

Unit-III (Quality Parameters)

* Biochemical Oxygen Demand (BOD)

It is a measure of the oxygen required to oxidize the organic matter present in a sample, through the action of micro-organisms contained in a sample of wastewater.

"It may be defined as the oxygen required for the micro-organisms to carry out biological decomposition of dissolved solids or organic matter in the wastewater under aerobic conditions at standard temperature."

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* Chemical Oxygen Demand (COD) :->

In COD test, which can be used to measure organic matter content of both wastewater as well as natural waters.

COD can be determined only in 3 hrs. In

COD test, a strong chemical oxidising

agent is used in an acidic medium to

measure the oxygen equivalent of organic

matter that can be oxidised.

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Quality Parameters

IX] Dissolved Oxygen (DO) :->

DO is the amount of oxygen in the dissolved state in the wastewater. Though wastewater generally does not have DO, its presence in untreated wastewater indicates that the wastewater is fresh.

Similarly, its presence in treated wastewater/effluent indicates that considerable oxidation has been accomplished during the treatment stages.

Demand (BOD)

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X] Solids :->

Sewage normally contains 99% of water and 0.1% of solids. Total solids exist in three different forms:

- (i) suspended solids
- (ii) colloidal solids
- (iii) Dissolved solids

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• Suspended solids (S_s) are those which can be filtered out on an asbestos mat or filter paper i.e. suspended solids are non-filterable solids.

• The suspended solids may be further subdivided into (a) settleable solids and (b) non-settleable solids.

• Settleable solids are those that will settle to the bottom of a cone-shaped container, called imbhoff cone in 2-h period.

• Non-settleable solids do not settle down by mere detention, but may be arrested by special laboratory filters.

✶ Oil, Fats and Grease :->

Such matters float on the top of sedimentation tanks, often choke pipes in the winter, and

clog filters. Fats are among the most stable of organic compounds and are not easily decomposed by bacteria.

These are soluble in hexane or ether.

It is therefore necessary to detect and remove these from wastewater.

✶ Conservancy System :-> or Disposal System

This is an old system in which various types of wastes, such as night soil, garbage etc. are collected separately in vessels or deposited in pools or pits and then removed periodically at least once in 24 hrs.

The system is also known as the dry system.

The following are the methods of collection of various types of wastes in the system.

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1) Night Soil:→

Night soils or human excreta in latrines, privies etc. is collected separately in pans or pails and carried on head of sweepers to a central place from where it is transported to final disposal. Normally, it is buried into ground, in trenches to give excellent manure in one or two years.

2) Garbage:→

Garbage is collected separately, in dustbins and conveyed on hand carts or van once or twice a day. Garbage disposal methods include the open dump, hog, feeding, incineration, dumping into sanitary fill or biological digestion. Incineration, if properly controlled, is satisfactory for burning combustible refuse.

3) Sullage and Storm Water:→

They are conveyed separately in closed or open gutters. The liquid and semi-liquid mass of filth which frequently overflow, is swept away by sweepers to drain from the privies

Disadvantages:-

- 1) Hygienic and Sanitary aspect
- 2) Transport aspect
- 3) Labour aspect : Labour (Sweepers)
- 4) Building design aspect
- 5) ~~C~~

Advantages:-

- 1) ~~System is unhygienic~~ since every thing is visible
- 2) Water consumption is small
- 3) Initial cost is small
- 4) No technical persons required
- 5) Good quality manure available from the end products
- 6) More suitable for rural conditions

Disadvantages:-

- 1) Due to putrefication, there is a lot of foul smell.
- 2) Compact house design is not possible
- 3) Large labour force is required
- 4) Running cost is high
- 5) Acute pollution problems
- 6) Risk of spread of epidemic
- 7) Large land is required for the disposal of untreated sewage.
- 8) Final disposal into streams etc. not free from risks.
- 9) System is unhygienic

Disposal of Refuse (or Solid Waste) :->

Disposed of by the following methods:

- 1) Controlled tipping
- 2) Filling of low lying areas (Landfilling)
- 3) Dumping into sea
- 4) Pulverisation
- 5) Incineration
- 6) Compositing
- 7) Trenching

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 2 m. While tipping, coarse material is tipped at the bottom while fine material is tipped on the top. These tips are covered with soil.

2) Landfilling:->

This method is quite common. The garbage is dumped into low lying areas. Dumping is done in layers of 1 to 2 m, and each layer is covered by 0.2 m thickness of good earth.

Advantages:-

- (i) Simple and economical
- (ii) No plant/equipment is required
- (iii) Separation of various materials of the refuse is not required.

(iv) There is no by-products -

Disadvantages:->

- (i) Proper site may not be available nearby
- (ii) Wind direction may not be favourable
- (iii) large land areas are required
- (iv) Unhygienic

3) Trenching:->

This method is generally adopted when low lying areas are not available.

