

**UNIT - 6**

**REFUSE COLLECTION AND DISPOSAL:** Garbage, Ash, Rubbish, Collection methods, Transportation, Disposal – salvaging, dumping, controlled tipping, incineration, composting, dung disposal – digester, biogas plant.

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**Garbage :** This consists of all sorts of putrescible organic waste from kitchens, hotels, restaurants, in the form of waste food articles, vegetable and fruit peelings. It is organic in nature and decomposes quickly. It normally weighs from 450 to 900 kg/m<sup>3</sup>. It should be handled carefully, because flies, insects, rats etc. breed in it.

**Ashes :** Ashes are incombustible waste products from houses, industries, hearths and furnaces. With the introduction of kerosene oil and cooking gas, its quantity is now gradually decreasing. It weighs between 700 to 850 kg/m<sup>3</sup>.

**Rubbish :** It consists of all non-putrescible wastes, excluding ashes. Common items that fall under this category are : rags, paper pieces, paper packets, glass and plastic bottles, broken pieces of glass, broken crockery, broken furniture and stationary items, card boards. It thus includes a wide variety of combustible and non combustible wastes.

**Organic Waste :** It includes dry animal and vegetable refuse, cow dung, excreta of birds, tree leaves, sticks, plastic bottles, paper waste, rags. This waste is subject to decay with time and evolve highly offensive odour and gases which are highly detrimental to health.

**Inorganic Waste:** This consists of non-combustible materials such as grit, dust, mud, metal pieces, metal containers, broken glass and crockery, tiles, waste building material. It is not subject to decay and is therefore not harmful to public health.

→ **Collection and Removal of Refuse :**

The frequency of collection of solid waste depends upon the quantity of the refuse and the season. Generally, refuse is collected in individual houses in small containers or cans kept outside the premises of the houses, from where it is removed daily by sweepers. Sometimes, public dust-bins are provided by the municipalities/local boards at convenient places by the sides of roads. Dry refuse fallen on the public streets and roads, along with road sweepings, are usually collected once or twice a day by the sweepers employed by the local authority. For this purpose, a portable galvanized iron receptacle with a closely fitting lid, and having a capacity of 0.02 to 0.1m<sup>3</sup> is generally used. The containers or cans used for refuse collection should be clean, without any dirt left in, otherwise fresh refuse gets seeded with the putrefactive organisms and start giving foul smell. The frequency of refuse collection is kept such that the refuse may not start giving nuisance by odour and fly breeding. The collection of refuse from the business areas should be done during non-working hours.

**Types of Collection :**

Residential solid waste may be collected and transported by any of the following methods :

**i. Curb (Kerb-side), Alley, and Backyard collection :**

In this system resident owner is responsible for carrying the solid waste from its storage location to curb / alley / backyard. From these curb or alleys collection crew will come and haul the waste in the truck. Crew will consist of one Driver and one or two Collectors. This is quickest and economical method of collecting refuse. And there will be no need to enter property.

**ii. Set-out, set back:**

In this method collectors have to enter property. Three crews are employed in this method namely: Set out crew, Collection crew and Set back crew. Set out crew carries full containers from resident storage location to curb/ alley before collection vehicle arrives. Where as Collection crew load their refuse into vehicle and Set-back crew return the empty container to storage area back.

**iii. House-to-house collection where refuse bags used in 20-30 liter bins.****TYPES OF COLLECTION AND TRANSPORT SYSTEMS:**

After collecting the refuse from each individual house it will be transported to the action site where all kinds of wastes are handled scientifically. There are two major collection and transport systems in practice :

1. Hauled Container System (HCS)
2. Stationary Container System (SCS)

**1. Hauled Container System (HCS) :**

In this hauled container system collection procedure starts with a empty truck leaves from the garage to the site and the filled container is hauled to disposal sites, emptied, and the empty container is again returned to original location or some other location. Then truck will go to another container location and haul filled container to disposal site and again empty container will be replaced back. Hence in this system truck has to cover twice distance for each collection point. At the end of the day work after replacing the last container to its original location the empty truck returns to its garage.

