JECRC Foundation

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE
DEPARTMENT OF CIVIL ENGINEERING

Class – VI Semester /III Year
Subject –S&HWM
Chapter – 2(Introduction to SWM)
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UNIT-II

- **Introduction to SWM:**
- **Definition of waste and solid waste,**
- **classification solid waste,**
- **sources of solid waste,**
- **composition,**
- **factors affecting waste generation,**
- **traditional methods of waste collection and disposal**

1. Introduction:

Waste:

Depending on their physical state they are classified as**:**

- Liquid wastes
- Gaseous wastes
- Solid wastes.

Solid waste: Solid waste is the unwanted or useless solid materials generated from combined residential, industrial and commercial activities in a given area.

Solid Waste Management:

- **Solid waste management** is the process of collection, transportation and disposal of solid waste in a systematic, economic and hygienic manner.

- ‘Or’

- **Solid-waste management** is the process of the collecting, treating, and disposing of solid material that is discarded because it is of no longer use.

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.

- Solid wastes are classified as**:**

✓ Based on their sources of origin:

- ❑ Residential wastes
- ❑ Commercial wastes
- ❑ Institutional waste
- ❑ Municipal wastes
- ❑ Industrial wastes
- ❑ Agricultural wastes

✓ Based on physical nature:

- ❑ Garbage
- ❑ Ashes
- ❑ Combustible and non-combustible wastes
- ❑ Demolition and construction wastes

S. No.	Type	Description	Sources
1.	Garbage (Biodegradable food wastes)	Residual vegetable or animal wastes resulting from the handling, preparation, cooking and eating of foods. They are putrescible, and decompose rapidly, especially in warm weather.	Houses, Hotels, Dairies, Meat stalls etc.
	Combustible and non-combustible solid waste	Combustible solid wastes, as paper, cardboard, plastics, textile, rubber, leather, wood, furniture and garden trimmings. Non-combustible solid wastes as glass, crockery, tin cans, ferrous and non ferrous metals.	Households, Offices, Hotels, Markets etc.

3.	Ashes	Residues remaining after the burning of wood, coal, coke and other combustible wastes.	Fire places and Kitchens of houses, hotels, hostels etc.
4.	Demolition and construction wastes	Inert wastes such as dirt, stones, concrete, bricks, pieces of plumbing and heating and electrical parts	Demolition and Construction of buildings
5.	Industrial wastes	They are specific for a specific industry. Their characteristics vary widely as inert, highly biodegradable, toxic, reactive, odorous, corrosive, hot, cold, coloured, viscous, inflammable and dusty	Different types of Industries, Thermal power plants etc.