Trenches of size 4 to 10 m long, 2 to 3 m wide and 1 to 2 m deep are excavated with a clear spacing of 2 m. Filled with refuse/garbage in layer of 15 cm. On the top of each layer, 5 cm thick sandwicing layer of night soil is spread in semi-liquid form. May cause harm to the soil.

4) Dumping into Sea:->

Solid waste can also be disposed of by bargeing out into the sea. The depth of such disposal point should not be less than 30 m.

Defects:-

- (i) bulky and lighter matter in the refuse may float, spread out and tend to return to the shores during high tides.

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(ii) during stormy weather and monsoon,
it is not possible to send barges out into
the sea.

(iii) Only possible 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 a poor quality manure
or else be disposed of by landfilling.

6) Incineration:->

This consists of burning of the refuse in
the incinerator plant. This is commonly
used in disposing of garbage from hospitals
and industrial plants. The byproduct
of this method is ash and clinker which
can be easily disposed of by landfilling.

Advantages:-

(i) Most hygienic method.

(ii) No odour trouble or dust nuisance.

(iii) Heat generated can be used for raising
steam power.

(iv) Clinker product can be used for road purposes.

(v) Lesser space required.

Disadvantages-

- (i) Large initial cost
- (ii) Air pollution problems
- (iii) High stack needed

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Compositing adopted in India:-

In India, there are two methods of mechanical composting:

- (i) Indore Method and
- (ii) Bangalore Method

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• In Indore Method, refuse, night soil and animal dung etc. are placed in small brick lined pits (3m x 3m x 1m) deep, in alternate layers of 7.5 to 10 cm height. Chemicals are added to prevent fly breeding. The material is turned regularly for a period of about 8 to 12 weeks and then stored in the ground for 4-6 weeks. In about 6-8 turnings and in about 4 months, the compost become ready for use as manure.

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• In Bangalore Method, the refuse is stabilized anaerobically. Earthen trenches of size 10 x 1.5 x 1.5 m deep are filled up in

alternate layers. The material is covered with 15 cm layer of good earth and left for decomposition. In about 4-5 months, the compost becomes ready for use.

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Methods of

17 The methods of disposal of wastewater may be classified under the following categories:

- (i) Natural methods: (a) By dilution
(b) By land treatment
- (ii) Artificial methods: (a) Primary treatment
(b) Secondary treatment
- (iii) Combined methods: (a) Primary treatment
(b) Effluent disposal by natural methods

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1) Disposal By Dilution:->

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It is the process whereby the treated wastewater or effluent from treatment plants is discharged either in large static water bodies or in moving water bodies such as rivers or streams. The discharged wastewater or effluent is purified, in due course of time, by the so called self purification process of natural waters. The limit of effluent discharge and the degree of treatment of wastewater depend upon the self purification capacity of natural waters.

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- Self Purification of Natural Streams

When the wastewater or the effluent is discharged into a natural stream, the organic matter is broken down by bacteria to ammonia, nitrates, sulphates, CO_2 etc.

In this process of oxidation, the dissolved oxygen content of natural water is utilised.

Due to this, deficiency of dissolved oxygen is created. As the excess organic matter is stabilized, the normal cycle will be reestablished in a process known as self-purification. Actions involved in this are:

1) Dilution:-

When wastewater is discharged into the receiving water, dilution takes place due to which the concentration of organic matter is reduced and the potential nuisance of sewage is also reduced.

$$C = \frac{C_s B_s + C_R B_R}{B_s + B_R}$$

When dilution ratio is quite high, large quantities of DO are always available which will reduce the pollutional effects. Aerobic conditions will always exist because of dilution.

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2) Dispersion due to currents:→

Self-purification of stream largely depends upon currents which will readily disperse the wastewater in the stream, preventing locally high concentration of pollutants. High velocity improves regeneration which reduces the concentration of pollutants.

3) Sedimentation:→

If the stream velocity is lesser than the scour velocity of particles, sedimentation will take place, which will have two effects: (i) the suspended solids, which contribute largely to oxygen demand will be removed by settling and hence water quality to the d/s will be increased, (ii) due to settled solids, anaerobic decomposition may take place.

4) Oxidation:→

The organic matter present in the wastewater is oxidised by aerobic bacteria utilising dissolved oxygen of the natural water.

5) Reduction:→

The reduction occurs in the streams due to hydrolysis of the organic matter biologically

or chemically.

6) Temperature :→

At low temperatures, the activities of bacteria is low and hence rate of decomposition will also be slow, though DO will be more because of increased solubility of oxygen in water. At higher temperatures, the self-purification takes lesser time, though quantity of DO will be less.

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7) Sunlight :→

Sunlight helps certain micro-organisms to absorb CO₂ and give out O₂. It acts as a disinfectant.

