

**CE2354 ENVIRONMENTAL ENGINEERING II**

**(FOR VI – SEMESTER)**



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## UNIT-IV

### SECONDARY TREATMENT OF SEWAGE

#### OBJECTIVE.

Selection of Treatment Methods.

Principles, Functions, Design and Drawing of Units.

Activated Sludge Process and Trickling filter.

Other treatment methods.

Oxidation ditches, Waste Stabilization Ponds

Reclamation and Reuse of sewage.

Recent Advances in Sewage Treatment.

Construction and Operation & Maintenance of Sewage Treatment Plants.

#### SECONDARY TREATMENT OF SEWAGE.

Secondary treatment is the removal of dissolve and suspended biological matter.

#### OBJECTIVES OF SECONDARY TREATMENT

The objective of secondary treatment is the further treatment of the effluent from primary treatment to remove the residual organics and suspended solids. Secondary treatment follows primary treatment and involves the removal of biodegradable dissolved and colloidal organic matter using aerobic biological treatment processes.

#### WASTE WATER TREATMENT METHODS

- Aerobic systems
- Anaerobic systems
- Natural systems
- Physico-chemical methods



## **AEROBIC TREATMENT SYSTEM**

An aerobic treatment system is a small scale [sewage treatment](#) system similar to a [septic tank](#) system, but which uses an [aerobic](#) process for [digestion](#). These systems are commonly found in [rural](#) areas where public sewers are not available, and may be used for a single residence or for a small group of homes. Unlike the traditional septic system, the aerobic treatment system produces a high quality secondary effluent, which can be sterilized and used for surface irrigation.

## **ANAEROBIC TREATMENT**

Anaerobic treatment is a biological process ideally suited for the pretreatment of high-strength wastewaters that are typical of many industrial facilities. The anaerobic process utilizes naturally-occurring bacteria to break down biodegradable material in an industrial wastestream. The anaerobic process is time-tested and does not require the purchase of special bacteria or nutrients. Because the bacteria are anaerobic they do not require oxygen like the organisms in an aerobic process. Reactors are enclosed or covered to prevent the introduction of air and the release of odors.

### **TYPES OF SYSTEMS(ANAEROBIC SYSTEM)**

#### **PACKED ANAEROBIC BED REACTORS (PABRS)**

These systems are designed for providing treatment for high-strength, low-solids wastewaters. PABRs are hybrid systems consisting of both suspended-growth and fixed-film sections, which makes these systems capable of handling relatively high organic and hydraulic loads at short retention times.

#### **HYBRID ANAEROBIC LAGOONS (HALS)**

HALs are suspended-growth systems designed to provide treatment for very high strength, high-solids wastewaters. They feature advanced mixing and flow management to promote high removal efficiencies, even under significant load variations. HALs are often designed to handle high-solids wastewaters that may otherwise require physical-chemical pretreatment prior to a biological process.

#### **PACKAGED ANAEROBIC SYSTEMS**

These modular anaerobic systems, available in suspended-growth or fixed-film configurations, are suited for small wastewater flows of 2,000 to 20,000 GPD. These units can be delivered complete to a project site, requiring only simple electrical and piping connections. The modular design allows for easy expansion and movement to new locations.

## **FACTORS FOR SELECTION OF TREATMENT METHODS**

### **AFFORDABILITY**

Depends upon financial ability of the community

Electric power available

Spare of the land needed for setting up the plan.

