Urban Waste-To-Energy by Incineration Process

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Abstract: **- Electrical power sector is the vital part of National Energy Sector. Various non-conventional and conventional energy sources are converted to electrical energy for quick, automatic controlled, easy, power transmission and supply of rich-quality and clean energy to satisfy the consumers at all times at lowest possible cost for ultimate utilization in domestic, industrial, commercial, transport and agricultural sectors.**

Today in rapidly changing Energy Scenario, Biomass is the important renewable energy source for the 21st century, particularly for rural and urban applications and has following principal routes of energy conversion:

- **Incineration of dry biomass to obtain heat.**
- **Anaerobic digestion of wet biomass to obtain methane.**
- **Biochemical reactions giving biogases, chemicals etc.**
- **Photo chemical processes of biomass energy conversion**
- **Fermentation to obtain ethyl alcohol.**

Key Words: **Incineration, Anaerobic, Photo chemical, Fermentation, Manure.**

I. INTRODUCTION

In the list of energy resources, new biomass fuels are introducing day-by-day. Biomass is being used for production of process heat and electricity, producing gaseous and solid fuels, liquid chemicals etc.

Among many biomass conversion processes, one of the most important technologies is Incineration (combustion). Incineration process is combustion up to formation of ashes. This process converts the biomass to heat by burning. The ratings of waste incineration power plants are in the range of fraction of KW to about 200 MW. As soon as in the incineration process, once the heating up takes place and the process is started, the energy conversion is continuous without delay of time. For smaller plants (furnaces, kilns, fluidized bed combustion chambers etc.) the incineration process gives the heat which is used for producing hot water, process steam etc. In case of large plants of MW range (1 MW to 200 MW) the thermal energy from biomass incineration is converted to electrical energy and the energy is transmitted to load centre for further distribution.

Urban Waste Incineration Power Plants are located in large cities. The urban waste is collected by municipal lorries (trucks). The waste is segregated and the combustible part is fed into the furnace of the power plant. Steam is produced. The steam and hot water are supplied for district heating in colder countries. Steam turbine power plants produce electrical energy.

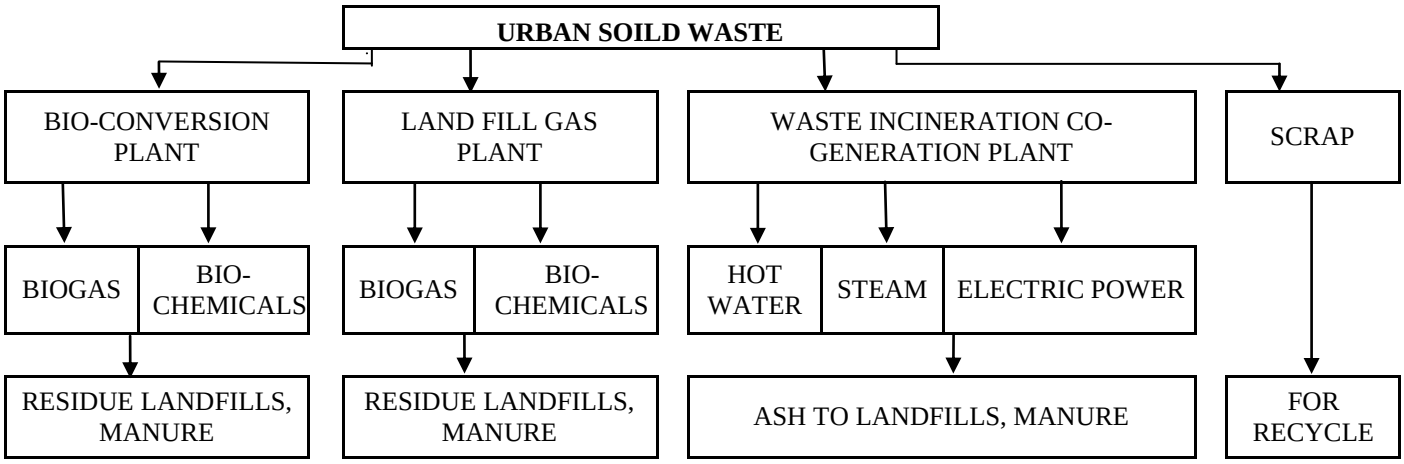
Table.1: Application of Incineration Process

Biomass Resources	**Conversion Technology**	**Products**	**Applications**
– Wood – Wood waste – Forest matter – Dry solid biomass	Incineration (Burning)	Heat Steam Electricity	– Co-generation plant – Heat steam – Electricity for industry and utility.
Urban solid waste (Municipal refuse)	Incineration	Heat Steam Electricity	Disposal of urban waste Energy to urban consumers.

