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Design of Energy Recovery Plant from Municipal Solid Waste

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***Abstract*— In modern world, due to rapid urbanization and increase in population, it becomes biggest challenge with management of wastes i.e. especially solid waste. Improper management of such waste can cause pollution and many health hazards to humans and environment. In olden days the wastes may be compost and reuse it as organic manure, but now-a-days due to increase in urbanization and industrialization it is not possible to follow all those. So, waste rate is increasing day by day and due to that reason, we need to have a sustainable waste management method without harming environment.**

The present study mainly involved with over view of current situation of waste management at Vikarabad, Telangana. For this study we have analysed the present methods of waste management following for Vikarabad town. And we have also interviewed many residents for accurate information and challenges to present methods of waste management. After preparing the assessment, we proposed various methods to accomplish sustainability in MSW management and also proposed a plant to recover energy from waste.

Keywords— Anaerobic digestion, bio-degradable, energy from waste, municipal solid waste, Vikarabad, wet waste.

I. INTRODUCTION (*HEADING 1*)

The concept of using waste to generate energy is not new. Incineration, which generally entails burning municipal and industrial waste to produce heat, and power generators that produce electricity for distribution, has been around for years. Traditional methods are, however, extremely inefficient and typically emit high concentrations of harmful emissions and toxins into the atmosphere.

Energy from waste offers recovery of energy by conversion of non-recyclable materials through various processes including thermal and non-thermal technologies. Energy that is produced in the form of electricity, heat or fuel using combustion, pyrolization, gasification or anaerobic digestion is clean and renewable energy, with reduced carbon emissions and minimal environmental impact than any other form of energy.

Waste-to-Energy can thus be defined as the process of generating energy from the primary treatment of waste materials to produce energy fuel sources and is a form of energy recovery. Various energy recovery techniques have evolved over the years, some of which are described briefly below:

- Anaerobic Digestion: A biochemical conversion of organic material that goes through a fermentation process where enzymes break down and decompose organic materials. Depending on the organic matter, methane and alcohol can be captured during the decomposition process.
- Landfill Gas Recovery: Various techniques that capture gases that are released from the slow decomposition of landfill. The main gas released is methane which can be used as a cooking gas or even in some types of engines and turbines.
- Gasification: Gasification is a process of chemical decomposition of various types of waste material, also known as feedstock, such as municipal solid waste, oil residue, petroleum coke, biomass and coal waste by exposing it to heat and reduced oxygen.

Anaerobic digestion is a slow process. Here in micro organisms are used to destroy the biodegradable content. No oxygen is present during this procedure. It is used both domestically and even on a commercial level to tap the release of energy during the process and use it. Anaerobic technologies are seen as good agents to reduce the green house gases from the atmosphere and also as a worthy replacement of fossil fuels. The process works as a boon for developing countries for creating low energies for cooking and lighting in homes. Both China and India have mastered the usage of this technology, employing it as a part of their respective development schemes and investing in it. Bio gas is used to run a gas engine, and energy is created for small scale use. There are two possible aims for anaerobic digesters. It can be either used to treat biodegradable waste or to produce saleable products (heat, electricity, fertilizers or cattle eatables). In this case we aim to produce as much as biogas from anaerobic digesters for generation of electricity. Most valuable use of anaerobic digesters are to combine both and by product use.

II. PROJECT SITE

Vikarabad is a town in Vikarabad district of the Indian state Telangana. It is located in Vikarabad mandal of Vikarabad revenue division. It is one of major town which is developing under Telangana state. Due to which it need major changes at regarding tackling municipality waste generation. Vikarabad is an upgrowing town and they are developing at very fast rate due to tourism and growing populations to meets its demand. The municipality of Vikarabad is tackling and finding a new remedies regarding generations of waste at very high amount. Municipality of vikarabad is the following method for waste generation i.e. composting.

