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Waste to Energy- Current Practices and Potential in India

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Abstract

Solid waste generated at domestic level is the single largest component of all wastes generated in our country. A number of research studies have shown that somewhere 300 to 600 gm of solid waste is generated per person per day in our country. Eventually, Municipalities everywhere face the problems of waste collection, processing and disposal or treatment of voluminous solid waste produced by the cities. Moreover, the rains and humidity on the garbage promotes the bacterial multiplication and enhances the spread of infectious diseases. However, due to their rich organic contents, the solid waste can be a good resource to produce manure & energy. It has been estimated that about 70 MW equivalent power could be generated from urban & municipal waste alone. This potential is likely to increase further with our economic growth. The present study includes the current practices of waste to energy in various cities of India. Also challenges and suggestive measures are presented for these cities in this field to achieve sustainability.
Keyword- MSW, Waste to energy, Composting, Bio gas, Methane emission

I. INTRODUCTION

Solid Waste Management in Indian cities has emerged as a major concern over the past few years. The rise in urban population and economic growth in the absence of an effective management mechanism has manifested in the current state of municipal solid waste management (MSWM) in Indian cities which is far from perfect. Given the present situation, the quantum of waste generated in cities especially larger ones with higher population is expected to increase. Greater attention needs to be focused towards devising appropriate and effective mechanisms for waste treatment and disposal in urban centers.[1]

Waste-to-Energy (WtE) technologies consist of any waste treatment process that creates energy in the form of electricity, heat or transport fuels (e.g. diesel) from a waste source. The development of WtE projects requires a combination of efforts from several different perspectives. Along with future technical developments, including the introduction in the market of alternative processes to incineration, it is nowadays crucial to take into account all the social, economic and environmental issues that may occur in the decision making process of this technology. Growing population, increased urbanization rates and economic growth are dramatically changing the landscape of domestic solid waste in terms of generation rates, waste composition and treatment technologies. A recent study by the World Bank (2012) estimates that the global MSW generation is approximately 1.3 billion tonnes per year or an average of 1.2 kg/capita/day. It is to be noted however that the per capita waste generation rates would differ across countries and cities depending on the level of urbanization and economic wealth

II. CURRENT PRACTICES OF MSWM IN INDIAN CITIES

A. Status of Waste Generation and Disposal in Indian Cities

Solid waste management in Indian cities has emerged as a major concern over the past few years. A review of existing literature reveals that a number of studies on municipal solid waste management have been undertaken. In India, municipal authorities are responsible for managing municipal solid waste and are often unable to perform their duties effectively because of lacking in-house capacity to handle the complexities of the process. The quantity of solid waste generated from various cities of India is presented in bar chart in Figure 1 and that of some of the major waste generating cities is tabulated in Table 1(at the interval of five years).

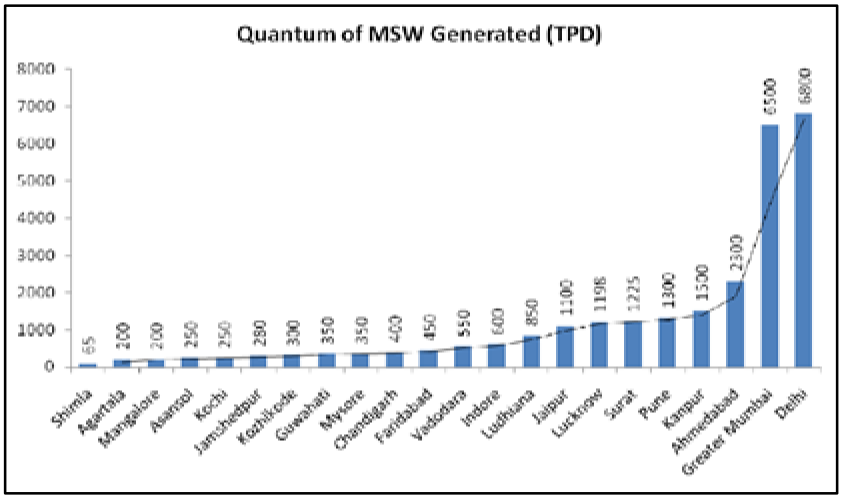

Fig. 1: Bar chart showing quantity of Waste generation in various cities of India

Source: Ref. 1

S. No.	*Name of City*	** Municipal Solid Waste (Tons per day)*		
		1999-2000(a)	*2004-2005 (b)*	*2010-11 (c)*
1	*Chennai*	*3124*	*3036*	*4500*
2	*Delhi*	*4000*	*5922*	*6800*
3	*Hyderabad*	*1566*	*2187*	*4200*
4	*Mumbai*	*5355*	*5320*	*6500*
5	*Surat*	*900*	*1000*	*1200*

Table 1: Solid waste generated in different cities of India

Source: Ref.1

B. Waste disposal practices in Indian cities

An overview of the existing solid waste management practices in various cities of India is presented here.

