

## Unit 2 : Solid Waste Management :

(1)

### Waste :

- Commonly called as Trash , garbage . It consists of everyday items which we use & throw away .
- It predominantly includes food wastes , yard wastes , containers & product packaging materials & other miscellaneous inorganic residue , from residential , commercial , institutional & industrial sources .

Ex: Used appliances , newspapers , clothing , food scrapes , boxes , disposable tableware , office & classroom paper , furniture , wood , pallets , rubber items & cafeteria wastes .

### Solid Waste :

Solid waste can be understood as any household , industrial & agricultural material that have been used up .

### Classification of Solid waste :

Solid waste can be classified on the basis of 2 types .

1) Sources of Generation .

2) Type of Waste .

## D) Source Based Classification:

Sources of waste are based on the sectors and activities.

- Residential: Waste from houses, apartments in the form of leftover ~~food~~ food, plastic, clothes, vegetable peels etc.
- Commercial: Waste generated from restaurants, markets, hotels, automobile repair shops etc.
- Institutional: Paper, glasses, plastic generated from schools, colleges, offices, prisons etc.
- Municipal: Generated from municipal activity like construction and demolition, street cleaning, landscaping etc.
- Industrial: Ashes, demolition and construction wastes, hazardous wastes, etc. due to industrial activities.
- Agricultural: Spoiled food grains & vegetables, agricultural remains, litter etc, generated from fields, orchards, vineyards, farms etc.

→ Open areas: Wastes from areas such as streets, parks, vacant lots, playgrounds, beaches, highways, recreational areas etc. (2)

### Type Based Classification:

On the basis of physical, chemical, & biological characteristics of waste.

1) Garbage. = Animal & vegetable wastes resulting from handling, sale, storage, preparation, cooking & serving of food. It comprises of wastes that contains organic matter which on rotting produces an ~~obnoxious~~ obnoxious odour and attracts rats & other vermin.

2) Ashes & Residue: The waste remained after burning of wood, coal, charcoal, coke & other combustible materials for cooking & heating in houses, institutions and small industrial establishments.

3) Combustible & Non-combustible waste: Waste generated from households, institutions, commercial activities, etc.

- Combustible material consists of paper, cardboard, textile, rubber, garden trimmings etc.
- non-combustible material consists of such items as glass, crockery, tin & aluminum cans, ferrous and non-ferrous material and dirt.

4) Bulky waste: large household appliances such as refrigerators, washing machines, furniture, crates, vehicle parts, tyres, wood, trees etc. Since these household wastes cannot be accommodated in normal storage containers, they require a special collection mechanism.

5) Street wastes: Collected from streets, parks and vacant plots & include paper, cardboard, plastics, dirt, leaves, vegetable matter.

6) Biodegradable and non-biodegradable wastes: Biodegradable wastes mainly refer to substances consisting of organic matter such as leftover food, vegetable & fruit peels. paper, textile wood etc. generated from various household and industrial activities. Because of the action of micro-organisms.

these wastes are degraded from complex to simpler compounds.

Non-biodegradable wastes consist of inorganic and recyclable materials such as plastic, glass, cans, metals etc.

7) Dead animals: ~~Kith~~ Dead animals are those that die naturally or accidentally killed on the road. ~~Animals~~

Dead animals are of two types, large & small. large animals are horses, cows, goats, sheep, pigs etc. & among small ones are dogs, cats, rabbits, rats etc.

The reason for this differentiation is that large ~~amo~~ animals require special equipment for lifting & handling when they are removed. If not collected promptly, dead animals pose a threat to public health since they attract ~~fit~~ flies and other vermin as they decay.

8) Abandoned vehicles: Automobiles, trucks, trailers that are abandoned on streets and other public places. However, abandoned vehicles have significant scrap value for their metal, & their value to collectors is highly variable. (2)

9) Construction and demolition wastes: Generated as a result of construction, repair and demolition of houses, commercial buildings & other structures. They consist mainly of earth, stones, concrete, bricks, lumber, roofing and plumbing materials, heating systems & electrical wires, parts of the general municipal waste stream.

10) Farm wastes: Results from agricultural activities such as planting, harvesting, production of milk, rearing of animals for slaughter & the operation of feedlots.

11) Hazardous wastes: Waste of industrial, institutional or consumer origin that are potentially dangerous either immediately or over a period of time to human beings.

and the environment. This is due to their physical, chemical and biological or radioactive characteristics like ignitability, corrosivity, reactivity and toxicity.

