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A REVIEW: CONTRIBUTION TO GREEN ENVIRONMENT THROUGH WASTE TO ENERGY

Miss P M. Pathak[1], Aesha Bodawala[2], Khushboo Kumari [3]
[1]Assistant Prof, [2,3]Student
Department of Civil engineering, Sinhgad Academy of Engineering
priyankapathak122@gmail.com
aaeshabodawala77@gmail.com
khushboosayshi2@gmail.com

Abstract— **Waste is the substance may be solid, liquid and gaseous generated by the living beings which affect the environment and being no longer in use or value for the respective economic, technologies and physiological process are removed from it. Understood as household, solid waste in a broader sense is understood as any household, industrial, agricultural material, etc that has been used up. Such waste collected in the area managed by municipalities for removal and storage, which is termed as Municipal Solid Waste (MSW) which further follows the path of its generation to its final disposal which is known as functional elements of MSW. A Waste-To-Energy (WTE) technology consists of any waste treatment process that creates in a form of heat, electricity or transport fuel from a waste source. Urbanization rates and economic growth increases with increase in population and this changes the landscape of generation rates (domestic solid waste), waste composition and treatment technology. Therefore it is necessary to recycle the waste generated by human beings as it fulfills the needs to some extent. It focuses on Waste, its technologies and improvements needed in processing and removal units as compared to existing one.**

Index terms- **Solid Waste Management, Life Cycle Assessment of MSW, Waste-to-Energy, Environmental impact, Incineration, Gasification, Heat Recovery.**

I. INTRODUCTION

Copious challenges such as Waste Disposal treatment, Pollution, Global Warming, Over-Population, Climate Change, Natural Resource Depletion, etc. and Waste Processing is one of the challenges being faced in the field of environmental protection. The focus is upon the challenges to identify and implement for long lasting solution. The wastes produced from living being are normally solid, liquid and gaseous and that are discarded as unwanted or thrown away type. As human population continues to grow, the negative impact on environment is evident. Every day we human produces or generate waste in large quantity. As world moves ahead the amount of Municipal Solid Waste (MSW) generation is passing the rate of urbanization. Waste is a problem that will not go away and it will continue or over grow as human population increases. Today, however, the government has taken various steps to deal with it. The most common is 3R's i.e Reduce, Reuse and Recycle.

Although reducing, reusing, recycling are preferable in the whole world, but there is a need of alternatives for non-recyclable materials. So here Recover came into existence to 3R's hierarchy as solution to fourth R.

Fig.1: Development of 4th R

Fourth R -"RECOVER" which refers to the practice of putting the waste product to use and to extract valuable material out of it.

Waste and its by-products are recycled again to get more useful products. Some waste materials can also be used as fuel in power plants to create electricity or other forms of energy. In general ,they are categorized into three : Municipal Waste (which includes food waste, rubber, ashes, residues, construction and demolition wastes, special wastes and treatment plant wastes), Industrial Waste , Hazardous Waste (which includes radioactive, toxins, pesticides etc).

Journey of waste right from its generation to its ultimate disposal can be explained with help of following diagram:

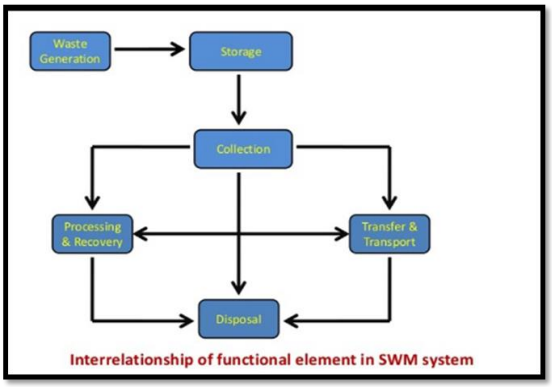

Fig.3: Functional elements of solid waste management

1. **Waste generation** is associated with the materials which are identified as no longer being value and gathered together for disposal.
2. **On site handling, storage and processing** is associated with handling, separation, storage and processing of solid waste on site.
3. **Collection** is associated with gathering of solid wastes and hauling it after the collection from different location.
4. **Transfer and transport** is associated with transfer of wastes from the smaller vehicle to larger transport equipment and transport of the wastes, usually over long distances for processing or ultimate disposal.
5. **Processing and recovery** is associated with techniques, equipment and facilities used both to improve the efficiency of other functional elements.
6. **Disposal** is associated with the final discarding of solid wastes collected and transported to the landfill site.

