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# Assessment of Waste To Energy Generation Potential of Municipal Solid Waste: A Case Study of South Delhi

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***Abstract:*** *Exponential population growth, unprecedented urbanization and changing life style has led to the substantial generation of municipal solid waste. Approximately only 20 percent of the waste generated is processed and remaining 80 percent is dumped in to landfill sites. Delhi is generating highest quantity of per capita municipal solid waste and about 28 million tonnes of waste lay at Bhalswa, Ghazipur and Okhla landfill sites.This waste have high calorific value and has lot of potential to convert into compost and energy for human use.There is an urgent need to find sustainable solutions and appropriate technology to better manage waste and to generate energy from the waste.The aim of this paper is to characterization the waste and to analyze the waste energy generation potential of municipal solid waste from South Delhi.*

***Keywords****: MSW, waste to energy, compost, reuse and recycle*

## I. Introduction

Unprecedented population growth coupled with economic development, industrialization and rapid urbanization have led to substantial generation of municipal solid waste (MSW).According to World bank(2012)Global municipal waste generation will increase from 1.3 billion tons per year in 2012 to 2.2 billion tons per year in 2025 .Management of solid waste is of paramount importance forenvironmental and human health.Delhi, with a population of about 16.3 million, making it the second most populous city and second most populous urban agglomeration in India and 3rd largest urban area in the world **(Census of India, 2011; UNSD, 2015).**Delhi generates approximately 11,558 tonnes of municipal solid waste daily (**Vij, D., 2012).**

Management has remained one of the most neglected areas of the municipal system in Delhi. The generation rate is about 700 gm/person/day, which is almost five times the national average. Poor collection and inadequate transportation are responsible for the accumulation of MSW at every nook and corner.Only 9% of the collected MSW is treated through composting, the only treatment option, and rest is disposed in uncontrolled open landfills at the outskirts of the city.70–80% of generated MSW is collected and the rest remains unattended on streets or in small open dumps. Presently existing composting plants are unable to operate to their intended treatment capacity due to several operational problems. Therefore, along with residue from the composting process, the majority of MSW is disposed in landfills**(Talyan etal 2008).**In india high calorific value solid waste dump in landfill therefore waste to energy technologies can be proposed **(Al-Khatib et al.2010**).Also construction of scientific landfill having gas tapping system is must in future**(Kumar and Sharma2014)**

Waste contain high calorific value and has lot of potential to convert into energy for human use. For sustain the economy of country energy generated from waste is very important and will reduce theheavy burden to exhausted landfill. Generating power from waste has greatly reduced the environmental impact and dependency on fossil fuels for electricity generation. Economically also it is an optimal solution for recovery of heat and power from waste. According to waste hierarchy, the best option to dispose waste is to recycle and reuse it. What cannot be reused andrecycled should go for energy recovery. Generating energy from waste could provide the best financial and environmental benefits to the society. Waste is turned into usable form of energy in the way of either heat or electricity which can be stored and utilized further. This approachpaves the way for utilizing maximum energy that

is stored in waste. To the dismay, a large fraction of solid waste in most of the developing countries is disposed off unscientificallyin open dumps or landfills that generate gases which is mainly composed of $CH_4$ and $CO_2$. These gases are proven cause of global warming; of which methane has global warming potential of 25 times higher than carbon dioxide **(Hegde et al. 2003; Srivastava et al. 2015).** Waste-to-energy conversion technology includes biochemical and thermal treatment of converting waste into usable form of energy **(Johri et al. 2011).**Energy can be generated from waste by many technologies such as biomethanation, incineration, gasification/pyrolysis, refused derived fuel (RDF) and plasma arc gasification etc.The paper aims to characterization the waste generated from the South Delhi and to analyze the waste energy generation potential of municipal solid waste.

## II. Methodology

***Study Area***

The study area is South Delhi total area of 646.91 Sq.kms and having population of approx. 70.00 lacs. It is spread over 104 wards and each wards having a colonies and villages.It consist of four zone i.e Central, South, West and Najafgarh zone. Fig 1 shows the map of south Delhi.

