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## A STUDY ON TECHNOLOGIES ADOPTED BY MUNICIPAL CORPORATION IN INDIA FOR SOLID WASTE MANAGEMENT

Anirudh Kumar

Research Assistant

### ABSTRACT

This paper discusses the technologies used by the municipal corporations for the solid waste management. There are various methods or technologies available for the disposal of solid waste, but still it is the major problem of every nation specially the nations which are in their developing phase. During the developing stage, there is an increase in the number of industries and the quantity of solid waste increase due to increased production and consumption level. Solid waste management is difficult in developing countries as the production rate is higher and the industries have not reached to their peak point of profits where they can start earning enough which can be invested on the latest technology or machines which can help in reducing the industrial waste. Neither the industries nor the government of developing countries have enough funds to invest on the latest technology for the solid waste management.

**KEYWORDS:** Legal framework, waste management, technology, India, Municipal Corporation and government.

### INTRODUCTION

In India, municipality does not focus on segregation of the solid waste, or recycling. Waste are usually thrown or dumped on the major parts of the lands which are on the out skirt of the city. Even if there are various laws for the mandatory landfilling of specific types of waste in the country but still there is a lack of proper system or policy for implementation of that law and also government has just made the laws but not provided any facilities for the land filing of the waste. Various methods which are being used by the municipalities are treatment of waste, sanitary land filling, vermin composting, composting, anaerobic digestion, incineration, palletisation and gasification. These techniques of solid waste management have been discussed in the below section:

**LAND FILLING:** This is the widely used and famous method all around the world. But in India, municipalities rarely use this method. Sanitary land filling is one of the very important methods for the waste disposal and helps in the environment protection as well. This method makes use of technology and requires effective monitoring by the authorities. Instead of land filling, in India majority of the solid waste are dumped on the abandoned land on the out skirt areas of the city or near to the water resources which lead to water pollution and the rise of diseases due to polluted water\*. This practice also leads polluting ground water in the area. Due to the dumping of municipal solid waste on the uncultivated or unused land in the village areas, there were huge instances when village panchayats or the local bodies have protested against these practices of municipalities. These local bodies or the gram panchayats have refused to give permission to municipality to dump their solid waste on the lands in the residential areas or on the village land even if it is not in use for residence or for cultivation purpose, in order to promote the cleanliness and the sanitation in the villages. There were several protested which have highlighted and reached to the national level authorities for polluting the water and land resources of the villages by MSW.

Land filling method of waste disposal requires lots of land to speed up the process of solid waste disposal and it has positive impact on the environment and the health of the people. Solid waste generates methane gas, which is more harmful than carbon dioxide, and hence it causes global warming more than the carbon dioxide. Thus, it becomes vital to use latest techniques for solid waste management to reduce the global warming, through recycling, composting, and reduction of waste generating techniques. The areas where the adequate land is not available for land filling; solid waste should be managed through bio gas plants in order to reach the optimum level of sanitary land filling<sup>†</sup>.

According to the Municipal Solid Waste Rules, 2000<sup>‡</sup> all the municipalities need to follow the rules laid down for management and handling of the solid waste disposal using sanitary land filling. According to this rule, all the state pollution boards have laid the guidelines for the municipalities for the waste management and for set up of facilities which should work for at least 20 to 30 years. Till today, municipalities in all the cities and towns make use of unscientific methods of

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\* Dayal, G., 1994. Solid wastes: sources, implications and management. *Indian Journal of Environmental Protection* 14 (9), 669–677.

† Kansal, A., 2002. Solid waste management strategies for India. *Indian Journal of Environmental Protection* 22 (4), 444–448.

‡ Municipal Solid Waste (Management and Handling) Rules, 2000  
<http://www.moef.nic.in/legis/hsm/mswmhr.html>

waste disposal and also land has not been allotted for the purpose of land filling. There is not covered system for waste disposal and waste is mostly dumped in the open area that creates foul smell and which creates air pollution as well. No actions have been taken by the municipalities for prevention of pollution due to the waste disposal<sup>§</sup>.

