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Conversion of MSW to transportation fuel

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Abstract: In a metro city like Mumbai Municipal Solid Waste (MSW) is increasing day by day. These solid waste are dumped on different places across the city. Due to this pollution is increasing which is not good for the people living in this city. It is not only dangerous for short term but solid waste also has long term effects and it adversely affects the health of the people living in Mumbai. Serious concerns arises due to it, making it obligatory to convert solid waste into other useful products like transportation fuel, electrical energy etc. Though reducing waste the waste ending in the environment. Transportation fuel can be generated from MSW by many methods which will restrict amount of waste and also give us transportation fuel. By converting MSW into other useful products the damage caused by generation and accumulation of solid waste can be effectively reduced. Thus it is of vital importance to make use of municipal solid waste in a way to reduce its quantity and simultaneously producing energy during the process. This way it would reduce the land required for dumping waste and make provision for future growth of a metropolitan city like Mumbai. The generated fuel can be used for powering vehicles. In this paper various methods implemented for obtaining transportation fuel from MSW is the main focus. Further the paper will disclose how other countries have successfully generated transportation fuel from MSW and also on how such methods can be implemented in Mumbai as well.

Keywords: Solid waste, transportation fuel, municipal solid waste, waste management, MSW, Mumbai, solid waste management.

I. INTRODUCTION

Usually garbage known as Municipal Solid Waste (MSW), consist of everyday items that are discarded by public. Mumbai the largest metropolitan city of India also produces tones of MSW per day. With increase in population in Mumbai there is increase in the municipal solid waste. According to the survey which was done in 2017, waste generated per day in Mumbai is 7800 MT. Of which 4500 MT is Biodegradable, 500 MT is dry waste consisting mainly of paper and cardboards, plastics, metals, glass, etc. 2500MT silt and debris and 25 MT is biomedical waste. This large quantity of waste is dumped into the dumping grounds everyday leading to increase in the land space required to store it, this wastes the land which can be utilized productively such as for agriculture, increasing the green cover of the city etc. Dumping ground acquire a large area which can be used for many other purposes rather than dumping waste. Also due to the waste the people in the locality nearby vicinity suffer from many health problems. It also results in uncontrolled release of methane which has 20 to 23 times higher GHG(Green House Gas) effect than CO_2, production of leachate which contaminates the soil and ground water, spread of pathogenic microorganisms and unpleasant odours. There is an immediate need of solutions that will solve all the problems. The most economical and environmental safe way of dealing with MSW is to convert MSW into transportation fuel. Vehicle fuel is the important issue which we are facing. All commercial vehicles operate on fossil fuel for e.g. Diesel, Petrol, Natural Gas, etc. Diesel and petrol are not only costly but also harmful for the environment. They are more emissive and responsible for Greenhouse effect. Whereas the fuel generated from MSW will help environment and is environment friendly. Successful generation of transportation fuel from MSW will reduce the portion of waste hence enhancing the environmental till condition. There are various methods used by many countries for this purpose. Some of the methods used for converting MSW into fuel are Gasification, Pyrolysis, Refuse derived fuel (RDF) system, anaerobic digestion, etc. The Integrated Waste Management (IWM) technique developed by the EPA is one such methodology in which use of different practices is adopted to effectively handle the solid waste

II. LITERATURE REVIEW

Humans are the main species known as main source of environmentally unsafe and harmful waste. In ancient times, people village had a fixed regular ritual to burn their waste in large dumps. London was very first to come up with solid waste management system in the late 1800 century. A system to recover resources from waste was established around the dust yards. Major part of municipal waste consisted of dust or coal Ash which had good market value as it can be used as a soil improver as well as for brick making. After removal of readily salable items by the informal sectors in the streets it was the dust-contractors who were encouraged to effectively recover 100% of residual waste in a profitable manner. This system of MSW management was a very good example in the early time. An act for provision of a steadily evolving process of regulated waste management named NRDPA (Nuisance Removal and Disease Presentation Act 1846) was implemented. The Metropolitan Board of Works was the first citywide authority for which sanitation regulation was centralized for the unexpectedly fast growing city and the Public Health Act 1875 made it obligatory for every home to collect all of their waste in a movable container once a week for dumping. The first concept for a

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dustbin. Due to the ever increasing waste and scarcity of land required for dumping let to the formation of the very first incineration plants called destructors.

