



# Content...

Solid Waste Management: Quantity,  
Composition and characteristics of solid waste,  
Methods of solid waste collection, conveyance,  
treatment and disposal.

➤ In a nutshell “ Solid waste can be regarded as refuse or waste from any kind of source”. But any refuse or waste can be economic resource to others.

## Basic terms related to solid waste

1. **Ash** : the non-combustible solid by-products of incineration or other burning process.
2. **Bulky waste**: large wastes such as appliances, furniture, and trees and branches, that cannot be handled by normal MSW processing methods.
3. **Co-disposal**: the disposal of different types of waste in one area of a landfill or dump. For instance, sewage sludges may be disposed of with regular solid wastes.

4. **Biodegradable material** : any organic material that can be broken down by microorganisms into simpler, more stable compounds. Most organic wastes (e.g., food, paper) are biodegradable.
5. **Compost** : the material resulting from composting. Compost, also called humus, is a soil conditioner and in some instances is used as a fertilizer.
6. **Composting** : biological decomposition of solid organic materials by bacteria, fungi, and other organisms into a soil-like product.

**7. Disposal :** the final handling of solid waste, following collection, processing, or incineration. Disposal most often means placement of wastes in a dump or a landfill.

**8. Environmental impact assessment (EIA) :** an evaluation designed to identify and predict the impact of an action or a project on the environment and human health and well-being. Can include risk assessment as a component, along with economic and land use assessment.

**9. Environmental risk assessment (EnRA) :** an evaluation of the interactions of agents, humans, and ecological resources. Comprised of human health risk assessment and ecological risk assessment, typically evaluating the probabilities and magnitudes of harm that could come from environmental contaminants.

**10. Garbage :** in everyday usage, refuse in general. Some MSWM manuals use garbage to mean "food wastes," although this usage is not common.

**11. Landfilling :** the final disposal of solid waste by placing it in a controlled fashion in a place intended to be permanent. The Source Book uses this term for both controlled dumps and sanitary landfills.



**12. Leachate :** liquid that has seeped through a landfill or a compost pile and has accumulated bacteria and other possibly harmful dissolved or suspended materials.

**13. MSW :** municipal solid waste.

**14. MSWM :** municipal solid waste management.

**15. Putrescible :** subject to decomposition or decay. Usually used in reference to food wastes and other organic wastes that decay quickly.

**16. Refuse :** all kinds of wastes in solid state excepting excreta from residential, commercial and industrial area.

**17. Refuse-derived fuel (RDF) :** fuel produced from MSW that has undergone processing. Processing can include separation of recyclables and non-combustible materials, shredding, size reduction, and pelletizing.

**18. Rubbish :** a general term for solid waste. Sometimes used to exclude food wastes and ashes.

**19. Waste-to-energy (WTE) plant :** a facility that uses solid waste materials (processed or raw) to produce energy. WTE plants include incinerators that produce steam for district heating or industrial use, or that generate electricity; they also include facilities that convert landfill gas to electricity.

# Kinds of Wastes

➤ **Solid wastes:** domestic, commercial and industrial wastes especially common as co-disposal of wastes

Examples: *plastics, containers, 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*

# Classification of Wastes according to their Properties

## ➤ Bio-degradable

can be degraded (paper, wood, fruits and others)

## ➤ Non-biodegradable

cannot be degraded (plastics, bottles, old machines, cans, containers and others)

## Classification of Wastes according to their Effects on Human Health and the Environment

### ➤ Hazardous wastes

waste that is reactive, toxic, corrosive, or otherwise dangerous to living things and/or the environment. Many industrial by-products are hazardous.

### ➤ Non-hazardous

Substances safe to use commercially, industrially, agriculturally, or economically.

# From where these comes???





# Solid Waste in India

- 7.2 million tonnes of hazardous waste
- One Sq km of additional landfill area every-year
- Rs 1600 crore for treatment & disposal of these wastes
- In addition to this industries discharge about 150 million tonnes of high volume low hazard waste every year, which is mostly dumped on open low lying land areas.