Government has constructed four sites for the sanitary landfills in Pune, Surat, Karwar and Puttur. Various other sites are under construction in various other states for sanitary landfills. The cost of construction for sanitary landfills is very high and requires people with skills and knowledge for management of sanitary landfills. Government is actively working for the construction of sanitary landfills in the state of West Bengal, Rajasthan and Gujarat.

**COMPOSTING:** It is another technique for the management of solid waste, which is used for the disposal of the organic waste. This technique is not very popular and being used in some selected areas only. Compositing is the process of decomposing the organic waste in the presence of heat, moist, air and anaerobic environmental setting which is provided specifically for the purpose of waste disposal<sup>\*\*</sup>. This method is very simple not too complex, and require less cost and resources. The compost generated through this method can be sold to the farmers which is very useful for the purpose of agriculture. In the year 2003, Ministry of Urban Development developed plan for using the compost from waste disposal for the purpose of plant nutrient management as per the orders of Supreme Court. In the year 2005, ministry of urban development accepted the report generated by the ministerial task forces and from the year 2006, the court implemented the action plan. Under this plan it was decided to construct around 1000 composting plants on the basis of quantity of waste of the city<sup>††</sup>.

**Vermi-composting** is another organic fertilizer prepared from the earthworms which are being fed on the semi-decomposed organic waste produced scientific waste disposal. It is very simple

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<sup>§</sup> Das, D., Srinivasu, M., Bandyopadhyay, M., 1998. Solid state acidification of vegetable waste. *Indian Journal of Environmental Health* 40 (4), 333–342.

<sup>\*\*</sup> Mor, S., Ravindra, K., Visscher, A.D., Dahiya, R.P., Chandra, A., 2006. Municipal solid waste characterization and its assessment for potential methane generation: a case study. *Journal of Science of the Total Environment* 371 (1), 1–10.

<sup>††</sup> Sharholly, M., Ahmad, K., Mahmood, G., Trivedi, R.C., 2005. Analysis of municipal solid waste management systems in Delhi – a review. In: *Book of Proceedings for the second International Congress of Chemistry and Environment, Indore, India*, pp. 773–777.

and less complex technique, and easy to operate<sup>††</sup>. The most important thing to be taken care of is to prevent entering of any toxic material into the decomposition process which can kill these earthworms that produce the organic fertilizers. Vermi-composting technique is being adopted by small towns while in large cities for waste disposal, aerobic compost plants are used as they have larger quantity of solid waste. Majority of Vermi-composting plants are operating at very low capacity when compared to their installed capacity<sup>§§</sup>.

**WASTE TO ENERGY:** Waste to energy is another technique used for the management of waste disposal. Under this technique, waste is used to generate energy by burning the waste or garbage. This energy can be used to produce the electricity<sup>\*\*\*</sup>. This method is complex in nature and require high amount of investment. Due to higher cost, this method is less used by the states. Government provides subsidies for setting up the plants where waste can be used to generate energy. Waste to energy projects are being promoted by the government and the Ministry of Non-Conventional Energy. There are two main schemes which promote the waste to energy projects namely; National programme for conversion of industrial and urban waste into energy, and UNDP/GEF supported projects for development of biomethanation processes. There are mainly four wastes to energy plants have been set up in the country at different places namely; Delhi, Lucknow, Hyderabad, and Vijayawada. The plant set up in Delhi was forced to shut down just after its commencement while the Lucknow plant was set up only and never started its operations. The feasibility of waste to energy projects are mainly determined by the amount of funds invested, scale of production and the quality of the waste.<sup>†††</sup>

The main technologies which are being used under the waste to energy projects are namely; Biomenthanation, Anaerobic Digestion, palletisation, incinerators and gasification processes. Governments have set up a bio-menthanation plant in Vijayawada which is operating at very

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<sup>††</sup> Ghosh, C., 2004. Integrated vermin – psci culture – an alternative option for recycling of municipal solid waste in rural India. *Journal of Bio Resource Technology* 93 (1), 71–75.

