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Urbanisation and Municipal Solid Waste Management

K.V. Marthandan
Narayanaguru College of Engineering, Manjalamoodu-629151, India

Abstract: Waste is an unavoidable by product of human activities. Economic development, urbanization and improving living standards in cities, have led to increase in the quantity and complexity of generated waste. Management of Municipal Solid Waste (MSW) resulting out of rapid urbanization, has become a serious concern for government departments, pollution control agencies, regulatory bodies and also public in most of the developing countries. Rapid growth of population and industrialization (www.earthscan.co.uk) degrades urban environment and places serious stress on natural resources, which undermines equitable and sustainable development. Inefficient management and disposal of solid waste is an obvious cause for degradation of environment in most cities of the developing world. Improper disposal of this waste leads to spread of communicable diseases, causes obnoxious conditions and spoils biosphere as a whole. Cleanliness is a major factor that influences development of any nation, which is otherwise hampered due to improper disposal of solid waste.

Key words: Urbanisation, municipal, solid waste management, economic development

INTRODUCTION

From study on MSW it is apparent that there are two major problems due to poor solid waste management. One is the loss/under utilization of resourceful material and other is social cost due to health impact on rag pickers, community living in dump site surroundings and general public suffering from improper or no collection of waste from streets resulting in nuisance and spread of diseases. Present municipal solid waste management in India has severe problems. Very high rate of urban growth is a major reason for the increased solid waste management problems. This problem of SWM is very intense in urban areas and it is due to the fact that 217 millions out of 844 million people of India (25.72%) live in urban cities. Waste generation is not rare in urban areas, or any other part of the world. The only difference is in the management of wastes. An effective, efficient and sustainable waste management system is still rare in India. Mumbai, is one of the largest and densely populated metropolitan cities in the world. The commercial capital of India, spans over an area of 437.71 sq km. with population nearing 15 millions. Solid waste generation of the city is the highest by any Indian city with more than 6256 tones a day. Per capita waste generation of Mumbai is among the highest in Indian cities with 0.450 kg of waste being generated per capita. Though it is not comparable with developed countries whose per capita waste generation goes over 2.5 kg, it is considerably high when compared with many cities in developing countries. The wastes are in the form of garbage, debris, silt removed from drains and nallahs, cow dung and also waste matter removed from common house gullies or inaccessible narrow lanes between old buildings. The waste comprises 890 tones of construction waste and silt 1420 t of mix waste (Biodegradable and Recyclable) 3950 t of Biodegradable waste Mumbai is considered to be having one of the best waste management systems though it is not up to the expectations on its own. I was chosen as a case because of the fact that with the expected growth of population and waste generation, Mumbai is expected to pose a severe MSW problem in the years to come. It is evident that the total waste quantity generated in 2047 would be approximately above 260 million tonnes—more than five times the present level. This enormous increase in solid waste generation will have significant impacts in terms of the land required for disposing this waste as well as on methane emissions.

Definition: Solid waste management is a planned process of effective control of the production, storage, collection, transportation, processing and disposal of solid wastes in acceptable and economic way .The most important principle of waste management is Reduce, Reuse and Recycle (known as the 3R's of waste management).

MATERIALS AND METHODS

Future plans are to carry out a through cost benefit analysis of the existing solid waste management system

(collection, transportation, disposal) in Mumbai considering following disposal methods as these are most prominent among all

