Design of Sewage Treatment Plant To Enhance The Existing System of Chiplun City

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Abstract- *This Paper is a design work on sewage treatment for chiplun city for next 30years. Rapid sewage generation IS common and serious problem in coastal area like Konkan in Maharashtra. Chiplun is is a tehsil place and main trade Centre of nearby villages with area of around 14.60 Sq.km and population around 1.59 Lakhs, having Latitude and longitude coordinates are: 17.532310, 73.517792. The urban population has grown steadily, resulting in an increase in domestic sewage but yet there is no treatment plant. Thus sewage treatment plant is designed considering major components such as screening chamber, grit chamber, skimming tank, sedimentation tank, secondary clarifier, active sludge tank, sludge drying beds are designed.*

Keywords- Sewage Treatment plan,screening chamber, grit chamber, skimming tank, sedimentation tank, secondary clarifier, active sludge tank, sludge drying beds

I. INTRODUCTION

hiplun is a town and municipal council in Ratnagiri district and the headquarter of Chiplun taluka of konkan region in Maharashtra, Indiahaving Latitude and longitude coordinates are: 17.532310, 73.517792. Geographically located between the Arabian Sea coast and the valley of the Western Ghats lies on the banks of the River Vashishti having area 24.73 sq. km and population 1.59 Lakhs (2017).City has a strong cultural background and industrial developments are very fast across the town. There are 3 MIDC developed at a distance of 12 to 15 km from town. Mumbai.As there is rapid growth in population resulting in large sewage generation. Thus design of sewage treatment plant is done to treat sewage generated for next 30 years.

1.1 Study area:

Study was conducted in chiplun city. Following map shows the study area of chiplun city

Figure 1 Study Area

1.2Objectives

1. Reduce the amount of sewage (solids) in the sewage and remove all elements that cause nuisance
2. Remove pollutants from wastewater and domestic sewage, including runoff (sewage) and domestic sewage. It includes physical, chemical and biological processes to remove physical, chemical and biological contaminants.
3. Change the characteristics of the sewage so that it can be safely discharged in the natural waterway applied to the land.
4. Production of disposable sewage will not cause harm or trouble to the community and prevent pollution.

1.3 Expected Outcomes

The project aims to find an effective solution to the sewage problems in the Chiplun city as the amount of sewage increasing in form of the amount of various solids, industrial sewage, etc. is increasing. Excess land or a large amount of water cannot be used in cities. In fact, cities need to treat sewage.

II. METHODOLOGY

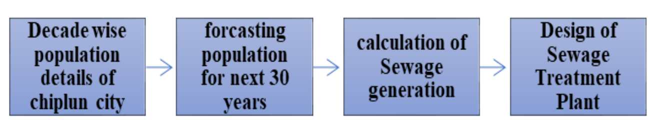

Figure2. Flow chart of proposed Methodology

2.1 Decade wise population with forecasted population

Decade wise growth in population of Chiplun City and percentage increase per decade is given in table 4.4 below.
Table1. Decade wise Population with forecasted population of Chiplun

Decade	Population	Increase in Decade	Growth in % Per Decade
1951	15,847	-	-
1961	17,335	1,488	9%
1971	21,000	3,665	21%
1981	27,240	6,240	29%
1991	34,299	7,059	25%
2001	46,022	11,723	34%
2011	55,034	9012	20%

2.2 Population Forecasting of Chiplun

Population forecasting is done by two methods as Incremental increase method and Geometric increase method and average weighted population is given in table 4.5 below

Table 2. Population Forecasting of Chiplun

Year	Population Forecast Methods		Population
	Incremental Increase	Geometrical Increase	(Weighted Avg.)
2013	53,867	58,561	57,174
2028	69,027	84,116	79,625
2043	88,260	1,20,904	1,11,111

III. DESIGN OF SEWAGE TREATMENT PLANT

The work deals with major componentsof Sewage Treatment plant like receiving chamber, screening chamber, grit chamber, skimming tank, sedimentation tank, secondary clarifier, active sludge tank and sludge drying beds. The design for each part is done below.

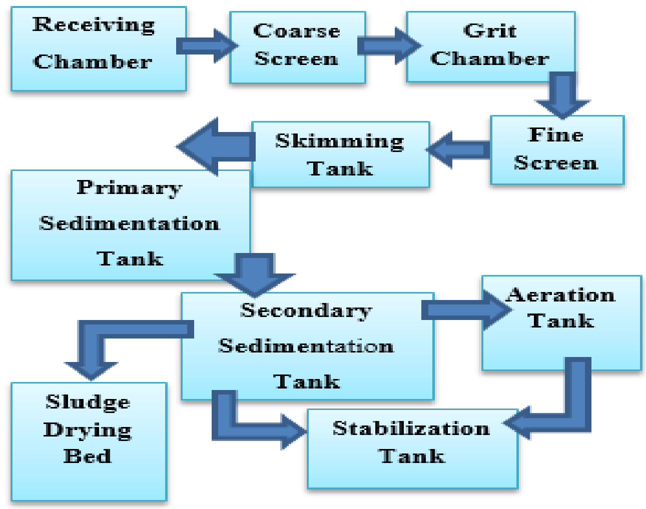

Figure 3.Design of Sewage Treatment plant

3.1 Sewage Generation :

Design period = 30 years
Forecasted population for year 2043 = 1, 20,904
Water Supply (per capita) = 135 lpcd
Average water supply (per day)
= 1, 20,904 x 135 = 16322040 = 16.32 MLD
Average sewage generation (per day)
= about 80% of supplied water
= 0.8 x 16.32 = 13.056 MLD
In cumec, Average Discharge = 0.15 cumec
Thus, MaximumDischarge = 3 x avg. Discharge
= 3 x 0.15 = 0.45 cumec

