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Planning and Designing of Wastewater Treatment Plant in Kumbakonam

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***Abstract*—** *Nowadays, water scarcity is the most hazardous threatening to our world and it should be a major problem factor in the future earth. Water sources both in surface and ground levels are leads to decrease day by day due to human and natural activities. So, it is need to preserve and recycle waste water for the future generation of the world to avoid such conflicts related to water. This project explains the planning and designing of a waste water treatment plant for an residential area in 'Kumbakonam'. The waste water from household should be collected and treated as per the proper procedures .The reclaimed water is to be used for irrigational and other constructive purposes there by reducing fresh water consumption. Manual calculation of population growth is to be done by using the census of the recent year and also the water demand is to be calculated based on the census data. The standards of waste water in the locality are forecasted by laboratory procedures based on that proposal for treatment plant is given with proper specifications by means of available waste water. This treatment is done on the basis of satisfying the waste water quality standards for irrigation purposes. The major reason for choosing kumbakonam as our project area is because for it is the Cauvery delta region with high ground water level. So, the generation of waste waters also more and an treatment plant is to be necessarily designed for the recycling of sewage water.*

I. INTRODUCTION

General-Waste water treatment process is designed to achieve improvements in the quality of waste water. Waste water treatment is closely related to the standards and expectations set for the effluent quality. Sewage has to be treated to make it harmless. The degree of treatment depends on the characteristics of the sewage. Water constitutes one of the important physical environments of man and has a direct bearing on his health Water is absolutely essential, not only for survival of human beings but also for animals, plants and all other living beings. Water may be polluted by physical, chemical and bacterial agents.

Water to be supplied for irrigation purpose must be portable i.e., satisfactory for irrigation purposes from the standard points of its chemical, physical and biological characteristics. The objective of our water treatment is to reduce the fresh water usage and reuse the treated water for irrigation activities.

Location

Kumbakonam is a town and a special grade municipality in the Thanjavur district in the southeast Indian state of Tamil Nadu. It is located 40 km (25 mi) from Thanjavur and 273 km (170 mi) from Chennai and is the headquarters of the Kumbakonam taluk of Thanjavur district. The Kumbakonam is a town bounded by rivers on two side, Arasalar River to the south and the Kaveri River to the north. According to the 2011 census, Kumbakonam town has a population of 140,186.

Population Forecasting

$$P_n = P_{0+N}\,\bar{x} + N\,(N+1)/2\,\bar{y}$$

P_{2021}=139551

P_{2031}=139616

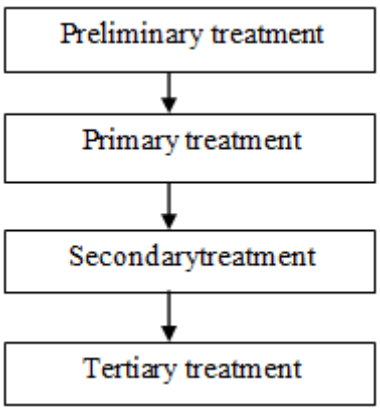
P_{2041}=140086

At design period of 30 years the forecast population of the Kumbakonam city is 1,40,086.

Sewerage Generation

Ultimate design period = 30 years
Forecasted population at 2040 =140086
Per capita water supply =135 lpcd
Avg sewage generation per day = 80%
= 15.2 MLD
Max discharge 3 times = 0.528 cumecs

II. METHODOLOGY



Preliminary Treatment

Preliminary treatment process contain following steps, solely in separating the floating particles, (like tree branch, dead animals, papers, pieces of waste, plastic, wood and so on.) and also the heavy organic and inorganic solids. It also helps to remove the greases and oil, etc. from the sewage water. This treatment decreases the BOD value of the

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sewagewater, by about 15 to 31%. The process used are: screening for removing rags, floating paper, wood, plastic etc.

Screening

Screening is the very first operation carried out at a sewage treatment plant, and consists of passing the sewage through different types of screens, so as a trap and remove the floating matters such as pieces of wood, cork, hair, fiber, kitchen refuse, fecal solids, etc, present in sewage. These floating materials, if not removed, will choke the pipes or adversely affect the working of the sewage pumps.

Design of coarse screen

Assume the velocity at average flow is not allowed to exceed 0.8 m/s

The net area screen opening required,

$= 0.66m^2$

Size = 10mm x 50 mm (10mm face)

Clear spacing = 80mm

The screen bar are placed at $60^0$to horizontal

L x B x D = 5 x 2 x 0.4 m

Design of Grit Chamber

Assume avg. detention period = 180s

Aeration volume $= 95.04m^3$

Assume depth of 2m & width : depth = 2:1

= 5.94

Width of channel = 2x2 = 4m

Length of channel = 47.52/ (2x4)

L * B * D = 7.13x4x2m

Primary Treatment

Primary treatment consists of in removing large suspended organic solids. This is usually accomplished by sedimentation in the settling basins. The liquid sewage from primary treatment mostly contains a huge and large amount of suspended organic and inorganic particulate materials, and has a high BOD value nearly 63% of original.

