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SOLID WASTE TREATMENT

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Abstract

Solid waste is the unnecessary or useless solid materials generated from mutual residential, industrial and commercial actions in a given area. It may be categorized according to its cause (domestic, industrial, commercial, construction or institutional); according to its contents (organic material, glass, metal, plastic paper etc.); or according to risk potential (toxic, non-toxin, flammable, radioactive, infectious etc.). Management of solid waste reduces or eliminates unhelpful impacts on the environment and human health and supports profitable development and improved quality of life. A number of processes are involved in effectively organization waste for a municipality. These include monitoring, collection, transport, processing, recycling and disposal. Methods of waste reduction; waste reuse and recycling are the preferred options when managing waste. There are many environmental profit that can be derived from the use of these methods. They reduce or prevent greenhouse gas emissions, reduce the release of pollutants, conserve resources, save energy and reduce the require for waste treatment technology and landfill space. So it is desirable that these methods be adopted and included as part of the waste organization plan.

Index Terms: *Solid waste, Pollutant, Treatment*

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1. INTRODUCTION

Waste is defined as an unusable or unwanted substance or material. Solid waste is a term usually used to describe non-liquid materials arising from domestic, trade, commercial, agricultural and industrial activities, and from public services.

Table 1- The type of solid waste generated and the approximate time it takes to degenerate.

Type of waste	Time it takes to degenerate
Organic waste such as vegetable and fruit	A week or two
Paper	10-30 days
Cotton cloth	2-5 months
Wood	
Woollen items	1 year
Tin, aluminium and other metal items such as cans	100-500 years
Plastic bags	Million years
Glass bottles	Undetermined

The components that constitute the solid waste are paper, textile, lather, food waste, yard waste, rubber, metals, plastic and glass. The most dangerous solid waste is the waste that does not or it needs a long time to degenerate. Some types of solid waste and the time it takes to degenerate are shown.

Increasing of the amount of solid waste and the pressure what it has on the environment, impose the need to introduce advanced approach to effectively managing of solid waste.

1.1 Classification Solid Waste

Typical classification of solid waste and it is as follows.

1. Garbage: Putrecible wastes from food, slaughterhouses, canning and freezing industries.

2. Rubbish: non-Putrecible wastes either combustible or non-combustible. These include wood, paper, rubber, leather and garden wastes as comestible wastes whereas then on-combustible wastes include glass, metal, ceramics, stones and soil.

3. Ashes: Residues of burning, solid products after heating and cooking or incineration by the public, manufacturing, sanatorium and apartments areas.

4. Large wastes: Demolition and construction wastes, automobiles, furniture's, refrigerators and other home appliances, trees, fires etc.

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5. Dead animals: Households pets, birds, rodents, zoo animals, and anatomical and pathological tissues from hospitals.

6. Sewage sludge's: These include screening wastes, settled solids and sludge's.

7. Industrial wastes: Chemicals, paints, sand and explosives.

8. Mining wastes: Tailings, slug ropes, Culm piles at mine areas

9. Agricultural wastes: Farm animal fertilizer, harvest residues and others.

Traditionally these wastes are categorized into the following five types.

1. Residential: It refers to wastes generated mainly from dwelling, apartments, and consisted of leftover food scrapes, vegetables, peeled material, plastics, wood pieces, clothes and ashes.

2. Commercial: This mainly consists of grocery materials, lingering food, glasses, and metals, vestiges generated from stores, hotels, markets, shops and medicinal facilities.

3. Institutional: The wastes generated from schools, colleges and offices include, paper, plastics, and glasses.

4. Municipal: This includes dust, leaf litter, building debris, and treatment plant sediments. These arise to form various activities like demolition, construction, street cleaning, land scraping etc.

5. Agricultural: This mainly includes spoiled food grains, vegetables, grass, litter etc., generated from fields and farms.

2. TREATMENT OF SOLID WASTE

Treatment methods are selected on the work, 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 substantial and use of organic processes to treat the waste. It should be noted that treatment and removal options are chosen as a last resort to the previously mentioned management strategies reducing reusing and recycling of waste.

