Biomass a Challenge for India: A Review

Anil Kumar Sharma, Department of Management Studies, Noida International University, Greater Noida, Uttar Pradesh, India. E-mail: tamotiaanilsharma@yahoo.co.in, (M) 9910000608.

Shailee Gaur, Department of Management Studies, Noida International University, Greater Noida, Uttar Pradesh, India.

Vikram Singh, Department of Chemical Engineering, BITS, Pilani, Rajasthan, India.

Abstract

Biomass is organic matter used especially as source of energy. Agriculture is a major contributor to India's Gross Domestic Product (GDP). As we produce more crops, it results in to more bio-mass waste. Biomass waste problem is growing in India. Common practice is burning of residue which creates health hazards. Repeatedly burning of paddy is observed in India. Government has introduced Solid Waste Management Rules, 2016 (SWM) & fixed the responsibilities. The total waste generated in India is 1.54 lakh metric tons per day, in which 50% of total waste is organic wastes and so composting has emerged as one of the best methods for treatment of wastes. It is observed that the regulation for SWM is not properly enforced. When government is planning for smart city projects, it is important to enforce SWM 2016. In this paper we will discuss SWM 2016 & various types with application of biomass.

Keywords- Biomass, Solid Waste Management Rule 2016, application of biomass, smart city.

Introduction

The items that the individuals, offices, schools, industries, hospitals don't need and discard are termed as wastes. These wastes are posing a serious challenge in their disposal and recycling, not only in developing countries but also in developed countries. Figure 1shows the distribution of the percentage contribution of various types of wastes in India. The various types of wastes can be further categorized as solid, liquid and gaseous.

A. Agricultural waste	*N. Marine debris*
B. Biodegradable waste	*O. Biomedical waste*
C. Brown waste	*P. Mining waste*
D. Chemical waste	*Q. Municipal solid waste*
E. Construction waste	*R. Open defecation*
F. Demolition waste	*S. Post-consumer waste*
G. Electronic waste	*T. Radioactive waste*
H. Food waste	*U. Scrap metal*
I. Green waste	*V. Sewage*
J. Hazardous waste	*W. Toxic waste*
K. Heat waste	*X. Wastewater*
L. Industrial waste	
M. Litter	

Fig. Different Types of Waste

According to Joshi and Ahmed (2016), the uncontrolled population growth & rapid urbanization are the main reasons of waste creation. The Municipal Solid Waste (MSW) in India consists of approximately 40-60% of compostable, 30-50% inert waste and rest is recyclable (*ibid*).Broadly MSW can be grouped in to 5 categories (Bhange et al., *n.d.*).

- Biodegradable waste : Food and kitchen waste
- Recycle material : Plastic, glass, paper, metals
- Inert waste : Dirt, rocks, construction & demolition waste
- Composite waste : Waste cloth, tetra packs etc.
- Households hazardous waste & Toxic waste : E-waste, paints, chemicals, CFL, batteries etc.

The typical composition of MSW in Indian cities is shown in Figure 1.

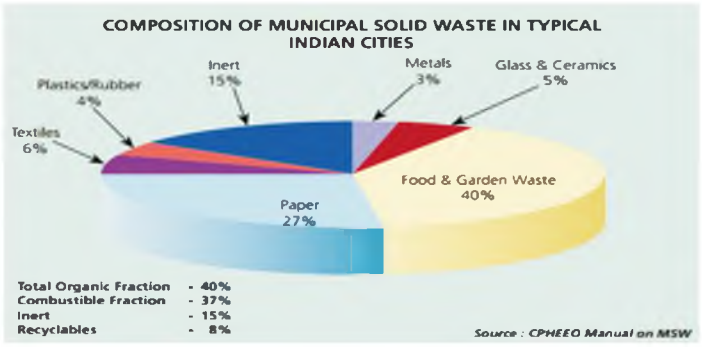

Fig. 1.Typical Composition of SWM in Indian Cities
(Source: http:// mytutorial.srtcube.com, Accessed on 7-10-2017)

The Government of India has introduced the Environment Protection Act, 1986, followed by Solid Waste Management Rules, 2016.

