

**(Management Topic in Environmental Studies)**

**B. Tech 7<sup>TH</sup> Semester**



# **Solid Waste management including Integrated Solid Waste Management (ISWM)**



**Department: Chemistry  
Subject: MTES (CHM2049)**



**LANDFILL**

**"...Technique for Solid Waste Disposal..."**

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# Solid waste

## Definition

- ❖ 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, crokery, 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 of Solid Waste

Plastic waste



Biomedical waste



Agricultural waste



Construction waste



E-waste

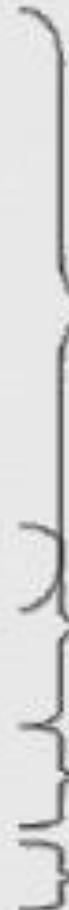


Hazardous waste



# Sources of solid waste

- Residential
- Commercial
- Institutional
- Construction and demolition
- Municipal services
- Treatment plant sites
- Industrial
- Agricultural
- Biomedical waste

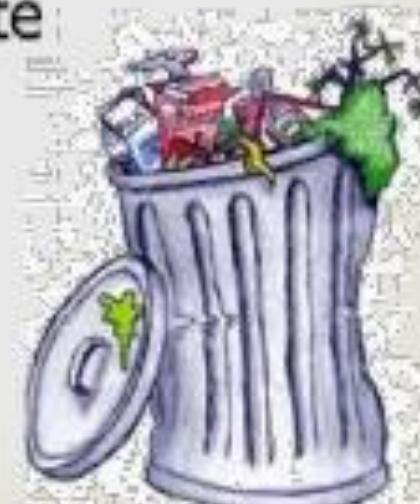


Municipal solid waste (MSW)