1) Delhi

Delhi Waste Management was formed in 2004 as a Special Purpose Vehicle (SPV) in the Public Private Partnership (PPP) format for collection, segregation and transportation to landfill sites of municipal waste. The city of Delhi generates 6500 TPD of waste and currently has three dumpsites, where 6400 TPD of waste is supplied. The city does not have an engineered landfill.

2) Kanpur

The city of Kanpur generates 1500 TPD of waste and supplies 1200 TPD of it to the Dumpsite. The city does not have an engineered landfill.

3) Jaipur

The city of Jaipur generates 1100 TPD of waste and supplies 990 TPD to its two dumpsites. The city is under the process of constructing an engineered landfill.

4) Pune

The city of Pune generates 1300 TPD of waste and supplies 1000 TPD to its single dumpsite The city does not have an engineered landfill.

5) Surat

The city of Surat generates 1225 TPD of waste and supplies 1175 TPD to two of its Dump sites. The city already has an engineered landfill and is the process of developing a second one as well.

6) Ludhiana

The city of Ludhiana generates 850 TPD of waste and supplies 850 TPD to its two dumpsites. The city does not have an engineered landfill.

7) Ahmedabad

The city of Ahmedabad generates 2300 TPD of waste and supplies 1800 TPD to the Dumpsite. The city has two engineered landfills [1].

8) In Hyderabad, following facilities are existing
- From doorstep to segregation point
- From segregation point to collection point
- Collection point to landfill

9) In Mumbai,

From all other parts of the city, garbage is sent directly to the dumping grounds. Nearly 95% of the waste generated in the city is disposed of in this manner.

10) Status of Sanitary Landfills (SLF)

45.45 % (10 out of 22) of cities do not have sanitary landfills which includes major generators such as Greater Mumbai, Delhi and Kanpur 27.27 % (6 out of 22) of cities have a sanitary landfill (Ahmedabad, Chandigarh, Jamshedpur, Mangalore, Surat and Vadodara).

Guwahati, Indore and Jaipur are in the process of constructing a SLF and Agartala and Lucknow are considering construction of SLF[1].

III. POTENTIAL OF "WASTE TO ENERGY"

Waste-to-energy technologies can be applied to several types of waste: from the semi-solid (e.g. thickened sludge from effluent treatment plants) to liquid (e.g. domestic sewage) and gaseous (e.g. refinery gases) waste. However, the most common application by far is processing the Municipal Solid Waste (MSW). The current most known WtE technology for MSW processing is incineration in a combined heat and power (CHP) plant. Moreover, higher organic content in waste is suitable for composting also. The methane potential in India from Municipal Solid Waste is discussed herewith.

A. Methane Potential in India from Municipal Solid Waste

Methane constitutes about 29% of the total Indian GHG (greenhouse gas) emissions, while the global average is 15% (IEA, 2008)3. Emissions from solid waste (6%) are also proportionately higher than the global average (3%). India is one of the world's largest emitters of methane from solid waste disposal, producing around 16 Mt CO2 eq 4 per year and is predicted to increase to almost 20 Mt CO2 eq per year by 2020 (IEA, 2008). This growth in methane emissions can be attributed to rapid urbanization in India, with many people moving from rural areas into the cities resulting in an increase in amount of municipal solid waste (MSW) generated per person. [1]

At present, the most common method employed by Municipal Corporations for disposal is dumping of the collected waste at open dumpsites. The waste at these dumpsites consists of rich organic content, which produces landfill gas over time by anaerobic digestion. Landfill gas is rich in methane (40-50%) and carbon dioxide. Gases such as nitrogen, hydrogen and oxygen are also produced in the process in insignificant quantities. The collected gas from large landfills can be effectively utilized as a clean fuel for power generation and gas collected from smaller landfills can be supplied to appropriate industries located in the vicinity of the site for direct use of gas in boilers or other equipment.

B. The Energy Content of Waste

The energy content of a fuel is measured in terms of its calorific value (CV), expressed as Joules per kilogram. In case of coal fuel, a typical value s approximately 30 MJ kg^{-1}, while for oil the value is about 40 MJ kg^{-1}. These values can be compared with that for MSW of about 10 MJ kg^{-1}. In fact that calorific value of MSW has increased about 20% since the early 1970s, because of factors such as the decreasing quantity of ash in the waste from coal fires, and the increasing proportion of dry packing material. Nevertheless, the principal cause of short-term fluctuation in calorific value (CV) of MSW is variations in its moisture content. [4]

A typical municipal waste incinerator installation consists of one or more individual streams, each of which consumes 200000tonnes per year for a city of about 400000 inhabitants.

