BIOGAS PRODUCTION USING COTTON STALKS AND PLANTAIN LEAVES

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Abstract
Now, a days the world is getting affected with so many problems. Among that one of the major issue, that polluting our environment is greenhouse effect. Here, is the solution to minimize greenhouse gas is production of gobar gas. Gobar gas otherwise, called as biogas. Also, biogas is the source of producing biofuels, bioenergy, biofertilizer which consists of so many uses in engines, vehicles, fertilizers to the agricultural land. Biogas is the replacement of Liquefied Petroleum Gas (LPG), which is used as cooking gas. Biogas is the renewable source that have the capacity to decompose all the organic matter and biodegradable wastes.so many people know about the biogas, but they won't take any steps to produce biogas. Here, is the paper which could encourage all to produce biogas by their own, also which is very useful for the farmers. One of the world largest agro-waste is cotton stalks and plantain leaves is used to produce biogas. Even the cotton stalks and plantain leaves are used for many plastics plates and boards products, it is difficult to manage by their own and also requires high skilled labour which leads to uneconomical.one of the best way for all of us is producing biogas by the anaerobic process in a compact place with low cost. This is one of the easy method for all the farmers to reduce air pollution by stopping the burning of cotton stalks and plantain leaves waste in over all the world, now a great methodology to get reuse from a waste source is biogas. Biogas production which improves the farmers over all economical level which increases country GDP rate, also protecting their own agricultural land by applying biofertilizer, which is the by-product of biogas production, it cause our country soil fertility getting improved.

Keywords: *gobar gas, cotton stalks, plantain leaves, biodegradable, anaerobic process, bio fertilizer, liquefied petroleum gas.*

Introduction

India has a rapidly expanding economy and the population to fit. This has created many problems such as demand for resources like fresh water, food, fossil fuels particularly with Liquefied petroleum gas (LPG or LP gas), supplies to expanding areas. Like most countries, India mainly uses fossil fuels. However, as resources prices fluctuate and the country's demand for gas and oil grows, the supply doesn't always keep up with the demand. Without a steady and sustainable fossil fuels supply, India has looking more seriously into renewable sources they can produce within the country. Biogas is an excellent candidate to meet those requirements and has been used for this goal before. Biogas is an often overlooked and neglected aspect of renewable energy in India. While solar, wind and hydropower dominate the discussion in the country, they are not the only options available. Biogas is a lesser known but highly important option to foster sustainable development in agriculture-based economies, such as India.

Biogas Plant

A biogas plant is the name often given to an anaerobic digester that treats farm wastes or energy crops. It can be produced using anaerobic digesters (air-tight tanks with different configurations). These plants can be fed with energy crops such as maize silage or biodegradable wastes including sewage sludge and food waste. During the process, the micro-organisms transform biomass waste into biogas (mainly methane and carbon dioxide) and digestate. Higher quantities of biogas can be produced when the wastewater is co-digested with other residuals from the dairy industry, sugar industry, or brewery industry. For example, while mixing 90% of wastewater from beer factory with 10% cow whey, the production of biogas was increased by 2.5 times compared to the biogas produced by wastewater from the brewery only.

Need of Biogas

By providing a non-polluting energy source which is also renewable, the earth is being kept clean of harmful emissions. Biogas is also the ideal way to ensure that all areas have access to electricity. With biogas, the waste that would be there anyway can be used to create fuel. The systems that are used to create bio-energy can greatly contribute to reducing greenhouse gases as they have the possibility of reducing the need to use fossil fuels. By providing a non-polluting energy source which is also renewable, the earth is being kept clean of harmful emissions. Biogas is also the ideal way to ensure that all areas have access to cooking gas. As a fairly cheap source of cooking gas, biogas is a fuel source that has the power to provide decent energy to the world. Deforestation is the result of trees being cut down and used as fuel for fires in areas where there is no access to gas and electricity. With biogas, the waste that would be there anyway can be used to create fuel. This means that trees do not have to be cut down and plants do not have to be damaged.

Objectives

- Cotton stalks are a common agricultural residue used to produce a valuable biogas.
- For nations who struggle to provide employment for people, the production of biogas can be the answer.
- Biogas plants are creating employment opportunities for people across all types of communities.
- Reduction of wastes from cotton stalks and plantain leaves prevents from environmental pollution.

