BHUBANANANDA ODISHA SCHOOL OF ENGINEERING, CUTTACK

DEPARTMENT OF CIVIL ENGINEERING

LECTURE NOTE ON: WATER SUPPLY AND WASTE WATER ENGINEERING

(TH-4) 5TH SEMESTER

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BOSE, CUTTACK

SEWAGE TREATMENT

Principles of treatment

→ Sewages contains various types of impurities and disease causing bacterias.

→ The sewage is disposed off by dilution on on land after its collection and conveyance

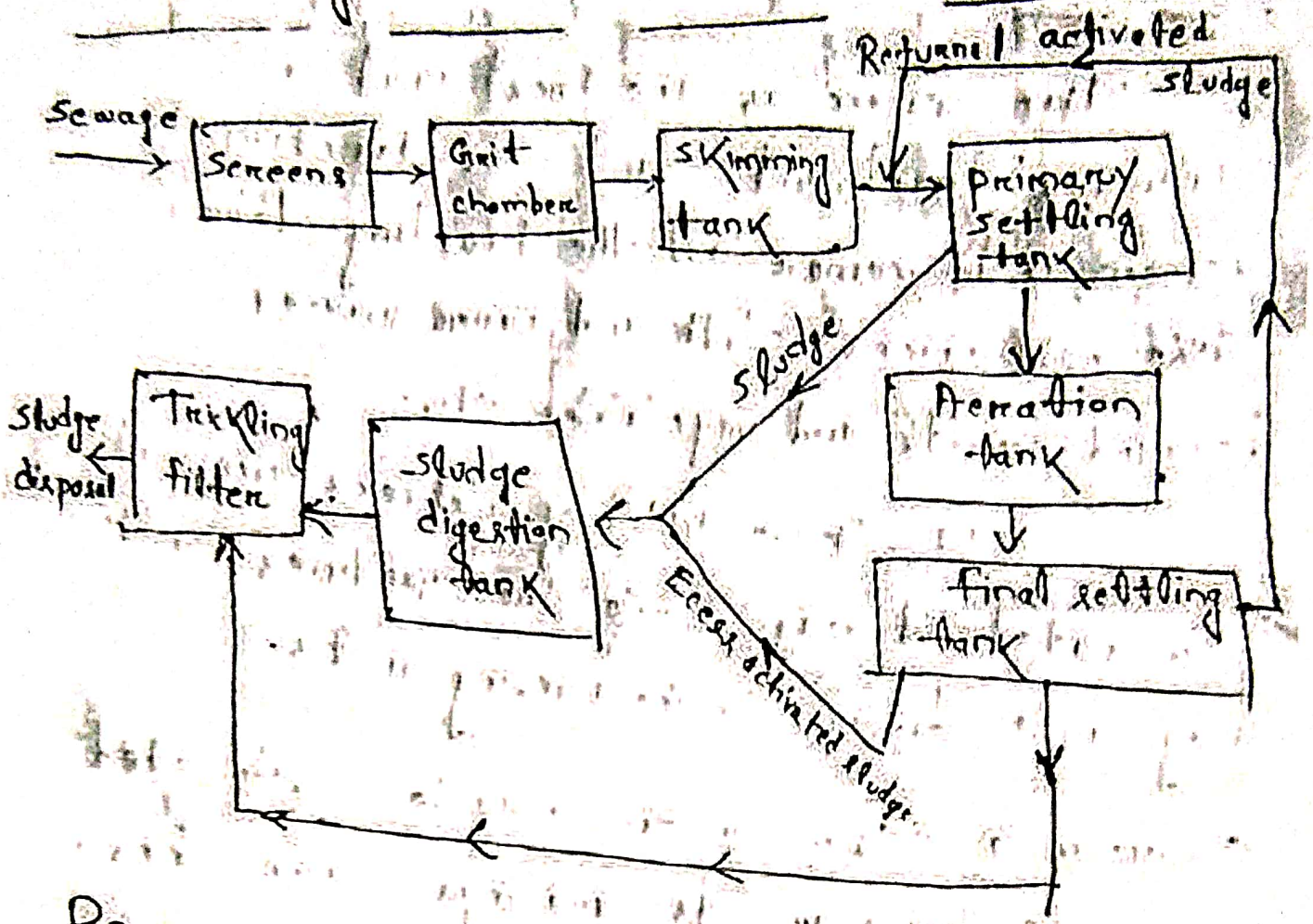
→ If the sewage directly disposed of, it will be acted upon the natural forces, and will convert into harmless substances. But, the natural purification can purify any amount of sewage within specified time.