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

- ***Source: The Energy &Resources Institute, New Delhi***

- 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

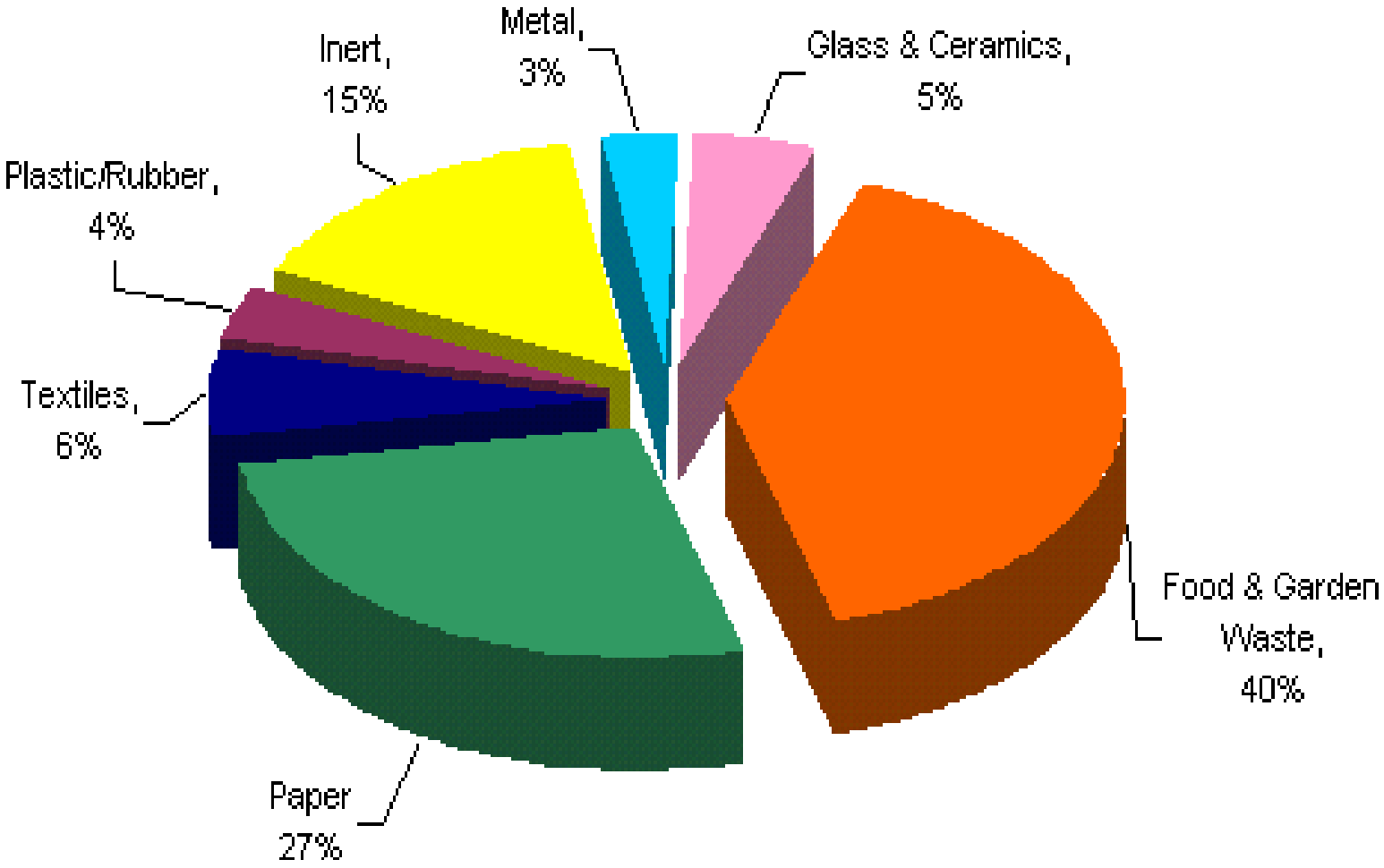
- Affects our health
- Affects our socio-economic conditions
- Affects our coastal and marine environment
- Affects our climate


DO NOT BURN WASTE
DO NOT LITTER WASTE

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

Factors affecting solid waste management:

There are certain factors that affect the management of solid waste: management. They are:

- Per capita income and status
- Climate and percentage moisture
- Systematic growth of city
- Status of the municipality
- Resources available

Characteristics of solid waste

Three types of characteristics:

1. Physical
2. Chemical and
3. Biological

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)
- 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:

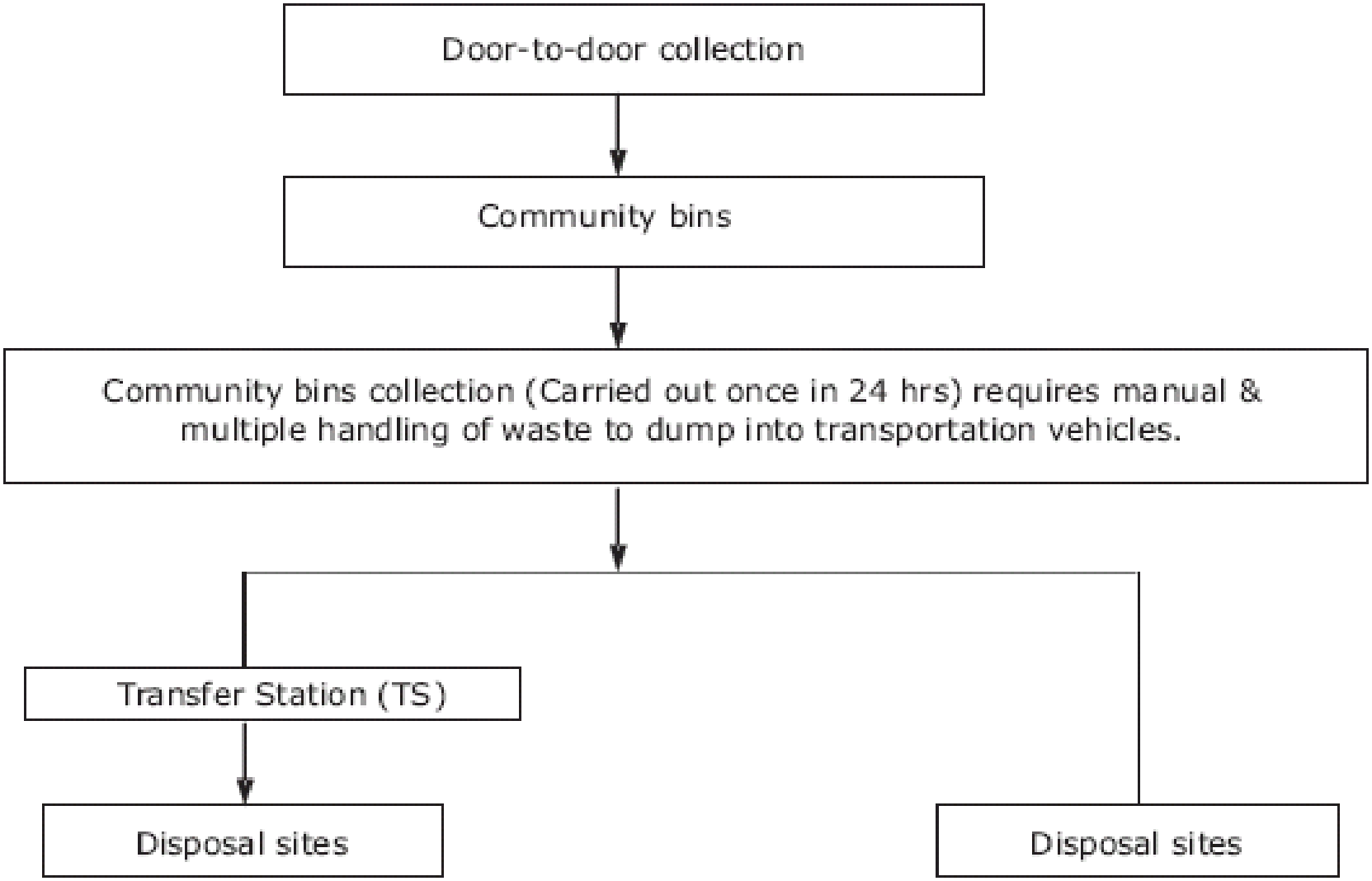
- must be pleasing to the eye (containers must be clean, shielded from public's view).

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 fouls odor
  - the length of fly-breeding cycle (< 7 days).


D.S.W.M.C
BIOMEDICAL WASTE
KEEP CLEAR
D.S.W.M.C
CAUTION
BIOMEDICAL WASTE
MANAGE YOUR WASTE CAREFULLY KEEP DOMINICA CLEAN AND GREEN


