Unit 5 Disposal of Sewage & Sludge Management.

Disposal of Sewage / Effluent:

01. Disposal in water.

02. Disposal on land.

Std. for disposal :-

S.No	Characteristics of Effluent	Tolerance limit for Sewage effluent when disposed inland water sewage. (Land)	Disposal of Indus Effluent i public Sewer (water)
01.	BOD	30 ppm	350 mg/
02.	COD	250 mg/lit	–
03.	PH	5.5 - 9	5.5 - 9
04.	Temperature	40°c	45°c
05.	Total Suspended Solids	100 mg/lit	600 mg/
06.	Oil & grease	10 PPM	100 PPm

07.	Pherolic Compounds	1 ppm	5 ppm.
08.	Cynides	0.2 ppm	2 ppm.
09.	Sulphide ✓	2 ppm	—
10.	Fluorides ✓	2 ppm	—
11.	Total residual chlorine	1 ppm	—
12.	Insecticides	0 ppm	—
13.	Cadmium ✓	2 ppm	—
14.	Arsenic	0.2 ppm	—
15.	Chromium	0.1 ppm	2 ppm.
16	Cu	3 ppm	3 ppm
17.	Pb	0.1 ppm	1 ppm
		0.01 ppm	—

Disposal by dilution :-

(2m) It is the process, where the treated sewage are effluent from STP is discharge into a river stream or large body of water like sea [The discharged sewage is due course of time is purified by itself & process is called Self purification of water]

(2m)

The various natural process of purifica

(i) Physical forces.

→ Dilution & dispersion

(2m) When the organic matter is discharge into large vol. of water, it gets rapidly disposed & diluted & results in reducing the concentration of organic matter.

$$C = \frac{C_s Q_s + C_R Q_R}{Q_s + Q_R}$$

~~Qs = Conc. of sewage.~~

~~QR = water flowing through river.~~

→ Sedimentation.

→ Sunlight

→ (b) Chemical forces: aided by biological forces

✓ Oxidisation :-

[removal of H^+, addition of O_2]

Oxidisation of organic matter, take place completely till the O_2 gets oxidised. the defecient O_2 will be full filled by atmospheric O_2

✓ Reduction :-

Hydrolies of organic matter settled at the bottom of river, either chemically or biologically

*** Self purification of Surface water bodies (13m)

01. Zone of degradation/pollution:

→ It is found for a certain length just below the point where the sewage is discharge.

→ This zone is chart. by water becoming dark & turbid with sludge deposits at the bottom.

→ D.O is reduced to 40% & increase in CO_2 take place.

Zone of ~~activity~~ active decomposition :-

→ In this zone, it is char. by heavy pollution, water becomes grey & darker than previous zone.

→ D.O level falls to zero

→ Anaerobic condition prevails.

→ Evaluation of gases takes place

→ As decomposition take place, D.O again raises to 40%.

Zone of recovery :-

→ In this zone, the water tries to recover from degraded condition to its former appearance

→ The water becomes clearer

→ BOD level falls.

→ D.O raises above 40%.

Zone of clearer water:

→ The water attains original condition with D.O above saturation value (8-12 ppm)

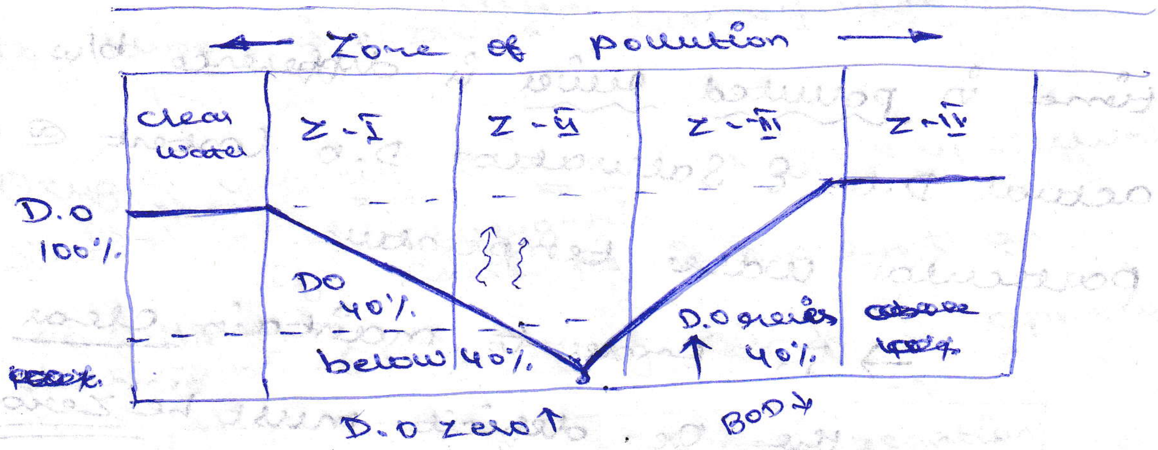
→ Water becomes clearer.