There are many processing technologies developed for green solution of environment such as:

1. MUNICIPAL SOLID WASTE (POWER PLANTS)

Municipal solid waste (MSW) commonly contains trash, garbage, refuse, rubbish etc and by this "mass burn" process is to be done, where it is directly combusted to energy as fuel to trifle the processing. It can undergo moderate to extensive processing before being directly combusted as Refuse Derived Fuel (RDF), or it can be gasified using pyrolysis or thermal gasification techniques.

- MASS BURN

Incoming trucks deposits the refuse into pits, where cranes then mix the refuse and remove any bulky or large non-combustible items such as large appliances etc. The refuse storage area can be maintained under atmospheric pressure to avoid odors from escaping. The cranes move the refuse to the combustor charging hopper to the feed the boiler. Further the heat is produce from the combustion process is used to turn the water into the steam and with the help of steam, the steam turbine generates the power. Then steam is condensed by different traditional methods such as wet cooling towers, once- through cooling etc. and routed back to the boiler. At the end the residues produced are ash which falls to the bottom of the combustion chamber and the fly ash get exodus from the combustion chamber with the flue gas.

- REFUSE DERIVED FUEL (RDF)

RDF typically consists of pelletized or fluff MSW that is the by-product of a resource recovery operation. In this process the removing materials are iron, glass, grit, and other materials that are not combustible. At the end the remaining materials are sold as RDF.

Each of these technologies can produce electricity. In contrast with many other energy technologies that require fuel to be purchased, MSW facilities are paid by the fuel suppliers to take the fuel known as "tipping fee". The tipping fee is comparable to the fee charged to dispose of garbage at a landfill.

The type of fuel source are biomass, digester gas, industrial waste, landfill gas, municipal solid waste etc. through which WTE power plant are identified.

II. LITERATURE SURVEY

Stehlik (2009) studied about WTE in paper Contribution to advances in WTE technologies gives idea about different recent advances for thermal processing of various type of waste in technologies and advancement units including MSW, which is regarded as WTE process wherever and whenever it is possible and feasible. Thermal treatment of waste accompanied by release of a considerable quantity of heat that depends on the heat value of the waste being processed. According to observation different strategies are being classified for heat utilization in WTE plant are:

- Power plant producing only heat whose net average heat efficiency is 63%.
- Power plants producing no heat or no heat delivery whose net heat efficiency is 18%.
- A cogeneration system whose net efficiency is 43%.

The focus is given on WTE challenge including various criteria for approach of WTE technologies and conflicting attitudes about waste management in Waste-To-Energy Center (WTEC). The concept of WTEC is necessary for effective and safe treatment of various types of waste, ensuring the proper utilization of energy, and it also helps as source of income by increasing the local employment. But here the question arises about the equipment? The units to be setup to run the WTECs? The solution is setting up basic units i.e unit for the thermal treatment of MSW, Industrial waste, incinerator plant for treating sewage sludge, Combined Heat and Power system(CHPs), a system for segregation of waste attached to a system for the fabrication of alternative fuels, system for utilizing ash and fly ash.

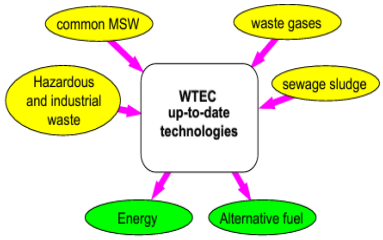

Fig.4: Types of waste produced in WTEC

Selection of appropriate technologies

Technology selection is one of the most important steps for setting up a waste treatment plant as entirety depends upon it. It has various criteria like firstly, according to the technology point of view, there is usually a best choice which should sustain long lasting, and it should consume less time and should have appropriate cost. Then secondly, potential of the technology supplier play key role. While, in case of customized technology specific character of waste treatment units should be taken into account.

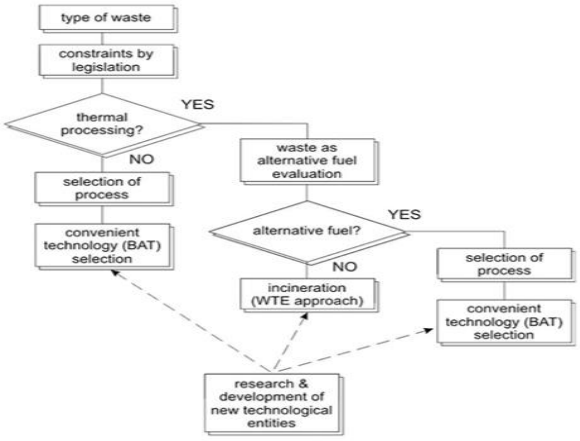

Fig.5: Flow chart of convenient technology selection

The author suggest the pre-requisite of waste management which are ensure proper segregation of waste, ensure the finest waste recycling and utilization of all known process for the management of biodegradable wastes.

