

Introduction to Waste Management

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Key concepts, objectives, and practical approaches

1. What Is Waste Management?

Aspect	Description
Definition	The systematic collection, transport, processing, recycling or disposal of waste materials to protect public health and the environment.
Scope	Includes solid waste (household, industrial, hazardous), liquid waste (sewage, industrial effluents), and gaseous waste (emissions).
Goal	Minimize waste generation, maximize resource recovery, and ensure safe final disposal.

2. Why Waste Management Matters

1. **Public Health** – Reduces disease vectors (e.g., rodents, insects) and exposure to toxic substances.
 2. **Environmental Protection** – Prevents soil, water, and air contamination; mitigates greenhouse gas emissions.
 3. **Resource Conservation** – Recovers materials (metals, plastics, organics) that can replace virgin resources.
 4. **Economic Benefits** – Creates jobs in collection, recycling, and treatment; reduces landfill costs.
 5. **Legal Compliance** – Meets national regulations and international agreements (e.g., Basel Convention).
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3. Waste Hierarchy – Prioritizing Actions

1. Prevention
2. Minimize
3. Reuse
4. Recycle / Recover

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5. Energy Recovery

6. Disposal (landfill/incineration)

- **Prevention:** Design products and processes that generate less waste.
 - **Minimize:** Optimize material use, improve efficiency.
 - **Reuse:** Extend product life (e.g., refillable containers).
 - **Recycle/Recover:** Separate and process materials for new products.
 - **Energy Recovery:** Convert non-recyclable waste to heat, electricity, or fuel.
 - **Disposal:** Last resort; secure landfills or controlled incineration.
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4. Types of Waste & Typical Management Methods

Waste Type	Characteristics	Common Management Techniques
Municipal Solid Waste (MSW)	Household and commercial trash	Source separation ? recycling ? composting ? landfill
Industrial Waste	By-products of manufacturing	Process redesign ? material recovery ? treatment plants
Hazardous Waste	Toxic, flammable, corrosive, reactive	Segregation ? secure storage ? treatment (neutralization, incineration)
Organic Waste	Food scraps, yard trimmings	Composting, anaerobic digestion, biogas production
Electronic Waste (e-waste)	Discarded electronics	Specialized collection ? dismantling ? material recovery
Construction & Demolition (C&D) Waste	Concrete, wood, metals	Deconstruction ? recycling (aggregate, lumber)
Medical Waste	Pathogenic, sharps, pharmaceuticals	Autoclaving, incineration, safe landfill

5. Core Components of a Waste Management System

1. Generation Assessment

- Quantify waste streams (weight, composition).

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- Identify hotspots for reduction.

2. Collection & Transportation

- Design efficient routes.
- Use sealed containers for hazardous streams.

3. Sorting & Separation

- Manual, mechanical (e.g., trommels, magnets), or optical sorters.
- Goal: maximize recyclable fraction.

4. Treatment & Recovery

- Physical (screening, shredding).
- Biological (composting, anaerobic digestion).
- Thermal (incineration with energy recovery).
- Chemical