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A Review on Biogas Production Using Various Wastes

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Abstract
Sugarcane bagasse is available in plenty in and around communities of almost all major and minor places of India. Among all the potential lignocellulosic sources of biogas production sugarcane bagasse was selected for this study related to enhancement of biogas production and minimization of retention time. It was clearly observed that biogas generation response from sugarcane bagasse treated mechanically was maximum both in terms of production rate and ultimate yield of biogas. Alkaline and acid treatment also led to biogas production but their corrosive effect on the sample might have been the possible reason for being less effective in enhancement of biogas yield as compared to that of mechanical treatment.

Keywords: *Sugarcane bagasse, lignocellulosic, treatment, production.*

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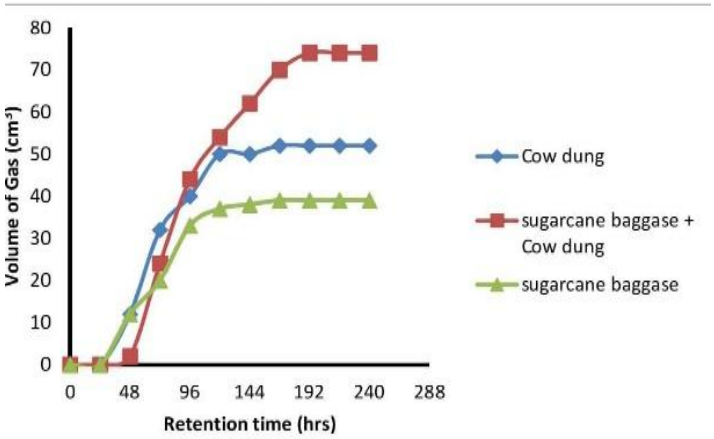
I. INTRODUCTION

The air pollution and global warming are the major problems created by a human being which affects the ecosystem. Some of the greenhouse gases are carbon dioxide (CO2), chloral fluorocarbon, nitrous oxide, etc., which are hazardous to mankind like global warming, caused due to the absorption of heat reflected from earth surfaces and retaining the heat in the atmosphere for a long time. This results in the increasing temperature of the earth's surface, a decrease in annual rainfall, depletion of ozone, acid rains, etc. To mitigate this, one should try and harness alternate source of energy. One of them known for its clean and minimal traces over environmental impact if Biogas energy. Biogas is an eco-friendly fuel that is produced by the anaerobic digestion of different organic and inorganic wastes. Upon considering different positive as well as negative results Biogas has been considered as major renewable energy which can replace conventional fuels. Biogas is produced from wastes that are of no use and can be converted into useful energy. The different types of wastes which we come across in our day-to-day life is municipal solid waste, food waste, industrial waste, sewage sludge, animal manure, and agricultural residue can be converted to biogas. Considering the local and worldwide impact of waste generation from agricultural, industrial in our case sugarcane juice vendor, and other prospective sources of sugarcane waste we reviewed the usage of sugarcane waste for the clean production of gas.

II. Literature Review:

These research papers are about experimental analysis of Biogas production with various compositions. These techniques show scope of use of agricultural, industrial and domestic wastes for energy generation.

Badiyya Hassan Mashi investigated biogas production from sugarcane bagasse, cow dung and co-digestion of the two substrates. In this research, sugarcane bagasse which is one of the most common wastes cellulosic materials was used as substrate to generate gas and to compare the rate of production with the most common substrate use i.e., Cow dung. For the research three bioreactors were taken labeled as A, B & C. 'A' for cow dung's' for sugarcane bagasse and 'C' for mixture of sugarcane bagasse and cow dung respectively. Higher volume of gas was observed when combine effect of cow dung and sugarcane bagasse.



