Solid Waste Management

Facilitator:

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Specific Learning Objectives

- At the end of session, the learner shall be able to know about:
- Solid waste
- Methods of Solid Waste Disposal in an Urban Area
- Methods of Solid Waste Disposal in an Urban Slum
- Methods of Solid Waste Disposal in an Rural Area

Introduction

- Solid wastes include materials
  - not economically useful,
  - present in solid, liquid or gaseous form,
  - originate from a wide range of human operations
    - such as industry, commerce, transport, agriculture, medicine and domestic activities.

Solid wastes

- contains food waste, demolition products, dead animals, manure and other discarded material
- should not contain nightsoil.
- output depends on the degree of urbanisation, dietary habits, lifestyles and living standards.
- between 0.25 to 2.5 Kg per capita per day.

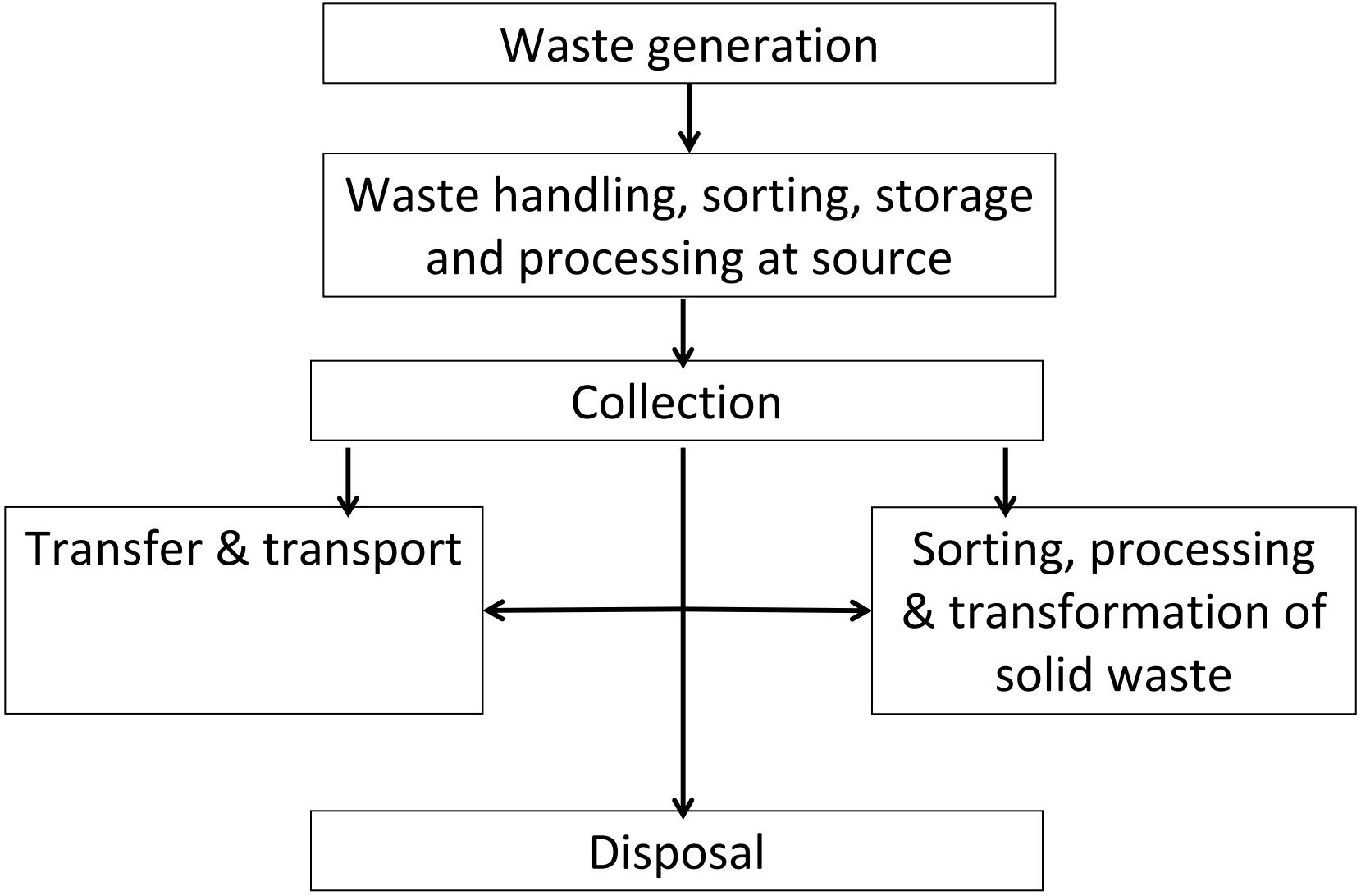
Environmental impact of solid waste disposal

