Environmental Engineering – Module 5: Solid Waste Management

1. Municipal Solid Waste (MSW)

Definition and Sources

- Solid waste generated from residential, commercial, institutional, and community activities.
- Includes everyday items like food scraps, paper, plastics, metals, glass, textiles, and yard trimmings.

Composition of MSW

- Varies by location, season, and socioeconomic factors.
- Typical composition includes:
  - Organic matter (40–60%)
  - Paper and cardboard (10–15%)
  - Plastics (10–15%)
  - Glass, metals, textiles, wood, inert materials

Chemical and Physical Parameters of MSW

- **Moisture content:** Affects decomposition and combustion.
- **Calorific value:** Important for incineration potential.
- **pH:** Usually neutral or slightly alkaline.
- **Density and bulk density:** Important for transport and landfill design.
- **Biodegradability:** Proportion of organic degradable content.

2. MSW Management

Collection

- Manual, semi-mechanical, or mechanical systems.
- Door-to-door collection, communal bins, and containerized systems.
- Collection frequency is critical for sanitation and odor control.

Transport

- Compactors, open trucks, closed refuse vehicles.
- Designed to minimize spillage, odor, and pests.
- Route optimization for cost and efficiency.

Treatment

- Physical processing: Sorting, shredding, baling.
- Biological treatment: Composting, anaerobic digestion.
- Thermal treatment: Incineration, pyrolysis, gasification.
- Recycling and resource recovery.

Disposal

- Landfilling (sanitary landfills preferred).
- Controlled dump sites are less desirable due to environmental hazards.
- Open dumping is banned or discouraged.

3. Special Solid Waste

Commercial Establishments and Other Urban Areas

- Paper, packaging, food waste, plastics from offices, markets, shops.

Construction and Demolition Waste

- Concrete, bricks, wood, metals, plastics.
- Often bulky, inert but may contain hazardous substances.

Biomedical Waste

- Infectious, pathological, sharps, pharmaceuticals.
- Requires special handling, segregation, treatment (e.g., incineration, autoclaving).

4. Effects of Solid Waste on Environment

Air Pollution

- Odor, emission of methane and other greenhouse gases due to decomposition.
- Particulate matter and toxic gases from open burning or incineration.

Soil Pollution

- Leachate infiltration contaminates soil.
- Heavy metals and pathogens pose risks to soil health.

Water Pollution

- Leachate contaminates surface water and groundwater.
- Nutrient loading causing eutrophication.

Health Hazards

- Breeding grounds for vectors (flies, rodents).
- Exposure to pathogens, toxic chemicals causes diseases.

5. Disposal of Solid Waste

Segregation

- Separation at source into biodegradable, recyclable, inert, hazardous.
- Facilitates recycling and reduces disposal volume.

Reduction at Source

- Minimizing waste generation through improved product design and consumer habits.

Recovery and Recycling

- Reuse of materials (paper, metals, glass).
- Material recovery facilities (MRF) sort and process recyclables.

Integrated Solid Waste Management (ISWM)

- Combines waste reduction, reuse, recycling, treatment, and disposal.
- Optimizes environmental, economic, and social objectives.
- Stakeholder participation and regulatory framework are vital.

6. Hazardous Waste

Definition and Nature

- Waste posing substantial or potential hazards to human health or environment.
- Examples: Chemicals, heavy metals, toxic sludge, batteries, electronic waste.

Types of Hazardous Waste (as per regulatory authorities like CPCB and Hazardous Waste (Management & Handling) Rules)

- Explosive, flammable, toxic, corrosive, reactive wastes.
- Waste from industries, hospitals, laboratories.

Regulation and Management

- Identification and classification as per Hazardous Waste Schedules.
- Required special treatment, handling, transport, and disposal (e.g., secured landfills, incineration).
- Licensing and monitoring of hazardous waste facilities.

If you want, I can prepare detailed notes, design examples, or case studies on any of these subtopics. Just let me know how to proceed!