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Design of Sustainable STP for Geeta University, Naultha

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Abstract: ***Sample for the test which is required in designing units was collected from the backyard of the hostels of university where all the waste water meets. Various quality parameters of wastewater were determined in the campus lab and also in third party lab located in Panipat. After analysis of wastewater samples it is found that influent standards are more than the permissible limit prescribed by CPCB. There is an urgent need for a sewage treatment plant in the campus with a capacity for forecast of 30 years population. In this paper we have designed a sustainable sewage treatment plant for the university wastewater. The units have been designed based on the experimental data Such as; Screen unit, Grit chamber, PST, Aeration tank and SST***

Keywords: CPCB, Grit Chamber, PST, SST

I. INTRODUCTION

In today's world the population is growing day by day so the number of industries and sewage generated from them is also increasing. Disposing it without the treatment causes various health related problems and also damage to the environment. As the number of industries is also increasing, the use of water in them is also increasing which cause exploitation of water resources. The efficient way to decrease this exploitation of water is the wastewater treatment plant. At that time almost every country has a problem of water pollution {6}.

If we talk about universities and colleges, the number of students is also increasing .Therefore the amount of wastewater generated is also increasing in those institutions.

In most of the cases, universities and colleges directly disposed the wastewater into the domestic sewer line. The wastewater generated in those institutions have high population equivalent and may contain different types of properties other than that of from the domestic wastewater i.e.; wastewater generated from labs, food zone etc. When this wastewater meets the domestic wastewater, the work of the treatment of that sewage is of public health Engineers or local government bodies of that particular area or in some cases contracts may be given to private companies {5}.

But in India the numbers of Sewage Treatment Plants are very less. In many areas the sewage treatment facilities are not able to provide the treatment up to the required degree. So it becomes the duty of a particular institution or industry to treat the water at their own level to prevent economical hazards.

If we look into our country India, the sewage generated is 62,000 Million litres per day but there are only 23, 277 million litres per day or 37 % water treated as per data released by Government of India in December 2015{4}. It comprises 70 % of wastewater is not treated which is not beneficial to the environment as when directly disposed of to the rivers or other water bodies, it may cause eutrophication and also reduce the penetration of sunlight in the water bodies. If this is going to increase then it will be very hazardous to the environment and may cause various health problems and scarcity of water.

It means that there is a critical need of increasing the number of sewage treatment plants by the government or the institutions should have their own sewage treatment plant.

So in this paper we are going to design a sustainable sewage treatment plant for Geeta University Naultha, Panipat. Here sustainable means to design the STP by taking the three pillars of Sustainability i.e.; Economical, Environmental and social into consideration.

Sample is taken from the backyard of university and tested for properties like pH, temperature, Solids , BOD,COD, Oil and grease and found that values are greater than as per specified by Indian standard code to dispose of sewage in any water body.

It means that there is a need for a sewage treatment plant in University. The sewage treatment plant includes mainly units i.e.; Screen, Grit chamber, Primary sedimentation tank, 2 degree biological treatment, Secondary sedimentation tank. Combination of screens, grit chamber and primary sedimentation tank is known as primary treatment.

Generally 60-70 % of solids get removed in primary treatment and then again 60% in secondary treatment .In primary treatment 30-40 % BOD is satisfied and 90% of BOD is satisfied in 2 degree biological treatment, in 2 degree biological treatment we will design an activated sludge process.Then the sludge from primary and secondary treatment is further treated and effluent water can be discharged into any water body.

II. LITERATURE REVIEW

We have studied several papers related to water and wastewater treatment, some of them are as follows:

Mariana F.T. Sá et.al. (2022)- There study was based on analysis of screening of organic contaminants and the characteristics of dissolved organic matter in the sewage network up to sewage treatment plant and found the effect of those on sewage treatment plant.

Sheng Miao et.al. (2021)- In that paper the author used machine learning in intelligent sewage treatment. They used sensors to manage the sewage treatment in a fine chemical plant.

M. Ramaganesh et.al. (2021) - Their analysis was based on finding hazard and risk assessment in sewage treatment plants. Their aim was to minimise the environmental hazard which we found in sewage treatment plants and applied fault tree analysis methods to decrease the risk involved in sewage treatment plants.