*Source: Ministry of Environment & Forest*

# Growth of Solid Waste In India

- In 1981-91, population of Mumbai increased from 8.2 million to 12.3 million
- During the same period, municipal solid waste has grown from 3200 tonnes to 5355 tonnes, an increase of 67%
- Waste collection is very low for all Indian cities
- City like Bangalore produces 2000 tonnes of waste per annum, the ever increasing waste has put pressure on hygienic condition of the city

- Estimated waste generation is 1,00,000 MT/day.
- Per capita waste generation ranges between 0.20 to 0.60 kg.
- Waste collection efficiency in bigger sized cities ranges from 70 to 90% and in small sized towns it is up to 50-60%.
- Local authorities spend less 5% of their budget on waste disposal and maximum cost is incurred on street sweeping and collection and transportation of waste.

S.No	City	Municipal solid Waste (TPD)	Per capita waste (Kg/day)
1.	Ahmadabad	1,683	0.585
2.	Bangalore	2,000	0.484
3.	Bhopal	546	0.514
4.	Bombay	5,355	0.436
5.	Calcutta	3,692	0.383
6.	Coimbatore	350	0.429
7.	Delhi	4,000	0.475
8.	Hyderabad	1,566	0.382
9.	Indore	350	0.321
10	Jaipur	580	0.398
11	Kanpur	1,200	0.640
12	Kochi	347	0.518
13	Lucknow	1,010	0.623
14	Ludhiana	400	0.384
15	Madras	3,124	0.657
16	Madurai	370	0.392
17	Nagpur	443	0.273
18	Patna	330	0.360
19	Pune	700	0.312
20	Surat	900	0.600
21	Vadodara	400	0.389
22	Varanasi	412	0.400
23	Visakhapatnam	300	0.400

## MAJOR DEFICIENCIES

- Littering of garbage due to unorganized primary collection
- Provision and operation of interim storage facilities unsatisfactory
- Irregular garbage lifting
- Transportation system not synchronize with storage facilities
- Processing/ treatment of MSW not practiced
- Final disposal through dumping and not SLF

## Effects of waste if not managed wisely

- Affects our health
- Affects our socio-economic conditions
- Affects our coastal and marine environment
- Affects our climate

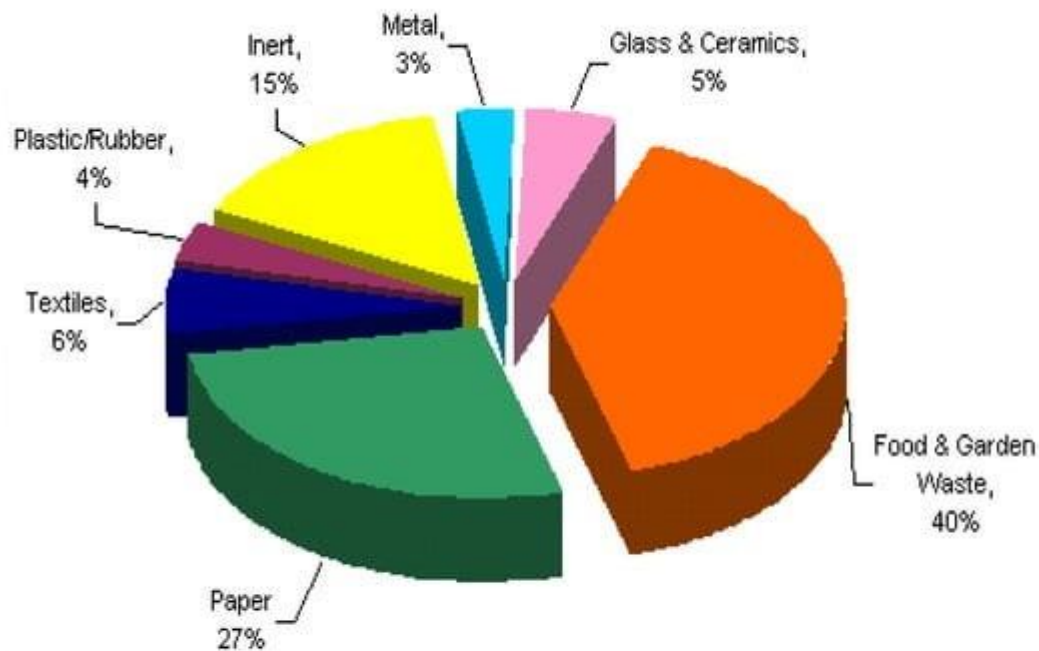






# Composition of solid waste

- The general composition of solid waste being generated from the cities of India is 40% Food & Garden waste, 5% glass & Ceramics, 3% Metal, 15% inert, 4% Plastic/ Rubber, 6 % Textile, 27 % Paper.
- Total Organic Fraction - 40%, Combustible Fraction - 37%, Recyclables - 8%, Inert - 15%



