UNIT-V

Miscellaneous Treatment Methods

(5.1) Biological Nitrification and Denitrification :-

waste head

→ The Bacteria remove the ammonia nitrogen from waste water by a two steps of biological processes

→ The two steps of biological process is Nitrification followed by denitrification convert it finally to gaseous nitrogen.

→ These two steps involved require different environmental conditions and hence generally they are carried out in seperate reactors

waste head

When the waste water containing ammonia is discharged into stream, It consumes dissolved oxygen (DO) from the stream. To convert ammonia into nitrates, be absorbing the (D.O) content in stream. while reducing the (D.O) content in stream the

Nitrification :- ammonia is oxidised to nitrates before it is discharged

The biological conversion of ammonium to nitrate nitrogen is called Nitrification

→ Nitrification is a two-step process.

First step :- $NH_4^+ + 3/2\ O_2 \xrightarrow{\text{Nitrosomonas}} NO_2^- + 2H^+ + H_2O$ (Nitrite)

second step :- $NO_2^- + 1/2\ O_2 \xrightarrow{\text{Nitrobacter}} NO_3^-$ (Nitrate)

overall Reaction :- $NH_4^+ + 2\ O_2 \longrightarrow NO_3^- + 2H^+ + H_2O$

www.Jntufastupdates.com

Scanned by CamScanner

→ Nitrification requires a long retention time, a low Food to micro-organisms ratio (F/M ratio), and high mean cell residence time (MCRT) and adequate (తగిన) alkalinity (క్షారత్వం)

→ The waste water temperature and pH affects the rate of nitrification.

→ In nitrification

Ratio of BOD_5 to TKN > 5 ⟶ combined carbon oxidation & nitrification

Ratio of BOD_5 to TKN < 3 ⟶ seperate stage carbon oxidation & nitrification

Note:- TKN = Total kejeldahl Nitrogen

Denitrification:-

~~For some applications, study~~

→ Denitrification means the loss (or) removal of nitrogen (or) nitrogen compounds specifically. reduction of nitrates (or) nitrites commonly by bacteria

→ Nitrates are removed by two methods

1) Conversion of NO_3 to N_2 gas by bacterial metabolism

2) Conversion of NO_3 to nitrogen contained in cell mass which may be removed by settling.

www.Jntufastupdates.com

Scanned by CamScanner

Nitrate (NO_3^-) → Nitrite (NO_2^-) → Nitric oxide (NO) → (2)

Nitrous oxide (N_2O) → Nitrogen (N_2)

→ Denitrification is the biological process by which nitrate is converted to nitrogen and other gaseous end products

$$NO_3^- + 5/6\ CH_3OH \longrightarrow 1/2\ N_2 + 5/6\ CO_2 + 7/6\ H_2O + OH^-$$

(NO_3^-): (Nitrate); CH_3OH: methyl alcohol; N_2: Nitrogen gas; CO_2: carbon dioxide; H_2O: water; OH^-: hydroxide.

(5.2) Removal

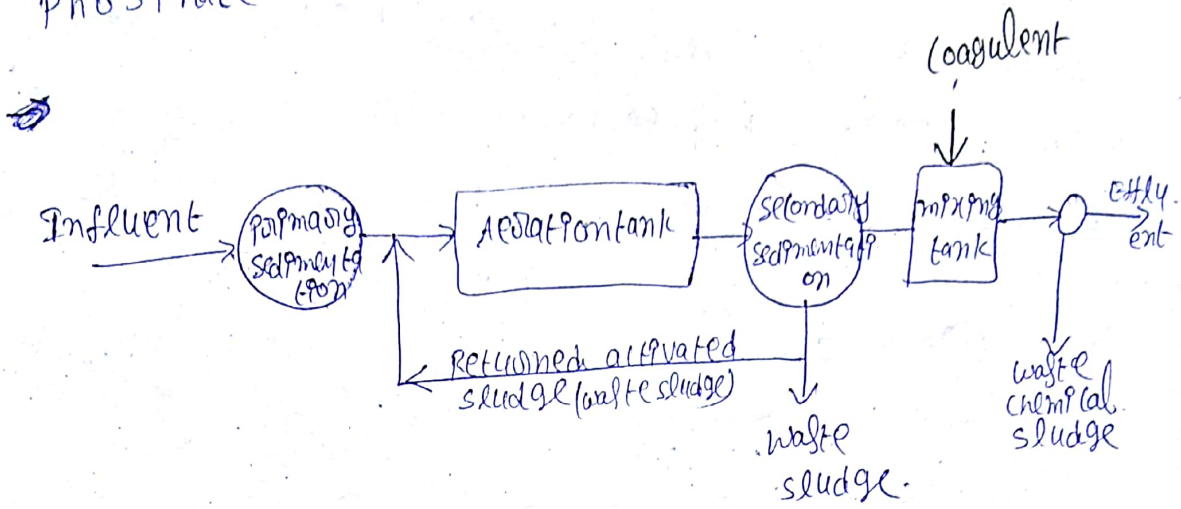
www.Jntufastupdates.com

Scanned by CamScanner

Internet

(5.2) Removal of Phosphates:-

→ Phosphorus in water found in the form of phosphate



→ Normally secondary treatment can only remove 1-2 mg/lt of phosphorus so a large excess of phosphorus is discharged in the final effluent. These effluent will be releasing the natural water bodies and lakes so the results eutrophication of lakes and natural water bodies

↓
water pollution caused by excessive plant nutrients

→ Phosphorus is required for microbes (సూక్ష్మజీవులు) for cell synthesis (కణసంశ్లేషణ) and energy transport, maintenance of cell of it is stored for subsequent use by microbes.

→ During secondary treatment process about 10-30% of influent phosphorus is removed

→ phosphate removal is currently achieved largely by chemical precipitation.

→ Chemical precipitation is used to remove ~~the~~ inorganic forms of phosphate by addition of a coagulant

www.Jntufastupdates.com

Scanned by CamScanner

→ By the adding of this coagulent and mixing of waste water and coagulent

→ The multivalent metal ions most commonly used are calcium, aluminium and iron. used as coagulents.

Calcium

It is usually added in the form of lime $Ca(OH)_2$

It reacts with the natural alkalinity in the (ద్రవ్యత్వం)
waste water to produce calcium carbonate

$$Ca(HCO_3)_2 + Ca(OH)_2 \Rightarrow 2CaCO_3 \downarrow + 2H_2O$$

→ As the pH value of the waste water increases beyond about 10, excess calcium ions will then react with the phosphate, to precipitate in hydroxyapatite

$$10\,Ca^{2+} + 6PO_4^{3-} + 2OH^- \longleftrightarrow Ca_{10}(PO_4)_6(OH)_2 \downarrow$$

→ Because the reaction between the lime and the alkalinity of waste water,
the lime dose is required can be approximated at 1.5 times the alkalinity as $CaCO_3$

www.Jntufastupdates.com

Scanned by CamScanner

Aluminium and Iron

Alum (or) hydrated aluminium sulphate is widely used precipitating phosphates and aluminium phosphates ($AlPO_4$) the basic reaction is

$$Al^{3+} + H_nPO_4^{3-n} \longleftrightarrow AlPO_4 + nH^+$$

→ In practice an 80-90% removal rate is achieved at coagulant dosage rates between 50 and 200 mg/l.

→ Dosages are generally established on the basis of bench-scale tests

→ Aluminium coagulents can adversely affect the microbial population in activated sludge

→ Ferric chloride (or) sulphate and ferrous sulphate also know as copperas, are all widely used for phosphorous removal the basic reaction is

$$Fe^{3+} + H_nPO_4^{3-n} \longleftrightarrow FePO_4 + nH^+$$

→ Generally, lime precipitation is most commonly used for phosphorus removal where phosphorus is removed in the form of waste sludge from the system.

www.Jntufastupdates.com

Scanned by CamScanner

Treatment technologies presently available for phosphorus removal include

(A) Physical :-

(a) Filtration for particulate phosphorus

(b) membrane technologies

(B) Chemical :-

(a) precipitation.

(b) other (mainly physical – chemical adsorption)

(C) Biological :-

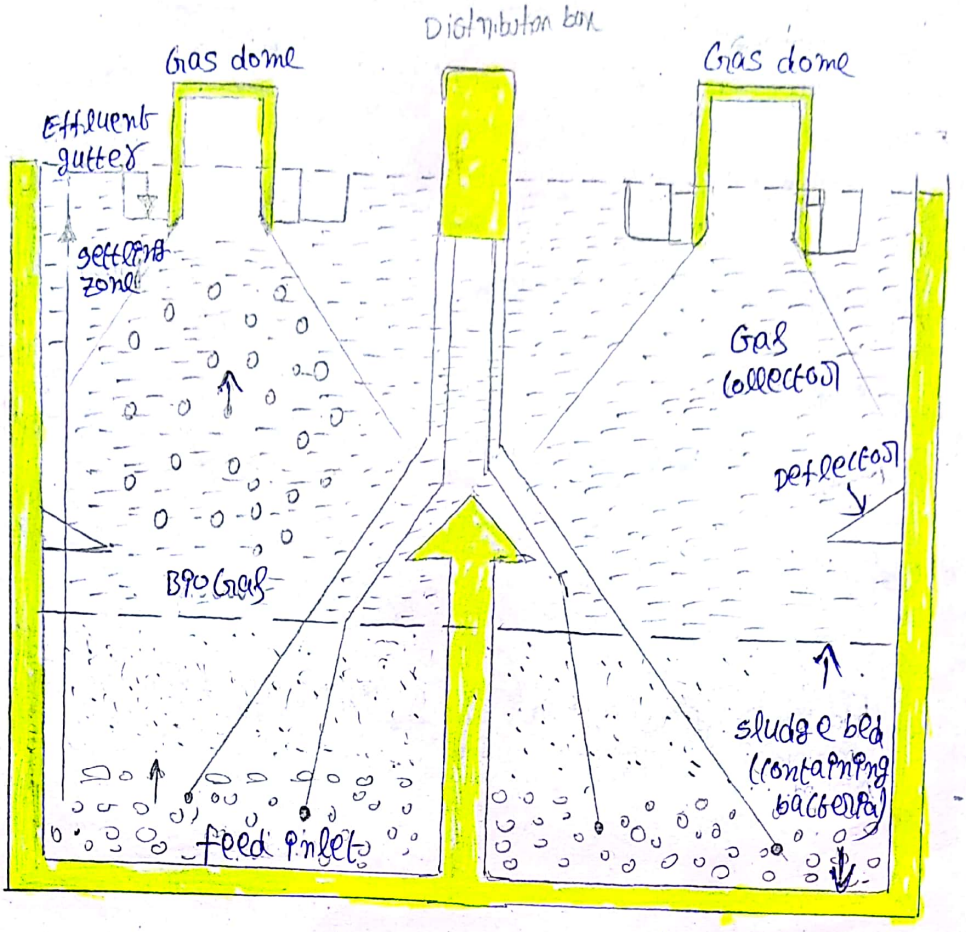
(a) Assimilation.

