Design of Sewage Treatment Plant

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Abstract— **The increasing demand for water in combination with frequent drought periods, even in areas traditionally rich in water resources, puts at risk the sustainability of current living standards. In industrialized countries, widespread shortage of water is caused due to contamination of ground and surface water by industrial effluents, and agricultural chemicals. In many developing countries, industrial pollution is less common, though they are severe near large urban centers. However, untreated or partially-treated sewage poses an acute water pollution problem that causes low water availability. Global trends such as urbanization and migration have increased the demand for water, food and energy. Development of human societies is heavily dependent upon availability of water with suitable quality and in adequate quantities, for a variety of uses ranging from domestic to industrial supplies and Rapid industrialization is adversely impacting the environment globally.**

Index Terms— **ph,TDS,TSS,Effluent**

I. Introduction

Pollution in its broadest sense includes all changes that curtail natural utility and exert deleterious effect on life. The crisis triggered by the rapidly growing population and industrialization with the resultant degradation of the environment causes a grave threat to the quality of life. Degradation of water quality is the unfavorable alteration of the physical, chemical and biological properties of water that prevents domestic, commercial, industrial, agricultural, recreational and other beneficial uses of water. Sewage and sewage effluents are the major sources of water pollution. Sewage is mainly composed of human fecal material, domestic wastes including wash-water and industrial wastes. The growing environmental pollution needs for decontaminating waste water result in the study of characterization of waste water, especially domestic sewage. In the past, domestic waste water treatment was mainly confined to organic carbon removal. Recently, increasing pollution in the waste water leads to developing and implementing new treatment techniques to control nitrogen and other priority pollutants. Sewage Treatment Plant is a facility designed to receive the waste from domestic, commercial and industrial sources and to remove materials that damage water quality and compromise public health and safety when discharged into water receiving systems. It includes physical, chemical, and biological processes to remove various contaminants depending on its constituents. Using advanced technology it is now possible to re-use sewage effluent for drinking water

i. Problem Statement

1. For college Building, Hostel & Canteen, etc we use plenty of water daily & thrown directly through drainage or effluent line directly. We just waste our water & cannot utilize it for our General daily routine such as Gardening, Toilet Flush, Bus or Car washing, Floor Cleaning etc. For this above operation we utilize potable & fresh water for it.
2. Nowadays ETP plant is very costly to built so the cost reduction is necessary task to achieve.

ii. Objectives

1. The principal objective of waste water treatment is generally to allow human effluents to be disposed without danger to human health or unacceptable damage to the natural environment.
2. An environmentally safe fluid waste stream is produced. No danger to human health or unacceptable damage to the natural environment is expected.
3. To study the physical, chemical and biological characterization of the domestic waste water from college
4. Design of the sewage treatment plant.

iii. Scope

1. Moving bed bio film reactor tank works under aerobic treatment in which we treat water for secondary purpose other than drinking.
2. We analyze only pH, TDS, TSS & Oil grease parameter.
3. The byproduct after treatment i.e. sludge is used as Fertilizer for Agriculture.
4. Treated water can also be used in agriculture this water is desalinated

