ZERO LEVEL WASTEWATER TREATMENT

A

PROJECT REPORT

Submitted in partial fulfillment of the requirements for the award of the degree

of

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

Under the supervision

of

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to

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

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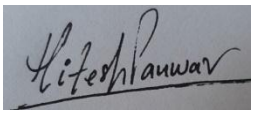
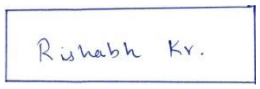
HIMACHAL PRADESH, INDIA

JUNE– 2020

STUDENT'S DECLARATION

I hereby declare that the work presented in the Project report entitled **"ZERO LEVEL WASTEWATER TREATMENT"** submitted for partial fulfillment of the requirements for the degree of Bachelor of Technology inCivil Engineering at **Jaypee University of Information Technology, Waknaghat** is an authentic record of my work carried out under the supervision of **Dr. Ashok Kumar Gupta Professor and Head of Department** of Civil Engineering, Jaypee University of Information Technology, Waknaghat**.** This work has not been submitted elsewhere for the reward of anyother degree/diploma. I am fully responsible for the contents of my project report.





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CERTIFICATE

This is to certify that the work which is being presented in the project report titled **" ZERO LEVEL WASTEWATER TREATMENT"** in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Civil Engineering submitted to the Department of Civil Engineering, **Jaypee University of Information Technology, Waknaghat** is an authentic recordof work carried out by **Hitesh Panwar(161685), Rishabh Kumar Tiwari(161676)** during a period fromAugust, 2019 to May, 2020 under the supervision of **Dr. Ashok Kumar Gupta Professor and Head of Department** of Civil Engineering, Jaypee University of Information Technology, Waknaghat.

The above statement made is correct to the best of our knowledge.

Date: - 02/06/2020

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ABSTRACT

Zero level wastewater treatment refers to the collection of wastewater from households or industries at the source itself and treating the wastewater before discharging it into the main sewerage lines. There are a lot of methods available for at source treatment of wastewater. In this study report we tried to generate a more advanced wastewater treatment system especially for the use of domestic households. We first performed certain tests on the influent and effluent that where obtained from sewage treatment plant of Jaypee University to check for desired quality parameters namely Biological Oxygen Demand (BOD), alkalinity, chloride content, Chemical Oxygen Demand (COD). It was found that the effluent values of various parameters differed from the standard parameters released by Central pollution Control Board (CPCB). This concluded that the sewage treatment plant was not able to clean the sewage produced from the University upto the desired mark and some changes are required to meet the effluent match the standards. The study suggests that installing zero level wastewater treatment models at different locations in the university can help in reducing the load on the sewage treatment plant of the university. As a septic tank system is already available for at source treatment ofwastewater we tried to come up with a more advance wastewater treatment model that can help in achieving much higher treatment of wastewater as compared to septic tank. The model is inspired by Johkasou treatment system and uses both anaerobic and aerobic treatment system along with disinfection. A model is prepared for zero level wastewater treatment using GPS-X software and simulations are run. The simulation results are used as the parameters for judgment. Septic tank model is also prepared and a comparison is done with the advanced treatment system andconventional septic tank treatment system based on the simulation results. The simulation results clearly show that the advanced treatment system is better than the septic tank system. Overall, the study concludes that the wastewater treatment systems in our country is not upto therequired standard and better systems have to be adopted to cope with this situation.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

Wastewater treatment has a very important role in handling the waste production of any city. The majority of wastes produced are from households and industries, so in order to protect our waterbodies and aquatic life it is needed that the waste produced are treated upto the required standards. But the majority if wastewater treatment plants are not functioning properly and large quantities of waste are not treated. As a result, the waterbodies of our country are highly polluted. If the discharge treatment plants are upto the required standard the pollution in our water bodies can be reduced to a great extent. Zero level wastewater treatment is a system which helps in collecting and treating the wastewater produced from households and industries at the source of their production is being adopted by many developed countries like Japan, Israel, and Russia. The majority of wastewater produced from the households and industries can be treated at the source itself and treated water can be reused for many purposes. Adopting zero level wastewater treatment models has helped certain countries in reducing the pollution load on the conventional treatment model and hence they function well. The reusability of treated water is also widely adopted by many countries. The treated water can also be used to recharge the groundwater levels.

Zero level wastewater treatment differs from conventional septic tank treatment as it uses more advance treatment operations compared to septic tank and cleans the sewage upto a greater extent. In India septic tank system are mostly used for at source treatment but a smaller number of households adopt this approach. Also, the treatment is not upto the required standard that the wastewater can be reused after treatment. The wastewater from septic tanks after the treatment flows into the main sewerage lines where it mixes with the main sewage or it is discharged into the ground using a soak pit. This method also contaminates the ground upto a large extent.

1.2NEED OF STUDY

Despite of all the capital, brain power, time, materials, space and technology spend in the treatment of wastewater from the houses of people and industries our rivers, ground water, oceans, and other surface and ground water sources are suffering because of serious water pollutants disposed into these water bodies or sometimes found due to a broken sewer line or inefficiency of present wastewater treatment systems.

Our goal through this project is simply to make sure that this could be reduced by a huge margin, thus providing with a new and better system of zero level wastewater treatment, which could be installed in the bottom of our houses or in front of our industries for their effluent to be as pure as possible. Right in this project we will try and make the influent of the projected sewage treatment plant to meet the permissible limits of effluent through our model of zero level wastewater treatment system.

1.3 DISCRIPTION OF SEWAGE TREATMENT PLANT OF JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY WAKNAGHAT, DIST SOLAN H.P INDIA

Jaypee University of Information Technology Waknaghat, Dist. Solan H.P Indiais recognized by the state government of H.P. Set up by Act No. 14 of 2002vide Extraordinary Gazette notification of Government of Himachal Pradesh dated 23 May 2002. University was approved by the University Grants Commission under section 2(f) of the UGC Act, the University commenced academic activities from July 2002.The university campus is spread over 25 acres on the slopes of Waknaghat. With 14 hostels including faculty buildings whose total wastewater influent is send to a sewage treatment plant situated inside of campus.