III. Current practices of waste management at Vikarabad

1. Collection and conveyance of Municipal solid waste

Collections that are following by that town are door to door step method for collection that Municipality had given to dustbins for every residential and commercial buildings for residential buildings and municipal waste they kept dustbins. They transfer the solid waste by three- wheeled motor rikshaws.

2. Treatment of Municipal solid waste

Composting using earthworms as biological agent to produce high quality is termed as vermin composting, vermin compost contains major and minor nutrients in plant- available forms such as enzymes, vitamins and plant growth harmone.

Segregated biodegradable waste is fed to the bed prepared in alternate layers of waste and cow dung slurry each layer may have thickness of 15-20cm. For the first 25days, the heap has to be kept moist by watering and mixed at random to distribute the worms. It is advisable to cover the pits to prevent the top layer from getting dried. After 45 days, the manure shall be kept heaped for a few days for maturity and then can be packed and marketed.

IV. Design of anaerobic digestion tank

1. Date generation:

The primary data required to design anaerobic digestion tank are as follows:

S. No.	Parameter	Details
1	No. of households	8877
2	No. of offices & institutes	158
3	Wet waste generated per day	11 Metric tons
4	Dry waste generated per day	8 Metric tons
5	Mixed waste generated per day	10 Metric tons

2. Design parameters:

Primary sludge
Solids (TS) produced = 11tonnes/day =11000kg/day
TS concentration = 5%
Specific gravity =1.02
Volatile solids (VS) = 65%
Thickened waste activated sludge TS produced = 907 kg/day
TS concentration = 4%
Specific gravity =1.00
VS = 75%

3. Calculations:

Daily Sludge Volume
Primary sludge volume = 11000 kg/day (1.02 ×1000 × 0.05) = 216m3/day
Thickened WAS volume = 907 kg/day/(1.00 ×1000 × 0.04) = 23m3/day
Total sludge volume = 216 + 23
=239m3/day

Digester volume
Assume SRT = HRT = 15d
volume = Q ×HRT
= 239 × 15 = 3, 585(m3)

Solids loading rate
Total VS produced = (primary sludge produced ×V S%)+(W ASproduced×V S%)T otalV Sproduced
= (11000 × 0.65) + (907 × 0.75) = 7830kg/day

VS loading rate
= V S produced/digester volume
= 7830/3585
= 2.184kgV Sm^{3}d

Digester Sizing
Assume 4 cylinder digesters with 15m diameters Active volume of each digesters.
= 3585/4
=896.25m^3
Surface Area = $2\pi rh + 2\pi r^2$
= $2\pi \times 7.5 \times 15 + 2 \times \pi \times 7.522$
= 1056m^2
Active Depth = Volume/ Surface Area
= 3585/1056 = 3m
Additional depth for Grit deposit (in addition to conical bottom) = 0.5m
Scum blanket = 0.5m
Space below cover = 1.00m
Total additional depth = 0.5+0.5+1 = 2m
Total side wall depth = 3+2 =5m

4. Output:

The volume of organic waste produced per day (Vikarabad)= 11tonnes/day

As per the current knowledge and practical data, approximately about 15-25 kg of organic waste can produce biogas of 1m^3.

Therefore, the quantity of biogas that can be generated Waste produced from Vikarabad: Biogas produced from daily waste = 11000/ 15-25 =733.33 to 440m^3

Biogas produced annually = 733.33 to 440m^3 ×365 = 2, 67, 665.45to1, 60, 600m^3

V. Conclusion

Anaerobic digestion contributes to reducing the greenhouse gases. A well- managed anaerobic digestion system will aim to maximize methane production, but not release any gases to the atmosphere, thereby reducing overall emissions. Anaerobic digestion also provides a source of energy with no net increase in atmospheric carbon which contributes to climate change. The feedstock for anaerobic digestion is a renewable source, and therefore does not deplete finite fossil fuels. Energy generated through this process can help reducing the demand for fossil fuels. This project will solve the energy demand at Vikarabad.

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