(b) Enhanced Biological Phosphorus Removal (EBPR)

www.Jntufastupdates.com

Scanned by CamScanner

(5.3) U.A.S.B Reactors :- (Up flow Anaerobic sludge Blanket Reactor)



→

→ The waste water flows upwards through a layer of very active sludge bed to cause anaerobic digestion of organics of the waste water

→ ~~Any biomass~~

→ Any bio maly leaving the reaction zone is directly (ಜೈವಿಕ ಪದಾರ್ಥ)
recirculated from the settling.

The process is suitable for both soluble waste waters as well as waste waters containing particulate matter.

www.Jntufastupdates.com
Scanned by CamScanner

→ This technique is used for treating municipal wastewater

→ This system was developed in the year of 1979 by a Netherlands scientist mr. Gatze Lettinga

→ This ~~type~~ type of treatment plants used in countries like China, India, Pakistan, Bangladesh, and some Latin American countries

→ It is a simple technique. In India this simple technique was adopted in the year of 1989, when testing of sewage treatment plant with 5 MLD (million ~~liters~~ liters per day) capacity of waste water treatment plant (UASB Reactor) installed at Kanpur (U.P.) under the Ganga action plan

→ The UASB (Upflow Anaerobic sludge ~~Blanket~~ Blanket Reactor) consists of an upflowing treatment tank, provided with a feed inlet distribution system at the tank bottom

→ waste water enters the tank from the bottom, and this waste water flows upward ~~through~~ through the sludge bed

www.Jntufastupdates.com

Scanned by CamScanner

→ The sludge bed (blanket) traps the suspended organics of the upmoving waste water.

→ The suspended solids trapped in the sludge bed are degraded by the aerobic and anaerobically working facultative bacteria, producing methane and carbon dioxide (ie bio gas, which is a mixture of 65-70% methane, and 30-35% carbon dioxide)

→ The methane (or) bio gas is collected at the top of the tank in a gas collector

→ While the ~~water sludge~~ waste water enter into the bottom of the tank passing upwards through a sludge. This water sludge mixture is made to enter a settling tank where the sludge settles down and flows back into the bottom of the reactor

→ The sludge will show good settling properties after an initial start up period, followed by granulation forming a sludge blanket (or) sludge bed in the lowest part of the reactor.

→ The UASB Reactor (Upflow anaerobic sludge Blanket Reactor) operates as a suspended growth system,

www.Jntufastupdates.com

Scanned by CamScanner

→ In this system, small particles of the suspended matter of sewage, to form granules (చిన్న కణాలు) (or) agglomerates and ultimately the (collection of things) sludge bed (blanket)

→ the gas produced in the process causes sufficient agitation (కలయిక) to keep the sludge fully mixed.

~~→ The detention time in the reactor to be~~

→ the treated effluent is collected in gutters and discharged out of the reactor.

→ the sludge is periodically shifted into the drying beds

→ the methane generated can be used as gas for domestic (or) industrial use.

→ It may also be used for generation of electricity for running the plant

www.Jntufastupdates.com

Scanned by CamScanner

(5.4) Integrated Fixed Film Reactor:-

The process that undergoes in this type of reactors is (Integrated - Fixed Film - Activated - sludge) IFAS process.

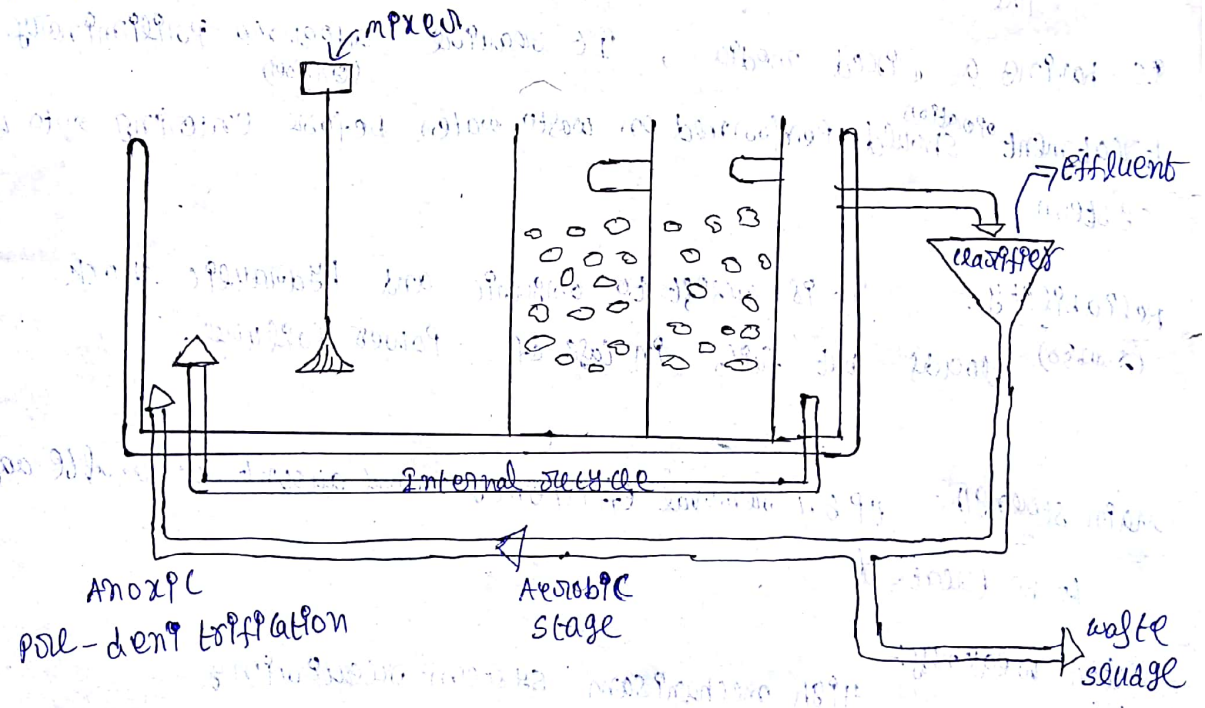
Working Principle:-

It is a simplar process to activated sludge process

In this process a fixed biomass (combines aerobic, anaerobic and anoxic zones and improves the sludge Retention time this better nitrification and promoting better nitrification compared to simple suspended growth systems.

→ The IFAS (Integrated Fixed Film - Activated sludge) technology is specifically designed for municipal wste water treatment in activated sludge processes

→ This technology was developed by Government of Canada in the year of 1994 - 97



www.Jntufastupdates.com
Scanned by CamScanner

Capacity :-

These high-tech systems are mostly used for upgrading existing treatment plants to enable extensive nitrogen removal

Performance :-

The added bio mass improves the performance of nitrifying plants

costs :-

very high construction and maintenance costs operation is very expensive why because high electricity consumption and costly mechanical parts.

self-help compatibility :-

self cleaning is very less and system parts are not locally available.

operation & maintenance :-

The IFAS (Integrated Fixed Film Activated sludge system is having a fixed media, It requires adequate preliminary treatment operation should performed on waste water before entering into the system

Reliability :- It is resist to organic and hydraulic shock loads but fails in case of power failure.

main strength :- High removal efficiency more amount of waste water to be treated.

main weakness :- High mechanisam system requiring expert design, operation & maintenance as needed of mechanical spare parts

www.Jntufastupdates.com

Scanned by CamScanner

(5.5) Septic Tanks & Imhoff Tanks

Septic Tank :-

→ septic tank may be defined as a primary sedimentation tank with a longer detention period (12 to 36 hours)

→ since the digestion of the settled sludge is carried out by anaerobic decomposition process. so the septic tank work on the principle of "Anaerobic decomposition"

→ in this septic tank will have a anaerobic decomposition of settled sludge will be releases a gases for decomposition process. of this sludge so these septic tank completely covered with water & Air tight ness and provide a vent pipe in higher position for escape of gases. into the septic tank

→ in septic tank the ~~settled~~ sludge settled at the bottom of the tank, and the oils and greasy matter rising to the top surface of sewage as scum (200) after a several months during which they are decomposed by the ~~bacteria~~ anaerobic bacteria to form gases and liquids by the process of sludge digestion

→ so the resultant sludge is to be obtained much less in ordinary settling tanks

→ in septic tank the sewage water is removed by near by sump

→ septic tanks are generally provided in areas where sewage have not been laid

www.Jntufastupdates.com

Scanned by CamScanner

→ In such areas like isolated buildings and institutions hostels, hotel, hospital, school, small residential colonies under ground sewage system with complete treatment of sewage is more economical (i.e) more safely so under such cases septic tanks are constructed. for sub surface disposal

→ The septic tanks are constructed should be far away the buildings

→ the septic tanks are donot constructed in flooding areas

→ the septic tank effluent should not be allowed into open drainage system. because it cause health hazards

www.Jntufastupdates.com

Scanned by CamScanner

Imhoff Tank:-

→ Imhoff is an improvement over septic tank

→ Imhoff tanks are two-storeyed tanks and was designed by a German scientist mr. karl Imhoff