The sewage treatment plant in itself is a STP unit which has basic treatment procedure. System of sewer pipe lines collecting in a chamber in which urea is added drip by drip following is aeration chamber 4 that too, followed by 2 sludge digestion chambers and at last a filtration tank. The treated wastewater is send to the top of the institute from where it is used for irrigationpurposes, although most of the water is disposed downhill form the sewage treatment

plant.

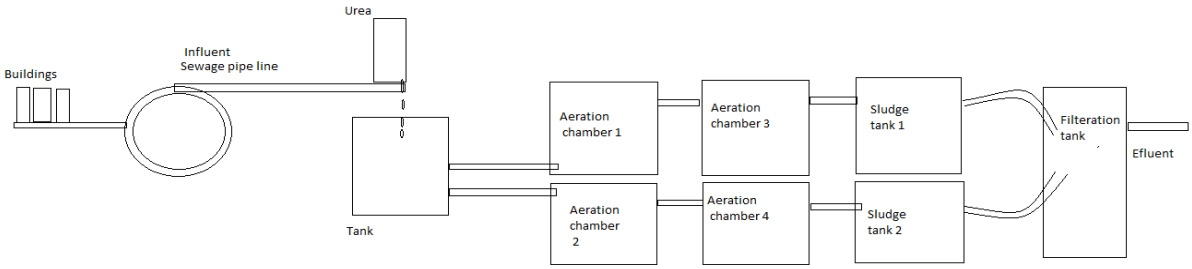

Figure 1.1 Schematic diagram of STP at JUIT

Figure 1.2 Typical view of STP

Figure1.3 Addition of urea in tank

Figure 1.4 Aeration tank of STP

Figure1.5 Sludge tank of STP

Figure 1.6 Effluents discharged from STP

Figure 1.1 shows the schematic diagram of STP at JUIT.

Figure 1.2 shows typical view of STP.

Figure 1.3 addition of urea in tank.

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Figure 1.5 shows sludge of STP

Figure 1.6 shows effluent discharged from STP

CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL

The main objective of this chapter was to gather information regarding the general and ongoing studies done so far in this specified domain. Focus was given to methodologies and procedures that are being used in this specified domain so that a suitable approach can be adopted.

2.2 LITERATURE REVIEW

Sharda, A.K Sharma., [1] water quality of Swan river flowing in Himachal Pradesh. Although the industrial units have waste treatment systems to treat their waste but the complexity of the effluent characterization makes it extremely difficult to meet the statutory standards despite the best efforts made by the industries. The lack of proper management of waste water generation, solid waste management and scarcity of fund, the impacts of conservation measures on part of local bodies has proved to be ineffective resulting in increased pollution in study stretch of Swan River. The required parameters do not match the values given by guidelines.

HP State Pollution Control Board., [2] it manages to conducts annual tests to investigate the parameters like pH, Total dissolvedsolids, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD) etc. which can be used as a handy source of information. It is found that most of the sewage treatment plants are not effective in treating the wastewater produced by industries and from households. This can cause serious impact on the river bodies of Himachal Pradesh.

Mayuresh Panda., [3]. Water quality of various water resources in Cuttack city. Samples from various parts of city were collected some areas shows variation from acceptable limits. It is found that the load on treatment plant is way more than what it is designed for.

A.Ikem, [4]the analytical results of the 51 wells analyzed in this research, revealed that groundwater from these private wells requires further purification to ensure their suitability for human consumption because the levels of some of the water quality parameters exceeded the WHO guidelines for drinking water. This study also revealed that nutrients and trace

metals in the soils and sediments from the two sites were mostly in form of exchangeable metals, carbonate bound metals, and as oxides and hydroxides. These metals are largely of anthropogenic sources from the extractions conducted.

S. Gupta and S Satpati., [5]. In this report the wastewater was collate with Indian standard for irrigation (IS 11624: 1986) which reveals that the values of, cyanide, total suspended solids(TDS), grease and oil exceed the given Indian standard values. There are no existing standards for irrigation water for most of the heavy metals. However, heavy metal concentrations which are very rare are of serious concern as they can bio accumulate through the food chain. The plant available nitrogen, phosphate, and potassium contents of the wastewater-irrigated soil are much lower than the control soil. The lesser potassium and nitrogen content in wastewater irrigated soil may be also due to long-lasting effluent irrigation which reduces the natural microbial activity in the soil, resulting in slower release of plant available nutrients into the soil.

Pandey B., [6]dissected the drinking water quality of Central Development district, Nepal. He investigated the total of 243 examples, 130 from ground water source and 113 from springs. 20 of the groundwater tests surpassed WHO standards. Moreover, we inferred that the greater part of the springs and groundwater sources were intensely tainted with fecal coliform microbes.

Dasaiah Srinivasulu, Yakkala Kalyan, Battala Gangadhar [7]. The present investigation is directed towards the study of wastewater treatment in the angle of continuous improvement and confirming to the norm prevailing as per the national standards. This cost-effective treatment leading to further reduction of COD, BOD, TDS, and SS and make use of the treated water for hygienic appellation such as agriculture, washing, and gardening.

R Reza and G. Singh., [8]. It was found out that the river system in Odisha in certain areas where acidic to highly alkaline (pH ranging between 6- 8.5). When tests were conducted on the samples collected from river system it was found that the major reasons where due to high deposition of heavy metals. This led to biomagnification of the river system. Other parameters were also tested which showed that the desired qualities of the water were not upto to mark and this was impacting the life of aquatic animals and plants. The reasons for the contamination of the river system were due to heavy discharge of industrial wastewater from industrial areas. As the treatment system was not efficient wastewater produced from

industries were not being treated properly and without proper treatment were discharged into the river streams.

Gorde S.P. and Jadhav M.V., [9] the most important compound that sustains life on this planet is water. As it is known that only 1% of the total water present on this planet is fresh water. Water depletion is a serious concern in today's time. Most of the cities in India are predicted to run out of groundwater in the next 2-3 years. Hence it is of utmost importance that more focus should be laid on water reusability i.e. treated water from various sources should be used. Hence water treatment systems have to be improved along with smart city and town planning.