II. URBAN SOLID WASTE (MUNICIPAL WASTE, MUNICIPAL REFUSE)

In various parts of the world, the numbers of mega cities are increasing rapidly. The domestic waste (Refuse) of these cities is usually carried to landfill sites, which are located far away from the centre of the city. Mega cities like Delhi, Mumbai etc are having large amount of waste and are facing waste disposal problems. The emerging solution is to produce useful electrical and thermal energy by waste-to-energy plants (WTE) located in the heart to the city. Such energy plants are rated in MW range (10-200 MW) and serve the following functions:

- Economical and safe disposal of urban waste.
- Supply of thermal and electrical energy to the consumers in the city.
- Protection of Environment from urban waste.



Energy routes of urban waste to energy

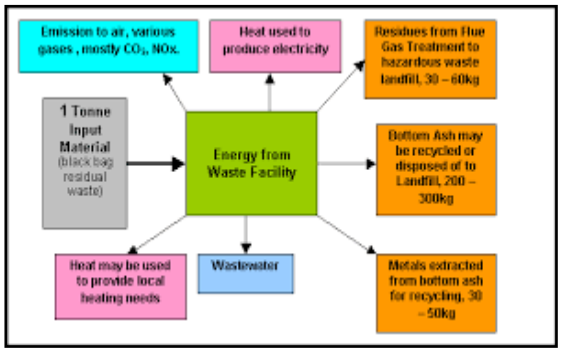


FIGURE: 1

Since from 1985 in several mega cities, WTE plants have been successfully built and or being operated and several such plants are being built during recent years.

III. WASTE-TO-ENERGY INCINERATION PROCESS

The energy route of the waste-to-electrical energy by incineration process is as follows.

Biomass energy from nature ➡ ***Thermal energy from incineration*** ➡ ***Mechanical energy from steam*** ➡ ***Electrical energy from generator*** ➡ ***Electrical energy to user or grid***

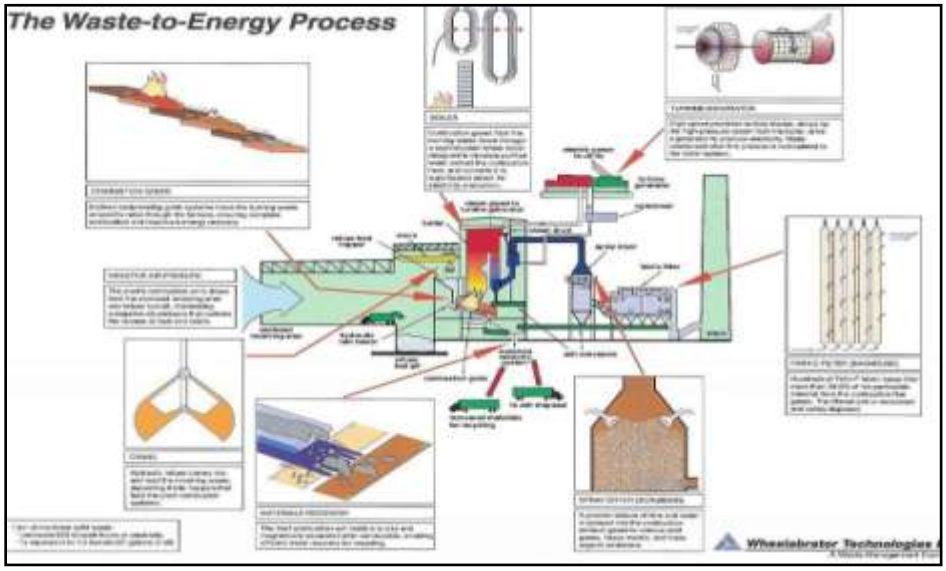


FIGURE: 2

IV. LOCATION OF WASTE-TO-POWER PLANTS

Waste Incineration Power Plant is usually located near the source of waste thereby minimizing the cost of fuel transport.

Table.2: Location of Waste-to-Power Plants

IN FEED	LOCATION OF PLANT	OUTPUT
Forest Produce -Trees, Tree residue -Wood -Wood waste	-Forest -Near furniture industry	-Electric power -Heat/steam for furniture industries.
Sugar Bagasse	Near sugar producing plants	-Electric power -Heat/steam for sugar plant.
Urban waste	In a large city	-Electric power -Heat and steam for urban consumer.

V. WORKING OF PLANT

Urban Refuse may be treated in a waste treatment plant before dispatching it to the power plant. Solid, Treated Dry biomass (Wood, Urban Waste, Agricultural or Aquatic Waste) is received and stored. The Shredder makes small pieces (about 2.5 cm dia) of the raw biomass.