→ Usual aquatic life prevail

→ Some pathogens may present.

→ Hence, it has to be treated, △

before using for domestic purposes.



Zone of degradation
Zone of active decomposition
Zone of recovery
Zone of clear water

Oxygen deficit :- (D) P.No: (194) SK

** (2m) [Saturation Value (8-12 ppm) − Actual D.O]

It is defined as "At any time in polluted river is difference b/w actual D.O & Saturation D.O content @ particular water temperature.

→ In order to maintain clear condition, the O_2 deficit must be zero.

Deoxygenation :-

(2m) In polluted water body D.O goes on reducing due to decomposition of Organic matter, the rate of deoxygenation depends upon amt. of Organic matter remain to be Oxidised @ given time.

→ At give temp. the curve showing depletion of D O with time is known as deoxygenation curve.

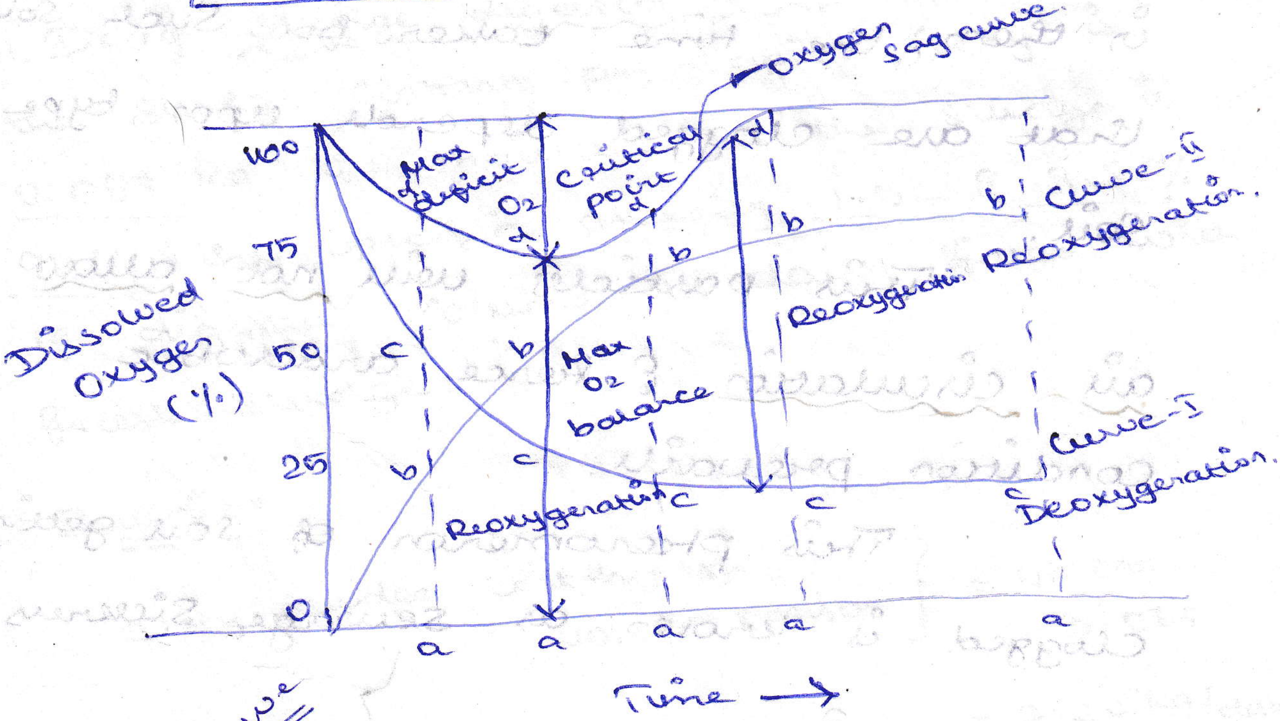
Reoxygeration curve:

(Em) In order to counter balance the O_2 consume the atmosphere supplies O_2 it is known as reoxygeration & the curve showing the desolved oxygen with respect to time is called reoxygeratio- curve.