→ Various consequences like sewage sickness and other problems may happen during natural purification

→ So, for this reason, it becomes essential to do some treatment of sewage, so that it can accepted by land or water body without any objection

→ Thus, the main principle of sewage treatment is to remove toxic impurities and nuisance creating agent from the sewage and to safely discharge it to the natural waters body and

Flow diagram of conventional treatment:



PRMARY TREATMENT

The sewage contains various suspended, floating and oily substances. By primary treatment these substances are removed from the sewage so that the working of secondary treatment units may be easy and there are no disturbances in the operation of those units.

The units of primary treatments are as follows.

SCREENS

The screen is the first unit of Primary treatment plant. The function of screen is to remove all the floating debris like wood pieces, cloth and paper pieces, decayed fruits and vegetables etc.

If these floating matters are not eliminated, it may choke the pipe lines or it may cause damage to the pumping units.

Construction:- The screens may be constructed of M.S. bars or rods, gratings, wiremeshes or perforated plates.

The screens may be fixed or movable. The inclination of the screen varies from 30° to 60°.

According to the spacing of M/s bars the screens are of following types:-

Coarse screen → spacing of bars is ≥ 40 mm c to c

Medium Screen → " " " is 10 mm to 40 mm.

Fine screen → " " " is 1.5 mm to 10 mm.

The screens are fitted in a rectangular chamber which inner surface is properly plastered plastered.

operation

The raw sewage is allowed to enter the chambers through inlet pipe and the floating debris are obstructed by screen. The sewage containing other suspended matter passes through the screen.

→ The debris may be cleaned by manual labourers or mechanical device and dumped in a area far from locality and allow them to dry.

→ After drying the debris are burnt to ashes and used as compost.

GRIT CHAMBER

The function of grit chamber is to remove the inorganic substances like grit, sand and other suspended materials.

The velocity of flow in the grit chamber is kept low so that a detention period is available for the settlement of the above substances.

Construction:- The grit chamber is an oblong rectangular chamber and constructed with brick masonary.

As shown in fig the floor of the chamber has a gentle slope used for the collection of grits at a particular zone.

The inner surfaces are plastered and finished with neat cement polish. It consists of an agitator for agitating the deposited grit at the time of ~~clean~~ cleaning.

A grit removal pipe is provided at the bottom of the chamber for periodical removal of the grits.

Operation :- The sewage from the screen chamber is allowed to enter the grit chamber and flow at a low velocity of 20 cm to 30 cm/sec.

Due to the low velocity the grits, sands etc are settled down at the bottom of the grit chamber.

The grits are generally dumped in low-lying areas for the reclamation of land.

Skimming tank/primary sedimentation tank

The function of primary sedimentation tank is to remove colloidal particles like silt and clay and some organic substance.

Moreover it reduces the load on the secondary treatment. In this tank, coagulants may be used if necessary.

Construction

It is a rectangular tank constructed with brick masonary. Baffle walls are provided in zigzag way so as to lengthen the path of the flow of the sewage.

→ Inlet & outlet pipe provided at opposite corners and are provided with valves.

→ A sludge removal pipe is provided at the bottom of the tank.

Operation

→ The sewage enters the tank through the inlet pipe and flows along the zigzag path and hence the velocity of flow is reduced. Thus the sewage is detained for a considerable period in the tank.

→ The colloidal particles and organic substances are settled down at the bottom of the tank.

→ The settled sludge is cleaned periodically through the removal pipe by opening the valve

Secondary treatment :

In the primary treatment, the large solids in sewage are removed, But the effluent still contains organic matters, bacterias, colloidal matters etc. Such effluent can not be discharged into the natural waters course.

So secondary treatments are given to the effluent of primary treatment to make it safe in all respects and suitable for discharging it into river.

The following are the units/process of secondary treatment.