<sup>§§</sup> Sannigrahi, A.K., Chakraborty, S., 2002. Beneficial management of organic waste by vermicomposting. *Indian Journal of Environmental Protection* 22 (4), 405–408.

<sup>\*\*\*</sup> Peavey, H.S., Donald, R.R., Gorge, G., 1985. *Environmental Engineering*. McGraw-Hill Book Co, Singapore.

<sup>†††</sup> Bhide, A.D., Shekdar, A.V., 1998. Solid waste management in Indian urban centres. *International Solid Waste Association Times (ISWA)* (1), 26–28.

limited scale<sup>†††</sup>. The plants for RDF or palletisation have just started their operations in the country at various places for conversion of waste into energy. Department of Science and Technology had started a demonstration plant in Mumbai with the help of Mumbai Municipal Corporation<sup>§§§</sup>. In this plant fuel pellets are produced with a calorific value of 3000 k cal per kg of waste and the sale value of that fuel was Rs 1000 per tonne in Mumbai. This demonstration plant was then handed over to the private companies namely; M/s. Selco International Limited and M/s. Sriram Energy Systems Ltd. to operate this plant for commercial operations.

**PYROLYSIS GASIFICATION:** It is an important process which is used to produce energy in terms of fuel gas or fuel oil from waste. This fuel oil or fuel gas can be used to replace the fossil fuels and do less harm to environment. This type of fuel gas or fuel oil cause less smoke and pollution can be compared up to the plant level. This process is highly technology intensive and requires huge funds or sluggish components in the waste<sup>\*\*\*\*</sup>. Moisture may create trouble in conversion process of waste to fuel oil and fuel gas. Due to moisture in the waste, the net recovery of energy from waste will be less and the process may not be profitable enough. It is an emerging technique for the solid waste management and till date there is no plant set up in India based on this technology, but the trials are in process<sup>††††</sup>. The hazardous waste need to be taken care of while performing the gasification process.

**Incineration** is the new technology which is used to convert the waste material into harmless material for the purpose of environment protection. The main disadvantage of this method is that it generates huge dioxins which are harmful for the human health during the process of incineration. Incinerators also require huge land where the ash can be filled into the land which contains hazardous waste<sup>††††</sup>. On an average, for three tonnes of garbage, one tonne of toxic ash is generated by one incinerator. The first incinerator was installed in the year 1987, by Delhi Municipal Corporation for burning the waste with a capacity of 3.75 MW at Timarpur. But due to

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<sup>†††</sup> Khan, R.R., 1994. Environmental management of municipal solid wastes. *Indian Journal of Environmental Protection* 14 (1), 26–30.

<sup>§§§</sup> Ahsan, N., 1999. Solid waste management plan for Indian megacities. *Indian Journal Of Environmental Protection* 19 (2), 90–95.

<sup>\*\*\*\*</sup> Ahsan, N., 1999. Solid waste management plan for Indian megacities. *Indian Journal Of Environmental Protection* 19 (2), 90–95.

<sup>††††</sup> Central Pollution Control Board (CPCB), 2004. *Management of Municipal Solid Waste*. Ministry of Environment and Forests, New Delhi, India.

<sup>††††</sup> Jha, M.K., Sondhi, O.A.K., Pansare, M., 2003. Solid waste management – a case study. *Indian Journal of Environmental Protection* 23 (10), 1153–1160.

the low calorific value of municipal solid waste, it could not operate successfully. The plant is non-operational and huge amount of capital got wasted<sup>§§§§</sup>.

#### **STRUCTURE FOR MSW MANAGEMENT IN INDIA<sup>\*\*\*\*\*</sup>**

This structure can be defined in to different levels:

**Level 1:** All the rules, policies are made by the parliamentary bodies of the country for the solid waste management in the country.

**Level 2:** Ministry of Environment and Forest take care of the implementation of the legislative policies, or the rules.