Methods and Materials

Collection of Sources

The sources used in this project are collected from a village named enathikottai, ramanathapuram district, the sources are waste of cotton stalks and plantain leaves. About 23 million tonnes of cotton plant stalks are generated in India annually. On an average about 2 to 3 tonnes of stalk are generated in one hectare of land. Most of the stalk is treated as waste, though a small part of it (15%) is used as fuel. But here is the paper which is helpful for the farmers, where in every home the farmers have to produce their own biogas with simple activities. High cellulose and hemicelluloses contents of CS makes it a potential feedstock for biogas production, it forms a recalcitrant lignocelluloses complex with lignin to the effective conversion to methane. The cultivation of plantain (musa species) results in the waste of plantain leaves amounting approximately 30 tonnes annually in an ace in one crop season in India. The leaves have a wide range of applications because they are large, flexible, waterproof and decorative. India is also one of the largest plantain producing countries in the world. The dried leaves, sheath and petioles are used as tying materials, sponges and roofing material. Plantain leaves are also used for wrapping, packaging, marketing and serving of food. Biogas has been produced from plantain fruits and peels, thereof, however, in this study, the biogas potentials of plantain leaves was carried out.

Experimental Setup

The setup comprised of plastic container of 50 L capacity of reactor capacity 30 L , height of 700mm and diameter of 350 mm. Sample inlet (for pouring cotton stalks and plantain leaves slurry).Sample outlet at the mid half of its height of reactor (bio fertilizer slurry collected).Sample outlet at just above the top of reactor (for gas collecting which connected to the tube and lead to stove). Pressure gauge at the top of reactor (to monitor the pressure inside the reactor). The cycle tube for accumulation of gas kept in a side.

Figure 1 Mixing and pouring the slurry through inlet

Pretreatment Process

The pre-treatment step is the removal of non-degradable waste and storing in a separate place before feeding into the digester. Homogeneity of mixer of cotton stalks and plantain, with water is taken place. Hence, before mixing it with water, both the cotton stalks and plantain leaf are cut in to a small piece in a crushing machine. Before, pouring it in to the digester tank, some amount of cow manure is added and left it for few days, that produce bacteria which consume organic matter that digester. Table 3.1 shows the composition of biogas.

Table 1 Composition of biogas

Constituents	% of Composition
Methane	55-75
carbon dioxide	30-45
Hydrogen sulphide	1-2
Nitrogen	0-1
Hydrogen	0-1
Carbon monoxide	Traces
Oxygen	Traces

Factors Affecting Biogas Production

Biogas digesters are technologies that can produce methane gas for cooking and lighting as well as organic, nutrient-rich bio-slurry for use as a fertilizer. Methane is produced by the anaerobic breakdown of organic materials, particularly biodegradable waste, but other organic wastes including sewage can also be fed into well-managed digesters. A key element to maximizing methane production is to add multiple substrates to the digesters. Environmental factors which influence biological reaction, such as pH, temperature, nutrients and inhibitors concentrations are amenable to the external control in the anaerobic process. Any drastic change in these factors can adversely affect the biogas production.

Stages in Anaerobic Digestion

The four key stages of anaerobic digestion involves hydrolysis, acid genesis, ace to genesis and methanogenesis. The overall process can be described by the chemical reaction, where organic material such as glucose is biochemically digested into carbon dioxide (CO_2) and methane (CH_4) by the anaerobic microorganisms. The process of biogas formation basically runs in four microbiological

Physiochemeical Properties

Before Anaerobic Digestion

Table 2 Properties before anaerobic digestion

Properties	Water	Water + Cowdung
Ph	7.0	7.2
Total solids (mg/lit)	890	1450
Suspended solids (mg/lit)	750	1260
Dissolved solids (mg/lit)	140	190

Below graphical diagram shows the comparison of pH, dissolved solids, total solids and suspended solids results for water and mixture of water and cowdung.

