Design of Sewage Treatment Plant

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Abstract— - Sewage is the waste water collecting from the different sourcessuch as domestic, industrial, public, institutional etc. In Indiamostly 25-30% waste water is getting treated to the satisfactorylevel also the central and state government invest large amountin sanitary sector. In the design of Sewage Treatment Plant thevarious unit such as Preliminary, Primary Secondary, Tertiarytreatment units are design by using ETP. After completion ofmanual analysis the design of STP is done on ETP software.

Keywords: Sewage, Wastewater, ETP, STP, Preliminary,Primary, Secondary.

I. INTRODUCTION

Sewage is a mixture of domestic as well industrial wastes. It is more than 99% water, but the remaining sewage contains some ions, suspended solids and harmful bacteria that must be removed before the water is released into the sea or ocean. Sewage treatment, or domestic wastewater treatment, is the process of removing contaminants from wastewater and household sewage, both runoff (effluents) and domestic. The water of College which become waste due to dissolve of various impurities in it from the canteen, hostels, workshop, college and also such as urinals etc. This can be directly transfer to the river and due to this it becomes polluted. The water supply to the college from the "Ground water" and well treatment such as filtering can be done before supply to the public so that if there is design STP then this expenditure on filtration can becomes less and the river water does not get polluted due to this plant and this waste water after filtration can be reuse, recycle for the future need of college such can be used again for irrigation, construction and for multipurpose. So there is best way to design STP; so that it can be reduced the problems which suffer the local people and health remains safe. And overall the college area remains clean, beautiful. This is our main aim behind this project. So we design STP for Jaihind College of Engineering Kuran, in the form of model and after our successful design of project this can be come in actual work

II. METHODOLOGY

The treatment of sewage consists of many complex functions. The type of treatment depends upon the characteristics of the raw inlet sewage as well as the required effluent characteristics.

Treatment processes are classified as:

A. Preliminary treatment
B. Primary treatment
C. Secondary treatment
D. Tertiary treatment.

A. PRELIMINARY TREATMENT

Preliminary treatment consist the separating the floating materials like tree branches, papers,pieces of rags , woods etc. and heavy settelable inorganic solids . It helps in removal of oils and greases and reduces the BOD by 15% to 30% . Preliminary treatment consist following process:

- Screening - To remove floating papers, rags, clothes.
- Grit chamber - To remove grit and sand.
- Skimming tank - To remove oils and grease.

B. PRIMARY TREATMENT

Primary treatments consist of removing large suspended organic solids. It is usually accomplished by sedimentation in settling basins. The liquid effluent from the primary treatment often contains a large amount of suspended organic material and has a high BOD.

C. SECONDARY TREATMENT

In this process the effluent from primary treatment is treated through biological decomposition of organic matter carried out either aerobic or anaerobic conditions.

Aerobic Biological Units:

i. Filters (trickling filter)
ii. Activated sludge process
iii. Oxidation ponds and Aerated lagoons

Anaerobic Biological Units:

i. Anaerobic lagoons
ii. Septic tank
iii. Imhoff tanks.

The effluent from the secondary treatment contains BOD (5%to 10%of original) and may contain several milligrams per litre of DO.

D. TERATIARY TREATMENT:

The purpose of tertiary treatment is to provide a final treatment stage to increase the effluent quality before it is discharge to the receiving environmental. If disinfection is practiced, it is always the final process. It is also called as "effluent polishing".

.GUIDELINE FOR DESIGN OF SEWAGE TREATMENT PLANT

All elements of STP should have easy operation and maintenance.

The mechanical equipment should be provided with on-line standby pump at the equalisation tank and chlorine dosing pump at the chlorination tank.

Swimming pool filter backwash should be discharged to the STP for treatment. Design of STP should take into account the flow and loading of such waste water.

An auto start standby power may be required if it is considered that discharge of untreated wastewater to a specific water course is unacceptable.

Design parameters

The designer should give a reasonable estimate of population and a detailed breakdown of the total flow rate in the calculation.

The basic design parameters for populations shall be taken as follows

0.30 to0.46 cumec/h/d depending on types of development

55g BOD/h/d

55g SS/h/d

The design peak flow arriving at STP as a proportion of dry weather flow (DWF) shall be taken as :

6 DWF for population equal or under 1000.

4 DWF for population over 1000 but not less than that based on 1000 population.

Primary sedimentation tank shall be designed for Maximum surface loading of 40cumec/meter square/day at peak flow,

- Minimum retention time of 2 hours at peak flow,
- Maximum retention time of 2 hours at peak flow.

Final sedimentation tank shall be designed for

- Maximum surface loading of 35cumec/meter square/d at peak flow if they are preceded by Rotating Biological Contactor (RBC) or biological filters
- Maximum surface loading of 22cumec/square meter/d at peak flow if any they are preceded by the extended aeration process,

Minimum retention time of 2 hours at peak flow.

The reduction of total BOD by different stages of primary treatment processes should be taken as follows

Equalization tank – nil

Coarse screen - nil

- Fine screen - 7.5%
- Primary sedimentation - 30%
- Fine screen and primary sedimentation - 30%

vii. Chlorination tank should be designed for minimum 30 minutes contact time at peak flow.

viii. Sludge quantities generated from the processes should include

Solids removed from PST, which should be taken as 70% of the influent tank.

