

## “Creating Wealth from Organic Waste: A Success Story of Biogas to Power Project set up by Pune Municipal Corporation, Maharashtra”



Pune Municipal Corporation has taken a remarkable step in developing a segregated municipal solid waste biomethanation projects those serves not only in generating power but also helps in the organising and disposal of waste in the city.

In today's energy deficit world, where conventional sources of energy are fast depleting and at a time when recycling and optimum utilisation of resources is the need of the hour, the city of Pune is setting an example through its biomethanation plants. It is a known fact that, municipal solid waste (MSW) generation in Pune is among the highest in Indian cities with an average of 350-450 gms (with 40% organic matter) of waste generated per capita per day. Pune's current population is >40 lakh and the city generates about 1300-1400 metric tonnes of MSW per day. The source wise broad composition of solid waste generated in the city can be broadly classified as : commercial - 25%; market area - 5%; hotels and restaurants - 25%; and vegetable market - 5%; household - 40%. What's interesting is that the organic and biodegradable portion of the solid waste is 70 per cent which is a significant consideration in the concept of solid waste management. The basic idea behind setting up a biomethanation plant was to treat the organic waste in a decentralised manner, at its source, in the most environmentally efficient way. This helps the PMC save on transportation costs of such wastes to the landfill site which is 22 km away from the model colony area.

**Table 1: Expected biogas, electricity and manure generation**

S.N.	Parameters	Specifications
i)	Plant capacity	1X5 TPD per day segregated organic biodegradable municipal solid waste
ii)	Type of process	Biomethanation through two stage process
iii)	Biogas generation	300 Cum/day
iv)	Electricity generation	375 kW/day
v)	Manure generation	500 kg/day (on 50 per cent moisture basis)

**MEDA's Initiative:-**

The Maharashtra Energy Development Agency (MEDA) is constantly striving to promote decentralised biomethanation cum power generation plants in Maharashtra in urban as well as rural areas. As a part of its initiative, an official visit of Dr. A. R. Shukla, Advisor, Ministry of New and Renewable Energy (MNRE), along with MEDA officials, to the Model colony plant, was arranged on 20<sup>th</sup> February, 2010. Post this visit, it was decided that all such decentralised biogas plants in urban areas ought to be considered for Central Finance Assistance (CFA) under the Biogas based Power Generation Programme (BPGP) of the MNRE, to boost the promotion of such projects. The PMC has installed 11 such biogas to power generation plants at various locations in Pune and is planning to set up many more such projects in the city.

**Biomethanation Process:-**

A major portion (40-60 per cent) of this waste is organic in nature and can be easily treated by anaerobic digestion. The solid wastes generated in urban areas from vegetable markets, hotels, hostels, kitchen wastes etc. are best suited for this process due to the high moisture content and organic fractions (up to 90 per cent). The total solids in the organic waste decompose rapidly (i.e. are highly putrescible) and therefore these wastes can be treated by the biomethanation process, more commonly called anaerobic digestion. The biomethanation plant at Model Colony is based on the two-stage anaerobic process. The sizes of the digesters for the first stage and the second stage are decided on the basis of the suspended organic contents of the slurry to be treated. The first stage fermentation is the hydrolysis stage and the second is the methanation and polishing stage. The first stage is designed to give maximum solid retention time for the hydrolysis and the second stage for acidification and biomethanation process operate in the mesophilic range. In this process, the wet waste generated within the model colony area (from household kitchens, commercial complexes, hotels/restaurants, fruit and vegetable markets wet wastes etc.) is collected and brought to the plant site by the PMC. Though, it is segregated wet waste, it still contains 2-5 per cent non-biodegradable material, such as plastics, glass, metal etc. All such material is removed manually in the first stage, known as 'fine segregation'. Thereafter, the segregated wet waste is mixed with water in 1:1 proportion and crushed in the shredder to convert it into slurry, before being fed to the primary digester. The slurry is then treated in closed vessels called

anaerobic digesters (primary and secondary digesters) where, in the absence of oxygen, micro organisms break down the organic matter into a stable residue, and generate a methane-rich biogas in the process. The generated biogas is cleaned with the help of scrubbers. In the scrubbing process, moisture, hydrogen sulphide and to a certain extent carbon dioxide are brought to an acceptable level and then the purified biogas is stored in a biogas balloon, made up of neoprene rubber. The purified biogas is then supplied to a 40 kVA indigenised biogas engine (run on 100 per cent biogas) to generate electricity. The solid residue which remains after biomethanation process comprising of solid/fibrous material and liquid, is separated in the slurry drying beds. About 50 per cent of the liquid manure is then re-circulated in to the system, as it contains nitrogen and some active anaerobic micro-organisms. The fibre contains an organic material, which is being used as manure for the PMC's public gardens.

