A CASE STUDY ON ADAMPUR LANDFILL SITE AT BHOPAL IN M.P.

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ABSTRACT
Municipal solid waste generation and management has been a challenging issue for Bhopal Municipal Corporation (BMC) from past two decades. Designing of Adampur landfill site for municipal solid waste is the only solution for BMC to solve the problem of municipal solid waste management. The design parameters were adopted from standards stipullated by the Govt. of India regulatory agency. These incorporate formulae tables, standards and guidelines.

KEYWORDS: *Landfill, municipal solid waste, generation, composition, treatment, transfer station, technology and transportation approach.*

I. INTRODUCTION

Industrialization and urbanization of Bhopal and surrounding region is continuously going on at a rapid pace. The existing infrastructure facilities are unable to keep pace with the population growth and economic development of the region. Environment and public health services are essential for the growth and well-being of the population and surrounding environment. Appropriate management of municipal solid wastes has considerable impact on health, physical and aesthetic environment. Therefore in order to move towards sustainable future development. Bhopal the capital of Madhya Pradesh needs to adopt an integrated and an advanced municipal solid waste management approach. Some component like construction of Transfer Station at Bhanpura & purchase of SWM Equipment will be executed. Sanitary Land fill site at Adampur Chhawni is proposed to be developed by Bhopal Municipal Corporation by their own finance.

Bhopal City

Bhopal, one of the largest city and capital of Madhya Pradesh, popularly known as Lake City, has experienced a rapid growth in the last decade. Bhopal is located at Longitude 23 16'N, Latitude 77 36'E, Elevation ranging from 503 to 550m MSL. The climate condition of the Bhopal is tropical and dry except in monsoon. The temperature ranges between 8^0C and 44^0C. Average annual rainfall is observed to be about 1244mm.

II. EXISTING SCENARIO OF WASTE DISPOSAL

Municipal Solid Waste

Waste disposal in Bhopal is practiced by dumping in low-lying areas in majority of the urban centers. Currently the solid waste is disposed unscientifically by open dumping at Bhanpura village disposal site. Bhanpura disposal site is located within the BMC limits which are spread over an area of 57.80 acres. This site is in use for last 25 years. The site has facilities such as electronic weighbridge cum record room (capacity 30 tonnes) and washing area for vehicle. Day to day records of waste brought to the site is being maintained. Transportation vehicles entering the landfill site are generally found to be under loaded. Slaughtering of dead animals is also carried out at the site. Plastics, cloths and

papers are scattered all around the site thereby spoiling the aesthetic appearance of the Bhanpur site has a bio-fertilizer plant of capacity 100 MT/day. This plant was set-up around 10 years ago by M/s. MP Agro Fertilizer Corporation Ltd. However this plant is not in operation due to some technical reasons.

Presently, the generated solid wastes are dumped at Bhanpur site without treatment and compaction. The inefficient operation has resulted in under utilization of the dumping site besides creating other environmental problems. The development of infrastructure facilities at the new landfill sites will take about one and half years after which they would come into operation. During this transition period, solid waste generated from the city will continue to be dumped at Bhanpur site.

III. OBSERVATIONS AND DEFICIENCIES IN THE PRESENT SYSTEM

- At present, crude dumping of waste is taking place.
- Daily cover material is not spread on dumped waste. As such waste remains open to atmosphere.
- No compaction of waste is done to increase life of dumping site.
- Existing disposal site is fenced to prevent unauthorized entry of persons/habitations and stray animals.
- Internal roads do not exist at existing site for easy movement of transportation vehicles.
- There is no control over the dumping of inert, organic waste, electronic and ash of biomedical waste at the site.
- Basic facilities as per the requirement of MSW (Management & Handling) Rules, 2000 are not available at existing dumping site.
- Apparently no studies have been carries out to determine the effect of the landfill operations on the environment and ground water. No environment impact assessment (EIA) study reports are available.
- Dumping of waste by private contractors are noticed in low-lying areas at Jamburi Maidan.
- Industrial waste and construction debris are being dumped unauthorized at the disposal site.
- The region has not identified site or facilities for the disposal of industrial waste.
- The safety and environmental aspects as per the MSW Rules (M&H) 2000 are neglected at the site.
- Open trucks are used to transport waste to the landfill site. This causes dropping of garbage, contamination of soil, odour and nuisance problems along the transport route.