Sedimentation tank

Sedimentation tank**,** also known as clarifier or settling tank, component of a modern system of water supply system or wastewater treatment plant. A sedimentation tank allows suspending particulates to settled down on a water or wastewater as it moves slowly through the tank, it increases the some more degree of purification. A layer of accumulated solids particles are known as sludge, they settled at bottom of the tank and its periodically removed. In this sewage treatment, primary sedimentation must be done before the secondary treatment to increase purification efficiencies. Sedimentation is generally by using bar screens and grit chambers process to remove huge particulate and coarse solids.

Design of rectangular sedimentation tank

Sewage generation = 15.2 MLD

Detention period = 2hours

Capacity of tank $= \frac{15.2}{24}$ x 2 = 1.267MLD

= 1266.6 ≈ 126cu.m

Assume velocity = 0.3 m/s

Length of tank = v x t =0.3 x 2x 60 = 36m

Area of tank $= \frac{V}{L} = \frac{1267}{36} = 35.19m^2$

Assume effective depth = 3m

Width $= \frac{35.19}{3}$ = 11.7m ≈12m

L x B x D = 36m x 12 x (3+0.5) m

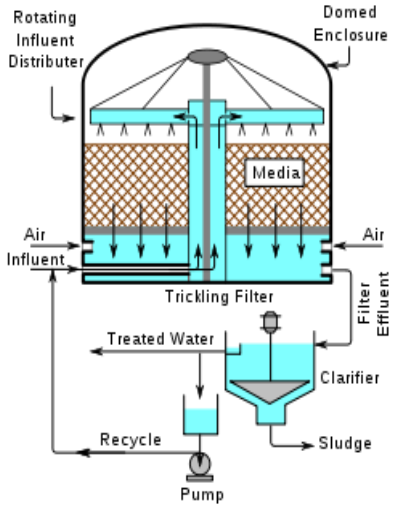
Secondary Treatment

Secondary treatment involves in treatment of effluent and sewerage, coming from the primary sedimentation tank. This is generally accomplished through biological decomposition of organic matter and inorganic matters, which can be carried out by using aerobic or anaerobic conditions. The biological units of bacteria will decompose the fine and coarse organic matter, to produces the clear effluent.

Trickling filter

A trickling filter is a one of the type in wastewater and sewage treatment system first used by Clowes and Dibden. It consists of a fixed bed of coke, lava, rocks, gravel, slag, polyurethane activated foam, sphagnum peat mess, cosmogony ceramic, or ploy plastic media over which sewage or other flow of wastewater in downward direction and causes a layer of microbial slime (bio-film) to grow, covering the bed of media. Aerobic conditions are maintained by diffusion, splashing, and either by compressed air flows through the bed or natural convection of air through the porous of filter medium.

The terms trickle filter, trickling bio filter, biological filter and biological trickling filter are often used to refer to a trickling filter.



Trickling Filter

Merits

Simple and reliable process that is suitable in areas where large tracts of land are not available for a WSP treatment system

- Effective in treating high concentrations of organic material depending on the type of media used;
- Very efficient in removal of ammonia from wastewater;

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- Appropriate for small- to medium sized communities
- Ability to handle and recover from shock loads
- Relatively low power requirements; They require power for pumping only and do not need large power-hungry aeration blowers. From motor-driven rotary distributors are powered by fractional horsepower electric motors.
- They produce less sludge than suspended-growth systems. The sludge tends to settle well because it is compact and heavy.
- Level of skill and technical expertise needed to manage and operate the system is moderate
- The cost to operate a trickling filter is very low.

Design of Tricklling Filter

Sewage generation per day = 15.2MLD
BOD of the wastewater = 224 mg/l
Total BOD present in the sewage to be treated per day
= 15.2 x 10^6x22 =3404.8 Kg
Assume, organic loading =2000Kg/heater meter /day
The volume of filter media required,
=(3404.8/2000) = 17024m^3
Assume effective depth = 3m
Area $= \frac{V}{D} = 5675m^2$
Required units $= \frac{\pi}{4} \text{ x } d^2 = 5675$
Assume d = 40m,
Therefore required units = 2units
Design of rotary distributors peak sewage flow per day
= 0.528m^3/sec
Assume that the velocity at the peak flow is 2m/sec through the central column of distributer, Average flow to each tank
$= \frac{15.2}{2}$ =7.6MLD
Q = 7600m^3/day
The total BOD entering STP = 224 mg/l
Assuming that negligible BOD is removed in screening and grid chamber i.e
Y_E = 20mg/l
BOD removed activated plant = 224-20 =204 mg/l
Minimum efficiency required in the activated plant
$= \frac{204}{224}$x100=91%
Since the adopted extended aeration process can be remove up to 95 – 98%
The dia of central column assume
$= \sqrt{\left(\frac{0.264}{2}\right) x \left(\frac{1}{\frac{\pi}{4}}\right)}$ = 0.4m

Provide a central column of 0.4m in dia find the velocity through the column at average flow, as it should not be less than 1m/sec.