3.2Design of Receiving Chamber

Detention time = 60 sec
Volume required=Design Flow(cumec) X Detention time(sec)
Length: Breadth = 2:1
Check: Vdes > Vrqd

3.3Design of Coarse Screen

Assume,velocity at average flow is not allowed to exceed 0.8m/s
Clear opening between bars = 30 mm = .03 m
Assume width of the channel = 1m
The screen bars are placed at 60° to the horizontal.
Velocity through screen at peak flow = 1.6 m/s

3.4Design of Grit Chamber

Average detention period = 180 seconds (assumed)
Aerated volume = 0.45 x 180 = 81 m^3

Two chambers are used for periodic evacuation of the passage for routine cleaning and maintenance,

3.5Design of Fine Screen

At average flow design velocity = 0.8 m/s
Area required = 0.45 / 0.8 = 0.56 m^2
SWD provided = 0.7 m
At peak design velocity = 1.6 m/s
Assume, the screen bars are placed at 40° to the horizontal.
Clear area = 0.45 / (1.6 x sin40) = 0.437 m^2
Clear opening = 8 = 0.008 m

3.6Design of Skimming Tank

Surface area = A = 6.22 X 10-3 X qVr m^2
Where q = rate of flow sewage in m3/day
Vr = minimum rising velocity of the oily material to be removed (m/min)
Q = 38880 m^3/day
Vr = 0.25 m/min = 0.25 x 60 x 24 = 360 m/day
A= (6.22 X 10-3 X 38880) / 360= 0.67 $m^2 \approx$ 0.7 m^2

3.7Design of Primary Sedimentation Tank

Maximum quantity sewage = 13.056 MLD
Surface loading = 40 m^3/m^2/day
Detention period is 1 hour
Volume of sewage = (13056 X 1) / 24= 544 m^3
Provide effective depth = 2.5 m
Surface area =544 / 2.5 = 217.6 m^2
Surface Area the tank = Total flow Surface loading
= 13056 / 40 = 326.4 m^2
Use greater area from these two

3.8Design of Aeration Tank

Number of Aeration tank = 2
Design flow (in MLD) = 13.056 MLD
Average flow = 13056 / 2 (for each tank)= 6528 m^3
BOD at inlet = 0.8 x 300
(BOD removed at Grit chamber is about 20 %)
Yo = 240 mg/l
BOD at outlet YE = 20 mg/l
For, Activated Plant BOD Removed = 240-20 = 220 mg/l
Minimum efficiency required = 220 / 240
Minimum efficiency = 91.7 %
The adopted extended aeration process can remove 85-92 %, hence it is OK MLSS (Xt) = 3000 mg/l
F/M ratio = 0.4
Volume of the tank required is V = Q FM x YoXt ≈ 1197 m^3
Assume, liquid depth of the tank as 4.5 m
The Ratio of Width to Depth as 2:2

3.9Design of Stabilization Tank:

Total return flow = 6920 m^3/day = 4.81 m^3/min
Detention time = 15 min
For wet well Volume = 72.15 m^3

3.10Design of Sludge Drying Beds

The sludge is applied to the drying bed at a rate of 100 kg / MLD
Applied sludge = 300 kg / day
Specific gravity = 1.015 Solid content = 2%
Sludge volume = 14.778m^3 / day
For Chiplun weather conditions, the beds are dry for about 10 days.
Number of cycles per year = 365/10 = 37 cycles.
Cycle per cycle = 10 days
The amount of sludge per cycle = 14.778 × 10 = 147.78 m^3
Spread a layer of 0.3 meters per cycle,
Required bed area = 147.780.3= 492.6 $m^2 \approx$ 500 m^2
Provide 5 pieces.
The area of each bed = 100 m^2
Five beds of 12.5 m x 8 m were designed.

IV. RESULTS

Forecasted population at 2043 = 1, 20,904
Water Supply (per capita) = 135 lpcd
Average water supply per day = 16.32 MLD
Avg. Sewage generation per day = 13.056 MLD = 0.15 cumec
Max. Discharge = 0.45 cumec

Table 3 is showing the Results i.e. details of Design of sewage treatment plant in the city

Table No. 3. Results

Sr.No	Component	Nos	Dimensions
1	Receiving Chamber	1	4 mX2.3mX3m(SWD)+0.5(FB)
2	Course Screen	2	0.6 mX0.7m(SWD)+0.5m(FB)
3	Grit Chamber	2	2.7mX6mX3m
4	Fine Screen	2	1.2mX0.8m(SWD)+0.5m(FB)
5	Skimming Tank	1	1mX0.7mX3m+0.5m(FB)
6	Primary Clarifier	1	20.4m(dia)X2.5m(depth) +0.5(FB)
7	Aeration Tank	1	27mX10mX4.5m
8	Secondary Clarifier	1	diameter of 26 m
9	Stabilization Tank	2	Each of 6.92 MLD capacity
10	Sludge Drying Beds	5	12.5mX8m

V. CONCLUSION

The work includes the design of the every component of a Sewage Treatment Plant considering all aspects of Chiplun's climate and terrain, as well as the population growth rate when designing a project. Through the implementation of the project, the entire sewage of the city can be treated not only effectively but also efficiently.

VI. FUTURE SCOPE

1. Entire sewage of the Chiplun city can be treated effectively.
2. Can achieve aspects of environmental, biological, chemical and civil engineering by treating sewage.

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