KwadwoKodom et.al. (2021) -The team had done a study on pharmaceutical compounds found in wastewater and its removal efficiency from wastewater treatment plants.

Julian Carrillo-Reyes et.al. (2020)- The author has done the study on presence of sars cov-2 RNA in sewage in Mexico based on RdRP, S and N gene analysis. Sewage is observed from the early stage of the epidemic to July 2020. They analysed that RNA is found to be more concentrated in activated sludge.

III. OBJECTIVES

The main objectives of studies are-

A. To find the Quality Standard such as physical and chemical quality parameters Wastewater Generated from University.

B. To compare the findings and Effluent std. as per IS code.

C. To design a sustainable STP to achieve optimum efficiency

D. SWOT Analysis.

IV. METHODOLOGY

AWastewater sample was taken from the backyard of the hostel. There is a well dug behind the hostels where all the wastewater of the university meets. The sample was taken to the lab of the university and also sent to a third party lab in Panipat then both results were analysed and optimum value from both is taken.

Tests performed are:

- pH
- Temperature
- Total solids
- Suspended solids
- Dissolved Solids
- COD
- BOD
- Oil and grease

The result obtained after tests are shown in table 4.1.

Table 4.1: Test results

Parameters	Units	Results of test conducted inuniversity	Results of test conducted in Haryana test lab Panipat	Percentage variation	Test Methods
1. pH		6.7	6.76	0.89	IS 3025(Part 11:1993)
2. Temperature	Degree Celsius	20	22	10	IS 3025(Part 9:1984)
3.Total solids	mg/l	1220	1217	0.246	IS 3025(Part15:1984)
4. Suspended	mg/l	400	402	0.5	IS

solids					3025(Part 17:1984)
5. Dissolved solids	mg/l	820	815	0.61	IS 3025(Part 16):1984
6. BOD(3 days)	mg/l	275	280	1.82	IS 3025(Part 44):1993
7. COD	mg/l	620	634	2.28	IS 3025(Part 58):2006
8.Oil and grease	mg/l	14.6	14.8	1.37	IS 3025(Part 39):2021

The effluent Std. is given in table 4.2 as per CPCB and HSPCB.

Table 4.2: CPCB and HSPCB standards

Characteristics	Units	CPCB STD.	Haryana state pollution control board
pH		5.5-9	5.5-9
Suspended solids	mg/l	Less than 100	Less than 100
BOD	mg/l	Less than 30 at 27 degree Celsius in 3 days	Less than 30
COD	mg/l	Less than 250	Less than 250
Oil and grease	mg/l	Less than 10	Less than 10

The Std. of wastewater generated from University is not in the permissible limit as prescribed byCPCB, It implies that there is an urgent need of STP in the University Campus.The units which we are designing and the steps of treatment of wastewater are shown below in the form of a Flowchart:

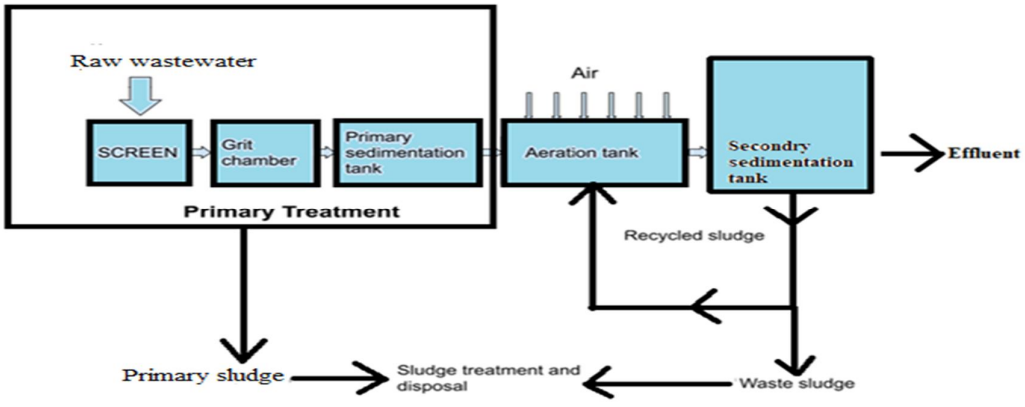

Figure 4.1: Systematic diagram of STP

The floating and coarser particles are being removed in screens, here medium screens are provided as less coarse particles are present in sewage generated from university. After that inorganic suspended solids are being removed in Grit chamber and then organic and inorganic both get settled in Primary sedimentation tank that's why 30-40 percent of BOD gets removed in Primary treatment and also 60 percent of SS solids get removed in it. After that wastewater goes to Secondary treatment in which 90