- Contamination of ground water.
- Surface water contamination.
- Aesthetically unpleasant and generates foul odour.
- Generation of inflammable gas such methane and green house gases inside the waste dump.
- Fly breeding, attracts rodents and pests.
- Transmission of disease through pests, stray animals and cattle

Classification of Solid wastes

- Street refuse
- Market refuse
- Industrial refuse
- Stable litter
- Rubbish
- Ash
- Garbage

Activities associated with Solid Waste Management



Solid Waste Disposal in an Urban Area

- Higher density of population.
- Diverse kinds of waste material from their domestic, commercial and industrial professions/establishments.
- Major constituent of waste is putrescible organic matter
  - with the balance of the content comprising of metal, glass, ceramics, plastics, textiles, dirt and wood in proportions depending on the local factors.
- The most ideal arrangement for collection of solid waste in an urban area would be door-to-door collection of waste material by a team of waste handlers.
  - However this is not practicable in all places in the cities especially in the urban slums.

Sorting

- ‘separation and storage of individual constituents of the waste materials’.
- helps in removing the material, which needs to be recycled and ensures that the hazardous wastes are handled separately.
- assists in minimising the waste and ensures reduction in landfill space for final disposal.

- Sorting could be carried out at household level, at the municipal bin, central sorting facility, waste processing site or the landfill site.
  - Informal recycling trade middlemen '*kabariwallah'*
  - Rag pickers
  - Wholesale dealer
  - Recycling factory

- Sorting could be carried out manually or by semi-mechanised or fully mechanised systems.

Storage

- Every establishment generates waste that it needs to be stored safely prior to giving it for collection.
- If do not maintain receptacles of adequate size for storage of waste, the solid waste lies overflowing the bins or littering the streets causing public nuisance.
- In some instances the waste generated is simply thrown out to the streets for the municipal sweeper to sweep it up.
- At worst the wastes may be thrown into the municipal sewers or drains, which end up blocking them and obstructing the flow of water in them.

- It is therefore essential at first to educate the people to
  - Store waste at source (type and size of waste bins with cover lid),
  - Dispose waste as per directions of the local bodies and
  - Effectively participate in the activities of local authorities to keep the cities clean.

- It needs to be emphasised that the recyclable wastes should be kept separate from the organic matter capable of decomposition.

Collection of waste

- The next essential step in waste management is primary collection of waste matter.

- A daily waste collection service should be provided to all sources of generation for collection of putrescible organic waste from the doorstep because of the hot climatic conditions of the country.

- Recyclable material can be collected at longer intervals as this waste does not normally decay and need not be collected daily.

- Domestic hazardous waste is produced occasionally hence needs to be collected less frequently and could be disposed off by the community in central bins kept for the purpose.

- ***Waste storage depots (secondary) :***
- Temporarily stored till the time they are taken to the final disposal site.
  - Cement-concrete-cylindrical bins, masonry bins, metal rings or open sites for storage of wastes.
- Temporary waste storage depots, which synchronize with primary collection and transportation system, are required to be located at suitable sites in a municipal area.

Disposal of solid waste

- Solid waste disposal in developing countries is carried out by:
  - filling up land sites.
  - incineration
  - composting.

- The choice of disposal method depends on the economic considerations, availability of land, local labour and circumstances.
- Some of the technologies in use in these countries include sanitary landfill, incineration, composting, biogas plant, Effective Microorganisms technology and salvaging.

Dumping

- In the low-lying areas or open tracts of lands, usually by the roadside.
- Disadvantages:

➢ Dispersed by the wind to nearby places, attracting rodents, insects and birds causing a risk of transmission of diseases and encouraging breeding of flies.

