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Renewable Energy Technologies from Solid Waste

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Abstract—*The waste to energy (W to E) is a process of generating energy in the form of electricity or heat from waste. W to E is a form of energy recovery in which any techniques or method of minimizing input energy. W to E technology consists of any waste treatment process that creates energy from waste sources. These technologies can be applied o several types of waste; from semi-solid to liquid and gaseous waste into various forms of valuable energy. However, the most common application by far is processing the municipal solid waste (MSW). The power generated through it can produce and distributed through local and national grid systems.As of today, the most common and well developed technology is in the form of combined heat and power plants which treat municipal solid waste and possibly a combination of industrial, clinical and hazardous waste, by this technology we can reduce the land filling and can also generate energy from the negative price wastes.*

Keywords*: municipal solid waste, waste to energy.*

1. RENEWABLE ENERGY TECHNOLOGIES FROM SOLID WASTE

Energy is the driving force for the development in all countries of the world. The increasing clamor for the energy and satisfying it with a combination of conventional and renewable resources is a big challenge .Therefore there is an urgent need to fulfill the energy requirements and to manage the waste that had been produced. Waste to Energy technologies is able to convert the energy content of different types of waste into various forms of valuable energy. Power can be produced and distributed through local and national grid systems. The most important economic difference between Waste to Energy technology and other combustion based energy generation units is strictly related to the nature of the input fuel. Waste has a negative price, which is regulated by prefix gate fees and usually considered as main source of income treatment. Regarding the technology related costs, initial investment costs for the constant plant play an important role because of large size of these facilities and main installed components. Incineration is the most developed and commercialized technique for Waste to Energy conversion. The thrust of the task force is therefore to minimize the quantum of waste for disposal by optimal utilization of the potential of all components of MSW by adopting the “concept of 5-R” – Reduce, Reuse, Recover, Recycle and Remanufacture.

2. TECHNIQUES OF WASTE TO ENERGY PROCESSES:

The methodologies which can be used to obtain energy from waste:

Thermal techniques:

- Incineration
- Thermal gasification
- Pyrolysis
- Co-combustion
- Mechanical heat treatment and other techniques.

Non thermal techniques:

- Anaerobic digestion
- Bio-Ethanol production
- Mechanical biological treatment
- Biogas production from landfills
- Microbial fuel cell and other techniques.

3. THERMAL TECHNIQUES

- **Incineration:** The incineration technique is widely used, the combustion of organic material such as waste with energy recovery, is the most common Waste to Energy implementation. The method of using the incineration to convert municipal solid waste to energy is a relatively old method of Waste to Energy production. Incineration generally entails the burning waste to boil water which powers steam generators that make electric energy and heat to be used in homes, business, institutions and industries. But it had environmental issues at the beginning but nowadays the modern incinerator plants are so well acquainted and established to reduce the pollution and environmental aspect related problems.

- **Thermal Gasification:** Thermal gasification is a process which is able to convert carbonaceous materials into an energy-rich gas. When it comes to gasification of waste fractions, it is often agreed that this technology is not yet sufficiently developed in comparison to combustion. However, this process could present many favorable characteristics such as an overall higher efficiency, better quality of gaseous outputs and of solid residues and potentially lower facility costs (Astrup T., 2011). Thus gasification, with proper future technology developments, could be considered a valuable alternative to combustion of waste.
- **Pyrolysis:** Pyrolysis uses heat to break down combustible polymeric materials in the absence of oxygen, producing a mixture of combustible gases (primarily methane, complex hydrocarbons, hydrogen, and carbon monoxide), liquids and solid residues. The products of pyrolysis process are: (i) a gas mixture; (ii) a liquid (bio-oil/tar); (iii) a solid residue (carbon black).
- **Co-combustion:** Co-combustion with another fuel (typically coal or biomass) is an Alternative that makes it easier to control the thermal properties of the fuel; in particular the Lower Heating Value. Also, co-combustion is an attractive alternative to simple coal combustion both in terms of costs and emission levels.

4. BIO-CHEMICAL CONVERSION

Energy can also be extracted from waste by utilizing bio-chemical processes. The energy content of the primary source can be converted, through bio-decomposition of waste, into energy-rich fuels which can be utilized for different purposes.

