Design analysis and Recommendation of new treatment technology to improve waste management system in Nagpur city

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Abstract

A study of the integrated waste management system for Nagpur was conducted along with a detailed waste characterization of municipal solid waste. The waste characterization exercise was undertaken by the National Environmental Engineering Research Institute (NEERI), Nagpur. A total of 34 samples were collected from all the 10 zones in the city in April/May 2017 and tested for physical and chemical composition analysis, including bio-methane potential. Results from the waste characterization indicate that the average waste composition for Nagpur includes organics at approximately 60%, along with plastics (16%), paper (11%) and inerts (2%). The balance of 11% constitutes wood, metal, glass, etc. In addition, a waste bioremediation project primarily for the existing waste is being practiced by the city on the existing dumpsite. According to discussions with the city officials, the project has managed to considerably reduce the height of the existing waste dump. However, the project and technology is currently under question and facing challenges because of recent incidences of a huge fire (March 2017) and odour issues. Other initiatives by the city include the signing of a contract with a private operator for setting up a new waste-to-energy facility.

Keywords- *NEERI, Waste Disposal, Waste Management.* ***Waste-to-energy***

I. INTRODUCTION

Currently, the waste collection and transportation service is privatized and is being provided by Kanak Resources Management Limited (KRML). Approximately 255 vehicles of various types are deployed by KRML for the transportation of waste, along with handcarts, small tricycles and tipper trucks for primary collection from the households. Analysis of the vehicle deployment plan shared by NMC for KRML indicates that the total carrying capacity is sufficient. However, operational inefficiencies of KRML result in waste accumulation at the community bins and other secondary storage points. Segregation of waste at source is not practiced by the generators. Segregation of waste (limited to recovery of high value recyclables) is practiced by the workers engaged in door-to-door collection of waste. The city had adopted the concept of "Bin Free City" as far back as 2008, which resulted in a significant reduction in the number of community bins from 700 in the year 2008 to 170 in 2017 (approximately 80% reduction). Nine. The annual quantity of solid waste generated in Indian cities has increased from six million tons in 1947 to 48 million tons in 1997 with an annual growth rate of 4.25 percent, and it is expected to increase to 300 million tons by Population explosion, coupled with improved life style of people, results in increased generation of solid wastes in urban as well as rural areas of the country. In India like all other sectors there is a

marked distinction between the solid waste from urban & rural areas. However, due to ever-increasing urbanization, fast adoption of 'use & throw concept'& equally fast communication between urban & rural areas the gap between the two is diminishing. The solid waste from rural areas is more of a biodegradable nature & the same from urban areas contains more non-biodegradable components like plastics & packaging. The repugnant latitude towards solid waste & its management is however, common in both the sectors. Universally 'making garbage out of sight' is the commonly followed practice. In India, the urban local bodies, popularly known as the municipal corporations/councils, are responsible for management of activities related to public health. However, with increasing public and political awareness as well as new possibilities opened by economic growth, solid waste. For the various waste treatment technology options such as composting, waste to energy, refused derived fuels (RDF), anaerobic and aerobic digestion, conduct a comprehensive market study, based on demand for each product, quality and reliability of demand, availability and reliability of supply, availability of secondary/ancillary infrastructure to facility supply (e.g. proximity of local grid, transmission lines, etc.), proximity of demand, pricing structure and tariffs, incentive schemes, regulatory framework, inter alia. The city of Nagpur requested advisory services for the improvement of their solid waste management programme, which is a serious concern for the city. The GIZ Urban Nexus Project and Nagpur Municipal Corporation (NMC) agreed to study the solid waste management problem in detail and in an integrated manner (links to energy, water, recovery of valuables views, recover, recycling) to come up with an economically feasible solution for implementation. The characterization of municipal solid waste was one of the main components of the request to be studied.

II. LITERATURE SURVEY

In our country municipal corporations are primarily responsible for solid waste management. But with the growing population and urbanization municipal bodies are facing financial crunch and can no longer cope with the demands. The limited revenues earmarked for the municipalities make them ill equipped to provide for high cost involved in the collection, storage, treatment and proper disposal of waste [1]. Municipalities are only able to provide secondary collection of waste, means they only collect waste from municipal bins or depots. A substantial part of the municipal solid waste generated remains unattended and grows in the heaps at poorly maintained collection centers. Open dumping of garbage facilitates breeding of disease vectors such as flies, mosquitoes, cockroaches, rats and other pests. At present the standard of solid waste management is far from being satisfactory [2]. The environmental and health hazards caused by the unsanitary conditions in the cities were epitomized by the episode of Plague in Surat in 1994. That triggered public interest litigation in the Supreme Court of India. Based on the recommendations of the committee set up by the apex court in that Public Interest Litigation (PIL), the Government of India has framed Municipal Solid Waste (Management and Handling) Rules 2000, under the Environmental Protection Act, 1986[3]. The Municipal Solid Waste (Management and Handling) Rules 2000. Though doorstep collection of segregated waste is important for municipal solid waste management, it is not carried out by many of the municipal bodies in the country as they are lacking in financial resources or the expertise to comply with those rules and they often make little effort to revise outdated and deficient waste management systems [4]. As the authorities were hardly able to provide cost-efficient service to citizens, one possibility was to outsource solid waste management by putting in charge professional private organizations like Centre for Development Communication (CDC). The key concept is a daily door-to-door collection of segregated domestic waste, but the model includes all aspects of solid waste management from waste generation to waste processing (e.g. recycling and vermi-composting) and the final