**Level 3:** Central pollution control board provides the technical assistance, conducts research activities for the waste management, provides training to the employees, and also coordinates the activities of the state pollution control boards.

**Level 4:** State pollution control boards work as per the directions of the control pollution control board and the state government, in order to reduce the water and air pollution, to regular check the pollution control devises. SPCBs also authorize to give permission for burning of waste or for the landfill of the waste disposal.

**Level 5:** Municipal corporations play an important role in execution for any legislative policy for the waste management. They set up and operate the facilities for the collection, transportation, treatment, disposal or the processing of the waste. These corporations outsource their work to private contractors for waste management.

Thus, it can be said that the structure of MSW management consists of mainly central government, state government, judicial system, central pollution control boards, state pollution control boards and the municipal corporations.

#### **LEGAL FRAMEWORK FOR SOLID WASTE MANAGEMENT IN GUJARAT<sup>+++++</sup>**

In order to address the issue of solid waste management in Gujarat, the government of Gujarat brought into effect the Municipal solid waste (Management and Handling) Rule in the year of 2000. Under the MSW (M&H) Rules 2000, it is the responsibility of each and every municipality to collect, group, and transport and dispose the solid waste of the respective region. The MSW (M&H) Rules also specifies responsibility of the authorities, whom are expected to be involved in the municipal solid waste management. The overall right for waste management is controlled by Gujarat Pollution Control Board. Each municipal authority is required to get the necessary

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<sup>§§§§</sup> Joardar, S.D., 2000. Urban residential solid waste management in India. Public Works Management and Policy 4 (4), 319–330.

<sup>\*\*\*\*\*</sup> Reddy J. Municipal Solid Waste Management: processing energy, recovery, global examples. Hyderabad.BS Publications; 2011.

<sup>+++++</sup> <http://gpcb.gov.in/municipal-solid-wastes-activity1.htm>

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permission from the Board in managing solid waste by processing units and disposal facilities. The Board has identified 159 Nagarpalika, 7 Municipal Corporations, 5 Notified Areas and 1 Urban Development Authority, which are under the jurisdiction of the Board. The Board authorizes a municipal body for waste management for a period of five years after which new applications are to be submitted to the Board.

Gujarat state is using the “common secured landfills” as a method to manage its municipal solid waste management. The government has set up a nodal agency, Gujarat Urban Development Company Ltd (GUDL) for the development of infrastructure, transportation and disposal of solid waste. After the study of the municipalities, it was arrived that the optimal way for waste management is to use common landfills for a region up to fifty kilometers. Hence multiple municipalities were assigned to a common landfill location where the waste is transported. GUDCL is responsible for implementation of the process of set up of the landfills and allocation of them to the regions. The entire Gujarat state was divided into four broad regions and 29 clusters were formed among the local bodies and municipalities. This classification is used for managing and disposing the solid waste across the state. Apart from the common landfills set up by the GUDCL, major urban regions have their independent landfills. Seven municipalities have their individual landfills or in the process of developing one.

There are 18 Landfill areas that are being developed in the Gujarat state currently. A large of number of areas is selected and acres of land are allocated for the formation of landfill. There are 7 major municipal corporations in Gujarat. Municipal corporations are important from the view of solid waste management, as they are the largest producers of waste. Management of the waste in municipal corporations needs meticulous planning and implementation. The infrastructure and capacity to handle the waste has to be created by the government in a timely manner. Ahmedabad Municipal Corporation tops the list of highest solid waste producers in Gujarat. It produces around 2550 MT/day solid waste. To manage the huge waste generated out of the city a 12.88 Hectare land was used as a landfill site. The site also has a compost facility. Surat Municipal Corporation produces 1129 MT/day of solid waste. The waste generated is second highest among the corporations in Gujarat. The waste generated in Surat is managed in a vast 60 Hectare land used as a landfill. Vadodara produces 510 MT/day of solid waste. The wastes produced are managed in a landfill of size 5.38 Hectare. Rajkot produces 400 MT/day of solid waste. It has 40 hectare of land for managing the waste. Bhavnagar produces 200 MT/day of solid waste and it is planning to develop a 10 Acres of landfill. Jamnagar Municipal Corporation produces a 170 MT/day of solid waste and 100 acres of land for landfills and solid waste management. Junagadh

produces as much as 150 MT/day of solid waste and 19.76 acres of land for landfills and solid waste management. GUDCL has built 93 Vermi-compost plants in Gujarat States.

