Internal Assesment Test - I

SOLID WASTE MANAGEMENT(15CV651)

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1. **Sources of Solid wastes:**

Sources of solid wastes in a community are in general related to land use and zoning. One method of classification is as follows:

1. Residential
2. Commercial
3. Institutional
4. Construction and demolition
5. Municipal services.
6. Treatment plant site
7. Industrial and
8. Agricultural

The different types of solid wastes that are generated are as follows.

Garbage: The organic fraction of residential and commercial solid which consists of materials such as food waste that decompose rapidly especially in warm weather is called as Garbage. This is also known as putrescible waste.

Rubbish wastes:- Combustible and non-combustible solid waste, excluding food waste or other putrescible materials. Typically combustible rubbish consists of materials such as paper, card board, plastic, textiles, rubber, leather wood, Furniture and garden trimmings.

Non combustible rubbish consists of items such as glass, crockery, tin cans, Aluminum case, Ferrous and non Ferrous metals, dirt and construction waste.

Ashes and Residue: Materials remaining from burning of food, coal, coke and other combustible wastes. Residues from power plants normally are not included in this category. **Demolishing and construction waste**: Waste from residential buildings and other structures are classified as demolition waste. Waste from construction, remodeling and repairing of residential, commercial and industrial building and similar structures are classified as construction waste. These wastes may include dirt, stones, concrete, bricks, plaster and plumbing, heating and electrical materials.

Special wastes or Wastes from municipal services:-

Wastes such as rubbish, street sweepings, landscape and tree trimmings, catch basin debris, general wastes from parks and recreational areas. It also includes dead animals abandoned vehicles.

Treatment plant waste: The solid and semisolid waste from water, water and industrial waste treatment facilities are included in this classification treatment plant wastes mainly consists of residual sludge.

Industrial solid waste: These wastes arise from industrial activities and include rubbish, ashes, demolition waste.

Sources of municipal solid waste:

General Sources of MSW:

Sl No	Source	Typical facilities, Activities or locations where waste are generated	Types of Solid waste
1	Residential	Single family, Multi family dwellings, low, medium and high raise apartments etc	Food waste, rubbish, ashes, special wastes
2	Commercial	Stores, restaurants, Markets, office buildings, hotels, print shops, Auto repair shops, Medical facilities, Institutions etc.	Food waste, rubbish, ashes, demolition and construction waste special waste,etc
3	Open areas	Street, parks, playground, vacant plots, beaches, highways, recreational areas etc.	Special wastes, rubbish.
4	Treatment plant site	Water, waste water, Industrial treatment process etc	Treatment plant waste composed of residual sludge.

2. Different design components which are to be considered for aerobic composting.

(i)Particle size: For optimum results the size of solid waste should be between 25 and 75mm (1 to 3inch)Particle size influences the bulk density, internal friction and flow characteristcs and drag forces of materials. A reduced particle size increases the biochemical reaction rate during aerobic composting process.

(ii)Carbon-to-Nitrogen Ratio: Initial carbon to nitrogen ratios (by mass) between 20 and 30 are optimum for anaerobic composting. At lower ratios, ammonia is given off. Biological activity is impeded at lower ratios. At higher ratios, nitrogen may be a limiting nutrient.

(iii)Blending and Seeding: If the organic fraction of MSW contains significant amounts of paper or other substrates rich in carbon, other organic materials such as yard wastes, manure, or sludge from waste water treatment plants can be blended to produce a near optimum C/N ratio. Seeding involves the addition of a volume of microbial culture sufficiently large to effect the decomposition of the receiving material at a faster rate. Composting time can be reduced by seeding with partially decomposed solid wastes to the extend of about 1 to 5 percent by weight.

(iv)Moisture Content: The optimum moisture content for aerobic composting is in the range of 50 to 60percent. Moisture can be adjusted by blending the components or addition of water.

(v)Mixing/Turning: To prevent drying, caking and air channeling, material in the process of being composted should be mixed or turned on regular schedule. Initial mixing of organic wastes is essential to increase or decrease moisture content to an optimum level. Mixing is used to achieve a uniform distribution of nutrients and microorganisms. Turning of the organic material is important to maintain aerobic activity.

(vii)Temperature: For best results, temperature should be maintained between 122 to 130°F(50 and 55°C) for the first few days and between 131 and 140°F (55 and 60°C) for the remainder of the active composting period. If temperature goes beyond 151°C (66°C) biological activity is reduced.