disposal [8]. The end consumer is both main contributor and main beneficiary, as he should segregate the waste instead of littering it and, in turn, profits from the cleanliness of the city and creation of a new awareness that CDC work is generating. Presently the Swachta Doot [9] project is being successfully being implemented in several cities of India. Management is starting to receive due attention.

III. DESGIN AND IMPLEMENTATION

Analysis and recommendation of the optimal treatment technology suitable for the city based on technical, legal, environmental, economic and commercial parameters. Conduct rapid global market study of the viable technology options for waste treatments that are suitable for Nagpur's cultural, climate and waste type and are economically viable to operate. Based on the analysis of alternatives of processing facilities, waste characterization studies, markets for use of processed and separated waste, likely performance of source segregation and technologies, identify feasibility for waste processing and separation plants. Demand study for products from waste processing and separation – provide recommendations for end use or treatment of recovered waste resources (high value recyclables, low value recyclables, Compost, combustible material, waste to energy) in the region. For the various waste treatment technology options such as composting, waste to energy, refused derived fuels (RDF), anaerobic and aerobic digestion, conduct a comprehensive market study, based on demand for each product, quality and reliability of demand, availability and reliability of supply. Availability of secondary/ancillary infrastructure to facility supply (e.g. proximity of local grid, transmission lines, etc.), proximity of demand, pricing structure and tariffs, incentive schemes, regulatory framework, inter alia. Based on realistic performance of source segregation and processing technologies, develop phased, conservative estimates of the potential diversion of waste to the landfill. For the identified processing and disposal option, map the infrastructure requirements for utilities such as power, water, land and other requirements for establishing and operating the proposed waste management systems. Topographic survey of the site identified for development of the facility. The topographical survey of the site with spot grid level of 10 m x 10 m, to prepare a contour map of the site at 0.3 m contour level. Setup local coordinate system with respect to the magnetic north and establish temporary benchmark (TBM) for future reference. The area surveyed includes main features in the adjoining area such as electric poles, overhead wires, buildings and other structures. In addition to the above wastes, another type of waste called **"Domestic Hazardous Waste"** may also be generated at the household level. These include used aerosol cans, batteries, and household kitchen and drain cleaning agents, car batteries and car care products, cosmetic items, chemical-based insecticides/pesticides, light bulbs, tube-lights and compact fluorescent lamps (CFL), paint, oil, lubricant and their empty containers. Waste that is considered hazardous is first required by the EPA to meet the legal definition of solid waste. The EPA incorporates hazardous waste into three categories. The first category are source-specific wastes, the second category is nonspecific wastes, and third, commercial chemical products. Generally, hazardous waste "is waste that is dangerous or potentially harmful to our health or the environment. Hazardous wastes can be liquids, solids, gases, or sludge. They can be discarded commercial products, like cleaning fluids or pesticides, or the by-products of manufacturing processes**.**

Basic principles of Solid Waste Management

1) 4Rs: Refuse, Reduce, Reuse & Recycle

- Refuse: Do not buy anything which we do not really need.
- Reduce - Reduce the amount of garbage generated. Alter our lifestyle
- Reuse - Reuse everything to its maximum after properly cleaning it. Make secondary use of different articles.
- Recycle – Keep things which can be recycled to be given to rag pickers or waste pickers (Kabadiwallahs).Convert the recyclable garbage into manures or other useful products.

2) Segregation at source: Store organic or biodegradable and inorganic or non-biodegradable solid waste in different bins. Recycle of all the components with minimum labor and cost.

3) Different treatments for different types of solid wastes: One must apply the techniques which are suitable to the given type of garbage. For example the technique suitable for general market waste may not be suitable for waste.

4) Treatment at nearest possible point: The solid waste should be treated in as decentralized manner as possible. The garbage generated should be treated preferably at the site of generation i.e. every house.