Biomass

Biomass is any organic material obtained from animals and plants (micro-organism). Generally, such organic materials can be used as fuel to produce energy. Forest debris, scrap lumber, certain crops manure & some types of waste residue etc. are some examples of biomass. Since biomass can be used to produce energy, the cost of capital installation of biogases based co-generation projects is dependent on technical, financial and operating parameters along with the plant load factor, and interest on term loans. The PLF of biogases co gen projects is about 45 - 55%, the capital cost of installation is Rs. 4.5 to 5.0 crore for biomass based power plants, based upon boiler pressure and capacity, with generation costs around Rs. 3.50 to Rs. 4.00/kWh. However, the PLF of biomass power projects is about 70-75%. The government of India has implemented a scheme for promotion of Grid Interactive Power Generation Projects based on Renewable Energy Sources, which includes projects based on biomass under Ministry of New and Renewable Energy (MNRE). In the last 15 years, the facilities created has produced a cumulative capacity of 2633 MW, comprising of 1636 MW Biogases Cogeneration Projects and 997 MW of Biomass Combustion Projects. The following states have a leadership position in the implementation of biomass power projects: Andhra Pradesh, Tamil Nadu, Chhattisgarh, Maharashtra, Karnataka, Punjab and Rajasthan. The capacity of the grid connected to the Biomass Power Project is varying from 8-12 MW (Source: www.mnre.gov.in, Accessed on 8-10-2017).

Types of Biomass Waste: There are various types of biomass available worldwide as well as in India. It depends on geographic conditions of respective areas.

The types of biomass further can be classified according to their sources as follow (www.reenergyholdings.com, Accessed on 8-10-2017).

(i) Rice Industry- The cultivation of rice produces two types of biomass residues - straw & husk. This can be used for production of energy. Approximately, 1ton of rice paddy gives 290 kg rice straw, which can produce 100Kwh of power as it has calorific value of 2400Kcal/Kg. Also, 1 ton of rice paddy gives 220 kg rice husk and 1 ton of rice husk can produce 550Kwh of power, as it has calorific value of 3000Kcal/Kg. It is reported that moisture content can affect the calorific value.

(ii) Sugar Industry- As per International Sugar Organization, energy equivalent of 1 barrel of crude can be produced by 1ton of sugarcane biomass. Sugarcane is a highly efficient converter of solar energy, and has the highest energy-to-volume ratio among energy crops. Presently sugar industry is using biomass (also called bagasse) to generate the steam & electricity for internal plant requirement. The technology to be developed to use efficiently the sugarcane biomass.

(iii) Palm Oils Mills Industry- Palm oil industry generates palm kernel shells (PKS), empty fruit bunches (EFBs) and palm oil mill effluent (POME). Generally palm oil industry uses all its biomass to produce energy and steam. The upgraded technology is available to use all residues including POME.

(iv) From Wood processing Industry- Wood processing industry includes furniture, building component, sawmilling, plywood, wood panel, flooring, particle board, molding, jointing and craft industries. Biomass produced in this industry includes sawdust, off cuts & barks. This biomass is generally used for production of steam

for drying. Heating or calorific value of 100% dry wood on a weight basis is relatively constant and to the maximum it is around 20 MJ/kg.

(v) Harvesting - Harvest biomass can be crop residue, woody & grass. The modern combine harvester segregates straw & chaff with separate thresher. Various forms of biomass are stubble from reaped crop & stover from maize & sorghum. Collection & transportation of biomass is a difficult task as weight to volume ratio is low. It is seasonal and also requires storage space for regular supply.

(vi) Miscellaneous - Other than the above, the are biomass, like bamboo, poplar, karajan, coconut etc. They should be cultivated in degraded and forest lands for different applications to be used as biomass.

Various types of biomass sources are shown in Fig. 2.

Fig. 2 Various Types of Biomass sources.
(Source: www.slideshare.net, Accessed on 8-10-2017)

Problems and Limitations

Biomass is a good alternative to energy, but in Indian context it has various problems with respect to biomass utilization, when it comes to handling the biomass waste for power generation. The main problems are highlighted as follow.

1.Government policies.

2.Transportation cost is high as weight to volume ratio is low.

3.Lack of mechanization in recycling in agriculture sector.

4.De-fragmentize land holding by the Indian farmers after population increase.

5.Price increase of waste by suppliers after recycling application like fuel, power etc.

6.Power purchase price by government.

7.Seasonal availability of waste, biomass results inventory carrying cost.

