SOLID WASTE MANAGEMENT

Waste is any unwanted or useless materials.Waste is also known as rubbish, trash, refuse, garbage or junk. In biology, waste is any of the many unwanted substances expelled from living organisms, metabolic waste; such as urea and sweat.

Kinds of wastes

Solid wastes: wastes in solid forms, domestic, commercial and industrial wastes Examples: plastics, bottles, cans, papers, scrap iron, and other trash

Liquid Wastes: wastes in liquid form Examples: domestic washings, chemicals, oils, waste water from ponds, manufacturing industries and other sources.

Bio-degradable: can be degraded (paper, wood, fruits and others)

Non-biodegradable: cannot be degraded (plastics, bottles, old machines, cans, Styrofoam containers and others)

Hazardous wastes: Substances unsafe to use commercially, industrially, agriculturally, or economically and have any of the following properties- ignitability, corrosivity, reactivity & toxicity.

Non-hazardous: Substances safe to use commercially, industrially, agriculturally, or economically and do not have any of those properties mentioned above. These substances usually create disposal problems.

Solid Waste

All solid and semisolid wastes, arising from human and animal activities, and which are discarded as useless or unwanted, are called Solid Wastes or Refuse.This definition excludes human excreta and sullage (liquid waste from kitchen and bathroom).

In normal life, solid wastes are seen in two common forms:

Rubbish: It include combustible (e.g., paper, card board, textile, plastic, rubber,

wood etc.) and non-combustible (glass, crockery, metals, construction wastes etc.)

solid wastes.

Garbage: It includes putrescible (that can rot) organic wastes, e.g., residue of fruits, vegetable and animals which are generally produced in cooking and eating of foods.

Types and Sources

The type and quantity of waste generated are affected by factors:

- the geographical region
- socio-cultural practices
- seasonal variations

In general, the volume of waste generated is likely to be small and largely degradable where the population is of rural origin and the food rations supplied are unpackaged dry foodstuffs. Displaced urban populations are more likely to generate large volumes of non-degradable waste, especially where packaged food rations

Figure: Types of solid waste

There are three main categories of solid wastes:

Municipal Wastes: These wastes arise from residential areas (household activities, streets), commercial areas (hotels, markets, institutions) and community areas (streets, parks, playground).

Industrial Wastes: These wastes arise from industrial activities and include rubbish, ashes, construction wastes, toxic wastes etc.

Hazardous wastes: These are highly harmful wastes arising from hospitals, industries, nuclear plants, research institutions, laboratories and include biological wastes, toxic chemicals, radioactive substances, explosives and flammable wastes.

Cause of increasing solid waste generation

Overpopulation and thereby increasing consumption and waste generation. Technological advancement leading to cheap production of commodities. Rapid urbanization and increasing availability of consumer products. Growing trend of "non-returnable packaging" and "use and throw" culture. Increasing purchasing power of public which lead to increasing consumerism, affluence and luxury.

Effects of solid waste pollution

Pathogens of different diseases arise from the wastes and spread diseases. Solid waste may choke drains and pits which result in water logging and breeding of mosquitoes. Stray animal (dogs, cattle) feed on the garbage, spread it and also fall ill. Pollutants from garbage dump contaminate ground water and surface water. Garbage dumps often destroy aesthetic value of the locality. Fumes arising from burning of wastes pollute the air and foul smell due to decomposition of organic wastes create are unpleasant and create health problems.

Associated risks

Disease transmission: Decomposition of organic waste attracts animals and files. Solid waste also provides breeding sites for insects.

Pollution: Poor management of the collection and disposal of solid waste may lead to pollution of surface water or groundwater. This may cause significant problems if the waste contains toxic substances.