Oxygen deficit curve (Oxygen sag curve)

~~X~~ - ~~X~~ If Deoxygation ~~deoxygen~~ is more than reoxygeration ~~deoxygen~~, Oxygen sag curve is appear.

Deoxygeration > Reoxygeration



Oxygen sag curve

Disposal on Land :-

- ✓ Surface irregation
  - Basin flooding (small piece of Land)
  - Furrow irregation
  - free flooding
  - border flooding
  - Check flooding
  - (large area)
- ✓ Sub surface irregation
- ✓ Sprinkler irregation

Sewage Sickness :-

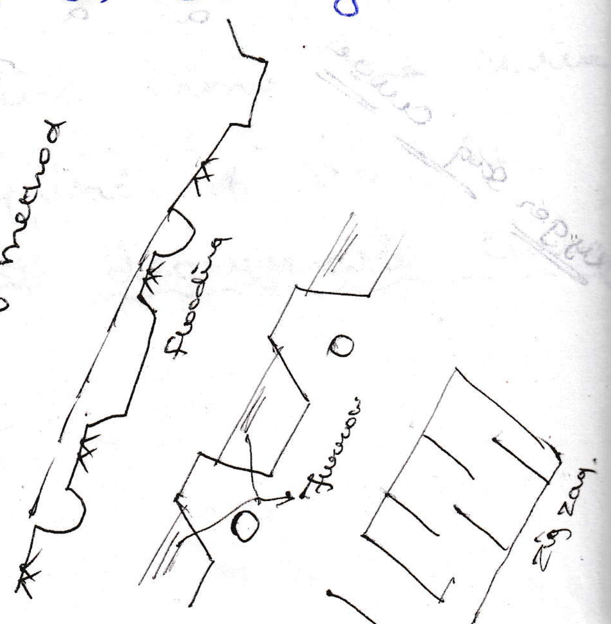
(2m) When Sewage is applied Continuously on a piece of land the soil pores filled up or clogged with solids retained in them, the time taken for such soils that are clogged depends upon type of soil.

This particles will not allow air circulation & hence anaerobic condition prevails.

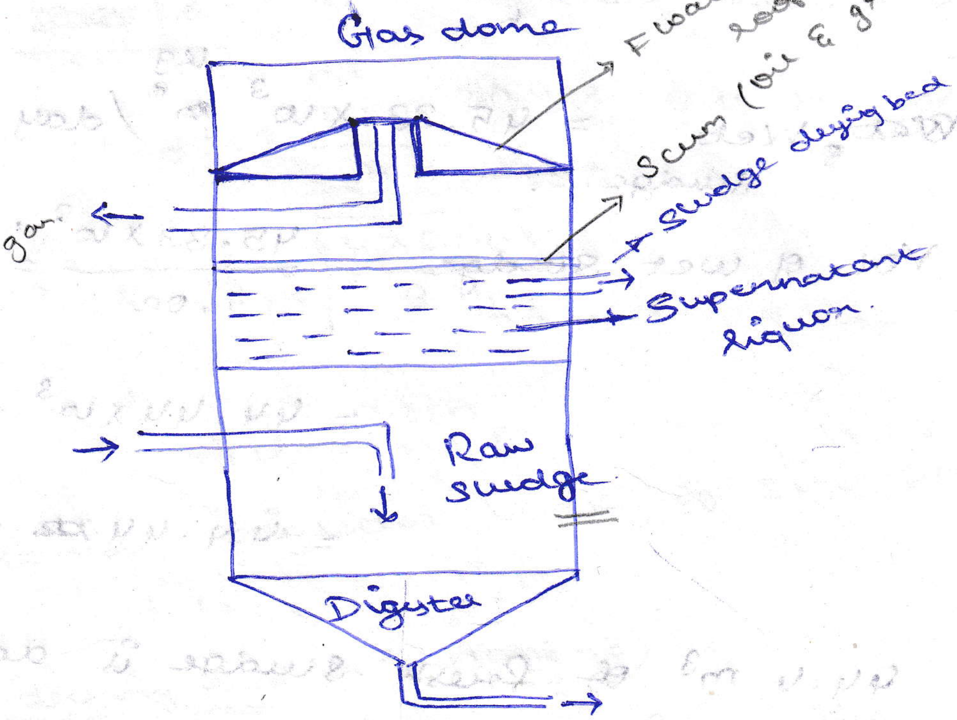
This phenomenon of soil getting clogged is known as sewage sickness.