Applications and Advantages

The fly ash discharged could be used in the manufacture of bricks for construction of buildings and civil works or even as bio-compost fertilizers in dry agricultural lands. As it is a renewable form of energy, it is carbon neutral and widely available. Also, it is cheaper as compared to fossil fuels and minimizes overdependence on traditional electricity, reduces amount of waste in landfill and can be used to create different products. For example, the electricity is produced when turbine runs with the help of steam generated by burning of biogas. The biomass is economically viable if used from residuals. As biomass cost effectiveness is an important factor for producing the energy, so clearing the forest is not viable. We should use residuals of paper mills, wood from forest floor, remainder wood & tree trimming. It will reduce the greenhouse gas emissions. It provides (a) thousands of jobs in local community (b) abundant renewable energy (c) fossils fuels dependency reduces and (d) steady, reliable clean power & heat (www.bioenergyconsult.com, Accessed on 17-09-2017).

Technology and Biomass Waste

Biomass waste, according to Yadav (2016),is of wide-reaching positive effect on environment, energy and agricultural sectors. Paddy straw based biogas plants are important pillars of sustainable development with a novel initiative to create a profitable partnership for mutual benefit among farmers and the industry. This project works as per the following:

- Paddy straw bales stored in open &converted to bales for better storage space utilization.
- Paddy straw being fed to the conveyor unit for grinding.
- Paddy straw(3–5 mm) mixed with water, up to 15 per cent of solid content, and fed to the anaerobic digester of biogas plant.
- Biogas produced from the plant is further filtered through hydrogen sulfide scrubber to reduce the concentration of hydrogen sulfide gas below 50 ppm.
- Biogas substrate process of decomposition during change in material characteristics.
- German-make six cylinders Biogas Generator set produces electricity with biogas consumption of about 500 m3/hour. Typical details for the project are shown below.

Table 1
Details of the Project

1	Capacity of Biogas plant	1.0 MW
2	Biogas Generation Capacity	12,000 m3/day
3	No. of working days	350 days/year
4	Paddy Straw requirement	25 tonnes/day
5	Power Generation	1,247 MWh/year
6	Manure (Compost)	439 tonnes/year
7	Slurry	560 kilolitres/year
8	Payback Period	5.16 years

Solid Waste Management Rules, 2016: Highlights

a) Earlier the scope was limited to the municipal corporations. But according to the new solid waste management (SWM) rules 2016 the area has been extended beyond limits with the aim to cover out growth in urban agglomerations, notified industrial townships, defense establishments, census town, special economic zones, Indian railways, central government organizations, airports, airbases, ports, harbors and places of religious and historical importance.

b) The issue of the collection and disposal of sanitary wastes like diapers, sanitary pads and other disposable items has been discussed.

c) The Swachh Bharat Abhiyan now has the concept of partnership. The responsibility for segregation, sorting and management of the wastes has been given to institutions and bulk generators, event organizers, hotels and various market associations in partnership with local bodies.

d) The Ministry of Urban Development has been assigned with more responsibilities, as it is a nodal Ministry on the Solid Waste Management subject.

e) The integration of waste pickers/rag pickers and dealers/ Kabaddiwalas in the formal system by the state government and self-help groups or any other group to be formed should be done.

f) User fee for solid waste management with on spot fine on littering will be charged by the local bodies as per the norms laid down by them.

g) Various ministries, department of fertilizers, ministry of chemicals, ministry of agriculture, ministry of power, the ministry of new and renewable energy sources etc., should support the implementation of SWM Rules.

h) The government officials, like the secretary, state urban development department, the commissioner of municipal administration, directors of local bodies, local authorities and village panchayats, as well as bodies such as the central pollution control board and the state pollution control board, are made responsible for the implementation of the SWM 2016.

i)There is emphasis on promotion of waste to energy plant in SWM Rules, 2016.

j) It also mandates that solid waste processing facilities to be set up by all local bodies having 100000 or more population within two years of census and towns below 100000 population to set up common or stand-alone sanitary landfills by or for all local bodies having a population of 0.5 million for the past three years. Also capping bioremediation of old and abandoned dump sites is suggested (GOI, 2016).

Conclusions

In India, the continuous urbanization results in to more waste generation. Waste management is the challenge for India as well other countries. To overcome this problem government is implementing the various waste management rules from time to time. But implementation of these rules is the challenge for the government & it requires infrastructure for the implementation. But government initiatives are not sufficient. People should be made aware and feel responsible about the pros & cons of the waste. Government has to provide the solution to promote biomass for the problems as highlighted, and among them the most important is to create awareness among rag pickers, farmers, house maids and youngsters regarding solid waste disposal.

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