of biomass energy in India and various policies on

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biomass. The prime moto is to encourage the use of non-conventional source of energy, which helps in sustainable development of nation.

K. C. Surendra, (2013) [2] et al Biogas as a sustainable energy source for developing countries: Biomass resources, Biogas production potential, and challenges. To achieve sustainable development in rural regions, by using renewable energy. The benefits of more sustainable way of life and economy may be realized at both the domestic and international level. S. Aravindhan, (2016) [3] et al Investigation of performance and emission characteristics of a Biogas fueled electric generator integrated with solar concentrated. This paper is aimed to describe the concept of integration of Biomass and solar concentrated photovoltaic (CVP) energy system. The biogas fuelled electric generator integrated with CPV system can attain sustainable rural energy supply.

WISIONS by energy forum Limited, (2007-2008) [4] Biogas electric power for rural communities in Sri Lanka. To develop and establish procedure and mechanisms to make electricity generated from biogas as a feasible option for rural off-grid communities in Sri Lankan dry zone. Biogas fuelled electric generator integrated with off-grid system can provide electrical supply for both rural and urban areas. Carlos H., (2014) [5] et al Brazilian projects on Condominiums of Agro-energy for Family Agriculture have demonstrated the feasibility of combining preservation of the environment to productivity and income generation through technologies accessible to small farmers gathered in a condominium energy. Such projects have also demonstrated the feasibility of transmuting the environmental liabilities of the Brazilian agricultural sector into electricity and fertilizer, working with the voluntary commitment to decrease the emission of greenhouse gases in Brazil by 2020. Seyed Eshan Hosseini, (2014) [6] et al Based on the biogas feedstock and its generation cycle, a considerable part of biogas ingredients are noncombustible gases. In this study, characteristics of biogas are investigated under various combustion regimes such as biogas conventional combustion, hydrogen-enriched biogas traditional combustion, biogas flameless mode and hydrogen-enriched biogas flameless combustion.

2.0 WORKING METHODOLOGY

A. Biogas Generation

Biogas generation process takes place in three different stages as follow,

- Biogas generation
- Biogas filtration
- Biogas to Electricity

The Biogas is generated by the anaerobic digestion of organic waste in a Biogas digester. A Biogas digester is a setup used for anaerobic digestion to take place, this work consists of a Biogas digester of 50 litres capacity. The digester consist of an inlet port for loading the organic waste, an outlet port for removing the sludge, and a gas outlet port for collecting the Biogas. The Biogas is collected in a rubber tube-tyre. The Figure 1 represents the schematic representation of a Biogas digester.

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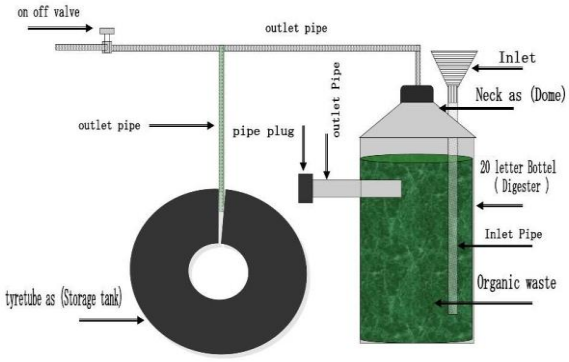

Fig 1. Biogas Digester Setup

B. Biogas Filtration

The raw Biogas collected from the digester consists of several impurities such as$Co2$, moisture, traces of $H2S$ gas and other dust particles. In order to improve the efficiency of the Biogas these impurities must be removed from it. In this work we are going to remove the traces of $H2S$ gas, which is a highly corrosive gas which affects efficiency of the Biogas. The filtration process carried-out in this project is a single stage filtration process, in which the raw Biogas is allowed to pass through a basic solution ($NaOH$ solution) which in turns reacts with the raw Biogas and neutralize the traces of $H2S$ gas. Then the filtered biogas is used for various applications. The Fig 2 represents the Biogas filtration process.

C. Biogas to Electricity:

In this work we are using the Biogas produced to run a miniature steam turbine to generate electricity which can be utilized for operating several electronic devices. If we increase the capacity of the steam turbine generator, then the electricity generated will be more which can be used as a power source by implementing off-grid technology in rural and remote areas where electricity cannot be supplied through a long distance lines.
Figure 3 represents the schematic representation of the Biogas to Electricity generation process.

3.0 BIOGAS

Biogas typically refers to a mixture of different gases produced by the breakdown of organic matter in the absence of oxygen. Biogas can be produced from raw materials such as agricultural waste, manure, municipal waste, plant material, sewage, green waste or food waste. Biogas is a renewable energy source.

$$2CH2O \rightarrow CH4 + CO2$$

Biogas with methane content higher than 45% is flammable.
Biogas consists mostly of methane ($CH4$, around 60-65%) carbon dioxide ($CO2$, around 28-30%) and varying quantities of water ($H2O$) and hydrogen sulphide ($H2S$) and some trace amounts of other compounds, which can be found, especially in waste dump biogas (e.g. ammonia, $NH3$, hydrogen $H2$, nitrogen $N2$, and carbon monoxide, CO). The amount of each gas in the mixture depends on many factors such as the type of digester and the kind of organic

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matter. Diverse sludge composition requires diverse/specialized reactor designs to achieve a high conversion.