#### **SOLID WASTE MANAGEMENT BY GANDHI NAGAR MUNICIPAL CORPORATION<sup>\*\*\*\*</sup>**

The city with a population of around 2 lakh people is spread across an area of 56 Square kilometres. In the recent years there is an increase in economic activity especially in construction sector, education and information technology. For managing its solid wastes and other administration activities the city has been divided into six wards. The city is actively managing its solid waste as prescribed by the MSW (H&D) 2000 rule. The city produces around 60 MT of solid waste in a day and around 50% of waste is collected from the street bins and by sweeping. The remaining waste is collected directly from the residents and is disposed off. The entire operation of waste management is well planned and implemented. Major waste collection locations are identified and waste is then transported to the community waste bins or location. The final process is to transport the waste from these bins to the landfill location where it is processed and disposed. The municipal has initiated an awareness program for the residents. It is titled as IEC – Information Education and Communication.

#### **SOLID WASTE MANAGEMENT BY AHMEDABAD MUNICIPAL CORPORATION<sup>§§§§§</sup>**

Ahmedabad is the 7<sup>th</sup> largest city in India and has a population of 6 million people. The city is expanding rapidly bringing unique challenges in urban area solid waste management. The city expanded to around 466 square kilometres in 2006 and the settlements are spreading further. The Ahmedabad Municipal Corporation (AMC) has taken several constructive planning and policy initiatives in solid waste management. It was the first metropolitan city in the developing world to sign the zero waste goals with the United Nations. The UN launched the International Partnership for Expanding Waste Management Services of Local Authorities (IPLA) in 2011. Under which it set forth the zero waste goal, which aims to minimize the resources and maximize the benefits the society gets out of waste generated.

Signing of the zero waste goals was a significant step and the AMC prepared a road map for the implementation of the goal by 2031. There is also technical support given by the United Nations Centre for Regional Development (UNCRD) and Zero Waste South Australia for the initiative. The AMC in association with a non-profit organization Urban Management Center (UMC) prepared the master plan.

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<sup>\*\*\*\*</sup> <http://gmc-egovern.org.in/solidWaste.html>

<sup>§§§§§</sup> [https://pearl.niua.org/sites/default/files/books/GP-IN3\\_SWM.pdf](https://pearl.niua.org/sites/default/files/books/GP-IN3_SWM.pdf)

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The Master plan for zero waste by 2031 has seven major components. First, a detailed profile for AMC was taken for the study and planning. A comprehensive study on the population, households and growth of the city was conducted. Then the complete organization and governance of AMC was studied. Roles and responsibilities, process of decision-making, process of funding and its allocation, information flow between AMC and other respective departments and current monitoring was studied in detail. Second, the status quo of solid waste management in Ahmedabad was studied in detail. This included studying of processes followed technology and machinery used, infrastructure available and mechanisms used in collection, transportation and disposal. Various field visits were also conducted for understanding the validity of the data and updating them. Third, there was a complete consultation with various stakeholders involved in the waste management was taken. This included consultation and interviews with experts in the city in waste management.

Fourth, projection of the future population and the amount of waste that will be generated was computed. Fifth, for the selection of the final plan, multiple plans with different scenarios were created. Each scenario has a different mechanism to collect the waste. Finally, the scenario with improving door-to-door collection of waste and minimizing secondary collection locations and bins was chosen. Finally, the study also proposed recommendation for improving and strengthening the solid waste management practices in Ahmedabad. The proposed strategy was broadly classified as short term or medium/long term. Some of the short-term recommendations are segregation of waste at the source, improving the door to door waste collection process, improving the public places sweeping and cleaning cycles and training the human resources to use modern equipment and technology. The medium/long term strategy included segregation of waste at source for waste generated in bulk like in markets, hotels etc. Another important long-term strategy was to include the waste management workers in the mainstream waste management system.