- Composting
- Vermiculture
- Sanitary landfills

Composting: Composting is the biological method of decomposing the solid wastes under aerobic or anaerobic conditions into humus and stable mineral compounds. This method is best suited to small and medium size Indian towns as it simultaneously solves disposal of solid waste, disposal of night soils and production of valuable manure for crops. During monsoon season high intensity rainfall and rapid run off erode valuable humus from crop land which may be remedied by applying compost The process starts with mesophilic bacteria which oxidise the organic matter in the refuse to carbon dioxide and the temperature rises to about 45°C. At this stage the thermophilic bacteria continue the decomposition and the temperature further rises to about 60°C. After about three weeks, the compost is stabilized, which can be measured by noting a drop in temperature. The compost should have an earthy smell and a dark brown colour.Modern methods of composting are either manual or mechanical. In the indore process, after removing the non-compostable materials, waste iron scraps etc. layers of vegetable waste and night-soil are alternated, each about three inches thick, to a depth of upto 1.5 m in a trench or form mound-about called a window. The mixture is kept aerobic by turning regularly for 2 or 3 months. The compost is then left for another month without turning. In Bangalore process, the material is placed in layers in a trench and not turned. It is digested under essentially anaerobic conditions whereby decomposition is complete in 4 or 5 months. The compost is free from pathogenic organisms and contains 1.5% N, 1.1% P_2O_5 and 1.5% K_2O on dry basis and proves a valuable nutrient for the soil. Since these 2 methods are laborious, time consuming and require large land areas, mechanical composting can be resorted to which stabilizes the solid waste within 3-6 days. The various unit operations involved in a large scale mechanical composting plant are reception of solid wastes, segregation, shredding, stabilization and preparation of the stabilized mass for the market. Stabilization is carried out in mechanical digesters. The mechanical digesters are of various types such as pits or wells, windows or stacks and vertical or horizontal silo type closed digesters. Closed digesters are most hygienic and occupy less space. The stabilized mass is sometimes enriched by adding chemical nutrients.

There are 4 processes of mechanical composting available in India, the Buhler process, the Dano process, the Tollemache process and the Nusoil process. A moisture content of about 55% should be established so that biological activity may proceed at an optimum rate. Composting and digestion of bones is carried out as a small industry in some developing countries. However, compost is not widely used in the U.S. because inorganic fertilisers are cheap and easy to apply and most farms are located where soil conditions are good.

Vermiculture: Currently the widely employed technique for solid waste disposal relies on earthworms-"farmers'-friend"-Vermicomposting or vermiculture (www.wm.com) provides for the use of earth-worms as natural bioreactors for cost effective and environmentally sound waste management. The biodegradable wastes are composted behind the street corner garbage dump yard and using earthworms. The compost is used in kitchen gardens. In this cool, but aerobic process, worms mechanically breakdown compostables by eating them and biochemical decomposition occurs via bacteria and chemicals present in the works digestive system.

Sanitary landfilling: Sanitary landfill (www.waste TreatmentInfo.com) is an engineered burial of refuse involving spreading of the solid waste on the ground, compacting it and then covering it with soil at suitable intervals. The refuse is dumped and compacted in layers of 30-60 cm and after day's work when the depth of filling reaches 1.5 m, it is covered by earth of 15-30 cm. thickness so that the refuse is not directly exposed. The area is divided into smaller portions and the second layer of filling is done prior to which the first layer is well-compacted. Insecticides and pesticides are to be applied at regular intervals. At final level, about 60 cm. of earth is laid and finally compacted well at the top of the land filled area. The filled up solid waste is stabilized due to the decomposition of organic matter in the following stages.

Initially oxidation takes place by the action of aerobic bacteria and fungi which depletes the oxygen.When all the oxygen are depleted, anaerobic bacteria plays a role in decomposing the organic matter resulting in generation of hydrogen and carbon dioxide.Methane gas is evolved caused by the methanogenic bacteria. The methanogenic activity gets stabilized and subside which indicates the depletion of organic matter. The landfill method is simple, economical, with the advantage of no residue left and hence no further disposal. By providing a water proof lining inside the landfill site, leaking of chemicals into underground aquifers can be prevented. Sanitary land fill operation is widely practicsed in western countries.

Finished landfill uses include development of parks, playgrounds and even golf courses.Since landfill gas is a rich and renewable source of energy, this potential can be harnessed.In India it has found only limited application.

RECYCLING

Recycling is an integral part of solid waste management which makes economic sense. For stable economic growth resources must be used carefully and technologies for recycling of wastes are to be evolved. A sustainable society make use of recycled materials so that they will be available for future generations. Construction materials can be harnessed from wastes such as red mud from aluminium industry, fly ash from thermal power plants etc. Sugarcane bagasse, an agricultural waste is a chief source of cellulose and can be used to get proteins. Furan compounds used as germicides for treating cattle diseases can be produced from corn cobs. The rising cost of petroleum has renewed the need for the production of ethanol by fermentation of agricultural wastes. Silk industry wastes containing large quantities of waste pupae, which is a rich source of protein can be used as a poultry feed as it significantly increases the growth rate of chicken.The manufacture of paper board is the main use of waste paper. The most promising reuse of waste paper is its conversion to energy as it has a high calorific value and does not cause air pollution. Scrap glass known as cullet can be used in each new batch of glass produced. The main problem in reuse of glass is its separation from the solid waste. Waste glass can also be used as an aggregate in asphalt.The glasphalt product exposes no Jagged edges and is skid resistant. Use ground glass as an ingredient of light weight building materials has been technically successful.