(viii)Control of pathogens: If properly conducted, it is possible to kill all the pathogens, weeds, and seeds during the composting process. To do this, the temperature must be between 140 and 158°F(60 and 70°C) for 24 hour.
(ix)Air requirement: Air with at least 50 percent of the initial oxygen concentration remaining should reach all parts of the composting material for optimum results, especially in mechanised systems.
(x)pH Control: To achieve an optimum aerobic decomposition, pH should remain at 7 to 7.5 range. To minimize the loss of nitrogen in the form ammonia gas, pH should not rise above 8.5.
(xi)Degree of decomposition: The degree of decomposition can be estimated by measuring degree of self heating capacity, amount of decomposable and resistant organic matter in the composted material, rise in redox potential, oxygen uptake and starch-iodide test.
(xii)Land Requirement: The land requirements for a plant with a capacity of 50 ton/day will be 1.5 to 2 acres. The land required for a larger plant will be less on a ton/day basis.

3. **Types of collection systems**:
Based on their mode of operation collection system are classified into 2 categories.

a) Hauled container systems
b) Stationary container systems.

Hauled container system (HCS):
Containers used for the storage of wastes are hauled to the disposal site, emptied and returned to either their original location or some other location. Hauled containers systems are ideally suited for the removal of wastes from sources, where the rate of generation is high. In this system containers of different sizes and shapes can be used and the use of such large containers reduce handling time. Hauled container systems have the advantage of requiring only truck and driver to accomplish the collection cycle. These are three main types hauled container system:

1. **Hoist truck systems**: It is used for the collection of wastes by a collector who has a small operation and collects from only a few pick up points at which considerable amounts of wastes are generated.
2. **Tilt Frame container system**
3. **Trash – trailer systems**

Stationary container systems (SCS)
Stationary container system may be used for the collection of all types of wastes. The systems vary according to the type and quantity of wastes to be handled, as well as the number of generation points. These are two main types.
This system is not suited for the collection of heavy industrial wastes and bulk rubbish like construction and demolition waste.

System with manually loaded collection vehicles:- In this system the collector manually empties the contents of a container into a collection vehicle. The major application of this system is in the collection of residential wastes and litter. Manual methods are used for residential collection because many individual pick up points are inaccessible to mechanized self loading collection vehicle.

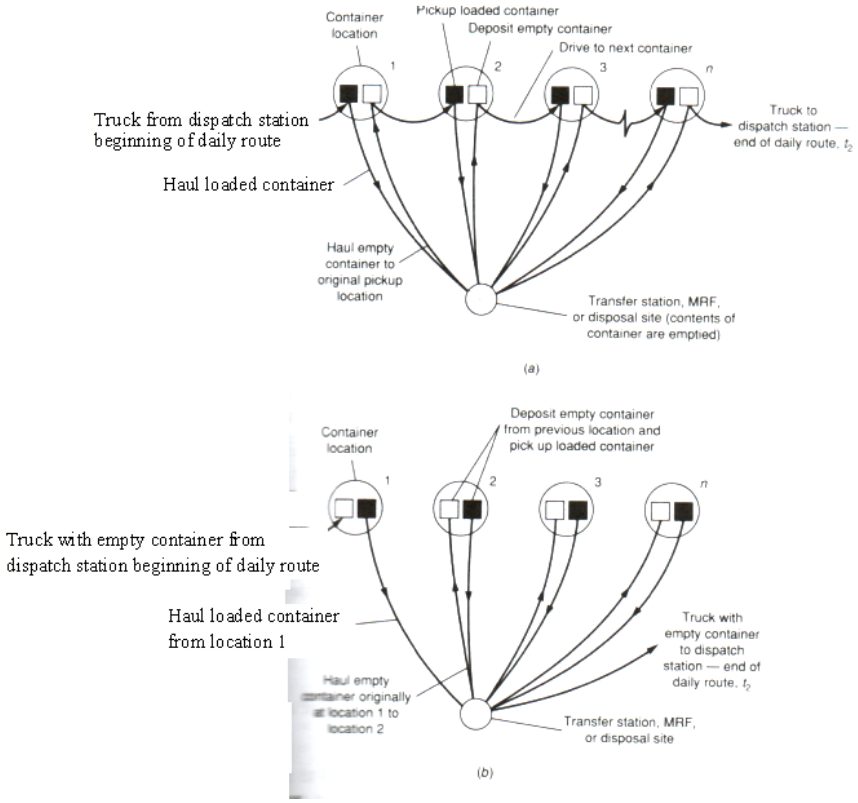

Figure Schematic of operational sequence for hauled container system a) conventional mode and b) exchange container mode