They are sometimes also known as Two-storey Digestion tanks

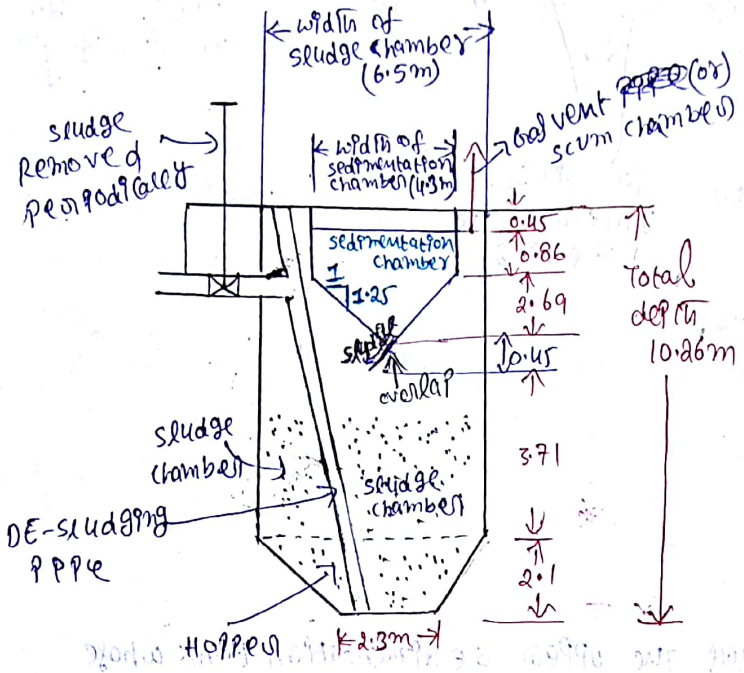


Fig:- side section of Imhoff Tank

→ It is a double chamber rectangular tank.

The upper chamber is called sedimentation chamber (or) flowing Through chamber.

For this chamber sewage flows at a very low velocity

→ The lower chamber is digestion chamber, in which the sludge gets digested due to anaerobic decomposition.

www.Jntufastupdates.com

Scanned by CamScanner

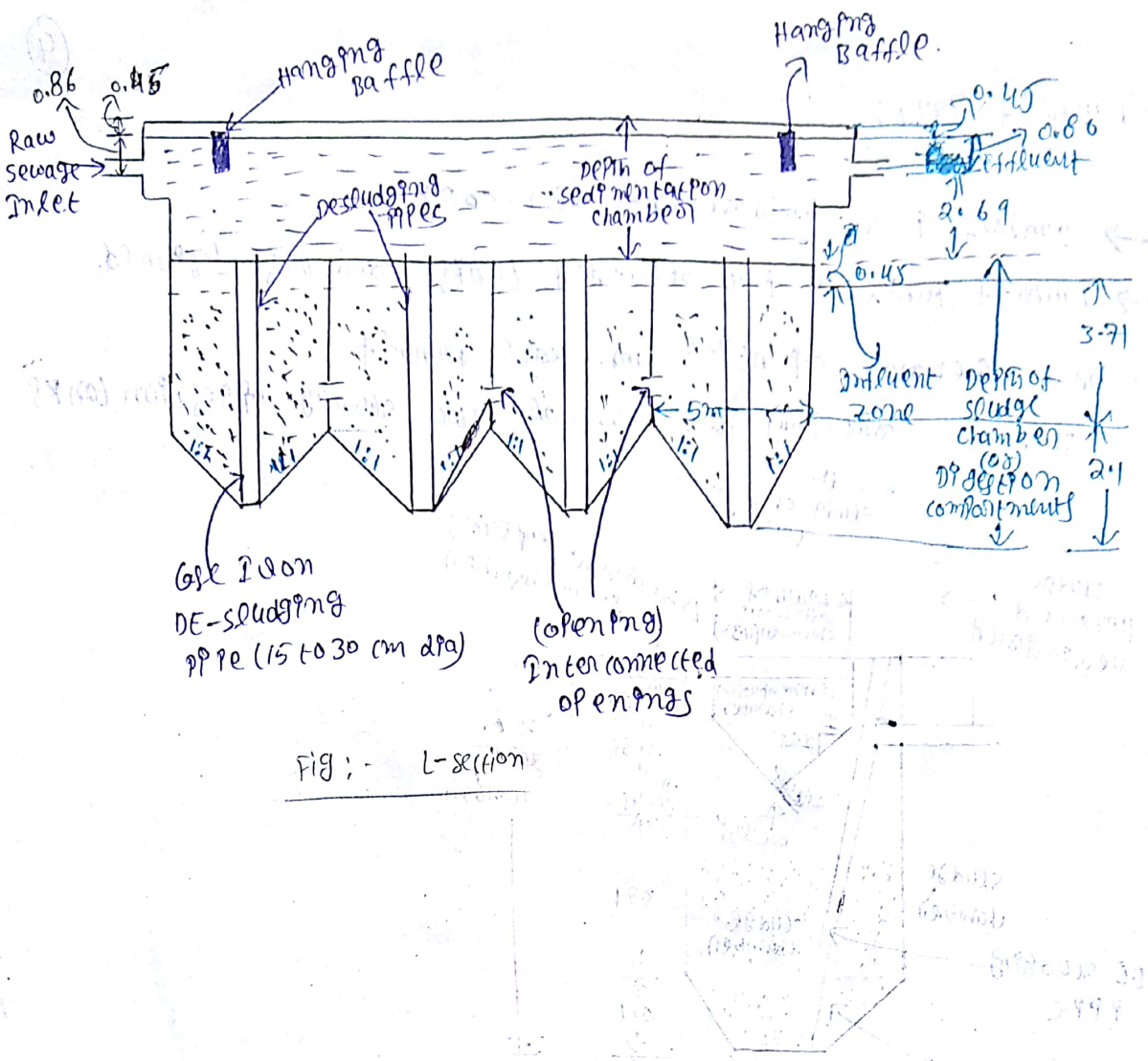


Fig :- L-section

→ First the sewage enters the upper sedimentation tank whose bottom has sharp inclinations.

→ the solids are settle in the ~~upper~~ bottom of the upper tank but in upper tank bottom sharp inclinations are providing. so these solids stop in upper tank will be settled in lower hoppers

→ these solids settled in the lower hopper for settled in a long period about 30-45 days. During this period they ~~are~~ bacterias are converted into stable solids, organic Acids and gases

→ the gases are allowed to escape in the atmosphere by providing a Gas vent pipe

→ the stabilized solids are having in bottom of the tank these stabilized solids are taken out by means of a sludge pipe under hydro static pressure.

www.Jntufastupdates.com

Scanned by CamScanner

→ The flow of solids in the lower hoppers is regulated by means of a triangular beam

→ When one hopper is filled up with the solids it's top is closed by means of the triangular beam and in that hoppers digestion starts

→ The organic matters are digested in the lower compartments. The digested sludge has black colour and has no odour. The moisture contents of this sludge is 90-95% therefore it can easily flow in the pipes.

→ The moisture content of the sludge can be removed by by. passing it through sand beds and sun-drying

→ These tanks are simple in operation and. The process is automatic, uniform and continuous the sludge can be easily removed under hydro static pressure therefore no pumping is required.

→ The dis advantage of these tanks being more depth (8-10m) on the operation process fouling gases released into the atmosphere

www.Jntufastupdates.com

Scanned by CamScanner

Septic Tanks & Imhoff Tanks:-

Septic tanks:-

Septic tanks are generally provided on areas where sewers are not having and no provision to collect toilet waste from the community.

They are best suitable if number of users are $\leq$ 300"

→ septic tank is a settling tank with long detention period. and extra provisions for digestion of the settled sludge.
(నిలువ)

→ since the digestion of the settled sludge is carried out by anaerobic decomposition process

septic tank = settling tank + digester

→ septic tank is a rectangular water tight and air tight tank constructed with masonary (or) concrete.

www.Jntufastupdates.com

Scanned by CamScanner

Imhoff Tanks:-

If numbers of users are more than 300 Imhoff tanks are preferred

Imhoff tank is a 2 compartment septic tank

upper compartment → settling of solids

lower compartment → Anaerobic digestion of settled solids.

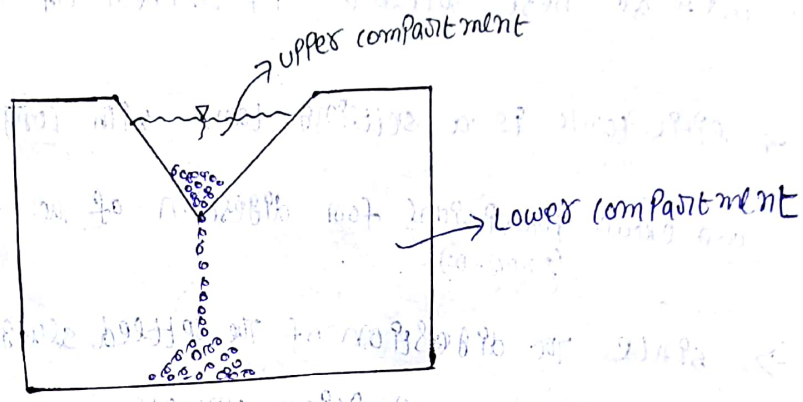


Fig:- Cross section of Imhoff tank

www.Jntufastupdates.com

Scanned by CamScanner

(5.6) Working principle & Design of septic tank:-

Septic tanks (or) soak pits are useful for disposal of waste in the areas (or) houses where public sewage system is not applicable.

→ Public sewage system is not laid at some places (or) houses are located large distance from the public sewage system. In this situation the pipe connected to house to public sewage pipe is difficult and not in economically

→ In this situation the waste produced in the house can be disposed through individual disposal system such as septic tank (or) soak pit etc

→ The septic tank is recommended for small community where population does not exceed 300

working principle:-

Sewage and waste generated in the house come into septic tank and solid matters settle down at the bottom of the tank

→ Anaerobic Bacteria convert the sewage into liquid and gases during the process of digestion

→ so result reduction in the volume of waste and it changes into semi solid condition, which is called sludge.

www.Jntufastupdates.com

Scanned by CamScanner

→ It is necessary that septic tank is covered with water tight top roof slab.

septic tanks are generally constructed in brick masonry.