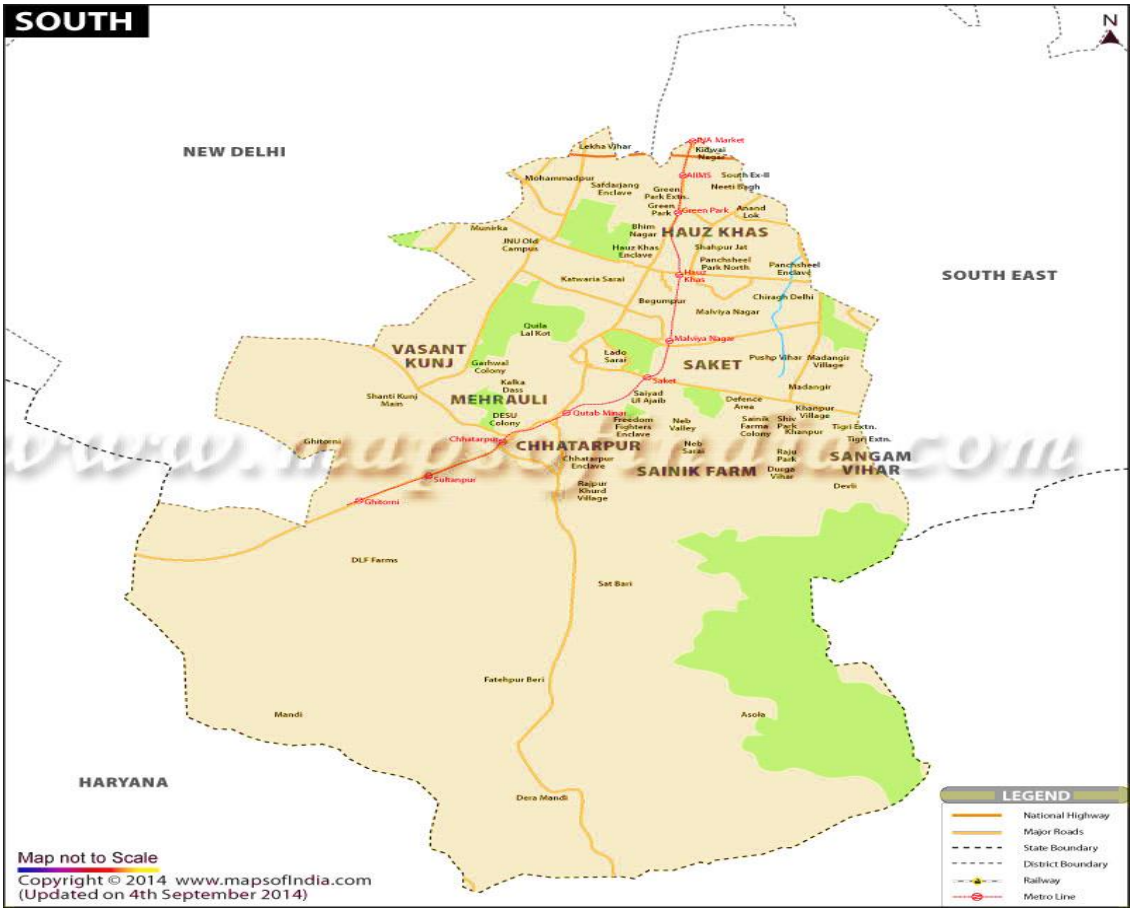


Fig:1 Map of South DelhiSource-Map of India 2014.

***Okhla Landfill :***Okhla Landfillsite is located at Okhla Phase-I at latitude and longitude of 28°30′42.05″N 77°17′4.47″E which is close to ESIC hospital an Established in 1994 and decommissioned in 2018 area of the landfill is 56 acres,But still used to dumping waste beyond its intake capacity.This Site serves for dumping of solid

waste generated from four zone of South Delhi. This landfill site ( Fig 2) is located at Okhla Phase-I. Site serves for dumping of solid waste generated from South Delhi and Central Delhi.