➢ Emits foul odours and is an aesthetic nuisance.

➢ Malodorous fumes and the toxic gases, which are emitted due to burning of wastes such as plastics and other materials.

➢ Accessible to animals and scavengers or rag pickers.

➢ The drainage from these dumps contributes to the pollution of surface and ground and the soil around.

Landfill (Controlled tipping)

- Method of selecting depressed areas or creating artificial trenches where waste matter is thrown and compacted with a layer of earth on top of it.
- Differs from dumping in that if properly carried out, it reduces the nuisance of foul odour, menace of flies, rodents and animals, prevents any dispersal of the waste matter, protected from scavengers, soil, water and air pollution is avoided.
- The reclaimed land could be utilised for growth of vegetation or parks after a period of time.
- Suitable if adequate land is available, within the economic range of the waste source.

- Some of the points which should be remembered while selecting a site for landfill are :

- Waste site should not be subject to flooding easily
- Deep sands with shallow water tables should be avoided, to prevent seepage of toxic wastes into the drinking water
- Fractured limestone soils, humid areas or wetlands with easy percolation should be avoided.
- Soil with pH 6.5 or above should be chosen such that the metals such as cadmium, mercury, lead, chromium and copper are less soluble in the subsoil water and reduce the chance of pollution.

Sites

1. **Trenches** - long trenches of 2 to 3 m depth and 4 to 12 m width are dug and the refuse is compacted and covered with excavated earth.

2. **Ramps or slopes** - where moderately sloping lands are selected and soil is excavated for compacting purposes.

3. **Unused areas** - such as disused quarries, pits and land depressions wherein the solid waste is packed and consolidated in uniform layers using mechanised equipment.

Process of disposal

- The refuse or solid waste is collected and deposited in these sites using bulldozers or crawler type tractor. In trenches the filling takes place from the farthest end.

- Each layer is upto 2 to 2.5 m deep. At the end of the day or as per the desired frequency the top of the refuse is layered with earth of at least 30 cms thick using mechanised equipment and evenly levelled.

- The mass is covered with fast growing shrubs.

- Over a period of time due to physical, chemical and biological processes in the buried waste matter, heat is generated and anaerobic decomposition of the organic matter takes place, which also destroys pathogens.

- Thereafter the process cools down and the waste is converted into an innocuous mass by the end of six months of burial.

- The land could thereafter be used as a green belt or parks could be developed on it.

Caution !

- Methane gas is generated during the decomposition of solid waste, which is explosive in nature.
  - This land should therefore not be used for construction purposes.
  - Vents could be created in the topsoil cover to release this gas.
- Dumping of bulky goods such as household equipment should be avoided. These goods could be recycled or incinerated.
- The method has a drawback that it requires soil cover, which has to be made available at all landfill sites.

Composting

- It is a method where in the combined disposal of solid waste is carried out along with stable litter, night soil and sludge.
- Compost is humus like material, which is generated due to the breakdown of organic matter under bacterial action,
- Rich manure.
- Thus the final product of degradation in composting has a recyclable component and the compost could be sold at a price to agriculturists.
- Composting uses aerobic method of digestion.

- **Pre-treatment :**
- The refuse or solid waste is pre-sorted to remove materials that could be recycled or have salvage value or those ones, which cannot be composted.
- It is thereafter ground to reduce the waste particle size and this improves the efficiency of decomposition process.

(a) Bangalore method

- Indian Council of Agricultural Research at the Indian Institute of Science, Bangalore.
- It is also known as the hot fermentation process due to the generation of heat in the process to decompose the waste.

- In this method long trenches are dug each with a depth of 1 m and width of 1.5-2.5 m.
  - Greater depths is not recommended since they delay the process of decomposition and therefore decrease its effectiveness.
- The refuse is then placed in the trench at the bottom making a layer of about 15 cms thick.
- Over this a layer of nightsoil is put to a depth of 5 cms.
- In this manner alternate layers of solid waste and nightsoil are layered one above the other till the heap rises 30 cms above the ground level.
- The top layer is recommended to be of refuse of about 25 cms thickness.
- Thereafter the heap is covered with excavated earth firm enough to not allow a person's legs to sink in the heap while walking.