WM

BLUE BOX **YELLOW BAG** **BLUE BAG**

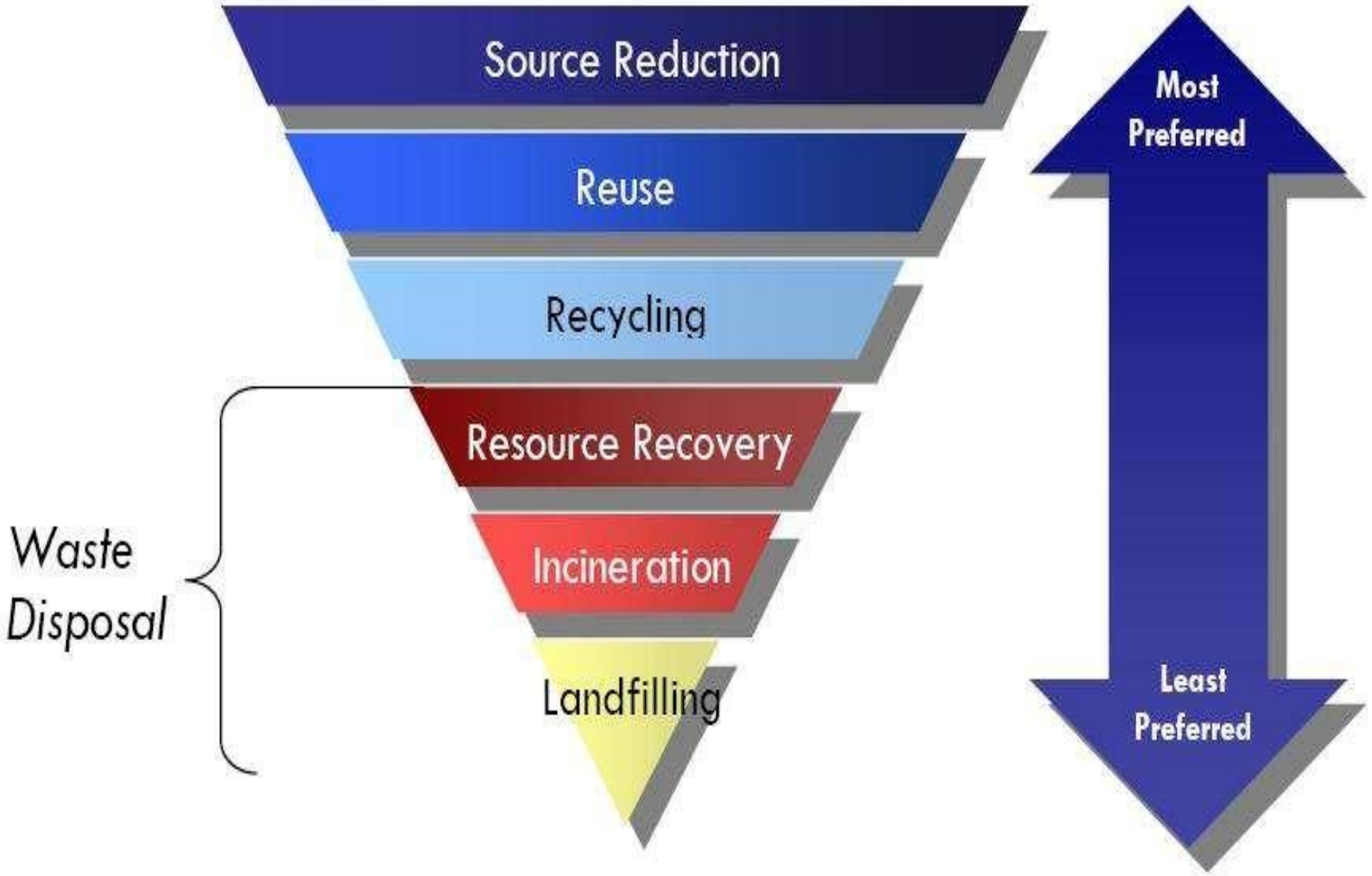
All material accepted in the Recycling Program is banned from the landfill.