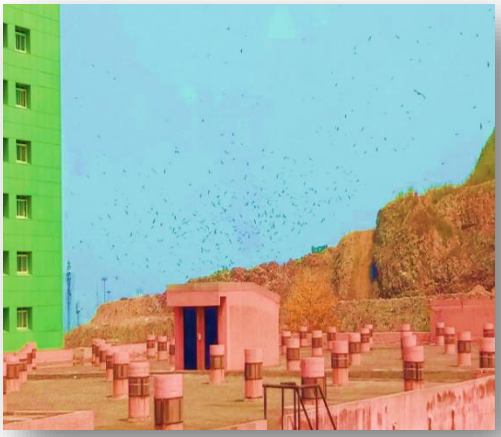

Fig: 2 OkhlaLandfill( a and b)

***Waste to Energy Plant***:Waste to Energy Plant(Fig 3)was started in 2012 in Timarpur Okhla waste management plant, located just opposite to the Okhla composting plant( Fig 4).

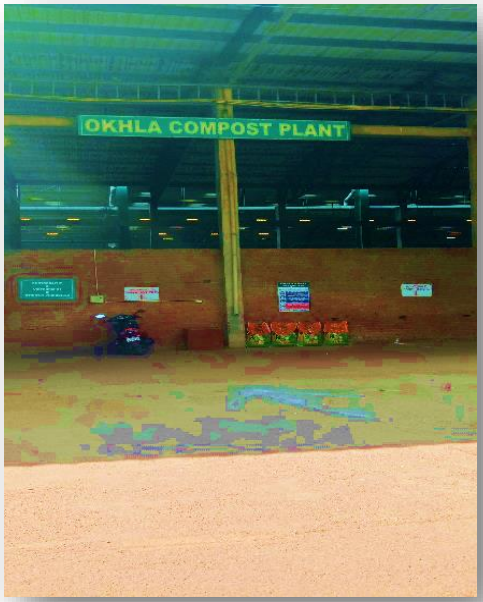


Fig:3 Okhla Waste to Energy PlantFig:4 Okhla Composting Plant

***Sampling, Data Collection and Analysis***: For the study purpose both primary and secondary data are used. The primary data was collected by survey questionnaire/ structured interview fromofficials of SDMC, workers of Sanitary Landfill Okhla, waste to energy plan Okhla, composting plant Okhla, New Delhi . The secondary data has been collected form SDMC office, sanitary landfill okhla office, waste to energy plan Okhla office, Okhla composting plant and recent published reports. The collected data were analyzed and the waste to energy generation potential of municipal solid waste were assessed.

## III. Result and Discussion

According to CPCB (2011), Delhi is generating highest quantity of municipal solid waste with 6800 tons per day followed by Greater Mumbai and Chennai. Waste generation in South Delhi is increase annually. According to SDMC(2019) an average of total 3600MT per day of waste is generated, out of this around 1650MT non segregated waste is transported to the Timarpur Okhla waste management plant for generation of energy and 100 MT of non-segregated waste is transported to Okhla composting plant for making compost. Remaining 1850 MTof non segregated waste is dumped in Sanitary landfill Okhla phase -1.

Management of municipal waste in south Delhi is done mainly by collection of waste from door to door and also from community bins by informal waste picker. Fig 5. Gives an estimation of Solid Waste Generated from Four Zone of South Delhifrom year 2011 to 2019.

