BIOGAS PRODUCTION FROM THE MUNICIPAL SOLID WASTE

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***Abstract*- Nowadays gas used in kitchen to cook food is in demand. Biogas is an alternative source which can be used to cook food. It is also be carried out to reduce greenhouse gas emission by replacing the fossil fuels to renewable sources, such as biogas. Biogas typically refers to an odourless gas produced by anaerobic digestion of biomass using microorganisms. It has an approximate composition of 50 - 70% methane, 25 - 50% carbon dioxide, nitrogen 0 - 5%, hydrogen 0 - 1% and some other gases depending on the nature of the biomass. It is an environmental friendly process utilizing the increasing amounts of organic waste produced worldwide. The performance of the anaerobic digestion process is highly dependent on the characteristics of feedstocks well as on the activity of the microorganisms involved in different degradation process. The digestion of municipal sewage sludge (MSS) occurs in three basic steps. During a 30 day digestion period, 80 - 85% of the biogas is produced in the first 15 - 20 days. Higher yields are observed within temperature range of 30 - 60ºC and pH range from 5.5 - 8.5. The Municipal Waste contains low level of nitrogen and carbon to nitrogen (C/N) ratios of around 40 - 70. The optimum C/N ratio for the anaerobic digestion should be between 25 & 35.**

***Keyword*: Biogas, Methane, Municipal solid waste, Carbon dioxide, Anaerobic digestion.**

INTRODUCTION

Municipal solid waste generation is significantly increasing in Indian urban areas and started creating enormous waste disposal problems in the recent past. In India, municipal solid waste management is the duty of the local municipalities. More than 90% of the municipal solid waste which is generated in India is dumped in an unsatisfactory way, what creates environmental hazard to water, air and land, which creates the need of system for municipal solid waste management development capable to minimize the production of these and able to reduce environmental impact and danger the public health. The main product of this treatment, i.e., the biogas, is a renewable energy resource, while the by- product, i.e., the digester residue, can be utilized as fertilizer because of its high nutrient content available to plants (Ward et al., 2008). The performance of the AD process is highly dependent on the characteristics of feedstock as well as on the activity of the microorganisms involved in different degradation steps (Batstone et al., 2002).

Biogas is produced in anaerobic conditions through bacterial reactions through the bio – degradation of organic materials. Biogas is produced as a raw material agricultural waste, plant waste, vegetable waste, municipal solid waste, manure waste, sewage, green waste or food waste. Biogas is a renewable energy source. Biogas comprises of methane (CH_6) and carbon dioxide(CO_2) and may have small amounts of hydrogen sulphide (H_2S) and moisture. The main advantage in using anaerobic digestion is the biogas production, which can be used for cooking, heating and generation of electricity.

SOURCE OF SAMPLE COLLECTION

The source of the sample collected from municipal solid waste. The sources of solid waste include residential, commercial, institutional, and industrial activities. The wastes are more commonly known as trash or garbage consists of everyday items we use and then throw away, such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries, housekeeping wastes, packaging, construction waste and demolition materials, hazardous wastes, ashes, other wastes. etc.,

SEGREGATION OF THE MUNICIPAL WASTE

Municipal Waste segregation means dividing waste into dry and wet. Dry waste includes wood and related products, metals and glass etc., Wet waste typically refers to organic waste or biodegradable waste and other waste .Waste segregation is different from waste sorting. Waste segregation is the grouping of waste into different categories. Each waste goes into its category at the point of dumping or collection, but sorting happens after dumping or collection. Segregation of waste ensures pure, quality material. Sorting on the other hand will end up producing impure materials with less quality.

Methods of Segregation:

Segregation can be carried out manually or through semi- mechanised and fully mechanized

Manual sorting operation:

1. Unloading the waste
2. Manually spreading the waste
3. Hand picking visually identifiable waste for reuse
4. Collecting and stockpiling the remaining waste

Semi-mechanized sorting operation:

1. Unloading of waste (mechanized)
2. Loading of waste on conveyor belts (mechanized)
3. Hand picking of visually identifiable waste off the belt for reuse (manual)
4. Collecting, stocking and reloading the remaining waste (mechanized)

Fully-mechanized sorting operation:

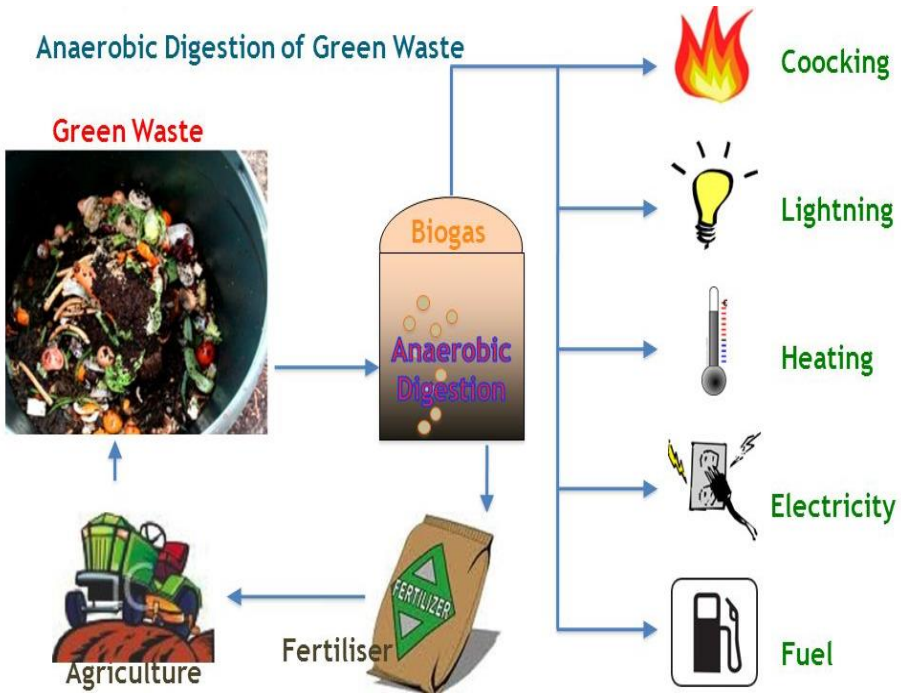
1. Unloading of waste
2. Size reduction of waste through shredders and crushers
3. Size separation of waste using screening devices
4. Density separation of waste
5. Magnetic separation of waste
6. Compaction of waste through balers/crushers

APPLICATION

The beneficial use of solid waste keeps materials out of landfills and reduces the amount of raw materials used in construction and other industries. It can also generate profits for participating organizations and reduce their disposal cost

1. Electricity generation
2. In combined heat and power (CHP) plants
3. Waste Management in agriculture
4. Cooking fuel as a sustainable energy source
5. Injection into a natural gas pipeline
6. As a Clean Renewable Fuel for Transport Vehicles
7. In Biogas Fuel.

ANAEROBIC DIGESTION PROCESS



LITERATURE REVIEW ON BIOGAS PRODUCTION

PULISHER NAME	YEAR	SOURCES OF WASTE MATERIAL	METHANE YIELD	SUMMARY
Zhu	2010	Using an integrated rotary drum for municipal waste	0.38 and 0.19 Lg^{-1} VS	This research was conducted to develop an integrated rotary drum reactor (RDR)-anaerobic-phased solids (APS) digester system for the treatment of municipal solid waste (MSW) to produce biogas energy and achieve waste reduction. A commercial RDR facility was used to provide a 3-d pretreatment and sufficient separation of the organics from MSW and then the organics were digested in a laboratory APS-digester system for biogas production.
Akpan	2015	Biodegradable component of MSW in nsukka metropolis	84277.17m	Since organic wastes are always available and unavoidable too, anaerobic digestion provides an efficient means of converting organic waste to profitable resources. Nsukka metropolis generates a large tonnage of municipal solid waste (MSW) per annum. This in turn has the potential of yielding biogas which is useful for heating and other domestic purposes. In this research, the potential of generating biogas (hence methane) from biodegradable components of municipal solid waste (MSW) found in Nsukka metropolis was assessed.

Sathish	2015	Using industrial waste (press mud)	0.68 m^3	The present work investigates the biogas production was performed using sugarcane waste-Press mud. The laboratory experiment was conducted in floating drum type anaerobic digester capacity of 1m^3 made of fiber material at continues process. The cowdung used as an inoculum of the anaerobic digester. Then raw material feeded as a Pressmud in two state one wet and dry pressmud 1:1 waste/water equal ratio and fermentation process at 30°C to 35°C was maintained in mesophilic condition. The initial pH, biogas yield, Methane concentration, and HRT these parameters was studied in the experiments. The maximum biogas yield was 0.68m^3 and methane concentration was reached in 67%. The maximum biogas production reported as 30min in mesophilic condition using inflammable time. The pH maximum level of 7.1 and end of the digestion period \pH (acid production) was decreased. HRT days calculated as 45 days.
Yebo li	2011	Methane production from organic waste		The principles and application of the SS-AD process are reviewed in this paper. The variation in biogas production yields of different feedstock is discussed as well as the need for pretreatment of lignocellulosic biomass to enhance biogas production. The effects of major operational parameters, including C/N ratio, solids content, temperature and inoculation on the performance of SS-AD are summarized. These challenges can be overcome with the improvement of process and reactor design. Continued improvement of continuous and batch SS-AD processes is necessary to treat not only MSW but lignocellulosic biomass such as crop residues and energy crops.
Kouichi izumi	2010	Anaerobic digestion of food waste		For this purpose, substrate of various particle size were prepared by bead milling to support hydrolysis. The result of pretreatment showed that the mean particle size of substrate ground with a bead mill decreased from 0.843 to 0.391mm and solubilization accounted for approx. 40% of the total COD for grinding pretreatment by bead milling. Furthermore, we plan to investigate the effects of size reduction using persistent organic substrates such as seaweed and phytoplankton in a future study.

