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Review Study on Trickling Filters Efficiencies to Reduce the BOD Load in Effluent

Abstract

Trickling filters in treatment of waste water to reduce the B.O.D. (Biochemical Oxygen Demand) load are used, there are various types of solid Trickling filter media are available as per the requirement and type of the impurities in the waste, there are other certain factors which highly impacts the efficiency of the trickling filters like B.O.D load, Hydraulic load, size of the media, area of entire filter, temperature, flow rate and detention time of the effluent.

Keywords: Trickling Filters, Waste Water Treatment, B.O.D., Aeration, Filter Media, Dissolved Oxygen, Hydraulic Loading.

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Introduction

In present time water pollution is a burning issue, one of the major causes of surface water pollution is industrial waste, which is directly, after primary treatment or improperly treated waste having undesirable parameters more than the accepted limits, like B.O.D., C.O.D. (Chemical Oxygen Demand), pH, Temp, TSS (Total Suspended Solids), and, Nitrogen. This type of waste from chemical, tannery, starch, foam, pulp and paper industries is affecting not only the human being but also disturbing the aquatic life also. We can reduce such organic load by selecting suitable treatment process with proper design. One of the effective process to reduce such pollution is Trickling Filters for decomposition of organic solids, and reduces the concentration of various pollutants in the wastewater.

Aim of the Study

To study the effect of various factors like B.O.D. load and Hydraulic load on B.O.D. removal efficiency

Media for Filters

Trickling filter packing medium is of crushed stone, stones of different sizes or plastic with of 45-150 mm as per requirement surface area, chemical resistance with low cost Filter Depth for *Stone media*, for low-rate applications with depths of 5 to 7 feet, for high-rate applications with depths of 3 to 6 feet, for *Synthetic media,* randomly placed polypropylene with a depths of 10 to 40 feet

Stone Media

Synthetic Media

Design Structure

A standard result orientation unit should have a different size of stone or synthetic media with a specific surface medium and proper aeration system to break down organic matter more efficiently, as Compared to conventional treatment practices. Although Trickling Filter systems an expensive one, but capable to reduce the BOD less than 30 mg/liter depend upon the BOD load, Hydraulic load which may be well under the limits, subject to conditions.

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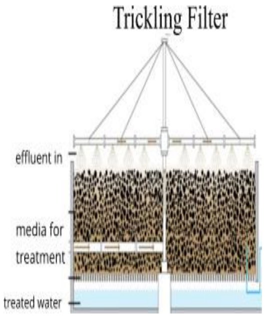
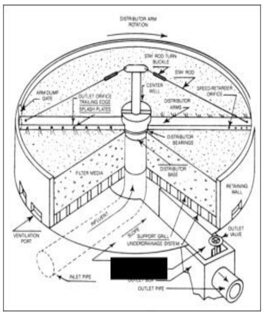


(a)



(b)

(c)

Image (a) Trickling Filter Topside, (b) Distribution of waste water scheme in Trickling Filter, (c) underground type Trickling Filter.

Process and Description

The effluent coming out from the process industry (with reference to small scale industry) has been fed from the top side in case of underground (digester base) trickling filters or in underground trickling filters from side. The effluent having BOD load and other types of pollutants pass through the media with the adhering film (which get developed after continuous flow of effluent through the media i.e. microorganisms that grows around Trickling filter media reduces organic BOD load from effluent.

Due to uneven and unsymmetrical size of the media there are tiny and wide spaces in media act as vent for incoming treated or untreated wastewater, air also circulated naturally via these tiny-wide spaces and provide the media surface to develop biofilm of microorganisms facultative bacteria are responsible to decompose the organic material and the level of D.O. (dissolved oxygen) also increases.

There are various factors affecting strongly the efficiency of trickling filter like hydraulic load, BOD load, Temperature, detention time and temperature. A high BOD organic loading rate promote the rapid growth of biomass. Excessive growth can block the tiny spaces and may reduce the efficiency of the wide spaces of the trickling filter media.