Industrial solid waste

Agricultural waste

Hospital waste



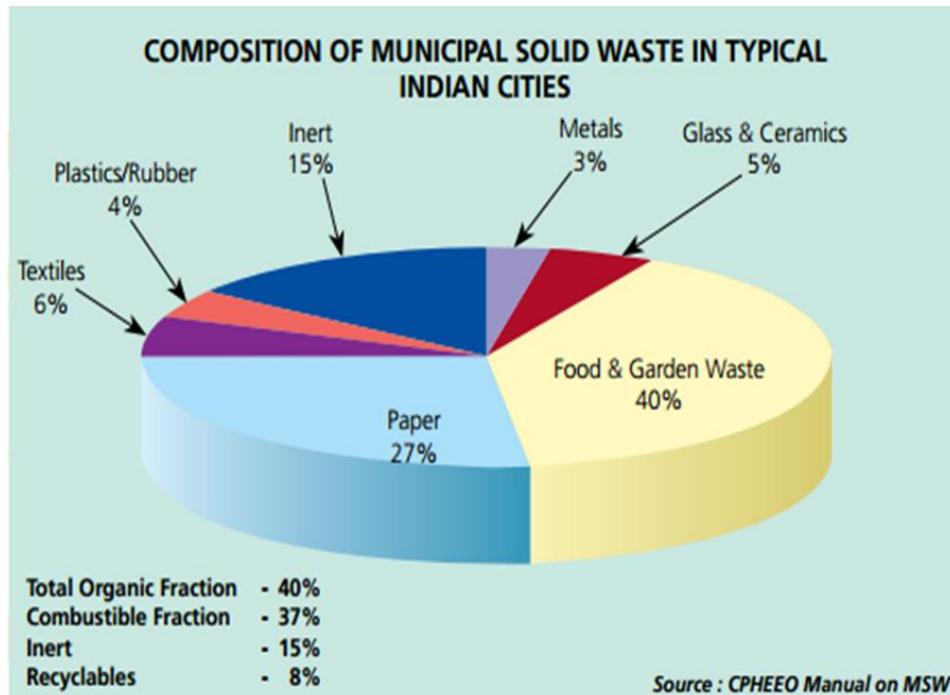