Methods

- Free flooding ✓
- Basin method ✓ (plant)
- Furrow method ✓
- Zig-zag method ✓
- Managed time method



Sludge digestion tanks :-



01. Design sludge digestion tank for 40,000 people is the sludge content per capita / day is 0.068 kg the moisture of the sludge is 94% the specific gravity 1.02 & 3.5% of digester volume is daily fixed with fresh sludge.

Solution :

Dry sludge content for 40,000 person $\}$ = 40,000 × 0.068

= 2720 kg/day

94% → 6 kg of moisture content (volume)

100 kg of wet sludge $\}$ = 6 kg dry sludge

⇒ 2720 kg will ~~provide~~ provide

$$= \frac{100}{6} \times 2720$$

Wt. of Wet sludge $= 45.33 \times 10^3$ kg/day

(1000 kg = 1 ton)

Vol. of wet sludge $= \frac{45.33 \times 10^3}{1.02} = \frac{45.33 \text{ t/day}}{1.02 \times 1 \text{ t/m}^3}$

(1.02 → s, 1 → w)

$= 44.44 \times 10^3$ kg/day

$= 44.44$ m³/day

44.4 m³ of fresh sludge is added to 3.5%

(44.4 → 3.5%)

$\Rightarrow \frac{3.5}{100} = 44.4$

Capacity $= 44.4 \times 100 / 3.5$

$= 1268.57$ m³

Provide 30% additional capacity

$= 1268 \times 0.3$

$= 380.4$ m³

Thus,

$= 1268 + 380$

$= 1648$ m³

provide 6 m depth,

$Q = AV$

$$A = \frac{Q}{V} = \frac{1648}{6} = 274.66 \text{ m}^2$$

02. Design size of sludge drying bed having the vol of wet sludge 44.4 m^3/day. Assume necessary condition.

Sol:-

Let, the sludge be spread over 25 cm thick layer, ∴ area of bed $= \frac{V}{D}$

$$= \frac{44.4}{0.25} = 177.6$$

$$= 178 \ m^2$$

Under tropical Indian conditions, bed gets dried in 10 days, hence assume drying time as 2 weeks.

We can utilise the same sludge drying bed for 26 times in a year. (1 Yr = 52 Wk, $\frac{52}{2} = 26$)

$$\text{Area of bed} = \frac{178 \ m^2 \times 365}{26}$$

$$= 2499 \ m^2$$

$$\boxed{A \simeq 2500 \ m^2}$$

Making 100% allowance & considering as 2 sludge drying beds,

hence,

Total area = 2 × 2500 = 5000 m^2

Use,
(20 × 30) m^2 bed

∴ No. of beds = $\frac{5000}{20 \times 30}$ = 8.3

Adopt,
10 no's of sludge drying bed.

——— × ——— × ———

Sludge disposal :-

- ✓ Incineration :- (Heating at high temp)
- ✓ Dumping into Sea :- (Deep Sea → outlet of sludge water)
- ✓ Lagooning (or) ponding :- ✓ Distribution by pipe line. ✓ Drying bed.
- ✓ Deep well injection :-

Biogas recovery :- [Anaerobic digestion → gas]

{Mixture of CH_3 & CO_2 }
CH_3: 65-70 %, CO_2: 30-35 %

——— × ——— × ———

Unit - 4

Recent advancement :-

- ✓ Depth filteration. (membrance filter)
- ✓ Adsorption. (Filteration)
- ✓ Gas ~~tran~~ Stripping. (Aeration)
- ✓ I~~on~~on Exchange.
- ✓ Reverse - Osmosis.
- ✓ Distilation. (water heat → collect steam → pure water)