iv. Methodology

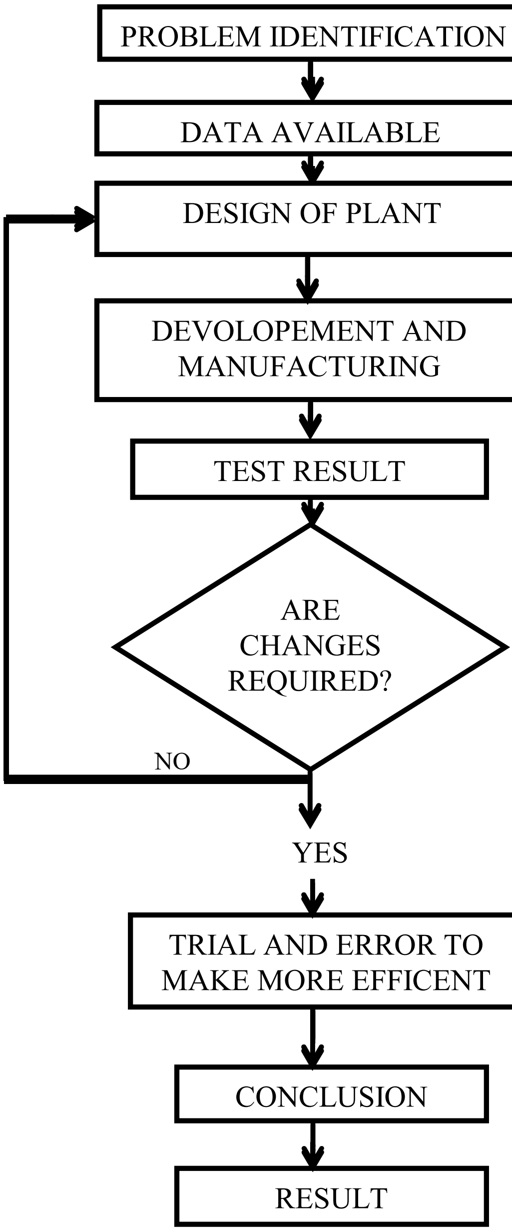


Fig. Flowchart of Methodology

Design, Development and Manufacturing

Basic units of plant are as follows.

1. Screening
2. Collection tank
3. Equalization tank
4. MBBR unit
5. Settling tank
6. Dosing system
7. Charcoal Filter
8. Sand Filter

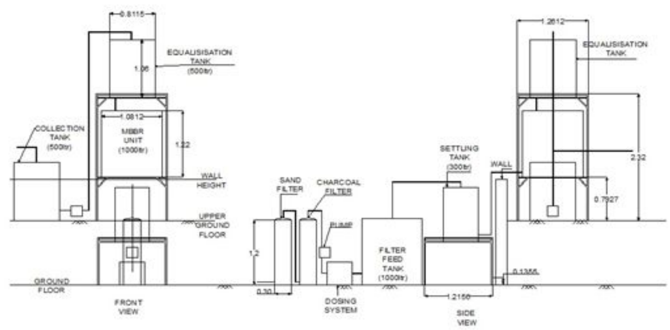
Take Result

After design and manufacturing we will take the final result of the sewage treatment plant

Conclusion

Finally we will take conclusion of developed plant for cost reduction and Efficiency.

LAYOUT OF PLANT



DESIGN OF PLANT

1. Raw sewage characteristics

Avg. sewage flow entering the plant=3000lit/day

Assume peak factor=1.5

Peak sewage flow entering the plant= Avg. sewage flow entering × peak factor

=3000 × 1.5

=4500lit/day

COD=392mg/lit

BOD=130mg/lit

TDS=868mg/lit

TSS=140mg/lit

pH=6.98

2. Inlet chamber

Quantity of the flow=25000m^3/day=3000lit/day

Peak flow$=\frac{\text{peak flow entering the plant}}{1000}$

$=\frac{4500}{1000}$ =4.5m^3/day =5.20×$10^{-5}$$m^3$/sec ≈ 0

Assume detention period=10sec

Volume of the inlet chamber = peak flow × assume detention period

= 0 ×10

= 0

So no inlet chamber is required.

Assume depth of flow=0.60m

Area required for inlet chamber= $\frac{\text{volume of inlet chamber}}{\text{Assume depth of the flow}}$

$= \frac{0}{0.60} m^2$

$= 0 m^2$

Assume length to breadth ratio = 1

Breadth of the tank= $\sqrt{\frac{\text{area required for inlet chamber}}{\text{lenghth to breadth ratio}}} \times 0.1$

$= \sqrt{\frac{0}{1}} \times 0.1$

$= 0.10 m$

Length of the tank = length to breadth ratio × breadth of the tank

$= 1 \times 0.1$

$= 0.10$

3. Screen chamber

Peak design flow=0.0m^3/s (CPHEEO page no. 201)

Assume clear spacing between bar = 6mm.