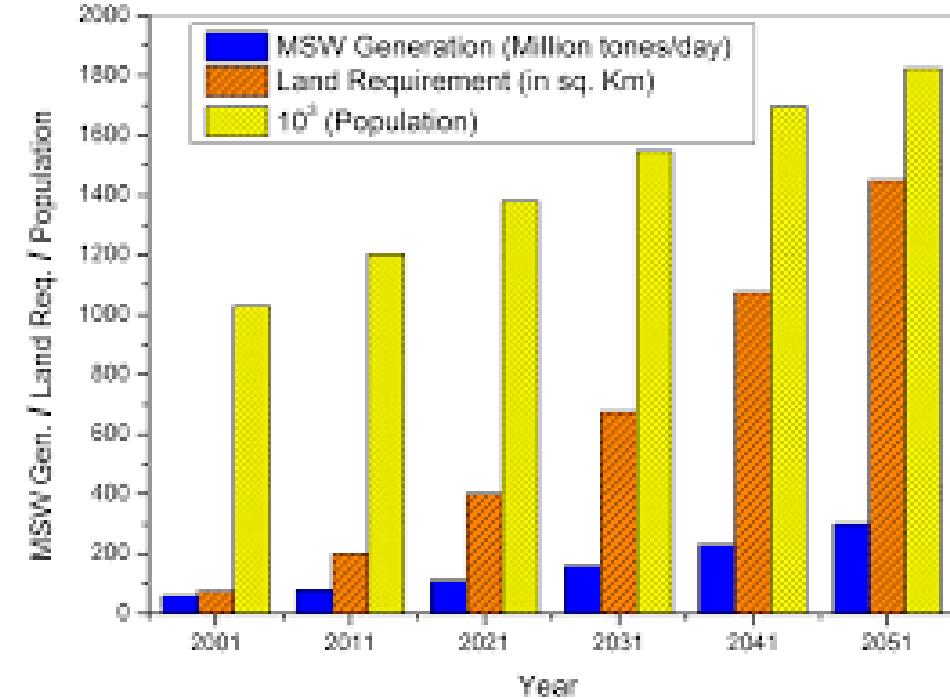
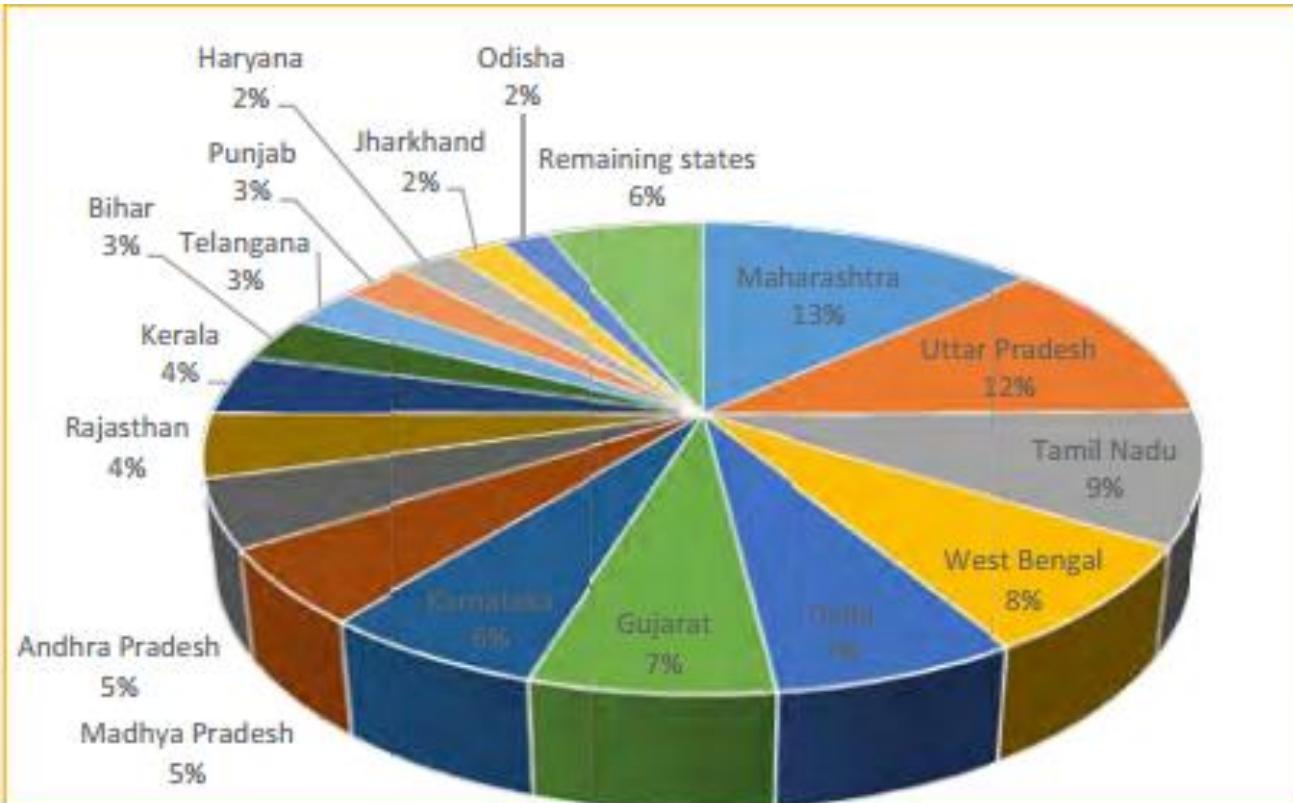
# Types and Sources