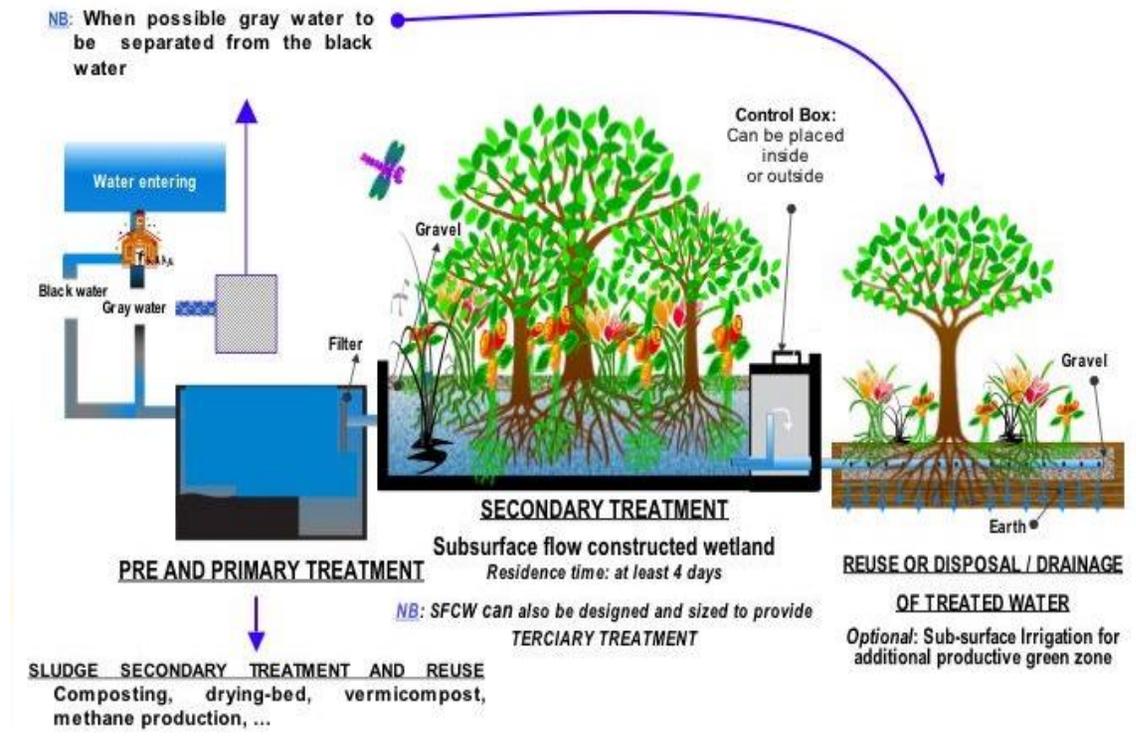
### **ACCEPTABILITY**

Pollution control authorities

Public who have to live near the treatment plant

## MANAGEABILITY

Refers to the routine operation of the plant.



## ACTIVATED SLUDGE PROCESS.

The process involves air or [oxygen](#) being introduced into a mixture of primary treated or screened sewage or industrial wastewater (called wastewater from now on) combined with organisms to develop a biological [floc](#) which reduces the [organic](#) content of the [sewage](#). This material, which in healthy sludge is a brown floc, is largely composed of [saprotrophic bacteria](#) but also has an important [protozoan](#) flora mainly composed of [amoebae](#), [Spirotrichs](#), [Peritrichs](#) including [Vorticellids](#) and a range of other filter feeding species.