He concluded that agricultural wastes such as groundnut shell, rice straw maize cobs and sugarcane bagasse which naturally have been dumped carelessly as domestic waste especially when co-digested can provide an alternative feedstock for efficient biogas production.[1]

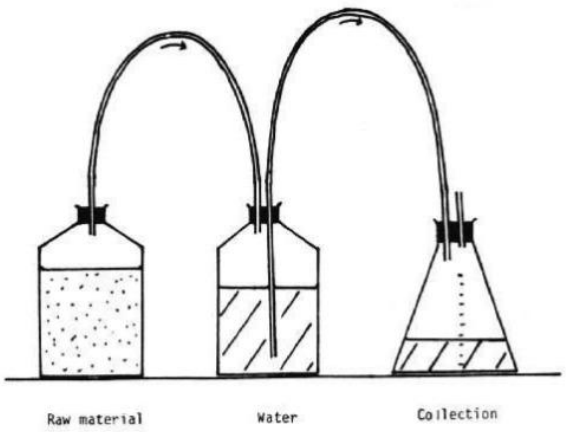
Siswo Sumardiono, Aldi Budi Riyanta focused over the influence of total solid content (TS) and effect of chemical pre-treatment on the volume of biogas. From study it is suggested that Pre-treatment can increase the total yield of methane. This is again subcategorized in Alkaline and Acidic pre-treatment processes. Alkali used as NaOH applied to biomass pre-treatment process. This influences the components of lignocellulose to undergo solvation and saponification reaction and components made of porous lignocellulose into the entrance of the enzyme. Other factors which influence the degradation are the substrate, the water content of the material/substrate, the ratio of C/N and P in the material / substrate, temperature, aeration, presence of toxic (poisonous elements), pH and stirring. Maintaining C/N ratio will create an equilibrium condition for digest

Statistical analysis also showed the content of TS has a significant effect on the biogas production. Higher the total solid of the amount of substrate on anaerobic co-digestion system, so that components with high substrate will easily degrade organic components. In the experiment carried out sample with 2% TS of Bagasse gives the best result. He concluded that pre-treatment and total solid content has a significant effect on yield of methane so can be practiced to maximize the results.[2]

Sthembiso Patrick conducted three sets of 12 independent batch laboratory experiment were carried out at temperature 35 degree Celsius and retention time of 14 days using 500 ml bottles as a digester The result indicated that the effect of feed ratio, media solution pH and digester moisture on biogas volume methane yield, biogas production, maximum biogas production the optimum biogas volume generated by bagasse, sugarcane leaves and molasses were found to be 305.87ml, 522.66 ml and 719.24 ml respectively.[3]

In this case study different pre-treatment methods were reviewed for SCB, both alkaline and alkali–acid process reveals efficient and successful approaches for obtaining higher glucose production from hydrolysis. Procedures for hydrolysis were evaluated, and results indicate that pre-treated sugarcane bagasse was susceptible to acid. Thermochemical processing of sugarcane bagasse also gave excellent biofuel yields. [4]

Figure 1:
Diagram of the experimental digester apparatus



Eight two-liter glass jars were used as anaerobic digesters in a trial to compare biogas production from mixtures of cattle slurry and pressed sugar-cane stalk. The PCS was degraded much more slowly than the cattle slurry, although total production was not reduced significantly by the presence of up to 56.7% PCS (dry-matter basis) in the fermentation mixture. The addition of urea had the effect of increasing pH, and substantially reducing the length of the lag phase of the cumulative biogas production curves. The sugar cane stalk was first pressed in a three-roller mill which extracted about half the weight of the cane as juice (19 o Brix), and then cut into pieces of 1-3cm length to facilitate entry into the digester bottles. Other work has shown that the C:N ratio of cattle slurry is below the optimum of approximately 30:1. However the fibrous PCS degrades slowly and a longer retention time would be needed to extract the same volume of gas as for pure slurry.

Figure 1:
Accumulative biogas production for different percentages of pressed cane stalk. With urea added added at 4% to the pressed cane stalk..