percent of BOD get satisfied and remaining suspended solids get removed. Then sludge is treated which comes from PST and SST. The sludge formed from primary treatment has high organic matter content so it can't be decomposed aerobically as microorganism content increases due to chain reaction. The sludge formed from secondary treatment has less organic content so it can be decomposed aerobically.

The flow chart drawn above shows activated sludge process in which active microorganism is sent back to the aeration tank to decompose the organic matter. Here the process used is a complete mix so that mixing of microorganism with organic sludge takes place and better efficiency would be there. In the complete mix process, there is the benefit that at every point F/M ratio is constant so proper decomposition takes place. Generally complete mix is provided when discharge is less than 25-30 MLD, in current Scenario sewage generated is 1.75MLD.

V. DESIGN PARAMETERS

Plant is designed for a 30 year population, population is calculated by geometric mean method for 2051.Water demand is calculated for both hostellers and non-hostellers by taking their average demand accordingly. The design data are shown in table 5.1:

Table 5.1: Design Parameters

Parameters	Values
Design period of plant	30 years up to 2051
Population forecast to 2051	15,400 day scholars and 2500 hostellers
Water supply for day scholars	45 l/c/d
Water supply for hostellers	135 l/c/d
Average daily demand	1.143 MLD
Maximum daily demand	1.8*1.143= 2.06MLD
Average sewage generated	85% of Maximum daily demand =1.75MLD
Average sewage per hour	72.92 m^3/hours
Design sewage flow	218.75 m^3/hours
Collecting pit (Retention time- 4 hours)	Diameter 15m and depth 5 m+0.5 m freeboard
Medium screens	Provide 16 bars of 10×50 mm with clear spacing of 20mm
Grit chamber	Provide 7.5*1*0.4+0.3m of freeboard
Primary sedimentation tank	Provide 24*6*3 m +0.5 m freeboard
Aeration tank	Provide 34*8*4m+0.5m tank
Secondary sedimentation tank	Provide 18 m diameter tank and 4m depth No weir is required as per design

- Grit chamber is checked for horizontal velocity and detention time, horizontal velocity comes out to be 0.15 m/s and length comes out to be 6m in designing but it is increased by 20 percent due to initial turbulence.
- Primary sedimentation tank is designed for a detention period of 2.5 hrs. and it is assumed that 30 percent of BOD is satisfied in it. It says that the effluent BOD from the tank is 196 mg/l. And 60 percent of solid got removed in primary treatment, remaining suspended solids after primary treatment-160.8mg/l.
- The Aeration tank is designed for 89 percent efficiency and its effluent BOD is 30 mg/l. F/M and MLSS is taken to be 0.3 and 3200 mg/l .The aeration tank is designed for complete mix, sludge volume index considered to be 110 mg/l. It is being checked for recirculation ratio and for sludge age.
- Secondary sedimentation tank is designed for both peak and average flow by taking a peak factor of 2.Then it is checked for weir loading but weir loading rate comes out to be less than 185 m^3/m^2/day so that's why no weir is provided.
  60 percent of remaining solids get settled in secondary treatment, remaining suspended solids after secondry treatment - 64.32 mg/l.