This table (1.0) gives the Total Solid Waste generatedby all the four zones of SDMC. The data was obtained from the report of SDMC( 2020)

| Year | Zones of South Delhi in (MT) | | | | |
|---|---|---|---|---|---|
| | Najafgarh (In MT) | South zone (In MT) | Central zone (In MT) | West zone (In MT) | Totals (In MT) |
| 2011-2012 | 106251.707 | 230703.375 | 245253.695 | 251421.825 | 833630.602 |
| 2012-2013 | 129856.945 | 199272.130 | 225550.970 | 254289.770 | 808969.815 |
| 2013-2014 | 148384.225 | 208551.17 | 214290.515 | 237823.575 | 809049.485 |
| 2014-2015 | 135347.810 | 229447.225 | 226637.495 | 277477.400 | 868909.930 |
| 2015-2016 | 174892.82 | 260440..63 | 256388.25 | 343360.070 | 1035081.77 |
| 2016-2017 | 212211.820 | 293862.635 | 313898.580 | 360507.990 | 1180481.025 |
| 2017-2018 | 272690.02 | 329595.09 | 354186.95 | 373,060.17 | 1329532.230 |
| 2018-2019 | 281198.620 | 305647.050 | 379323.225 | 266928.055 | 1233096.950 |

Table 1 Total solid wastegeneration at south Delhi at all the four zones(2011-2019).

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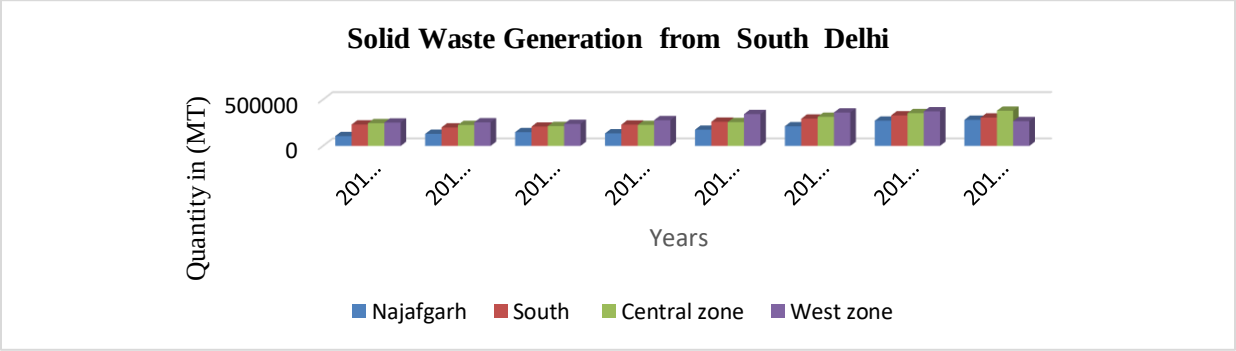


SDMC:2020 Fig:5 Generation of solid waste from(2011-2019) of South Delhi2012-2013

As shown in Table 1.0 and Fig 5 the observed maximum quanity of waste were generated in the year of (2017-2018) and minimum waste were generated inthe year of (2012-2013)from the South Delhi. Out of all the four zone west zone of South Delhi generated maximum quanity of waste from (2011-2018) except 2018-2019 where central zone generated generatedmaximium waste than west zone. Najafgarh zone of South Delhi generated minimum waste than other zone from 2011-2019.

Presently there are no primary segregation of solid waste at household level , Segregation of waste is done mainly by informal sector i.erag picker and they collect solid waste from door to door in partial segregated or non segregated form. Waste picker segregate waste in community bin and separate recycled item for theiradditional income for livelihood .Primary collection of waste is done with resource like Auto tipper E-Rickshaw , cycle rickshaw, wheel barrow for street level collection.After these same waste are transported to Waste to energy plant, compost plant and sanitary landfill through secondary transport like Mobile compactor, fixed compactor transfer station.Out of total municipal waste collected 3% of waste is transported to composting unit on basis of capacity of composting plant per day treatment potential and 46% of total waste is transported to waste energy plant which was run by private firm. 51% of unsegregated waste is directly transported to landfill for dumping.

