Review of Municipal Solid Waste Management Techniques In Institutional Campus – Case Study

Vipul .S. Alkunte[1], Yash.K.Anvekar[2], Dhanraj.K. Khude [3]

[1] BE Student, Dept. civil Engineering, Sanjay Ghodawat Institutions, Kolhapur, India
[2] BE Student, Dept. civil Engineering, Sanjay Ghodawat Institutions, Kolhapur, India
[3] BE Student, Dept. civil Engineering, Sanjay Ghodawat Institutions, Kolhapur, India

---***---

Abstract - *Waste treatment and management has now become a crucial problem due to the inadequate and insufficient collection, disposal and treatment techniques, we are facing a severe problem of environmental pollution in our campus. It is the duty of the campus governing authorities to provide proper solid waste treatment and management techniques in order to keep our campus hygienically clean and environmentally healthy. Even though disposal of the solid waste has become a serious techno-economic problem for treatment, Campus Council is working & planning towards making the campus clean. Two method used in order to reduce this grave problem of disposal is the conversion of the wet waste to electricity and green waste for composting. This paper includes the technology adopted by the campus Council that involves the utilization of the solid waste generated as a resource for the generation of electricity and composting. This paper includes everything right from the way collection of solid waste is done to the generation of electricity using the anaerobic digester and composting from green waste*.

Key Words: **Solid waste management, anaerobic treatment, methane, electricity, composting**.

1. INTRODUCTION

"Waste" is a very important word in the present world which is associated with negative or positive consequences. In the categorical aspects, different types of wastes (e.g. biodegradable and non-biodegradable) are produced but it is very critical to manage non-biodegradable than biodegradable waste. In addition, solid waste makes unprotected or sensitive to living organism and environmental health. According to data collection report, the estimated solid waste generation in the Sanjay Ghodawat University campus is around 3.25 tons per day. Waste is an emerging issue in the developed and developing campus, owing to its negative consequences on environmental and human health. Poor collection, inadequate transportation and insufficient space to treat the waste of entire campus are responsible for the accumulation of solid waste at every corner. Unscientific disposal and treatment has led to an adverse impact on all components of the environment and human health. Solid wastes are usually defined as the organic and inorganic waste materials produced by various activities of the campus and which have lost their value to the first user. Rapid increase in population has led to increased rate in waste generated from several sources as kitchen wastes, institutional wastes, plastic waste and paper wastes etc.

1.1 OBJECTIVES

The main objective of the project is to design a biogas digester and composting to study the efficiency on using a digester for production of biogas with food waste and also to study the feasibility of implementation in campus. The objectives can be listed as below-
To design biogas digesters and test them for biogas production from food waste.
To generate electricity from biogas plant
To produce manure from composting plant.

1.2 WASTE MANAGEMENT STRATEGY

Based on following waste management hierarchy, an assessment of local needs and conditions should lead to the selection of an appropriate mix of processes and technologies.
At source reduction and reuse at source: The most preferred option for waste management is to prevent the generation of waste at various stages including at product design stage, production, packaging, use and reuse stages of a product. Waste prevention helps reduce handling, treatment, and disposal costs and reduces various environmental impacts such as leachate, air emissions and generation of greenhouse gases.
Waste recycling: Recovery of recyclable material resources through a process of segregation, collection and re-processing to create new products is the next preferred alternative
Waste to composting: The organic fraction of garden waste can be composted to improve soil health and agricultural production.

Waste-to-Energy: Where material recovery from waste is not possible, energy recovery from kitchen waste through production of electricity is preferred.

2. DATA COLLECTION OF WASTE

In our campus following types of waste are generated such kitchen waste, plastic waste, paper waste, E waste, garden waste, and construction and demolition waste. For the treatment of waste weight of waste is collected in our campus as shown in table 1.

Table -1: Sample Table format

Kitchen waste	2 tonne/day
Paper and plastic waste	15 Kg/day
Garden waste	200Kg/day
Other waste	30Kg/day

3. METHODS FOR TREATMENT OF WASTE

3.1 Biogas Design Plant size calculations:-

The minimum daily substrate feeding (*min sub fee*d) is equal to the minimum required gas production for the smallest installation divided by the specific gas production min sub feed = min gas produce / specific gas produce.
Min sub feed= 1.00 / 0.040 = 25 kg dung/day
For 2 m^3 waste = 2.00 / 0.040 = 50 kg dung/day
A feeding of dung of 50 [kg dung / day] requires with a 1:1 dung to water ratio an equal amount of water. The minimum feeding (*min feed*) to the plant thus arrives at 100 [litre / day].
For the situation in which the daily feeding corresponds with the minimum feeding amount for which the plant will be designed, the hydraulic retention time is maximal (*HRT max*). The required digester volume (*dig vol*) is equal to the hydraulic retention time multiplied by the daily feeding:
dig vol = HRTmax feed.
dig vol = 60 x 100 = 6,000 [litre]
For the situation in which the daily feeding corresponds with the maximum feeding amount for which the plant will be designed, the hydraulic retention time is minimal (*HRTmin*). The maximum feeding (*max feed*), then, equals the digester volume divided by the minimum hydraulic retention time: *max feed = dig vol / HRTmin*
max feed = 6,000 / 40 = 150 [litre/day]
A maximum feeding of 150 [litre/day], with a dung / water ratio of 1:1, then requires a maximum substrate feeding (*max sub feed*) of 75 [kg/day].
The maximum gas production of this installation equals the maximum substrate feeding (*max sub feed*) multiplied by the specific gas production: *max gas prod= max sub feed* x *spec gas prod*.
$max\ gas\ prod_1$ = 75 x 0.040 = 3 [m^3 biogas/day]