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

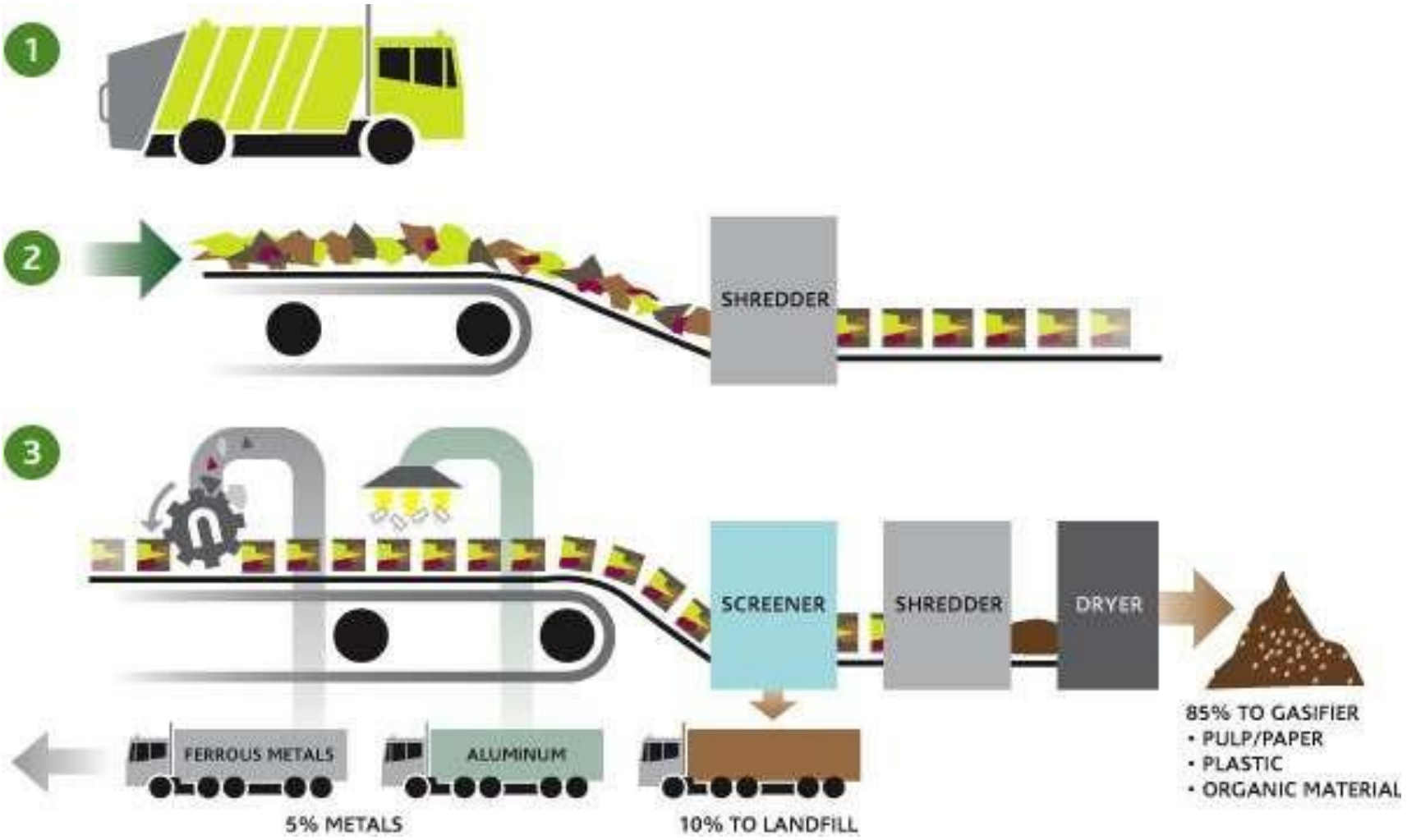
- Trenches 3 – 12 m long, 2 – 3 m wide and 1- 2 m deep with spacing 2 m.
- Dry wastes are filled up in 15 cm. On top of each layer 5 cm thick sandwiching layer of animal dung is sprayed in semi liquid form.
- Biological action starts in 2- 3 days and decomposition starts.
- Solid waste stabilize in 4- 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.