Hydraulic flow rates with increase in the hydraulic load rate and temperature the reduction BOD increases up to a certain level, extreme low temperature conditions may result change in nature of biofilms.

Recirculation

Recirculation is a recommended to increase the BOD removal efficiency of high- trickling filter processes. It is accepted with different flow rate in all types trickling filters treating domestic wastewater.

Ventilation

Provides aerobic conditions required for effective results. Ventilating manholes at both ends of the chamber provide the aerobic type environmental conditions.

Experimental Methods and Calculation

Standard procedure for determination of five days BOD **(BOD_5)**

Apparatus

BOD bottles., 20 ± 1°C incubator, Burette

Reagents

Manganese Sulfate Solution

Dissolve 480 g $MnSO_4.4H_2O$, 400 g $MnSO_4.2H_2O$ or 364 g $MnSO_4.H_2O$ in distilled water, filter, and dilute to 1L.

Alkali-iodide-azide Reagent

1. For saturated or less than saturated samples: Dissolve 500g NaOH (or 700g KOH) and 150g KI in distilled water and dilute to 1000mL. Add 10 g sodium azide, NaN_3dissolved in 40 mL distilled water. This solution should not give color with starch solution when diluted and acidified
2. For supersaturated samples: Dissolve 10g NaN_3in 500mL distilled water. Add 480g NaOH and 750g NaI and stir to dissolve the contents.

Starch Solution

Dissolve 2 g laboratory grade soluble starch and 0.2 g salicyclic acid as preservative in 100 mL hot distilled water.

Standard Sodium Thiosulfate Titrant

Dissolve 6.205 g $Na_2S_2O_3$ $.5H_2O$ in distiller water and add 1.5 mL 6N NaOH or 0.4 g solid NaOH and dilute to 1L. Standardize with bi-iodate solution.

Procedure

1. Prepare dilution water by adding 2 mL/L of following reagents in distilled water: **a.** Sodium Sulfite solution **b.** Calcium chloride solution **c.** Magnesium sulfate solution **d.** Ferric chloride solution **e.** Phosphate buffer solution
2. Now collect sample in a BOD bottle.
3. Add 1mL $MnSO_4$ followed by 1mL of alkali-iodide-azide reagent to a sample collected in specialized BOD bottle up to the neck mark. Put stopper immediately. **b.** Mix well by inverting the bottle 2-3 times and allow the precipitate to settle leaving 150 mL clear supernatant. The precipitate is white, and becomes increasingly brown with rising oxygen content.
4. Then, add 1mL conc. H_2SO_4.
5. Mix well till precipitate goes into solution.
6. Take 201 mL of this solution and titrate against std. $Na_2S_2O_3$ solution using starch(2drops) as an indicator till the color of the solution becomes either colorless or changes to its original sample color.
7. Note down volume of 0.025N sodium thiosulfate consumed.
8. As 1 mL of sodium thiosulfate of 0.025N equals to 1mg/L dissolved oxygen.

9. Dissolved oxygen (D.O) (in mg/L) = mL of sodium thiosulfate (0.025N) consumed

Results

B.O.D.

B.O.D. removal efficiency of Trickling Filters is quit good if the B.O.D. concentration below 1000 ppm.

B.O.D. concentration has been decreased and well under the limits.

DO (Dissolved Oxygen)

Level increases.

Biomass

Biomass Microorganism it is in the form of film developed around the media (natural stones or synthetic media)

pH

pH Value also improves.

Temperature

Temperature is also decreases.

Discussion

B.O.D. load and Hydraulic loading

Calculated amount of B.O.D. load should be fed with co-relation with hydraulic load. The concentration of BOD has been decreased well under the limits. About 60-70% in case of inlet BOD load is under 1000 ppm.

D.O. (Dissolved Oxygen)

Level increase due to natural aeration system employed in process, hydraulic load and microorganism

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