All the assumed values are taken as per central public health and environmental engineering organisation manual Government {11}

VI. SWOT ANALYSIS

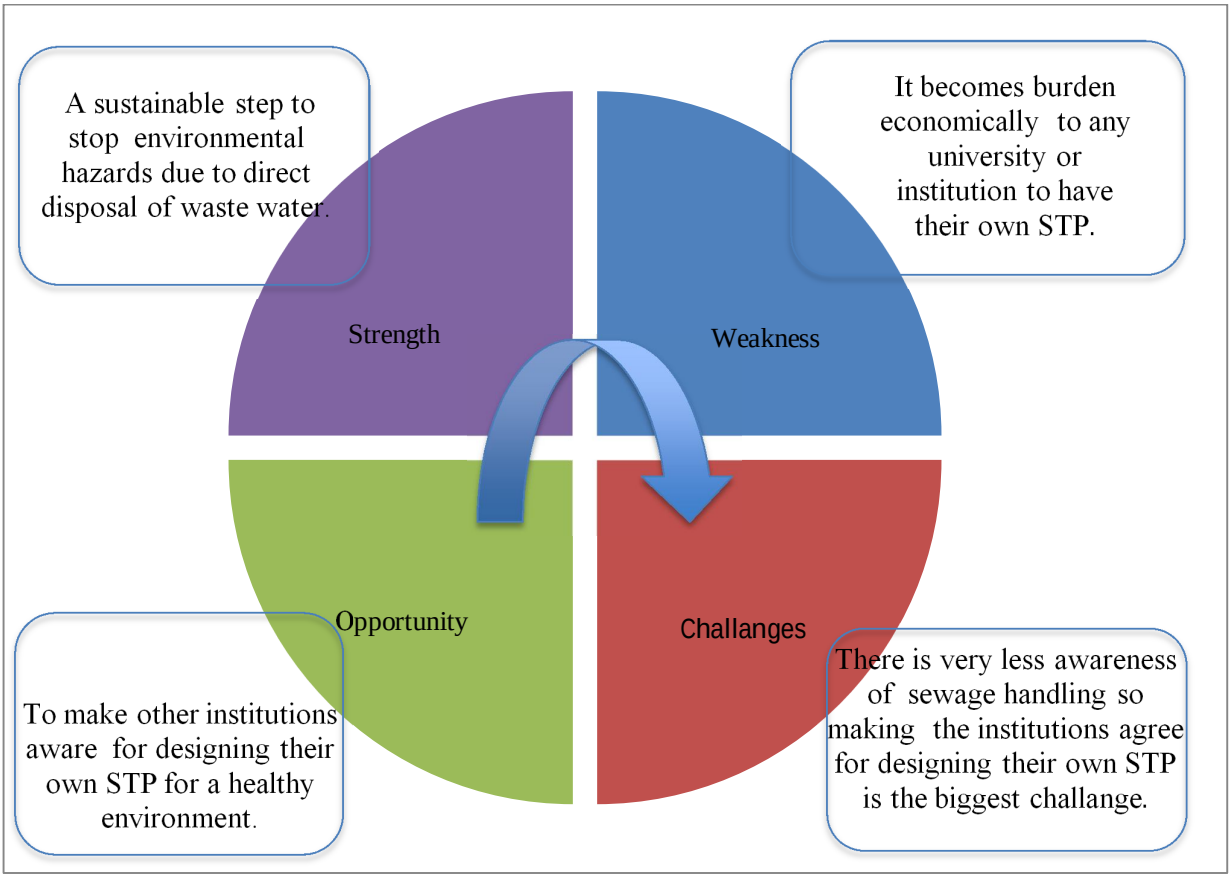

Figure 6.1: SWOT Analysis

VII. RESULT AND DISCUSSION

In that paper design of the sewage treatment plant for Geeta University is being done. The total sewage generated from university is 1.75MLD, initial BOD and suspended solids in the wastewater are 280 and 402 respectively.The characteristics of effluent after the treatment is as follows:

A. Suspended solids removal efficiency - 84.42%.Initial Suspended solids-402 mg/, Suspended solids after treatment-62.63 mg/l

B. BOD removal efficiency- 89.28% .Initial BOD-280 mg/l, Final BOD after treatment-30 mg/l

C. Oil and grease removal efficiency-46%.Initial oil and grease-14.6 mg/l, Final oil and grease -7.88 mg/l
SWOT Analysis for Sewage treatment plant is also performed.

