

Model Colony Solid Waste Treatment –A case study

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Abstract - Due to insufficient and inadequate collection, treatment and disposal techniques, waste management as well as treatment has become a critical issue and we are facing stern problems related to the environment. In order to avoid this grave problem of solid waste treatment and management, it is the duty of every local authority to provide proper facilities for the same. In spite of this crucial problem of solid waste collection, disposal and treatment, Pune municipal council has provided such efficient and proper facilities in which solid waste that is generated is collected and used as a resource for the generation of electricity. Due to this ultimately the burden or rather the environmental issues are reducing to such an extent that the problems in the vicinity where this plant is located is minimal. This paper includes everything right from the way collection of solid waste is done to the generation of electricity using the anaerobic digester.

Key Words: Solid waste treatment, biodegradable waste, electricity, biogas

1.0 INTRODUCTION

Today, Solid Waste Disposal technology is an urging field & it is also needed for further survival & welfare of human being. Being environmental engineers staying updated with the latest trends and technologies as well as advanced and practical applications has become very crucial in order to survive in the co-operate world. Similar to many imminent cities, Pune also faces a major shortfall in the demand and supply gap in its waste management services due to huge population escalation and small scale waste management services.

About 2500 TPD waste collected 68% is domestic waste coming from residents, 11% from street sweeping and drain cleaning, 10% from hotel and restaurants, 5% from Construction and demolition Waste, 4% from market and commercial area, 2% from Fruit, vegetable, fish, meat market waste, Bio-medical waste etc. Thus it is seen that the residential, street sweeping and hotel -restaurant are the major waste generation sources. The PMC is responsible for collection, transportation and disposal of the above waste except untreated bio-medical waste. Pune city's approach for

its solid waste management is non conventional. They accept the solid waste as a resource rather than a matter to dispose.

ENPROTECH solutions approach towards waste management is done in a comprehensive manner with careful selection and sustained application of appropriate technology, working conditions. We carried out a case study at one of their Solid Waste Management projects i.e. model colony Pune.

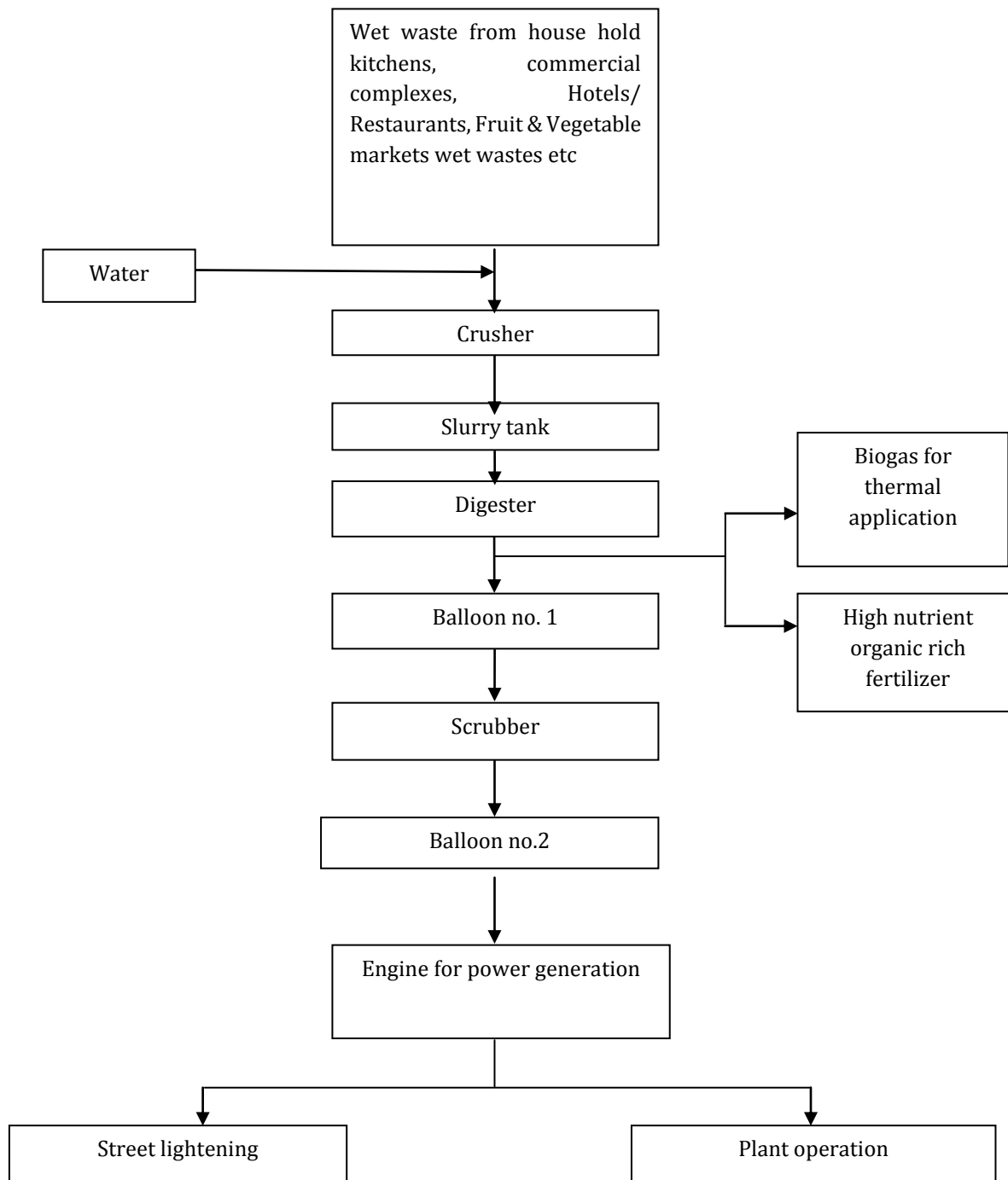
Environmental Protection Techniques (Enprotech) solutions Solid Waste Management Project