The suggestion is given on new heat recovery system in thermal treatment of waste which consists of design and operation equipment for energy utilization contained in flue gas. The solutions that author suggested are back pressure steam turbines and condensing bleeder turbines with one or more extractions.

Psomopoulos et.al, (2009) gives idea about energy from solid waste in paper Life cycle assessment of energy from solid waste – part 1: general methodology and results in which author has discussed about merits and demerits of various methods for treatment of solid waste and to classify critical factors in the systems including landfilling, incineration, recycling, digestion, compositing etc. it also gives idea about replacement of oils and coal as waste for energy source which reduces the emission of greenhouse gases, start increasing the use of renewable fuels i.e Waste and the recycling of paper, plastic materials, etc. is in general favorable regarding to overall energy usage, emission of gases contributing to global warming and total weighted results. So, the basic scenario is to "Save the Biomass" that is left in the forest after recycling of paper products and it is used as production of heat instead of natural gas and associated emissions. According to study the waste management system in Sweden was recently affected by the decision of introducing the landfill tax and to stop landfilling the organic waste.

The focus is given on total energy use where, incineration is better and more efficient than digestion and demand for transportation distances especially by passenger car.

After seeing the results of the existed power plant, the energy answer crop of Massachusetts, USA came up with modernized technique called The Southeastern Massachusetts (SEMASS) the most successful RDF type process which is operated by American ref-fuel, has a capacity of 1 million tons/year in which one third of the total waste is developed by long term contracts, while two third is delivered by commercial accounts and private haulers.

It has recovering facilities of recyclable metals of around 50,000 tons from pre combustion magnets and bottom ash annually.

The waste which is carried by the trucks is being weighed by the in-bound truck scale as they arrive to SEMASS facility. The incoming trucks follow the traffics pattern. According to the pattern, the trucks dumped their waste on the tip floor before existing the tip area and then to the exit door.

Types of vehicles/trucks

- Rear load and side load compacting type vehicles.
- Front load compacting vehicles.
- Roll-off compactors.
- Roll-off open top compactors.

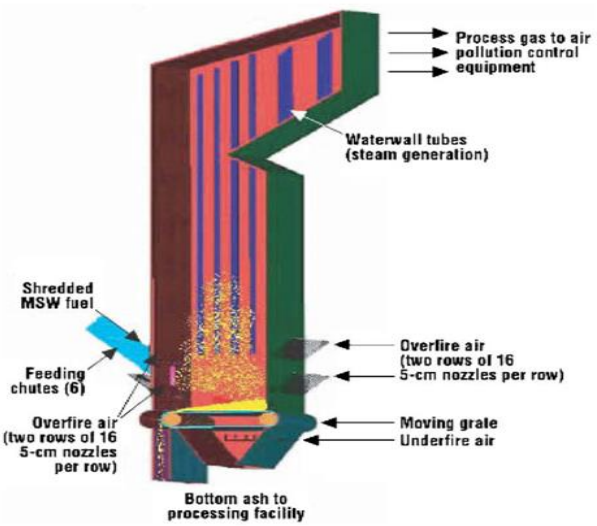

Fig.6: Schematic diagram of SEMASS

Pavlas et.al, (2009) studied about energy production processes and technologies from waste in paper an evaluation of the environmental impact. The focus is given on saving of energy and comparison of different techniques used for generating energy and electricity.

The cogeneration plant is based upon reciprocating combustion engine. It simultaneously generate power and heat. Natural gas is also generated along with it. Its ouput ranges between KW to MW where cogeneration plant output is 2MW. The net efficiency is around 80-85 %.

A. Various Concepts

1) Anaerobic Digestion:

These are airtight reactors in which decomposition of organic waste is carried out and then it is transformed into biogas process. Biogas is recovered and transformed into heat or any other form of energy and the remaining sludge in the process contains many nutrients and can be used in agriculture and it is one of the advantages. The other advantages are the energy recovery with production of high grade soil conditioner, there is no requirement of power unlike aerobic composting, and there is less emission of greenhouse gases. It is free from bad odour, rodent etc**.** This leads to high rates of purification. And economical advantage is it can be done at small scales. The disadvantages are heat released is less- resulting in lower and the destruction of pathogenic organisms effect is less than in aerobic compositing. It is Unsuitable for wastes which have less organic matter. It requires segregation of waste for improvement in digestion efficiency.

