# UNIT I: Solid Waste & Principles

## Solid Waste - Definition

• Unwanted or unusable substances discarded after primary use

• Generated from human & animal activities

• Impacts health & environment

## Types of Solid Waste

• Hazardous Waste in Home: combustible, poisonous, corrosive, reactive

• Construction/Demolition Debris: bricks, concrete, timber, glass

• Industrial/Commercial Waste: chemicals, plastics, metals

• Medical Debris: pathological waste, sharps, infectious materials

• Electronic Waste: contains lead, mercury, cadmium

• Discarded Oil: contaminated lubricants, coolants

## Sources of Waste

• Industrial: factories, chemical plants, metals

• Commercial: schools, offices, markets

• Domestic: kitchen waste, leaves, peels

• Agricultural: cattle waste, husk, pesticides

## 4R Principle

• Reduce: minimize unnecessary use, choose durable items

• Reuse: use items again without altering form

• Recycle: convert waste into new products

• Recover: reclaim useful materials/energy

## 3R Principle

• Reduce: buy in bulk, compost, opt for digital docs

• Reuse: donate, repurpose, repair

• Recycle: paper, metals, plastics into new products

# UNIT II: Waste Collection, Storage & Transfer

## Waste Segregation at Source

• Sorting waste where generated

• Biodegradable, Dry, Domestic Hazardous

• Mandated by SWM Rules 2016

## Collection & Storage

• Source-separated vs. comingled waste

• Storage containers: inert, covered, durable, smooth surface

• Types: stationary, hauled/movable, communal

## Collection Systems

• Hauled Container System: hoist truck, tilt frame, trash trailer

• Stationary Container System: manual or mechanical loading

## Transfer Stations

• Intermediate facility between collection & disposal

• Small (<100 t/day), Medium (100-500 t/day), Large (>500 t/day)

• Functions: segregation, size reduction, treatment

## Hazardous Waste Handling

• Label: hazard warning, owner info, waste type

• Chemical Waste: PPE, labelled storage

• Pesticides: store in original containers

• Paints/Solvents: sealed containers, no drains

• Batteries: recycle safely

• Medical Waste: sharps containers, follow OSHA rules

## Transfer Station Technologies

• Open top trailers, Surge Pit, Stationary Compactors

• Pre-compactor (walking floor), Balers

• Intermodal containers for sealed transport

# UNIT III: Waste Processing & Regulations

## Waste Processing Technologies

• AI-powered sorting: better recycling rates

• Smart bins with IoT: optimize collection

• Waste-to-energy: electricity & heating

• Mechanical Biological Treatment (MBT): sorting + stabilization

• Anaerobic Digestion: biogas production

## Volume Reduction

• Mechanical: compaction at vehicles, stations, landfills

• Thermal: incineration, gasification (reduce >90% volume)

## Composting

• Decomposes organic waste aerobically

• Produces humus-like compost, nutrient-rich

• Benefits: reduces landfill load, improves soil

## Vermicomposting

• Earthworms digest organic matter into vermicasts

• Bed method, Pit method

• Pros: improves soil fertility

• Cons: time-consuming, odor, pest issues

## Termigradation

• Termites degrade plastics, lignin

• Gut microbes break complex substances

• Environmental friendly, no toxins

## Fermentation

• Anaerobic: biogas

• Aerobic: composting, biofertilizers

• Solid-state: biofuels, biochemicals

• Benefits: waste reduction, energy, nutrient recovery

## Regulatory Aspects

• MSW Rules 2000, SWM Rules 2016

• Specialized rules for hazardous, biomedical, plastic, e-waste