The required gas storage volume for this plant then is 60% of the maximum daily gas production.
Gas storage vol= 0.6 x 3 = 1.8 [m^3]
The resulting **main dimensions** of plant size 1 then are:
Digester volume: 6.00 m^3
Gas storage volume: 1.80 m^3

3.2 Composting Design: -

Daily garden waste generation = 200 Kg/day
= 200 x 30 = 6000 Kg/month
Total garden waste = 6 m^3/month
A useful rule of thumb to prepare a starting mix is Fill waste layer by layer means fill first layer of garden waste spread some water and fill another layer of night soil and silt.
Adopt moisture content 40-45% of waste
Adopt night soil 30% of waste
Adopt silt 30 % of waste
Organic residues and night soil are put in alternate layers
After filling, the pit is covered with a layer of refuse of 5cm.
The materials are allowed to remain in the pit without turning and watering for two months.
During that period, the material settles owing to reduction in biomass volume.
Additional night soil and refuse are placed on top in alternate layers and plastered or covered with mud or earth to prevent loss of moisture and breeding of flies.

For 200 Kg/day,
Night soil required = 30/100 x 200 = 60 Kg/ day
Silt required = 30/100 x 200 = 60 Kg/ day
Total volume = 200 + 60 +60 = 320 Kg/day
Total volume = 320 x 30 = 9600 Kg/month
Means 9.6 m^3/month
Adopt size of composting pit as 4m x 2m x 1.2m
Provide 4 composting pits

3. CONCLUSIONS

The biogas will run well, and the results are beginning to show that will how much gas will be generated from what quantity of kitchen waste. Biogas electrification has a very bright future for a country like India where the conventional grid supplies are unreliable especially in rural areas. A well planned biogas plant in campus will help in the management of organic waste, renewable energy generation, reduction of greenhouse gas. We can conclude that there are different methods for handling different waste. For kitchen waste biogas is provided and for green waste composting is provided. Anaerobic digestion is a sustainable way of waste management. Efficiency of anaerobic digester can be increased by reducing particle size. The bigger the organic solids particle, lower is the biogas production because it takes long time to disintegrate the particle. Currently, there is no proper way of waste management; even landfill site has not been allocated yet. In such situation, organic waste can use for energy production instead of unmanaged dumping. The biogas digester is the best option to

ACKNOWLEDGEMENT

The project was a great opportunity for us as senior students to evaluate our capabilities and Engineering skills, but also to apply the concepts learnt during our bachelor at Sanjay Ghodawat University to a concrete example. We would like to express my sincere gratitude to the people who helped me during my final project.
First of all, we would like to thank Prof. Kulkarni S.A who supervised us very carefully throughout our project. She was patient, comprehensive and very helpful. We are very grateful to her for sharing his knowledge with us and giving us the support that we needed. Her precious advice guided us from the beginning to the end.
We would like to thank also housekeeping staff who helped us finding key information for our project. A special thanks to HOD Dr. Patil N.K and Principal Dr. Kulkarni V.V for helping us gathering information about SGU's waste. A special thanks also for ground and maintenance staff for providing us with enough information.

REFERENCES

[1] A. Apte, V. Cheernam, M. Kamat, S. Kamat, P. Kashikar, and H. Jeswani." Potential of Using Kitchen Waste in a Biogas Plant". International Journal of Environmental Science and Development, Vol. 4, No. 4, August 2013
[2] Ministry of Urban Development, Government of India, "Manual on Municipal Solid Waste Management", 2000 Edition
[3] Ravi P Agrahari and G N Tiwari, "The Production of Biogas Using Kitchen Waste", International journal of Energy Science (IJES)
[4] Andersen, J.K, Boldrin, A., Christensen, T.H. & Scheutz, C. 2009. Mass balances and life cycle inventory for a garden waste windrow composting plant (Aarhus, Denmark). Submitted to Waste Management & Research.
[5] Areivala, S.J.1971. Solid Wastes Disposal in India, Central/Public Health Engineering Institute. Nagpur.
[6] Ramachandra T.V. and Saira Varghese K. 2003. Exploring possibilities of achieving sustainability in solid waste management, Indian Jl Environmental Health, 45 (4):255-264
[7] OMOH, O.L. YUSUF; NWAOGAZIE, L. Ify "Effect of Waste Paper on Biogas Production from Co-digestion of Cow Dung and Water Hyacinth in Batch Reactors "J. Appl. Sci. Environ. Manage. December, 2008 Vol. 12 (4) 95 – 98

BIOGRAPHIES

ALKUNTE VIPUL SUNIL
BE student, Dept. of Civil Engineering, Sanjay Ghodawat Institutions, Atigre, Kolhapur, India

ANVEKAR YASH KISHOR
BE student, Dept. of Civil Engineering, Sanjay Ghodawat Institutions, Atigre, Kolhapur, India

KHUDE DHANRAJ KUMAR
BE student, Dept. of Civil Engineering, Sanjay Ghodawat Institutions, Atigre, Kolhapur, India