3.1 Waste generation in Bhopal city

Increasing population, changing consumption patterns, economic development, changing income, life style and overall urbanization and industrialization results in increased generation of solid waste. In order to know the quantity of solid waste generation and disposal in Bhopal city, survey for quantification and characterization of MSW was carried out recently by Bhopal Municipal Corporation. The samples were collected from different locations such as residential areas (HIG, MIG, LIG and EWS), commercial area, fruit and vegetable markets, weekly market, slaughter house, fish and meat market, hotels, restaurants, garden, hospitals and nursing homes, industrial and MSW disposal at Bhanpur dumping ground. The samples were collected for 4 days in a row from two to three sources in each category. For each source samples were collected from three waste generating points. Spring balances at every waste collection point were used for recording the weight of waste. Samples collected everyday was packed in poly bags and were sent to a laboratory for analysis. After weighing each sample accurately in the laboratory, composite samples of each category were prepared for physical and chemical analysis.

3.2 Municipal solid waste

Municipal solid waste consists of household waste construction and demolition debris and waste from streets excluding industrial hazardous wastes but including the treated bio-medical wastes. This garbage is generated mainly from residential and commercial complexes. With rising urbanization and change if lifestyle and food habits the amount of municipal solid waste has been increasing rapidly and its composition and qualities are changing.

3.3 Composting

The presence of High organic content in MSW makes the composting process one of the suitable option. The process of composting helps to recycle the nutrient back to land. Aerobic composting is the process of degradation of biodegradable waste matter into simple organic compounds using certain micro- organisms in the presence of air. The process beings (Phase-I) at ambient temperature by the activity of mesophilic bacteria which oxidize carbon to carbon dioxide, thus liberating large amount of heat. Usually, the temperature of the waste piles reaches 50 C within two days and this presents the limit of temperature tolerance of the medophilic organisms. During the thermophilic phase (Phase-I) which takes place in the temperature range 55^0-65^0C, there will be break down of cellulose ligning and other resistant materials. Phase-III is the maturation stage where the temperature stabilizes and some fermentation occurs, converting the material to human through nitrification reactions.

The advantages and disadvantages of the compositing technology are given in the Table-1

Table-1 : Advantages and Disadvantages of Composting Technology

Advantages	***Disadvantages***
• It helps reduce the adverse effects of excessive alkalinity, acidity, excessive use of chemical fertilizer. • It aids in preventing soil erosion by keeping the soil covered. • Accepted by public • Environmentally sound • Proven and suitable for Indian waste • Low cost technology	• High land requirement compared to other technologies. • Longer processing time (usually around 25-45 days) compared to other technologies. Labour intensive technology • Odour problem while processing • Seasonal demand for end product • Limited shelf life and hence blockage of funds • Possibility of heavy metal contamination if not separated properly.

3.4 Bimethanation

In this process, the organic fraction of waste is segregated and fed to a closed container (biogas digester) where, under anaerobic conditions, the organic wastes undergo biodegradation producing methane-rich biogas and effluent/sludge. The biogas can be utilized for their for generating steam or electricity. The sludge from anaerobic digestion can be used as a soil conditioner or even sold as manure depending upon its composition which is determined mainly by composition of the input waste.

The digestion of waste inside the reactor occurs in four stages.

- Hydrolysis
- Acidogenesis
- Acetogenesis

The advantages and disadvantages of the biomethanation technology are given in the Table-2.

Table-2: Advantages and Disadvantages of Biomethanation Technology.

Advantages	***Disadvantages***
• Make landfills easier to manage by removing problematic organic waste material which is responsible for gaseous and liquid emissions. • The feedstock for biomethanation plant is a renewable source Energy generated through this process can help reducing the demand for fossil fuel. • the technology reduces the emission of Green House Gases to atmosphere • The use of digested also participates to this reduction by decreasing synthetic fuel uses in fertilizer manufacturing which is an energy intensive process. • An end product can be used as a soil conditioner	• Nature of organic may vary according to location and time of year. This msey lead to a variation in the C/N ration and affect the rate of gas production. • Relatively expensive and requires a major capital investment • Wastewater from the process may contain a high concentration of metals, nitrogen and organic material. • Because of the complex association of different types of bacteria, digesters have a higher risk of breakdown and may be difficult to control. • Blockage of pipes can be caused if large pieces of waste enter the system, this cause problems

• Clean Technology • Acceptable by public • Environmentally Sound • Best suitable to Indian conditions if proper biodegradable feed is provided for use plant • Proper designing of the plants initially can be easily scalable as per the need	particularly in continuous system This can be avoided with appropriate measures. • Non utilization of End Product in nearby area lead to plant installation unviable • Not suitable for mixed waste

The advantages and disadvantages of the bioreactor landfill technology are given in the Table-3

Table-3: Advantages and Disadvantages of Bioreactor Technology.