VIII. FUTURE RECOMMENDATIONS

The above analysis is based on treatment of wastewater only and to get the desired parameters of effluent wastewater. Future recommendations are as follows:

A. The effluent wastewater can be further tested so that it can be used for gardening of University plants or for irrigation purposes in nearby fields.

B. The sludge generated can be further treated and after drying it can be used as manure in fields.

C. Awareness programme can be organised to aware the institutions about sewage handling.

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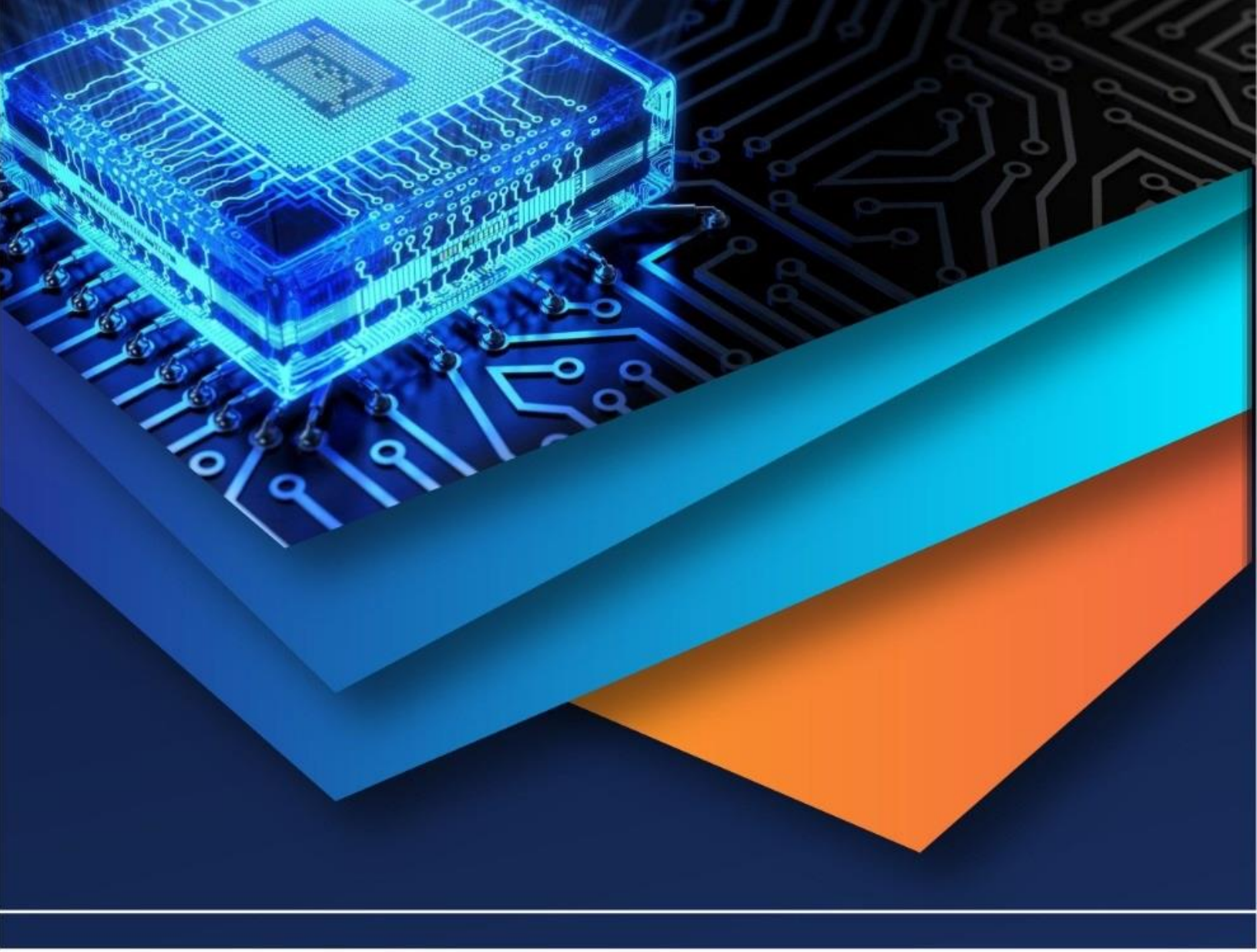

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