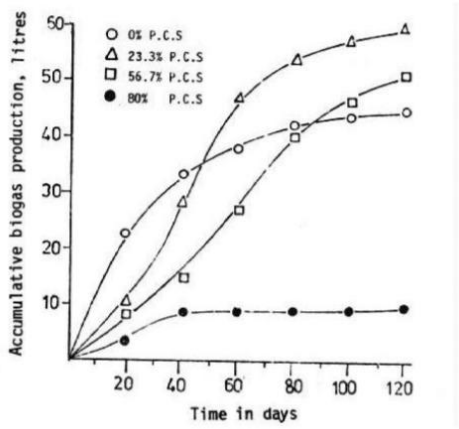


Figure 2:
Accumulative biogas production for different percentages of pressed cane stalk. Without added urea

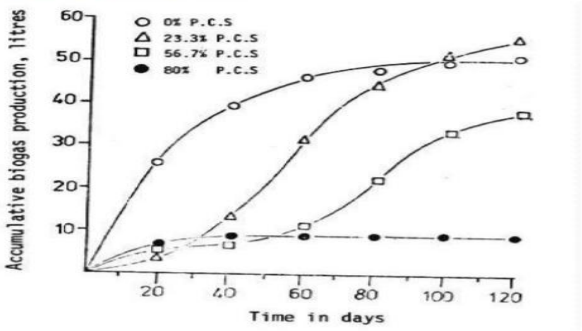


Figure 3:
Variation of pH with time and percentage of pressed cane stalk. With urea added at 4% to the pressed cane stalk

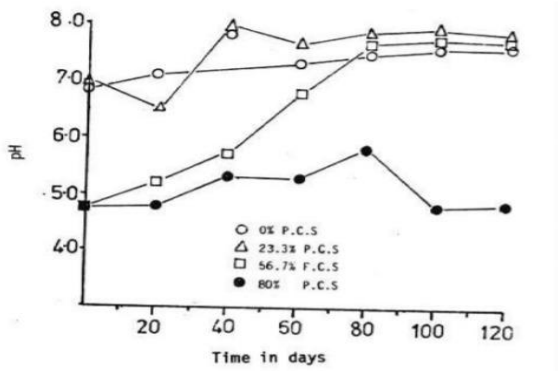
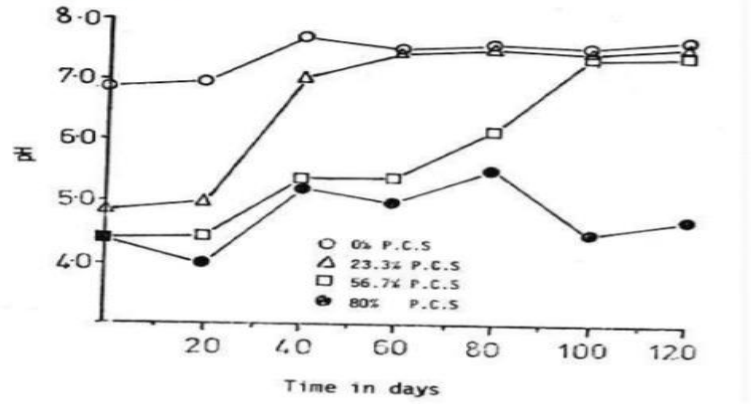


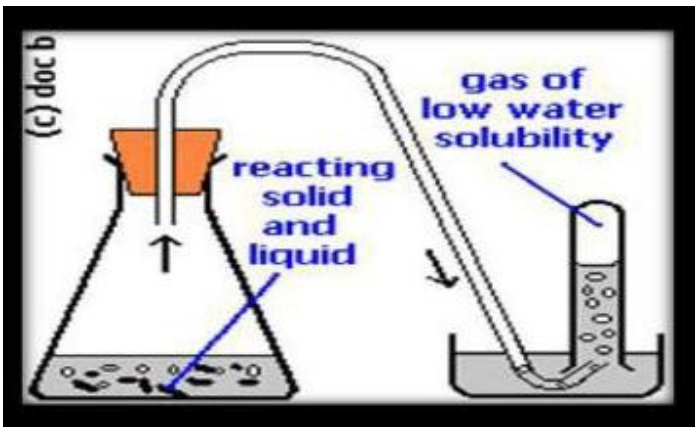
Figure 4:
Variation off pH with time and percentage of pressed cane stalk. Without urea added.