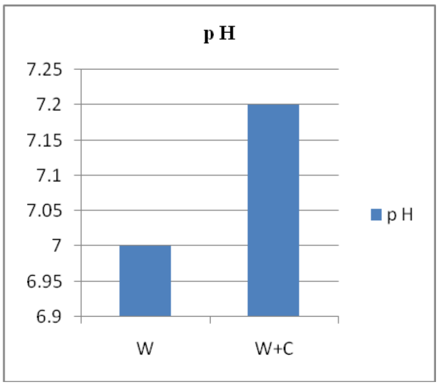

Figure 2 PH before digestion

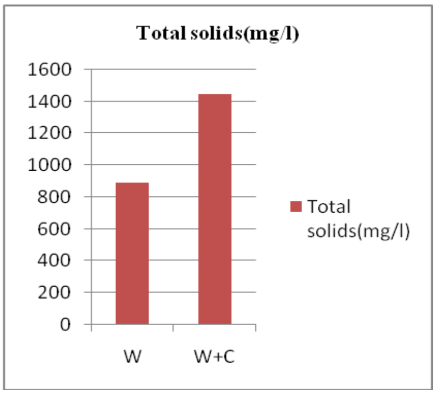

Figure 3 Total solids before digestion

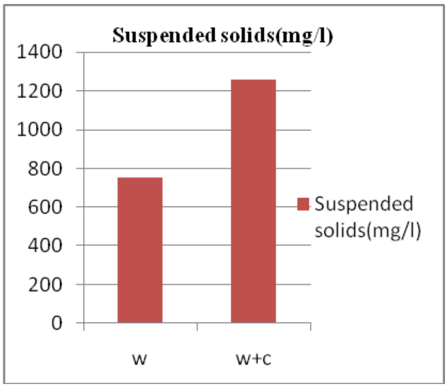

Figure 4 Suspends solids before digestion

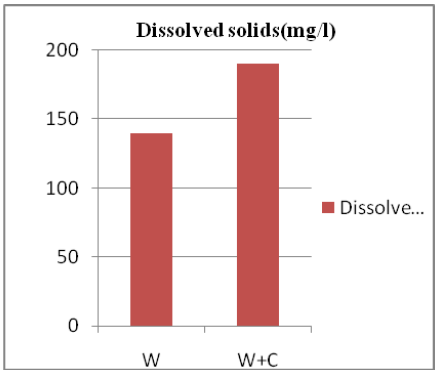

Figure 5 Dissolved solids before digestion

Table 3 Properties after anaerobic digestion

TEST	5th Day	10th Day	15th Day	20th Day	25th Day	30th Day	35th Day
Temperature(^{0}C)	28	33	30	36	37	33	31
pH	7.2	7.0	7.1	6.8	7.3	7.4	7.1
Total solids(mg/l)	890	1020	1410	1530	1870	2160	2400
Suspended solids(mg/l)	750	850	1360	1380	1690	2040	2290
Dissolved solids(mg/l)	140	170	170	150	180	120	110

PH Properties

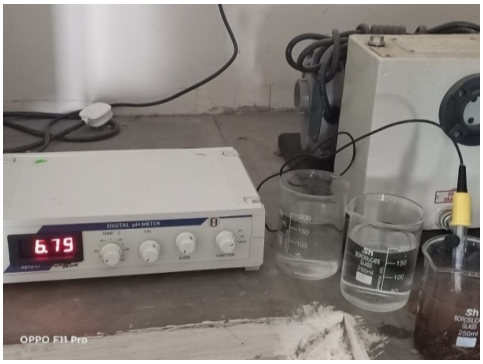

Figure 6 PH in laboratory

We calibrated the electrode with three standard buffer solutions of pH 4, 7 and 9.2.The sample temperature is determined at the same time and is entered into the meter to allow for a temperature correction. We rinsed the electrode thoroughly with deionized distilled water and carefully wiped with a tissue paper and dipped the electrode into the sample solution swirled the solution and we waited up to one minute for steady reading. Figure

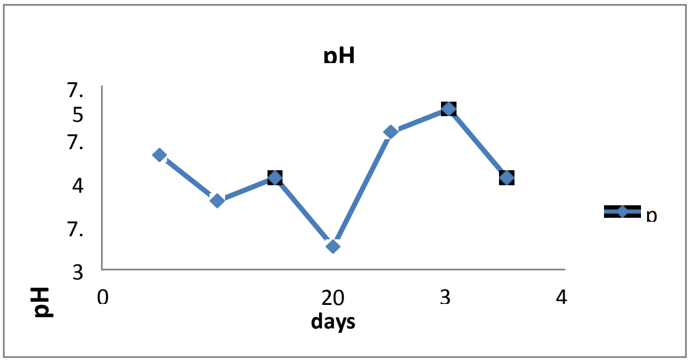

Figure 7 PH results for various days

Temperature

Temperature measurements are usually made at the time of sampling using a mercury filled thermometer. The reading should be made by dipping the bulb of the thermometer well in the sample. Sufficient time should be allowed before constant reading is obtained. The temperature is expressed to the nearest degree centigrade. Figure 5.6 shows the temperature for various days.

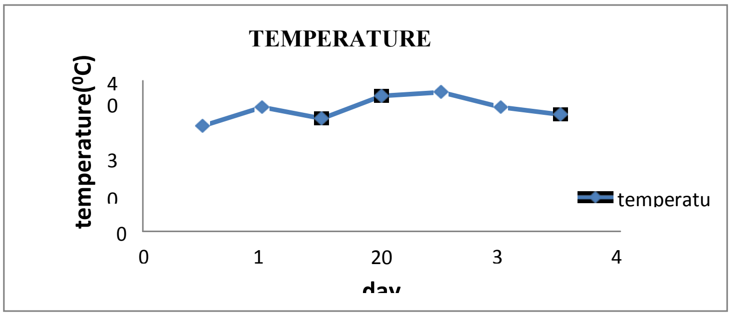

Figure 8 Temperature after anaerobic digestion

Total Solids

Wash and wipe the china dish and dry it in a hot air oven for dryness. Measure the initial weights of dishes by using electronic balance. We have taken 20 ml of sample in a china dish and evaporate in a water bath at 103^{o}c to 105^{o}c. Cool the container to dryness in a desiccators and weigh the dishes again. We noted the increase in weight. The amount of total solids present in the sample can be calculated. Figure 5.7 shows the total solids for various days.

