

Environmental Engineering - II Unit - V Disposal of sewage and sludge

Standards for disposal - Methods - dilution

Self purification of surface water bodies - Oxygen sag curve

- Land disposal - sewage farming - Deep well

injection - Soil dispersion system - Sludge characterization

- Thickening - Sludge digestion - Biogas recovery -

Sludge conditioning and dewatering - disposal - Advances

in sludge treatment and disposal.

Disposal:

The methods of disposal of wastewater

may be classified as follows:

* Natural methods - by dilution

- by land treatment

* Artificial methods - Primary treatment

- Secondary treatment

* Combined methods - Primary treatment

- Effluent disposal by natural method

Dilution, a predominant method of

natural disposal, consists of discharging the

wastewater into receiving water body such as

River, sea, lake, etc.

Disposal by Dilution:

Disposal by dilution is the process whereby the treated wastewater 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.

Conditions favouring dilution without treatment:

- * wastewater is quite fresh (discharged within 2-3 hr of its collection)
- * floating matter and settleable solids have been removed
- * water body has large volume in comparison to the volume of wastewater
- * diluting water has high content of DO
- * where it is possible to thoroughly mix or diffuse the wastewater through the water body
- * swift forward currents are available, there is no deposition of sewage
- * the receiving water is not a source of drinking water intakes immediately to the

Conditions essential for treatment before dilution: ⁽¹⁾

- * wastewater discharge is detrimental to aquatic life
- * wastewater contains industrial waste containing toxic or industrial effluent is quite warm.
- * volume of diluting water is insufficient.
- * receiving water is a source for drinking water.
- * effluent is not likely to be dispersed easily due to tides, winds, cross-currents etc.

Standards of dilution:

The ratio of quantity of receiving water to that of wastewater or effluent discharge is called the dilution factor.

Dilution factor Standards of purification required

* Above 500	No treatment required
* 200 - 500	effluent ^{not} contain more than 150 ppm of SS.
* 150 - 300	effluent ^{not} contain more than 50 ppm of SS.
* Less than 150	effluent ^{not} contain more than 30 ppm of SS.

Types of Receiving water for Dilution:

Wastewater or effluent can be discharge for dilution into

- * Perennial rivers and streams
- * Lakes
- * Ocean or sea
- * Estuaries
- * Creeks

A creek is in the form of an inlet on sea coast, which may not have dry weather flow during some part of the year.

Self Purification of Natural streams:

When the wastewater 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 DO content of natural water is utilized.

As the excess organic matter is stabilized, the normal cycle will be reestablished in a process known as self-purification, where in the oxygen is replenished by its reeration by wind.

Actions involved in self purification:

into the receiving water, dilution takes place due to which the concentration of organic matter is reduced.

If C_S and C_R are the concentrations of any impurity (organic, BOD, SS) and Q_S and Q_R are the discharge rates of sewage and River respectively, the resulting concentration 'c'

$$C_S Q_S + C_R Q_R = c (Q_S + Q_R)$$

$$c = \frac{C_S Q_S + C_R Q_R}{Q_S + Q_R}$$

* Dispersion due to currents:

Self purification of stream largely depends upon currents which will readily disperse the wastewater in streams.

High velocity improves reaeration which reduces the concentration of pollutants.

Sedimentation:

If the stream velocity is lesser than the mean velocity of particles, sedimentation will take place, which will produce two effects

* suspended solids removed by settling will be increased the water quality is

* due to settled solids, anaerobic decomposition may takes place.

* Oxidation :

The organic matter in wastewater is oxidized by aerobic bacteria utilizing DO of natural water. This process prevails till complete oxidation of organic matter takes place.

The streams which is capable of absorbing more oxygen rapidly through reaeration, etc. can purify heavily polluted water in a short time.

* Reduction :

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

Anaerobic bacteria will split the organic matter into liquids and gases.

* Temperature :

At low temperature, the bacterial activity is low, hence rate of decomposition will also be slow, though DO will be more because of increased solubility of O₂ in water.

At higher temperature, the self-

* Sun light :

Sunlight helps certain microbes to absorb CO_2 and give out O_2 .

Sunlight acts as a disinfectant and stimulates the growth of algae.

Wherever there is algal growth, the water may be supersaturated with DO during day hours, though anaerobic conditions exist in night.

Dilution into sea :

The saturation concentration of DO in water decreases with increasing salt content.

When the sewage is discharged into sea, the following points are considered:

* Sewage should be discharged deep into the sea, preferably 1-1.5 km away from shore.

* Outfall should be designed that proper dilution of waste with sea water is accomplished before the waste tries to rise to the surface.

* Minimum depth of water at outfall point should be 3-5 m.

* Sewage should be disposed off only during the low tides.

* While deciding the position of outfall, the direction of wind velocity and direction of

Disposal by Land Treatment:

When the wastewater, either raw or primary treated, is applied or spread on the surface of land is called disposal by land treatment.

It is also called "sewage farming".

The three principal processes of land treatment of wastewater are

- * Broad irrigation of sewage farming

- * Rapid infiltration

- * Overland runoff

Sewage farming

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.

Rapid Infiltration:

Rapid infiltration may be used for waste disposal, ground water recharge or both.

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Bottom of the basin may be covered with grass like bermuda which can persist in wet or dry condition.

Overland Run off :

This technique is applied when soils have poor permeability.

It is not a true disposal system since wastewater must be collected after passage over the soil.

Plant or tree cover is essential to minimise and assist in nutrient removal.

Sewage Sickness:

After continuous application of sewage on land, the pores of the soil get clogged, preventing oxidation and causing noxious smells.

The land is unable to take any further load of sewage.

This phenomenon of soil is known as sewage sickness.