- **Process :**
- The fermentation process begins in a week's time with generation of considerable amount of heat, which stays for 2 to 3 weeks.
- The organic mass is decomposed and pathogenic microorganisms are destroyed in the process, which is completed in 4 to 6 months.
- Gases such as ammonia, methane, carbon dioxide and nitrogen produced in the process are released into the atmosphere.
- The resultant manure is well-decomposed, odourless, innocuous material of high manurial value.
- The soluble material produced may leach into the underlying or surrounding soil or ground water.

(b) Mechanical composting

- It is a process in which the compost is manufactured in a short period of time with use of waste materials and night soil.
- A sorting is done in the initial stages and items such as rags, bone and metal pieces and glass, which are likely to interfere with grinding operation, are removed.
- The waste matter is then pulverised by mechanised equipment and thereafter mixed with night soil or sludge in a rotating machine.
- This mixture is then incubated under controlled conditions of pH, temperature and aeration.
- The compost is ready in 4 to 6 weeks time as humus like material with a total nitrogen, phosphorus and potassium content of 1 to 3 percent.
- The product thereafter is cured, blended with additives, bagged and marketed.

(c) Vermicomposting

- It is a method of disposal of kitchen and plate wastes, which serves the dual purpose of disposing off the garbage as well as proving eco-friendly.
- Here a suitable area is chosen which is bound by a 2 to 3 feet high brick wall and few hundred earthworms are introduced in it.
- The waste is dumped in this area and water is sprinkled daily on this dump.
- The waste matter is broken down by the worms and compost, which could be used as bio-fertiliser, is produced in 2 to 3 months.

- The process does not generate any explosive gases or leachate and can be used in agriculture and organic farming.
- It enriches the soil due to the deep burrowing worms and bacteria in the organic matter.
- The process could generate green areas and is used in small scale disposal of waste matter.

- The process of vermicomposting has the advantage of dual disposal of nightsoil and solid waste in a manner that the end product could be reused as organically rich manure.
- However the process needs training of manpower who are required to handle the mixing and incubation of night soil with refuse and may generate hesitation on their part to be involved in the process.

Effective Microorganisms (EM) Technology

- This is a modern eco-friendly technology consisting of use of friendly microorganisms such as phototropic bacteria, lactic acid bacteria, Actinomyces and yeasts.
- These microorganisms are added to kitchen wastes in specially designed drums.
- The wastes are converted into compost, which can thereafter be utilised as manure.
- The EM solutions available commercially are classified into EM 1 and EM 2 categories depending on their shelf life, which varies from 30 days in the latter to 6 months in the former.
- EM technology also has the advantage of keeping the drains clean by decomposing the sewage and suppressing its bacterial content.

Incineration

- This is a process of disposal of solid waste material by thermal technology and has gained popularity in several developed countries.
- The incinerators use heat recovery process and also have air pollution controls.
- Incineration is also chosen in those places where suitable land mass is not available.

- Many industrialised countries are practising this method under strictly controlled environment, with appropriate training to the waste handlers.
- Waste generated in hospital premises is disposed off in this manner in most countries.
- Incineration of waste material is not a useful method for India because of the fair proportion of ash, which is contained in it.
- The ash contained in the refuse makes its combustion difficult.
- Hence pre-treatment of the waste material is required, which is expensive and requires heavy infrastructural outlay.
- Besides this incineration involves wastage of precious bio-fuels and deprives the communities of much needed manure.

Solid Waste Disposal in an Urban Slum

- a congregation of temporary or semi permanent structures
- most instances by illegal occupation of land
- low socio-economic strata, who are poorly educated and as a consequence show a lack of awareness regarding the hygiene and sanitation issues especially related to solid waste management.
- The slum dwellers use common toilets and bathing facilities, where the waste water or night soil is connected to the sewers or in certain instances to the larger storm water drains.

Disposal of solid wastes in the slums has the following peculiarities :

- Solid wastes mostly comprise of used bottles, tins, plastics and ashes, since most of the salvageable items are recycled.
- Animal manure and feeds are a significant part of solid wastes from slums since small farm animals co-habit with humans.
- Vegetable peels and kitchen wastes are discarded in large quantities while the food product packages are not usually a part of the waste matter.
- Sometimes small-scale industries give rise to hazardous or toxic chemicals such as from the dyeing and tanning industries. Some industries are also engaged in recycling of goods salvaged from the refuse bins. Hence the wastes from these places need to be disposed off properly.

