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GREEN ENERGY RECOVERY FOR SUSTAINABLE DEVELOPMENT

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Abstract - *Waste-to-Energy is simply production of electricity from wastes that is useful to people all around the world. It is a challenging management in developing countries. Energy supply and waste management are great challenges that humans have faced for millennia. Generally, WtE is the process of generating green energy in the form of electricity and/or heat from the primary treatment of waste, or the processing of waste into a fuel source. It is a form of green energy recovery. It is called green energy because it is eco-friendly It also has potential in reducing CO_2 reduction and can be sustained for future generation. There are different technologies to generate electricity from wastes. However, reuse and recycling are first prioritized as left a fraction of waste can be used as energy recovery.*

Key Words: Wastes, Waste-to-Energy, Green Energy, Sustainibility, Generation of electricity etc.

1. INTRODUCTION

Electricity from Municipal Solid Waste (MSW) is commonly known as Waste-to-Energy process. Waste is an inevitable product of society, and one of the greatest challenges for future generations is to understand how to manage large quantities of waste in a sustainable way. One approach has been to minimize the amount of waste produced, and to recycle larger fractions of waste materials. However, there still is a considerable part of undesired end products that must be taken care of and a more suitable solution than simple land filling needs to be found.

The waste management sector faces a problem that it cannot solve on its own. The energy sector, however, is considered to be a perfect match, because of its need to continuously meet a growing energy demand. Waste is now not only an undesired product of society, but a valuable energy resource as well. Energy recovery from waste can solve two problems at once: treating non-recyclable and non-reusable amounts of waste; and generating a significant amount of energy which can be included in the energy production mix in order to satisfy the consumers needs.

The interaction between waste management solutions and energy production technologies can vary significantly, depending on multiple factors. Different countries across the world choose to adopt different strategies, depending on social, economic and environmental criteria and constraints. These decisions can have an impact on energy security, energy equity and environmental sustainability when looking at the future of the energy sector.

If waste-to-energy (WTE) technologies are developed and implemented, while following sustainability principles, then a correct waste treatment strategy and an environment friendly energy production can be achieved at the same time, solving challenges in both the waste management and energy sectors.

The energy obtained from organic matter derived from biological organisms (plants and animals) is known as green energy. Various sources of biomass such as concentrated wastes, dispersed wastes etc can be used as a solid fuel or converted in to liquid or gaseous forms to produce electric power, heat, chemicals or fuels. Biomass is considered as a renewable energy source because the growth of new plants and trees replenishes the supply.

Green energy is obtained through the conversion of organic matter, either directly through combustion to generate heat, or converted in to a more manageable energy carrier such as liquid or gas. The resources are mainly classified in to two categories:

- Waste from cultivated fields, crops and forests.
- Waste from municipal waste, animal dung, forest waste, fishery waste etc.

Thus, green energy can be derived from a wide range of raw materials and produced in a variety of ways.

1.1 Biomass to Green Energy

- Green energy can be transformed either by chemical or biological processes to produce intermediate bio-fuels such as methane, producer gas, ethanol, charcoal etc.
- During combustion, it reacts with oxygen to release heat, but the element of material remains available for recycling in natural ecological or agricultural processes. When they are burnt, the release of carbon-dioxide amounts to the same level since they are absorbed by plants and trees while growing.
- It can be used for heat, power and combined heat and power.
- It is also able to produce continuous energy and therefore doesn't have intermittency problems.

1.2 Biomass Resources

Biomass resources for green energy production include a wide spectrum of materials ranging from forest, agriculture, industrial and social activities such as food processing, urban refuse etc. In India, we have plenty of agricultural and forest resources for reproduction of biomass, which in turns to produce green energy. Due to this, there is a great potential for application of biomass as an alternative source of green energy.

a) **Forests:** Forests, natural or cultivated, serve as sources of fuel wood, charcoal and producer gas. Some fast-growing intensive trees such as eucalyptus, poplar and pine are specially cultivated for energy production.
b) **Agricultural Residues:** Crop residues such as straw, rice husk, coconut shell, groundnut shell, sugarcane baggage etc., are gasified to obtain producer gas.
c) **Energy Crops:** Certain cultivated plants produce raw material for bio-fuels. They are as follows:
    - Sugarcane: It is a raw material for bio-ethanol. It consists of alcohol that represents one third of the total sugarcane mass and other similar amount is available in bagasse, leaves and tops.
    - Oil Producing Plants: Oil producing plants such as sunflower, rapeseed, palm oil, castor oil, soybean, ground nut and cotton seed have capabilities of producing energy.