Assuming that the CV of the waste is 10 MJ kg^{-1}, the total energy output of such a plant can be evaluated very simply since 1 ton (i.e. 1000kg/0 per hour yields:

$$1000 \text{ x } 10/3600 \text{ MJ sec}^{-1} \text{ (MW)} = 2.8 \text{ (MW) per ton of waste per hour}$$

This corresponds to a continuous output of more than 150 watts per person. About 75% of this total energy can be used to generate a combination of electricity and district heating/cooling. It is therefore clear that the energy-efficient incineration of waste water can provide a large proportion of the energy needs of a city population.

The above facts explain the feasibility and desirability of the use of solid wastes for the combination of power generation and district heating, which is known as combined heat and power (CHP).

C. Waste to Energy option for MSWM

1) Some of the options for waste to energy are listed below:
- Bio-methanation

- Pelletisation
- Sanitary Land filling with gas recovery
- Gasification / Pyrolysis
- Incineration
- Mix of above technologies

However, based on the study of WtE plants operational in other developed countries, the efforts are made to propose a Waste to Energy treatment for MSWM in Indian context. The flow diagram in Figure 2 shows the proposed WtE treatment for Indian cities.

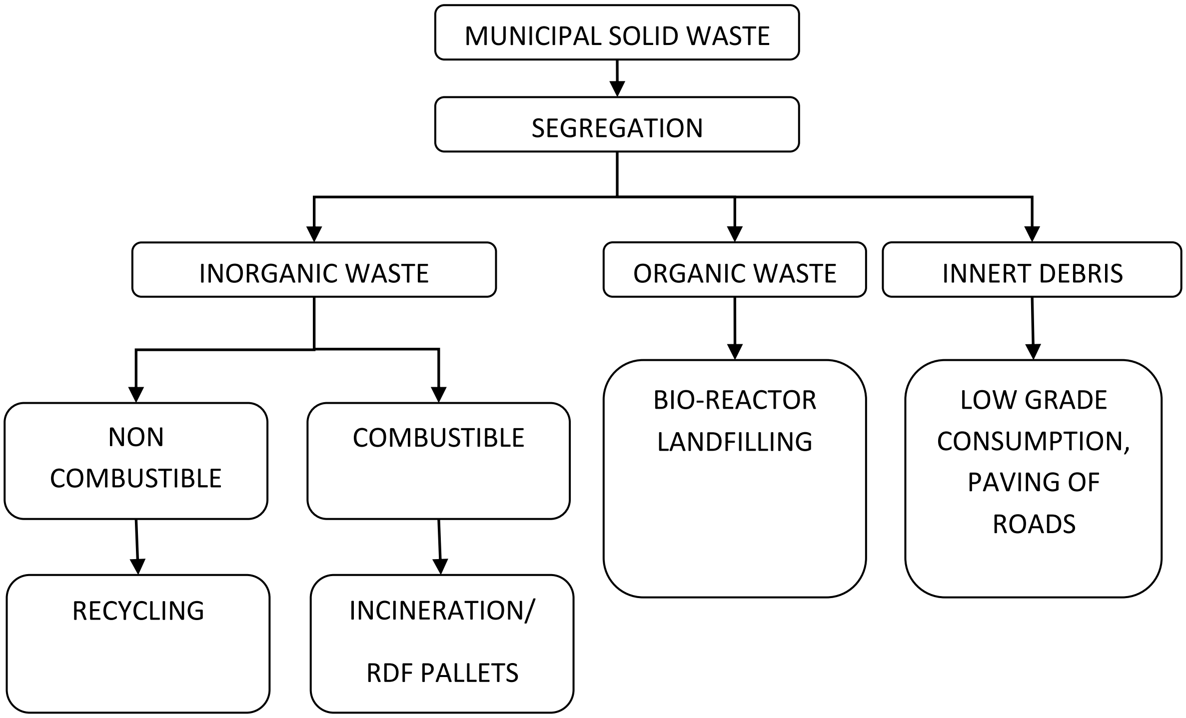

Fig. 2: Proposed WtE treatment for Indian cities

IV. CONCLUSION

It is therefore imperative for the municipal corporations to first equip themselves to identify the loop holes and then work towards better understanding of the existing situation. An effective treatment of WtE viz. Bio reactor landfilling, Recycling and preparation of RDF pallets should be taken up in gearing up to achieve the long term goals of cleaner environment.

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