The vehicle employed for this system is Hoist truck which can handle Tilt frame container of 10 - 40 m<sup>3</sup> size. Some times Trash trailers are also used for heavy, bulky rubbish (construction, commercial, usually open top container). This system consists of 2 crew per vehicle.

**2. Stationary Container System (SCS):**

This stationary container system starts the collection work with a truck carrying an empty container to collection point where the filled container is located. Crew will replace the full container with the empty container brought from the garage. The filled container is then hauled to the disposal site and is emptied. Then the truck will go to next collection point with this empty container. Then empty container will be unloaded at that point and the filled container will be loaded to truck and hauled to the disposal site for emptying. Then truck will move on to next location with empty container and so on. Lastly after emptying the last container at disposal site truck will return to the garage with the empty container to end up that day work.



### TRANSPORT OF REFUSE :

The refuse collected in the public dustbins located by the sides of roads, is transported to the disposal site by means of following vehicles: (i) Auto-rickshaws, (ii) Trailers, and (iii) Trucks.

**Auto rickshaws:** These, having three or four wheels, have covered bodies. Since their capacity is limited to 1/2 to 3/4 tonnes, these are used only for those narrow localities where other heavy vehicles cannot go.

**Trailors:** Trailors have slightly larger capacity ( 2 to 3 tonnes). They are also used for localities where trucks cannot go. Loading of trailors is done manually. However, they are of tilting-tipping type and hence their unloading is done automatically with the help of hydraulically operated jacks.

**Trucks:** Trucks have larger capacity ( 5 to 10 tonnes). They are generally of tilting-tipping type so that unloading is automatic. Special types of trucks, capable of bodily lifting covered skip boxes (in place of ordinary dust bins) are now available, and should be used so as to avoid nuisance of flies.

The vehicles employed for the transport of refuse should be of such pattern and design that collected garbage does not fall once again on the road during the transport. The transport vehicle should be strong durable and watertight. They should be made of steel with smooth interior surface and round edge and corners, so that they can be kept clean.

### DISPOSAL OF REFUSE

Refuse or solid waste can be finally disposed of by the following methods.

- 1) Controlled tipping
- 2) Filling of low lying areas.( Land filling).
- 3) Dumping into sea
- 4) Pulverisation
- 5) Incineration
- 6) Composting

#### 1) Controlled tipping:

This method is useful where adequate site for redevelopment is available. The method consists of tipping the refuse in hollows to a depth of 1 to 2m. While tipping, coarse material is tipped at the bottom while fine material is tipped on the top. These tips are covered with soil, so as to provide a seal under which bacterial decomposition takes place. At the end of about 12 months period, the decomposition is complete, due to which the tip settles down to a height of 30cm only. Normally, an area of 0.3 to 0.5 m<sup>2</sup> per year is required.

#### 2) Filling of low lying area (land filling):

This method is quite common. The garbage is dumped into low-lying areas or depressions each layer is covered by 0.2m thickness of good earth. A rest of 2 to 3 weeks is given before dumping the second layer. If dry refuse is loosely packed, it may give rise to health hazards. Hence each layer should be compacted by movement of dumping vehicles, for its settlement, before starting filling the second layer of refuse.

The advantages of the method are:

- (i) It is simple and economical.
- (ii) No plant / equipment is required.
- (iii) Separation of various materials of the refuse is not required.
- (iv) There are no by-products and hence there is no problem of the disposal of the by-products.
- (v) The low lying areas can be reclaimed and put to better use by this method.

The disadvantages are :

- (i) Proper site may not be available nearby.
- (ii) Wind direction may not be favorable.
- (iii) Large land areas are required.
- (iv) It may be difficult to get large quantities of covering material.
- (v) Dumped garbage containing carcinogenic non-biodegradable matter (such as plastics, unused medicines, paints, insecticides, sanitary napkins etc) may cause trouble later because of leachate coming out of the dump during rainy season. And
- (vi) Leachate from the dumped garbage may pollute surface water as well as ground water.

