# Module 5: SOLID DISPOSAL

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Lecture 1

Municipal and Solid Waste Disposal
MUNICIPAL SOLID WASTE

Municipal Solid Waste (MSW) is waste collected by or on behalf of a local authority. It mostly comprises of household waste, although it may also include some commercial and industrial wastes. MSW is more commonly known as trash or garbage, and it consists of everyday items such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries.

Some facts & figures [1]

- In India, collection, segregation, transportation, and disposal of solid waste are often unscientific and chaotic. Uncontrolled dumping of wastes on the outskirts of towns and cities has created overflowing landfills, which have environmental impacts in the form of pollution to soil, groundwater, and air, and also contribute to global warming [2, 3]
- About 0.1 million tonne of municipal solid waste is generated in India every day. That is approximately 36.5 million tonne annually.
- Per capita waste generation in major Indian cities ranges from 0.2 kg to 0.6 kg.
- Difference in per capita waste generation between lower and higher income groups range between 180 to 800 g per day.
- The urban local bodies spend approximately Rs. 500 to Rs. 1500 per tonne on solid waste for collection, transportation, treatment and disposal. About 60-70% of this amount is spent on collection, 20-30% on transportation and less than 5% on final disposal.
- Calorific value of Indian solid waste is between 600 and 800 kcal/kg and the density of waste is between 330 and 560 kg/m³.
- Out of the total MSW collected, on an average 94% is dumped on land and 5% is composted.
- Between 2000 and 2025, the waste composition of Indian garbage will undergo the following changes:[4]
  - Organic waste will go up from 40 percent to 60 percent
  - Plastic will rise from 4% to 6%
  - Metal will escalate from 1% to 4%
  - Glass will increase from 2% to 3%
  - Paper will climb from 5% to 15%
o  Others (ash, sand, grit) will decrease from 47% to 12%

Common problems associated with unsound MSW disposal

• The disposal of solid waste has always been a huge problem throughout India. The overwhelming majority of landfills in India are open dumps without leachate or gas recovery systems. Several are located in ecological or hydrologically sensitive areas. They are generally operated below the standards of sanitary practice. Municipal budgetary allocations for operation and maintenance are always inadequate [5]
• Careless and indiscriminate open dumping of wastes creates unsightly and unsanitary conditions within municipalities e.g. along the roads and highways [6]
• Delay in delivery of solid wastes to landfills (which are in fact dump sites), resulting in nuisance dumps and unpleasant odours which attract flies and other vectors. Such dumps also lead to pollution of land/soils, ground and surface water through leachate and air through emission of noxious and offensive gases.
• Open solid waste dumps can also be a public health risk. Direct contact with refuse can be dangerous and unsafe to the public, as infectious diseases such as cholera and dysentery can be spread through contact with these wastes. In most municipalities, scavenging on refuse dumps is a common practice, and such people face danger of direct exposure to hazardous waste. Open solid waste dumps can also provide suitable breeding places for vermin and flies and other disease vectors, and can also contain pathogenic micro-organisms [6].
• Some categories of solid wastes block permeability of soils and drainage systems, including water courses, open drains and sewers, thus posing difficulties in the functioning and maintenance of such facilities;
• Due to the capital-intensive nature of solid waste handling and disposal operations, these can become an economic burden and constrain service delivery in other areas such as medical care, education and road construction.
Classification of MSW [7]

- MSW can be classified into recyclable waste, organic fraction, inert debris and hazardous waste.
- MSW can also be classified into "dry" and "wet" materials on the basis of their moisture content.
- From the perspective of energy recovery, the non-recyclable "dry" fraction can be divided into combustible materials such as paper, plastics and wood; and non-combustible or "inert" materials such as metals and glasses.
- Medical or clinical waste from medical institutions can be classified into the following types: general waste, sharp objects such as used needles, blades and scissors; syringes, pathological wastes, including contaminated bandages, dressings, linens, dead tissues, organs etc; and radioactive wastes [8].
- Some of the industrial wastes generated by industrial processes may be hazardous also.
- Biodegradable waste include mainly organic wastes such as peelings of potatoes, bananas, saw dust and water hyacinth dumped within the municipal environs, etc.
- Non-biodegradable waste, e.g. polythene bags (buvera), plastic products, pesticide residues, process wastes, highly flammable and volatile substances, furniture, abandoned vehicles, used tyres; industrial wastes including metal scrap and medical wastes such as used needles, plastic and glass bottles and syringes.