Bittner A[10] Since most studies focuses on the testing of wastewater samples and less importance is given to the drinking water parameters. A study was conducted on drinking water sources and it was found that the most of the sources for drinking water are contaminated and surpassed the maximum permissible limit. It is of utmost importance that the drinking water sources are cleaned on a periodic basis so that there are no chances of any water borne diseases caused by drinking water.

UP State Pollution Control Board[11] Uttar Pradesh state pollution control board conducts monthly surveys on the river bodies of Uttar Pradesh. It surveys includes study conducted on Hindon River passing through Ghaziabad, Ganga River passing through Varanasi and Gomti River through Lucknow. These tests were conducted in January month 2018. It was found that the dissolved oxygen level is very less as compared to the standard value. Biological oxygen demand (BOD) value was in satisfactory range and total coliform bacteria were way above than normal value. This suggested that the wastewater coming from industrial areas were not treated and they were the primary source of contamination of these rivers.

Uttrakhand State Pollution control Board [12]. A study was conducted in the state of Uttrakhand was State Pollution Control Board in the year 2019. The river in observation is Pilakhar which passes through Bilaspur. It was found that the dissolved oxygen and BOD levels of the river were much higher than the standard value and this was due to contamination from household waste. As it is difficult to install sewer lines in mountains and maintain them most of the sewer lines break down due to various actions of weathering and landslides. This causes contamination of water bodies of mountains leading to pollution which also affects the river in plain areas.

Tong and Elimelech [13]. Zero liquid discharge is the need of the world at this point. The zero liquid discharge system helps in treating waste water upto a level that it can be drinkable. Most of the river systems are polluted because of industrial waste water and a lot of useful solid wastes are also released into the river system which can be reused by industries. Zero liquid discharge system makes it feasible for us to recover the solid waste from the wastewater and this can be used by industries for their specific purposes.

Strande Linda [14]. A study was conducted on the Jiuzhaigou national park which constitutes of nine villages. The village wastewater treatment system was failing to meet its desired requirements and was hence contaminating the valley river. Zero level wastewater treatment system was installed in the villages and monitoring was done after months. The river had certainly improved in meeting its standard requirements and reusability of treated wastewater helped the villagers for many purposes. Also, a night soil treatment system was installed which helped in treating the sludge produced and was used as a manure.

Suharyanto, Matsushita, Jun [15] controlling of water pollution in developed cities is very tiring and laborious task. A large surveillance team is required to monitor the waste water parameters and lot of testing has to be done to check whether the quality of the waste is standard or not. A zero level wastewater treatment plant is installed in an area in Cirebon city in Indonesia. It was concluded that the wastewater treatment facility improved in that area after installing the zero level systems further local government needs to support and public works department bodies have to take in measures to ensure that the treatment system functions smoothly.

Kelly D. Alley, Nutan Maurya [16]. It conducted studies on surface and groundwater parameters in India and concluded that groundwater is going to be discharged at greater rates in upcoming years. To recharge the groundwater there needs to be a more rapid development model. Rainwater harvesting and zero level wastewater treatment models can be used in large quantities to recharge the wastewater at a higher rate than usual.

Sukanya Das[17] concerned environmental bodies are finding ways to reuse the waste water that is generated in Urban areas. It is estimated that by 2022 many urban cities in India will run out of groundwater and there will be water scarcity. So, it is highly recommended to reuse the treated wastewater for certain purposes. For this zero level wastewater treatment

systems can be installed which provide a much better treatment facility than conventional septic tanks and clean the wastewater upto much greater level.

Praidt A Louis [18] a large quantity of wastewater is produced on a daily basis and a large quantity is treated as well. After the treatment of wastewater, a large amount of night soil is left which is usually thrown away or used as manure in some cases. A night soil treatment plant will help in treating the night soil upto the required parameter so that it can be used as manure and this will help in crop production and farming.

UP State Pollution Control Board [19] Uttar Pradesh state pollution control board conducts monthly surveys on the river bodies of Uttar Pradesh. This survey includes study conducted on Hindon River passing through Ghaziabad, Yamuna River passing through Allahabad and Rapti River through Gorakhpur. These tests were conducted in January month 2018. It was found that the dissolved oxygen level is zero. Biological oxygen demand (BOD) value was way less than the standard value and total coliform present exceeded the standard value by a higher margin. This shows that wastewater treatment systems are not effective in these areas.

Jayanthi, Mahalakshmi [20] a study was conducted in Bhubaneswar capital city of Odisha to check the efficiency of the wastewater treatment plant. A total of 10 samples were tested from the discharged effluent of the wastewater treatment plant and were tested for standard parameters. It was found that the desired qualities of the treated wastewater do not match with the required parameters and large amount of nitrogen content was found in the effluent. This clearly shows that the treatment systems for wastewater are not functioning properly and there need to be a better treatment system.

2.3 SUMMARY OF LITERATURE REVIEW

Generally all the tests are performed to check the river qualities for various parameters. It is done to ensure that rivers have the necessary conditions to ensure that aquatic life can survive.
Unfortunately most of the rivers fail to meet the standard guidelines and aquatic life is severely affected in the rivers. The most important reasons are inadequate treatment of domestic sewage and industrial sewage. To make sure that our river bodies are safe we need new measures to manage our waste systems.

2.4 OBJECTIVES

Our major expectation from the project is to successfully make a model that can treat sewage water at the source of its discharge and help in better performance of the traditional sewage treatment plant. The model will change how we treat and use our sewage water.

2.5 SCOPE OF STUDY

One can use the model to treat the wastewater right at the source, the water can be used to recharge ground water source, and it can be safely mixed with natural flow of rivers. Once this type of models are placed in every house our rivers will be clean, no foul water will be discharged out in the open.

CHAPTER 3

METHDOLOGY

3.1 GENERAL

All the necessary parameters of wastewater recognition are performed; this will help to establish the extent of working capabilities of the treatment plant that we have tested for. This will also help in knowing how much treatment the water requires and we can prepare the model in accordance with that.

