

Solid Waste Management

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Abstract

The waste which is generated out of human or animal activities which is generally solid is known as solid waste. This is discarded as unwanted and useless (except human waste). Solid waste is the unwanted or useless solid materials generated from combined residential, industrial and commercial activities in a given area. It may be categorized according to its origin (domestic, industrial, commercial, construction or institutional); according to its contents (organic material, glass, metal, plastic paper etc); or according to hazard potential (toxic, non-toxin, flammable, radioactive, infectious etc). A number of processes are involved in effectively managing waste for a municipality. These include monitoring, collection, transport, processing, recycling and disposal. The solid waste generally includes garbage, refuse, ash, thrash and special wastes.

Garbage: The term garbage is used to indicate dry refuse & it includes decayed fruits, grass, leaves, paper pieces, vegetables, etc. It is essentially food waste, which is generated due to cooking, eating, handling, selling of food products. It is generally organic decomposable waste. **Rubbish:** The waste which is non-decomposing (organic or inorganic). It includes plastic, paper, rubber, metal, cans, cloth, etc. **Ash:** This is a residue left over after the burning of coal, wood, paper, etc. This also causes nuisance and it spreads by winds. **Thrash:** These are large bulky materials which cannot be dumped into the bins like large logs, metal scraps, etc. **Special waste:** It includes special waste from industries, construction wastes, etc.

Classification of Solid Waste

1. **Municipal waste:** Food waste, rubbish, ashes, construction waste, special waste

2. Industrial waste: The waste which is left over after the process of manufacturing is complete is called as industrial waste. This includes: rubbish, special waste, ash
3. Hazardous waste: These are toxic, reactive and unhealthy. These are resulted from atomic reactions etc. This includes: special waste, ashes

Keywords: Incineration, Pyrolysis, Gasification, Integrated Solid Waste Management.

1. Introduction

Solid waste is the unwanted or useless solid materials generated from combined residential, industrial and commercial activities in a given area. It may be categorized according to its origin (domestic, industrial, commercial, construction or institutional); according to its contents (organic material, glass, metal, plastic paper etc); or according to hazard potential (toxic, non-toxin, flammable, radioactive, infectious etc). A number of processes are involved in effectively managing waste for a municipality. These include monitoring, collection, transport, processing, recycling and disposal.

1.1 Reduce, Reuse, Recycle

Methods of waste reduction, waste reuse and recycling are the preferred options when managing waste. There are many environmental benefits that can be derived from the use of these methods. They reduce or prevent green house gas emissions, reduce the release of pollutants, conserve resources, save energy and reduce the demand for waste treatment technology and landfill space.

1.2 Waste reduction and reuse

Waste reduction and reuse of products are both methods of waste prevention. They eliminate the production of waste at the source of usual generation and reduce the demands for large scale treatment and disposal facilities. Methods of waste reduction include manufacturing products with less packaging, encouraging customers to bring their own reusable bags for packaging, encouraging the public to choose reusable products such as cloth napkins and reusable plastic and glass containers, backyard composting and sharing and donating any unwanted items rather than discarding them. All of the methods of waste prevention mentioned require public participation.

1.3 Recycling

Recycling refers to the removal of items from the waste stream to be used as raw materials in the manufacture of new products. Recycling occurs in three phases: first the waste is sorted and recyclables collected, the recyclables are used to create raw materials. These raw materials are then used in the production of new products. The sorting of recyclables may be done at the source for selective collection by the municipality or to be dropped off by the waste producer at a recycling centers. Another

option is to mix the recyclables with the general waste stream for collection and then sorting and recovery of the recyclable materials can be performed by the municipality at a suitable site.

2. Treatment and Disposal

Waste treatment techniques seek to transform the waste into a form that is more manageable, reduce the volume or reduce the toxicity of the waste thus making the waste easier to dispose of. Treatment methods are selected based on the composition, quantity, and form of the waste material. Some waste treatment methods being used today include subjecting the waste to extremely high temperatures, dumping on land or land filling and use of biological processes to treat the waste.

3. Thermal Treatment

This refers to processes that involve the use of heat to treat waste. Listed below are descriptions of some commonly utilized thermal treatment processes.

3.1 Incineration

Incineration is the most common thermal treatment process. This is the combustion of waste in the presence of oxygen. After incineration, the wastes are converted to carbon dioxide, water vapour and ash. This method may be used as a means of recovering energy to be used in heating or the supply of electricity. Incineration technologies have the advantage of reducing the volume of the waste, rendering it harmless, reducing transportation costs and reducing the production of the green house gas methane.

3.2 Pyrolysis and Gasification

Pyrolysis and gasification are similar processes they both decompose organic waste by exposing it to high temperatures and low amounts of oxygen. Gasification uses a low oxygen environment while pyrolysis allows no oxygen. These techniques use heat and an oxygen starved environment to convert biomass into other forms. A mixture of combustible and non-combustible gases as well as pyrolytic liquid is produced by these processes.

3.3 Open burning

Open burning is the burning of unwanted materials in a manner that causes smoke and other emissions to be released directly into the air without passing through a chimney or stack. This includes the burning of outdoor piles, burning in a burn barrel and the use of incinerators which have no pollution control devices and as such release the gaseous by products directly into the atmosphere. Open burning has been practiced by a number of urban centers because it reduces the volume of refuse received at the dump and therefore extends the life of their dumpsite. Garbage may be burnt because of the ease and convenience of the method or because of the cheapness of the method. Open burning has many negative effects on both human health and the environment.