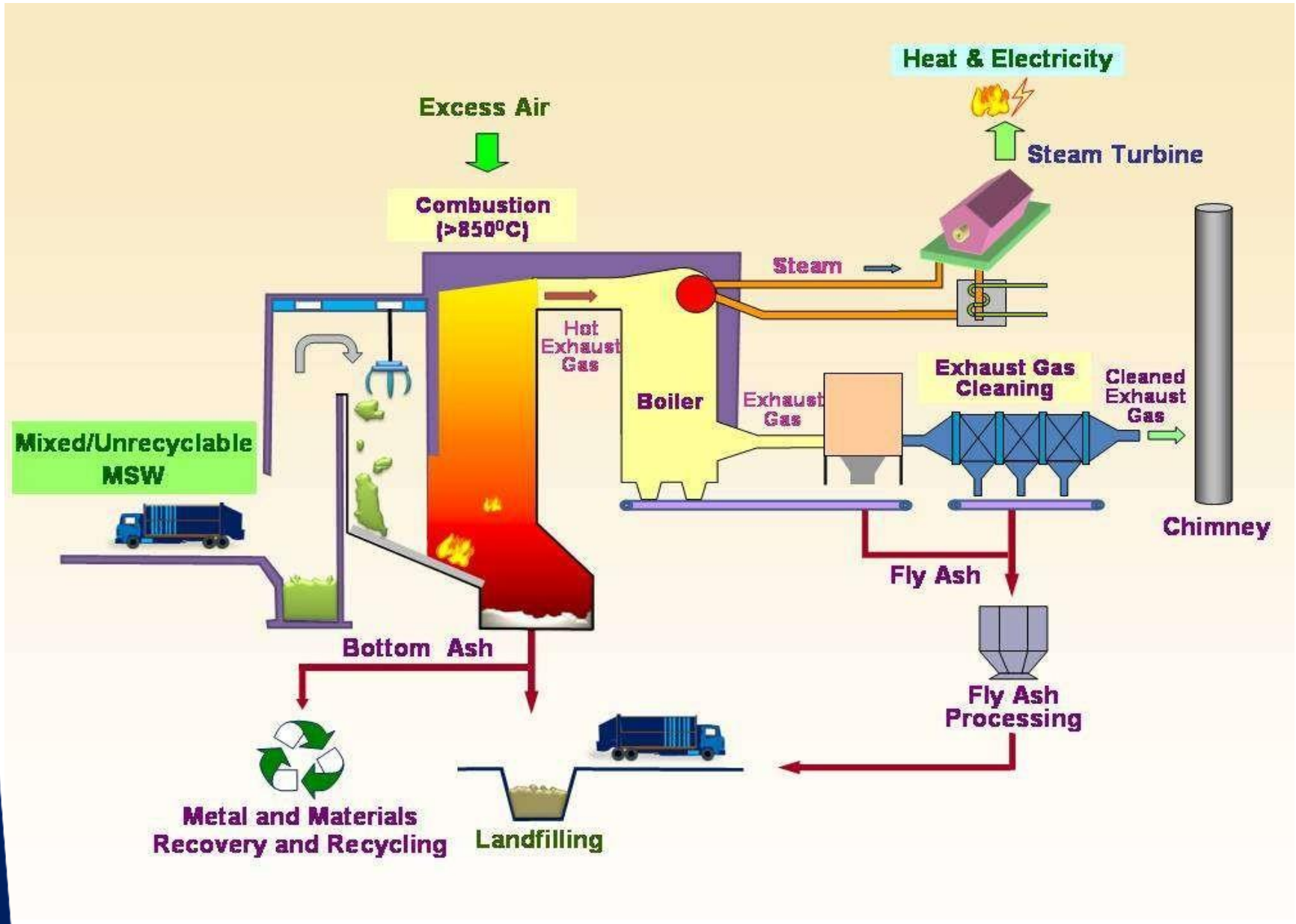
Mechanical composting

- 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


1
2
SHREDDER
3
SCREENER
SHREDDER
DRYER
85% TO GASIFIER
• PULP/PAPER
• PLASTIC
• ORGANIC MATERIAL
FERROUS METALS
ALUMINUM
5% METALS
10% TO LANDFILL

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.


Heat & Electricity
Excess Air
Steam Turbine
Combustion
(>850°C)
Steam
Hot
Exhaust
Gas
Boiler
Exhaust
Gas
Exhaust Gas
Cleaning
Cleaned
Exhaust
Gas
Mixed/Unrecyclable
MSW
Chimney
Fly Ash
Bottom Ash
Fly Ash
Processing
Metal and Materials
Recovery and Recycling
Landfilling

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 ˚C.

