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MICROBIOLOGY OF STPs.

Typical activated sludge process

Wastewater is generated as a result of household activity. Purification of wastewater can be achieved by a variety of techniques. Biological purification processes achieve high purification efficiencies most economically.

Some of the well-developed technologies as on date, relate to suspended growth processes such as, activated sludge process and attached growth-bio film technologies. In suspended growth requirement of maintaining desired level of microbial activity in the aeration tanks still remains a challenge requiring personnel with knowledge of microbiology. Wash out of biomass from the aeration tank has been a handicap in such technologies. Generally any level of purification efficiency can be achieved based on the principle of micro-organisms metabolism.

Selection of appropriate technology to achieve the desired results depends on:

- Capital cost
- Power consumption
- Personnel required to operate the plant
- Recurring expenditure.

It is necessary to ensure high degree of purification by microorganisms to permit reuse or release of treated water into water bodies.

All conventional bio treatment plants using suspended processes are time consuming requiring 24 – 30 hours for nitrification to take place in the aeration tank. Nitrogen removal is accomplished in the absence of oxygen. Nitrate nitrogen formed in the aerobic process is then eliminated under anoxic conditions. De-nitrification occurs in oxygen deficient environment and requires carbon source.

These reactions require 24 hours for effective de-nitrification for total nitrogen removal in a separate tank**.**

Our hybrid plants maintain a high cell count and cell viability of the microbial consortium. The active cells in a biofilm are normally 85% to 95% in comparison to just 30 to 35% (max) in conventional suspended growth process such as Activated Sludge Process. When a biofilm having sp. gr. 1.03 fluidizes, high quality of treatment is rendered in less than half the time and produces less sludge, stabilized (fully composted), which can be disposed for horticulture application. In hybrid plants, the presence of high cell count and high cell viability, the reaction time in the reactors are drastically reduced by more than half.

Sewage contains urea, proteins, fats, organic acids and synthetic surfactants.

In flowing systems in a biological treatment facility, self-regulation of bio mass to food (pollutants) available is achieved by itself. Purification is attained in four phases:

Phase 1: Absorption of organic pollutants on the surface of active bio mass occurs in approximately 30 minutes

Phase 2: Bio oxidation of organic compounds such as carbohydrates normally occurs in 1 hour.

Phase 3: Bio degradation of heavily oxidized organics such as fats, proteins, etc. occurs in this phase.

Bacterial disintegration of protein by hydrolysis → peptones
Peptones are oxidized → amino acids → ammonia.
Ammonia nitrogen is one of the components of food for aerobic microorganism.
Nitrifying bacteria converts ammonia nitrogen→nitrite →nitrate nitrogen during their metabolism.

These reactions occur with low organic load in the aeration tank. This means - reaction time of 24 to 30 hours in suspended growth process, including Batch reactors.

This phase leads to increase in total quantity of bio mass as a result of transfer from food to bio mass. The duration of this phase varies from 3 to 30 hours depending on the bio degradability. Nitrification develops intensively during this phase.

Phase 4: This is a starvation phase also called endogenous respiration. Self-oxidation of sludge cellular element occurs.

Most biological processes do not effectively remove phosphates. Generally chemical precipitation of phosphates is resorted for complete removal which otherwise is not possible.

Presence of nitrogen and phosphorous causes growth of algae. The biological nutrient can effectively be removed by algae in the settling tank under sunlight. This is the most effective method of nutrient removal employing solar power.

Removal of suspended solids after bio treatment is relatively simple and requires simple filtration units to produce suspended solids of less than 5 ppm for reuse in cooling tower water make up. However, most settling tanks having retention beyond 3 hours produce high quality solids removal.

It is imperative to have a good biological treatment facility to produce high quality water for reuse.

Main considerations required to achieve a high degree of treatment in a conventional treatment plant are:

- One day holding in the collection tank for equalization of organic load and flow
- Nitrification in the aeration tank – requires 24 hours of retention time
- Physical filtration of suspended solids to permit reuse of water in case the settling time not enough in treated water tanks.

Pressure sand filtration followed by disinfection after proper biological treatment will permit reuse of treated water for cooling water makeup and for flushing in toilets.

Membrane bio reactors are only a substitute for physical filtration systems. A good biological treatment produces an excellent biomass separation quality which does not require an expensive method of solid liquid separation. A pressure sand filter would be more than adequate to achieve excellent results for reuse in cooling water make up, firefighting & flushing purposes.

COMPARISON ON FILTRATION PROCESSES

Any physical filtration system installed after biological treatment does not have any effect on reduction of organic loads (contamination-BOD). The physical filtration units can only reduce the suspended solids and to the extent of elimination of bacteria and viruses.

I. Conventional Filtration Process:

In the filtration process using Pressure Sand & Activated Carbon filters the clarity can be achieved with suspended solids being less than 5 mg/L. After the filtration, it would be necessary to disinfect the treated water to make it safe for reuse.

In a situation where the treated water is purely to be reused for cooling tower water make up, toilet flushing and gardening, the conventional filtration unit with sodium hypochlorite disinfection would serve the purpose.

2. Ultra Filtration Process:

This type of filtration produces excellent quality of treated water which is virtually free of bacteria and virus. The pore size of the ultra-filtration membrane is 0.02 microns.

The filtered water need not be disinfected. This water can be processed in an R O plant to obtain potable water.

To ensure long life of ultra-filtration unit one has to install a pre filtration system (Sand filter & micron filter) before the Ultra filtration unit to ensure suspended solids < 1 mg/L.

Membrane Bio Reactor Process:

The MBR may either be of immersed type in the aeration tank or externally fixed cross flow type. The immersed MBR can be installed only in case of the tanks open to sky.

The cross flow type MBR is externally fitted and does not require any expensive physical filtration systems. However, the power requirement in this type would be enormous as the flow across the membrane is maintained at a high velocity to produce quality treated water.

The MBR process eliminates the requirement of a settling tank and clarified water tank. As a stand-alone treatment plant, especially in hospitality sector, as a matter of abundant precaution considering replacement of any element in the MBR, it would be necessary to design the treatment unit for the worst scenario.

The MBR produce excellent quality of treated water free of bacterial and most viruses. The pore size of the membrane of 0.03 microns virtually eliminates virus as in the case of Ultra Filtration.

Visit www.oxyo.co for further information on hybrid systems.