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**Project Components:-**

The project includes the following sections:

- Waste reception and fine segregation section
- Mechanical crushers - 2 nos. of 5 HP (horse power)
- Two stage anaerobic reactors – 200 m<sup>3</sup>. In building-block methodology (BBM) - with aeration, biogas & leachate recirculation facility
- Manure handling section - 35 sq. m in BBM
- Biogas collection section - 2 nos of 75 cubic metre each in neoprene rubber with enclosure
- Biogas cleaning system - CO<sub>2</sub> and H<sub>2</sub>S scrubbers, pressure vessel & vacuum pump.
- Power generation - 40 kVA, 100 per cent biogas based I Indian engine.
- Recirculation system.
- Solar water heating system - 500 lt/day

**Advantages:-**

Apart from the fact that the biogas produced is effective in reducing harmful greenhouse gas emissions, the compact design of the plant makes it convenient for use and utilises less footprint area. The treatment of organic solid waste is done in a closed vessel hence there is no odour and organic matter is recycled to generate nutrient-rich manure.

**1. Present Economics of the Plant (Till 31<sup>st</sup> July 2015)**

<b>1</b>	<b>Total Inputs</b>	
1.1	Total Wet waste fed to the plant	9877 Tones
<b>2</b>	<b>Total Outputs</b>	
2.1	Electricity Fed to the Street Lights	129000 kWh (Units) + We

	(With 15 KW Load and 151 Street Lights)	operate biogas engine during day time as well to generate electricity, which is being used for carrying out feeding operations.
2.2	Total Manure Generated	700 Tones
<b>3</b>	<b>Total Savings</b>	
<b>3.1</b>	<b>Savings due to Electricity Generation</b>	165500 kWh X 5.50 Rs./kWh = Rs. 9.07 Lakhs
<b>3.2</b>	<b>Savings due to Manure Generation</b>	700 Tones X Rs.1200 Rs./Tone = Rs. 8.40 Lakhs
<b>3.3</b>	<b>Savings in Transportation of wet waste to the landfill site</b>	9877 Tones X Rs. 650 Rs./Tone = Rs. 64.20 Lakhs PMC is currently spending @ Rs.1300 per ton to collect, transport and to dump the waste at Devachi Urli Landfill site. Even if, it is considered that due to this plant they are going to save at least 50% of the transportation cost.
<b>3.4</b>	<b>Total Savings (3.1+3.2+3.3)</b>	Rs. 81.67 Lakhs
<b>4</b>	<b>O&amp;M Cost for 63 Months</b>	Rs. 36.60 Lakhs
<b>5</b>	<b>Total Savings in 69 months</b>	Rs. 45.00 Lakhs
<b>6</b>	<b>Capital Cost of the Project</b>	Rs. 60.00 Lakhs
<b>7</b>	<b>Subsidy form MNRE</b>	Rs. 12.00 Lakhs
<b>9</b>	<b>PMC Share</b>	Rs. 48.00 Lakhs
<b>10</b>	<b>Payback period with the current performance / economics</b>	Less than 6 years from the date of commissioning of the plant.

#### **Indirect Benefits:-**

Indirectly too, the benefits for the PMC are many. Apart from providing better hygienic conditions to the citizens of Pune, the plant will go a long way in increasing the operational life of existing sanitary landfill. It will help avoid the release of methane gas (from uncontrolled open dumping at landfill sites) into the atmosphere, which can cause serious environmental damages. In other words it stalls the release of 180 cubic metre of methane (which is 22 times more potent than CO<sub>2</sub>) per day into the atmosphere. Further it reduces the release of CO<sub>2</sub> since there is a reduction in the use of transportation fuel.

#### **Present Status:-**

The biomethanation plant has been operational since November 2009. The connected electricity load is 22 kW and 250 street lights (mix of 70 / 100 / 250 W lights) in the Model Colony area are illuminating for 10-11 hours daily. As of 31<sup>st</sup> July, 2015, the biogas engine had generated 129000 kWh of electricity.