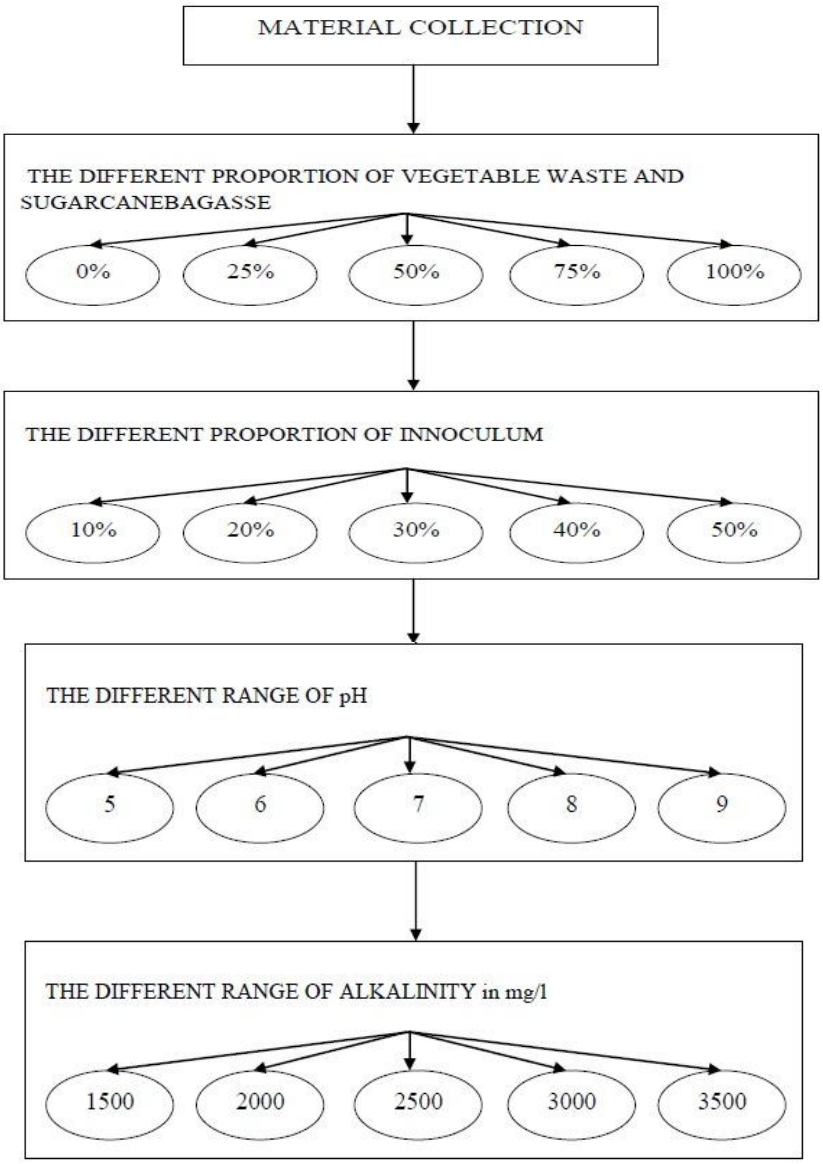


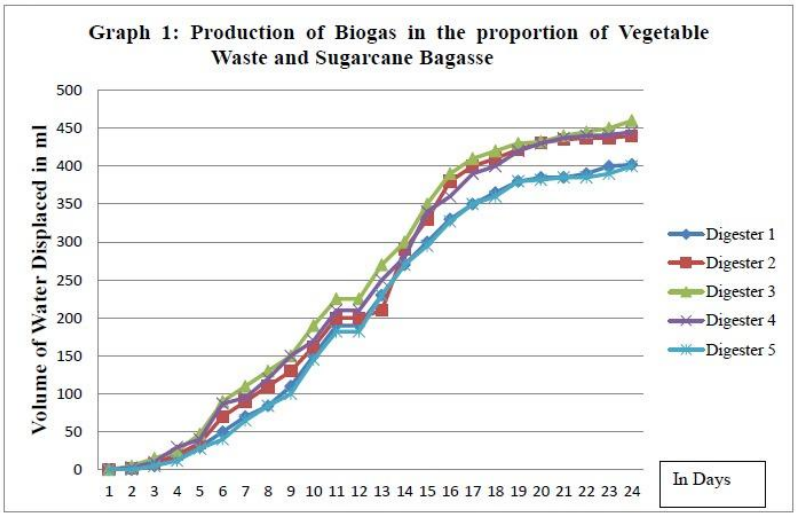
From the consequences of this trial, it is recommended that pressed cane stalk is a potential source for biogas generation and that it can be mixed with farm animals' slurry as much as the level of 56.7% on a dry be counted basis without reducing overall gas manufacturing. but the fibrous PCS degrades slowly and an extended retention time could be needed to extract the equal extent of fuel as for pure slurry. The addition of PCS depresses the pH of the sample and this results in a lag phase whose period depends on the pH. The lag phase may be reduced via the addition of urea.[5]