Effective management practices should ensure that hazardous wastes are stored, collected, transported & disposed of separately, preferably after suitable treatment to render them harmless.

12) Sewage wastes: They are mostly organic & derived from the treatment of organic sludge separated from both raw and treated sewages.

### Effects of Solid Waste:

#### D Health Hazard:

- If solid wastes are not collected & allowed to accumulate, they may create unsanitary conditions.
- This may lead to epidemic outbreaks.
- Many diseases like cholera, diarrhea, dysentery, plague, jaundice, or gastro-

intestinal diseases may spread & cause loss of human lives.

- In addition, improper handling of the solid wastes is a health hazard for the workers who come in direct contact with the waste.

### 2) Environmental Impact:

- If the solid wastes are not treated properly, decomposition & putrefaction (decay) may take place.
- The organic solid waste during decomposition may generate obnoxious (intolerable) odors.

### Solid Waste Management:

The functional elements that constitute the system are.

- 1) Waste collection.
- 2) Waste segregation.
- 3) Waste transfer & transport.
- 4) Waste disposal.

Waste Collection: It includes gathering of wastes and taking them to the location, where the collection vehicle is emptied.

which may be a transfer station, a processing plant or a disposal site.

- Collection depends on the number of containers, frequency of collection, types of collection services and routes.
- Typically, collection ranges from municipal services to franchised services and under various forms of contracts.

## 5) Waste Segregation:

- Waste segregation involves separating wastes according to how its handled or processed.
- Waste segregation is an essential step to boost the process of recycling.
- When we segregate waste, there is reduction of waste as that gets landfilled and occupies less space. Thus, air and water pollution rates are considerably lowered.
- Separating biodegradable waste from non-biodegradable ones can help many recycling companies.

### 3) Waste Transportation:

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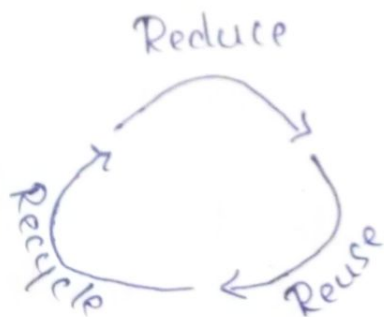
- The transfer of wastes from smaller collection vehicles, where necessary to overcome the problem of narrow access lanes, to larger ones at transfer stations.
- The subsequent transport of the wastes, usually over long distances, to disposal sites.
- The factors that contribute to the designing of a transfer station include the type of transfer operation, capacity, equipment, accessories and environmental requirements.

### 4) Waste disposal:

- Disposal is the ultimate fate of all solid wastes, be they residential wastes, semi-solid waste from municipal and industrial treatment, incinerator residues, composts or other substances that have no further use to the society.
- Thus, land use planning becomes a primary determinant in the selection, design and operation of landfill operations.

- A modern sanitary landfill is a method of disposing solid waste without creating a nuisance and hazard to public health.
- Generally, engineering principles are followed to confine the wastes to the smallest possible area, reduce them to the lowest particle volume by compaction at the site and cover them after each day's operation to reduce exposure to vermin.

### 3R's of Waste Management : [3R's concept]



3R's - Reduce, Reuse, Recycle.

- The 3R's conserve natural resources, landfill space and energy.

Reduce: Reducing the amount is most important of all the options to manage waste. Composting is a common technique to reduce the kitchen waste to zero waste.

It is an effective method through which kitchen waste can be recycled back into nature. The basic is to only purchase goods that we need & in the right amount. (7)

Reuse: There are definite items in our garbage that can be reused. Reusing waste items means that instead of dumping them, we can put them to use again in a different form.

Recycle: ~~of~~ The Kabariwalas who visit our home, and to whom we sell old newspapers, bottles, tins, magazines etc. perhaps you have never thought where these products go. These products are used as raw materials for manufacturing other items.

E-waste: Electronic waste.

- E-waste is any refuse created by discarded electronic devices and components as well as substances involved in their manufacture or use.
- It is one of the fastest growing waste streams in the world today.

- India is among the top five e-waste generating countries.
- The presence of heavy metals and highly toxic substances such as mercury, lead, beryllium and cadmium pose a significant threat to the environment even in minute quantities.
- Example - Mobile phones, television, refrigerator, home appliances etc.