2.1 Thermal Treatment

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

2.1.1Incineration:

Incineration is the most common thermal treatment process. This is the combustion of waste in the presence of oxygen. After incineration, the wastes are changed 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. In addition to supplying energy incineration technologies have the advantage of reducing the volume of the waste, rendering it undamaging, reducing transportation costs and reducing the production of the green house gas methane.

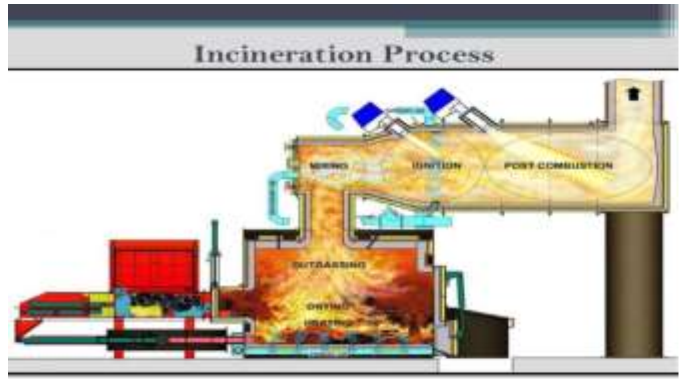

Fig. 1 Incineration of thermal treatment process

2.1.2 Pyrolysis and Gasification:

Pyrolysis and gasification are similar processes they both decay untreated waste by exposing it to high temperatures and low amounts of oxygen. Gasification uses low oxygen from environment while pyrolysis do not oxygen. These techniques use heat and an oxygen starved environment to convert biomass into other forms. A combination of combustible and non-combustible gases as well as pyroligenous liquid is produced by these processes. All of these products have a high heat value and can be utilized. Gasification is advantageous since it allows for the incineration of waste with energy recover and without the air pollution that is characteristic of other incineration methods.

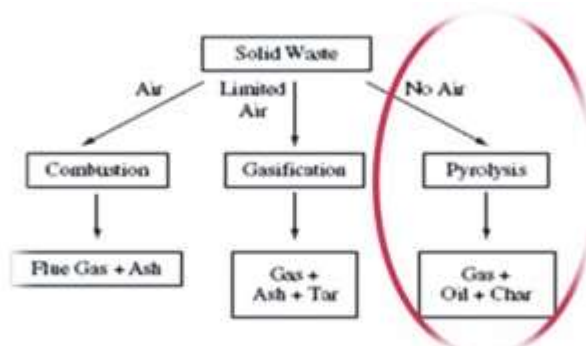

Fig. 2 Pyrolysis and Gasification

2.1.3 Open burning:

Open burning is the burning of unnecessary 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, flaming in a burn barrel and the use of incinerators which have no pollution control devices and as such free the gaseous by products directly into the atmosphere. Open burning has many negative effects on both human health and the environment. This uncontrolled burning of garbage releases many pollutants into the atmosphere. These include dioxins, particulate matter, polycyclic aromatic compounds, volatile organic compounds, carbon monoxide, hexachlorobenzene and ash. All of these chemicals pose serious risks to human health. The

Dioxins are capable of producing a multitude of health problems; they can have adverse effects on reproduction, development, disrupt the hormonal systems or even cause cancer. The polycyclic aromatic compounds and hexachlorobenzene is considered to be carcinogenic. The particulate matter can be harmful to persons with respiratory problems such as asthma or bronchitis and carbon monoxide can cause neurological symptoms.

The injurious 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 daylight to produce ozone which can be risky.

2.2 Dumps and Landfills

2.2.1 Sanitary landfills:

Sanitary Landfills are designed to very much decrease 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..

In addition to the planned placement of the landfill other protective measures are included into its design. The bottom and sides of landfills are lined with layers of clay or plastic to maintain the liquid waste, known as leach ate, from escaping into the soil.