## TRICKLING FILTER

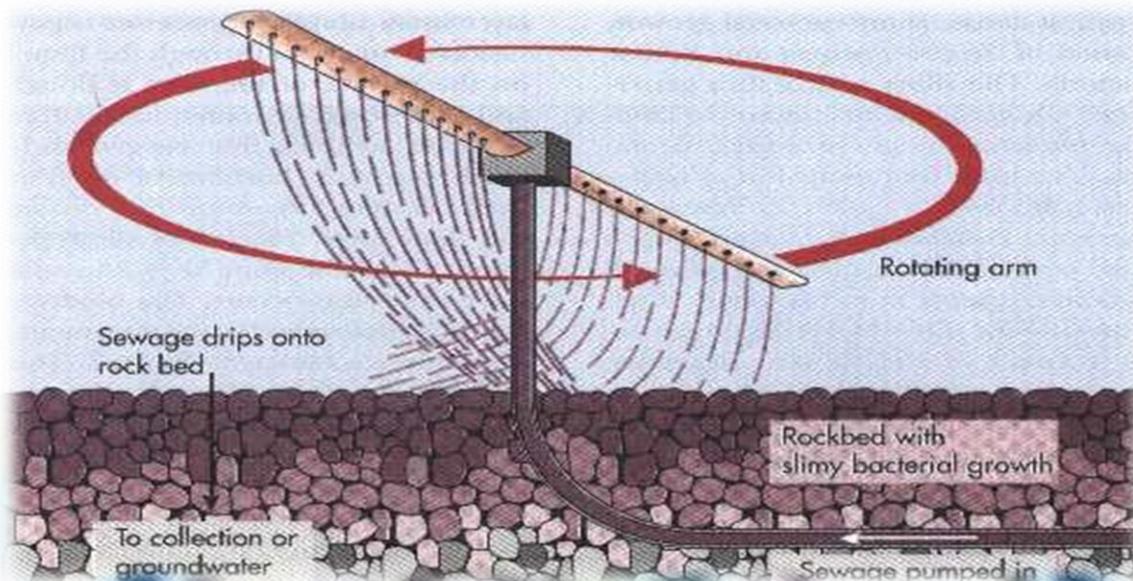
### Types of trickling filter

- ❖ Low rate trickling filter or standard rate trickling
- ❖ High rate trickling filter or high capacity trickling filter

### LOW RATE TRICKLING FILTER

The trickling filter system is relatively simple and inexpensive. It is an aerobic sewage treatment method in which the sewage is distributed by a revolving sprinkler suspended over a bed of porous material as seen in the figure. The sewage slowly moves through the porous bed and the effluent is collected at the bottom. This porous material becomes coated with a dense slimy bacterial growth which provides a home for a [heterogeneous](#) microbial community which includes bacteria, fungi, and protozoa as well as other organisms. As the sewage drains through the porous bed, this microbial community absorbs and breaks down dissolved organic nutrients in the sewage; this reduces the BOD. Aeration of the

sewage occurs by the movement of air through the porous bed. The sewage may need to be recirculated several times through the filter in order to reduce the BOD sufficiently.



### HIGH RATE TRICKLING FILTER

High rate trickling filters are similar to standard rate trickling filters. The exception is that the rate of loading for high rate trickling filter is more. This is effected by adopting the process of recirculation of sewage. Recirculation is the process of repassing a part of the filter effluent into the primary settling tank and the filter.

#### Advantages

- Improves the quality of raw sewage.
- Increase rate of loading.
- Reduce odour and fly nuisance.
- Improves treatment efficiency.