Activated sludge process

Activated sludge:- The sludge which is made powerful by the process of aeration is known as activated sludge.

It contains high content of oxygen and high no. of aerobic bacteria.

* The activated sludge when mixed with sewage, the microorganisms multiply rapidly
* The activated sludge oxidises the organic substances rapidly.
* It converts the colloidal matters to settleable size rapidly.

Aeration tank :- It is the first unit of the activated sludge process.

→ The process of aeration is based on pumping of air into a tank, which promotes the microbial growth in the waste water.

→ As aeration process provides oxygen to the sewage, the micro-organisms present in it uses the oxygen and degrade the organic matters as well as feed on the organic matter and form flocks which can easily settle out in the final settling tank.

→ After aeration the activated sludge settled down at the bottom of final settling tank is recirculated and mixed with the effluent of primary settling tank just before entry to the aeration tank.

Final settling tank

The final / secondary sedimentation / settling tank is the second unit of activated sludge process.

After agitation in aeration tank, the effluent is taken to the secondary settling tank and detained for a specified period, generally of 1 hr.

As we know the settled sludge is also known as activated sludge, some portion of this sludge is recirculated to the aeration tank and the remaining portion is sent into the sludge digestion tank.

Thus the cycle of activated sludge process goes on working.

SLUDGE DIGESTION

The decomposition of complex organic matters in sludge by the bio-chemical reactions created by anaerobic bactria is termed as sludge digestion.

A portion of solids is converted into liquid and gases due to which volume is reduced by 60-75%.

Necessity of sludge digestion

→ To destroy pathogenic bacteria.
→ to reduce volume of sludge so that it can be disposed easily.
→ To obtain Combustible
→ to obtain

Sludge digestion tank

Features

— Enclosure tank :- The enclosure tank is generally circular in shape and is constructed with RCC.

→ The dia of the tank, is varies from 5-20 mt and depth varies from 3-5 mt

The ~~slope of the~~ floor of the tank is made sloping like hopper and slope is generally 1:2 or 1:3.

Gas dome

→ A gas dome is provided with the floating roof for the collection of gas formed during the process of digestion.

Inlet and outlet

An inlet pipe is provided for the entry of raw ~~sewage~~ sludge. A outlet pipe is provided at the bottom. Supernatant liquid outlets are provided at different levels. A gas outlet pipe is provided at the top for drawing the gases from dome.