Source: CPHEEO Manual on MSW, 2005

# Characteristics of solid waste

Three types of characteristics:

1. Physical
2. Chemical and
3. Biological

# Physical characteristics

- This includes the determination of percent contents of various ingredients of the solid waste.
- Bulk Density is generally calculated.
- Function of location, season, storage time, equipment used, processing (compaction, shredding, etc.)
- Used in volume calculations.

# Chemical characteristics

- Used primarily for combustion and waste to energy (WTE) calculations but can also be used to estimate biological and chemical behaviours.
- Waste consists of combustible (i.e. paper) and non-combustible materials (i.e. glass).

### Proximate Analysis

- Loss of moisture (temp held at 105 C)
- Volatile Combustible Matter (VCM) (temp increased to 950 C, closed crucible)
- Fixed Carbon (residue from VCM)
- Ash (temp = 950C, open crucible)

### Fusing Point of Ash

- Clinker (agglomerations of carbon and metals) formation temperature, 2000 to 2200 F

### Ultimate Analysis

- Molecular composition (C, H, N, O, P, etc.)

### Energy Content

- Determined through lab calculations using calorimeters

# Biological characteristics

## Biodegradability

- Organic fraction often equated with the volatile solids (VS) content of the waste
  - However, not all organic materials are easily degradable
- Biodegradable fraction -
- Degradation produces odours
  - Hydrogen sulfide,  $H_2S$  (rotten eggs)
  - Methyl mercaptans
  - Aminobutyric acid
  - Methane is odourless.
- Attracts flies, vermin, rodents (vectors)

# Solid waste collection and transport

## Factors considered:

### i) Types of Containers:

- Depend on:
  - characteristics of SW collected
    - E.g. Large storage containers (Domestic SW: flats/apartment)
    - Containers at curbs
    - Large containers on a roller (Commercial/Industrial)
- Collection frequency
- Space available for the placement of containers



- Residential; refuse bags (7 -10 litres)
- Rubbish bins - 20 -30 litres
- Large mechanical containers - more commonly used to cut costs (reduce labor, time , & collection costs)
- must be standardized to suit collection equipment.

ii) Container Locations:

- side/rear of house
- alleys
- special enclosures (apartment/condos)
- Basement (apts. in foreign countries)/ newer complexes

iii) Public Health:

- relates to on-time collection to avoid the spread of diseases by vectors, etc.

iv) Aesthetics:

- must be pleasing to the eye (containers must be clean, shielded from public's view).

## v) Collection of SW

- 60-80 percent of total SWM costs.
- Malaysia (other developing nations) - labor and capital intensive.
- Major problems:
  - Poor building layouts - e.g. squatters
  - Road congestion - time cost, leachate, transport costs.
  - Physical infrastructure
  - Old containers used (leaky/ damaged)
  - Absence of systematic methods (especially at apartments, markets with large wst. volume).

Collections were made by:

1. Municipal/ District Council
2. Private firm under contract to municipal
3. Private firm contract with private residents

Door-to-door collection



Community bins



Community bins collection (Carried out once in 24 hrs) requires manual & multiple handling of waste to dump into transportation vehicles.



Transfer Station (TS)



Disposal sites

Disposal sites

# Types of collection

## Municipal Collection Services:

a. Residential:

1. Curb (*Kerb-side*)
2. Alley
3. Set out and set back
4. Backyard collection

## Curb (Kerb-side)

- House owner is responsible for placing solid waste containers at the curb on scheduled day.
- The work man come, collect and empty the container and put back at the curb.
- House owner is required to take back the empty containers from the curb to his house.
- Quickest/ economical
- Crew: 1 driver + 1 or 2 collectors
- No need to enter property

# Set-out, set back

- Collectors have to enter property
- Set out crew carries full containers from resident storage location to curb/ alley before collection vehicle arrives.
- Collection crew load their refuse into vehicle
- Set-back crew return the container to storage area.