Figure 9 Total solids

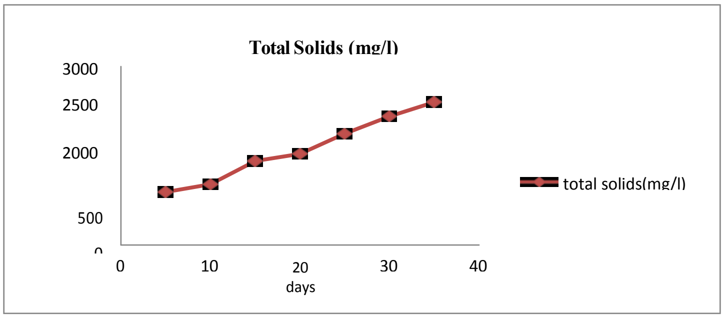

Figure 10 Total solids after digestion

Dissolved Solids

Wash and wipe the china dish and dry it in a hot air oven for dryness. Measure the initial weights of dishes by using electronic balance. We have taken 20 ml of filtered sample in a china dish and evaporate in a water bath at 103°c to 105°c. Figure 5.8 shows dissolved solids for various results.

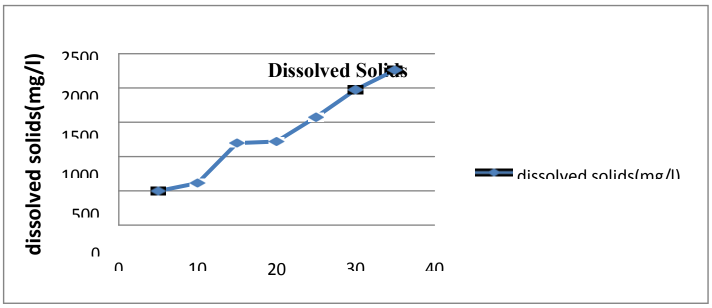

Figure 11 Dissolved solids after digestion

Gas Measurement

Biogas measurement is done either manometrically by keeping the volume constant and measuring the pressure increase, or volumetrically by providing constant pressure conditions allowing measurement of the biogas volume. The rate and volume of biogas produced from anaerobic biodegradability assays include different techniques such as lubricated syringes, volume displacement devices, pressure manometers or transducers, manometer assisted syringes, or low pressure switch meters. Measurement of gas at low headspace pressure is an important requirement to all manometric or volumetric determinations of anaerobic biodegradability. Different researchers have developed different types of displacement gas measurement devices depending upon the research requirements. Gas chromatography (GC) is a popular instrument and has several advantages such as high resolution, high speed, high sensitivity and good quantitative results. GC is an ideal method since it is well suited for the measurement of gas which is in contact with its liquid phase. Samples are inserted into the GC after running the prepared calibration standards of CO_2 and CH_4 . The thermal conductivity detector (TCD) is widely used for the detection of light hydrocarbons and compounds that respond weakly to the flame ionization detector (FID). The TCD is less sensitive than the FID (10-5-10-6g/s, linear range: 103-104). The FID is very sensitive towards organic molecules (10-12 g/s, linear range: 106 –107). The FID analysis is important when measurement is required for small amounts of hydrocarbons as it can give larger signals and hence better precision than TCD.

Results and Conclusion

The study proved that it is possible to produce biogas from a mixture of agrowastes and cowdung. The simplicity of the operating procedures of discontinuous- type installations (batch reactors) is an advantage for popularizing its use. Bio gas is a good quality fuel that can be used as a replacement for firewood and several other energy sources. The figure 15 shows the comparison of a tire tube that is with biogas and without biogas.

Figure 12 Comparative results of gas collection

On the basis of present study, the following recommendation made on batch reactor treating water cotton stalks and plantain leaves with cow dung.

- Ph values were maintained between (6.5 to 7.5) for anaerobic process in the reactor.

- The investigation gives the data about the mixing ratio for the study is suitable as follows 60% of cotton stalks and 30% of plantain leaves and 10% of cow dung.
- The study demonstrates the capabilities of reactor design for biogas production and energy production for the real time study.
- The study also deals the environmental pollution due to burning of agro waste.
- The residue from the reactor is suitable for compost for the crops.

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