The principal non-ferrous metals which are subject to recycling are aluminium, copper and lead. Aluminium recycled from municipal waste contains iron, zinc, copper and silicon which add strength to the end product. The recycled aluminium is converted into alloys for use in the die casting industry. Pure copper and its alloys may be melted for reprocessing and cast into billets o ingots for various applications. Lead scrap is readily melted and converted into alloys for cable sheathing.

In India, plastics form a rather small percentage of total wastes, but their use is increasing at an accelerated pace. Due to their non-biodegradable nature, they remain intact in disposal operations.One possible method of recycling plastic is mixing the raw plastic during the production of new packs. Recycling of mixed plastics can be accomplished by reusing the plastic in another form. Plastics can be pyrolysed to producehard and soft waxes, greases, adhesives and tars, when exposed to ultraviolet light, certain chemical groups in plastics absorb the light and releases energy. This energy breaks the polymer chain so that plastic loses its strength, becomes brittle and is broken up by wind and rain. The small pieces then mix with the soil and can be decomposed by normal soil bacteria into basic chemicals. A class of sulpher loving bacteria consume the sulphur from tyre wastes and leave the polymer backbone of carbons intact during recycling.

Agenda 21, the agreement reached among participating nations at the United Nations Conference on Environment and Development in Rio de Janeiro in 1992, emphasized in chapter 21 that reducing wastes and maximizing environmentally sound waste reuse and recycling should be the first step in waste management.

E-WASTE

India is witnessing an explosive consumption of electronic goods and equipments and is on its way to become the choice destination of manufacturing (Solid.BusinessCamber.com). Toxic contamination from e-waste is a looming environmental disaster in cities like Bangalore. According to a green-peace survey some of the biggest brands in electronics industries and their suppliers are contaminating rivers and underground wells with hazardous chemicals such as Poly-Brominated Disphenyl Ethers (PBDES) and Tetra Bromosbisphenol-A (TBBPA). They are added as fire retardants to and components, delay of many electronic goods such as computers.

SUGGESTIONS

A few suggestions for environmentally sound management of solid waste are:

- Every individual should contribute towards waste minimization at source, segregation and management.
- Reuse or Recycling of utilizable components of municipal solid waste may be made essential.
- Finding new economical and acceptable way-outs like fuel pelletisation of combustible components is essential.
- Refining or improving the conventional ways of disposal like landfilling, composting etc.
- To adopt an integrated approach for the management of garbage, studies for undertaking survey and analysis of garbage being generated along with past, present and future trends in its management etc. need to be initiated immediately.

- Attention should be paid to improve technologies for absolutely safe disposal of hazardous waste.
- Plantation of suitable trees, shrubs, climbers and grasses along the boundary of dumping ground as green beets and within the yard in specific rows is essential. This will promote the natural degradation process by providing suitable conditions for multiplication of micro- organisms.
- Garbage collection points at appropriate places in whole of the town should be provided during the town planning and subsequent development process to avoid problems in future.
- The problem of open dumping and ocean clumping should be reduced by strict laws.
- It is time IT ministry should regulate the toxic impact of electronic industry hand in hand with promoting its growth like world wide governments including China.
- Finally the attitude of the general public needs to be changed and the consciousness, responsibilities and moral/ethical behaviour of every individual needs to be strongly built up.

CONCLUSION

Once the technological problems are overcome, recycling of waste materials will be the potential way of solid waste management. It could provide energy and would lower the waste burden and the natural environment. A thorough economic analysis for better waste management in Mumbai is required. Cost benefit analysis can be carried out with consideration for all possible costs and benefits involved in waste management system. This would result in representing the real value of the entire waste management system and support policy amendments for its improvement. Further cost benefit analysis can be used to analyze the existing system of recycling industry and suggest possible policy/economic measure to achieve improved performance of the recycling industry which in turn results in better waste management.

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