Advantages

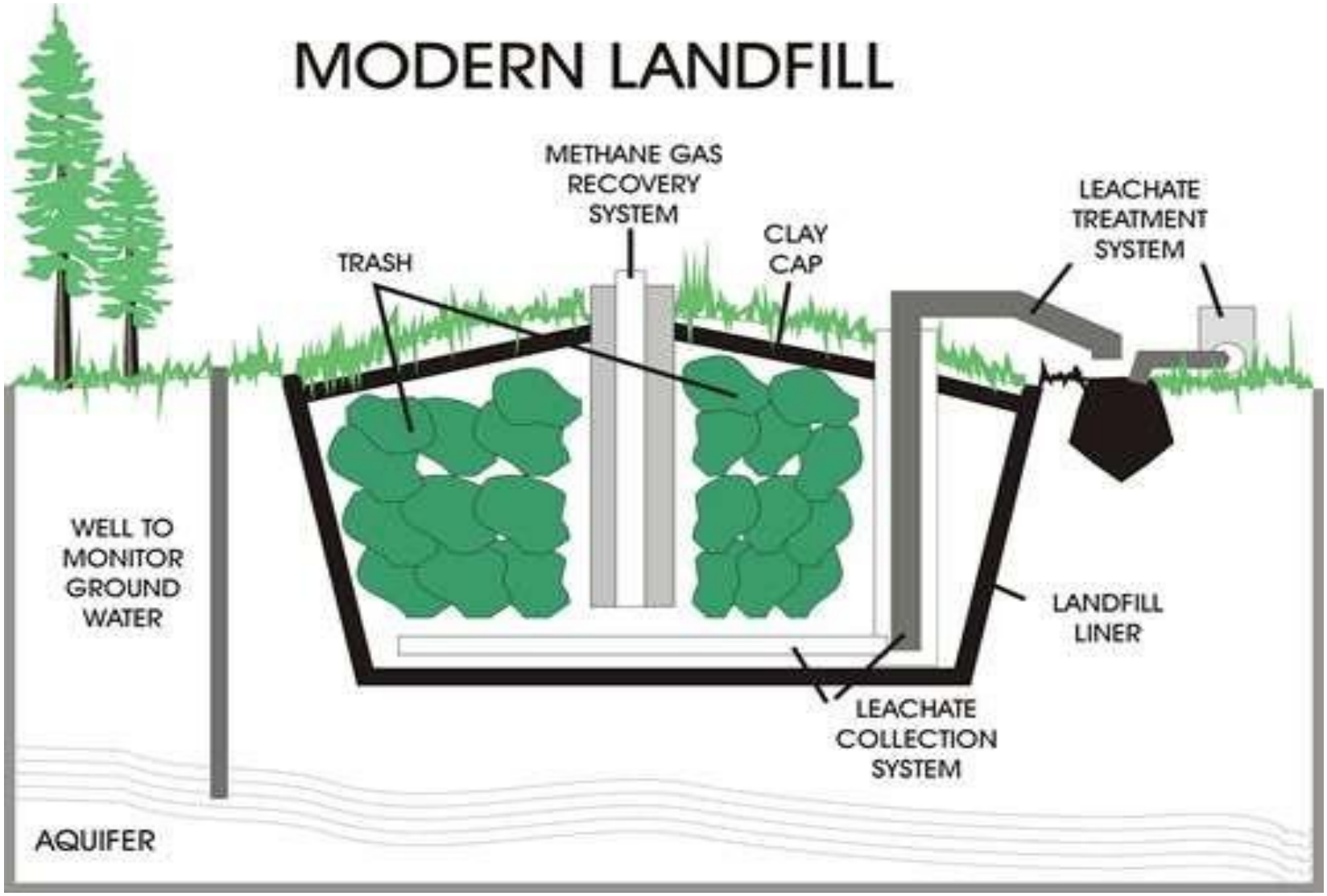
- Most hygienic method.
- Complete destruction of pathogens.
- No odor trouble.
- Heat generated may be used for steam power.
- Clinkers produced may be used for road construction.
- Less space required.
- Adverse weather condition has no effect.

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
METHANE GAS RECOVERY SYSTEM
TRASH
CLAY CAP
LEACHATE TREATMENT SYSTEM
WELL TO MONITOR GROUND WATER
LANDFILL LINER
LEACHATE COLLECTION SYSTEM
AQUIFER

Advantages

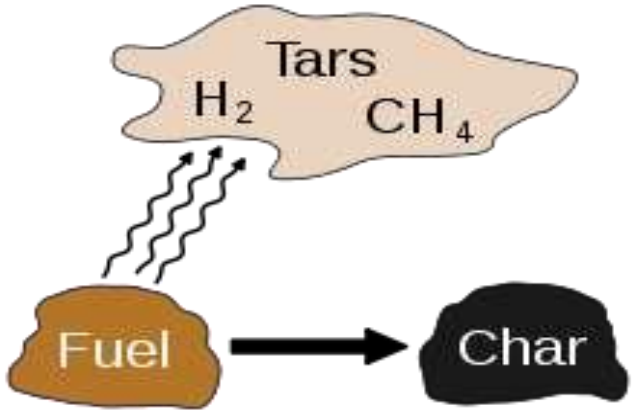
- Simple method.
- No costly plant required.
- No residues or by products need to be disposed.
- Separation not required.
- Unused land can be used.
- Methane gas can be used ass fuel.