3.2 STUDY AREA AND TYPE OF WASTEWATER

With the altitude of the university around 1544 meters, the winter temperatures usually touch 2-3 degree Celsius. The variation of lengths of sewer pipelines is from 150m to 20m.

The sewage water contains mainly of human excreta, wastewater from washing, and discharge from mess facilities, thus making this water mostly black wastewater. The treatment plant is designed for a capacity of 10 m^3 /day. Figure 3.1 shows the study area i.e. JUIT

Figure 3.1 Location of the study area(JUIT)

3.3 SAMPLING PROCEDURE

Sampling is done thrice in different weeks for both influents and effluents in a plastic container of 4-liter capacity. The laboratory is approximately 140m away from the sewage treatment plant. The samples are tested on the same day on which they are collected.This reduces the chances of any microbial contamination from air and very less alteration is possible in the values obtained.

3.3.1 Sampling procedure:

- Washing the 4-liter plastic bottle with tap water. This reduces the possibility of any external contamination.
- Shake before pouring the remaining wastewater from the bottle. Ensures that the samples is properly mixed
- Taking the sample just before the addition of the urea.
- Transferring the sample in the testing equipment's with ease and after washing the equipment with clean water.
- Proper lab conducts are followed in the laboratory.
- A total of three samples are taken and tested.
- Both the influent and effluent water is tested.
- A total of 3 readings are taken from the testing and an average value is considered.
- Sample 1 for influent testing is taken on 14th October 2019.
- Sample 2 for influent testing is taken on 14th November 2019.
- Sample 3 for influent testing is taken on 22nd November 2019.
- Sample 1 for effluent testing is taken on 21st October 2019.
- Sample 2 for effluent testing is taken on 21st November 2019.
- Sample 3 for effluent testing is taken on 27th November 2019.

3.4 EXPERIMENTAL PARAMETERS

After taking the samples, experiments were performed so that water quality can be found. Listed below are the tests that were performed in order find the water quality.

1. Determining Total Dissolved Solids (TDS)

2. Determining pH of influent and effluent

3. Determining chloride content of influent and effluent

4. Determining Conductivity

5. Determining dissolved oxygen present in influent and effluent

6. Determining biological oxygen demand

7. Determining chemical oxygen demand

8. Determining alkalinity of the influent and effluent

3.5 ANALYSIS

The wastewater collected from university's sewage treatment plant is analyzed at the Civil department's Environment lab. The major reason to conduct the test is to check the desired qualities of the effluent obtained from the sewage treatment plant of the university. The results are then used to find out whether the effluent qualities meet the desired standard or not. This will help us in inferring whether the treatment plant of the university is functioning properly or not.

3.5.1 pH DETERMINATION

pH of the sample was measured in accordance to IS: 3025 part11.

EQIPMENTS USED

1. pH meter
2. Standard flask
3. Funnel
4. Beakers

REAGENTS USED

1. Buffer solutions of pH4.0 and 9.2
2. Potassium chloride
3. Distilled water

3.5.2 ANALYSIS METHOD FOR ALKALINITY

The test is conducted in accordance with IS: 3025 part23.

APPARATUS USED

1. Pipette

2. Pipette bulb
3. Conical flask
4. Standard flask
5. Wash bottle

REAGENTS USED:

1. Purified H_2O.
2. Standard 0.02N H_2SO_4
3. Phenolphthalein indicator
4. Methyl orange indicator

3.5.3 ANALYSIS METHOD FOR TURBIDITY

Turbidity of the sample was measured in accordance to IS: 3025 part 10. Figure 3.2 shows turbidity meter.

EQIPMENTS USED

1. Turbidity Meter
2. Sample Flasks
3. Sample cells
4. Funnel
5. Wash bottle
6. Tissue papers

REAGENTS USED

1. Hexamethylenetetramine
2. Hydrazine sulphate
3. Distilled water

Figure 3.2 Turbidity meter

3.5.4 ANALYSIS METHOD FOR DISSOLVED OXYGEN

Dissolved oxygen is determined in accordance with IS: 3025 part 38.Figure 3.3 shows DO meter.

EQIPMENTS USED

1. Burette
2. Burette stand
3. Glass stoppered BOD bottle
4. Pipettes with elongated tips
5. Pipette bulb
6. Wash bottle

REAGENTS USED

1. Starch indicator
2. Manganous sulphate solution
3. Concentrated sulphuric excess
4. Sodium thiosulphate
5. Potassium hydroxide

Figure 3.3DO Meter

3.5.5 ANALYSIS METHOD FOR BIOCHEMICAL OXYGEN DEMAND

The biochemical oxygen demand is calculated in accordance to IS: 3025 part44.

EQIPMENTS USED

1. BOD incubator

2. Burette and burette stand
3. 300ml glass stopper BOD bottle
4. Pipettes with elongated tips
5. Pipette bulb
6. Wash bottle

REAGENTS USED

1. Calcium chloride
2. Magnesium sulphate
3. Ferric chloride
4. Phosphate buffer

3.5.6 ANALYSIS METHOD FOR CHEMICAL OXYGEN DEMAND(COD)

COD is conducted in accordance to IS: 3025 part 58.

EQIPMENTS USED

1. COD digestor
2. Burette and burette stand
3. Conical flask
4. Pipettes and pipette stand
5. Wash bottle

REAGENTS USED

1. Potassium dichromate
2. Sulphuric acid
3. Silver sulphate
4. Ferroin indicator
5. Ferrous ammonium sulphate

3.5.7 ANALYSIS FOR CHLORIDE CONTENT

Test procedure is in accordance with IS: 3025 part32

EQUIPMENTS USED

1. Burette with burette stand and porcelain dish
2. Pipettes with elongated pipes

3. Conical flask
4. Standard flask
5. Beaker

REAGENTS USED

1. Silver nitrate
2. Phenolphthalein indicator
3. Sodium chloride
4. Potassium chromate

3.5.8 ANALYSIS FOR TOTAL DISSOLVED SOLIDS(TDS)

Total dissolved solids are calculated in accordance with IS: 3025. Figure 3.4 shows TDS meter.