### 3) Trenching:

This method is generally adopted when low-lying areas are not available. Trenches of size 4 to 10m long, 2 to 3m deep are excavated with a clear spacing of 2m. These trenches are then filled with refuse/garbage in layers of 15cm. On the top of each layer, 5cm thick sandwiching layer of night soil/ animal dung is spread in semi liquid form. On the top layer protruding 0.3 m above ground surface, 10cm layer of good earth or other non-combustible material is spread to act as a seal, so that flies do not get access and wind does not blow the refuse off. The dumped garbage is converted into a type of compost by the fermentation carried out by anaerobic bacteria, within a period of 6 months. The compost available from trenching is of low agricultural value: on the contrary, it may sometimes have elements, which may be harmful to the soil.

### 4) Dumping into the sea:

Solid waste/refuse can also be disposed of by bargeing out into the sea, after carrying it at reasonable distance (say 15 to 20 km) into the sea. This is necessary to prevent the shores from refuse nuisance, because sea waves can carry back the refuse to the shores. The depth at such disposal point should not be less than 30m.

The following are the defects of this method :

- (i) Bulky and lighter matter in the refuse may float, spread out and tend to return to the shores during high tides.
- (ii) During stormy weather and monsoons, it is not possible to send barges out into the sea. And
- (iii) In spite of best care, some portion of refuse may return the shores and spoil them, also the method is possible only in cases of coastal cities.

### 5) Pulverisation:

In this method, the dry refuse is pulverised into powder form, without changing its chemical form. The powder can either be used as poor quality manure, or else be disposed of by land filling. In some countries the pulverised refuse is discharged in the sewer. The method is quite costly and hence not commonly used in India.



**6) Incineration:**

This consists of burning the refuse in the incinerator plant. This is commonly used in disposing of garbage from hospitals and industrial plants. Before incineration, non-combustible and inert materials like earth, broken glass, chinaware, metal etc are separated, so as to reduce the load on the hearth. The by-product of this method is ash and clinker, which can be easily disposed of by land filling. The heat generated by burning the dry refuse may be utilized for raising steam power. The quantity and quality (moisture and calorific value) of refuse is, however, changing and hence the power generated will fluctuate. Emission of air pollutants from incinerators includes particulate such as flyash, unburnt fuel and others. Permissible level of particulate emissions from large incinerators is 0.23g per standard cubic metre of exhaust gas corrected to 12% CO<sub>2</sub>. Smoke includes all liquid and solid matter in the exhaust that hinders visibility. Smoke can be eliminated by mixing the exhaust with hot air to complete combustion, but black smoke requires fairly high air temperatures.

The following points should be carefully observed during incineration:

- 1) The refuse charging should be through, rapid and as nearly continuous as possible.
- 2) Each batch of refuse entering furnace should be well mixed.
- 3) Auxiliary burners are usually installed above the refuse to ignite it and to establish the draft at the beginning of the cycle. This is all the more necessary when the moisture content of air is high.
- 4) Minimum temperature in the combustion chamber should be sufficient ( 670 °C) so that all the organic matter is incinerated and foul smelling gases are oxidised.
- 5) After burners are sometimes required, together with particulate removal devices such as settling chambers or scrubbers.

**Advantages of incineration :**

- (i) This is most hygienic method, since it ensures complete destruction of pathogens.
- (ii) There is no odour trouble or dust nuisance.
- (iii) The heat generated can be used for raising steam power.
- (iv) Clinker produced can be used for road purposes.
- (v) The disposal site ( i.e. incineration site) can be located at a convenient distance.
- (vi) Lesser space is required for disposal of residues.
- (vii) Modern incinerates can burn a great variety of refuse materials which are otherwise not biodegradable.
- (viii) Adverse weather condition have no effect on the incinerator's operation.

