STATUS OF SOLID WASTE MANAGEMENT IN BANGALORE & REVIEW OF SOLID WASTE TECHNIQUES ADOPTED

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Abstract: Municipal Solid Waste (MSW) management is one of the vital issues in the contemporary urban environment, more particularly in developing countries. Municipal solid waste generation consists of organic and inorganic waste materials generated by various activities of the society. Improper disposal of solid wastes can pollute all vital components of the environment (i.e., air, land and water). This paper addresses the status of waste management practice in Bangalore city, the state capital of Karnataka (which is one of the fastest developing cities in Asia) and a review of waste treatment technologies adopted to keep in the trends of waste management practice over time. The Bangalore metropolitan (BBMP) area covers an area of 1258 sq km and with a population of about 9.0 million generates around 4000 MT/day of municipal solid waste (MSW) at an average of 0.27 kg/day/per capita. Presently, Bangalore city faced with the problems with such high quantities of solid waste continuously and it is planning to upgrade its management system. The major issues in Bangalore city is open dumping without a liner and without a leachate management facility and the threat of ground water pollution, as well as saturation of an existing landfill site are the most pressing problems for the city today. This paper describes the current practices of waste technologies for composting. The importance of participatory process of each sector of society to enable waste management socio economically sustainable and ultimately provide an environmentally sustainable solid waste management system. The major problems in MSW management at Bangalore are due to the lack of waste segregation at source, low operational efficiency of waste transport system with old vehicles, low collection efficiency in newly added residential and industrial areas, and an inefficient and informal recycling system. As per the MSW Rules, the wet waste can be collected door-to-door in an ideally bin-less city and sent for composting, while the dry waste can be left to the informal sector like rag pickers and kabadiwalas for recycling. The MSW Rules make it mandatory for biodegradable urban wastes for composting / vermicomposting, etc, and bans the burning of garbage and the dry leaves. Bangalore city might need to focus for a better solution of waste disposal considering unavailability of landfill sites. In this context a review of solid waste techniques adopted within India and elsewhere will be reviewed and summarized with recommendations.

Keywords: Engineered landfill, Municipal Solid Waste Management, Vermicompost.

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INTRODUCTION

A Solid Waste is one the major problem, in polluting the land, air and water etc. proper understanding and utilization of solid waste management techniques may help in protecting not only land but also the environment from further deterioration. In early times, disposal of solid waste did not pose significant issues, initially population was small and the amount of land available for disposal of waste was large. Due to rising population, increasing urbanization of this population, industrial growth etc. resulted in ever increasing volume of wastes. Most of the Literature reports that waste generation rate of 0.4 to 0.6 Kg per capita per day. The 0.5 kg per capita per day is proposed as waste generation pattern for Bangalore city [2]. From past two decades of economic growth, since 1990 the composition of India's urban wastes has changed. At present Bangalore city generates 4000MT/day of house hold municipal solid waste (MSW). Roughly 40% is dry waste and remaining 60% is organic waste. Nature can assimilate these wastes to certain extent. The production of waste has exceeded the assimilating capacity of nature; natural resources like air, water and land get polluted. The ecosystem is the addition to the pollution, which has a detrimental effect on it. Solid wastes management need to be discipline associated with the characterized by sources, generation rates, types of wastes produced, storage, collection, transfer and transport, processing and disposal of solid wastes in a manner that is in accordance with the best principles of public health, economics, aesthetics and other environmental considerations [4].

SOLID WASTE MANAGEMENT

As per the MSW rules 2000, the stipulation BBMP is responsible for taking the waste management. Generally BBMP is divided into 8 zones, 3 zones in core area (old area) and 5 zones in new area (adjacent 7 CMC's and 1 TMC).