This uncontrolled burning of garbage releases many pollutants into the atmosphere. The particulate matter can be harmful to persons with respiratory problems such as asthma or bronchitis and carbon monoxide can cause neurological symptoms. The harmful effects of open burning are also felt by the environment. This process releases acidic gases such as the halo-hydrides; it also may release the oxides of nitrogen and carbon. Nitrogen oxides contribute to acid rain, ozone depletion, smog and global warming. In addition to being a green house gas carbon monoxide reacts with sunlight to produce ozone which can be harmful. The particulate matter creates smoke and haze which contribute to air pollution.

4. Dumps and Landfills

4.1 Sanitary landfills

Sanitary Landfills are designed to greatly reduce or eliminate the risks that waste disposal may pose to the public health and environmental quality. They are usually placed in areas where land features act as natural buffers between the landfill and the environment. For example the area may be comprised of clay soil which is fairly impermeable due to its tightly packed particles, or the area may be characterized by a low water table and an absence of surface water bodies thus preventing the threat of water contamination. The bottom and sides of landfills are lined with layers of clay or plastic to keep the liquid waste, known as leachate, from escaping into the soil. The leachate is collected and pumped to the surface for treatment. Boreholes or monitoring wells are dug in the vicinity of the landfill to monitor groundwater quality. A landfill is divided into a series of individual cells and only a few cells of the site are filled with trash at any one time. This minimizes exposure to wind and rain. The daily waste is spread and compacted to reduce the volume, a cover is then applied to reduce odours and keep out pests. When the landfill has reached its capacity it is capped with an impermeable seal which is typically composed of clay soil. Some sanitary landfills are used to recover energy. Thus some landfills are fitted with landfill gas collection (LFG) systems to capitalize on the methane being produced. The process of generating gas is very slow, for the energy recovery system to be successful there needs to be large volumes of wastes.

4.2 Controlled dumps

Controlled dumps are disposal sites which comply with most of the requirements for a sanitary landfill but usually have one deficiency. They may have a planned capacity but no cell planning, there may be partial leachate management, partial or no gas management, regular cover, compaction in some cases, basic record keeping and they are fenced or enclosed. These dumps have a reduced risk of environmental contamination, the initial costs are low and the operational costs are moderate. While there is controlled access and use, they are still accessible by scavengers and so there is some recovery of materials through this practice.

5. Biological Waste Treatment

5.1 Composting

Composting is the controlled aerobic decomposition of organic matter by the action of micro organisms and small invertebrates. There are a number of composting techniques being used today. These include: in vessel composting, windrow composting, vermicomposting and static pile composting. The process is controlled by making the environmental conditions optimum for the waste decomposers to thrive. The rate of compost formation is controlled by the composition and constituents of the materials i.e. their Carbon/Nitrogen (C/N) ratio, the temperature, the moisture content and the amount of air.

Moisture content greatly influences the composting process. The microbes need the moisture to perform their metabolic functions. If the waste becomes too dry the composting is not favored. If however there is too much moisture then it is possible that it may displace the air in the compost heap depriving the organisms of oxygen and drowning them.

A high temperature is desirable for the elimination of pathogenic organisms. However, if temperatures are too high, above 75°C then the organisms necessary to complete the composting process are destroyed. Aeration is a very important and the quantity of air needs to be properly controlled when composting. If there is insufficient oxygen the aerobes will begin to die and will be replaced by anaerobes. The anaerobes are undesirable since they will slow the process, produce odours and also produce the highly flammable methane gas. Air can be incorporated by churning the compost.

5.2 Anaerobic Digestion

Anaerobic digestion like composting uses biological processes to decompose organic waste. However, where composting can use a variety of microbes and must have air, anaerobic digestion uses bacteria and an oxygen free environment to decompose the waste. Aerobic respiration, typical of composting, results in the formation of Carbon dioxide and water. While the anaerobic respiration results in the formation of Carbon Dioxide and methane. In addition to generating the humus which is used as a soil enhancer, Anaerobic Digestion is also used as a method of producing biogas which can be used to generate electricity.

6. Integrated Solid Waste Management

Integrated Solid Waste Management (ISWM) takes an overall approach to creating sustainable systems that are economically affordable, socially acceptable and environmentally effective. An integrated solid waste management system involves the use of a range of different treatment methods, and key to the functioning of such a system is the collection and sorting of the waste. It is important to note that no one single treatment method can manage all the waste materials in an environmentally effective way. Thus all of the available treatment and disposal options must be evaluated equally and the best combination of the available options suited to the particular community chosen.

7. Conclusions

The quantities of garbage collected and transported need to be monitored against targets, preferably by citizen monitoring, through effective management information systems and a recording weigh - bridge: computerized for 1 million+ cities. At least 80% of waste-clearance vehicles should be on-road, and two-shift use implemented where there is a shortage of vehicles. Decentralized ward-wise composting of well-segregated wet waste in local parks is recommended, for recycling of organics and also for huge savings in garbage transport costs to scarce disposal sites.

Cities must fulfill their obligatory functions (like waste management) before funding any discretionary functions, while being granted fiscal autonomy to raise adequate funds. Solid-waste-management and other charges should be linked to the cost-of-living index, along with levy of “administrative charges” for chronic littering. Funds should be earmarked for minimum expenditure on solid waste management: Rs 100 per capita per year in 5-lakh-plus cities, or a minimum of Rs 50 per capita in smaller towns. Many cities are already providing conditional funding to residential areas or colonies willing to take responsibility for improved waste-management of their respective areas.

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