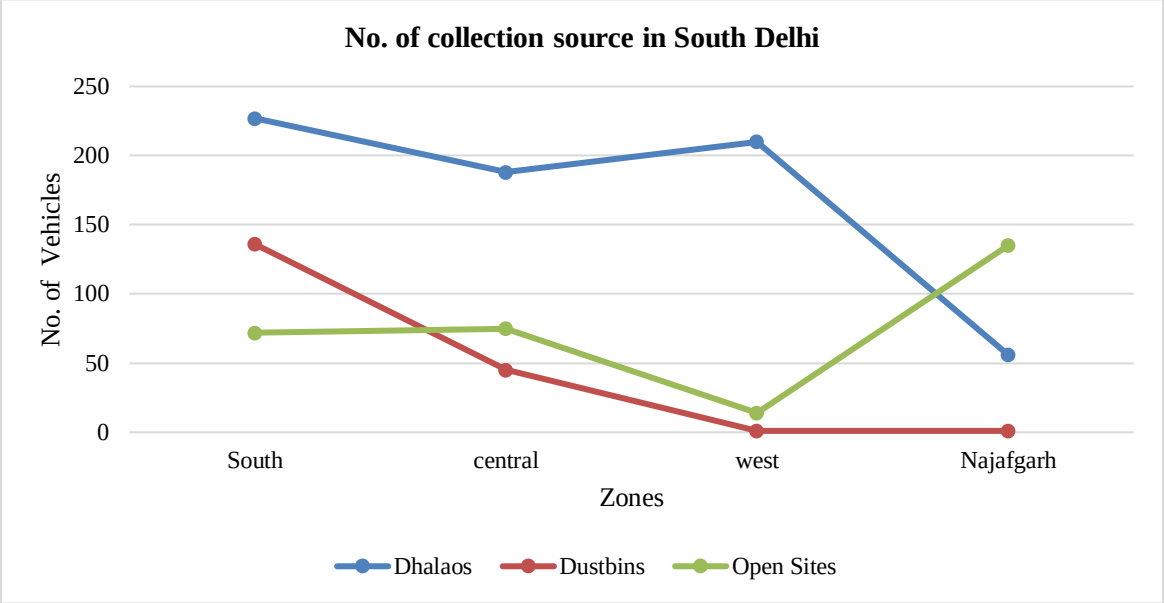


Fig:6 No. of collection source in South Delhi

This table (2.0) gives thenumber of vehicles used for transportation of Solid Waste by SDMC through various vehicles. The data was obtained from the report of SDMC( 2019)

| **SDMC (Vehicle)** | **Central zone** | **South zone** | **West zone** | **Najafgarh zone** |
|---|---|---|---|---|
| FCTS | 17 | 26 | 31 | 1 |
| Mobile compactor | 34 | 31 | 38 | 13 |
| Hook loader | 15 | 16 | 20 | 2 |
| autotipper | 301 | 148 | 177 | 34 |
| Tipper truck | 15 | | 9 | 21 |
| Backhoe loader | 2 | 2 | - | - |
| TATA 407 | 18 | - | - | - |

| | | | | |
|---|---|---|---|---|
| Bin washer vehcile | 4 | 2 | - | - |
| Road sweeping | 5 | - | - | - |
| Refuse collector | - | 6 | - | - |
| Manual rickshaw | - | 56 | 60 | - |
| Open dumper | - | 4 | - | - |
| Three wheeler | - | 28 | - | - |

Table 2.0 No of vehicles for transportation of solid waste at south Delhi at all the four zones.

***Physical And Chemical Composition Of Waste***

Physical composition investigation of Delhi was done by various institute of Delhi .A few investigations have been led by various associations in Delhi and organizations (IHPH) 1982, NEERI 1996, TERI 2002) to decide the physical and compound synthesis of MSW.Fig 7 gives the physical composition of waste generated.