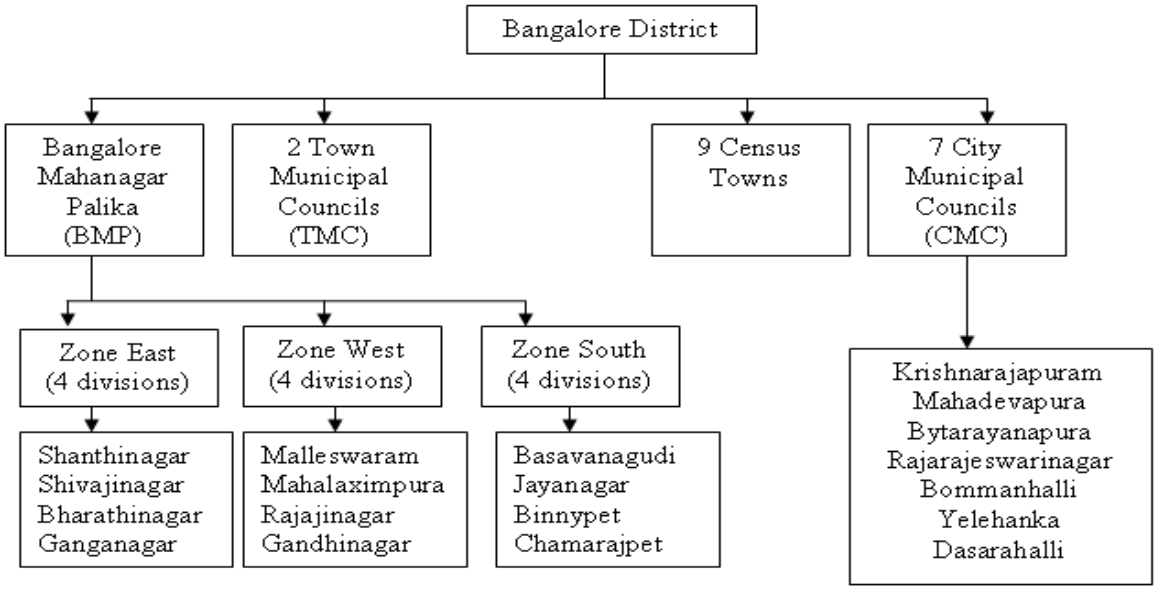

Fig1. Bangalore District Composition

About 30 % of the MSW is managed by BBMP and 70% of the MSW activity starting from primary collection to disposal has been outsourced. BBMP has assigned 3197 Pourakarmika (Sweepers) and 18562 Pourakarmikas (Sweepers) from contractor who performs Door to Door collection and sweeping activities. Annually about 250 crores is spent on solid waste management (BBMP Poura Karmikas salary, Contract payment, Tipping fees) [1].

The main objective of solid waste management is to remove discarded materials from inhabited places in a timely manner to prevent the spread of disease, reduce aesthetic results arising from purifying organic matter and equally important, is to dispose of the discarded materials in manner that is environmentally acceptable [3].

For effective management of solid wastes from point of generation to final disposal have been grouped into seven functional elements:

1. Waste segregation and storage at source
2. Primary (Door to Door) collection
3. Street Sweeping
4. Secondary waste storage
5. Transport of waste
6. Treatment and recycling options for solid waste
7. Disposal.

Fig 2. Shows the MSW collection system

MAJOR ISSUES IN WASTE TRANSPORT SYSTEM

- Due to open beds in tractors and trucks, the waste spills from the truck, during transport, thereby causing nuisance.
- Loading of waste by manual without use of the protective gears is dangerous to the health of workers.
- Secondary storage system is not synchronized with the transport system. Problems arise when a transport fleet is modernized, because waste at secondary storage system is still dumped on the ground.
- Due to inadequate number of vehicles, area cannot be serviced properly.
- Due to inadequate workshop facilities and maintenance procedures, the vehicles are poorly maintained. This problem leads to break down and trucks that is out of services for long time.

WASTE TECHNOLOGIES IN BANGALORE

AEROBIC COMPOSTING

In aerobic composting process involves, piling up of waste and it required regular turning, by manually or by mechanical devices, sufficient air and oxygen has to be provide during the decomposition by bacteria, fungi and microorganisms like antinomycetes. A mesophilic bacterium is the initial process, which oxidise the organic matter to carbon dioxide and generates the heat and temperature rises to about 45°C. In the next process thermophillic bacteria continue the decomposition, in this phase temperature further rises to about 60°C. Generally 3 weeks is required for stabilised compost and fall in temperature of the compost mass. The final product of compost should have a dark brown color and earthy smell.

WINDROW COMPOSTING

The waste is dumped in the windrow platform, large items like woods, plastics, clothes, thermocol…etc is removed and innoculum will be sprayed on the waste. The innoculum will be prepared using the mixture of bacteria, cow-dung and water. The treated waste is then heaped in windrows with large rows approximately 2 meter height and 3 meter width, length will be depending on the size of the landfill site. Generally 7 rows, each row for each day of the week. Every week these rows are turned for 5 weeks. These rows are turned to remove moisture, improve porosity and oxygen content, and redistribute hotter and cooler portions of the pile. As time passes, the sizes of the rows get reduced due to decomposition of the waste and the resultant volume reduction. Hence the number of final rows will be reduced than the number of initial rows. Composting will be completed in 25-30 days. This interval, know as maturation, after waste will undergoes mechanical process operation. In mechanical processing, sieving at three stages, in the first stage sieve employs 36mm mesh, the second stage applies 16mm mesh and the third stage has a 4mm mesh as shown in fig 3. At each stage of sieving the reject materials is separated, either reused or disposed at landfill.

Challenges in Windrow Composting

1. Minor mechanical fault leads to a breakdown due to unavailability of spare parts.
2. Major difficulty, due to nature of waste. Pulverizers get frequently clogged with pieces of plastic, rubber, leathers…etc and due to metal and glass pieces the blades are break down. If waste is mixed with soil, causes problem in the process and lowering the quality produced.
3. Lack of continuous power supply
4. In the rainy season, the process cannot be carried out.