EUIPMENTS USED

1. TDS meter
2. Beaker
3. Distilled water
4. Standard flask
5. Wash bottle
6. Oven
7. Pipette
8. Filter paper

Figure 3.4 TDS Meter

3.5.9ANALYSIS FOR CONDUCTIVITY

Conductivity test is conducted in accordance with IS: 3025 part 14. Figure 3.5 shows conductivity meter.

EUIPMENTS USED

1. Conductivity meter
2. Magnetic stirrer
3. Standard flask
4. Measuring jar
5. Funnel
6. Beaker

REAGENTS USED

1. Potassiumchloride
2. Distilled water

.

Figure 3.5 Conductivity Meter

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 GENERAL

It will tell us how much of treatment the water requires if the water treatment plant is not working up to the requirements of CPCB and WHO, thus shaping the requirements of the model that will be made to achieve the zero level wastewater treatment.

4.2 DATA ANALYSIS

4.2.1 RESULT OF INFLUENT

The tables listed below shows the measured parameters of the influent of the sewage treatment plant of Jaypee University of Information Technology Waknaghat, Distt Solan H.P India. Table 4.1 shows results of influent for sample 1. Table 4.2 shows results of influent for sample 2. Table 4.3 shows results for influent for sample 3.

Table 4.1 Results of parameters of sample 1 (influent) 14th of October 2019.

PARAMETERS	**SAMPLE 1**
pH	8
Conductivity(micro mho/cm)	0.460
TDS(mg/l)	658
Turbidity(NTU)	77
Alkalinity(mg/l)	240
BOD (mg/l)	436
Chloride content(mg/l)	49.644

Table 4.2 Shows the results of parameters of sample 2 (influent) 14th November 2019

PARAMETERS	**SAMPLE 2**
Ph	8
Conductivity(micro mho/cm)	0.432
TDS(mg/l)	600
Turbidity(NTU)	75
Alkalinity(mg/l)	220
BOD (mg/l)	429
Chloride content(mg/l)	48.6

Table 4.3 Shows the results of parameters of sample 3 (influent) 22nd November 2019

PARAMETERS	**SAMPLE 3**
pH	9
Conductivity(micro mho/cm)	0.5.1
TDS(mg/l)	625
Turbidity(NTU)	71
Alkalinity(mg/l)	225
BOD (mg/l)	419
Chloride content(mg/l)	46.21

4.2.2 RESULTS FOR EFFLUENT

The tables listed below shows the measured parameters of the influent of the sewage treatment plant of Jaypee University of Information Technology Waknaghat, Distt Solan H.P India. Table 4.4 shows effluent results for sample 1. Table 4.5 shows effluent results for sample 2 and Table 4.6 shows effluent results for sample 3.

Table 4.4 Comparison of parameters of sample 1 (effluent) 21st October 2019

PARAMETERS	**SAMPLE 1**	**WHO**	**CPCB**

pH	12	6.5-8.5	5.5-9
Conductivity(micro mho/cm)	0.415	0.07	1
TDS(mg/l)	445	30	30
Turbidity(NTU)	68	-	-
Alkalinity(mg/l)	250	50	50
BOD (mg/l)	136	20	30
Chloride content(mg/l)	39.71	600	250

Table 4.5 Comparison of parameters of sample 2 (effluent) 19th November 2019

PARAMETERS	**SAMPLE 2**	**WHO**	**CPCB**
pH	11	6.5-8.5	5.5-9
Conductivity(micro mho/cm)	0.409	0.07	1
TDS(mg/l)	431	30	30
Turbidity(NTU)	65	-	-
Alkalinity(mg/l)	245	50	50
BOD (mg/l)	128	20	30
Chloride content(mg/l)	41.2	600	250

Table 4.6 Comparison of parameters of sample 3 (effluent) 27th November 2019

PARAMETERS	**SAMPLE 3**	**WHO**	**CPCB**
pH	11	6.5-8.5	5.5-9
Conductivity(micro mho/cm)	0.401	0.07	1
TDS(mg/l)	420	30	30
Turbidity(NTU)	61	-	-
Alkalinity(mg/l)	256	50	50
BOD (mg/l)	125	20	30
Chloride content(mg/l)	43.2	600	250

4.3DISCUSSIONS

From the following tests we can come to know that parameters of the effluent like pH value, BOD value, and alkalinity value are quite more as compared to the standard values released by CPCB. Here we can conclude that the sewage treatment plant of university is not efficient in treating the wastewater and a better treatment system is needed. Thus, we can continue our research on zero level wastewater treatment and provide an alternative source for treating the waste water.

4.4 MODEL GENERATION

A wastewater treatment model is generated using GPS-X software. The software was used for modeling and simulation of the wastewater treatment model. This software was downloaded from Hydromantic official page. Figure 5.1 shows generated zero level treatment model