# Alley service

- The containers are placed at the alley line from where they are picked up by workmen from refuse vehicles who deposit back the empty container.

# Backyard service

- The workers with the vehicles carry a bin, wheel - barrow or sack or cloth to the yard and empty the solid waste container in it.
- The bin is taken to solid waste vehicles where it is emptied.

## Commercial-Industrial Collection Services:

- i. Large movable and stationary containers
- ii. Large stationary compactors (to form bales)

## Collection Frequency:

- residential areas : everyday/ once in 2 days
- communal/ commercial : daily
- food waste - max. period should not exceed :
  - the normal time for the accumulation of waste to fill a container
  - the time for fresh garbage to putrefy and emit fould odor
  - the length of fly-breeding cycle ( < 7 days).







**BLUE BOX**



**YELLOW BAG**



**BLUE BAG**

All material accepted in the Recycling Program is banned from the landfill.

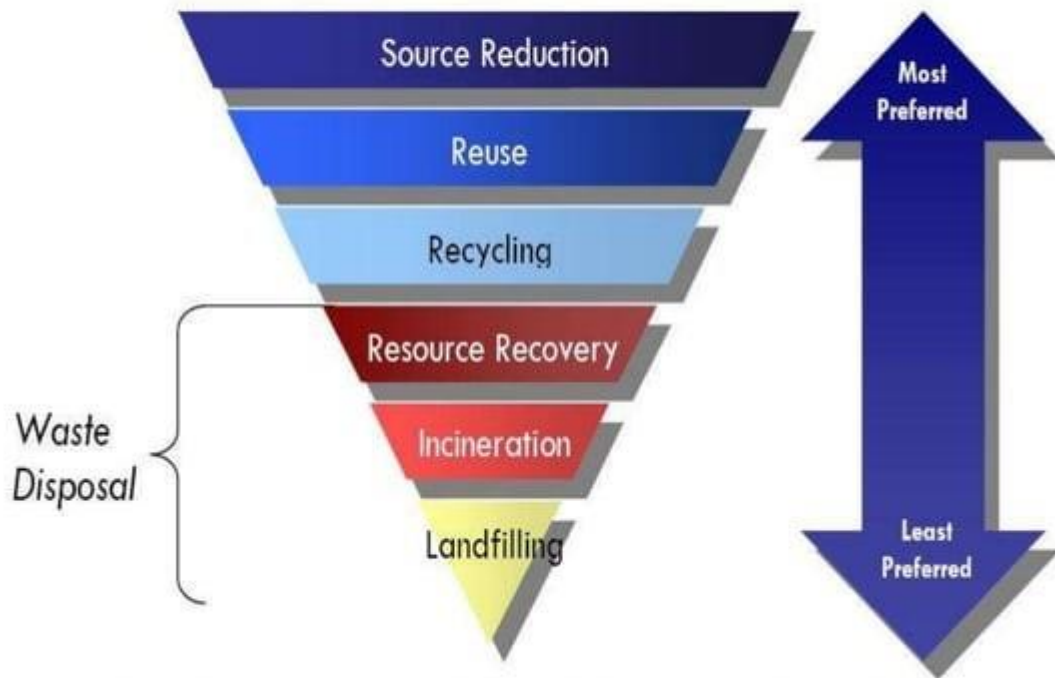
# Treatment and disposal of solid waste

Several methods are used for treatment and disposal. These are:

1. Composting
2. Incineration
3. Landfilling
4. Pyrolysis
5. Recycling



*Figure 3-1. The Solid Waste Management Hierarchy*



# Composting

- It is a process in which organic matter of solid waste is decomposed and converted to humus and mineral compounds.
- Compost is the end product of composting, which used as fertilizer.
- Three methods of composting:
  - (a) composting by trenching
  - (b) open windrow composting
  - (c) mechanical composting

## Composting by trenching

- Trenches 3 - 12 m long, 2 - 3 m wide and 1- 2 m deep with spacing 2 m.
- Dry wastes are filled up in 15 cm. On top of each layer 5 cm thick sandwiching layer of animal dung is sprayed in semi liquid form.
- Biological action starts in 2- 3 days and decomposition starts.
- Solid waste stabilize in 4- 6 months and changed into brown colored odorless powdery form known as humus.