### Harmful Effects of E-Waste:

- The lead, zinc, barium, arsenic etc. found in electronic waste tend to harm human health.
- When e-waste meets the landfills, the toxic chemicals seep into the soil and water, leading to groundwater pollution that further impacts sea health and human health.
- People associated with sorting or recycling E-waste are also exposed to harmful substances.

## Recycling of E-waste:

### Treatment options of E-waste.

- \* Land filling - It is the disposal of waste material by burying it. Space at landfill sites is becoming scarce. It is not appropriate to dispose of waste from electric & electronic equipment in landfill sites because of the harmful substances that waste from electric and
- \* Incineration: It is the process of burning materials at high temperatures & reducing to harmless end products

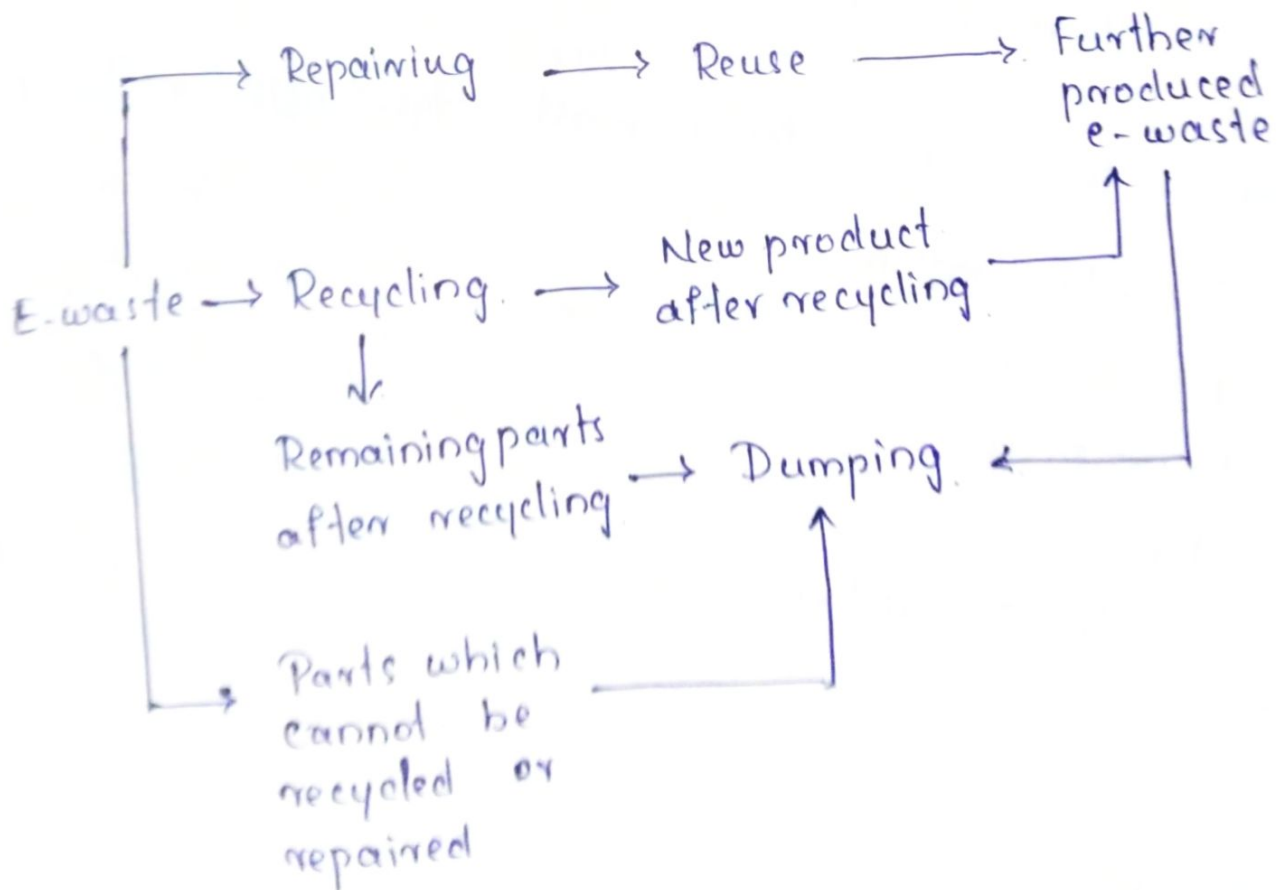
### Technology used for E-waste treatment in India:

- Decontamination.
- Dismantling
- Hammering.
- Shredding.
- Density separation.

