

A review of recovery of energy from waste

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Abstract: Energy is the driving force behind all the technological evolution that's happening around the world. Since fossil fuels are one of the main sources of energy, its volume is getting reduced by day. Hence, to overcome this, situation the fossil fuels must be replaced by some other alternative source of energy so that these fossil fuels can be saved to certain extend. This review is about recovery of energy from combustible, organic or bio degradable waste.

Key Words: Municipal Solid Waste, Waste to Energy

I. Introduction

Waste, in other words trash or garbage or refuse is an unwanted material discarded by public. Waste can be classified based on its composition. Biodegradable wastes, which includes food waste, agricultural waste and paper. Recyclable waste, which includes paper, glass, tin cans, aluminum foil, plastics, fabrics, tires metallic debris. Composite waste, which includes waste cloths, tetra packs. Volume of MSW is increasing with increase in industrial growth and population. Reduction of solid waste in mass and volume is a biggest challenge. Due to economic and industrial growth, the country is in need of more electric power. Therefore, to reduce the volume of waste and at the same time generation of power out of it can be achieved by municipal waste to energy plant.

II. Current Status of Municipal Solid Waste In India

Municipal Solid Waste is a residue. It consists daily used matter generated by residential, commercial and industrial sectors. Composition of MSW varies from region to region and country to country. Generally the major composition of MSW includes green waste, food waste, paper, plastics, fabrics etc. MSW is majorly generated from commercial, industrial, and residential sectors of the country. In India almost 50% of MSW contains biodegradable matter. According to CPCB report solid waste generation in India is approximated of about 115,000 tons per day. The estimated annual rise in per capita quantity of waste is about 1.33% per year. Adequate amount of municipal solid waste produced across the country can be used to generate power.

At the same time the volume of it can be reduced by WTE plant. This provides the daily used waste to the commercial to the industrial sectors so that the minimize wastage will be avoided for the future purpose with the proper biodegradable matter which solid waste generation in India can be approximated

Year	Population in millions	Per-capita Waste Generation	Total Waste Generation(t thousand tons /year)
2001	197,3	439	31,63
2011	260,1	498	47,3
2021	342,8	569	71,15
2031	451,8	649	107,01
2036	518,6	693	131,24
2041	595,4	741	160,96

Table-1 Shows impact of population growth on overall Waste Generation and Future predictions

III. Segregation of Waste

The waste reaching the WTE plant is composed of different types of non-degradable materials such as glass, ceramics and metals, which cannot be easily processed in WTE plant. Metallic substances are separated by magnetic and gravity separation techniques. A sorting and segregation unit will be installed in WTE plant in order to remove unwanted material present in waste.

IV. Process of Waste-To- Energy

Waste-to-energy is a process of generation of electricity from the incineration of biodegradable or organic and combustible waste. WTE is a process of generation of heat by direct combustion of waste or by producing a

combustible fuel through gasification/pyrolysis process, such as methane, ethanol or synthetic fuels.

V. WTE Technologies

Waste to energy technologies consists of waste treatment process that converts waste to different forms of energy such as heat, electricity and combustion fuels.

Direct Combustion of MSW

Direct combustion of MSW is a process of mass combustion of MSW to generate heat. Heat generated from combustion of waste is utilized to convert water into steam. This steam is used to rotate a steam-turbine generator to generate electricity.

Pyrolysis

It is the thermal process of breaking down or decomposition of biomass to into combustible fuel, in the absence of oxygen.

Gas or Methane Capture

Production of electricity by combustion of landfill gas produced, as biodegradable waste decomposes.

Plasma Gasification

Plasma gasification is a process, which uses plasma torch to produce high temperatures (4,000 to 25,000 °F) to breakdown the organic matter forming hydrogen and carbon monoxide which can be used as a combustion fuel to generate energy or electricity.