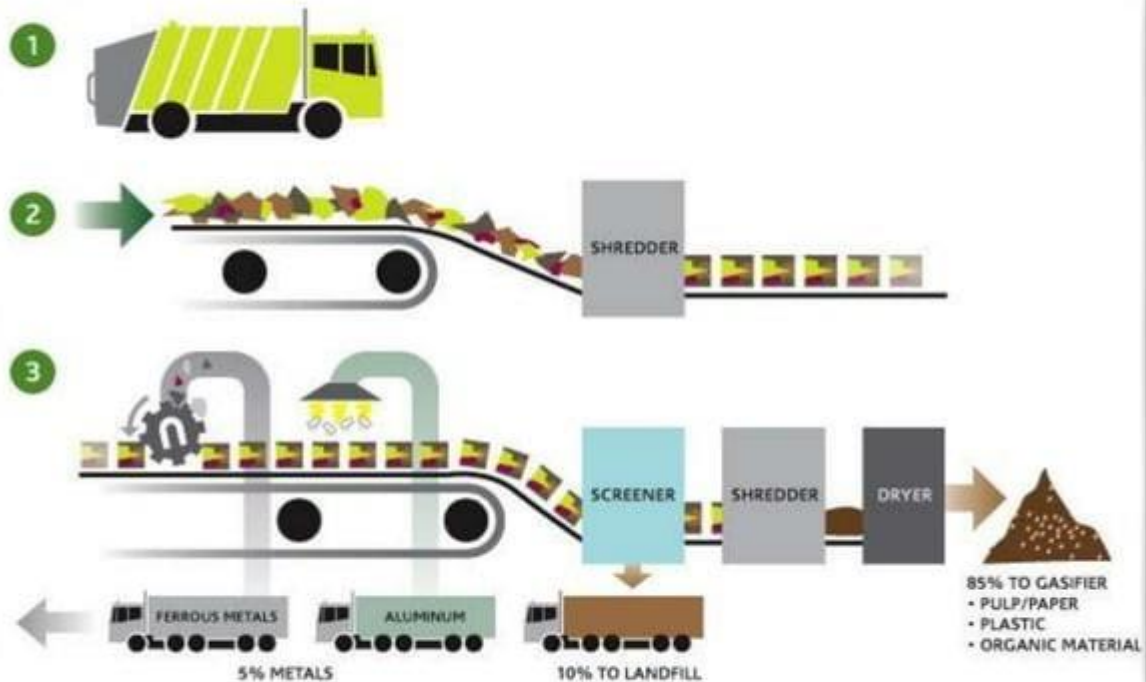
## Open windrow composting

- Large materials like broken glass, stone, plastic articles are removed.
- Remaining solid wastes is dumped on ground in form of piles of 0.6 – 1 m height.
- The width and length of piles are kept 1- 2 m and 6 m respectively.
- Moisture content maintained at 60%.
- Temp. increases in side pile.
- After pile for turned for cooling and aeration to avoid anaerobic decomposition.
- The complete process may take 4- 6 week.



## Mechanical composting

- It requires small area compare to trenching and open windrow composting.
- The stabilization of waste takes 3- 6 days.
- The operation involved are
  - reception of refuse
  - segregation
  - shredding
  - stabilization
  - marketing the humus





# Incineration

- Incineration is a waste treatment process that involves the combustion of organic substances contained in waste materials.
- Incineration and other high temperature waste treatment systems are described as "thermal treatment".
- Incineration of waste materials converts the waste into ash, flue gas, and heat.
- Incinerators are used for this process.



## Important points regarding incineration

- Supplying of solid waste should be continuous.
- Waste should be proper mixed with fuel for complete combustion.
- Temp. should not less than  $670^{\circ}\text{C}$ .

## Advantages

- Most hygienic method.
- Complete destruction of pathogens.
- No odor trouble.
- Heat generated may be used for steam power.
- Clinkers produced may be used for road construction.
- Less space required.
- Adverse weather condition has no effect.