Working principles

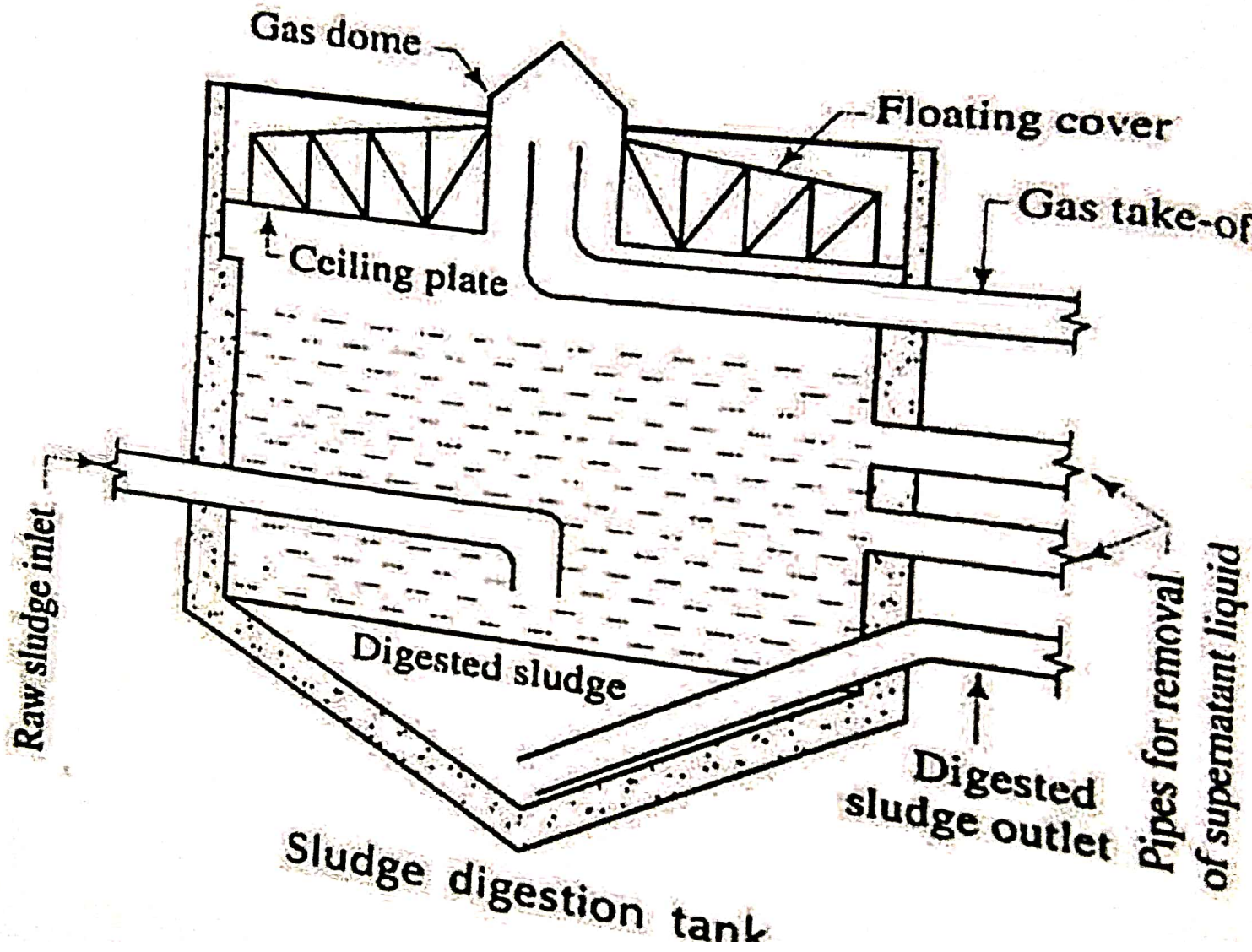
→ The raw sewage is allowed to enter the tank through the inlet pipe and is thrown at the centre of the tank.

→ The sludge is digested by the decomposition of complex organic matters by anaerobic bacteria.

→ The digested sludge is settled at the bottom of the tank which is withdrawn through the outlet valve and left for drying.

The gases are collected at the dome. The gases are withdrawn through the outlet pipe and used as fuel.

→ The supernatant liquid is collected, at the space between the digested sludge zone and the gas dome. The liquid withdrawn from different levels and disposed of in the natural water course.


Gas dome
Floating cover
Gas take-of
Ceiling plate
Raw sludge inlet
Digested sludge
Digested
sludge outlet
Pipes for removal
of supernatant liquid
Sludge digestion tank

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TRICKLING FILTER

The theory of trickling filter is based on the principle that the bacteria film (bio-film) which is formed around the filter media, ~~in the~~

→ Gradually the bacterias present in bio-film forms a number of bacteria colonies.

→ These bacteria decompose the organic matters for their survival.

→ So, the trickling filter serves the purpose of breaking the complex

bacteria.

Construction of filter

→ Generally, the trickling filter is circular in shape.

→ It consists of four numbers of rotary distributing arms which have perforation at the bottom faced horizontally

→ The arms are fitted with a central support which is rotated by a suitable device or may be rotated automatically

→ The floor of the filter is made of concrete and is slope is made towards the periphery.

Filter media

The filter media consists of broken stones, clinkers, gravels etc with their size varying from 20 - 50 mm. The largers size stones are placed at the bottom layer and smaller size stones arranged towards the top.

Dosing of Filter

A siphonic dosing tank is provided with the trickling filter for intermittent supply of effluent over the filter media.

A central pipe is provided at the filter which carries the effluent from siphonic dosing tank to the filter by rotating arms.

Ventilation

→ The ventilation of filter is necessary for smooth working of the filter as the aerobic conditions generated inside the filter media.

→ The ventilation is achieved by providing vent pipes at the periphery

Working

The effluent is spread over the filtering media of broken stones and gravels by rotating / revolving arms.

The effluent trickles down the media and gets collected in the channel.

The channel carries the effluent to the outlet pipe through which the effluent is taken for disinfection.