Advantages	***Disadvantages***
• Waste in large quantity can be deposited and managed efficiently • Bioreactor landfill produces degradable organic waste materials within a short time. • Increases landfill space capacity reuse and consequently the amount of waste that can be placed into it. • Operation with leachate recirculation can reduce cost of leachate management • Methane gas generation is expanded and concentrated during the active life of the landfill. • Utilization of the gas gives economic benefits • Operations with methane oxidation is possible which minimizes the greenhouse gas effect.	• Waste and leachate are exposed to the environment during the operation of the landfill. Thus, it needs stricter management control and regulatory involvement • Instrumentation and monitoring of the performance during changes in solid, liquid and gas phases are intense. Thus investment costs will be higher. • Investment costs of the aerobic bioreactor are higher that the other bioreactor types. • When there is a dearth of leachate liquid waste if available can be placed in the MSW only permitted by local regulations and under strict management for public safety and environmental security.

3.5 Incinerations

Incineration is a waste treatment technology that involves the combustion of organic materials and/or substances. Sufficient quantity of oxygen is required to fully oxidize the fuel for combustion. Incineration plant combustion temperatures are in excess of 850cal and calorific value of the waste should be more than 1200 Kcal/kg. The waste is mostly converted into carbon dioxide and water and any noncombustible materials (e.g. metals, glass, stones) remain as a solid known as incinerator Bottom Ash (IBA) that always contains a small amount of residual carbon. An incineration is a fumce for burning waste. There are various types of incinerator plant design as moving grate, fixed grate. Rotary-kiln and Fluidized bed incineration. Based on the intended application incineration plant equipment may be grouped in four main categories/stages namely pretreatment, combustion system, Energy recovery, fuel gas cleaning. While incineration is extensively used as an important method of waste disposal, it is associated with some pollution discharged which are of environmental concern although in varying degrees of severity. These can fortunately be effectively controlled by installing suitable pollution control devices and by suitable furnace construction and control of the combustion process.

The advantages and disadvantages of the incineration technology are given in the Table-4.

Table-4: Advantages and Disadvantages of Incineration Technology

Advantages	***Disadvantages***
• The primary benefit of MSW incineration is a substantial reduction of the weight (up to 75%) and volume (up to 90%) of solid waste (volume reduction). Hence residues going to the landfill are reduced. • Minimum of land is needed as compared to the waste disposal technologies (minimum land requirement)	• The air pollution control equipments required in incineration plants are extremely expensive, • Effective and timely maintenance of the plant and equipments is required for smooth operation of plant. This results into high O & M costs. • The extremely high technical standards of the plants require skilled workers/staff, which leads to higher

The advantages and disadvantages of the pyrolysis technology are given in the Table-5.

Table-5: Advantages and Disadvantages of Pyrolysis Technology.

Advantages	*Disadvantages*
• By using less oxygen, fewer air emissions may be produced. • Emissions are easier to control because they are scrubbed to remove contaminants. • The plants are modular flexible • They are quicker to build. • The process produce a more useful • product than standard incineration- gases, oils and solid char can be used as a fuel or purified and used as a feedstock for petrochemicals and other applications. • The syngas can be used to generate energy more efficiently via a gas engine (and potential ly fuel cell) whilst incineration generates energy less efficiently via steam turbines	• Net energy recovery may suffer in case of wastes with excessive moisture. • High viscosity of pyrolysis oil may be problematic for its transportation may lead to burning. • Inherent complexity of the system and lack of appreciation by system designer of the difficulties of producing a consistent feedstock were the causes for failure. • Other disadvantages are same as mass burn incineration.

Selection of Treatment for MSW

Different types of treatment processes for MSW in Bhopal have been studied. As detailed above considering the physical and chemical characteristics and type of waste available following four treatment technology may be suggested for the MSW in Bhopal.

