International Journal of LNCT

Volume-4 Issue-18 June -2020

ISSN: (Online):2456-9895

EXPERIMENTAL INVESTIGATION ON MUNICIPAL WASTE BLENDED WITH COW DUNG WITH THE EFFECT OF DIFFERENT PARAMETERS

Rajeev kumar[1] and Jitendra Raghuvanshi[2], Dr.Yogesh Dewang[3]
[1]Research Scholar, Dept. of Mechanical Engineering, LNCT Bhopal (M.P.),
[2] Professorate Department of Mechanical Engineering LNCT Bhopal (M.P.),
[3]Professorat Department of Mechanical Engineering LNCT Bhopal (M.P.)

Abstract

With the increase in population excessive generation of waste as an output is seen these days. Among the waste produced high amount of municipal waste gets generated. And with the increase in quantity and reoccurring process of municipal waste generation a numerous steps have been taken place by government bodies to convert these waste into useful form. Considering the techniques for conversion of waste into useful form biogas production using municipal waste is the evolving technique which can result in reduction of municipal waste and conversion into useable form. In the present study a biogas plant was constructed in the LNCT campus for the inhouse production of biogas. This biogas plant was constructed under an initiate to reduce the burden of municipal corporation which gets affected and invest a lot of amount in collection and other activities related to municipal waste.This study opened the door for the execution and implementation of biogas plant in educational campus so as to provide economic benefits for educational bodies at a same time reduction in burden of municipal corporation. Steps like these can benefit the society in economic as well as in environmental safety forms.

Keywords

Municipal Solid Waste, Biogas plant construction, Cost Analysis, Gas emission in Biogas

1.Introduction

Municipal solid waste (MSW) mainly contains food waste, straws, leaves, fruit and vegetable wastes, among which the food waste accounts for the majority of the organic fraction of MSW. According to the reports of 2012, the MSW collected and disposed in China amounted to 1.3 billion tons. As a result, the processing of MSW has become a big environmental problem. Currently, the main disposal method for food waste (FW) in China is landfill (90.5%), with a small percentage of FW being disposed off through incineration and composting. However, these disposal methods are problematic as the FW is putrescible. In landfill situation the organic fraction of FW will gradually produce methane, which has a global warming potential over a 100 year time, 23 times that of CO_2. Many EU countries have introduced high landfill levies, and have even banned dumping untreated MSW. Anaerobic digestion has been suggested as an alternative method for high organic content waste to recovery a renewable energy-biogas in a controlled andefficient ways, producing a potential energy source, e.g., power generation or fuel gas. Different research groups have developed anaerobic digestion processes for different organic wastes such as FW, FVW (food and vegetable waste), and the organic fraction of MSW.

Fig.1 Municipal Solid waste

PROBLEM IDENTIFICATION

Waste is defined as any unutilized raw material or products of a particular process intentionally thrown away for disposal. Unsystematic and unplanned waste management and disposal methods are the key influencing factors for the increase of environmental problems. The main disposal methods for municipal solid waste are open dumping as landfill. The environmental condition of the uncontrolled dumpsites is extremely unhealthy and the cause of severe environmental pollution. On open dumping grounds, foul odors and air pollution are dangerously affecting the surroundings. Rodents are spreading pathogens in the surrounding areas and the workers are highly exposed to disease and hazardous waste. Apart from these the seepage of leachate pollutes the waterways and other water resources used for human consumption. Considering the low water Table in the area this is a serious problem. The cost of maintenance

of the infrastructure of the central sewer disposal system keeps on going up. Some of the sewerage treatment facilities are not properly functioning or abandoned due to lack of proper technology, management and economic issues. The local government authorities currently spend enormous amount of their revenue for collection and disposal of waste. Further the indirect cost to the people due to environmental issues though not quantified is substantial.

2. PROPOSED METHODOLOGY

The main of the current project is to encourage different educational bodies to establish some environmental measure in the form of installing an biogas plant in the campus. The installation of this setup can reduce the burden of BMC at same time providing economical benefits to educational bodies.

1. There is no reported study carried out to estimate the potential of generating biogas from treatment of either MSW that is available within the LNCT CAMPUS area which is further transferred to BMC (Bhopal Municipal Corporation). If biogas is produced from any of these waste materials or in combination of these materials, there is a possibility of recovering some of the cost associates with disposal and treatment of these wastes.
2. The objective is to first identify the environmental conditions and characterize the waste generated within the LNCT CAMPUS AREA.
3. To develop an appropriate bioconversion process that is sustainable by generating energy through methane. Finally, to estimate the methane generation potential of the processes identified.