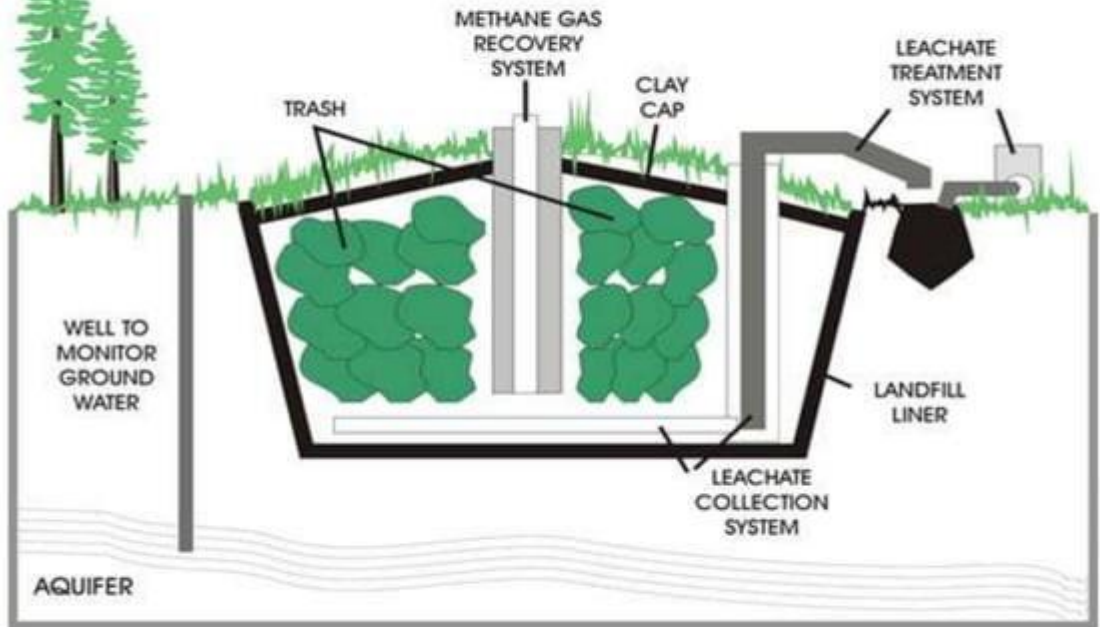
## Disadvantages

- Large initial expense.
- Care and attention required otherwise incomplete combustion will increase air pollution.
- Residues required to be disposed which require money.
- Large no of vehicles required for transportation.

# Landfilling

- A landfill site is a site for the disposal of waste materials by burial and is the oldest form of waste treatment.
- Historically, landfills have been the most common methods of organized waste disposal and remain so in many places around the world.
- The dumping is done with layers of 1- 2 m.
- The layer is covered with soil of 20 cm thickness.

# MODERN LANDFILL



## Advantages

- Simple method.
- No costly plant required.
- No residues or by products need to be disposed.
- Separation not required.
- Unused land can be used.
- Methane gas can be used as fuel.