Geo joy	2014	Biogas production from food waste using anaerobic reactor		This work was carried out to create an organic processing facility for biogas production in an anaerobic condition which will be cost effective, eco-friendly and eliminate landfill waste problem. From the result it is seen that the generation of biogas is time dependent and takes a few days for its incubation. This is evident because of the fact that the generation of methanogenesis bacteria is progressively retarded with the prevalence of acidgenesis is bacteria because of absence of fresh feed from outside. Therefore to make the process continuous feed supply should be continuous.
Abishek joel J	2015	Biogas from kitchen waste		In this project food waste was collected from different places as feedstock for the reactor. The main objective of this work is to utilize food wastage for generation of biogas. This work was carried out in a reactor comprising of a plastic water tank with a crusher, gas purifier and gas collector using different source of food waste available in SNS college of engineering hostel mess and canteen. The same composition is implemented in the 120 liter digester and the gas produced in measured. The gas produced in this plant can be measured, analyzed and utilized for diesel engine in upcoming days.
Firas Al-Zuahiri	2015	Solid state anaerobic digestion for municipal waste		Experiments were carried out in batch stirred reactors using different amounts of inoculum under mesophilic conditions. The maximum specific biogas production was obtained using the minimum amount of inoculums. The experimental results gave indication about the measures to be adopted to optimize the anaerobic digestion of the MSW. The experimental results showed that, in some instances, a minimum inoculums volume is to be preferred. In order to obtain a further optimization of the process, a selective pressure against methanogens is to be provided.
Shovon Bhattacharjee	2013	Biogas from municipal solid waste		The use of waste biomass to generate energy has a huge potential. This approach can decrease waste management problems, pollution, greenhouse gaseous emissions, global warming and the use of fossil fuels. Waste materials, particularly municipal solid waste, can be a resource if we can safely and efficiently convert it into energy. Converting waste into energy can turn a waste management problem into an energy generating solution in all over the world especially in over populated developing countries.
D Elango	2007	Biogas from MSW with domestic waste	0.36m^3/Kg	In this study, experiments were conducted to investigate the production of biogas from municipal solid waste (MSW) and

				domestic sewage by using anaerobic digestion process. The maximum biogas production of 0.36 m3/kg of VS added per day occurred at the optimum organic feeding rate of 2.9 kg of VS/m3/day. The maximum reduction of total solids (TS) (87.6%), VS (88.1%) and chemical oxygen demand (COD) (89.3%) occurred at the optimum organic loading rate of 2.9 kg of VS/m3/day. The quality of biogas produced during anaerobic digestion process was 68–72%.

ANALYSIS TESTING

The Biochemical Methane Potential (BMP) test is a batch experiment used to determine the maximum methane potential and biodegradability of an organic substrate. During the test, the substrate is mixed with an anaerobic bacteria culture (the inoculum), normally retrieved from an active digester. Optimal conditions for the completion of the process (temperature, mixing, nutrients, pH, alkalinity) must be ensured for the whole duration of the experiment.

Biogas**,** mainly composed of methane and carbon dioxide, is produced during the testing period due to the anaerobic degradation of organic contents of the substrate. Carbon dioxide (acidic gas) can be removed by chemical absorption with alkaline chemicals/chemical solutions: the methane generated from the substrate is then measured and referred to the mass of volatile solids or to the chemical oxygen demand (COD) of substrate added in the test vessel, which is called the biochemical methane potential of the substrate.

CONCLUSION

The paper reviewed about the anaerobic digestion for the production of biogas from municipal solid waste and it has high nutrition value suitable for the production of biogas and the maximum methane yield is 404 mlg $^{-1}$ VS and the minimum methane yield is 0.40 N m3/Kg. The future work will be devoted to achieve a maximum production of the biogas system and it can be applied in different applications

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