Cleaning

After working for long period, the upper surface of media may be clogged by sediments

In other case, the bio-film over the gravel surface get increases.

So either we can scrapped off the upper layer or we can regulate the water flow through the filter media to make the bio-film in perfect for working.

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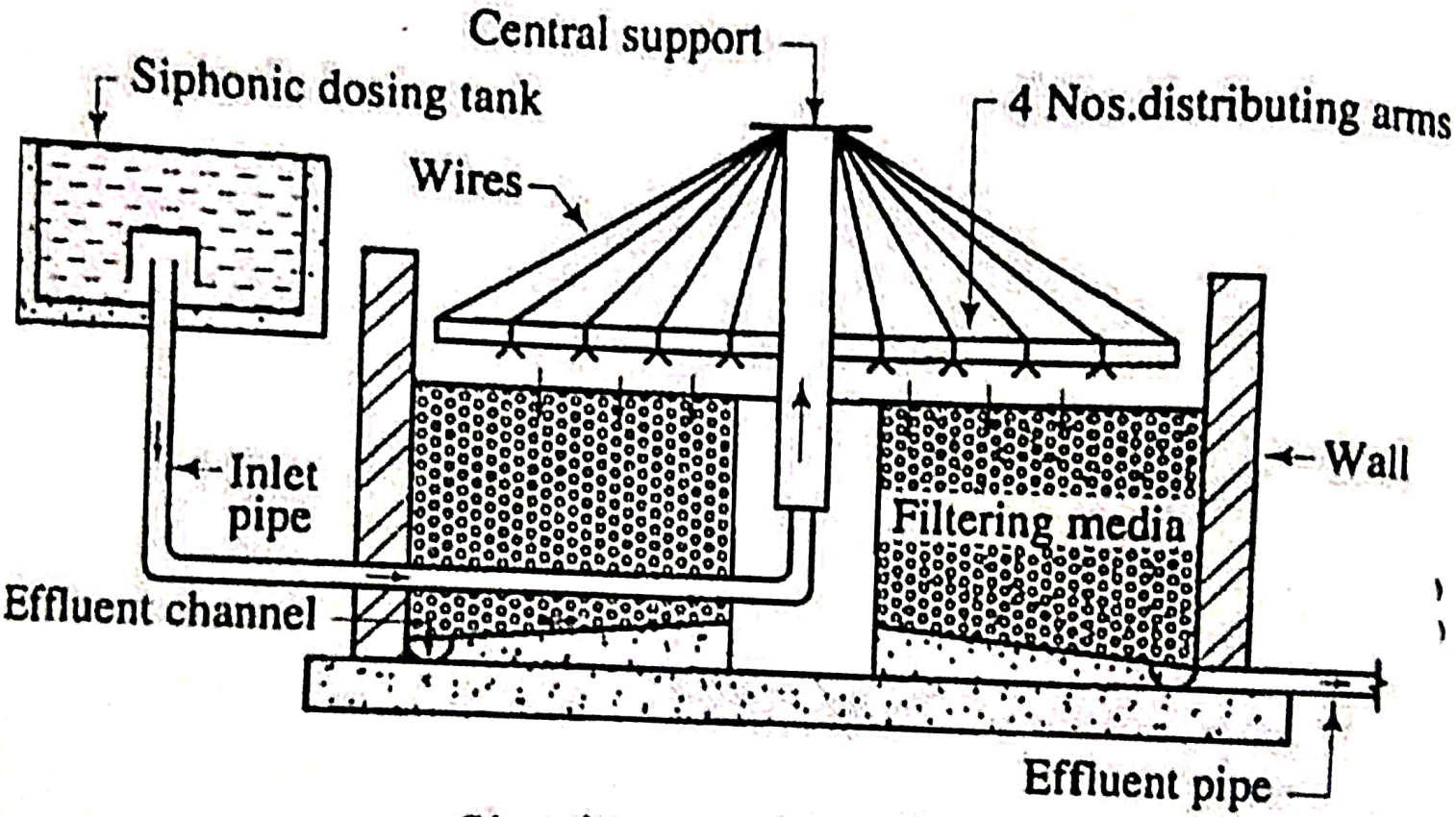

Circular trickling filter