Some sanitary landfills are used to make progress energy. The natural anaerobic decay of the waste in the landfill produces landfill gases which include Carbon Dioxide, methane and traces of other gases. Methane can be used as an energy source to create heat or electricity. Thus some landfills are fitted with landfill gas collection systems to take advantage of 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.

These landfills present the smallest amount environmental and health risk and the records kept can be good source of information for future use in waste organization, however, the cost of establishing these sanitary landfills are high when compared to the other land disposal methods.

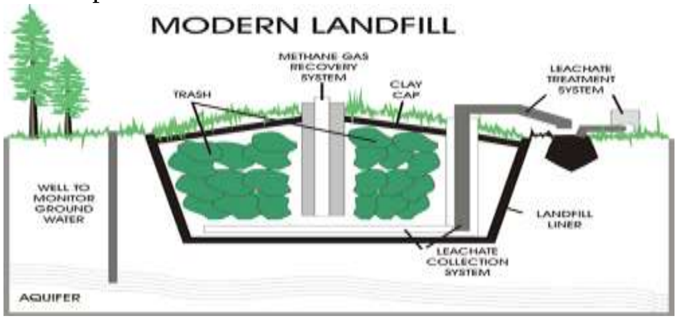

Fig. 3 Main features of a modern landfill

2.2.2 Controlled dumps:

Controlled dumps are disposal sites which fulfil with most of the requirements for a sanitary landfill but usually have one shortage. They may have a designed capacity but no cell planning, there may be partial leach ate management, partial or no gas managing, regular cover, compaction in some cases, basic record keeping and they are fenced or enclosed. These dumps have a reduced danger of environmental contamination, the initial costs are low and the working 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.

2.2.3 Bioreactor Landfills:

New technological advances have guide to the introduction of the Bioreactor Landfill. The Bioreactor landfills use improved microbiological processes to accelerate the decomposition of waste. The main controlling factor is the constant addition of liquid to maintain most advantageous moisture for microbial digestion. This liquid is usually added by re-circulating the landfill leach ate. In cases where leach ate in not enough, water or other liquid waste such as sewage sludge can be used. The landfill may use either anaerobic or aerobic microbial absorption or it may be designed to combine the two. These enhanced microbial processes have the advantage of quickly reducing the volume of the waste creating more space for additional waste; they also maximize the production and confine of methane for energy recovery systems and they reduce the costs connected with leach ate organization. For Bioreactor landfills to be successful the waste should be comprised mainly of organic matter and should be produced in large volumes.

2.3 Biological Waste Treatment

2.3.1Composting:

Composting is the controlled aerobic decay of organic matter by the exploit of micro organisms and small invertebrates. There are a number of composting techniques being used today. These include: in craft composting, windrow composting, vermicomposting and static pile composting. The process is controlled by making the environmental conditions most favourable for the waste decomposers to thrive. The rate of compost arrangement 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.

The C/N ratio is very significant for the process to be well-organized. The micro organisms require carbon as an energy source and nitrogen for the synthesis of some proteins. If the correct C/N ration is not achieved, then application of the compost with also a high or low C/N ratio can have unfavourable effects on both the soil and the plants. A high C/N ratio can be corrected by dehydrated mud and a low ratio corrected by adding cellulose.

Aeration is a very important and the quantity of air needs to be correctly controlled when composting. If there is inadequate oxygen the aerobes will begin to expire and will be replaced by anaerobes. The anaerobes are unwanted since they will slow the process, produce odours and also produce the highly combustible methane gas. Air can be included by churning the compost.

2.3.2Anaerobic Digestion:

Anaerobic absorption like composting uses biological processes to decay organic waste. However, where composting can use a variety of microorganisms and must have air, anaerobic digestion uses bacteria and an oxygen free environment to decompose the waste. Aerobic respiration, distinctive of composting, results in the configuration 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 absorption is also used as a method of producing biogas which can be used to generate electricity.