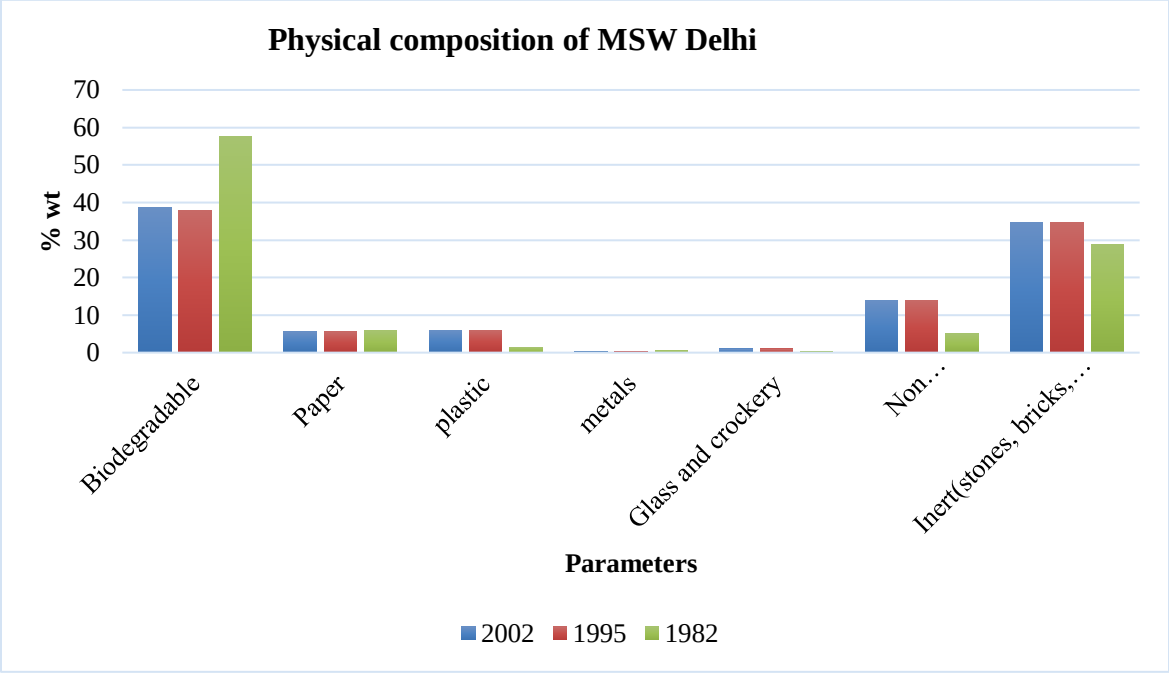


Fig:7 Physical characteristic solid waste of Delhi

Biodegradable waste was found in maximum amount. The inert matter like stone,brick,ashes and construction and demolition wasteare produced in huge quantity which is because of high pace of construction and demolition activities in Delhi. The other major components of the MSW are paper, plastic metal, glass and crockery and non-biodegradable waste (leather, rubber, bones and synthetic material). In Delhi, the recyclable material, like paper, plastic and metal, are available in high quantities, but it is not properly processed, because of lack of knowledge, man power, machinery and financial support from the Government.

Fig 8showed the chemical composition of municipal solid waste in Delhi. It has been observed that the waste is characterized by high moisture content which pave the way for the process of composting rather than incineration. The waste has very high calorific value and is very good for energy generation.