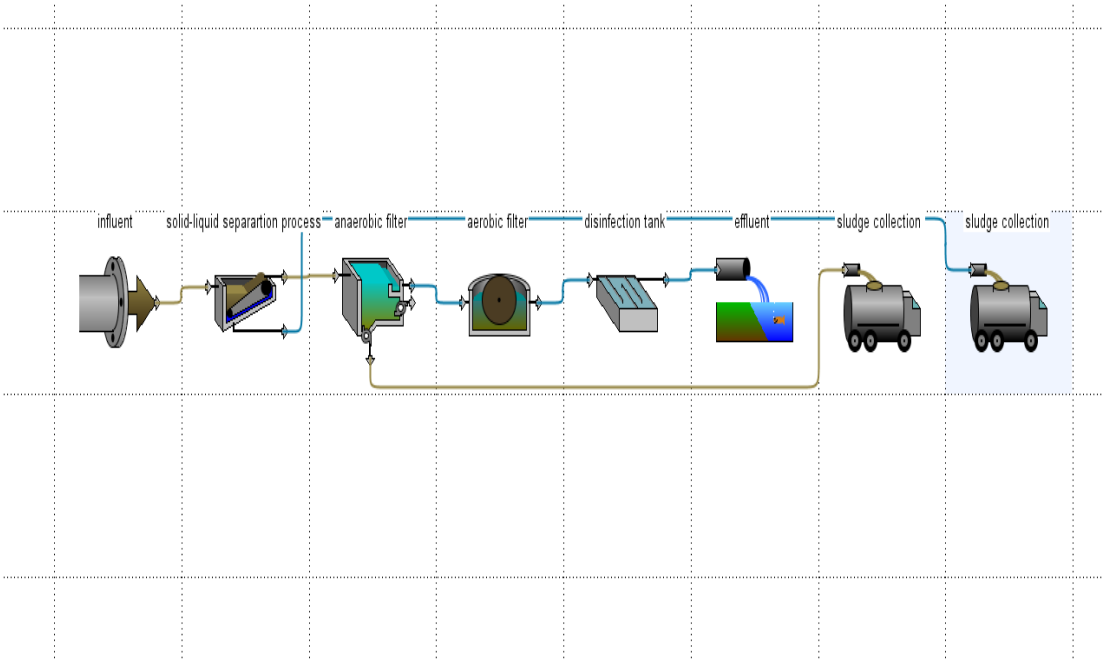

Figure 4.1 Generated Zero leveltreatment model

4.5 EXPLANATION OF MODEL

The model consists of three stages of treatment of domestic wastewater namely,

1. Physical process includes screening and sedimentation tank.
2. Biological process includes contact aeration tank.
3. Chemical process includes disinfection using chlorine tablets.

4.5.1 PHYSICAL PROCESS

1. The wastewater from the influent enters into the screen chamber where large particles of floating and suspended matter are removed by using coarse screens.
2. After passing from the screen chamber, wastewater flows into the sedimentation tank where by using the type-1 settling principle suspended solids are removed.
3. The detention period of sedimentation tank is 2 hours.

4.5.2 BIOLOGICAL PROCESS

1. After passing from sedimentation tank, the wastewater flows into contact aeration tank.
2. In this process the organic matter is decomposed by using aerobic bacteria.
3. A diffusion pipe is attached to the contact aeration tank which helps in providing constant air from bottom so that sludge does not settle there.
4. Air provided from bottom helps in providing aerobic bacteria which help in digestion of the organic matter.

4.5.3 CHEMICAL PROCESS

1. After passing from aeration tank most of the pathogenic bacteria have been removed. In this process chemical dosage is provided to further remove the pathogens to meet the potable water conditions.
2. Bleaching powder ($Ca(OCL)_2$) is used as a disinfection agent.
3. Chlorine acts as strong oxidizing agent which oxidizes the microbial cells that are required for metabolic reactions.

4.6 SIMULATION RESULTS

4.6.1 INFLUENT CHARACTERISTICS

1. The flow of the influent is $2m^3$/day.

2. The values of all the other variables taken are the average of the three influent samples that are tested before.
3. An assumption is made that the influent properties are same for a single house or a building as it is for a sewage treatment plant.
4. The model generated by using GPS-X software is made for a single house.
5. The lab results obtained from testing the influent of the sewage treatment plant of Jaypee University of Information Technology is used as the input variables for the influent of the model generated. Table 4.7 shows the influent values for zero level model

Table 4.7 Influent values for Zero Level Model

influent values for zero level model		
Flow	m3/d	2
TDS	mg/L	626
cBOD5	mg/L	432
Total Alkalinity	mgCaCO3/	228.33
pH	-	8

4.6.2 EFFLUENT RESULTS

1. Out of all the characteristics of the effluent, only four important characteristics are considered.
2. They are biological oxygen demand (BOD), Ammonia content, total alkalinity and pH value.
3. For alkalinity carbonate alkalinity is considered.
4. A total of two simulations are run and their values are recorded.
5. For taking the final results average of the two simulations are considered. Table 4.8 shows effluent results of zero level treatment model.

Table 4.8effluent values for Zero Level Model

effluent results		
Simulation Results	0	
1st simulation	0	
cBOD5	**mg/L**	**22.3**
Ammonia N	**mgN/L**	**52**
Total Alkalinity	**mgCaCO3/L**	**48**
pH	**-**	**5.8**
2nd simulation		
cBOD5	**mg/L**	**21.4**
Ammonia N	**mgN/L**	**56**
Total Alkalinity	**mgCaCO3/L**	**47.3**
pH	**-**	**5.8**
average results		
cBOD5	**mg/L**	**21.85**
Ammonia N	**mgN/L**	**54**
Total Alkalinity	**mgCaCO3/L**	**47.65**
pH	**-**	**5.8**

4.7 SEPTIC TANK MODEL GENERATION

A septic tank is generated using the software GPS-X .The software is used for modeling and simulation of the septic tank.

Figure 4.2 shows the generated septic tank model.

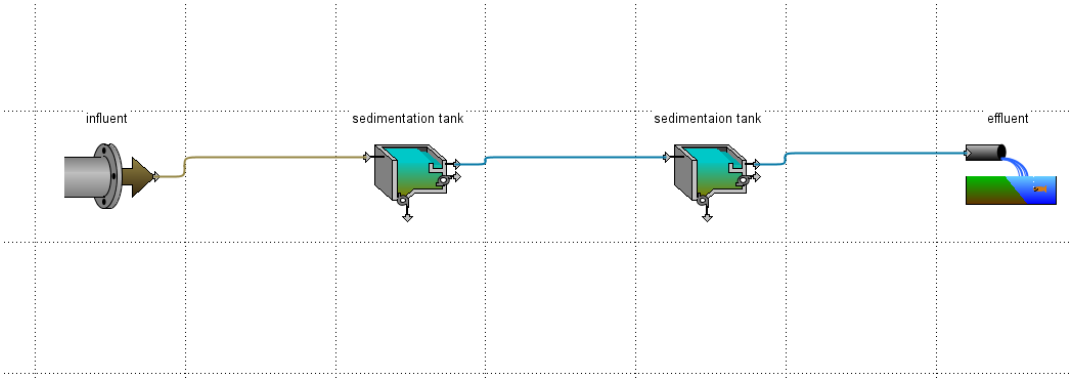

Figure 4.2 GeneratedSeptic tank model

4.8 EXPLANATION OF MODEL

The model works on two stages of treatment of domestic wastewater, namely

1. Physical process which includes sedimentation tanks.
2. Biological process which includes anaerobic digestion.

4.8.1 PHYSICAL PROCESS

1. The influent flows into the sedimentation tank. The design is such that the detention period of the tank is around 24 hours.
2. In the sedimentation tank the sludge is detained for 24 hours.
3. Certain suspended solids settle down in the tank during the detention period and certain bacterial decomposition takes place