- Sludge yield from tertiary processes, which should be taken as 0.5 kg solids/kg BOD removed after primary sedimentation, or 1 kg solids/kg BOD removed when not preceded by primary sedimentation in the latter case no inclusion of primary sludge is necessary.

ix. Solid concentration of sedimentation tank sludge shall be taken as

1% for extended aeration sludge,

2%for RBC, biological filter and primary sludge.

DESIGN

A sewage treatment plant is design for a population of 3160. Daily water supply is 200000 litres. Daily sewage generation is about 80% of daily water supply.

Jcoe, Kuran College Survey

Total Number Of Students – 3160

Daily Water Supply-200000 Litre.

No Of Students In Degree College 1300

Staff Members And Workers -150

No Of Students In Diploma College 950

Staff Members And Workers -110

No Of Students In Hostel- 325

No Of Students In Mess- 325

. Receiving Chamber

i. Total supply of water -200000 lit/day

ii. Wastage of water =2 X 0.8

= 1, 60,000 lit/day

= 6666.66 lit/hr

= 111.11 lit/min

= 1.85 lit/sec

= $0.00185m^3$/sec

Volume required =Flow × Detention Time (assume D.T = 60sec)

= 0.00185×60

= $0.111m^3$

Provide depth = 0.2 m.

Area = 0.111/0.2

= 0.555 m^2

Length: Breadth =2:1

L×B=0.555

= 2B×B

$2B^2$ = 0.555

B=0.526m 0.6m

L= 1.05m 1.2 m

H = 0.4m 0.4m

Screen

i. Clear opening between bars should be 25mm to 50 mm.

ii. Total flow- 0.16MLD

iii. Maximum flow – 1.85 lit/sec

iv. Submerged area required – 0.00436 m^2

v. C/s area of screen chamber

A= Maximum flow / Velocity in the screen chamber

A= 0.0123 m^2

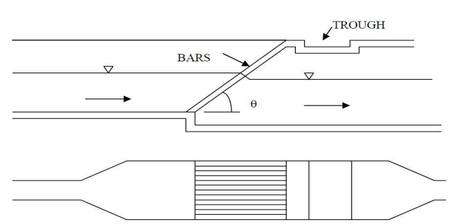


Fig 1 c/s of screen chamber

C. Skimming tank

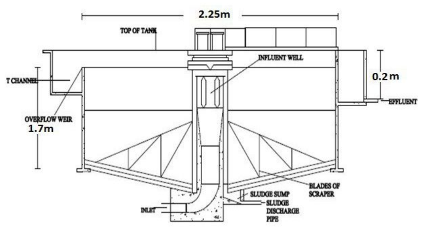
i. The surface area of tank

A = 6.22×10-3 Xq / Vr

Where,

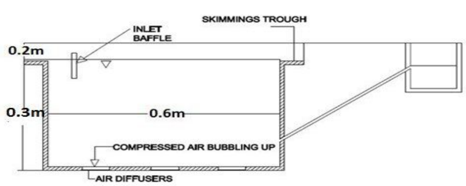
q= Rate of flow of sewage in m^3/day

Vr = Minimum rising velocity of the oily material to be removed in m/min.
$A=0.24m^2$
Provide the depth of skimming tank is 2 m
The length breadth ratio is 1.5:1
L=1.5B
B= 1m.
Skimming tank dimension is 0.6m×0.4m×0.5m.



C/S of Primary Settling tank

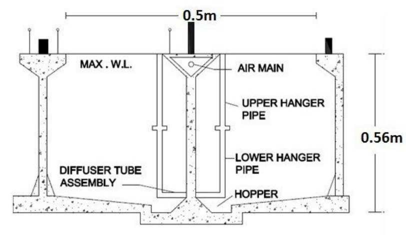
D. Grit chamber
i. Sp gravity of particle – 2.65
ii. Dia. of particle – 0.2 mm
iii. Flow through velocity- 0.25 m/sec
iv. Settling velocity (vs)= d(3T+70)
=0.03 m/sec
Q= velocity× c/s area
$Q=0.00185\ m^3/sec$
$A= 0.055m^2$
vi. Overall depth of grit chamber D= (water depth above the crest of weir+ schich+ free board)
D= 0.56 m
vii. Detention time = 10 sec.
viii. Length of chamber = vh × detention time
= 0.92m
Using about 10% increase in length
L= 1m.



CROSS SECTION OF SKIMMING TANK

E. Primary settling tank
i. Daily flow of sewage-
= 1.16MLD
Assume detention period of 1hrs.
ii. Tank capacity = (Daily flow of sewage / 24) × detention time
$= 6.8m^3$
iii. Surface area of tank
Assume effective depth of tank as 1.7 m.
Surface area of tank= tank capacity/ effective depth
$4m^2$
iv. Total depth of the tank
Total depth of tank= (effective depth + depth for sludge accumulation + free board)
= 2m

The dimension of tank =Diameter-2.25m,Depth-2m
Provide one unit of primary settling tank as stand by unit.



SECTION OF AERATED GRIT CHANNEL

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