Solid waste management

With growing rate of solid waste generation all over the world, solid waste management has become one of the major necessities of the society, particularly in urban areas. In order to establish effective solid waste management in the affected area the following process should be used:

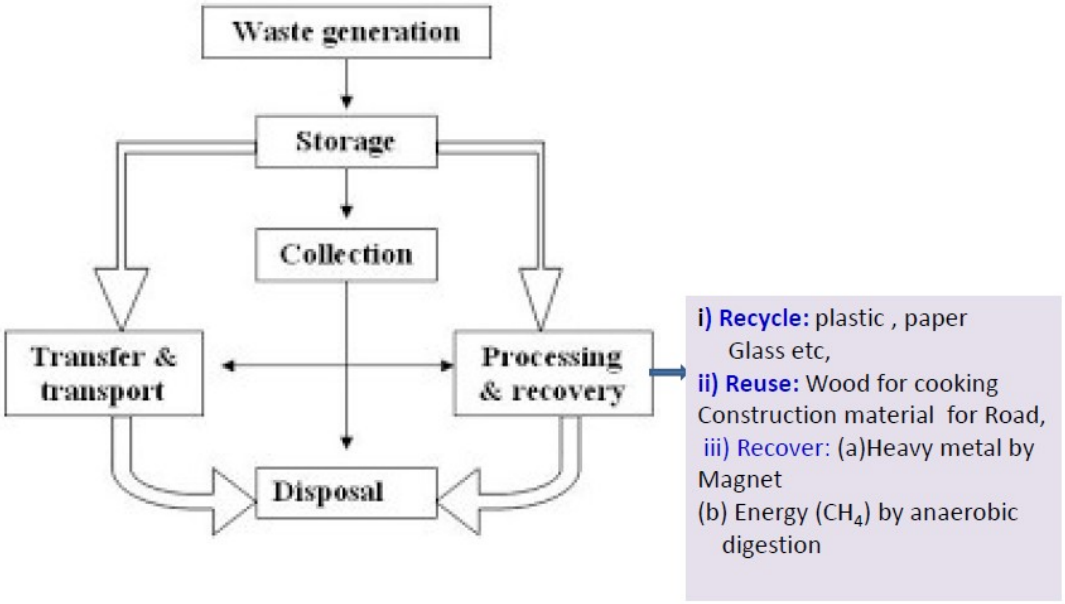

Figure: Representation of management of solid waste

Key components of solid waste management

Solid waste management can be divided into six key components

A. Generation
B. Storage
C. Collection
D. Transportation
E. Disposal
F. Recovery

A. Generation

Generation of solid waste is the stage at which the materials become valueless to the owner and they are no longer required.

B. Storage

Storage is the system for keeping the materials after they have been discarded and prior to collection and final disposal. Where on-site disposal systems are implemented, such as where people discard items directly into family pits, storage may not be necessary. But the improved storage facilities include:

- Small containers, household containers, plastic bins
- Large containers, communal bins
- Shallow pits

C. Collection

It involves collection of solid waste from the point of generation. Households usually collect their waste in dust bins and throws it in community storage place from where municipality or similar body pick it up and transport to disposal site.

D. Transportation

This is the stage when solid waste is transported to disposal site. There are various modes of transport which may be adopted and the chosen method depends upon the local availability and the volume of waste to be transported. Types of transportation can be divided into three categories.

E. Disposal

Disposal means processing of waste so as to get rid of it. It also means to reduce volume, harmful effect and unpleasant appearance of solid waste. The collected solid waste is disposed in one of the following ways:

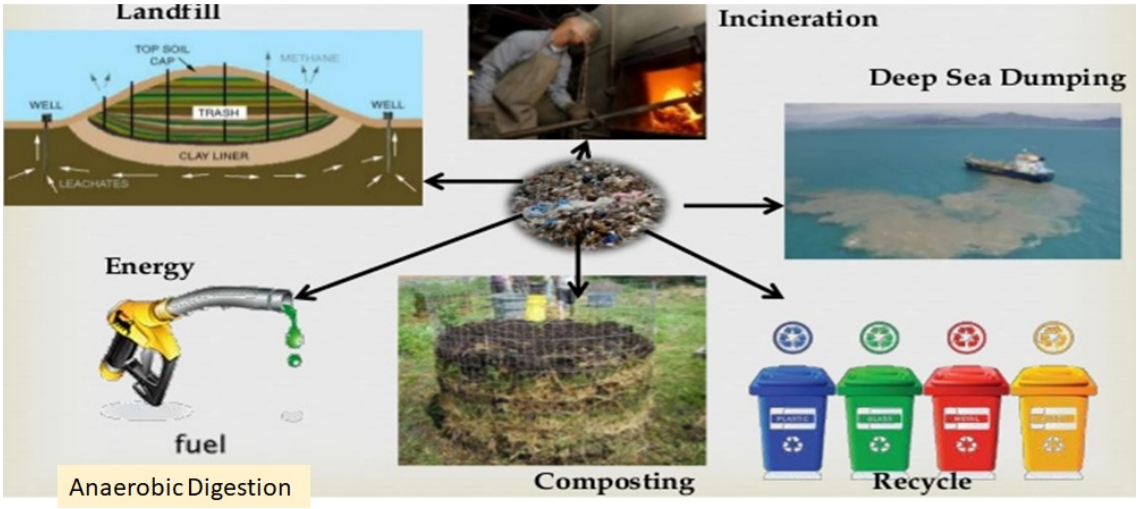

Figure: Techniques for solid waste disposal

Open dumping

Waste is deposited in low laying land, usually on out skirt of town.No further processing is done. This is cheap and easier method, but it causes of air and water pollution and health hazards.Open dumping is commonly applied for disposing of community waste in many towns of India.

land-filling

This is modified form of open dumping in which waste is deposited in layers of about 1.5 m thickness. These layers are covered with soil (20 cm) and compressed by bulldozers. Insecticides like DDT are sprayed on top layer to prevent mosquitoes and flies. The waste undergoes decomposition, stabilizes within a period of 2-12 months and settles down by 20-40% of its original volume.

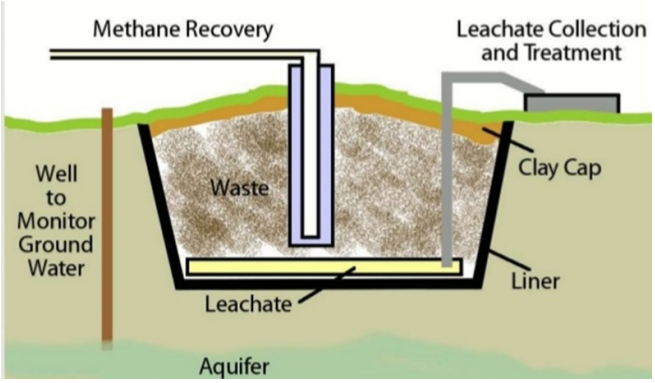

Figure: Essential components of land fill

- ✓ Sanitary land-filling is applied for disposing of municipal waste in metros and big cities of India.
- ✓ This method is simple, economical, does not require skilled labour and costly equipment, does not involve segregation or further processing, and can be done to reclaim low-lying areas.

Types of landfill:

Sanitary landfills-Landfill that uses a clay liner to isolate the trash from the environment.

Municipal solid waste (MSW) landfills- uses synthetic liner to isolate the trash from the environment.

Construction and demolition waste landfills-consist of debris generated during construction, renovation and demolition of buildings, roads and bridges.

Industrial waste landfills-consists of non-hazardous wate associated with manufacturing and other industrial activities. Ex: fly ash, solid generated after metal extraction from ore.

Secure landfills-land fills for the disposal of hazardous waste.

- ✓ Negative aspects include large area requirement, soil requirement for covering, and use of insecticides and risk of ground water pollution.

Composting

It involves biological decomposition of organic substances available in waste, under controlled conditions. It operates in both aerobic and anaerobic conditions. As a result of this

volume and harmful effects of waste is reduces. The residue of the process is organic manure which contains minerals and can be applied in agriculture as fertilizer.