→ A soak pit, also known as a soak way (or) leach pit, is a covered, porous-walled chamber that allows water to slowly soak into the ground.

~~→ The waste collecting from the storage (or) treatment~~

→ Soak pits can offer a cost-efficient opportunity for a partial treatment of waste grey (water) or storm water from a primary treatment-

Ex:- septic tank, twin-pits for pour-flush toilets.

→ The soak pits are used to discharging of water under the soil so result infiltrate the water into the surrounding soil and recharging ground water bodies.

→ A waste water percolate through the soil from the soak pit, small particles are filtered out by the soil and organics are digested by micro organisms.

www.Jntufastupdates.com

Scanned by CamScanner

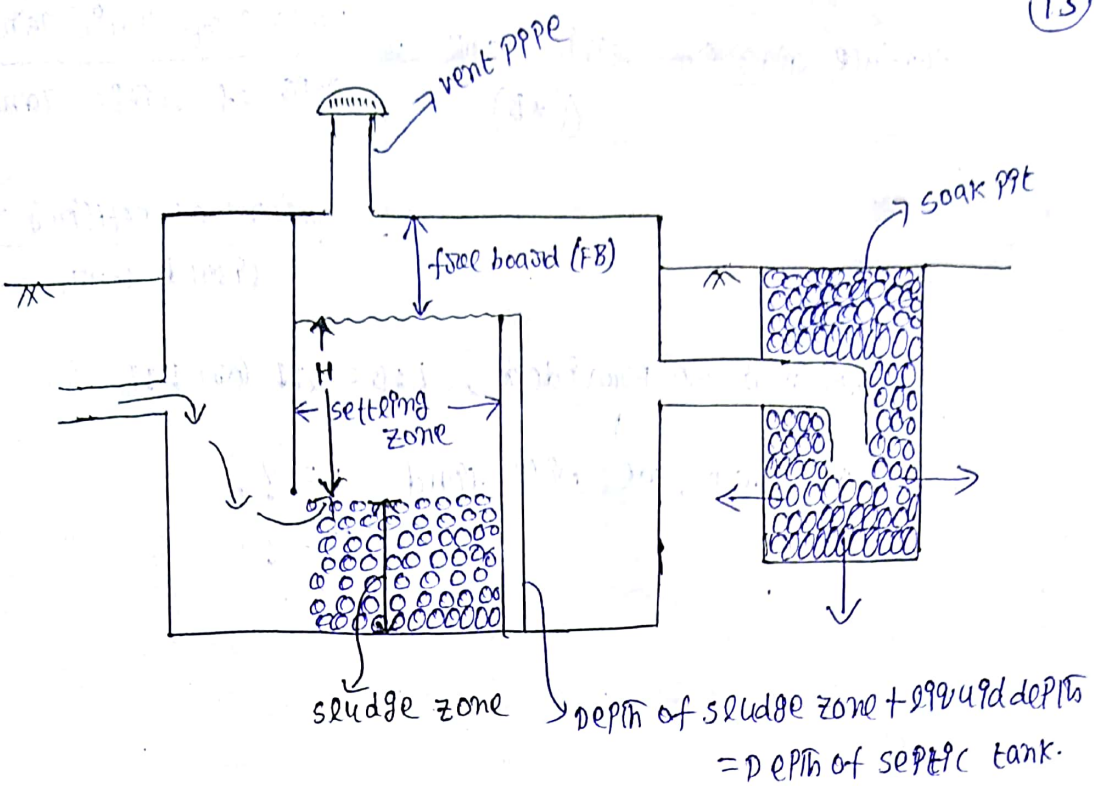


Fig:- longitudinal section of septic tank

Design:-

volume of septic tank = volume of settling zone + volume of sludge zone

volume of settling zone:-

Detention time (D.T) = 24 to 48 hours (1 to 2 days)

volume of settling zone = Q * D.T

[Q = Q_{DWF}]

volume of sludge zone:-

Rate of sludge production (ROS) = 30 to 40 lit/person/year

De sludging period (or) cleaning period = 1 to 3 years

volume of sludge zone = Ros * number of users * cleaning period.

www.Jntufastupdates.com

Scanned by CamScanner

Surface area of septic Tank (L*B) = $\frac{\text{volume of septic tank}}{\text{depth of septic tank}}$

= $\frac{\text{volume of settling zone}}{\text{provided depth}}$

Generally we provided, L:B = 2:1 (or) 4:1

based on that, we will find, L = ?

B = ?

www.Jntufastupdates.com

Scanned by CamScanner

Problems

(1) Design a septic tank for a colony of 200 people. The colony is supplied with water at a rate of 135 litres per capita per day. Assume a detention period of 24 hours and 75% of water will become sewage (waste water). The tank is cleaned once in a year. The Rate of deposition of sludge is 40 litres per person per year? Depth of tank to be kept is 2m with free board and its Ratio may be kept as 3:1?

Sol:

Given data

Population = 200 < 300 (septic tanks)

So septic tank will be used.

Detention time = 24 hours
= 1 day.

factor = 75%

$= \frac{75}{100}$

$= 0.75$

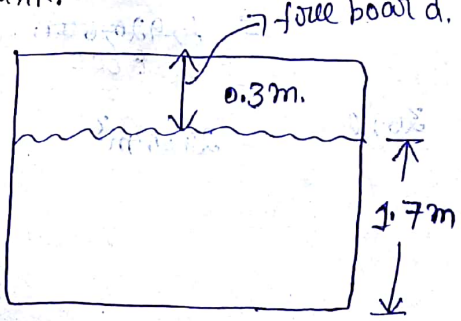
Q = 135 ~~litres/day~~ LPCD (Litres per capita per day)

Rate of deposition of sludge (ROS) = 40 litres per person per day

Depth (D) = 2m. (Including free board)

$= (1.7 + 0.3)$ → free board.

Note:
A free board ~~of~~ of about 0.3m may be provided above the top sewage line in the tank. This will help accommodate the scum in the tank.



www.Jntufastupdates.com
Scanned by CamScanner

$L/B = 3:1$

$L/B = 3/1$ (∵ given in problem)

Discharge (Q) = population * per capita supply * factors.

$= 200 * 135 * 0.75$ lt/capita/day

$= 20250$ lt/day. [∵ 1 liter $= \frac{1}{1000} m^3 = 0.001 m^3$]

$= 20250 * \frac{1}{1000} m^3/day$

$= 20.25 m^3/day.$

volume of septic tank = volume of settling zone + volume of sludge zone

volume of settling zone = Q * detention time (D.T)

Given detention time = 1 day

volume of settling zone = $20.25 m^3/day * 1 day$

$= 20.25 m^3$

(2) volume of sludge zone = Ros (Rate of sludge production) * number of users * desludging period.

$= 40$ lt/capita/year $* 200 * \frac{1 \text{ year}}{365 \text{ days}}$ [∵ 1 year]

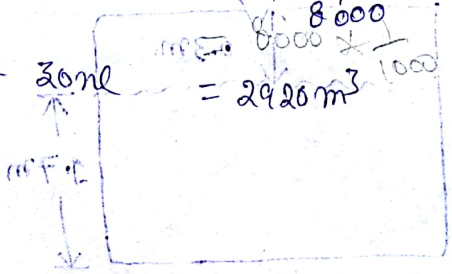
$= 40$ liters per capita/day $* 200 * 1$

$= \frac{2920000}{8000}$ liters

[∵ 1 liter $= \frac{1}{1000} m^3$]

$= \frac{2920000}{8000} * \frac{1}{1000} m^3 \Rightarrow 8 m^3$

volume of sludge zone $= 2920 m^3$ $\Rightarrow 8 m^3$



www.Jntufastupdates.com

Scanned by CamScanner

$$\text{Surface Area (L*B)} = \frac{\text{volume of septic tank}}{\text{liquid depth}}$$

$$= \frac{20.25\ m^3 + 8\ m^3}{2\ m}$$

$$= \frac{28.25\ m^3}{2m}$$

$$= 14.125\ m^2$$

In problem Given

If the ratio of the length to width is kept of 3:1 we have

$$3B^2 = 14.125\ m^2$$

$$B^2 = \frac{14.125}{3}$$

$$B = \sqrt{\frac{14.125}{3}}$$

$$= 2.16\ m$$

∴ width should be provided of (B) = 2.16 m

[∵ L:B = 3:1]

$$\text{Length (L)} = 3 * 2.16\ m$$

$$= 6.5\ m$$

∴ Area of cross section = $2.16\ m * 6.5\ m$

$$= 14.06\ m^2$$

www.Jntufastupdates.com

Scanned by CamScanner

∴ The dimensions of the septic tank will be

$= 6.5\,m \times \underset{2.16}{\cancel{4.06}}\,m \times (1.7 + 0.3\,m)$

(0.3 m → free board; 1.7 + 0.3 m → overall tank depth)

Hence use of tank size is

$= 6.5\,m \times \underset{2.16\,m}{\cancel{4.06}} \times 2\,m$

www.Jntufastupdates.com

Scanned by CamScanner

(2) Design the dimensions of a septic tank for a small colony of 150 persons provided with an assured water supply from the municipal head-works at a rate of 120 litres per person per day. Assume any data, you may need.

Sol:

The quantity of water supplied,

= Per capita rate * Population

= 120 * 150 litres/day

= 18,000 litres/day.

Assuming that 80% of water supplied become sewage

we have the quantity of sewage produced.

$= 18{,}000 * \frac{80}{100}$

$= 18{,}000 * 0.8$

= 14,400 litres/day.

Assuming the detention time to be 24 hours we have the quantity of sewage produced during the detention period. (i,e the capacity of the tank)

Volume of settling zone $= 14{,}400 * \frac{24}{24}$ (24 hours; 120 litres per day; days & 24 hours)

= 14,400 litres.