Biogas captures by anaerobic digestion

Anaerobic digestion is a process by which bacteria breakdown the organic matter in the absence of oxygen to produce gaseous fuels. Advanced digester systems produces biogas with methane content higher than 95%

Fermentation

It is the process which uses Bacteria and yeast to convert Biomass waste to liquid Ethanol. Fermentation is a metabolic process that converts sugar to acids, gases or alcohol. It occurs in yeast and bacteria, and also in oxygen-starved muscle cells, as in the case of lactic acid

VI. Generation of Thermal Energy by Incineration of MSW through District Heating Methods.

Incineration of waste is more efficient in generation of heat than producing electricity because certain amount heat loss occurs during the process of conversion of heat into electricity. Production of heat and distributing it to different location such as residential heating systems in the form of direct heat or steam is done by district heating system. So, when WTE power plant is added with district heating system

the plant becomes more effective source of energy. The district heating is carried out by following ways:-

Heat - only boiler station

It is the station where thermal energy is produced in the form of steam or hot water for the use of heating systems in houses and other buildings.

Cogeneration or Combined Heat and Power (CHP)

It is the station where thermal energy is produced for residential and commercial heating systems, along with electricity.

VI. Status of Waste-To-Energy in India.

About 188,500 tons waste per day is produced from urban part of India. Due to increased population the per capita waste generation as considerably increased in past decade. Various WTE plants in India are adopted based on the properties and composition of the waste. WTE plant is setup based on the availability of raw material. In India the properties of raw material varies from region-to-region. A plant proposed in south Andaman uses coconut shell as the raw material. A plant in Ludhiana, Punjab uses cattle dung as the raw material. It generates 2MW/day of electricity out of 235TPD of the waste. Whereas three plants in Delhi uses only MSW as the raw material to generate power. Timarpur - Okhla Waste to Energy Plant in Delhi generate 16 MW power per day which is currently in operation. Ghazipur and Narela Waste to Energy Plants are under construction. The Secretariat of Delhi as adopted biogas plant which uses the waste produced in the premises to produce biogas which is utilized for cooking purposes.

VII. Currently Working and Under Construction Plants in India

Okhla plant

Okhla WTE plant in Delhi is currently under operation, which uses the method of direct combustion of MSW, produces 16 MW/day of power with an input of 1350 TDP of waste. The waste is segregated before combustion process. Air Pollution Control Systems such as Turbo-reactor and Fabric Filtration Air Quality Control System are equipped to prevent the hazardous gases coming out after combustion.

Vijayawada Plant

A power plant at Vijayawada utilizes wastes from vegetable market and slaughterhouse by generating 0.15 MW power per day.

Power Plant in Punjab

A power plant in Ludhiana, Punjab utilizes cow dung produced at Heabowal dairy complex to generate 1.0 MW power/day.

Gazipur Plant

This plant at Gazipur is under construction and is expected to produce 12MW/day power with the input volume of 1300TPD of waste. The plant has a capacity of taking up 2000TPD.

Narela-Bawanaplant

A WTE plant at Bawana, which is under construction, is expected to produce 12MW/day power with 600TPD waste. It uses mass combustion technology.

IX. Status of WTE In Other Countries.

WTE in SWEDEN.

According to the reports, 48% of municipal residue was converted into energy in the year 2009. Sweden stands first in recovering energy from waste in the world. Sweden even imports millions of tons of trash from other parts of world. The production cost of WTE is less compared to all known energy recovery technologies in Sweden.

WTE in AMERICA

There are 87 WTE plants in united states that generate approximately 2720 MW of power or 0.4 % of overall country power generation. USA combusted 12% of country waste for energy recovery in the year 2009. Environmental Protection Agency as stated that WTE technologies are clean reliable sources of renewable energy with less environmental than any other source of energy. The District of Columbia has recognized waste has renewable source of energy.

10. MAJOR POLLUTANTS EMITTED BY WTE PLANT AND THEIR CONTROL SYSTEMS.

The main drawback of WTE plants is pollutant emissions. Due to this reason many WTE plants in western nations were shutdown. Later due to advancement of pollution control technologies the WTE is now considered as clean, reliable, renewable source of energy.

Table-2, show the pollutants emitted by WET plant and their control systems

X. Conclusion

The main objective of this review 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.

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Source	Emission	Causes	Control System
Nitrogen in RDF fuel and primary air	Nitrogen Oxides	High temperature conditions	Flue gas recirculation, selective non-catalytic reduction
Sulfur in RDF	Sulfur Dioxide	Oxidation	Packed bed absorption with alkaline scrubbing liquid
Chlorine in RDF	Dioxins and Furans	Incomplete combustion	Auxiliary burners, high temperature oxidizing conditions, rapid gas cooling, adsorption by activated carbon injection

10. Karnataka Waste-to-Power (KWP).