4.8.2 BIOLOGICAL PROCESS

1. In the septic tank anaerobic bacteria plays an important in sludge decomposition.
2. As the anaerobic bacteria decomposes the sludge, it decomposes into two components, the first is the settle solids which settle down in the sedimentation tank and the second is the scum which floats on the surface of water.
3. After passing from the first sedimentation tank the effluent flows into the second sedimentation tank where it again goes into the same process of anaerobic digestion and settling.
4. After passing from the 2^{nd} sedimentation tank the treated sewage flows into the municipal sewer line.

4.9 SIMULATION RESULTS

4.9.1 INFLUENT CHARACTERISTICS

1. The flow of the influent is $2m^3$/day.
2. The values of all the other variables taken are the average of the three influent samples that are tested before.
3. An assumption is made that the influent properties are same for a single house or a building as it is for a sewage treatment plant.
4. The model generated by using GPS-X software is made for a single house.
5. The lab results obtained from testing the influent of the sewage treatment plant of Jaypee University of Information Technology is used as the input variables for the influent of the model generated. Table 4.9 shows the influent values for septic tank.

Table 4.9 Influent values for Septic Tank

influent values for septic tank		
Flow	m3/d	2
TDS	mg/L	626
cBOD5	mg/L	432
Total Alkalinity	mgCaCO3/	228.33
pH	-	8

4.9.2 EFFLUENT RESULTS

1. Out of all the characteristics of the effluent, only four important characteristics are considered.
2. They are biological oxygen demand (BOD), Ammonia content, total alkalinity and pH value.
3. For alkalinity carbonate alkalinity is considered.
4. A total of two simulations are run and their values are recorded.

5. For taking the final results average of the two simulations are considered. Table 4.10 shows the effluent values for septic tank.

Table 4.10 Effluent Values for Septic Tank Model

effluent results for septic tank		
simulation results		
1st simulation		
cBOD5	mg/L	130
Ammonia N	mgN/L	63
Alkalinity	mgCaCO3/L	67
Total Alkalinity	mgCaCO3/L	67
pH	-	7
2nd simulation		
cBOD5	mg/L	132
Ammonia N	mgN/L	58
Alkalinity	mgCaCO3/L	71
Total Alkalinity	mgCaCO3/L	71
pH	-	7.3
average simulation		
cBOD5	mg/L	131
Ammonia N	mgN/L	60.5
Alkalinity	mgCaCO3/L	69
Total Alkalinity	mgCaCO3/L	69
pH	-	7.15

4.10 COMPARISON OF THE TWO MODELS

1. The septic tank works on sedimentation and anaerobic process whereas the wastewater treatment model works on three process namely, sedimentation tank, anaerobic process and aerobic process.
2. In the septic tank no disinfection is done whereas in wastewater generated model disinfection using bleaching powder is done.
3. In the septic tank process no nitrification is done i.e. treatment of ammonia (N) whereas in the wastewater treatment model nitrification is done.

4. The nitrification removes the ammonia and nitrite which helps in reducing eutrophication.
5. Construction of septic tank requires brickwork and RCC work. The bottom floor of the tank is concreted and proper ventilation has to be provided to remove the foul gases.
6. The wastewater generated model is inspired from the Johkasou modelwhich is adopted in Japan.
7. The construction is done in a specialized laboratory and the in the site only installation process in needed.
8. The wastewater treatment model treats the sewage to a much higher extent than the septic tank.
9. The biological oxygen demand (BOD) in the generated model is 21.84 mg/l whereas in septic tank it is 131 mg/l. This clearly shows that model adopts advance treatment technology.
10. As the BOD value is quite less as compared to the standard value adopted by CPCB, the effluent can also be reused for certain purposes.
11. Ammonia and nitrites are also removed upto a greater extent as compared to septic tank. This helps in preventing eutrophication.
12. On-site topographical conditions have very less impact on the installation of this model
13. Whereas in septic tank it has to be designed during the planning of the building.
14. The treated wastewater from the model can be used to recharge the ground water without providing any soak pit whereas in septic tank a soak pit has to be provided.
15. The sludge or the night soil that is produced is also treated upto a certain extent so that it can be used as a fertilizer or manure.
16. Septic have to be cleaned periodically about every 1 year whereas this model requires cleaning after every 2 to 3 years.
17. By designing a certain piping system, the effluent produced can be reused for toilet flushing, car washing, house cleaning and for activities that do not require fresh water for its purposes.
18. This model will greatly enhance the on-site treatment of wastewater produced from houses and buildings and help in proper reuse of the treated water.

CHAPTER 5

CONCLUSIONS

5.1 GENERAL

This chapter shows the summary of the work done in the project, the conclusions that are drawn from it and the scope for future studies in this domain.

5.2CONCLUSIONS

1. The zero-level model designed cleans the wastewater upto a much greater extent than the conventional septic tank.
2. The BOD value is much less compared to CPCB guidelines. This means that the treated wastewater can be safely discharged into the drains for any lake or river network.
3. Ammonia and nitrite content is very less in zero level model and within the permissible limit as given by CPCB. Hence the chance of eutrophication is reduced.
4. The treated wastewater can also be reused by designing certain piping system. It can also be used for recharging of groundwater.
5. The model can be installed for separate buildings/hostels of Jaypee University of Information Technology and the wastewater can be treated at the source.
6. A single treatment plant can also be installed collectively for different hostels and after treating the wastewater at the source it can be discharged into the drains.
7. The treated wastewater can be stored separately and can be used at the time of emergency by providing further disinfection.
8. The areas where the system can be installed should follow this model and other areas can be connected to main drainage line that leads to main sewage treatment.
9. This will also reduce the load on treatment plant and it can work better. Hence it can meet the desired parameters without much maintenance which will also help in reducing the overall cost.