**Disadvantages:**

- (i) Large initial expenditure.
- (ii) Improper operation results in air pollution problems and incomplete reduction of the waste materials.
- (iii) Disposal of the remaining residues is required.
- (iv) High stacks needed for natural draft chimneys present safety problems.

It should be clearly noted that municipal incineration of solid waste or refuse is a volume reduction process and not one of complete or ultimate disposal. Safe disposal of remaining residue is an essential requirement. Also, the plant need be operated properly so that the gases are completely burned and a stable residue is produced.

**BIO GAS PLANT****Need For Biogas Plant**

At present farmers use cow dung as fuel by making dried cakes out of it. But if the dung is digested in a biogas plant, the following products are obtained:

- 1) Methane gas can be used as fuel for domestic purposes.
- 2) The liquid humans after digestion is a good natural fertiliser

In the biogas plant. Which is commonly called as gobargas plant, not only animal dung but also urine and human excreta can be used. The slurry that comes out of the plant is rich, odourless and harmless fertiliser. The gas has a high calorific value and gives out bright light and odourless flame. The utensils will not be stained by smoke.

**Details of Go bar Gas Plant**

A biogas plant consists of the following parts:

- 1) Digester
- 2) Gas- holder

1) **Digester:** The digester consists of an underground well constructed with brick masonry wall in cement mortar. The well can be constructed with other suitable materials also. The depth of the well can be from 3.5-6m and diameter from 1.2-6.0m. The well is divided into two parts by a vertical wall. Two small tanks are constructed on the ground on either side of the well. In one tank, the slurry consisting of dung and water are mixed. An AC inlet pipe of 100mm diameter, is fixed in a sloping position which feeds the slurry from this tank into the digester. Another pipe acts as an outlet pipe through which the digested slurry is brought out and collected in the second tank.

2) **Gas-holder:** The gas-holder is a tank placed on top of the digester. The plant can also be constructed horizontally. The gas produced in the digester is collected in the gas-holder by means of pipe fixed in the central wall. The gas is drawn through MS pipes or black polythene pipes of diameter 32mm. Polythene pipes are not only economical but easy to lay. The pipes in the house can be of 12 mm or 6 mm diameter. The gas holder can be raised or lowered with the help of the central pipe, due to pressure of gas moving in a vertical pipe fixed on the central vertical wall.

The gas-holder is made of mild steel sheets or polyester fiber glass. The gas-holder made of MS sheet should be cleaned first and painted to avoid rusting. The polyester fibre-glass holder even though costly need not be painted for its maintenance.

**Operation of Plant:** The dung and water are mixed in the ratio of 4:5 in the mixing tank and fed into the digester. After purification and digestion, the slurry collects in the second tank. The gas is collected in the gas-holder ready to use. The gas can be conveyed to places up to 30m and the gas generated will have a pressure of 75 to 150mm of water column. This will be sufficient for lighting the kitchen ovens, stoves, lights, etc. The gas can be used to run engines too.

Nearly 50 kg of dung is required daily. Normally an animal gives 10-20 kg of dung daily based on its size. Also, excreta of 60 human beings can be used for each plant. In hostels and public lavatories, such plants can be attached. Each time only one litre of water is to be added. If it is more, putrefaction does not take place and enough gas will not be produced. The slurry can be stored in open pits dug in the soil and utilised as fertilizer.

**Location:** The gas plant is usually located near the 'goshala' ( never more than 20 m away). If sufficient water is not available, construction of plant should not be taken up. The gas plant can also be located near slaughter houses, pig farms and poultries if sufficient excreta are available.



**Conclusion:** It may be seen that the major benefits is that the gas produced with  $\frac{1}{4}^{\text{th}}$  of the dung will give 20% more heat than the dried dung cakes made of full quantity. Also the fertilizer made of slurry will have 43% more strength than dung used directly. Approximately for 2-3 animals 2 cu. m. of gas plant is required. The plant can be designed accordingly. Special equipment is required to achieve an efficiency of 100%, which is available with the khadi Gramudyog Board.