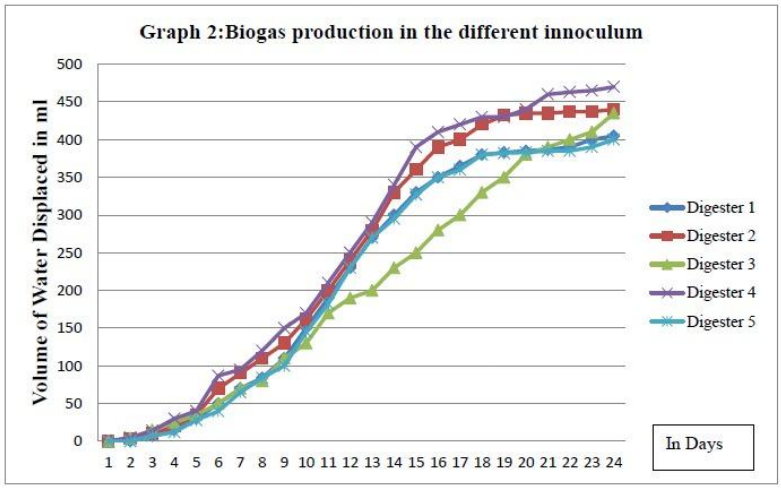
The amount of solid waste generated is continuously increasing and due to the improper handling, its management has become an environmental and social concern. Vegetable waste comprises 12.4 % of the total municipal solid waste (MSW), according to Indian EPA estimates. But now the co-digestion process can be used in the anaerobic digestion process to improve digestion performance. Here they have optimized the different proportion (0%, 25%, 50%, 75% and 100%) of sugarcane bagasse, inoculum, moisture content, pH and alkalinity.