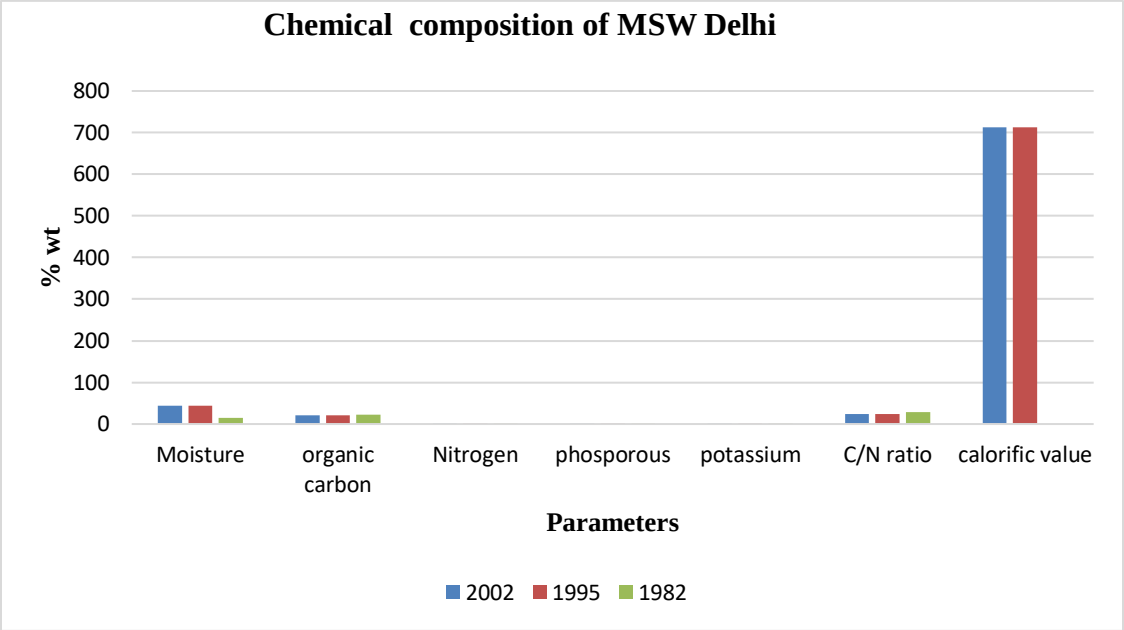


Fig:8 Chemical characteristic solid waste of Delhi

Physical and chemical composition of Solid waste of South Delhi which dumped in Okhla landfill has contain Biodegradable wasteof 28.62% and inert material of 32.7% , Bioresistant 19.7%, Plastic 4.45%,Metal 0.1% has high potential for biomethanation and also containing high calorific values and moisture content having hugepotential to convert into ecofriendly energy for society**(Kumar and Allapat 2003)**

***Energy Generation Potential of South Delhi Municipal Solid Waste:-***

The Okhla landfill site receive around 2000 MT of non-segregated Solid Waste daily. There is no arrangement for leachate collection and treatment at this site. Leachate is being generated and migrate into existing sewer through open drains. The solid waste received at site is leveled, restructuring and compacted with the help of hydraulic bulldozers, for this around hundreds of worker were engaged for this work.At south Delhi waste treatment facilities are available i.eTimarpurokhla waste management run by company name Jindal Ecopolispvt limited and Okhla composting is managed by IL&FS company pvt. limited**.**

The Okhla waste to energy plant receives 2000MT of waste per day and processes approx. 1950MT per day. Timarpur Okhla waste to energy plant is India largest waste to energy plant and it is based on UNFCCC carbon credit project. (SDMC) South Delhi municipal corporation transports 1650MT and 100MT of non segregated waste per day to these plant for treatment and generate energy and compost. This plant also receives waste from NDMC (New Delhi Municipal Corporation), DCB( Delhi Cantonment Board) and APMC(agriculture Produced Marketing Committee). In Delhi first incinerator to treat MSW was built in Timarpur, New Delhi, in 1987. It was a large-scale incinerator that has the capacity to process 300 tonnes of waste per day and costs `250 million. But the plant failed because of seasonal variations in waste composition and properties, poor waste segregation, inappropriate technology selection and maintenance, and operational issues **(IUKR 2015).**

In India generation of energy from waste are still not fully practice and also lack of ecofriendly technology, infrastructure and space required for it. Generation of waste is increase over a year and it is responsibilities of scientific community to adopt new technology to recover heat and energy from waste. Currently, the informal sector picks up part of the resources from the streets and bins to earn their living still portion of organic waste as well as recyclable material goes to landfills untreated. Over 81% of MSW annually is disposed at open dump sites without any treatment. With planned efforts to Reduce, Reuse, Recover, Recycle, Remanufacture and appropriate choice of technology, the country can profitably utilize about 65% of the waste in producing energy and/or compost and

another 10 to 15% to promote recycling industry and bring down the quantity of wastes going to landfills/ dumps under 20% **(Planning Commission report 2014)**.