2) Landfill Gas Recovery:

When waste is landfilled, organic matter decomposes and releases landfill gas (LFG) which consists of hundreds of gases such as methane (CH_4), carbon dioxide (CO_2), nitrogen, oxygen , ammonia, sulfides, hydrogen, etc.

3) Processing and Delivery

This includes methane gas which is passed to a gas scrubber, which extracts moisture and filters out particulates and it is transported to compression system. Finally, the gas is used to fuel turbines or engines to produce electricity. For industry, it can be used as alternate fuel source. Its advantages are less economical and gas created can be utilized for power generation or as domestic fuel for direct thermal application and there no requirement of skilled person. Natural resources are returned to soil and recycled. No wastage of land i.e low lying marshy land can be converted to useful areas. Now the dis-advantages are like by polluted leachate, the groundwater aquifers may get contaminated in the absence of proper leachate treatment system.

Process is to be carried on large land area. Significant cost for transportation for faraway landfill sites may upset viability cost of pre-treatment to upgrade the gas to pipeline quality.

The chances of spontaneous ignition /explosions due to possible build up of methane concentration in atmosphere.

4) Incineration:

This treatment includes the waste materials that are converted into ash, flue gas and heat by combustion process at 1000 ^{0} C. The ash is formed by the inorganic constituents of the waste and gases due to organic waste and the heat generated by incineration is used to generate electric power. The incineration has net capacity of 300 tones and the output in combustion chamber is about 33MW. As plant works for 8000h/year. The important parameters which affect the chain of waste management are availability and reliability. It is very beneficial in technical ways as well as economical ways such as it is most suitable for high calorific value waste, noiseless and odorlesss, it can be done on small scale, Hygienic, possibilities of locating the plant within city limits which Reduce the cost of waste transportation, thermal energy recovery for direct heating or power generation. Some of the disadvantages are like it is least suitable for aqueous, high moisture content, low calorific value and chlorinated waste. The overall efficiency for small power stations is low. Skilled and knowledgeable person for operating is required. Need high capital. The parameters which affect the net energy recovery are excessive moisture and inert content. Auxiliary fuel support may be required to sustain combustion.

5) Pyrolysis / Gasification:

Pyrolysis includes thermal degradation of waste in the absence of air to produce char, pyrolysis oils and syngas and external source of heat is employed in the process. Gasification is a process in which materials are exposed to some oxygen, but enough to allow combustion to occur.

This includes four stages. Firstly, the preparation of waste feedstock is done. Then, it is passed to heating process and further it is passed for scrubbing of the gas and at last by using scrubbed gas, electricity is generated.

It has some positive points like production of fuel gas or oil, which is useful for a various applications. Control of atmospheric pollution can be dealt with in a superior way, in techno-economic sense as compared to incineration plant. And few negative points like excessive moisture content which saffects the net energy recovery. High viscosity of pyrolysis oil may be problematic for its transportation and burning.

III. CONCLUSION

The review concludes that the one of the most efficient technique of treating the waste is thermal treatment of SWM with heat recovery is. The energy generated from WTE units leads to energy generated from biomass. On comparing the techniques or method, the recycling of paper and plastic material is in favorable. If longer transportation distances is neglected than incineration is in more favorable over landfilling.

According to our study the reduction in emission of greenhouse gases and reduction in total usage of energy is our aim and it can only be possible by saving biomass from increased recycling waste which is used as fuel replacing fossil fuels.

REFERENCES

[1] Finnveden G, Johansson J, Moberg G, Lind P. Life cycle assessment of energy from solid waste—part 1: general methodology and results. Journal of Cleaner Production 2005.

[2] Pavlas M, Tous M, Bebar L, Stehlik P. Waste to energy – An evaluation of the environment impact. Applied Thermal Engineering 30(2010) 2326-2332.

[3] Psomopoulos C, Bourka A, Themelis N. Waste-to-energy: a review of the status and benefits in USA. Journal of Cleaner Production 29 (2009) 1718-1724.

[4] Stehlik P. Contribution to advances in waste-to-energy technologies. Journal of Cleaner Production 17 (2009) 919-931.

[5] Moberg G, Finnveden G,Johansson J, Lind P. Life cycle assessment of energy from solid waste—part 2: focusing on land-filling as a treatment method. Journal of Cleaner Production 2004; 12 doi: 10.1016/j.clepro.2004.02.025

[6] ISO. Environmental management—life cycle assessment—principles and framework. Geneva, Switzerland: International Organization for Standardization; 1997.

[7] ISO. Environmental management—life cycle assessment—goal and scope definition and inventory analysis. Geneva, Switzerland: International Organization for Standardization; 1999.