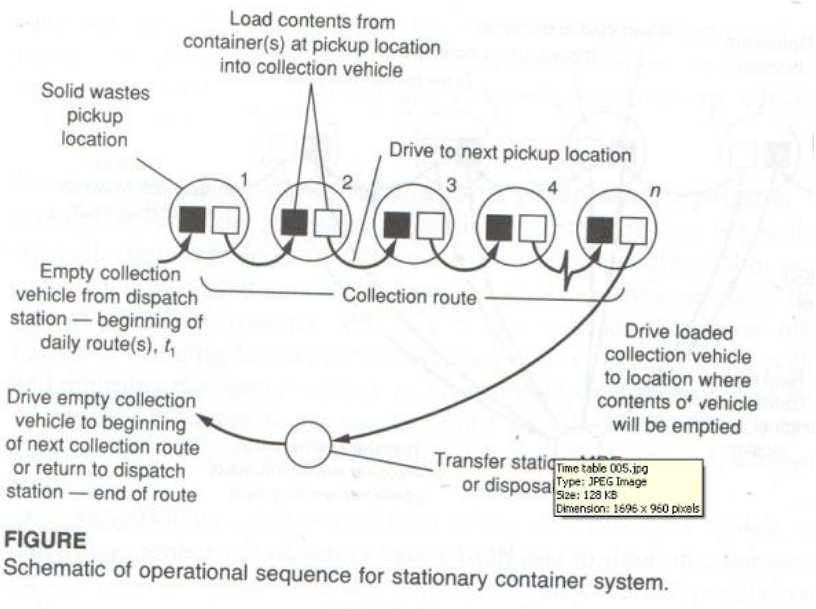

FIGURE
Schematic of operational sequence for stationary container system.

4. Calculation of total amount of Solidwaste **generation in a day.**

Total amount of Solidwaste generated = population x per capita Solidwaste generation

$= 50000 \times 360$

$= 18 \times 10^6$ g/day

$= 18 \times 10^3$ kg/day

II Calculation of volume of Solidwaste

Volume of Solid Waste $= V = \frac{\textbf{Total amount of SW}}{\textbf{Compacted density}}$

$$= \frac{18000\ \text{kg/day}}{504\text{kg/m}^3}$$

$$V = 35.71\text{m}^3/\text{day}$$

III Calculation of landfill area

Given that the average depth of compacted Solidwaste is 3m

Therefore total landfill area required for the municipality $= \frac{35.71}{3}$

Total landfill area $= 11.9\ \text{m}^2$

6. Factors that must be considered in the selection of a site for a sanitary landfill.

Factors	Remarks
Available land area	Site should have a useful life of more than five years (minimum value)
Haul distance	Length of the haul significantly affects the overall design and will have significant impact on operating cost.
Soil conditions and topography	Cover material must be available at or near the site.
Surface water hydrology	Impacts drainage requirements.
Geology and Hydrology conditions	Probably most important factor in landfill site, especially with respect to site preparation.
Climatological condition	Provision must be made for wet weather operation.
Local environmental conditions	Noise, odour and aesthetics
Ultimate use of site	Affects long term management for site.
Location restrictions	Restrictions apply with respect to siting land near Airports, wet lands, area with known faults, in seismic impact zone and in unstable areas.
Site access	As the number of operating landfills continues to decrease, new landfills are sited where roadways are accessible.

5.

Ans 5)

Total no of houses = 4000

Observation Period - 1 week

No of persons in each house = 5

Vehicle type	No of loads	Volume of vehicle (m^3)	Density (kg/m^3)	Weight (kg)
Compactor Truck	12	16	300	57600
Flat bed Truck	10	2.5	150	3750
				61350

Total weight of solid waste generated

= 61350 kg per week

Weight per day = $\frac{61350}{7}$ = 8764.29 kg/day

Per capita generation rate = $\frac{8764.29}{4000 \times 5}$

= 0.438 kg/capita/day