- **Biogas production from anaerobic digestion:** Anaerobic digestion is a biological conversion process which is carried out in the absence of an electron acceptor such as oxygen . The main products of this process are an effluent (or digest) residue and an energy-rich biogas. The entire conversion chain can be broken down into several stages in which different groups of microorganisms. Drive the required chemical reactions. The obtained biogas can be used either to generate power and heat or to produce bio-fuels. The digest can also be utilized in many different ways depending on its composition.
- **Bio-ethanol production:** Bio-ethanol can be produced by treating a certain range of organic fractions of waste. Different technologies exist; each of which involving separate stages for hydrolysis (by enzymatic treatment), fermentation (by use of microorganisms) and distillation. Other than bio-ethanol, it is possible to obtain hydrogen from the use of these technologies, which is a very useful and promising energy carrier (Karakashev D. & Angelidaki I., 2011)
- **Biogas production from landfills:** Other than in an anaerobic digester, it is possible to extract biogas directly from landfill sites, because of the natural decomposition of waste. In order to do so, it is necessary to construct appropriate collecting systems for the produced biogas. Biogas in landfills is generally produced by means of complex bio-chemical conversion processes, usually including different phases like Initial Adjustment, Transition Phase, Acid Phase, Methane Fermentation and Maturation Phase (Zaman, 2009).

5. COST AND ECONOMY

The techno-economical analysis of the waste-to-energy plant that includes combined heat and power production is presented. The technology of waste combustion on the grate is chosen as the proven technology most often in use even today. Selection of this technology assumes application of all the most stringent environmental protection standards The parameters on which the cost-effectiveness of the waste-to-energy cogeneration plant depends range from purely technical, like plant capacity and the waste calorific value.

6. STATUS OF WASTE TO ENERGY IN INDIA

About 188,500 tons waste per day is produced from urban part of India. Due to increase Population the per capita waste generation as considerably increased in past decade. Various W TO E plants in India are adopted based on the properties and composition of the waste. W TO E 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 purpose.

According to the Indian express news six waste to energy plants to be set up under ***Swachch bharat mission.*** In a significant step towards generating power from garbage under the swachch bharat mission, six waste-to-energy plants with installed capacity of about 74 MW will be commissioned next year including two in the national capital.

7. ADVANTAGES

W TO E Reduces Greenhouse Gases:

New policies to encourage W TO E can have a sizable effect on reducing the nation's greenhouse gas emissions.

W TO E Reduces Dependence on Fossil Fuel:

New policies to encourage W TO E can also have a meaningful impact in reducing dependence on fossil fuels and increasing production of renewable energy. MSW is currently comprised of 56% biogenic and 44% non-biogenic materials. Combusting the biogenic fraction of W TO E is considered renewable by the DOE.The nation currently landfills about 248 million tons of waste per year so there is significant potential to increase energy production from W TO E. Every ton of MSW processed in a W TO E facility avoids the mining of one third ton of coal or the importation of one barrel of oil. If all waste were processed in modern W TO E facilities it could satisfy 3 to 4 percent of the country's electricity demand.

W TO E Provides Clean Energy:

W TO E technology has significantly advanced with the implementation of the Clean Air Act, dramatically reducing all emissions. The EPA concluded W TO E now produces electricity with less environmental impact than almost any other source.

Reliable Electricity:

W TO E operates 24/7 to reduce base load fossil fuel generation and is desirably located in proximity to urban areas where the power is needed the most.

Recovered energy:

The energy produced by process is recovered from discarded materials.

8. DISADVANTAGES

Environmental Issues: The incineration process produces two types of ash. Bottom ash comes from the furnace and is mixed with slag, while fly ash comes from the stack and contains components that are more hazardous. In municipal waste incinerators, bottom ash is approximately 10% by volume and approximately 20 to 35% by weight of the solid waste input. There are no safe ways of avoiding their production or destroying them, and at best they can be trapped at extreme cost in sophisticated filters or in the ash. Human Health Concerns: Waste incineration systems produce a wide variety of pollutants which are detrimental to human health.

Financial Impacts: All over the developed world, almost half the investment is put in control systems to reduce toxic emissions such as mercury, cadmium, lead, dioxins, furans, volatile organic compounds etc.

9. CONCLUSION

In this report we have studied the various innovation techniques from which waste is use as energy sources to harness electricity by using different technologies and at the same time reducing the daily volume waste. The first impression that the city creates in mind of a visitor is how clean the city is. The urbanization is done without a remarkable change in the attitude which is still rural, rustic and down to earth. The habit of throwing garbage on road and waiting for sweeper to sweep once in 24 hours needs to change. Solid waste management is a part of health and sanitation, and according to the Indian Constitution, falls within the purview of the State list. Since this activity is non – exclusive, non – rivaled .And also the adoption of alternative cleaner methods for the disposal of municipal garbage is necessary. However, the need for low cost solution and some environmental friendly process needs to innovate and ideas to established widely economic.

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