d) **Aquatic Plants:** Some water plants grow very fast and provide raw materials for producing biogas or ethanol. These are water kelp, seaweed, algae etc.
e) **Urban Waste:** Urban waste is of two types:
    - Municipal Solid Waste (MSW)
    - Sewage (Liquid Waste)

2. CATEGORIES OF ENERGY RECOVERY

The following three processes are mainly used for the green energy recovery:

2.1 Thermo-Chemical Conversion

In this process, biomass is decomposed, in various combinations of temperature and .pressure. Thermo-chemical Conversion takes place in three forms:

Direct Combustion: Confined and controlled burning, known as combustion, can not only decrease the volume of solid waste destined for landfills, but can also recover energy from the waste burning process. The vast majority of plants recover heat from the flue gases via a steam boiler. Very low emissions and high overall thermal efficiencies can be achieved in modern waste combustion plant.

Gasification: In gasification, charcoal , woodchips, forestry residues, agricultural wastes and other wastes are transformed into high flammable gases at high temperature about 800^0C to 1000^0C .They are of two types:

- Fixed Bed Gasifier
- Fluidized Bed Gasifier

Pyrolysis: Pyrolysis is the conversion of biomass to useful green energy in the absence of air at about 500^0C. The process typically occurs under pressure and at very high operating temperatures. There are three types of pyrolysis process:

- Slow Pyrolysis- It is used when the desired product is char.
- Fast Pyrolysis- It is used to produce a larger fraction of liquid called Bio-Oil.
- Conventional Pyrolysis- Carbon content residue 35%.

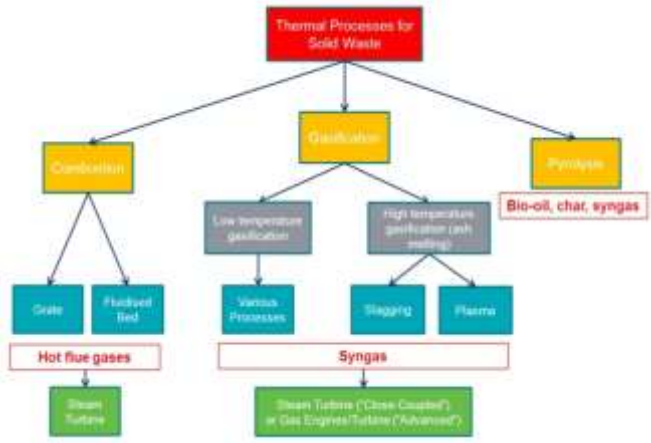

Fig 1: Thermo-Chemical Conversion

2.2 Bio-Chemical Conversion

Bio-chemical conversion can take place in two ways:

- Anaerobic Digestion
- Alcoholic or Ethanol Fermentation

Anaerobic Conversion: Anaerobic digestion (AD). AD is can be used to recover energy from wet, biodegradable waste streams (such as food waste and farm slurry). AD uses micro-organisms in carefully controlled conditions to convert biomass into biogas consisting primarily of methane and carbon dioxide, and a stabilised residue known as digestate.

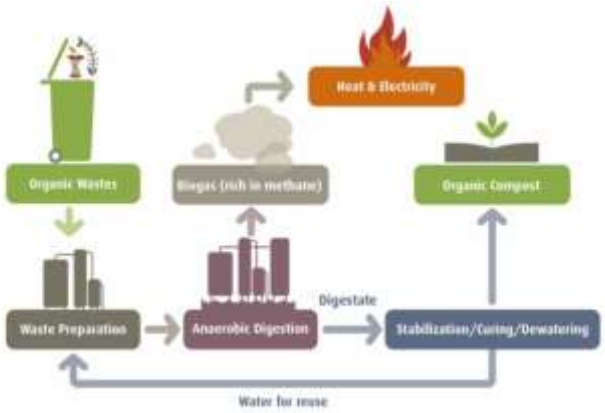

Fig 2: AD Process Treating Biodegradable Waste

Biological conversion technologies utilise microbial processes to transform waste and are restricted to biodegradable waste such as food and yard waste. Accordingly, the wet matter from the waste (the biogenic fraction) and agricultural waste are the most suitable feedstocks for biochemical conversion technologies.

