Solid Waste Management- A Review

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Abstract— Solid Waste Management is a complex task which requires appropriate organizational capacity and cooperation between numerous stakeholders in the private and public sectors. Although it is essential to public health and environmental protection, solid waste management in most cities of developing countries is highly unsatisfactory. If it is not handled carefully the problem of Solid Waste will multiply and will become a disaster for the world. To resolve this issue, cities and their citizens should join together to create sustainable lifestyles and an ecological civilization in which people and environment coexist in harmony.

Keywords: Solid Waste Management, Anaerobic Digestion, RDF, WTE

I. INTRODUCTION

India is the second largest nation in the world, with a population of 1.21 billion, accounting for nearly 18% of world's human population, but it does not have enough resources or adequate systems in place to treat its solid wastes.

The current SWM services are inefficient, incur heavy expenditure and are so low as to be a potential threat to the public health and environmental quality. Improper solid waste management deteriorates public health, causes environmental pollution, accelerates natural resources degradation, causes climate change and greatly impacts the quality of life of citizens.

The present citizens of India are living in times of unprecedented economic growth, rising aspirations, and rapidly changing lifestyles, which will raise the expectations on public health and quality of life.

The per capita waste generation rate in India has increased from 0.44 kg/day in 2001 to 0.5 kg/day in 2011. Urban population growth and increase in per capita waste generation have resulted in a 50% increase in the waste generated by Indian cities within only a decade since 2001. The total MSW generated in urban India is estimated to be 68.8 million tons per year (TPY). Increase in waste generation within a decade has severed the stress on all available natural, infrastructural and budgetary resources.

II. METHODOLOGY

A. Hierarchy of Sustainable Waste Management

The hierarchy of waste management recognizes that reducing the use of materials and reusing them to be the most environmental friendly. Source reduction begins with reducing the amount of waste generated and reusing materials to prevent them from entering the waste stream. Thus, waste is not generated until the end of "reuse" phase. Once the waste is generated, it needs to be collected. Material recovery from waste in the form of recycling and composting is recognized to be the most effective way of handling wastes.

B. Material recovery

1) Recycling

Recycling is a resource recovery practice that refers to the collection and reuse of waste materials such as empty beverage containers. The materials from which the items are made can be reprocessed into new products. Material for recycling may be collected separately from general waste using dedicated bins and collection vehicles, a procedure called kerb side collection. In some communities, the owner of the waste is required to separate the materials into different bins (e.g. for paper, plastics, metals) prior to its collection. In other communities, all recyclable materials are placed in a single bin for collection, and the sorting is handled later at a central facility.

2) Aerobic Composting

Similar to the recycling of inorganic materials, source separated organic wastes can be composted and the compost obtained can be used as an organic fertilizer on agricultural fields. Organic compost is rich in plant macro nutrients like Nitrogen, Phosphorous and Potassium, and other essential micro nutrients.

C. Energy Recovery

Energy requirements of a community can be satiated to some extent by energy recovery from wastes as a better alternative to landfilling. Energy recovery is a method of recovering the chemical energy in MSW. Chemical energy stored in wastes is a fraction of input energy expended in making those materials. Due to the difference in resources (materials/energy) that can be recovered, energy recovery falls below material recovery on the hierarchy of waste management.

1) Anaerobic Digestion

The USEPA defines Anaerobic Digestion (AD) as a process where microorganisms break down organic materials, such as food scraps, manure and sewage sludge, in the absence of oxygen. In the context of SWM, anaerobic digestion (also called Anaerobic Composting or Biomethanation) is a method to treat source separated organic waste to recover

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energy in the form of biogas, and compost in the form of a liquid residual. Biogas consists of methane and carbon dioxide and can be used as fuel or, by using a generator it can be converted to electricity on-site.

2) Refuse Derived Fuel (RDF)

Refuse Derived Fuel refers to the segregated high calorific fraction of processed MSW. RDF can be defined as the final product from waste materials which have been processed to fulfill guideline, regulatory or industry specifications mainly to achieve a high calorific value to be useful as secondary/substitute fuels in the solid fuel industry. RDF is mainly used as a substitute to coal (a fossil fuel) in high-energy industrial processes like power production, cement kilns, steel manufacturing, etc.