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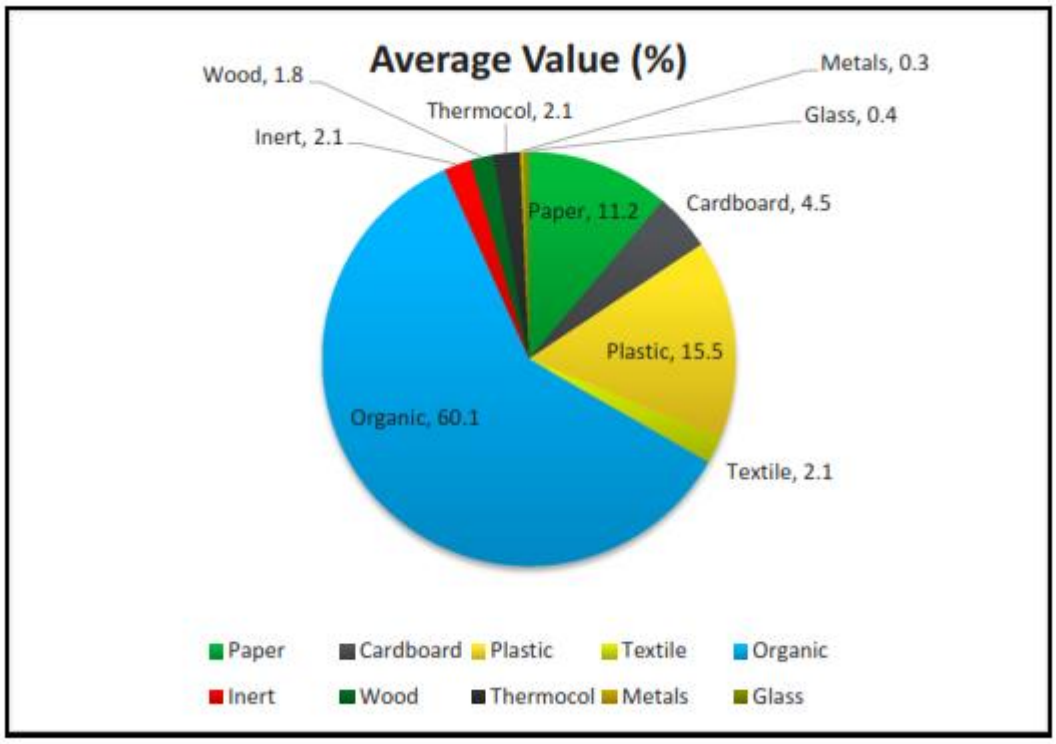

Figure 1 .Results of Waste Characterisation Analysis conducted by NEERI for waste at dumpsite.

Biological Processing Technologies

Biological treatment involves using microorganisms to decompose the biodegradable components of waste.

The biological process can be aerobic and anaerobic and the main biological technologies adopted internationally for the treatment of municipal solid waste are:

- Composting (aerobic processes); and
- Biomethanation (anaerobic processes)

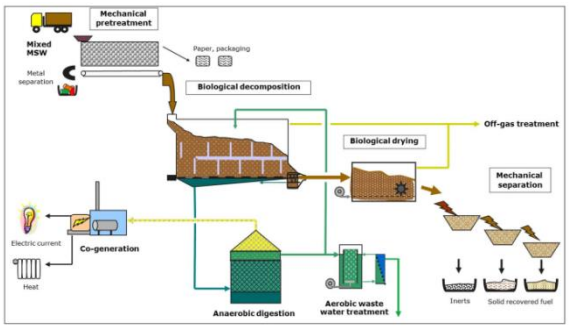

Figure 2. Waste processing unit

The process is controlled so that it is managed with the aim of accelerating decomposition, optimizing efficiency, and minimizing any potential environmental or nuisance problems that could develop. The microbes, fungi, and macro-organisms that contribute to this biological decomposition are generally aerobic. The composting of the waste generally yields 15-20% compost. The high organic content in the municipal waste stream is ideal for composting. Market for products and by products Low carbon footprint Modular *and flexible* plant to address the increasing waste supply in future

IV. CONCLUSION

Due to the high moisture and organic content of the MSW and taking into consideration that the MSW collection takes place as mixed waste, mass incineration is not recommended for Nagpur. We recommend an enhanced process which operates without waste segregation at the source therefore providing easy transformation to energy. According to our assessment, the mechanical-biological treatment of the MSW is the most suitable technology under the existing scenario; and the MYT process based on the technology providing maximum utilization of waste, minimum diversion of rejects to landfill and highly flexible process for heterogeneous waste is most suitable for Nagpur. MYT is a proven technology for mixed as well as segregated waste and aims at maximizing the resource recovery from waste. In comparison to the traditional waste treatment solutions of land filling, composting and incineration, MYT extends the technological portfolio of waste management, allowing for optimum economic exploitation of MSW in the form of raw materials, quality-assured fuels and energy-rich biogas. The waste characterization study conducted for Nagpur indicated a very high percentage of organic fraction (approximately 60%) and moisture content (56%), which makes it unsuitable for incineration-based processes. At the same time, the waste characteristics are extremely favorable for processing.

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