### OTHER TREATMENT METHODS

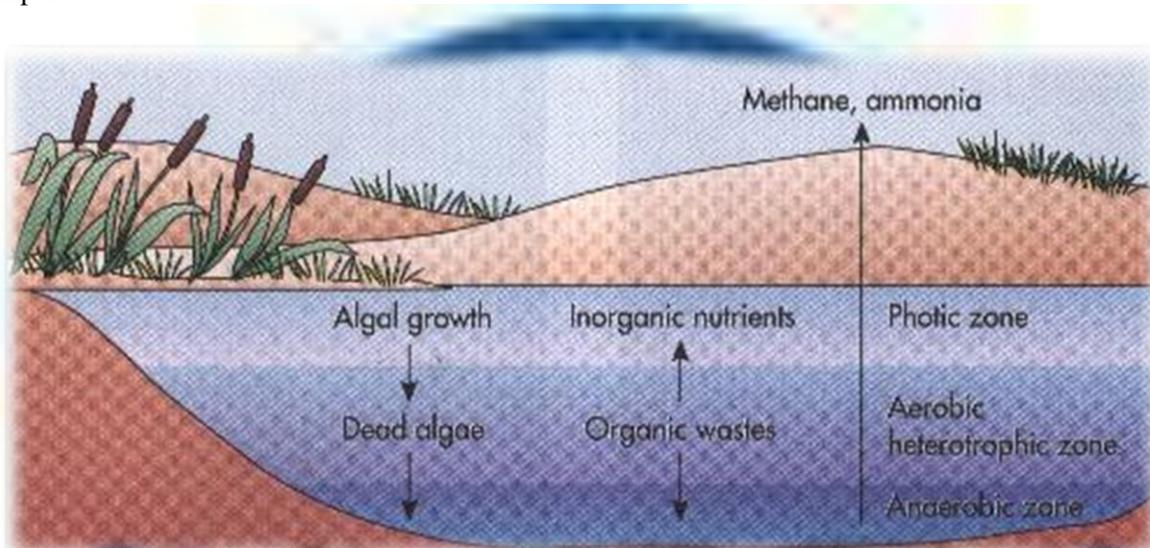
#### OXIDATION DITCH

In some areas, where more land is available, sewage is treated in large round or oval ditches with one or more horizontal aerators typically called brush or disc aerators which drive the mixed liquor around the ditch and provide aeration. They have the advantage that they are relatively easy to maintain and are resilient to shock loads that often occur. Oxidation ditches are installed commonly as 'fit & forget' technology, with typical design parameters of a [hydraulic retention time](#) of 24 - 48 hours, and a sludge age of 12 - 20 days. This compares with nitrifying activated sludge plants having a retention time of 8 hours, and a sludge age of 8 - 12 days.

#### STABILIZATION PONDS OR OXIDATION POND.

Oxidation Ponds are also known as stabilization ponds or lagoons. They are used for simple secondary treatment of sewage effluents. Within an oxidation pond [heterotrophic](#) bacteria degrade organic

matter in the sewage which results in production of cellular material and minerals. The production of these supports the growth of algae in the oxidation pond. Growth of algal populations allows further decomposition of the organic matter by producing oxygen. Typically oxidation ponds need to be less than 10 feet deep in order to support the algal growth. Oxidation pond is a body of water employed to retain sewage or organic waste water until the wastes are rendered stable and inoffensive for discharge into receiving waters or on land. The waste water in the pond is purified through physical, chemical and biological processes involving the action algae and bacteria under the influence of sunlight and air. Oxidation pond is suitable where the temperature is high with bright sunshine and the land is flat and impervious.



## RECENT ADVANCES IN SEWAGE TREATMENT

### MEMBRANE PROCESSES

A number of pressure-driven membrane processes are finding increased use for advanced water treatment, including Microfiltration (MF), Ultrafiltration (UF), Nanofiltration (NF), and Reverse osmosis (RO)

## CONSTRUCTION, OPERATION AND MAINTENANCE OF SEWAGE TREATMENT PLANTS

- Self depended
- Cost effective
- Power saving
- Eco friendly system with Ground recharge

### **ABOUT NEW STP:**

Advanced proven technology

MAR (Multistage bio-aerobic reactor) technology

### **FEATURES OF NEW STP:**

Odorless operation with self regulating system

Non-clogging design, better oxygen transfer efficiency

Simple to operate with low maintenance

compact plant with high loading rates

### **SIMPLICITY IN OPERATION AND MAINTENANCE:**

Easy to operate and maintain under widely fluctuating conditions

Easy to install

Enable easy operation, even by unskilled operator

No disposal problem:

The new STP system produces quality water

After reuse, excess water will be recharged in earth

### **PREVENTIVE MEASURES RELATING TO TREATMENT PLANT MAINTENANCE**

Regulating water consumption to decrease treatment plant loading

Taking care of regular precipitation tank emptying and excess sludge removal, usually 1–3 times per year

Inspecting the treatment plant once a month.

Having the treatment plant serviced once a year.

Taking care to prevent any harmful substances from entering the treatment plant.

Keeping information about the treatment plant up-to-date (plan, installation, siting, inspections, precipitation tank emptying and sludge removal and possibly any malfunctions and repairs).

### **TREATMENT PLANT MAINTENANCE**

Inspection visit procedures

The property owner carries out general inspection:

Inspecting the appearance and odour of water in the treatment plant basins.

inspecting the effluent monitoring container sample

checking the amount of chemical

Adding the following information to the log: number of loads treated, problem situations, procedures carried out and other observations.

excess sludge is removed, chemical added, and the precipitation tank emptied as needed.

The time needed for the inspection is 5–30 minutes.