There are three categories of soil wastes:

- ❖ **Municipal Wastes:** These wastes arise from residential areas (household activities, streets), commercial areas (hotels, markets, institutions) and community areas (streets, parks, play ground).
- ❖ **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.  
**ignitability, corrosivity, reactivity & toxicity**



# Solid waste generation in India



# 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

# Technique for solid waste disposal



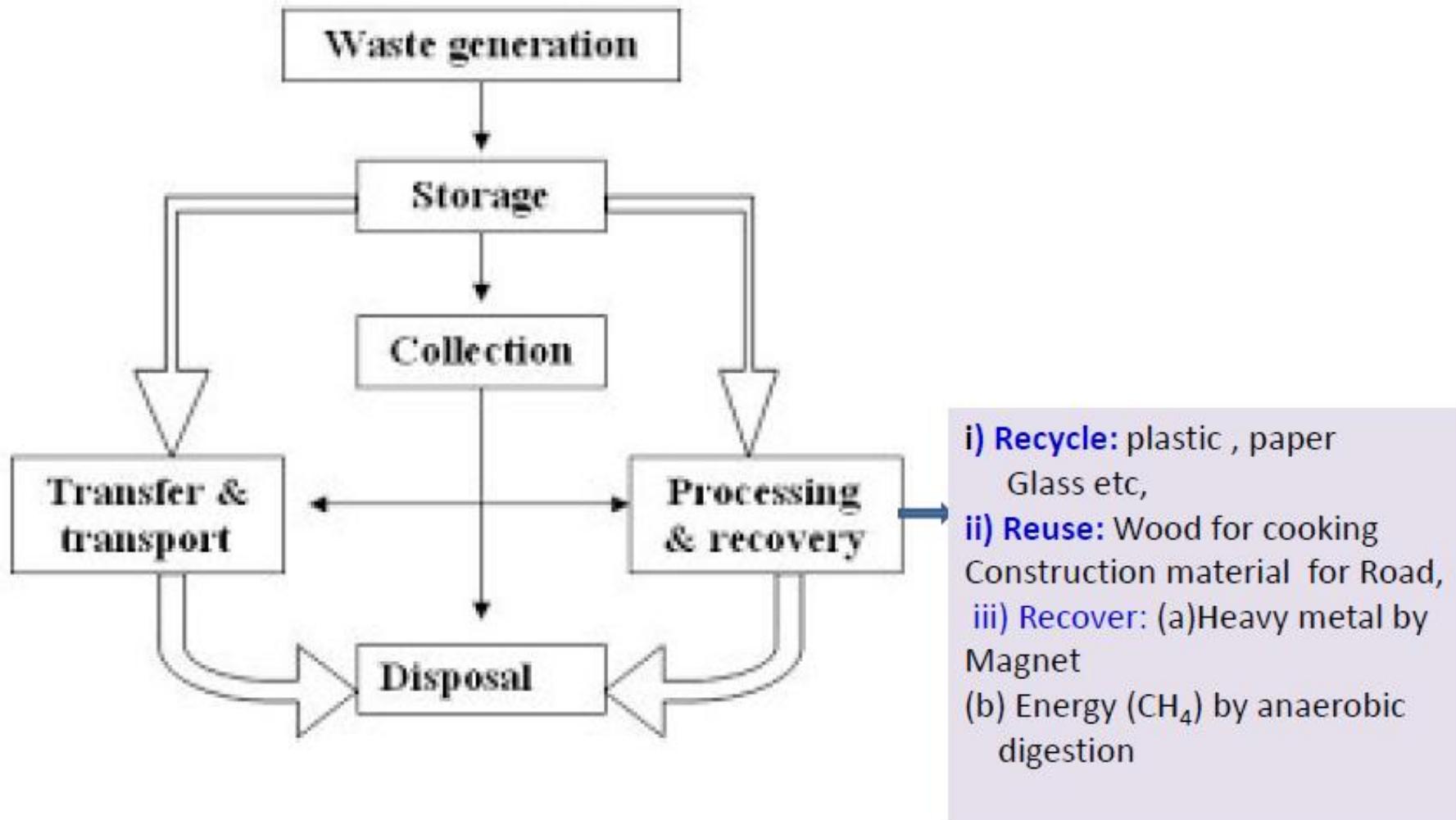
# Solid waste management

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.

There are three parts of solid waste management:

- A. Collection
- B. Disposal
- C. Recovery

# Municipal Solid waste management



# Solid waste management

## A. Collection

- ✓ It involves collection of solid waste from the point of generation and its transportation to disposal site.
- ✓ 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.

# Solid waste management

## B. 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:

### ❖ 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.

# Types of Land fill

- ☞ **Sanitary Landfills** - landfill that uses a clay liner to isolate the trash from the environment
- ☞ **Municipal solid waste (MSW) landfills** - uses a synthetic (plastic) liner to isolate the trash from the environment
- ☞ **Construction and demolition waste landfills** - consist of the debris generated during the construction, renovation, and demolition of buildings, roads, and bridges.
- ☞ **Industrial Waste Landfills**- consists of nonhazardous waste associated with manufacturing and other industrial activities  
*Fly ash, sold generated after metal extraction from ore*
- ☞ **Secure Landfills** - landfills for the disposal of hazardous waste.