This project consists of a 1X5 TPD Capacity decentralized bio-methanation-cum-power generation plant at ward no. 34, Pune, to treat segregated organic MSW—commissioned on 1st November 2009. The basic philosophy of setting up this plant is to treat the wet organic wastes in an appropriate manner at source point itself in a most environmental friendly manner. Solid Waste Management Project is one of the most important & significant aspect of this entire exercise.

The model colony biogas project plays an important role in maintaining the health & sanitation of model colony area of Pune. It is one of the well functioning plants in Maharashtra. The important features of the plant are mentioned below:

- Location : Model colony, Pune
- Commissioning of the project: 1st November 2009
- Capital cost :60 lakhs
- Plant Capacity: 1X5 TPD per day segregated organic biodegradable municipal solid waste.
- Type of process: Biomethanation through Two Stage Biomethanation Process
- Biogas Generation :250-300 m³/day
- Electricity Generation :375 kWh/day
- Manure Generation :500 kg/day (on 50% Moisture Basis)

2.0 Flow Sheet



2.1 Process Components

The project includes the following sections:

- A. Waste Reception and Fine Segregation Section
- B. Mechanical Crushers – 2 crushers of 5 HP each.
- C. Two Stage Anaerobic Reactors - 200 m³ (With Aeration, Biogas & Leachate Recirculation facility)
- D. Manure Handling Section – 35 m²
- E. Biogas Collection Section – 2 collection sections of 75 m³ each in Neoprene Rubber with an enclosure.
- F. Biogas Cleaning System – CO₂ & H₂S Scrubbers, Pressure Vessel & Vacuum Pump.
- G. Power Generation – 40 KVA 100% Biogas based Indian Engine.

As the main aim of setting up this plant is to treat the wet organic wastes at source point itself in a most environmental friendly manner, this helps PMC directly in saving on transportation of such wastes to the landfill site which is about 22

kms away from the model colony area. The major portion of MSW is the organic fraction (40-60%) this kind of waste can be easily treated by anaerobic digestion.

Apart from this, the solid wastes generated in urban areas from vegetable markets, hotels, hostels, kitchen wastes etc. are also preeminently suited for this process due to the presence of high moisture and organic fractions (up to 90%). The total solids in the organic waste decompose rapidly (i.e. is highly putrescible) and therefore these wastes can be treated by biomethanation process (more commonly called Anaerobic Digestion, AD) in more effective manner.

In this process the waste that is generated within model colony area i.e. (From house hold kitchens, commercial complexes, Hotels/Restaurants, Fruit & Vegetable markets wet wastes etc).

2.1.1 Stage 1 Waste Reception and Fine Segregation Section

About 5 TPD per day segregated organic biodegradable municipal solid waste is collected from the above mentioned places by means of trucks/tempo. This waste also contains non biodegradable material such as plastic, glass, metal, etc (about 2-5%). All such material is removed manually which is referred as 'Fine Segregation'. After the non-biodegradable material is separated from the wet waste, water is added to this wet waste in 1:1 proportion.