III.METHODOLOGY

Transportation fuel is generated through various methods as listed above viz. gasification, pyrolysis, anaerobic digestion, etc. Each method has its own challenges with certain merits and demerits which include their economic efficiency, their effect on environment during and after completion of the process and also on the final by-products obtained. Anaerobic digestion - It is a slow process which takes roughly 5 to 15 days. This process usually involves moderate temperature of about 35^0C to 63^0C for a bio-mass in an environment with deficiency of oxygen, oxygen deficient since it is an anaerobic process. The reaction can also include presence of some pathogens and microbial organisms. It is biologically active organic waste. The most appropriate example of active organic waste is food. It requires low operating cost and low capital. But the waste to fuel efficiency is relatively low.

- Primary by-products – Methane CH4.
- Secondary by-products – CO2, undigested biomass and compost.

Pyrolysis: pyrolysis is method which converts different type of waste into useful fuel. Pyrolysis yields recovered energy from waste which can be utilized as an alternative to fossil fuel. It is basically a process in which organic material is decomposed by heat which gives different hydrocarbon gasses in an oxygen deficient environment. High inter molecular vibration is obtain due to increased temperature in pyrolysis. Such high temperature leads to breakdown of molecular structure. For slow pyrolysis solid charcoal and gasses are obtain whereas liquid fuel is produced form fast pyrolysis for free stack like wood. When waste plastic is burnt using pyrolysis technique then millions of litre of fuel can be produced. Metal glass and sand cannot be converted transformed into gas by this process. On comparing with incineration, pyrolysis process does not release harmful product such as sulphur, alkali metals and chlorine. In this process the amount of emission of contaminated gas is less as compared to other process which makes for smaller Clean-up methods that would reduce cost.The reaction is carried out at the medium temperature of 400 C to 500 C in a controlled environment with deficiency of oxygen. It is expensive in comparison with anaerobic process. This process requires more cleaning of product before use as compared to gasification products. Due to this it is less economical.

- Primary by-products – Contains bio-oil containing 300 different compounds consisting of carbon, Hydrogen and oxygen.
- Secondary by-products – water, acidic gases, toxic metals, charcoal, PAHs, etc.

Gasification - Gasification is also a process requiring an environment with deficiency of oxygen and high temperature of about 750^0C to 1500^0C for operation. It has high operating cost but is the most economic and efficient in converting MSW to Transportation fuel. It converts carbons up to 98% to 99% i.e. it minimises char.

- Primary by-products – Syngas which is a ccompound of CO and H2 in varying proportions.
- Secondary by-products – it contains water vapour, char, CH4, CO2 and other compounds such as sulphur compounds, alkali compounds, nitrogen compounds and other contaminants.

This process consists of four Major steps as follows:

a. Drying – The feedstock is broken in small particulates and then heated to remove all moisture.
b. Devolatization - The feedstock is again heated to remove volatile matter.
c. Combustion - It is an exothermic process giving heat to the last step. CO2 and CO are by-products of
d. Reduction reactions - The energy from the above steps gives energy to the further reduction reactions.

$$C + H2O \Rightarrow CO + H2 \quad C + CO2 \Rightarrow 2CO$$
$$CO + H2O \Rightarrow CO2 + H2$$
$$CO + 3H2 \Rightarrow CH2 + H2O$$

Biotechnological process - It is a process in which MSW is converted into other molecules with the help of microorganisms. Generally using this process the MSW is converted into liquid fuel such as ethanol and gaseous fuel such as methane and hydrocarbon. As it is evident that different sources of waste have different composition of MSW, and this has effect of the final product which is obtained by this process. Therefore, waste containing vegetable and food waste gives higher yield as they are easily degradable on comparison with papers, cardboard etc.