**Table 5.1.1. Classification of MSW.**

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<tr>
<th>Combustibles Wastes</th>
<th>Non-combustibles Wastes</th>
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<tr>
<td><strong>“Dry” Stream</strong></td>
<td><strong>“Wet” Stream</strong></td>
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<tr>
<td><strong>Paper:</strong> Corrugated Cardboard, Newspapers, All other papers</td>
<td>Food Waste, Grass/ Leaves, Brush /Prunings /Stumps, Disposable Diapers, Miscellaneous Organics</td>
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<tr>
<td><strong>Plastics:</strong> HDPE (clear &amp; colored), Films and Bags, PET, Polypropylene, polystyrene, PVC, All other plastics</td>
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<tr>
<td><strong>Other dry combustibles:</strong></td>
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<tr>
<td>Wood, Textiles, Rubber &amp;</td>
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STANDARD PROCESSES FOR MANAGING MUNICIPAL WASTE [7]

- **Incineration**: Energy is stored in chemical form in all MSW materials that contain organic compounds i.e. which can be used to generate electricity and steam. It is being done by a few major hospital for managing clinical wastes.

- **Composting**: The natural organic components of MSW (Food and plant wastes, paper, etc) can be composted aerobically to carbon dioxide, water, and a compost product that can be used as soil conditioner. Anaerobic digestion or fermentation produces methane, alcohol and a compost product.

- **Recovery/recycling**: Recovered paper, plastic, metal, and glass can be re-used. In the absence of formalized waste segregation practices, recycling has emerged only as an informal sector using outdated technology, which causes serious health problems to waste–pickers [9].

- **Land filling**: MSW materials that cannot be subjected to any of the above three method, plus any residuals from these processes (e.g. ash from combustion) must be disposed in properly desinged landfills. Almost all categories of waste may be disposed to better managed landfills directly. However, those types of wastes which will destroy the microbiological degradation processes within the landfill are unwelcome i.e. the non-biodegradable wastes. Management of these could include: incineration, recycling and reusing [10].

ENERGY RECOVERY FROM MSW

Energy recovery can also be achieved from different methods of managing waste including:

**Advanced Thermal Treatment** - production of electricity and/or heat by the thermal treatment decomposition of the waste and subsequent use of the secondary products (typically syngas)

**Anaerobic digestion** – production of energy from the combustion of the biogas which is produced from the digestion of biodegradable waste

INTEGRATED SOLID WASTE MANAGEMENT [12]

Integrated solid waste management (ISWM) takes an overall approach to create sustainable systems that are economically affordable, socially acceptable and environmentally effective.

- **Economic affordability** requires that the costs of waste management systems are acceptable to all sectors of the community including householders, commerce, industry and government.
- **Social acceptability** requires that the solid waste management system meets the needs of the local community, and reflects the values and priorities of that society.
  - **Environmental effectiveness** requires that the overall environmental burdens of managing waste are reduced both in terms of consumption of resources (including energy) and the production of emissions to air, water and land [13].
  - The collection and sorting are at the epi-centre of any solid waste management system [5]. After this, various systems analysis techniques can be applied to handle MSW streams through a range of integrative methodologies. The methodologies are broadly classified as:

1) **System engineering models** including cost-benefit analysis (CBA), forecasting models (FM), simulation models (SM), optimization models (OM), and integrated modeling system (IMS), as well as
2) **System assessment tools** including management information system (MIS)/decision support system (DSS)/expert system (ES), scenario development (SD), material flow analysis (MFA), life cycle assessment or life cycle inventory (LCA or LCI), risk assessment (RA), environmental impact assessment (EIA), strategic environmental assessment (SEA), socioeconomic assessment (SoEA), and sustainable assessment (SA) [5].

Use of above methodologies facilitates the selection of the most appropriate waste management technologies and design of sustainable solid waste management systems. A range of treatment options including [13] materials recovery, biological treatment (composting/biogasification), thermal treatment (mass-burn incineration with energy recovery and/or burning of Refuse Derived Fuel (RDF) and land filling may additionally required to form an ISWM system. Implementation of appropriate solid waste management practices requires reliable waste statistics. The data should represent a sufficiently long time frame (usually more than a few years), with relatively short measurement frequencies, to be statistically acceptable [14].
REFERENCES