2.1.2 Stage 2 Mechanical Crushers

This is further crushed in the shredder (mechanical crushers) to convert it into a paste like slurry before it is fed to the primary digester.

2.1.3 Stage 3 Two Stage Anaerobic Reactors

The resulting slurry is then treated in an anaerobic digester where microorganisms break down the organic matter into a stable residue, and generate a methane-rich biogas. This is done in the absence of oxygen. About 250-300 m³/day of biogas is generated every day. The resulting gas is stored in a balloon made up of Neoprene rubber.

2.1.4 Stage 4 Biogas Cleaning System

The generated biogas is cleaned with the help of Scrubbers. In this scrubbing process, moisture and H₂S contents and to certain extent CO₂ gets removed to an acceptable level.

2.1.5 Stage 5 Biogas Collection Section

The resulting purified biogas is stored in a biogas balloon, which is made up of Neoprene rubber.

2.1.6 Stage 6 Power Generation

The purified biogas is then supplied to the 40 KVA Indigenized biogas engine that uses 100% biogas to generate electricity. 375 kWh/day of electricity is generated everyday. 150 street lights (Mix of 70 / 100 / 250 Watt lights) from Model Colony area are illuminating for about 5-6 Hrs from the electricity generated from this wet waste. Besides this the electricity generated from the plant is also used for in plant operations.

2.2 Manure Handling Section

The solid residue resulting after the biomethanation process basically comprises of solid/fibrous materials and liquids that can be separated in a slurry drying bed. About 50% of the liquid manure is then re-circulated in to the system, as it contains nitrogen and some active anaerobic microorganisms. The fibrous material acts as an effective organic material. 500 kg/day of manure is generated that is being used as manure for PMC's public garden.

2.3 Advantages of Biomethanation Process

- Treatment of organic solid wastes in a closed vessel hence there is no odor.
- Biogas is generated that is used as a source of energy.
- Compact design and therefore has less footprint area.
- Reduce greenhouse gas emissions as biogas is generated from the waste.

- Recycling of organic matter and nutrients is done in the form of manure.

2.4 Indirect Benefits to PMC

- Increases the operational life of existing Sanitary Landfill
- Avoid release of methane gas (from uncontrolled open dumping at landfill site) in the atmosphere, which reduces the serious environmental damages caused due to the emission of methane gas. It stops the release of about 180 m³ of Methane per day in to the atmosphere which is considered to be 22 times dangerous than CO₂.
- Stop release of CO₂ by saving in transportation fuel.
- The project is eligible for availing CDM benefits
- Provide better hygienic conditions to the citizens of Pune.

Chart 1.0 Present Economics of the Plant (Till 31st Oct. 2015)

1	Input	
	Total waste fed to the plant	10,270 Tones
2	Output	
	Electricity Fed to the Street Lights (With 15 KW Load and 151 Street Lights)	129000 kWh (Units) + biogas engine is operated during day time which is being used for carrying out feeding operations
	Manure generated	700 Tones
3	Total savings	
	Savings due to Electricity Generation	165500 kWh X 5.50 Rs./kWh = Rs. 9.07 lakhs
	Savings due to Manure Generation	700 Tones X Rs.1500 /Tone =Rs. 10.50 lakhs

	Savings in Transportation of wet waste to the landfill site	10270 Tones X Rs. 650 Rs./Tone = Rs. 66.72 lakhs
	Total	Rs. 85.84 lakhs
4	Operation and maintenance cost for 72 months	Rs. 39.00 lakhs
5	Total Savings in 72 months	Rs. 46.84 lakhs
6	Capital Cost of the Project	Rs. 60.00 lakhs (Subsidy from Ministry of new and renewable energy MNRE -12 lakhs PMC Share -48 lakhs)

CONCLUSIONS

After carrying out a detailed case study on Solid Waste Management project of Enprotech solutions at Model Colony, Pune, we have drawn the following conclusions:

- The entire process of MSW disposal & treatment plant is understood.
- Biomethanation cum electricity generation Plant plays very important role in treatment of solid waste of Pune city.
- This plant is also closely concerned with sanitation of city.
- It treats only the wet waste from house hold kitchens, commercial complexes, Hotels/Restaurants, Fruit & Vegetable markets wet wastes etc) and therefore deals only with some portion of the waste i.e. the wet waste. It is therefore not a feasible option for dry waste.
- As the maintenance of the plant has to be done every now and then, it is resulting into the maintenance cost going up.

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