Now assuming the rate of deposited sludge as 30 litres/capita/year and also assuming the period of cleaning as 1 year, we have

www.Jntufastupdates.com

Scanned by CamScanner

The volume of sludge deposited (or) volume of sludge zone

= ROS (Rate of sludge production) * number of users * de sludging period

= 30 * 150 * 1

= 4500 lpt or ltrs

∴ Total required capacity of the tank (or) Required volume of the septic tank

= Capacity for sewage + capacity for sludge

= volume of settling zone (or) + volume of sludge zone

= 14,400 + 4500 [∵ 1 liter = $\frac{1}{1000}$ m³]

= 18,900 lpt or ltrs ⇒ $18,9000 * \frac{1}{1000}$ m³ ⇒ 18.9 m³

Assuming 1.5m as the depth of the tank, we have

The surface Area of the tank (L * B) = $\frac{\text{volume of septic tank}}{\text{liquid depth}}$

= $\frac{18.9 \text{ m}^3}{1.5 \text{ m}}$

= 12.6 m²

Assume:

If the ratio of the length to width is kept as 3:1, we have

$3B^2 = 12.6$

$B = \sqrt{\frac{12.6}{3}}$

$= \sqrt{4.2}$

= 2.04 m

∴ Provide width (B) = 2.04 m and,

Provided length of the tank = 3 * 2.04 [∵ L : B = 3 : 1]

= 6m.

∴ Area of cross-section provided = 6 * 2.04

= 12.24 m² ≅ 12.6 m²

∴ Thus, the dimensions of the septic tank will be

6m * 2.04m * (1.5 + 0.3) m overall depth [∵ 0.3 m used as free-board]

∴ Hence the size of tank is 6m * 2.04m * 1.8m

www.jntufastupdates.com

Scanned by CamScanner

Design considerations of Imhoff tank:-

In designing Imhoff tanks, the following important design points may be kept in mind.

(A) sedimentation chamber:-

It is a rectangular in shape with the following specifications

(i) Detention period = 2 to 4 hours (usually 2 hours)

(ii) Flowing Through velocity = should not be more than 0.3 m/minute

(iii) surface loading = should not exceed 30,000 litres/m^2 of plan area/day.

It may, however, be increased to about 45,000 lt/m^2/day for effluent coming activated sludge plant (or) where recirculation is adopted.

(iv) Length of the tank should preferably not exceed 30 m (or) so as to provide good sludge distribution. Length to width ratio may vary between 3 to 5

(v) In practice, a total depth of 9 to 11 m has been found sufficient for Imhoff tanks with the depth of sedimentation chamber as about 3 to 3.5 m (or) so. The free-board provided may be about 45 cm.

www.Jntufastupdates.com

Scanned by CamScanner

(B) Digestion chamber:-

This chamber is generally designed for a minimum capacity of 57 litres per capita But in warmer climates where shorter periods between sludge ~~with~~ withdrawls are possible it may be reduced to about 35 to 40 litres per capita

(C) Gas vent (or) scum chamber:-

The surface area of the scum chamber should be about 25 to 30 percent of the area of the horizontal projection of the top of the digestion chamber

The width of vent should be 60 cm (or) more

www.Jntufastupdates.com

Scanned by CamScanner

Problems

(1) Design an Imhoff tank to treat the sewage from a small town with 30,000 population. The rate of sewage may be assumed as 150 lit/day per head per day. Make suitable assumptions, wherever needed.

Sol:-

Design of sedimentation chamber:-

The sewage discharge per day

$= \underset{\text{(Population)}}{30,000} * 150 \text{ lit/day}$

$= 4,500,000 \text{ lit/day}$.

$1 \text{ lit} = \frac{1}{1000} m^3$

$= 4,500,000 * \frac{1}{1000} m^3/\text{day}$

$= 4500 \text{ cu-m/day (or) } m^3/\text{day}$

Assuming a detention period of sewage in the sedimentation chamber as 2 hours, we have.

∴ The volume of sewage entering in two hours (i.e) the capacity of the sedimentation chamber

$= 150 * 30,000 * \frac{2}{24}$ lit

(→ per day is 24 hours so)

$= 3,75,000$ lit

$= 3,75,000 * \frac{1}{1000} m^3$

$= 375 m^3$

Ans

www.Jntufastupdates.com

Scanned by CamScanner

Assume an effective depth of 2.2m (effective depth includes part of the bottom sloping walls of the chamber) and a width of 4.3m (say)

The length of the sedimentation chamber

$$(L) = \frac{\text{volume}}{\text{width} \times \text{Depth}}$$

[∵ Area = width × Depth]

$$= \frac{375\ m^3}{4.3\ m \times 2.2m}$$

$$= 39.64\ m$$

$$\simeq 40m.$$

This length is too large for a single tank. So let us adopt two tank units, each of length 20m and width 4.3 m ∴ The n.

$$\frac{L}{B} = \frac{20}{4.3}$$

$$= 4.65$$

which is between 3 to 5 and, therefore, satisfactory

Now discharge passing through each unit

= ½ of the total discharge

[∵ 2 tanks ಇರುವುದರಿಂದ each tank ಗೆ ½ discharge ತೆಗೆದುಕೊಳ್ಳಬೇಕು]

$= \frac{4.5}{2}$ million litres/day

[∵ Total discharge = 4.5 million litres already find out]

$= 2.25$ million litres/day

www.Jntufastupdates.com

Scanned by CamScanner

Check for velocity :-

length of tank = velocity * detention time

20m = velocity in m/min * (2*60 min)

$\therefore$ velocity in m/min = $\frac{20}{2*60}$

= 0.17 m/min < 0.3 m/min

and therefore, safe.

Check for surface loading :-

surface loading = $\frac{Q}{B*L}$

= $\frac{2.25 \text{ million litres/day}}{4.3\text{m} * 20\text{m}}$ [1 million = 10^6]

= $\frac{2.25 * 10^6 \text{ litres/day}}{(4.3*20)\text{ m}^2}$

= 26,162 litre/m^2/day

which is less than 30,000 lt/m^2/day ; and, therefore, satisfactory

Hence, the dimensions chosen can be accepted.

Now let us decide the depth of the rectangular and sloping portions of the sedimentation chamber with its effective depth as 2.2m → previous ಅವಶ್ಯಕತೆಯಲ್ಲಿ

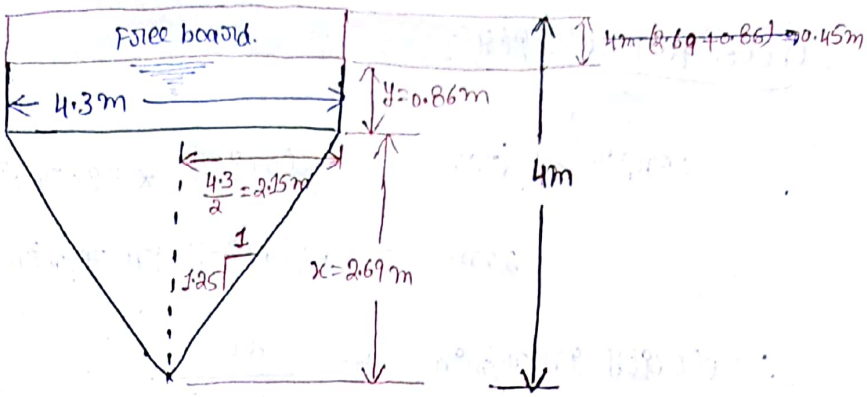
width 4.3m ~~and bottom sides~~ and also assume bottom sides sloping at 1H : 1.25V (Horizontal, vertical)

$\therefore$ the height of the sloping bottom x = 1.25 * 2.15

= 2.69 m

www.Jntufastupdates.com

Scanned by CamScanner



Now, with effective depth of 2.2m, the height of the vertical position below the liquid surface (y) is given by

$$y = 2.2 - \frac{1}{2}(2.69)$$

$$= 2.2 - 1.345$$

$$= 0.855\ m$$

$$\simeq 0.86\ m$$

Assuming value

Adding 0.45m for the free board,

The total depth of the sedimentation chamber up to bottom at the entrance of the slot

$$= 0.45 + 0.86 + 2.69$$

$$= 4m.$$

Design of Gas vent and Neutral zone:-

Provide a neutral zone of 0.45m below this depth of 4m the tank, in general, is of 20m length, but below this 4m depth of tank, it shall be devided into a number of compartments, say 4, each compartment length is

$$\frac{20}{4} = 5m$$

www.Jntufastupdates.com

Scanned by CamScanner

The area of gas vent has now to be provided on both sides of the sedimentation chamber

The width of gas vent should be about 25 to 30% of the total width of the tank

Assume an overall width of tank is 6.5 m (on the tank adding both sides of gas vent)

Assuming 15cm thickness of chamber walls

$= 6.5 - 4.3 - 2 * 0.15$ → 2 gas vent provide చేస్తున్నారు ఎందుకు 15 cm thick కాబట్టి

width of tank after adding gas vent

width of tank is not adding of gas vent

$\frac{15}{100} = 0.15$ m

[∵ 1m = 100cm. $\frac{1}{100}$ m = 1cm]

$= 1.9$ m

This is about $\frac{1.9}{6.5} * 100 = 29.23\%$ of the ~~vent pipe~~ width of gas vent of the total width of 6.5m ~~so tente OK~~

so the width of gas vent should be in the range of 25 to 30% of the total width of the tank Hence OK

⇒ The gas vent should be provided both sides of sedimentation chamber. so each side the width of Gas vent should be provided as $\frac{1.9}{2} = 0.95$ m. width of gas vent will be provided on either side of the sedimentation chamber

www.Jntufastupdates.com

Scanned by CamScanner

Design of Digestion Chamber:-

Assuming the capacity of the digestion chamber @ 40 litres/capita we have

The capacity of the digestion chamber

$= 30,000$ (population) $* 40$ litres

$= 12 * 10^5$ litres $\quad 1 \text{ litre} = \frac{1}{1000} m^3$

$= \frac{12 * 10^5}{} * \frac{1}{1000} m^3$

$= 1200 \ m^3$ (or) cu-m

Now, considering four compartments (or) units per tank so in this problem will be provided 2 tanks so each tank will be having 4 units so total in both tanks will be having 8 units so both tanks with 6.5 m width