Optimal conditions for the process require nutrients such as nitrogen, phosphorous and potassium, it requires that the pH be maintained around 7 and the alkalinity be suitable to buffer pH changes, temperature should also be controlled.

2.4 Integrated Solid Waste Management

Integrated Solid Waste Management takes an overall approach to creating sustainable systems that are inexpensively reasonable, publicly suitable and environmentally effective. An integrated solid waste organization system involves the use of a range of different treatment methods, and key to the functioning of such a systems the collection and sorting of the waste. It is most important to note that no one single management method can manage all the waste materials in an environmentally effective way. Thus all of the obtainable treatment and removal options must be evaluated equally and the best mixture of the available options suited to the particular community chosen. Successful management schemes therefore need to work in ways which best meet current social, economic, and environmental conditions of the municipality.

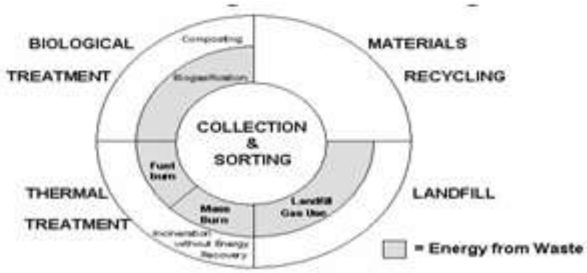

Fig. 4 Elements of Integrated Solid Waste Management

3. EFFECTS OF SOLID WASTE

3.1 Effects on Human Health

Solid waste management is an important fact of environmental hygiene and it needs to be integrated with total environmental planning. Its storage, collection, transport, treatment and disposal can lead to short term risks. In the long run there may be dangers arising particularly from the chemical pollution of water supplies. These problems are also connected with other problems of human health and marine systems.

3.2Effects on the Environment

Apart from the disease for which insects and rats are the carriers, the handling of it causes illness to workers. A survey in India conducted by CEPHERI, 1971 (Central Public Health Engineering Institute) showed that in Bhopal city up to half of the sample of refuse in the slum areas restricted roundworm ova. The accident rate among workers is also high as a result of lifting heavy load of waste and dealing with mechanical equipments.

Atmospheric Pollution:

When refuse is burnt in an open area, a dense smoke often covers the site and neighbouring land. Old-fashioned incinerators without air pollution control equipment are little better than open burning. Apart from particulate matter that constitutes smoke, the gaseous discharges from the incomplete combustion may include SO_2, NOx and various gases. If PVC is a part of the refuse, the gases may include hydrogen chloride. In addition to pest nuisance and health hazards, the solid wastes also cause air pollution.

Visual Pollution

The aesthetic feeling is offended by the insightfulness of piles of wastes on the roadsides .This situation was being made worst by the presence of scavenging animals, especially in the third world countries. The scavenging natural worlds search their food in the waste and extend it around places. Similarly the rag pickers in India also create such unhygienic scene while collecting recyclables. This creates an ugly situation and under such conditions apart from cleaning the waste, there is a need to educate the public about environmental health. Undesirable noise and traffic sound is also produced while operating the landfills and incinerators. This is due to the movement of vehicles and large machines.

Water Pollution

When the rain run-off joins the surface water sources there is an inevitably pollution due to suspended solid particles. Organic matters exert soaring oxygen require and pathogen load can create a health risk to downstream users. Unless the water table is not high or underlying rock is not fissured, the ground water will be hardly affected. Dumps should not be close to shallow wells. A distance of 12 kms is suggested. On the other hand escaping of ground water pollution is of dominant importance in the discarding of refuse.

4. CONCLUSION

Different waste treatment options have different type of impacts; however, environmental soundness of the technology should be accounted in the long time perspective. Paralysis-gasification has found one of the emerging technologies which have lower environmental impact than the incineration process. Sanitary landfill with energy generation has the least environmental impact among the three waste treatment technologies. However, due to the socio-economic and environmental perspective landfill is not favourable waste treatment option. Disposal of final residue is one of the prime environmental concerns in thermal waste treatment processes.

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