Velocity ahead of the screen=0.60m/s

Area of the screen channel= $\frac{\text{peak design flow}}{\text{velocity}} \times 2$

$= \frac{0}{0.60} \times 2$

$= 0 m^2$

Keeping side water depth=0.50m

Width of each screen channel (w)

W= $\frac{\text{Area of the screen channel}}{\text{keeping side water depth}} \times 2 \times 0.1$

=0 m

No. of the opening in the chamber

W=X.O+(X-1)t

Where, X=no. of opening

O=clear space between the bar

t=thickness of the flat

$= (((\frac{\text{width of the each screen channel}}{\text{spacing between the bar/1000}} \times 2)+t) \times 6)$

$= (((\frac{0+0.01}{6/1000} \times 2)+0.01) \times 6)$

=1

Total width of the opening=Ws=X.O

$= \frac{\text{No.of opening in the chamber} \times \text{clear spacing}}{1000}$

$= \frac{1 \times 6}{1000}$

= 0.006

Assume angle of inclination=60^o.

Assume detention period in screen channel=6sec

Assume length of screen chamber=detention period×velocity head of the screen

$= 6 \times 0.60$

$= 3.6m$

4. Equalization Tank

No. of the tank propose= 1.

Peak design flow= $\frac{\text{peak sewage flow}}{1000}$

$= \frac{4500}{1000}$

=4.5m^3/day.

Assume detention period=3hr

Volume of the tank= $(\frac{\text{peak design flow}}{24}) \times$ detention period

$= (\frac{4.5}{24}) \times 3$

=0.5625m^3

Assume depth of liquid column=2m

Area required for equalization tank= $\frac{\text{volume of the tank}}{\text{Depth of liquid coloumn}}$

$= \frac{0.5625}{2}$

= 0.28125m^2.

Length to breadth ratio=1

Breadth of the tank= $(\sqrt{\frac{\text{area required for equlisation tank}}{\text{lenghth to breadth ratio}}}) \times 0.5$

$= (\sqrt{\frac{0.28125}{1}}) \times 0.5$

=1m

Length of the tank= Breadth of the tank × length to breadth ratio

$= 1 \times 1$

=1m

5. Mixing arrangement

Assume BOD required in tank=15%

Incoming BOD of raw sewage=130mg/lit

BOD to be reduce= Assume BOD required in a tank × Incoming BOD of raw sewage

= 15%×130

=19.5mg/lit

BOD load= $\frac{\text{BOD to be reduce} \times \text{Peak design flow}}{1000}$

=0.1kg/day

Oxygen required to remove the BOD load = 2 kg/kg of BOD..

Oxygen required=BOD load× Oxygen required to remove BOD load

$= 0.1 \times 2$

=0.2kg/day

=0.01kg/hr

Actual air required= $\frac{\text{Oxygen required in kg/hr}}{0.6 \times 0.7 \times 1.2 \times 0.21 \times 0.15}$

$= \frac{0.01}{0.6 \times 0.7 \times 1.2 \times 0.21 \times 0.15}$

=0.46m^3/hr

Provide coarse bubble aeration grids for 10m^3/hr.

6. Raw sewage pump

No. of pump=2

Type of the pump=

Avg. Flow=25000m^3/day.

No. of working hours=8hrs

Flow capacity of pump required= $\frac{\text{Avg. flow}}{\text{no.of working hours}}$

$= \frac{25000}{8}$

=3125m^3/hr

Head required=14m

7. Aeration tank

No. of aeration tank=1

Flow completely mixed

Q-per tank=12500m^3/day BOD=110

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=130-20

=110

MLSS (Mix liquor suspended solid)=2500 mg/lit.

Type aeration=

No. of compressor=1

Area of each tank=2877.60 m^2

Assume breadth to length ratio=1

Diameter of the tank

Capacity of aeration tank=1000lit.

Assume depth=2m

Area=0.5m^2

$$D=\sqrt{\frac{area\times 4}{\pi}}$$

$$=\sqrt{\frac{0.5\times 4}{\pi}}$$

=0.7978m

8.Sand filter

Average flow=25000m^3/day.

Filter operating hours=8hrs.

$$\text{Operating flow}=\frac{\text{Avg. flow}}{\text{filter operating hours}}$$

$$=\frac{25000}{8}$$

=3125 m^3/hr.

CONCLUSION

The plant will reduce the effluent In the considerable amount. efficient reduction in parameter from treatment units of STP. Up to 20% COD. reduction is obtained at biological treatment. pH variations are there in outlet but

outlet pH values are in required range so pH. Design of the stp plant with economical consideration is done.

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