∴ ఈ problem లో రెండు 2 tanks each tank length 20m అని ఇచ్చారు tanks length నుండి 2 tanks width without adding of gas vent is 4.3m అని gas vent & both sides of tank & add చేస్తే ఇచ్చిన tank width 6.5 m అవుతుంది

The capacity of each unit (or) compartment

$= \frac{1200 \text{ cu-m}}{8}$

$= 150$ cu-m

www.Jntufastupdates.com

Scanned by CamScanner

Now, assume the depth of each hopper as 2.1m, side slopes 1:1 and bottom section as

$$\left[6.5 - (2*2.1)\right] * \left[5 - (2*2.1)\right]$$

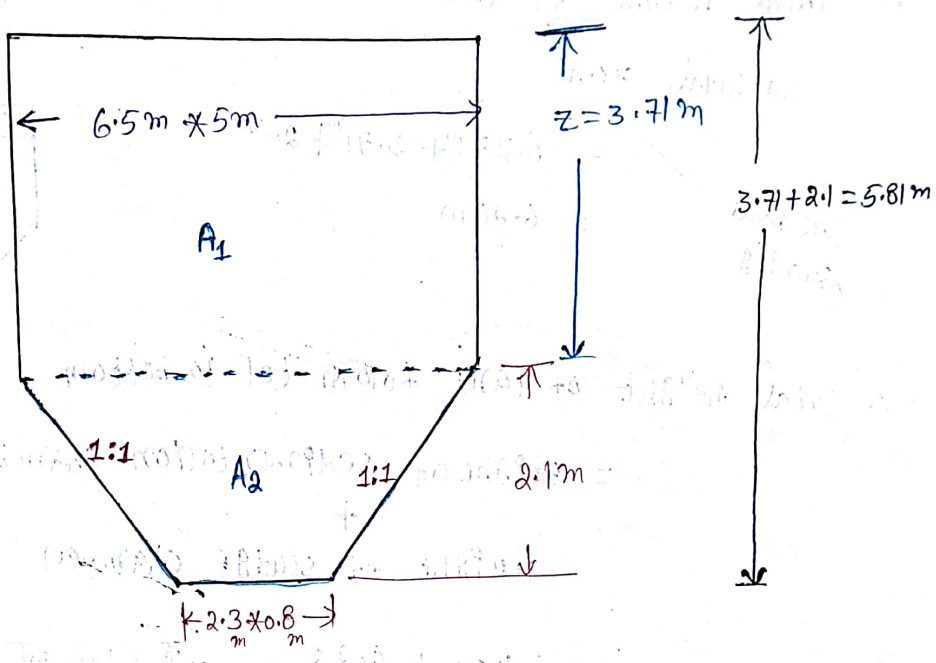
(total width of tank including gas vent)

$= 2.3m * 0.8m$ is provided at bottom section of hopper

[$\because \frac{20}{4} = 5m$]

~~Capacity of each hopper~~

$$= \frac{h}{3}\left[A_1 + A_2 + \sqrt{A_1 A_2}\right]$$



Capacity of each hopper $= \frac{h}{3}\left[A_1 + A_2 + \sqrt{A_1 A_2}\right]$

where $h = 2.1m$

$A_1 = 6.5m * 5m$

$= 32.5 m^2$

$A_2 = 2.3m * 0.8m$

$= 1.84 m^2$

Capacity of each hopper $= \frac{h}{3}\left[A_1 + A_2 + \sqrt{A_1 A_2}\right]$

$= \frac{2.1}{3}\left[32.5 + 1.84 + \sqrt{(32.5 * 1.84)}\right]$

$= 0.7\left[32.5 + 1.84 + 7.73\right]$

$= 29.45 m^3$

www.Jntufastupdates.com

Scanned by CamScanner

Balance capacity to be provided by rectangular portion of section $6.5\,m * 5\,m$

$$= 150 - 29.45$$

$$= 126.55\ m^3$$

$\left[\because \frac{1200}{8} = 150\ m^3\right]$

[∵ మొత్తం కెపాసిటీ 20]

∴ Height of this portion

$$(z) = \frac{120.55}{(6.5 * 5)}$$

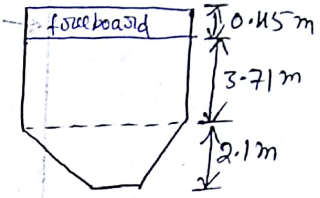
$$z = 3.71\ m$$

∴ Total height of digestion chamber including natural zone

$$= 0.45^m + 3.71^m + 2.1^m$$

$$= 6.26m$$

free board Assuming

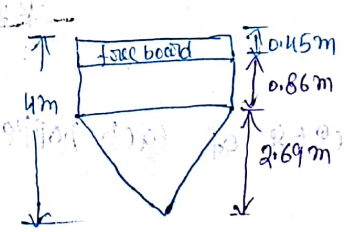


∴ Total height of tank from top to bottom

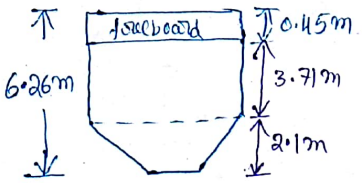
= Height of sedimentation chamber + Height of sludge chamber

$$= 4m + 6.26$$

$$= 10.26\ m.$$



This height is well with in the practical limits (i.e 9 to 11 m) and hence the design is O.K



www.Jntufastupdates.com

Scanned by CamScanner

(5.7) Disposal of septic tank effluent:-

The effluent coming out from a septic tank is no better than the effluent coming from ordinary sedimentation tank

→ It contains large amount of putrescible organic matter (200 to 250 mg/lt) and its BOD is quite high (100 to 200 mg/lt)

→ This effluent should therefore be disposed carefully otherwise will be arrived some problems that is nuisance problems and some health problems are ~~arrived~~ coming. while reducing of this problems this septic tank effluent can be disposed carefully.

The following three methods are used to disposal of septic tank effluent

1) Soil Absorption system.
2) Biological Filters and.
3) Up flow anaerobic filters.

(1) Soil Absorption system:-

The soil absorption system involves the disposal of effluent on land so we can chose sufficient land on that land soil will have a porous (will allow water inside the material) the percolation rate not exceeding 60 minutes

www.Jntufastupdates.com

Scanned by CamScanner

→ In case, sufficiently porous soil (or) porous ground is not available, the effluent coming from the septic tank send into the secondary treatment on secondary treatment will perform to treat the effluent either in a biological filter (or) in an up-flow anaerobic filter

→ After completion of treatment this effluent can dispose either in a city sewer (or) drain, (or) for gardening purposes.

⇒ The soil absorption system may be of the following two types

(a) seepage pit (or) soak pit and

(b) dispersion trench.
(వ్యాపింపజేయు) (కందకం)

(a) soak pit (or) seepage pit :-

A soak pit is a circular covered pit, the effluent is allowed into the soak pit to be soaked (or) absorbed into the surrounding soil
(నానడం)

→ The soak pit (or) sewage pit may either be filled with stone aggregate as shown in figure

www.Jntufastupdates.com

Scanned by CamScanner

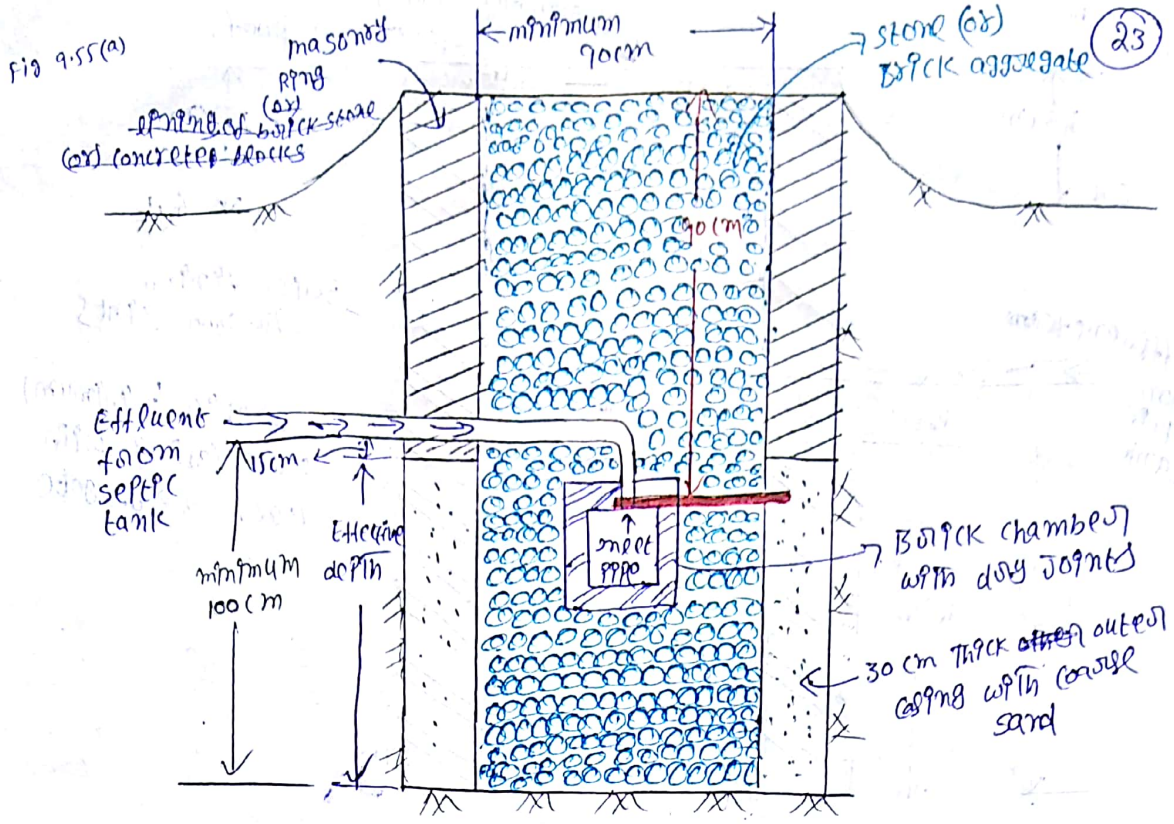


Fig:- unlined soak pit filled with stone (or) brick aggregates 9.55(a)

→ when the soak pit is empty, the pit is lined with brick, stone (or) concrete blocks with dry open joints.

