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Municipal Solid Waste (MSW) As Renewable Energy Source

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***Abstract*- With rapid economic growth and massive urbanization, India faces the problem of municipal solid waste (MSW) disposal and the pressing need for development of alternative energy. Waste-to-energy (WTE), which recovers energy from discarded MSW and produces electricity and/or steam for heating, is recognized as a renewable source of energy and is playing an increasingly important role in MSW management in India. 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.**

***Index Terms* - Municipal Solid Waste (MSW), Compositions of MSW, Waste to Energy**

I. INTRODUCTION

Solid Waste is the unwanted substance(s) arising from human or animal activities. Rise in population, rapid urbanization, industrialization and changes in life style across the country led to massive increase in waste. In India approximately 55 million tons of MSW are generated in urban areas of India annually (1.5 lakh tons per day). It is estimated that the amount of waste generated in India will increase at a rate of approximately 1-1.33 % annually. Average organic content of these MSW in India is around 50% .150 tones of organic waste have potential for production of 1 MW energy. By 2047, MSW generation India expected to reach 300 MT per annum and land requirement for disposal of the same would be 169.6 Km2 [1].Organic waste can be a renewable as well as cost efficient resource for energy production. The Ministry of Environment and Forests (MoEF) promulgated the Municipal Solid Wastes (Management and Handling) Rules in 2005 requiring municipalities across India adopt sustainable and environmentally sound ways of processing MSW, including incineration. In this regard, Waste to Energy (WtE) provides a solution towards complying with government regulations, and achieving integrated solid waste management. [6]

II. COMPOSITIONS OF MSW

The composition of MSW is closely related to the level of economic development and lifestyle of the residents. In different districts of the same city, the composition of MSW will be different. In general, the composition of MSW in India with six major categories of waste was identified: organic matter, paper-cardboard, plastics, glass, metals, and others. A major fraction of urban MSW in India is organic matter (51%). Recyclables are 17.5 % of the MSW and the rest 31% is inert waste. The average calorific value of urban MSW is 7.3 MJ/kg (1,751 Kcal/kg) and the average moisture content is 47% [5]

III. WASTE TO ENERGY

According to the Ministry of New and Renewable Energy (MNRE), there exists a potential of about 1700 Mega Watt from urban waste (1500 Mega Watt from MSW and 225 Mega Watt from sewage) and about 1300 Mega Watt from industrial waste. The ministry is also actively promoting the generation of energy from waste, by providing subsidies and incentives for the projects. Energy recovery techniques include thermal treatments as incineration, gasification and other techniques as e.g. anaerobic digestion. Thermal treatments require the burning of waste with recovery of energy. Anaerobic digestion has been used for the treatment of agricultural and sewage sludge. [4] About 65.34% of the electricity consumed in India is generated by thermal, 21.53% by hydroelectric power plants, 2.70% by nuclear power plants and 10.42% by renewable energy sources Electricity can be produced by burning MSW as a fuel. MSW power plants, also called waste to energy plants, are designed to dispose of MSW and to produce electricity as a by-product of the incinerator operation. Burning MSW can generate energy, while reducing the volume of waste by up to 90 percent. [4]

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IV. RENEWABLE TO ENERGY

Energy from waste is not a new concept, but it is a field which requires a serious attention. There are various energy conversion technologies available to get energy from solid waste, but the selection is based on the physicochemical properties of the waste, the type and quantity of waste feedstock, and the desired form of energy. Energy recovery in the form of electricity, heat and fuel from the waste using different technologies is possible through a variety of processes, including incineration, gasification, pyrolysis and anaerobic digestion. These processes are often grouped under "W to E technologies". Two groups of technologies could be used for processing the fractions of wastes:

1. Bio-chemical waste to energy technologies
2. Thermo-chemical waste to energy technologies

Bio-chemical conversion of biodegradable MSW can be categorized into composting, biomethanation and fermentation. Composting is an aerobic process in which biologically degradable wastes are converted through solid state biochemical transformation to yield stable granular material - which could be used as soil conditioners and nutrients. Biomethanation is an anaerobic slurry-phase process that can be used to recover both nutrients and energy contained in biodegradable waste. Biogas can be used either as a source of thermal energy or to generate electricity by using gas engines and turbines.