Fig 3. Windrow composting process

COMMUNITY COMPOSTING

In this Process daily wet waste is collected by the house keeping staff and directly dumping into the tank. After filling, the tank is covered with a layer of refuse 15-20cm deep. The materials are allowed to remain in the pit without turning and watering for three months. To keep the

decomposers working, the aeration aid is needed during the initial pile construction. As long as plenty air is available, aerobic decomposers work faster and more efficiently, providing you with finished compost on a faster time. Charcoal is placed on the tank, hence foul smell is avoided. It takes about three months to obtain the finished product. Community composting process show in Fig 4.

Fig 4. Community composting process

BIO MECHANICAL COMPOSTING

In this process, organic waste such as vegetable and fruit peels. Food leftovers, bones, meat, eggshells, household sweeping , dry leaves, garden waste ,Cattle dung etc. collected from the apartments and place was identified for segregation for removal of plastic, glass, clothes, paper, leather…etc. for recycling purpose. After segregation of organic waste is then fed into the mechanical unit (i.e. organic waste converter) which converts this into homogenized, crushed, odour free output. The output goes to the curing system for stabilization. The entire process is controlled by aerobic microbial decomposition, transition take place from low pH levels to high pH levels and then stabilizes. This manure is free from weed, foul smell and pathogen as the process is aerobic. This is environment friendly operation; this system takes only 15 min to convert the organic waste into a homogenized output.

Fig 5. Biomechanical process

VERMICOPOSTING COMPOSTING

More than 50,000 populations, of worms can support in the moist compost heap of 2.4 m by 1.2 m and 0.6 m high. Organic residues such as straw and other crop residues, animal manure, green weeds, and leaves are filled in the pit and covered by loosely with soil and kept moist for a weak. On the top of the heap, well watered and the worms will be introduced, air is provide for quick decomposition. Lumbricus rubellus (red worm) and Eisenia foetida are thermo-tolerant is particularly useful for vermicomposting. Ideally the compost pits were left for a period of two months and such pits should be shaded from hot sunshine and kept moist. 1kg of worms can produce 10kg of castings within two months. Then pit will be excavated to an extent of about two-thirds to three-quarters and worms will be removed by hand. The remaining worms will be left in the pit itself for further composting with fresh organic residues. To get a good quality of compost material the sun-dried and sieved has to be carried out. The end product of compost is ideal constitution and structure. Vermicompost unit has to be protected against chicken, other birds, rodents and heavy rains

Challenges in Vermi-Composting

1. This concept is suitable for only small scale application and not an appropriate solution for large scale application e.g. 100-300MT/d capacity plants.
2. The exotic species are found to be costing between Rs. 500-1000/kg and indigenous species of earth worms are not found effective.

3. The raw waste cannot be fed directly to earth worms, thus necessitating pre-processing of waste to avoid toxicity.
4. Earthworms are so sensitive to temperature (ideally between 20-28°C); worms die due to heat built up in the rotting pile or summer.

Fig.6. Vermicomposting process

BIOMETHANATION COMPOSTING

Biogas is produced in the absence of oxygen or in an anaerobic environment, due to the decomposition of organic material through certain bacteria. Whole process is referred as anaerobic digestion. Due to biological decomposition take place in reactor, where bacteria produce biogas. This biomass can stays in the reactor for about 2-3 weeks. At the end, the by-product produced in this process is a solid residue which is high-grade manure. Generally in the biogas plant, biomass like vegetable wastes, animal excreta undergo decomposition in the absence of oxygen and form a mixture of gases. Biogas consists of about 2/3 methane (CH_4), 1/3 carbon dioxide (CO_2) a little hydrogen sulphide (H_2S) and a little hydrogen (H_2). It is created by the decomposition of manure and other forms of organic waste from households or industry in anaerobic tanks where it is heated. The biogas it is used for cooking and lighting purpose.

Fig 7. Biomethanation process

Disadvantages of Biogas

1. In large industrial scale, this process is not very economically compared to biofuel.
2. It is very difficult to increase the efficiency of biogas systems.
3. The gases come out from biogas as impurities, which are corrosive to the metal parts of internal combustion engines.
4. Not feasible to locate at all the locations.

CONCLUSIONS

Improper waste management can lead to serious environmental health hazards. Unscientific disposal of solid waste has led to the development of large number of waste dumps around almost all major towns and cities.

Detailed analysis of the composition of municipal waste of different cities has lead to the following conclusions:

- It is strongly recommended to go for composting, at least for a major portion which is biodegradable and which can be easily transported to the locations of composting factories.

- The waste originating from areas close to the landfill area can go for a facility having combined composing or landfill with a leachate and gas collection systems.
  Methods can be developed for economical recovery of energy from waste using available technology.

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