- There is no existing system of door-to-door collection of waste items. The people in the slum community deposit their garbage in the public bins located centrally.
- The roads/paths in the slums are narrow, hence the refuse lorries are unable to negotiate the paths and therefore the waste bins are placed at fewer points.
- The wastes from these bins require more frequent emptying to prevent waste matter to spill over in the ground below and create nuisance.
- Adequate sorting of the wastes take place in the bins located in the slum localities, hence the remaining waste meant for final disposal is non-recyclable matter.

Waste Disposal

- Waste disposal in slums in carried out in the same manner.
- The waste bins are placed at the pre-determined points.
- The wastes are collected at these sites from the households and these are thereafter taken to the disposal area.
- Sorting of the wastes is carried out by the rag-pickers at the municipal bins and the recyclable material salvaged by them is sold to informal middlemen.
- The remaining wastes comprise of non-recyclable material, which is easily decomposed by the processes such as sanitary landfill, composting or incineration or any modern day technology.

Solid Waste Disposal in Rural Areas

- comprise of villages and some temporary nomadic settlements or camps.
- Waste generated in the rural areas is lesser in quantity compared to urban wastes.
- It consists primarily of organic matter from the households or the rural industry such as vegetable peels, crop wastes, manure, fodder, animal feeds, ash and lesser quantities of tins, bottles or paper unless there is a particular industry located in the rural area.
- Majority of the recyclable wastes are salvaged before disposal to be used in households.

- No system of organised collection and disposal of refuse
- Temporarily deposited in a pit or a bin to be disposed later by burning or dumping outside the village or is thrown around indiscriminately.
- The waste ends up polluting the nearby soil, water and air and at times hazardous wastes from small industries could be harmful to the human life.
- The local self-governing bodies or the Panchayati Raj Institutions are responsible for maintenance of hygiene and sanitation in the rural areas and they influence the methods of waste disposal.

Methods of waste disposal

(a) Manure pits :

- This method of waste disposal could be practised by the individual households in the rural areas.
- Pits could be dug near the house and the wastes such as kitchen wastes, cattle dung, fodder or animal feeds, leaves could be thrown into them.
- Two such pits could be dug simultaneously of 1 to 1.5 m and used one at a time.
- When one pit is filled up it is covered with a top layer of soil and compacted.
- In 5 to 6 months time, the wastes are decomposed and converted into manure, which could be returned to the fields.

(b) Burial :

- Burial method of disposal is suitable for disposal of refuse of the village or small settlements.
- This could be undertaken in an area if sufficient land is available.
- The method is similar to sanitary landfill and the involves digging a trench 2 m deep and 1.5 m wide in which the refuse from the village or camp is deposited and at the end of the day the refuse is covered with 20 to 30 cms of earth.
- The disposal continues in this manner till the time the level in the trench is 40 cms from ground level, when the trench is filled and compacted and a new trench is dug out.

- The waste matter is decomposed in 4 to 6 months time when it can be taken out and used as manure in the fields.
- A trench of this size and 1 m long would suffice for 200 persons for a week.

- **(c) Biogas plant:**
- The animal excreta generated in the rural areas are fairly large in quantity and could be utilised to generate bio-fuels and thus be recycled.
- In the rural areas this excreta is mixed with straw to make dung cakes which are used as fuel for cooking purposes.
- Animal excreta also carry an enormous potential of fly breeding and thus its sanitary disposal is required. This could be achieved by disposing them in bio-gas plants or through landfills or by composting.

- Community participation is the key to ensure success in the implementation of solid waste disposal.
- To ensure that community participation is optimum, strong and sustained Information, Education and Communication (IEC) programme needs to be adopted.
- The acts and rules governing the disposal of solid wastes in India, published by the Ministry of Environment and Forests are:
  - Environment (Protection) Act 1986,
  - Bio-Medical Waste (Management and Handling) Rules 1998
  - Municipal Wastes (Management & Handling) Rules 1999.