Alcoholic or Ethanol Fermentation: In this process, organic matters are decomposed by microorganisms especially bacteria and yeast. For the conversion of grains and sugar crops in the ethanol, this fermentation process is widely used.

3. METHODOLOGY

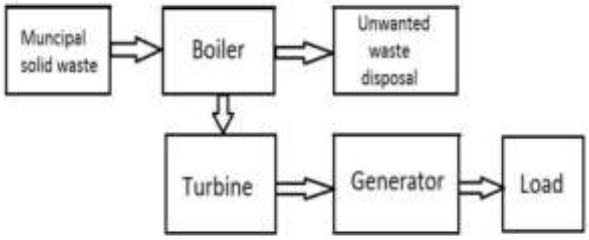

Fig 3: Block Diagram for Waste-to-Energy

The municipal solid waste is collected and then removed all the primary effluent such as large solid wastes and is collected. Then it is passed to the boiler which consists of water inside it and burning process takes place. When the boiler is heated, the water inside the boiler gets heated and the high pressure steam is produced in the boiler. The steam produced is then passed to the turbine from the nozzle of the boiler. Then due to the high pressure of the steam the blades of the turbine will rotate the shaft of the turbine is coupled to the shaft of the generator due to rotation of the turbine the generator will also rotate due to which electricity will be produced.

3.1 Working Principle

The process of generating electricity in a mass burn waste to green energy plant has seven stages:

1) Waste is dumped from garbage trucks into a large pit.
2) A giant claw on a crane grabs waste and dumps it in a combustion chamber.
3) The waste (fuel) is burned, releasing heat.
4) The heat turns water into steam in a boiler.
5) The high-pressure steam turns the blades of a turbine generator to produce electricity.
6) An air pollution control system removes pollutants from the combustion gas before it is released through a smoke stack.
7) Ash is collected from the boiler and the air pollution control system.

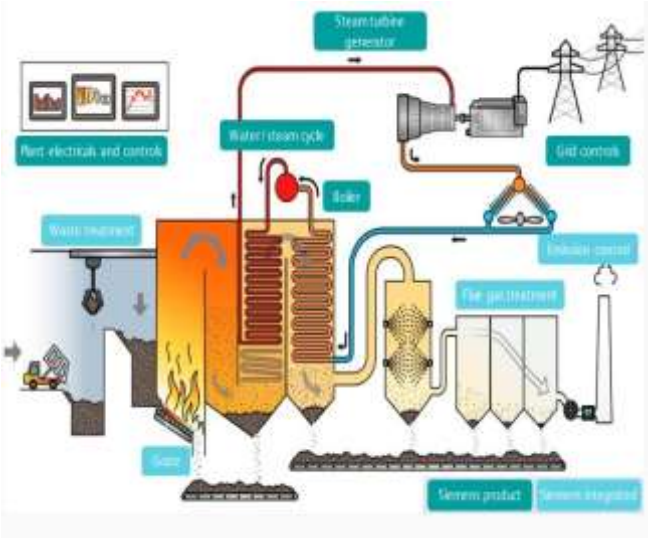

Fig 4: Schematic Diagram of Waste to Green Energy Process

Essentially, these plants burn MSW to power steam turbines. These turbines send electricity to the power grid. The products of this burning process are water vapor and harmless ash that is used for aggregate and metals.

The rest of this ash is disposed in landfills but takes up 90% less space than MSW. Electricity can be produced from waste through direct combustion, and the released heat is utilized to produce steam to drive a turbine. This indirect generation has an efficiency level of about 15% to 27%, with modern plants reaching the higher end of the range. The electrical efficiency rate from incineration is usually higher than from gasification due to lower operating temperatures, steam pressure and overall energy required to run the plant.

Green Energy recovery from waste is the conversion of non-recyclable waste materials into usable heat, electricity, or fuel through a variety of processes, including

combustion, pyrolyzation, anaerobic digestion and landfill gas recovery.