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Standards For Dilution

- 1) Above 500 - No treatment required.
- 2) Between 300 to 500 - Primary treatment consisting of plain sedimentation is required.
- 3) Between 150 to 300 - Treatment such as sedimentation, screening and chemical precipitation are required.
- 4) Less than 150 - The sewage should be treated thoroughly.

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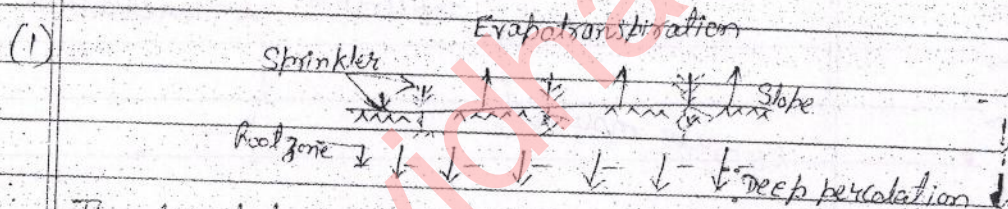
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or Sewage Farming Disposal by Land Treatment:-

When the wastewater, either raw or partly treated, is applied or spread on the surface of land, the method is called disposal by land treatment. The three principal processes of land treatment of waste water are:

- (1) Broad irrigation or Sewage farming.
- (2) Rapid infiltration, and
- (3) Overland runoff

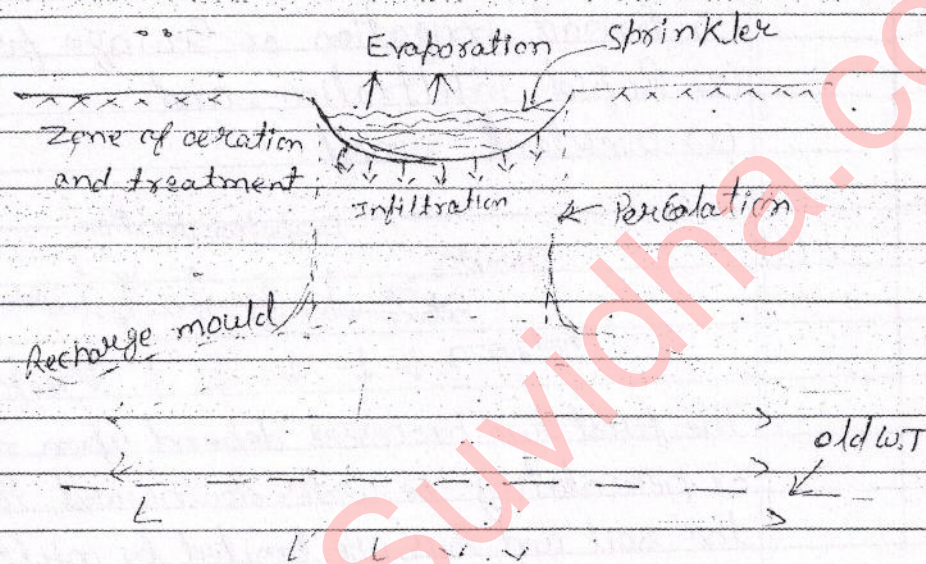


The first two processes depend upon moving or percolating the water downward through the soil and thus are limited by infiltration and percolating capacity of land. While the percolating capacity is a function of soil characteristics, the infiltration depends upon the degree of clogging at the soil surface. For percolation rate of 6 to 25 mm/min, irrigation is suitable. For 2 to 6 mm/min.

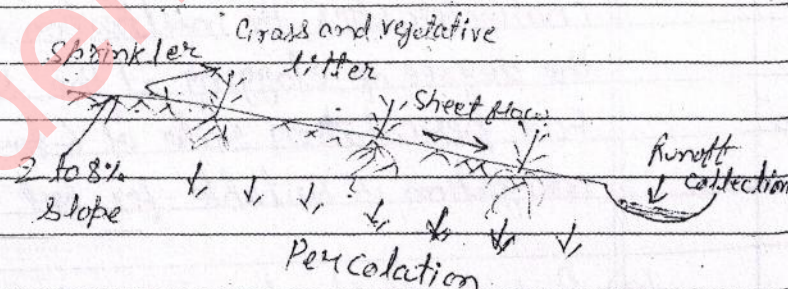
- (2) Rapid infiltration may be used for waste disposal, ground water recharge or both. For this process, wastewater is discharged

into large basin may be covered with underlined by sand and soils of high permeability. Bottom of the basin may be covered with grass which can persist in wet or dry condition. The grass assists in nitrogen removal and helps maintain the infiltration capacity of the surface.

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The overland runoff method is applied when soils have poor permeability. It is not a true disposal system since waste water must be collected after passage over the soil. Plant or tree cover is essential to minimise and assist in nutrient removal. Hay grasses are usually employed.