Work details

For the experimental work municipal waste is used for producing the methane in the biogas plant. Also, the effect of different environmental parameters on the performance of biogas plant is studied. The overall process comprise of various steps which are explained in the below.

1. Selection of working site for the construction of biogas plant.
2. Construction of biogas plant in the LNCT College premises.
3. Selection of raw material to produce biogas.
4. Collection of material for the production of biogas in the plant (Municipal waste and cow dung)
5. Evaluate different environmental parameters in terms of gas produced.
6. Collect the methane produced from the biogas plant and use it for the desired application.

Table 1: Raw materials with quantity used in biogas plant installation

Material	Quantity	Price
Sand	As per requirement	800
Cement	12 PKT	3600
Steel rod		1000
Bricks	650	3900
Stone	As per requirement	1000
Labour Cost	15 days	14250
Miscellaneous (pressure gauge, pipes etc.)		1000
Total		25,550

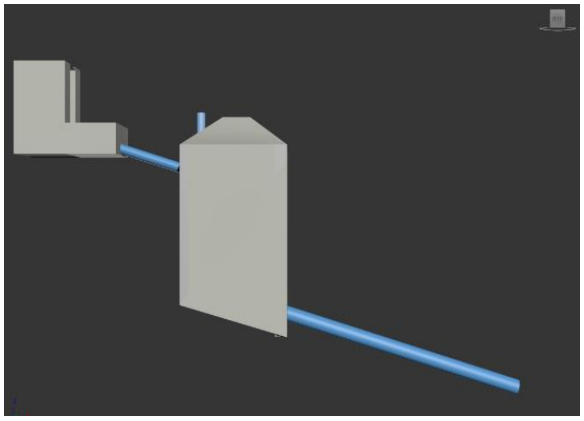


Fig. 2 Design Layout for the biogas plant construction

In the initial phase of the experimental work the waste is collected from the Bhopal municipal corporation but in the future stage the self-generated municipal waste in the LNCT Premises will be utilised for the biogas plant.

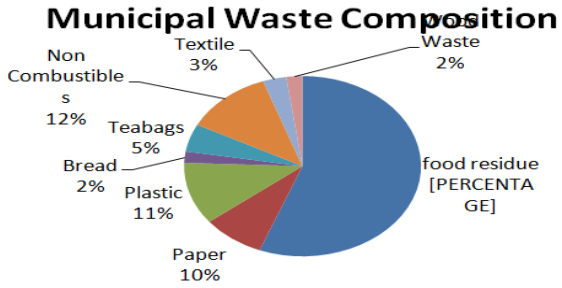


Fig. 3 Municipal Waste Composition

The composition of waste comprised of food residue, wood waste, textile, non-combustibles, teabags, bread, plastics, paper etc.

3. RESULT & DISCUSSION

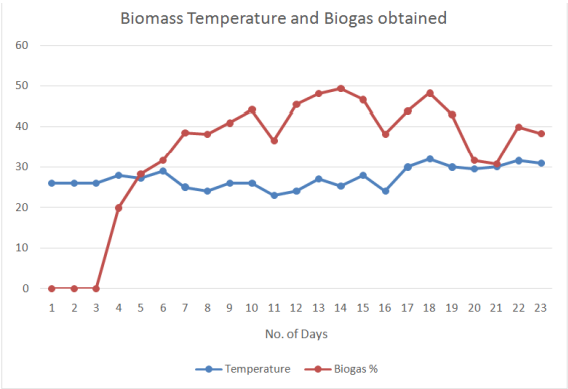
In the present study effect of different parameters like atmospheric temperature, biomass temperature, pressure and pH values were determined to have an overall performance of biogas plant for methane production

Table 2 Different values recorded per day for atmospheric temperature, biomass temperature and pH in terms of methane produced.

DAY	Atmosphere Temperature	Biomass temperature	Pressure (MPa)	pH	CH4
1	31	26.0	0.103	0	0
2	32	26.0	0.106	0	0
3	32	26.0	0.110	0	0
4	31	28.0	0.114	6.57	19.9
5	31	27.3	0.114	6.66	28.3
6	30	29.0	0.113	6.5	31.6
7	29	25.0	0.117	6.8	38.5
8	27	24.0	0.121	7.03	38.2
9	28	26.0	0.120	7.2	40.9
10	30	26.0	0.128	7.16	44.2
11	31	23.0	0.129	7.2	36.6
12	31	24.0	0.124	7.51	45.4
13	28	27.0	0.130	7.34	48.1
14	29	25.3	0.131	7.3	49.3
15	27	28.0	0.130	7.26	46.6
16	30	24.0	0.129	7.52	38.1
17	32	30.0	0.130	7.36	43.9
18	33	32.0	0.131	7.8	48.2
19	34	30.0	0.129	7.28	43
20	32	29.5	0.128	7.16	31.6
21	33	30.1	0.127	7.4	30.8
22	35	31.6	0.128	7.24	39.9
23	36	31.0	0.125	7.16	38.3

Above table illustrates different values obtained for continuous 23 days and which were recorded to evaluate the overall performance of biogas plant with respect to various affecting parameters.

