

Design of a Prototype Sewage Treatment Plant for SHIATS Campus

Rupesh Kumar Patel¹, Deepak Lal²

PG Scholar, Department of SWLEM Sam Higginbottom Institute of Agriculture, Technology and Sciences

ALLAHABAD, U.P. India¹

Associate Professor, Department of SWLEM Sam Higginbottom Institute of Agriculture, Technology and Sciences

ALLAHABAD, U.P. India²

ABSTRACT: The demand of water in India is growing at a very frequent rate. Though the three sides of this country are surrounded by water bodies yet scarcity of water occurred every year. In India in 1951 the demand of per capita water was 3450 cumec. It is expected that by 2030 the per capita demand of water drastically increases from the current 18000 cumec to 1200-1500 cumec .By 2030, 1.9 billion people will be living in country with absolute water scarcity .Thus there will be lack of water for human being as well as irrigation purposes. The study gives the idea how to use sewage water for irrigation purpose by applying various purpose .In India there are many colleges and universities where in huge quantities sewage are produces. Which can either discharge in river or discharge in open area as a waste fluid. If the proper sewage Treatment plant establishes in these colleges and universities then the sewage water can be used for gardening purposes, floor washing purposes, fountaining Purposes etc. hence up to a limit demand of water can be reduced by applying particular treatment.in this study design of a prototype sewage treatment plant will be done for SHIATS University.

KEYWORDS: Per Capita Demand, Prototype, Cumec, STP (Sewage Treatment Plant)

I. INTRODUCTION

Sewage treatment is the proses of removing contaminants from waste water and household sewage both run off and domestics. In this process various activity such as physical, chemical and biological take place and removal of their respective contaminants. The objective of this treatment is that a treated effluent and solid sludge is produced and hence discharge or reuse back into the environment. Sewage implies the collecting of waste water from various departments of universities and conveying them to some point of disposal. The liquid wastes will require treatment before their discharged into water bodies otherwise these are endangering the public health or causing hazardous condition. The design proposed in this analysis includes. A receiving chamber of dimension 4m x 2m x 1.5m, the coarse screen of dimension 0.6m x 5.3m, Grit chamber of dimension 5.2m x 3m x 1.3m, Primary sedimentation tank with diameter of 7m and depth 2.5m, trickling filter of diameter 15.5m and depth 2m, aeration tank of dimensions 15m x 8m x 4m and sludge dry bed of dimensions 12.5m x 8m will effectively treat the sewage water at primary stage keeping the sewage quality within the permissible limits.

II. LITERATURE SURVEY

The sewage treatment old studies are as follows [1] song et al. in this study using thermodynamics, modal the effects of P and Ca concentration, ph temperature, and strength on theoretical removal. [2] joshi and pathak in this study reported that effect of sewage assessing the effect if sewage application on soil properties identified the problem. [3] Tchobanoglous et al. in this study express that chemical precipitation has long been used for P removal. The chemical most often employed are compounds of calcium, aluminium's and iron. [4] Storm. In this study say that use of alum after secondary treatment can be predicted to produce much less sludge, but the increase could still be problematic.

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III. STUDY AREA

Allahabad is one of the most significant industrial hubs in the state of Uttar Pradesh. It has got an integrated Plant a number of industries, chemicals, explosives, ceramics and distillery units and large number of small and medium industries. Sam Higginbottom Institute of Agriculture, Technology and Sciences deemed university is one of the most important educational institutes in the state of Uttar Pradesh which has a large number of people residing in its campus, a number of laboratories of various departments, residential units, academic blocks and number of hostels for the students studying here. Thus the large amount of sewage is generated in the study area. This is either discharge in river or discharge in open area as a waste fluid. If the proper sewage Treatment plant establishes in these universities then the sewage water will be supplied for irrigation to Forestry, Horticulture, and Toilet flushing, Industrial use as in non-human contact cooling towers, and Indirect & incidental uses. And the remaining sludge after treatment can be used as manure on farm. The use of treated water will reduce the ground water use and additionally the treated sludge will be very useful for increasing the fertility of soil.

IV. METHODOLOGY

Following method are used in sewage treatment plant for SHIATS campus.

- a. Preliminary treatment plant
- b. Primary treatment plant
- c. Secondary treatment
- d. Tertiary treatment

a. Preliminary treatment:

Initially the sewage sample is subjected to screening process where most of floating matter is removed. After screening the sample of sewage effluent is sent into grit chamber. Where effluent is retained for 2 minutes with the permissible velocity of .3 m/s, later all the inorganic particles more than 3 mm size such as grit and sand, silt is removed in grit chamber. Oil and Grease that are present in sewage effluent are removed in skimming tank.

b. Primary treatment:

After preliminary treatment the sewage effluent is retained in primary sewage treatment for a period of 2 hours with the velocity .3 m/ min. In this suspended solids are removed.

c. Secondary treatment:

In this process the sewage is stabilized aerobically and anaerobically. The main purposes are this treatment is to convert colloidal dissolved solids into biomass. The processes available in secondary treatment are.

1. Aerobic process
 - a. Oxidation pond
 - b. Trickling filter
 - c. Activated sludge process
2. Anaerobic process
 - a. Septic tank
 - b. Imhoff tank
 - c. Sludge digestion tank

The solid residue left after secondary treatment has high mineral content and may be used as a soil conditioner and fertilizer on agriculture use.

V. RESULTS AND DISCUSSION

a. Water quality parameters

The sewage water samples were obtained from hostels and staff campus. These samples were tested for PH, BOD, TSS, alkalinity, chloride and DO.