Properties of Biogas	
Methane	66.5%
Carbon di oxide	30.5%
Humidity	2.5%
Oxygen + nitrogen	0.5%
Traces of H2S	0.1%
Critical Pressure	75-89 bar
Critical Temperature	825°C
Normal Density	1.2 kgm3

Table 1. Properties of Biogas

III. TECHNICAL PROCESS

After loading the biogas digester with the organic waste like cow dung, food waste, and other organic waste, the digester is kept for 10 days undisturbed. Then the methanogens in the organic waste start to produce Biogas as a by product of Anaerobic digestion. The Biogas produced in the anaerobic digester is then collected in a tyre tube for processing and utilization.

Then the tube filled with the biogas is fitted to the NaOH Filtration set-up to start the filtration process. The raw biogas is passed to the inlet port of the filter and it passes through the NaOH solution to remove the traces of H_2S gas and then the filtered gas is passed through the outlet port for utilization.

Figure 2 Biogas Digester

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Figure 3 Tube filled with Biogas

The filtered Biogas from the outlet port is used to light the burner which is used to heat the boiler for producing steam. The steam produced from the boiler is used to rotate the turbine fitted to the DC dynamo which in turns produces DC voltage which can use as a power source for many electronic devices.

If we increase the capacity of the boiler and the generator, then the power generated will be more which can be used as a power source for off-grid technology in remote areas.

4.0 EXPERIMENTAL RESULTS:

A. Electricity Conversion

Biogas can be converted to electricity directly by using a fuel cell. However this process requires a very clean and pure biogas. Therefore this work involves in a generation of electricity using a prototyped gas turbine which converts the biogas in to electricity.

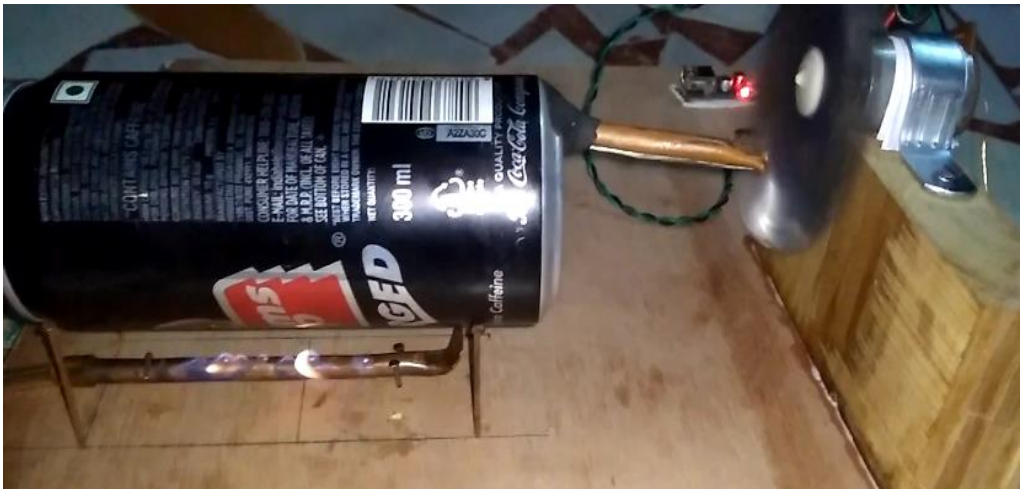

Figure 4 Rotating Turbine using the generated Steam

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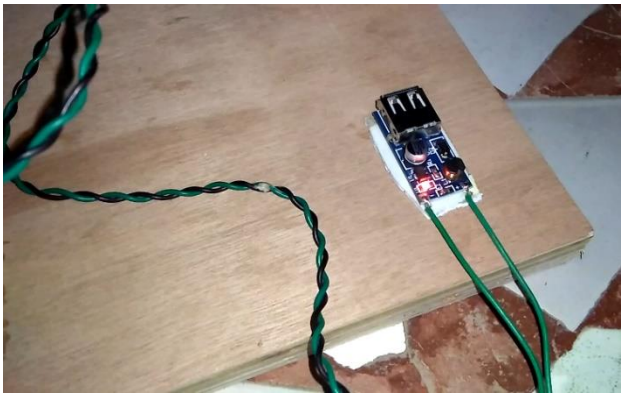

Figure 5 Output LED blinking in the Boost converter

The biogas produced is used to light the burner which is used to heat the boiler for producing steam. The steam produced from the boiler is used to rotate the turbine fitted to the DC dynamo which in turns produces DC voltage which can use as a power source for many electronic devices as shown in Figure.

B. Flash Test

The flame test of the biogas in this work is done by passing the filterd biogas in a burner set-up as shown in the Figure 6. After lighting the burner the biogas burns brightly. The ignition temperature for biogas is about 82.5 degree celcious. Meanwhile the temperature of the flame is 87 degree celcious. The flame is generally considerd of two regions, referd to as preheat and reaction zones.

Figure 6 Lighting of the Biogas in the burner

5.0 CONCLUSION:

By implementing Biogas plants in various areas where large amount of domestic wastes are produced, it can reduce the amount of waste produced in that area. The Biogas produced can be used for domestic purpose. Then the further purified Biogas can be used as a fuel for operating various kinds of engines. “In rural areas where electrical power supply is being a major issue can be rectified by implementing off grid technology using “THE BIOMÜLL POWER GENERATOR”.

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