Need of waste to energy plant at South Delhi is for reduction of burden on landfill, generation of renewable energy and reduce depend on fossil fuel, save time for long distance to transportation of waste, also reduce risk of ground water contamination of leachate generated from waste at landfill, proper utilization of methane and reduce risk fire break at landfill.SDMC also process and treat municipal solid waste at decentralized level for these they developed a facilities like biomethanation, Biogas plant, Compost pit etc. at selected wards of four zone of South Delhi some of these facilities are in operation and some will be operated in future. Biomethanation is better than incineration because in incineration various toxic gas release in environment but for biomethanation required segregation of waste into organic and inorganic . SDMC plan to set up new waste to energy plant which is extension of Okhla waste to energy plant at Okhla landfill.It give hope to convert 51% of nosegregated waste directly dumped into landfill for converting into energy.Presently 46% of total waste collected from South Delhi are utilize for waste to energy generation.

Presently 16MW of energy are generated by conversion of 1650MT(46%) of waste from South Delhi ,it can be estimated that energy will be double if waste which directly dumped in landfill used in waste to energy plant.For conversion of 51% of waste into energy there is need of infrastructure and ecofriendly technology to boost the waste to energy potential.In this year on June 30,2020**(www.Republicworld.com)** India Oil ,NTPC(National thermal power corporation) and SDMC(South Delhi Municipal Corporation) signed MoU to develop a waste to energy facility at Delhi Okhla landfill site by using gasification technology.In gasification process is for converting solid or liquid feedstock, in this case, waste, into a gaseous or liquefied fuel that can be burned to release energy. With this technology, one ton of Municipal Solid Waste (MSW) can be used to produce up to 1,000 kilowatt-hours of electricity, a much more efficient and cleaner way to utilize this source of energy.India Oil,NTPC and SDMC come together for these project Has the potential to carve out a greener and more energy-efficient future for the Atmanirbhar Bharat as Envisioned by Prime minister.

## IV. Conclusion

Municipal solid waste is main environmental issue which has been face by Municipalities of whole world, and management of these type of waste are not possible without support from public themselves because they are generator of waste. In South Delhi of National capital of India management of municipal solid waste come under jurisdiction of SDMC (South Delhi Municipal Corporation) and they put their best effort to collect, transport,processing and disposal but one step lack is segregation of waste which is responsibilities of household or waste generator to segregate their waste into three categories according to solid waste management rule 2016.Maximumquantity of waste is generated from South Delhi were biodegradable and huge opportunity to converted into biogas, compost. There is good potential of waste from South Delhi to converted into energy by the extensionof present waste to energyplant and by using all solid municipal waste which are directly dump into Okhla landfill.Looking at the huge quantity of waste and its potential to convert in to energy Government should increase the Waste to energy and composting plant capacity in future.

***Recommendation***

1. SDMC should organize a community based workshop /training so as to aware the people about Segregation of waste.
2. Waste to energy plant should increase their intake capacity so reduce burden on landfill.
3. There should be a waste segregation center at each ward where rag picker can segregate waste
4. No. of Waste picker/Rag picker who collect waste from door to door tobe recorded and should get recognition from SDMC.
5. Waste to energy plant and compostingplant shouldreceiveonlysegregated waste from SDMC**.**
6. People who engaged in waste collection, segregation, transportation anddisposal should have health care facilities and health card report to maintain themselves protect and safe.
7. Waste to energy plant shouldbe away from public residential area, eco sensitive zone, silent zone area.
8. Aware the public on Decentralised waste management and involve NGO with local govt for this activities.

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