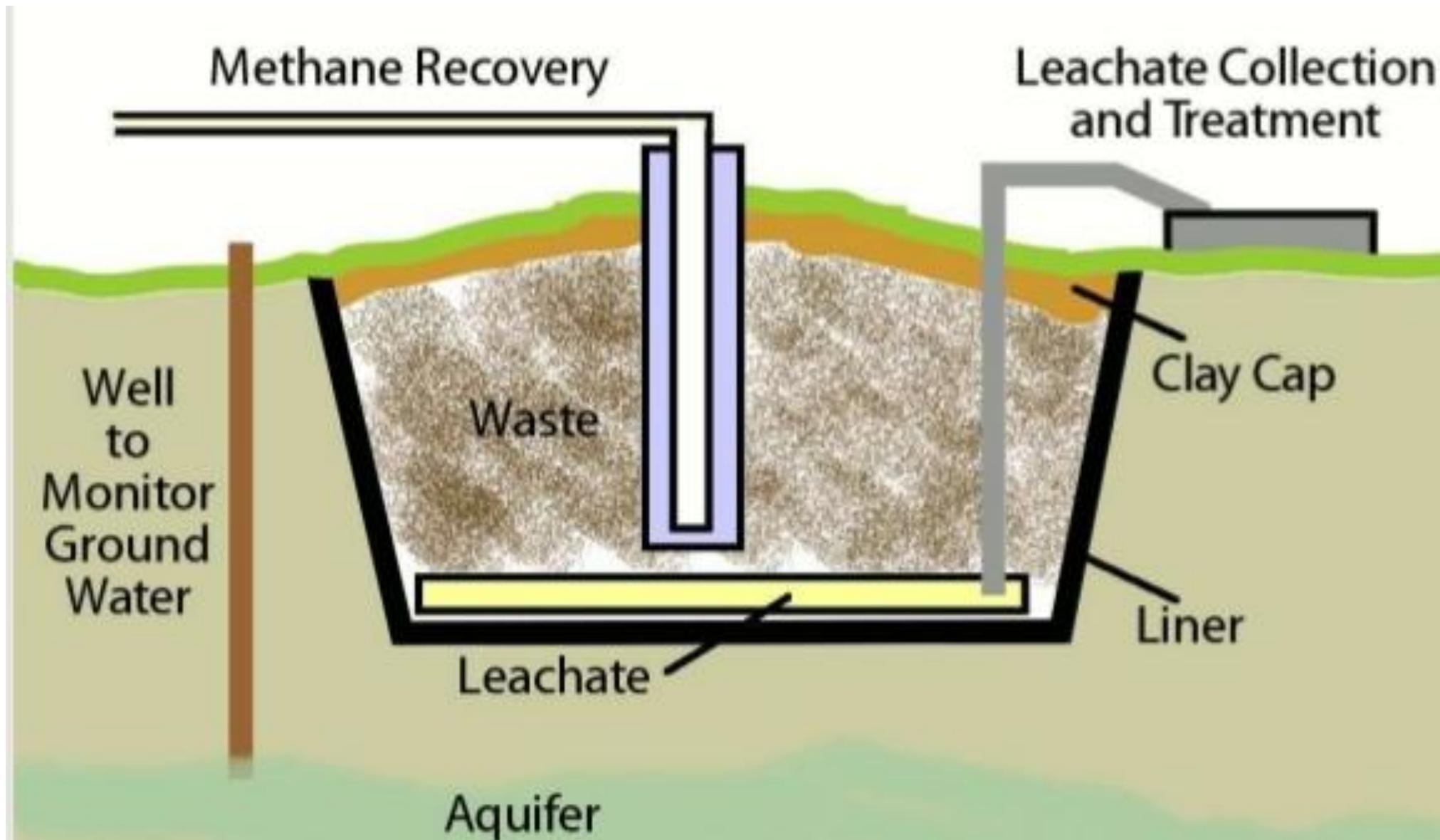
# Solid waste management

## ❖ Sanitary 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.

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

# Essential components of Land Fill



# Solid waste management

❖ **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 reduced. 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.

# Solid waste management

- ❖ **Incineration:** Waste is burnt in controlled manner, at high temperature ( $700^0\text{-}1000^0\text{C}$ ) 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  $\text{CO}_2$ ,  $\text{N}_2$  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. It may generates some more toxic gas

# Solid waste management

## ❖ Pyrolysis or destructive distillation

In this method waste is heated at high temperature ( $700^0$ - $1000^0$ C), but in anaerobic conditions (low or no O<sub>2</sub>). Unlike incineration, Pyrolysis is exothermic process which is meant to recover chemical energy of organic wastes. The process converts organic wastes into CO, CO<sub>2</sub>, CH<sub>4</sub>, tar etc.

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

## ❖ Pulverization

In this method waste is 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.

# Solid waste management

## ❖ 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. (Nuclear waste)

- ✓ 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 storm.

# Numerical Solid waste Management

- Compute the landfill area requirement for 20 years of a city with population of 10 lakh. (*Given: MSW generation = 500 gm per capita per day; MSW density = 500 kg/m<sup>3</sup>.*)
- **Solution:** total time = 20 year= 20x365 day

Total population = 10 lakh

*MSW generation = 500 gm per capita per day;*= 0.5 kg

Thus total mass of MSW generation in year by 10 lakh peoples =  
0.5kg/daypx10,00000px20x365day=3650000000kg = 36.5x10<sup>8</sup>kg

Given MSW Density = *Mass/volume = 500kg/m<sup>3</sup>* (1)

Putting earlier calculated mass in equation 1

$$36.5 \times 10^8 \text{ kg/volume} = 500 \text{ kg/m}^3$$

$$\text{Volume of landfill required} = 36.5 \times 10^8 \text{ kg}/500 \text{ kg m}^{-3} = 73,00000 \text{ m}^3$$

Assume height of land fill is 10 m

$$\text{Thus area of land fill} = \text{total volume of land fill}/ \text{height} = 73,00000 \text{ m}^3 / 10 \text{ m} = 73,0000 \text{ m}^2$$

Since in a land fill total land requirement = land required to dump solid waste+ same amount of land required to construct road for vehicle movement

$$\text{Thus total land requirement} = 73,0000 \times 2 = 1,460,000 \text{ m}^2$$



**THANK YOU**