Thermal processing of MSW can be accomplished in several ways including incineration, pyrolysis, gasification and mass burning. Typically, the feedstock could be segregated or un-segregated MSW or refuse derived fuel. Incineration is the complete combustion of waste with the recovery of heat, to produce steam, which in turn produces power through steam turbines. Mass burning of MSW is achieved by burning unprocessed wastes. Pyrolysis uses heat to break down organic materials in the absence of oxygen, producing a mixture of combustible gases (primarily methane, complex hydro, carbons, hydrogen, and carbon monoxide), liquids and solid residues. Gasification is a process that converts organic or fossil based carbonaceous materials into carbon monoxide, hydrogen and carbon dioxide at elevated temperature (500-1800oC) in the presence of limited amount of oxygen – typically called as Syngas at temperature above 900oC along with the conventional fuels like coal without any ill effects for generating heat. Operation of thermal treatment systems involves higher costs and a relatively higher degree of expertise. [7,8]

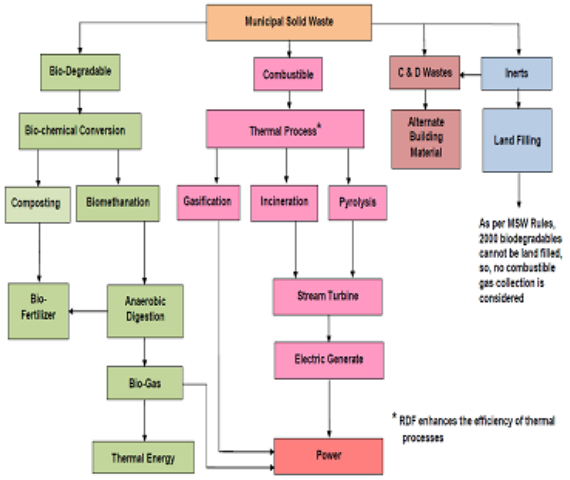

Figure1 illustrates options available for municipal solid waste treatment and utilization. [9]

The waste generated and its composition analysis can help in decision making on which method of energy recovery can be utilized. The selection of technologies is based on the factors like the desired form of the energy, economic conditions, quantity and characteristics of feedstock, end-use requirements and environmental standards. For The selection of technologies is based on the factors like the desired form of the energy, economic conditions, quantity and characteristics of feedstock, end-use requirements and environmental standards. MSW provides an opportunity of tapping potential energy to meet part of the energy demand of the country. [10]

Desirable range of important waste parameters for technical viability of Energy Recovery as shown in following table [11]

Waste Treatment Method	Basic Principle	Important Waste parameters	Desirable range*
Thermo-chemical conversion - Incineration - Pyrolysis - Gasification	Description of organic matter by action of heat	• Moisture content • Organic / Volatile matter • Fixed Carbon • Total Inert • Calorific Value (NCV)	< 45% > 50% < 16 % < 36 % >1200 kcal/kg.
Bio-chemical conversion -Anaerobic Digestion / Bio-methanation	Decomposition of organic matter by microbial action	• Moisture Content • Organic / Volatile matter • C/N Ratio	> 60 % > 40 % 25 - 30
* Indicated values pertain to segregated / processed / mixed waste and do not necessarily Correspond to wastes as received of the treatment facility.			

V. CONCLUSION

Rapid growth of industries and commerce in India necessitates uninterrupted power supply. Therefore, all options need to be explored to generate power from conventional and non-conventional sources. The MSW is used as a source of renewable energy. The waste with a big portion of organic waste the composting or incineration can be utilized. The main objective of this is to use waste as one of the energy resources to harness heat/electricity by using different technologies and at the same time reducing the daily volume of waste. Technology alternatives are available to use MSW for energy generation. This can be either done by using MSW as a fuel or in combination with conventional fuels.

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