III. ECONOMIC ASPECTS

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Mumbai overall produces 7,800 MT of waste per day. Generally MSW consists of 27% green waste, 25% paper, 19% plastic, 27% food by weight. Chemically MSW consist of 15 to 30% carbon, 2 to 5% hydrogen, 12 to 24% oxygen and 0.002 to 1% other matter. Many densely populated areas of Mumbai have encountered difficulty providing sufficient landfill capacity for MSW and face rapidly escalating landfill costs. Due to this, alternative to landfilling, such as converting the solid waste in fuel should be adopted. For nearly 100 years, MSW has been used as a fuel to produce steam and drive electric-generating machinery at many places of the world. Burning MSW as fuel and recovering energy has gained worldwide acceptance as an effective way of waste management, since 1950. Also viewing it as a method of reducing waste volume, with the other benefits considered of lesser importance. For e.g. if a municipality has landfilling capacity of 5 years and by reducing the waste volume by 90% by resource recovery, the life of the landfill will increase from 5 years to 50 years on basis of volume. On comparing of different scenarios on an equivalent basis, there should be a degree of equality between products and services. A quantified measure of functional output and functional unit, forms basis of system comparison. The main purpose of MSW management is to treat the waste. But products of different values are produced such as fuel, electricity and materials. Thus, MSW is compared with other processes on an equivalent basis. If 200,000 tonnes of MSW is processed by gasification then an equivalent of 1.45 x 109 km of transport work can be carried out for a 5 passenger mid-sized vehicle. Thus the waste generated per day in Mumbai is 7,800 tonnes. Yearly Mumbai produces approximately 28, 47,000 tonnes of waste which can be used for 2.064 x 1010 km of transport work through gasification process.

IV. CONCLUSION

By adopting these methods we can cut the quantity of solid waste by about 90% in volume and 75% by weight. Thus, reducing the amount of landfill space required. This also helps in reducing the potential for disease and pathogenic organisms. Air quality and overall aesthetics of the city can be improved. Minimizing the amount of toxic waste polluting the soil and surface-water supplies. Not only decreasing the amount of MSW but also making productive use of it through production of energy and other materials such as transportation fuel. Thus the useless waste is transformed into useful transportation fuel which is not only economical but environment friendly as well.

REFRENCES

1] https://www.google.co.in/amp/m.timesofindi a.com/city/mumbai/mumbais -waste-drops-2000-tonnes-per-dayin-4-years/amp_articleshow/60240649.cms
https://www.google.co.in/search?client=msandroidvivo&q=municipal+solid+waste+definition&sa=X&ved=2ahUKEwiVnsTpqnYAhUIqY8KHZMTCUEQ1QIoAH oECAsQAQ&biw=360&bih=616
2] Mumbai-Solid waste generated, classification-recyclable https://www.google.co.in/url?sa =t&source=web&rct=j&url=https://www.mygov.in/sites/default/files/user_submission/1407227455.pdf&ved=2ahUKEwjh_rb7wO_YAhWEuo8KHSIp
3] Green conversion of municipal solid wastes into fuels and chemicals. https://www.sciencedirect.com/science/article/pii/S0717345817300040
4] Status and prospects of MSW to energy. http://www.springer.com/cda/content /document/cda_ downloaddocument/9 789811001482-c2.pdf?SGWID=0-0-45-1584716-p177809503
5] History of waste management https://en.m.wikipedia.org/wiki/History_of_waste_management
6] Garbage to Gasoline: Converting MunicipalSolidWaste to Transportation fuel
7] https://dukespace.lib.duke.edu/dspac e/bitstream/handle/10161/6835/MP% 20Paper_Farv