The air classifier has flowing air which separates dry light fuel pieces from heavy metal/glass and other by strong air stream (Horizontal or Vertical). The lighter fuel pieces are sent to the furnace. The heavy metal pieces, glass pieces etc. are sent to material recovery chamber.

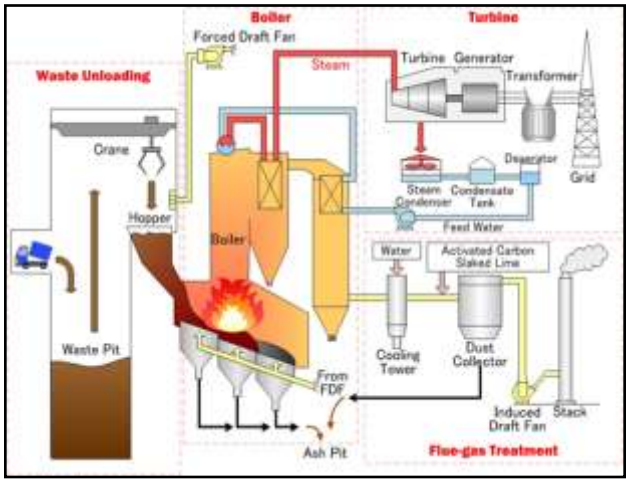


FIGURE: 3

The furnace burns the dry shredded biomass and the boiler produces steam. The superheated steam is supplied to the steam generator. The synchronous generator produces electrical energy from mechanical shaft energy.

Flue gases from the furnace are passed through:

- Heat Recovery Steam Generator
- Electrostatic precipitator and filters for removal of particulates.
- Scrubber and chemicals treatment plant for removal of SO_χ and NO_χ.
- Induced Draft Fan sends the cleared exhaust gases through the stack to the external atmosphere.

Steam from the turbine is condensed in condenser and is re-cycled through the boiler.

VI. ENVIRONMENTAL CONSIDERATIONS

The Urban Waste-to-Energy plants have to meet stringent standards of pollution control regulations. The typical limiting values of pollutants discharged by a Waste-to-Energy Plant are as follow:

Table.3: Units of Pollutants

Pollutant	Limit as per EC Standard mg/Nm^3
Particulates	– 30 mg/Nm^3
$S0_2$	– 300 mg/Nm^3
HCL	– 50 mg/Nm^3
MF	– 2 mg/Nm^3
Pb+Cr+Cu+Mn	– 5 mg/Nm^3
Ni+As	– 1 mg/Nm^3
Cd+Ag	– 0.2 mg/Nm^3

VII. ADVANTAGES

- Waste Incineration Plants provide solution to utilize domestic waste, municipal waste and produce useful energy.
- Waste disposal problems are been eliminated.
- Plans are located nearby city.
- Transportation of waste is minimized.
- Quick and rapid start of plant.

VIII. DIS-ADVANTAGES

- High investments are required.
- Highly increasing operational costs.
- Growing social opposition.
- Uncertain control of atmospheric pollutants.

IX. CONCLUSION

Waste Incineration plants serves couple useful:

- Transportation of waste to remote dump yards is eliminated.
- In the load centre itself, useful power and heat can be generated.

The consumption of urban waste is in the range of 1000t/day to 8000t/day. Such plants supply hot water, process steam and

electrical energy to consumers located in the city. In upcoming decade, this system will be most significant as the practical efficiency of such power generation will not be less than 60%.

Table.4: Waste Generation trends in India

Year	Per capita waste generation (g/day)	Total urban municipal waste generation (MT/ yr)
1971	375	14.9
1981	430	25.1
1991	460	43.5
1997	490	48.5
2025	700	Double the amt. of 1997

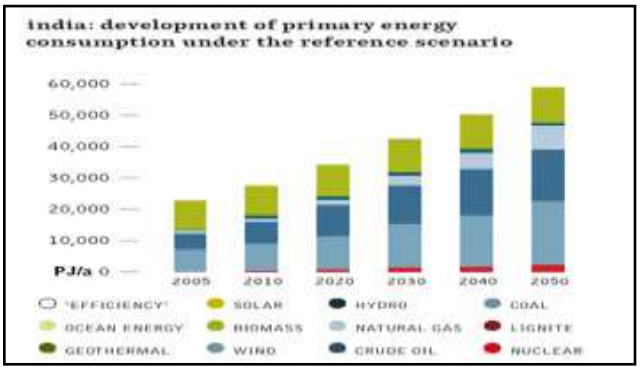


FIGURE:4

Presently there are about 125 Waste-to-Energy Incineration Power Plants in the world. Several other mega cities are planning to have such plants for solving their waste disposal, environmental and energy problems.

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