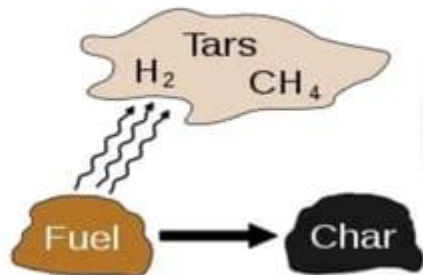


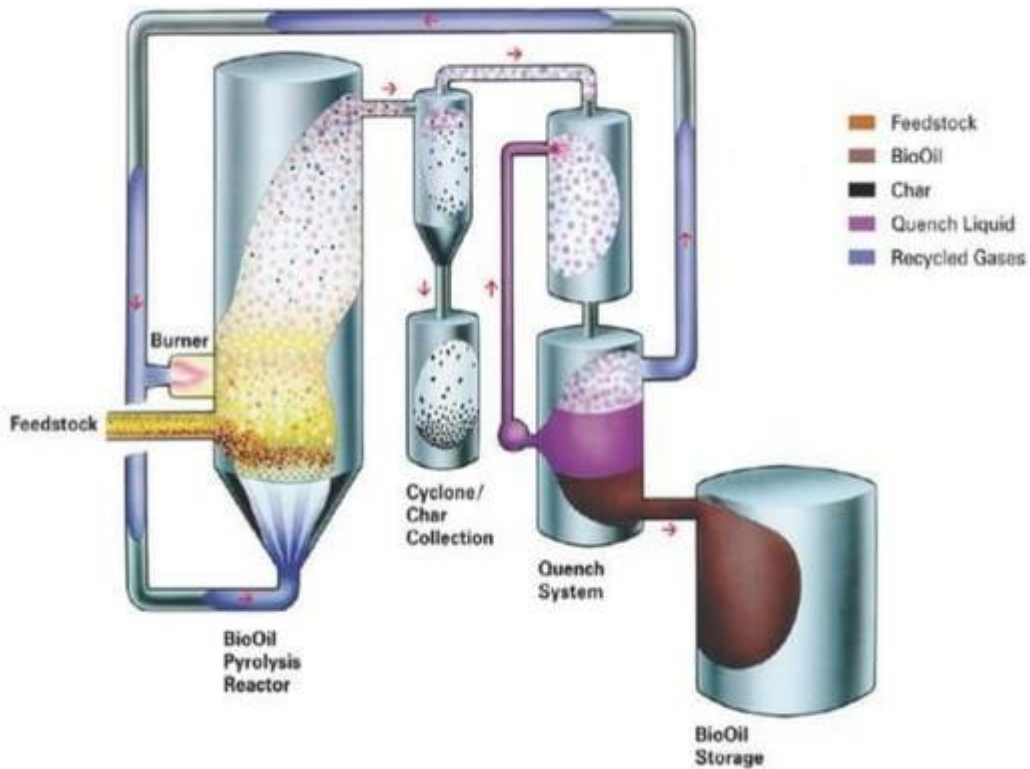
## Disadvantages

- Large land required.
- Proper dumping site may not be available.
- Odor problem.
- Use of insecticides required.
- Leachate should be collected regularly.
- Methane gas should be collected properly.
- Green house gas problem.

# Pyrolysis

- Heating of the solid waste at very high temp. in absence of air.
- Carried out at temp. between 500 °C – 1000 °C.
- Gas, liquid and chars are the by products.





# Recycling

- Recycling is processing used materials into new products .
- It reduce the consumption of fresh raw materials, reduce energy usage, reduce air pollution (from incineration) and water pollution (from landfilling).
- Recycling is a key component of modern waste reduction and is the third component of the "Reduce, Reuse, Recycle" waste hierarchy.

- Recyclable materials include many kinds of glass, paper, metal, plastic, textiles, and electronics.
- Although similar in effect, the composting or other reuse of biodegradable waste – such as food or garden waste – is not typically considered recycling.
- Materials to be recycled are either brought to a collection centre or picked up from the curbside, then sorted, cleaned, and reprocessed into new materials.

# WASTE RECYCLING





**Thank u ...**

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ





# LANDFILL

“...Technique for Solid Waste Disposal...”



Presented

By

Debashree Dutta (Environmental Engineer)

Sri Sai Manasa Nature Tech. Pvt. Ltd.





# SOLID WASTE MANAGEMENT



## ZERO WASTE

Presenter: Pallabi Priyadarsini

1<sup>st</sup> yr MPH

Mod: Dr. M. R. Narayana Murthy

Professor,

Department of Community Medicine

JSS MC

# 17CE413 SOLID AND HAZARDOUS WASTE MANAGEMENT

## 2.6 – Types of transfer stations

I only feel angry when I see waste.  
When I see people throwing away  
things we could use. - Mother  
Teresa

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## CHAPTER 2

# SOLID WASTE GENERATION

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# Solid Waste Management

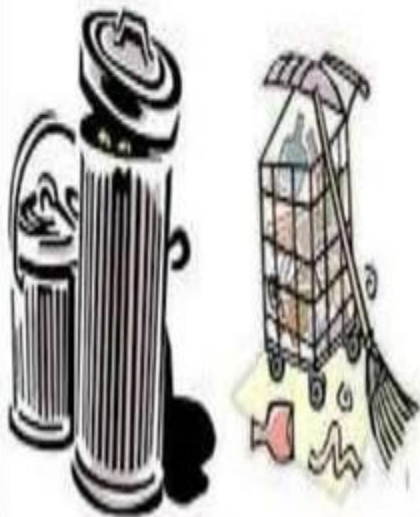
# SEMINAR REPORT ON "SOLID WASTE MANAGEMENT"

- Submitted in Partial Fulfilment of the Requirements for the award of degree of Bachelor of Engineering in CE



# SOLID WASTE MANAGEMENT

**MY WASTE, MY RESPONSIBILITY**



BY,  
BHANUPRIYA R