3) Waste-To-Energy Combustion (WTE)

Waste-to-Energy combustion (WTE) is defined as a process of controlled combustion, using an enclosed device to thermally breakdown combustible solid waste to an ash residue that contains little or no combustible material and that produces, electricity, steam or other energy as a result .

III. Sanitary Landfilling

Sanitary landfills are sites where waste is isolated from the environment until it is safe. It is considered when it has completely degraded biologically, chemically and physically. In high-income countries, the level of isolation achieved may be high. However, such an expensive high level of isolation may not be technically necessary to protect public health. Four basic conditions should be met before a site can be regarded as a sanitary landfill. The ways of doing this should be adapted to local conditions. The immediate goal is to meet, to the best extent possible, the four stated basic sanitary landfill conditions, with a longer term goal to meet them eventually in full area.

Large landfills will require more investment to improve standards than smaller sites. However, the unit cost of these improvements (measured per tone of waste landfilled or per head of population served) will decrease with increasing site size. There are financial and other benefits to sites with long operating lifetimes (ten years or more). Large regional sites serving two or more cities could be economically beneficial, providing waste transport costs are not too high.

IV. Composting or Mechanical Biological Treatment

A mechanical biological treatment (MBT) system is a type of waste processing facility that combines a sorting facility with a form of biological treatment such as composting or anaerobic digestion. MBT plants are designed to process mixed household waste as well as commercial and industrial wastes.

The terms mechanical biological treatment or mechanical biological pre-treatment relate to a group of solid waste treatment systems. These systems enable the recovery of materials contained within the mixed waste and facilitate the stabilization of the biodegradable component of the material. The sorting component of the plants typically resemble a materials recovery facility. This component is either configured to recover the individual elements of the waste or produce a refuse-derived fuel that can be used for the generation of power

V. Open Burning, Landfill Fires & Air Quality Deterioration

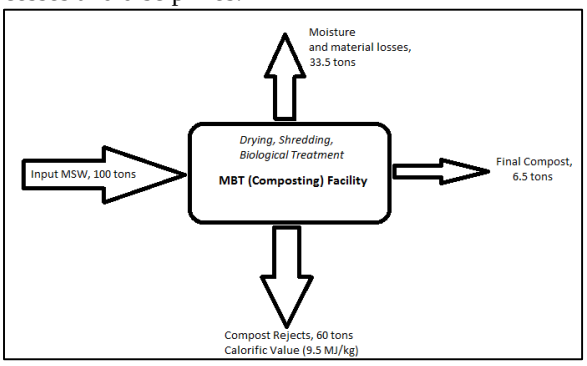
Open burning is the burning of any matter in such a manner that products of combustion resulting from the burning are emitted directly into the ambient (surrounding outside) air without passing through an adequate stack, duct or chimney. Open burning of wastes is practiced all over India due to reasons like

1) Open burning by waste-pickers for recovery of metals from mixed wastes;
2) Open burning in bins by municipal workers or residents to empty MSW collection bins
3) Open burning of plastic wastes by street dwellers for warmth at night.

VI. Composting

Composting is a way of harnessing the natural process of decomposition to speed up the decay of waste. The history of composting dates back to the history of early agriculture. Many find that composting is as much of an art as a science. Recent concern about managing wastes and producing food in an environmentally sound manner has led to a renewed interest in small-scale, backyard composting as well as an interest in developing large-scale, commercial and municipal composting systems.

Designing successful composting systems requires an understanding of certain biological, chemical, and physical processes such as the movement of air, uptake of carbon and nitrogen, and heat production and transfer. Students can be a part of the process of obtaining scientific information about composting, whether their results are applied in their own home, school, or by industry. At the same time, students engage in hands-on, minds-on composting activities with an opportunity to improve their understanding of many scientific processes and disciplines.



VII. Conclusion

Two decades of economic growth since 1990 has changed the composition of Indian wastes. The quantity of MSW generated in India is increasing rapidly due to increasing population and change in lifestyles. Recycling, composting and waste-to-energy are integral parts of the solution and they are all required; none of them can solve the India's SWM crisis alone.

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