Once the plan was finalized, Bylaws were created to provide a legislative and legal framework for the solid waste management. It was named Health Bylaws for Solid Waste Management. The Bylaws has a jurisdiction over every individual and commercial entity in the region. It also provides for the violations and fines that are charged for the violations. It even defines obligatory responsibility of authorities in solid waste management. The Health Bylaws has regulation for the complete process of the waste management. This includes classification of waste into categories, classification waste sources or generators.

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There are clear regulation guidelines for segregating waste that is collected, method of the collection, transportation and disposal of the waste. There are also detailed regulations on processing the waste before disposal. Apart from the solid waste management process it also provides guidelines on prevention of water borne, vector borne and food borne diseases. The final part covered in the Bylaws is details of offenses, fines and enforcement of the laws.

Further to ensure the compliance and to improve enforcement, AMC started a first of its kind mobile court for health and sanitation in 2009. The mobile court is operational even today to work on health and sanitation cases. A magistrate, an administrative clerk and eight to ten sanitary inspectors appointed by the AMC are staffs of the mobile court. The mobile court visits a place and the inspectors under take the checks for compliance of the commercial establishments in the region. If there are any violations found, the respective commercial establishment is asked to pay the fine for it in the mobile court.

Nearly 600-750 cases are filed and resolved per month by the mobile court. This has increased the efficiency of the compliance monitoring and enforcement system. Also it has reduced the burden on the municipal courts. As of 2012, 95,566 cases were filed and tried in the mobile court and fines worth 3.25 crores were charged and collected.

#### **JUDICIAL CASES IN SOLID WASTE MANAGEMENT IN GUJARAT**

In *Ilaben vs State* on 29 December 2011, Public Interest Litigation, filed against the State for inefficiencies of the Municipal Corporation in Sanitation and Health particularly post monsoon season when many diseases spread across the state. The court ordered the government and the municipal agency responsible for the situation to take immediate action.

*Pravinbhai Jashbhai Patel vs State of Gujarat and Others*, on 5 August, 1995, was a Public Interest Litigation filed against the state for action to be taken against the polluting industries near the vicinity of Kharicut Canal and protect the water resources for agricultural usage. The court ordered the government and the Gujarat pollution Board for immediate and large-scale action to prevent pollution in the region and implement the recommendation of the National Productivity Council.

*Rajkot Municipal Corporation Vs District Collector &* on 14 July, 2017, was a litigation seeking more landfill sites for managing solid waste of the Rajkot municipal area. The petitioner was seeking an allotment of 10 acres of additional land for use as landfill and other solid waste management process. The case highlights the common problem in identification and allotment of land to waste management.

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Swashrayi Mahila Seva Sangh vs Ahmedabad Municipal Corporation on 1 December, 2014, was a petition to include the waste pickers into the mainstream municipal corporation waste management policy especially with respect to Right to work and life of women and the backward section of the society. Reliance vs State, 2012 a petition was filed in response to the Green Cess Act of the Gujarat government. The Act was brought by the government to encourage renewable sources of energy. It was aimed to reduce the pollution and solid waste arising from use of fossil fuel in electricity generation and encourage entrepreneurs to take up renewable energy projects. The act was to incentivize renewable energy sources investments.

### **CONCLUSION**

Overall, it can be said that main laws which is applicable in India for the municipal solid waste are Municipal Solid Waste Rules (2000) and various other waste management rules support the solid waste management practices. Various methods which are being used by the municipalities are treatment of waste, sanitary land filling, vermin composting, composting, anaerobic digestion, incineration, palletisation and gasification. India is still lagging behind in the solid waste management, if requires strong legal system with provision of penalty and awareness among people, and the training of the manpower is necessary for the success of solid waste management practices in India.

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