Secondary Treatment of textile effluents

Lecture-30
Design of a secondary treatment system.

• After Primary treatment, once suspended solids are removed, BOD/COD reduction is achieved, turbidity and colour are removed, the water has to be subjected to secondary treatment for the recovery of water.

• There are several aspects that should be considered in the design of a secondary treatment system.

1. The secondary treatment system, that normally employs reverse osmosis membranes, should be able to operate with the desired TDS level typical of the effluent. It should also generate permeate with acceptable quality.

2. It should be able to withstand membrane scaling caused by various constituents in the effluent. Bio-fouling is another problem that has to be suitably controlled.
3. To achieve maximum benefits, the percentage of recovery of pure water shall be maintained at higher side. However, increased recovery also require higher operating pressure and also results in frequent fouling of the membrane. Therefore, it is essential to utilize highly optimized system in place.

4. By monitoring the reverse osmosis feed quality with suitable sensors, automated backwash and diversion of effluent with undesirable quality to a separate tank can be achieved
Secondary treatment

• Secondary treatment refers to those treatment processes that use biological processes to convert dissolved, suspended, and colloidal organic wastes to more stable solids that can either be removed by settling or discharged to the environment without causing harm.

• The main purpose of secondary treatment (sometimes referred to as biological treatment) is to provide BOD removal beyond what is achievable by primary treatment.

• There are three commonly used approaches, and all take advantage of the ability of microorganisms to convert organic wastes (via biological treatment) into stabilized, low-energy compounds.
Trickling filters

• Two of these approaches, the trickling filter and the activated sludge process, sequentially follow normal primary treatment.

• The third, ponds (oxidation ponds or lagoons), can provide equivalent results without preliminary treatment.

• Secondary treatment processes can be separated into two large categories: fixed film systems and suspended growth systems.

• Fixed film systems are processes that use a biological growth (biomass or slime) that is attached to some form of media.

• Wastewater passes over or around the media and the slime. When the wastewater and slime are in contact, the organisms remove and oxidize the organic solids.
Suspended growth systems

• The media may be stone, redwood, synthetic materials, or any other substance that is durable (capable of withstanding weather conditions for many years), provides a large area for slime growth and an open space for ventilation, and is not toxic to the organisms in the biomass.

• Fixed film devices include trickling filters and RBCs. Suspended growth systems are processes that use a biological growth that is mixed with the wastewater. Typical suspended growth systems consist of various modifications of the activated sludge process.
Use of Ponds

• Textile Wastewater treatment can be accomplished using ponds. Ponds are relatively easy to build and manage, can accommodate large fluctuations in flow, and can also provide treatment that approaches conventional systems (producing a highly purified effluent) at much lower cost.

• Ponds can be classified (named) based upon their location in the system, the type wastes they receive, and the main biological process occurring in the pond.

• Types of ponds according to their location and the type of wastes they receive are: raw sewage stabilization ponds, oxidation ponds, and polishing ponds.

• Whereas the ponds classified by the type of processes occurring within the pond are: Aerobic Ponds, anaerobic ponds, facultative ponds, and aerated ponds.
Description of Trickling filter

• A trickling filter consists of a bed of coarse media, usually rocks or plastic, covered with microorganisms. The trickling filter process involves spraying wastewater over a solid media such as rock, plastic, or redwood slats (or laths). As the wastewater trickles over the surface of the media, a growth of microorganisms (bacteria, protozoa, fungi, algae, helminthes or worms, and larvae) develops.

• This growth is visible as a shiny slime very similar to the slime found on rocks in a stream. As the wastewater passes over this slime, the slime adsorbs the organic (food) matter. This organic matter is used for food by the microorganisms.

• At the same time, air moving through the open spaces in the filter transfers oxygen to the wastewater. This oxygen is then transferred to the slime to keep the outer layer aerobic.
How does trickling filter work

• As the microorganisms use the food and oxygen, they produce more organisms, carbon dioxide, sulfates, nitrates, and other stable by-products; these materials are then discarded from the slime back into the wastewater flow and are carried out of the filter.

The process is shown in the following equation:

Organics + Organisms \rightarrow More Organisms + CO + Solid Wastes

• The growth of the microorganisms and the build up of solid wastes in the slime make it thicker and heavier. When this slime becomes too thick, the wastewater flow breaks off parts of the slime.

• These must be removed in the final settling tank. In some trickling filters, a portion of the filter effluent is returned to the head of the trickling filter to level out variations in flow and improves operations (recirculation).
Rotating Biological Contactors RBC

- The RBC is a biological treatment system and is a variation of the attached growth idea provided by the trickling filter. Still relying on microorganisms that grow on the surface of a medium, the RBC is a fixed film biological treatment device; the basic biological process is similar to that occurring in the trickling filter. An RBC consists of a series of closely spaced (mounted side by side), circular, plastic (synthetic) disks that are typically about 3.5 m in diameter and attached to a rotating horizontal shaft.
• Approximately 40% of each disk is submersed in a tank containing the wastewater to be treated. As the RBC rotates, the attached biomass film (zoogeleal slime) that grows on the surface of the disk moves into and out of the wastewater. While submerged in the wastewater, the microorganisms absorb organics; while they are rotated out of the wastewater, they are supplied with needed oxygen for aerobic decomposition.

• As the zoogeleal slime re-enters the wastewater, excess solids and waste products are stripped off the media as sloughings. These sloughings are transported with the wastewater flow to a settling tank for removal. Modular RBC units are placed in series simply because a single contactor is not sufficient to achieve the desired level of treatment; the resulting treatment achieved exceeds conventional secondary treatment.

• Each individual contactor is called a stage and the group is known as a train. Most RBC systems consist of two or more trains with three or more stages in each.
Advantage in using RBCs

• The key advantage in using RBCs instead of trickling filters is that RBCs are easier to operate under varying load conditions, since it is easier to keep the solid medium wet at all times.

• The level of nitrification, which can be achieved by a RBC system, is also significant.

• This is especially the case when multiple stages are employed.