→ This lined brick stone (or) concrete blocks are supported by 7.5 cm thick backing of coarse aggregate (see the second picture 7.5 cm thick coarse aggregate behind brick stone)

→ ~~The~~ ~~soakpit~~ This pit top should be covered with cement mortar and in that covered mortar a manhole should be provided as shown in figure. 9.55(b) Lined soak pit

(ఈ matter ఇక్కడ Fig 9.55(b) Lined soak pit diagram కి)

www.Jntufastupdates.com
Scanned by CamScanner

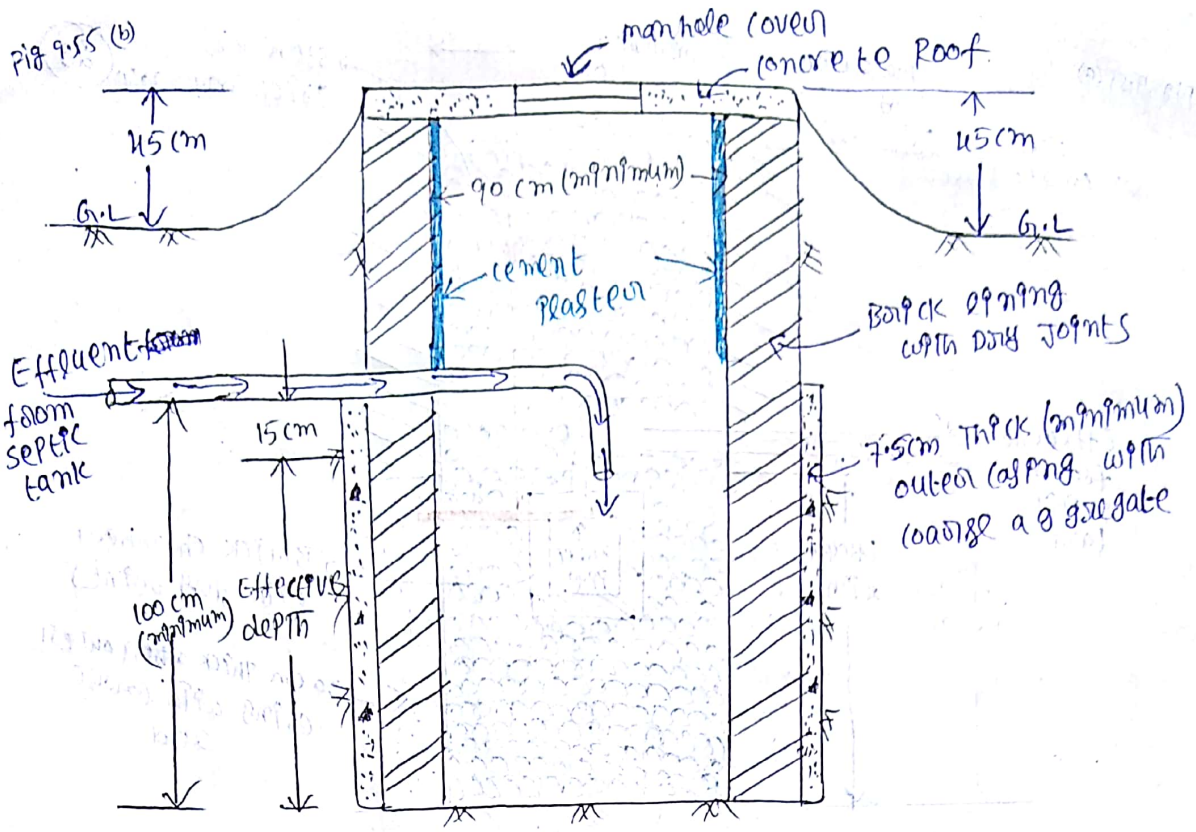


Fig 9.55 (b) Lined soak pit

→ when soak pit is filled with stone (or) brick aggregate no lining is required. but on top masonry ring is constructed to prevent damage by flooding of the pit by surface run off

[i.e matter given in Fig 9.55(a) unlined soak pits]

www.Jntufastupdates.com

Scanned by CamScanner

(b) Disposal on Absorption Trenches :-

~~→ distribution of soil by contour canal~~

In this method, the septic tank effluent is allowed to enter into a masonry chamber (called distribution box)

→ This masonry chamber is used to uniformly distributed the effluent coming from septic tank by underground network of open jointed pipes while connected with masonary chamber (or) distribution box

→ the masonry chamber (or) distribution box connected to number of absorption trenches this trenches is also called as dispersion trenches as shown in figure below

Fig 9.56 (a)

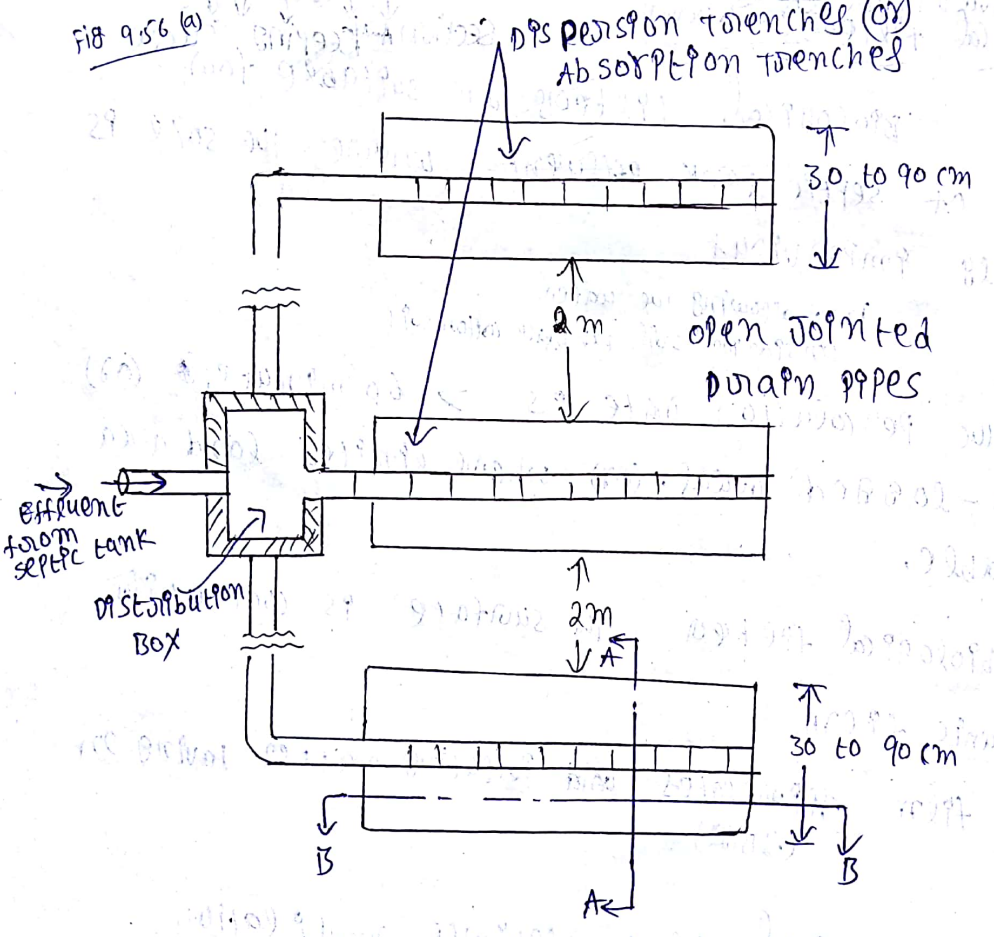


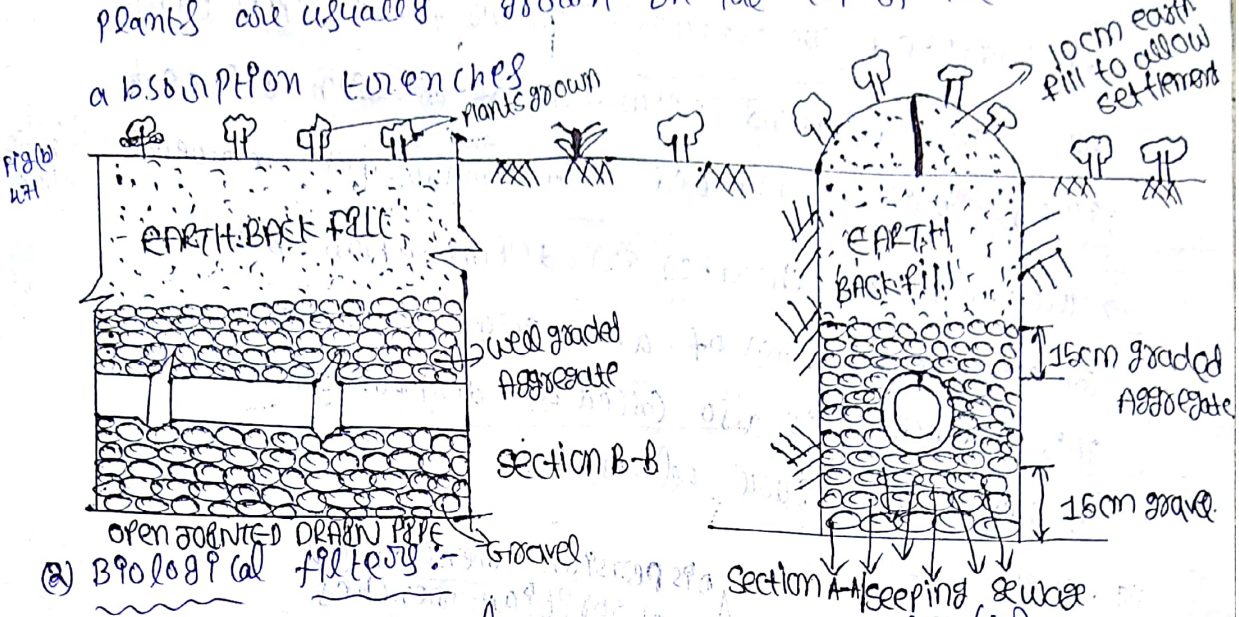
Fig:- Plan (under ground)

www.Jntufastupdates.com
Scanned by CamScanner

→ the suspended organic matter present in the effluent will be absorbed in the absorption trenches which are filled with gravel and well graded aggregate gaps the gravel & aggregates are having in absorption trenches

→ the cleaner water will seep down to the water table

plants are usually grown on the top of the absorption trenches



(2) Biological filters:-

Biological filters are suitable for treatment of septic tank effluent where the soil is relatively impervious

b) not allowing the water inside the soil Ex:- black cotton soil

→ where the percolation rate is > 60 minutes (or) water-logged areas. (or) where limited land area is available.