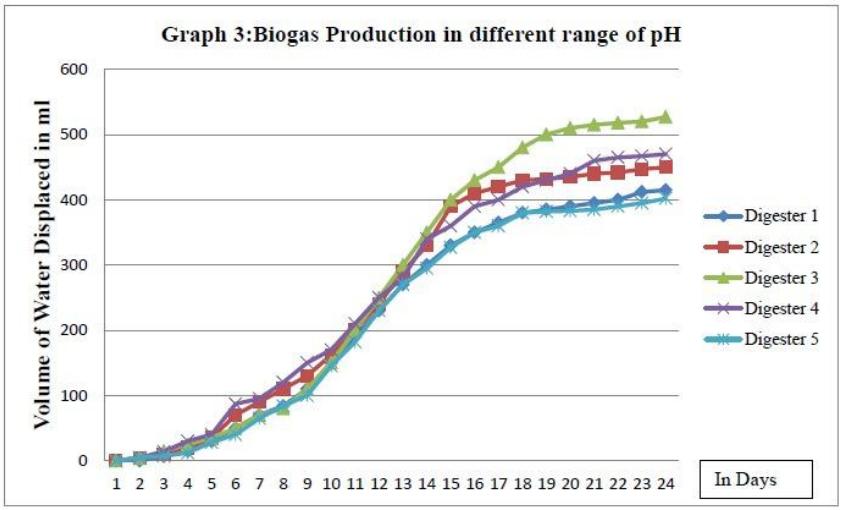
In conclusion, anaerobic co-digestion of sugarcane bagasse waste and vegetable waste appears to be a suitable technology to treat such wastes, obtaining a renewable source of energy from biogas.[6]

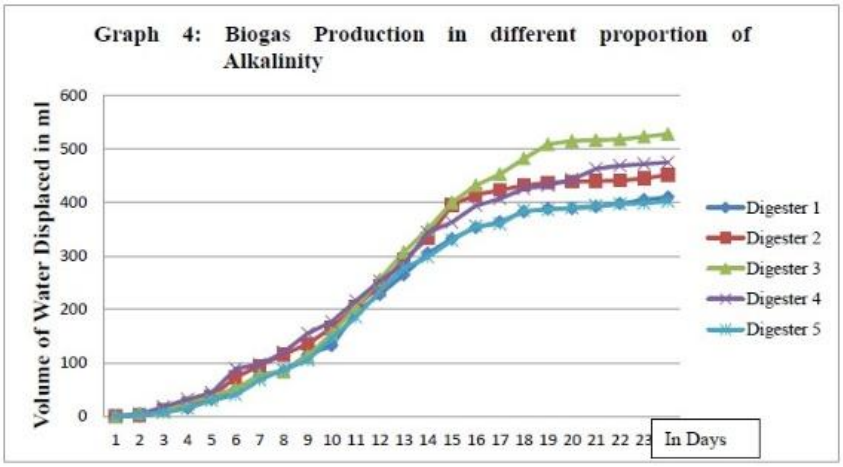



MATERIAL COLLECTION
THE DIFFERENT PROPORTION OF VEGETABLE WASTE AND SUGARCANEBAGASSE
0%
25%
50%
75%
100%
THE DIFFERENT PROPORTION OF INNOCULUM
10%
20%
30%
40%
50%
THE DIFFERENT RANGE OF pH
5
6
7
8
9
THE DIFFERENT RANGE OF ALKALINITY in mg/l
1500
2000
2500
3000
3500


Graph 1: Production of Biogas in the proportion of Vegetable Waste and Sugarcane Bagasse
Volume of Water Displaced in ml
500
450
400
350
300
250
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
In Days
Digester 1
Digester 2
Digester 3
Digester 4
Digester 5







III. CONCLUSION

This review paper enlightens the usage of sugarcane wastes from various sources like agriculture, industries, etc. for generation of clean fuel like biogas. And investigates its production characteristics which depends upon Total Solid Content, Pretreatment, pH, feeding ratio and moisture content of the Feedstock.

The production of biogas is observed to be influenced by usage of the one of the agricultural wastes, sugarcane waste and hence been extensively studied. The production is studied with various variations with modulated total solid content and has been observed to yield maximum with 2% TS and with Acidic and Alkaline pretreatment with NaOH over sample [2]. Also, the influence of pH, feed ratio and moisture content over the rate and yield of biogas production, it can be concluded that pH of 7 and 50% feed ratio is best suitable

[6]. The yield and its rate can be increased with introduction of various additives like urea [5]. And from all above study we can conclude that sugarcane can be a potential alternative for energy generation.

All the research papers give motivation to do research over production of biogas from sugarcane waste for getting better and better results that can be fulfilling of its requirement.

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