4. COST ESTIMATION AND FUTURE SCOPE

4.1 COST ESTIMATION

The typical plant with capacity of 1GWh energy production annually costs about 77 million rupees to build. The capital investments for the construction and implementation of these technologies, and the costs needed to operate them for the entire lifetime of a chosen project can influence decisions when it comes to deciding the best way of green energy production. As of today, incineration of waste still presents the most desirable economic conditions on the market, and is therefore the preferred option in most markets.

4.2 FUTURE SCOPE

- Proper use of waste.
- Clean environment.
- Sustainable for future.
- Economical issue.

5. ADVANTAGES AND DISADVANTAGES

5.1 Advantages

- Reduces costs and risks associated with landfills.
- Additional source of revenue.
- Stimulates local economy.
- Creates jobs, Money stays at home.
- Reduces Petroleum Dependence.
- Helps meet alternative fuel mandates.
- Green energy recovery i.e, energy is produced with the benefit of clean source of energy.

5.2 Disadvantages

- Initial cost to build plants.
- Residues still require proper testing and disposal.
- Plants will have to be built to comply with the clean air act.
- The potential to neglect other plans for recycling and reuse of waste.
- The public's concern about dioxins produced by emission gas.

6. CONCLUSIONS

Waste-to-energy isn't just a trash disposal method. Waste-to-Energy is a vital part of a sustainable waste management chain and is fully complementary to recycling. It's a way to recover green energy. It is possible to reuse major parts of the metals contained in the bottom ash and the remaining clinker can be reused as road material. Green energy recovery solves the problem of solid waste disposal while recovering the energy from waste material with the benefits of environmental quality, increasingly accepted as a clean source of energy. The solid waste is used as fuel for the production of electricity. The solid waste should be considered as alternate source of energy and every municipal corporation should use this technology to reduced pollution, preserve coal, and reduce production of greenhouse gases protection the ozone layer. By using municipal solid waste as fuel the pollution will be reduced and we will get the power which can be used in the poor village were electricity is less.

Waste-to-energy facilities produce clean, renewable energy through thermo-chemical, biochemical and physicochemical methods. The growing use of waste-to-energy as a method to dispose off solid and liquid wastes and generate power has greatly reduced environmental impacts of municipal solid waste management, including emissions of greenhouse gases. Waste-to-energy conversion reduces greenhouse gas emissions in two ways. Electricity is generated which reduces the dependence on electrical production from power plants based on fossil fuels. The greenhouse gas emissions are significantly reduced by preventing methane emissions from landfills. Moreover, waste-to-energy plants are highly efficient in harnessing the untapped sources of energy from a variety of wastes.

Through this paper we gained a lot of practical knowledge regarding green energy production which creates a safe environment. We feel that the paper work is a good solution as it leads to recover green energy in the foregoing future. And we are proud that green energy recovery makes a great impact on the future generation as it serves the future with a Sustainable Green Energy Development.

REFERENCES

[1] U. Di Matteo, B. Nastasi, A. Albo, D. Astiaso Garcia, "Energy Contribution of OFMSW (Organic Fraction of Municipal Solid Waste) to Energy-Environmental Sustainability in Urban Areas at Small Scale", Energies,10 ,p. 229,2017.

[2] M.S. Korai, R.B Mahar and M.A. Uqaili, "Optimization of waste to energy routes through biochemical and thermo-chemical treatment options of municipal solid waste in Hyderabad, Pakistan", Energy Conversion and Management, 124, pp. 333-343,2016.

[3] Prachuab Peerapong, "Waste to Electricity Generation: Technology, Policy, Generation Cost, and Incentives of Investment", IEEE, Volume20, Issue4, 2016

[4] Fayeen Shariar, "Waste to Energy: A New Dimension in Generating Electricity in Bangladesh", IACSIT, Volume 4, Issue 4, 2016.

[5] S. Al-Salem, S. Evangelisti, P. Lettieri, "Life cycle assessment of alternative technologies for municipal solid waste and plastic solid waste management in the Greater London area", Chemical Engineering Journal, 244, pp. 391-402, 2015.

BIOGRAPHIES

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