→ In a biological filter. The surface is coated with an organic film.

→ This film assimilates polluting matter having in effluent

→ This biological filter requires ventilation

→ the biological filters may either be rectangular (or) circular as shown in figure

www.Jntufastupdates.com

Scanned by CamScanner

Fig plan

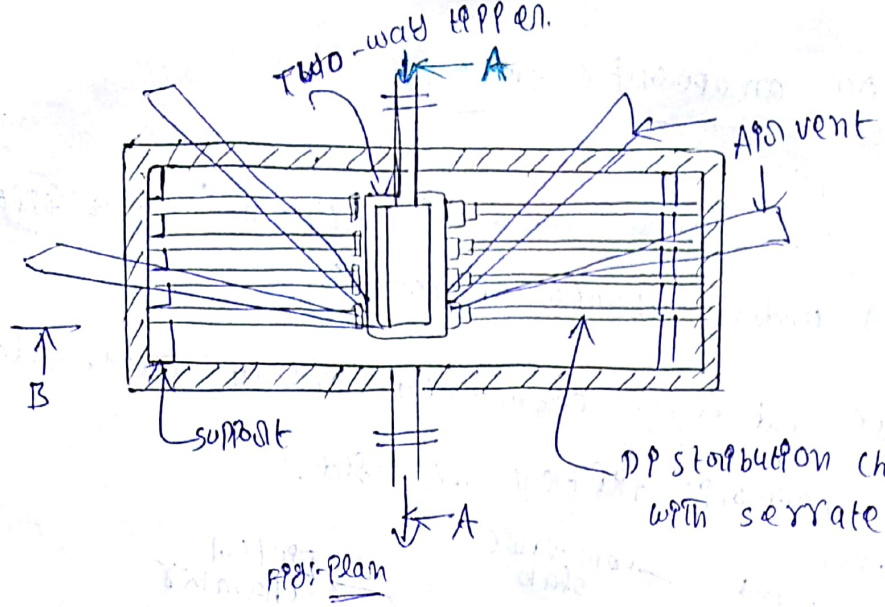


Fig:- Plan

→ A series of fixed channels (or) rotating arm distributors may be used for distributing the effluent on the media. ventilation of biological filters is essential by providing vent pipe.

→ The biological filter is below the ground level, the vent pipes from the ends of the under-drains should be carried to 150mm above the ground level outside the filters

→ Normally the filter should not be covered, but wire netting may be used to prevent falling of leaves in to the Air vent pipe.

→ The septic tank send the effluent into the Biological filters This Biological filters removing the polluting matter having in septic tank effluent so the Result the effluent volume should be reduced.

→ the Biological filters finall send into Treated Effluent into the city surface drain (or) sewer (or) is evenly distributed over a grass plot form

www.Jntufastupdates.com
Scanned by CamScanner

(3) upflow anaerobic filters:-

The upflow anaerobic filters (or) reverse filters operating under submerged condition

→ single and double chambered type of rectangular upflow anaerobic filters all used.

fig 9.58 (a)

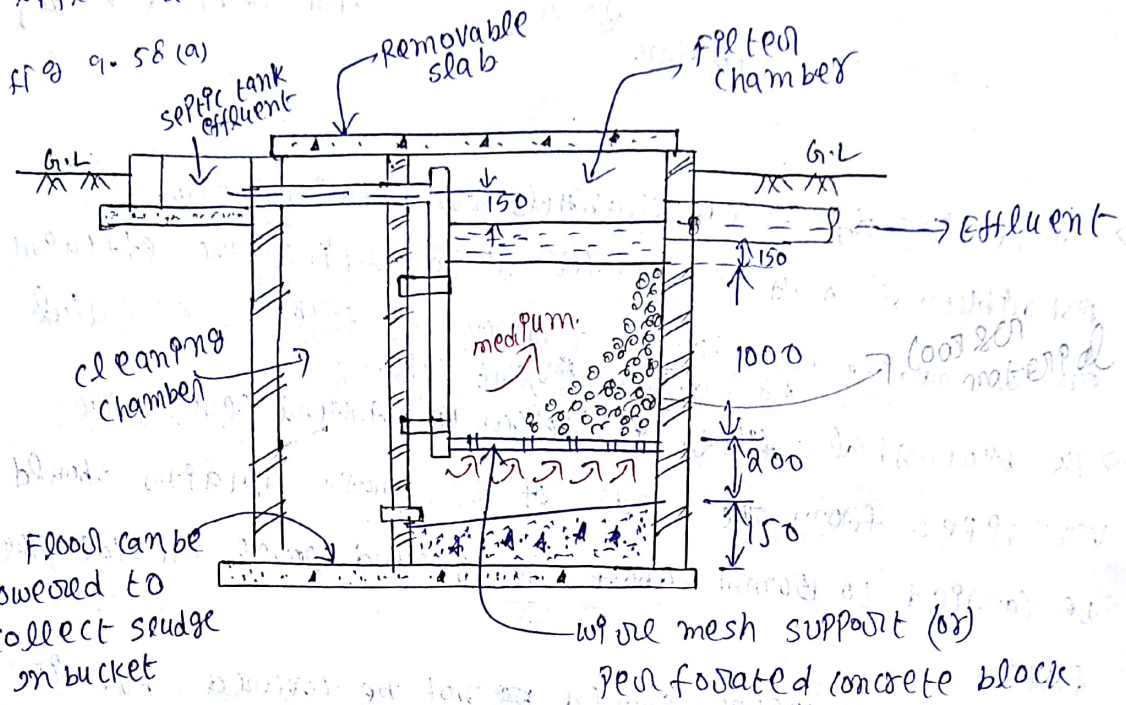


Fig:- single chambered rectangular upflow anaerobic filter

→ in single chambered rectangular upflow tank the chamber is packed with coarse material and size of packing media should be 20 mm.

→ This stone media rest on bottom concrete slab

→ The effluent coming from septic tank enters the bottom of the filter chamber through 150 mm dia pipe and distributed upward.

www.Jntufastupdates.com

Scanned by CamScanner

→ In double-chambered rectangular type of the filter consist of two inter-connected compartment

→ the first chamber is filled to a depth of 0.55m with 20mm coarse medium.

the second chamber is filled to a depth of 0.45m with 20mm size coarse medium.

→ The effluent falls through a 1st compartment and enters the second compartment directly at the ~~bottom~~ opening provided at bottom

→ In second compartment the effluent escapes over a V-notch placed 75mm above the top of the medium

diagram
fig 9.58(b)

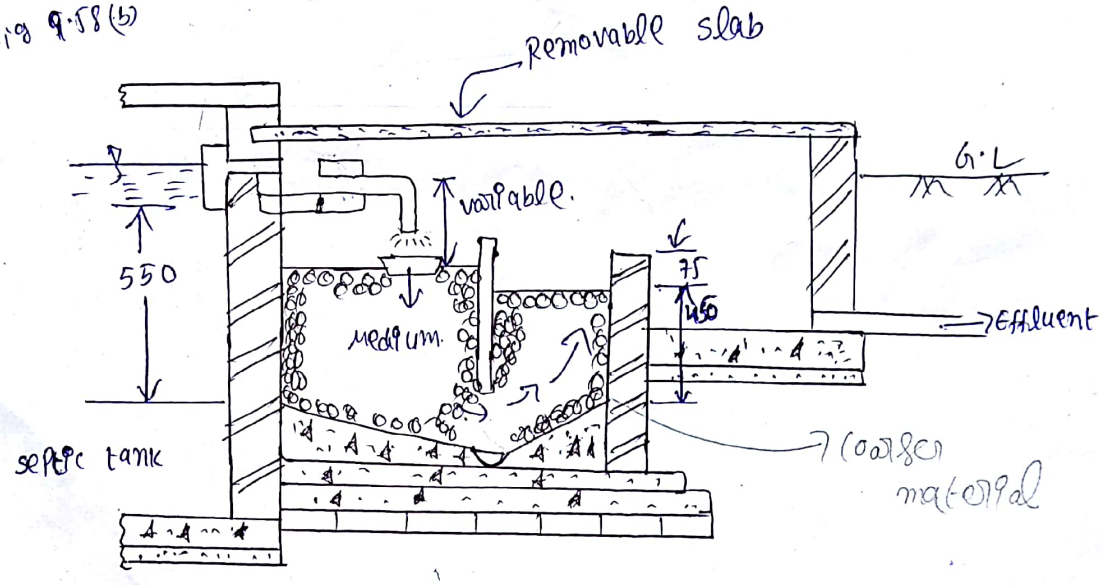


Fig (b) Double chambered rectangular upflow anaerobic filter

www.Jntufastupdates.com
Scanned by CamScanner