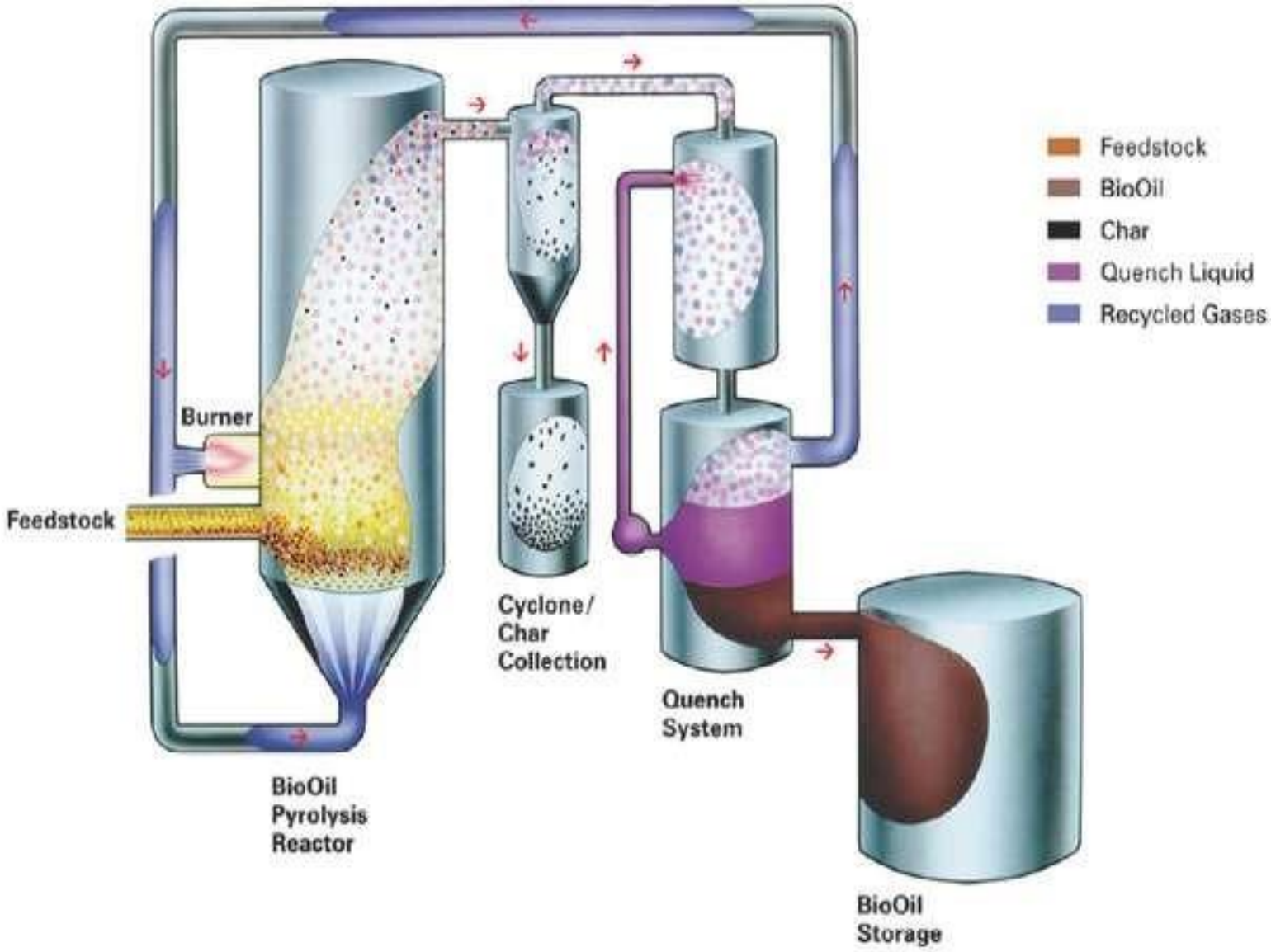
Disadvantages

- 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.




Feedstock
BioOil
Char
Quench Liquid
Recycled Gases
Burner
Feedstock
Cyclone/
Char
Collection
Quench
System
BioOil
Pyrolysis
Reactor
BioOil
Storage

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
Low Cost Rugs
Carpet Waste,
Cutouts & Rejects
Cardboard &
Paper Waste
Recycled Paper
Extrusion & Backing
Offcuts Waste
Ash
Plastic Tables & Chairs
Waste Yarn & Fibres
Low Cost Housing
Carpet Underlay