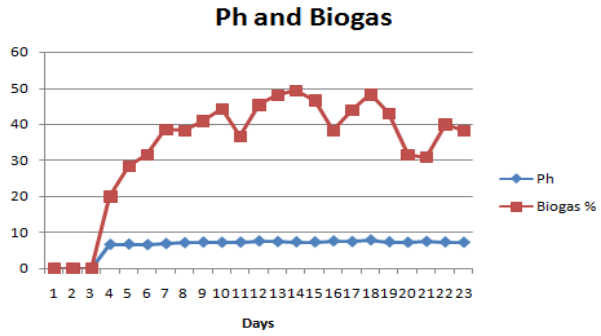
Temperature



Graph 1effect of temperature and biogas obtained for 23 days of working

Above graphs represents the production of biogas with respect to the biomass temperature variations. Biomass temperature means the temperature inside the biogas plant. This graph provides the detail of effect of temperature produced inside the biogas plant on the production of biogas. The graph presents an idea that to a certain limit below approx. 40°C in case of maximum temperature the amount of gas production increase with the increase in biomass temperature.

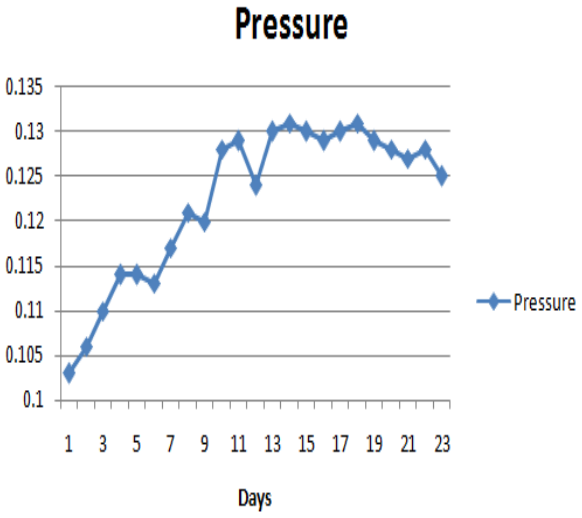
pH value



Graph 2effect of pH and biogas production for 23 days of working

In the graph above effect of pH values on the performance of biogas plant was studies. For the anaerobic reactor biogas plant pH values should remain in between 5-7.5.Once the methane production level has been stabilized, the pH range remains between 7.2 and 8.2. If the pH is higher than 8.5, it will start showing toxic effects on methanogen population.

Pressure



Graph 3variations in pressure values for 23 days of working

Pressure also plays a vital role inside the biogas plant.The accurate amount of pressure is important for biogas production. It has been confirmed through experiments that the biogas production is halted with the hydrostatic pressure, which allows the methanogenic bacteria to raise across 400 - 500 mm H_2O. Thus, lowering the hydrostatic pressure to the desired level helps in resuming the biogas production process.

4. Conclusion and future work

The conclusions of the present work are discussed in this chapter with other future scopes of work. Various conclusion of this study are:

1. Design and construction of biogas plant using municipal waste was successfully installed in the LNCT College.
2. On comparing the performance of biogas plant with respect to the biomass temperature inside the biogas plant it was predicted that temperature enhancement enhances the productivity of biogas plant.
3. Optimum values of biogas production was obtained on 14th day of experimental study with 25°C biomass temperature. Maximum biogas obtained was 49.3 m^3.
4. Maximum pH Value was obtained on 18th day of experimental process i.e. 7.8 in the biogas plant.
5. With yearly use of biogas plant from the waste collected from the LNCT Campus approx. 19 Cylinders of biogas can be obtained. Which comprise of 29,082.62 INR i.e. total revenue generation using biogas plant.

Finally, the output use of this biogas plant and gas obtained can be availed by LNCT College campus canteen for their cooking use which can further result in their cost benefits.

1. Further new materials can be used for the biogas plant and their performance can be determined.
2. Similar techniques in other institutions can be proposed for their economic benefits.

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