## E-Waste Management :

E-Waste management includes the following activities.

- Collection of E-waste.
- Sorting of E-waste.
- Processing of E-waste.
- Repairing of E-waste.
- Recycling
- Dismantling
- Component Recovery from E-waste.
- Residual disposal of E-waste.



Landfill / Burying:

- It refers to disposal of waste by burying it.
- It is an extended storage area for non-biodegradable waste.
- Landfill is an area that prevents contamination of the surrounding areas like soil or water from the buried waste.
- It also helps in reducing bad odour & pests.

Incineration:

- It involves burning of solid waste in a furnace under controlled temperature conditions.
- In this process the combustible waste burns in presence of oxygen to form  $CO_2$  &  $H_2O$  that is released in the atmosphere.
- Incinerators do give off much heat while burning the waste.
- They reduce the volume of waste by about 20% to 30% of the original volume.

## Biomedical Waste:

Biomedical waste is solid waste generated during the diagnosis, testing, treatment, research or production of biological products for humans or animals.

- WHO estimates,
  - 85% of hospital waste is non-hazardous
  - 10% is infectious.
  - 5% is non-infectious but consists of hazardous chemicals like methyl chloride & formaldehyde.

## Sources of Biomedical Waste:

- \* Major Sources: Hospitals, labs, Blood banks, Nursing homes, Mortuaries, Autopsy centers, Animal/medical research centers.
- \* Minor Sources: Clinics, Dental clinics, Home care, Funeral services, Paramedics.

## Components of Bio-medical waste:

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1. Human anatomical waste (tissues, organs, body parts etc.)
2. Animal waste (as above, generated during research / experimentation, from veterinary hospitals etc.).
3. Microbiology and biotechnology waste, such as laboratory cultures, micro-organisms, human and animal cell cultures, toxins etc.
4. Waste sharps, such as hypodermic needles, syringes, scalpels, broken glass etc.
5. Discarded medicines.
6. Wastes such as dressing, bandages, plaster casts, material contaminated with blood etc.
7. Solid wastes - disposable items like tubes, catheters etc.
8. Liquid waste generated from any of the infected areas.
9. Incineration ash
10. Chemical waste.

## Health hazards of Bio-medical waste:

1. Injury from sharp objects to staff & waste handlers associated with the health care establishment.
2. Hospital acquired infection (HAI) from patients due to spread of infection.
3. Risk of infection outside the hospital for waste handlers / scavengers and eventually general public.
4. Occupational risk associated with hazardous chemicals, drugs etc.
5. Unauthorized repackaging & sale of disposable items & unused / date expired drugs.

## Classification of Biomedical Waste:

1. Infectious waste
2. Pathological waste.
3. Sharps.
4. Pharmaceutical waste
5. Genotoxic waste
6. Chemical waste.
7. Wastes with high content of heavy metals.
8. Pressurized containers.

## Disposal of Yellow colour Bags:

- ① Yellow Bags: Type of waste collected is.:
- Human, animal, anatomical waste.
  - Chemical waste.
  - Expired cytotoxic drugs.
  - Discarded mattress, contaminated with blood or body fluid.
  - Microbiology, Biotechnology & other clinical laboratory waste.

Treatment & disposal option ⇒ Incineration / Plasma pyrolysis / deep burial.

- ② Red Bags: Contaminated disposable items
- Treatment → Autoclaving or microwaving  
shredding or mutilation or  
combination of sterilization &  
shredding.
- Plastic waste should not be sent to landfill sites.

3) White bag: Waste sharps including metal.

Treatment: Autoclaving or dry heat sterilization

4) Blue bag: Glassware & Metallic Body implants.

Black bag:  
Treatment:

Treatment: Disinfection (by soaking the washed glass waste after cleaning with detergent & sodium hypochlorite treatment).

Unsafe disposal of Biomedical waste can lead to.

1. Infections
2. Chemical toxicity.
3. Radioactivity Hazard.
4. Physical Injuries
5. Cytotoxicity & Genotoxicity.

Biomedical waste treatment technologies:

1. Incineration Technology.
2. Non-Incineration Technology.
3. Autoclaving.
4. Chemical methods.
5. Microwave Irradiation.
6. Plasma Pyrolysis.