Deisgn of Arms

Now let as use rotary reaction spray type distributor with 4 arms.
The discharge per arm $= \frac{0.264}{4}$ = 0.07m^3/sec
Arm length $= \frac{40-2}{2}$ = 19m

Design of aeration tank

Number of tanks = 2 MLS
=3000mg/l $\frac{F}{M}$ ratio = 0.2
$\frac{F}{M} = \frac{Q}{V} \text{ x } (Y_o / X_T)$
V $= \frac{7600 \; x \; 224}{.12 \; x \; 3000} = 4728.9m^3$
Let us adopt an aeration tank of liquid depth 4m and width 10m. Then,
The length of the tank = $\frac{V}{B.D}$ = 118m
Therefore dimension of the aeration tank is 118x10x4m

Tertiary Treatment

This treatment is removing the organic load left after the secondary treatment, and particularly to kill the pathogenic bacteria. This treatment, which is normally carried out the chlorination

Cholorination of sewage

Sewage may be disinfected by adding chlorine to it, either before the treatment or after the treatment, as is done for disinfecting water supplies. When chlorine is added to the treated sewage as a final step in each its treatment, its called post chlorination. This may be adopted where an effluent, low in the bacterial count, its necessary. The disinfecting action of chlorine will, no doubt, reduce the bacteria but its oxidizing action will also reduce the BOD to some extent.

Disinfection tank

Design flow = 0.528 $M3/S$
Detention time = 60 sec
Volume required = flow x time
= 31.68m^3
Provide depth = 3m
Area = 10.56m^2
L: B = 2:1
SB^2 = 10.56
B = 2.296
≈ 2.3m
L =4.6

III. RESULTS

S.NO	Description	No	Length (m)	Breadth (m)	Depth (m)	Diameter (m)
1	Screen Chamber	1	5	2	0.4	-
2	Grit Chamber	1	7.13	4	2	-
3	Sedimentation Tank	1	36	12	3.5	-
4	Trickling Tank	2	-	-	3	40
5	Arms	4	19	-	-	-
6	Secondary Clarifier	-	-	-	3.8	27
7	Aeration Tank	2	118	10	4	-
8	Disinfection tank	1	4.6	2.3	3	-

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IV. CONCLUSION

- ✓ From the investigation done is clearly suggest the role of reclaimed water in future .The forecasted population in the year 2040 for Kumbakonam has huge per capita needs.
- ✓ Hence we are properly suggesting a suitable water treatment plant for the area to convert used water into freshwater for irrigation activities there by reducing the fresh water usage.
- ✓ It clearly explains the role of water conservation in future, to avoid water demand problems.
- ✓ Government and the municipality should take necessary steps for this major issues which is going to be great bane in the future so we are requesting this in concern for the peoples welfare in future.
- ✓ Water in the current scenario after usage should be properly treated with the treatment plant we suggested and those treated water can be used for various irrigation purposes.
- ✓ By the use of reclaimed water the need of freshwater for irrigation activities should be reduced and water demand should be controlled in the future.
- ✓ People should be educated about this issue no fresh water should be used instead we can use the treated water for irrigation and population control measures are also campaigned among peoples to avoid unwanted dispute in water .

REFERENCE

[1] Water and Waste Water Engineering , "1968 Vol 1 water supply and waste water removal fair G.M.Geyer J.C and Okun D.A
[2] Metcalf And I. Eddy, 1982. Water Engineering treatment: Disposal And Refuse.
[3] Manual of Water Quality and treatment, American Water Work Association.
[4] Manual of water treatment plant Design,1969 American Society of Civil Engineering and American Water Work Association
[5] Operation an control of water treatment process, 1964 Cox, C.R, world health organization.
[6] Central public Health and environmental "Manual on sewage and sewage treatment, (1983) 2nd Ed prepared by expert committee constituted by Govt. of India (Ministry of urban development New Delhi)
[7] Camp T.R (1948) "sedimentation and the design of settling tank, Trans ASCE vol.111. Benjamin, M.M.(2001) water chemistry, Mc Graw –Hill, New York

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