- ✓ There are three common methods of composting: (i) Trenching based composting (ii) Open window composting and (iii) Mechanical composting.
- ✓ Composting is practiced since long in India and it is the best suited to our environment. Composting is an ecofriendly method in which wastes are finally converted into simple compounds of nature. It produces valuable manure which protects soil fertility and reduces soil erosion. It can be practiced even a household level.
- ✓ Negative aspects or limitations include its slow processing, production of unpleasant smells, and its applicable only for bio-degradable wastes.

Incineration

Waste is burnt in controlled manner, at high temperature (700^0-1000^0C) in a large furnace known as incinerator. Prior to burning non-combustible items (e.g., metals, glass, crockery etc.) are segregated and removed. The combustion process produces CO_2, N_2 and water vapour. Waste reduces to ash which is only 10% of original volume.

- ✓ Incineration is commonly adopted for disposing of hazardous toxic waste in

  India. It is more common in developed countries.
- ✓ This method is quick, require little space, involve less transportation cost, highly reduce volume of waste and provide safest disposal.
- ✓ Negative aspects include high capital (initial) and operating cost, need of skilled manpower and air pollution. Besides it, segregation of waste and final disposal of ash is also required.

Pyrolysis or destructive distillation

In this method waste is heated at high temperature (700^0-1000^0C), but in anaerobic conditions (low or no O_2). Unlike incineration, Pyrolysis is exothermic process which is meant to recover chemical energy of organic wastes. The process converts organic wastes into CO, CO_2, CH_4, tar etc.

- ✓ It is less frequently applied method in India. Its merits and demerits resembleto that of incineration.

Pulverization

In this method waste in converted into powder by mechanical grinding. This reduces volume of the waste and changes its physical character. This is further disposed of by land-filling.

- ✓ Due to high capital and running cost, it is not common in India.

Disposal into sea

This method is adopted in coastal areas which have deep sea water (>30 m) at a moderate distance (<16-20 km) with strong forward current.

- ✓ This is cheap method that can be adopted in coastal areas.
- ✓ Negative aspects include limited applicability for coastal areas, spoiling of sea beaches due to return of wastes to coasts, and difficulties during monsoon and storms.

F. Recovery of materials

The material present in waste can be recovered and utilized for useful purposes i.e., the waste is converted into resource. Two common strategies are used for this:

Reuse

- ✓ It means using the waste material in some or other ways without much reprocessing. e.g., making rubber rings from discarded cycle tubes which can be used by newspaper vendor instead of rubber bands.

Recycling

- ✓ Recycling means reprocessing of discarded materials into new useful products. Paper and other cellulose products are commonly recycled to make recycled paper and card board. Metallic wastes are recycled by melting and recasting into new items.

Numerical

Q. Compute the landfill area requirement for 20 years of a city with population of 10 lakhs. (Given MSW generation = 500gm per capita per day, MSW density = 500 Kg/m^3).

Solution

Total time = 20 years = 20 X 365 days

Total population = 10 lakhs

MSW generation = 500gm per capita per day = 0.5 Kg

Thus, total mass of MSW generation in a year by 10 lakhs people =

0.5 Kg/day X 10,00000 X 20 X 365 days = 3650000000 = 36.5 X 10^8 Kg

Given MSW density = Mass / Volume = 500 Kg/m^3

putting the calculated mass in the above equation;36.5 X 10^8 Kg/ volume = 500 Kg/m^3

Volume of landfill required =36.5 X 10^8 Kg/500 Kg/m^3 = 73,00000 m^3

Assuming the height of the landfill =10m

Thus, area of the landfill = total volume of the landfill/height = 73,00000 m^3/10m = 73,0000m^2

Since in the landfill, the total land requirement = land required to dump solid waste + same amount of land required to construct road for vehicle movement.

Thus, total land requirement =73,0000 X 2 = 1, 460,000 m^2.