Table No.1 Summarized the value of these aforementioned water quality parameters tested and a comparison with the standard values from World Health Organization (WHO).

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Table 1: Parameter Tested

S.NO.	Parameter	Tested Value	Standard Range (WHO)
1	PH	9.2	5.5-9
2	BOD	200mg/L	≤ 30 mg/L
3	TSS	600 mg/L	≤30 mg/L
4	DO	2.4 mg/L	1-6 mg/L
5	Alkalinity	80mg/L	50-200mg/L
6	Chloride	57.9mg/L	≤250 mg/L

The ph. of the water sample was found to be 9.2 which are greater than standard value of 5.5-9(WHO). Similarly both BOD & TSS were greater than the standard limit of less or equal to 30 mg /L. And the DO of the water sample was found to be 2.4 mg/L which is greater than the standard value of 1-6 mg/L. And alkalinity was found to in the range of standard value. And the last parameter chloride was found to be 57.9 mg/L which are lesser than the standard limit of greater or equal to 250 mg/L.

b. STP Design Parameter:

The current population in the hostels and residential campus is around 3500. The STP was designed considering the future population that is expected in the next 30 year. This Population was projected to be 23000. While calculation of waste water generation it was assumed that the average waste water produced by an adult is 156 lit. /day and hence the total waste water volume generated through design population was estimated 3.6 MLD. Based on the total amount of waste water generated the STP. For SHIATS was designed that include the following major section.

1. Receiving chamber
2. Corse screen
3. Grit chamber
4. Skimming tank
5. Primary Sedimentation Tank
6. Trickling Filter
7. Aeration Tank
8. Sludge Drying Bed

The dimensions of all the aforementioned section & other related parameter are summaries in table 2

Table 2: Design Parameter for STP

S.NO.	Design Parameter	Value
1	Design Period	30 Year
2	Estimated Population By The Year 2045	23000 Adults
3	Water Supply Per Capita	
	In Hostels	180L/h/d
	In Residential Area	250L/h/d
4	Total Volume Of Sewage Water Estimated From The Population Of SHIATS Hotels And Residential Area	3.6 MLD
5	Average Discharge	0.042 Cumecs
6	Maximum Discharge	0.126 Cumecs
7	Design Of Receiving Chamber	

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	Length	4m
	Width	2m
	Depth	1m
	Free Board	0.3m
	Detention Time	60 Sec
8	Design Of Corse Screen	
	Width	0.2m
	Depth	0.6m
	Free Board	0.3m
	Velocity	.8 m/s
	Opening Area	.115 m ²
	Head Loss Through The Screen	.013m
9	Design Of Grit Chamber	
	Length	5.2m
	Width	3m
	Depth	1.5m
	Detention Time	3 Min
10	Design Of Skimming Tank	
	Length	.532m
	Width	.355m
	Depth	1m
	Free Board	0.3m
	Peak Flow Of Sewage	10886.4m ³ /Day
11	Design Of Primary Sedimentation Tank	
	Diameter	7m
	Depth	2m
	Free Board	0.5m
	Detention Time	2 Hours
	Volume Of Sewage	75 m ³
	Quantity Of Sewage	3.6 MLD
12	Design Of Trickling Filter	
	Diameter	15.5m
	Depth	2.5m
	Length	15m
	Bod Left In The Sewage Entering Per Day In The Filter Unit	504kg
	Total Bod Left In The Effluent Per Day	83 Kg

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	Bod Removed By The Filter	432 Kg
	Efficiency Of The Filter	85.70%
13	Design Of Aeration Tank	
	Length	15m
	Width	8m
	Depth	4m
	Average Volume Flow	3600 m ³
	Bod In Inlet	160 Mg/L
	Bod In Outlet	20 Mg/L
	Bod Removed In Activated Plant	140 Mg/L
	F/M Ratio	0.4
14	Design Of Sludge Drying Bed	
	Length	12.5m
	Width	8m
	Depth	1.7m
	Sludge Applied To The Drying Bed	300kg/Day
	Sp. Gravity	1.015
	No Of Cycle In One Year	46
	Volume Of Sludge	14.77 m ³
	Area Of Bed Required	492.6 m ²
	No Of Dry Bed	5
	Area Of Each Bed	100 m ²

VI. SUMMARY AND CONCLUSION

In the present study a scheme domestic waste water treatment and management of sewage generated in SHIATS hostels and residential area has been developed. The total domestic waste water generated in one day is 3.6ML. The scheme is proposed to be constructed at SHIATS Crop Research Farm near NH-27. The treated water will be supplied for irrigating the crops on Research Farm and the remaining sludge after treatment will be used as manure on Farm. The use of treated water will reduce the ground water use and additionally the treated sludge will be very useful for increasing the fertility of soil. Important units of the scheme have been designed for a specific case are:

1. The prototype of domestic waste water treatment plant is for the predicted population of 23,000 and estimated sewage of 3.6 MLD.
2. The prototype receiving chamber will have these dimension 4m x 2m x 1.5m.
3. The prototype screen chamber will have this dimension 0.6m x 5.3m.
4. The prototype grit chamber with aeration will have these dimension 5.2m x 3m x 1.3m.
5. The prototype primary sedimentation tank will have these dimension 7m and depth 2.5m.
6. The prototype trickling filter will have these dimensions, diameters of 15.5m and depth 2m 7.
7. The prototype aeration tank will have these dimensions 15m x 8m x 4m.
8. The dimension of sludge dry bed is 12.5m x 8m.

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