- Compositing of Biodegradable waste (30-40%)
- Recycling (about 15-20%)
- RDF/Incineration (15-20%)
- Land filling (30-40%)

IV. COMPOST PLANT FOR TREATMENT OF MSW

General

Municipal Solid Waste is processed through composting as one of the widely used cost effective and eco-friendly technology. Though the process of organic matter decomposition (compositing) is being practiced for centuries, it takes a very longtime of 6 to 8 months and is suitable only in on-farm situations. In order to treat municipal solid waste the decomposition has to be achieved in compressed time cycle of 5 to 6 weeks due to several constraints in areas. This can be achieved by specialized treatment of microbial induced process with controlled operating conditions.

Unlike farm waster MSW is heterogeneous mixture of biodegradable materials having fruits, vegetables, meat fish, poultry etc along with several non-biodegradable materials. Sometime the waste is already under putrifaction process which generates foul smell and carry swarms of files. Under such situations quick control of foul smell and suppression of fly nuisance through herbal & biological sanitization products is extremely essential. In order to ensure effectiveness of bioculture/inoculants and sanitizers the following parameters are to be monitored regularly. Some of these are temperature odour files leachates and dusty matter particulates. Amongst these, temperature is one of the first quick indicator of rapid microbial activity which ensures that the process of organic matter breakdown is progressing rapidly. Other parameters like smell presence of files and chemical analysis are indicators of progress of decomposition.

MSW transfer station for Bhopal Municipal Corporation

Waste transfer stations act as a n intermediate step between garbage collection and final disposal waste transfer stations are sized and designed on the basis of communities or townships they serve. Waste transfer station may serve multiple purposes depending on the requirements of the final disposal facility. However, their basic aim is to serve as the principal link between collection and compression of garbage from multiple sources and its subsequent economical transportation to its disposal side. Typically at a waste transfer station, garbage is received compacted and then further

loaded into larger, long haul vehicles or rail carts as the case may be for their transportation to their final disposal site. The final disposal site could be a landfill or a waste to energy plant or a recycling or composting facility. Thus a waste transfer station acts as a temporary holding area for the collected garbage and hence it does not require large area. Waste transfer stations primary responsibilities include consolidating waste from multiple sources followed by their compaction and hauling them to their final destinations. Compaction allows collection crews to make fewer trips for the same volume of wastes thus giving fuel and vehicular maintenance costs are reduced and inconvenience caused by traffic and generated noise pollution is diminished.

Residents manually discard their wastes and recyclables into dumpsters called convenience centers. Waste collected from such convenience centers is ideally transported to waste transfer stations or directly to the final disposal sites for land filling dumping or incineration as the case may be. Certain garbage collectors drop off collected waste to waste transfer station directly. This process may become more efficient and adept if waste is reduced and separated at the source itself allowing reduction in transportation land filling and incineration costs. Significant reduction in community wastes can occur by diligent source reduction and recycling leading to lower transportation costs and smaller waste transfer stations. Source reduction entails changing the basic methods of manufacturing packing and sales methods. Sorting such wastes reduce the volume of waste handled and also generates revenue from recycling facilities. Thus, sorting wastes at waste transfer stations is far more efficient and provides cost-effectiveness and environmentally sustainable options. This allows policy and decision makers to competitively design facilities and select service providers that suit their townships. Waste transfer stations with special options for managing bulky and hazardous wastes and recyclables often double as convenience centers allowing the local communities to directly delivery their wastes. This initiative could educate the community on effective solid waste management and recycling thus lowering the burden on disposal facilities.

V. CONCLUSION

The existing condition of municipal solid waste management and administrative view, there is a vast gap between them. The condition are generally depicted gradually complexity of problems by increasing urbanization, composition of wastes are changed. The manpower and methods of management of waste become a large limitation. Income directly related with waste generation, for better management waste analysis depends on real cost of waste disposal. To sustain better landfill management implementation of complete landfill budget are to be used. In absence of complete understanding of sustainable landfill management it is not possible to enhance the required capacity along with financial sources.

After going through the existing and proposed landfill site, it is analysed that existing landfill (Bhanpur) actual is dumping yard, while the proposed landfill at Adampur Chhaoni has equipped with all facilities of engineering landfill like base liner or membrane, composting plant, leachate collection tank and treatment system, landfill gas collection and treatment system, leachate and landfill gas processing system, conventional cover and final cover.

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