5.3SUMMARY

1. The influent and effluent of sewage treatment plant of Jaypee University of Information Technology was tested.
2. After testing for various parameters, it was found out that the effluent value does not meet the guidelines as provided by CPCB.
3. This means that the sewage treatment plant was inadequate in treating the wastewater.
4. This could be due to several reasons like the load for which the plant is designed is not sufficient to meet the load of the incoming influent.
5. Other reasons could be insufficient working of plant chambers, not getting periodic maintenance.
6. So, a need for better treatment plant was needed. We came up with an idea that if the wastewater produced from buildings is treated at the source and then discharged into the drainage lines the load on treatment plant will reduce drastically.
7. So, we designed a system that can treat wastewater at the source of its production and called it zero level treatment.
8. This model was designed different than the conventional septic tank that is mostly used for zero level treatment.

5.4 FUTURE STUDY

1. As wastewater management and treatment is a major concern in today's era the scope of future study is always possible in this field.
2. Zero level wastewater models can be further modified with more advance treatment mechanisms to treat the sewage water.
3. Recycling is the way to go in today's time whether it's water, plastics or any other source for that matter. So, more awareness needs to be spread among people for recycling of wastewater and using that treated water for several purposes.
4. This kind of models can only be adopted when there is a involvement of government bodies like PWD, irrigation departments etc. Hence more needs to be spread among

people regarding the water crisis and people and government should actively participate for making it possible.

5. Recharging of groundwater is necessary in today's time especially when there have been studies regarding the depletion of groundwater in major cities in India. Adopting this model can help in recharging of groundwater at several places.
6. Also zero liquid discharge systems can be installed which help in treating the wastewater upto such an extent that it can be used for drinking purposes. This requires much advance mode of treatment but is achievable.

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ANNEXURE A

INFLUENT CHARACTERITICS	**Various tests-** pH, BOD, conductivity, TDS, chloride content, alkalinity	**A**

A.1 INFLUENT RESULTS

Table for SAMPLE 1

PARAMETERS	**SAMPLE 1**
pH	8
Conductivity(micro mho/cm)	0.460
TDS(mg/l)	658
Turbidity(NTU)	77
Alkalinity(mg/l)	240
BOD (mg/l)	436
Chloride content(mg/l)	49.644

Table for SAMPLE 2

PARAMETERS	**SAMPLE 2**
pH	8
Conductivity(micro mho/cm)	0.432
TDS(mg/l)	600
Turbidity(NTU)	75
Alkalinity(mg/l)	220
BOD (mg/l)	429
Chloride content(mg/l)	48.6

Table for SAMPLE 3

PARAMETERS	**SAMPLE 3**
pH	9
Conductivity(micro mho/cm)	0.5.1
TDS(mg/l)	625
Turbidity(NTU)	71
Alkalinity(mg/l)	225
BOD (mg/l)	419
Chloride content(mg/l)	46.21

ANNEXURE B

EFFLUENT RESULTS	**Various tests-** pH, BOD, conductivity, TDS, chloride content, alkalinity	**B**

B.1 EFFLUENT RESULTS

Table for SAMPLE 1

PARAMETERS	**SAMPLE 1**	**WHO**	**CPCB**
pH	12	6.5-8.5	5.5-9
Conductivity(micro mho/cm)	0.415	0.07	1
TDS(mg/l)	445	30	30
Turbidity(NTU)	68	-	-
Alkalinity(mg/l)	250	50	50
BOD (mg/l)	136	20	30
Chloride content(mg/l)	39.71	600	250

Table for SAMPLE 2

PARAMETERS	**SAMPLE 2**	**WHO**	**CPCB**
pH	11	6.5-8.5	5.5-9
Conductivity(micro mho/cm)	0.409	0.07	1
TDS(mg/l)	431	30	30
Turbidity(NTU)	65	-	-
Alkalinity(mg/l)	245	50	50
BOD (mg/l)	128	20	30
Chloride content(mg/l)	41.2	600	250

Table for SAMPLE 3

PARAMETERS	**SAMPLE 3**	**WHO**	**CPCB**
pH	11	6.5-8.5	5.5-9
Conductivity(micro mho/cm)	0.401	0.07	1
TDS(mg/l)	420	30	30
Turbidity(NTU)	61	-	-
Alkalinity(mg/l)	256	50	50
BOD (mg/l)	125	20	30
Chloride content(mg/l)	43.2	600	250

ANNEXURE C

INFLUENT CHARACTERITICS FOR WASTEWATER MODEL	**VARIOUS TEST-** Total dissolves solids, BOD, total alkalinity expressed as carbonate alkalinity and pH	**C**

C.1 INFLUENT CHARACTERISTICS

Table for influent values

Parameters	Unit	Value
Flow	m3/d	2
TDS	mg/L	626
BOD	mg/L	432
Total Alkalinity	mgCaCO3/L	228.33
pH	-	8

ANNEXURE D

EFFLUENT RESULTS	**VARIOUS TEST-** Total dissolves solids, BOD, total alkalinity expressed as carbonate alkalinity and pH	**D**

D.1 EFFLUENT RESULTS

Table for effluent values

1st simulation

Parameters	Unit	Value
cBOD5	mg/L	22.3
Ammonia N	mg/L	52
Total Alkalinity	mgCaCO3/L	48
pH	-	5.8

2nd simulation

Parameters	Unit	Value
cBOD5	mg/L	21.4
Ammonia N	mg/L	56
Total Alkalinity	mgCaCO3/L	47.3
pH	-	5.8

ANNEXURE E

INFLUENT CHARACTERISTICS FOR SEPTIC TANK MODEL	**VARIOUS TEST-** Total dissolves solids, BOD, total alkalinity expressed as carbonate alkalinity and pH	**E**

E.1 INFLUENT CHARACTERISTICS

Table for influent values

Parameters	**Unit**	**Value**
Flow	m3/d	2
TDS	mg/L	626
BOD	mg/L	432
Total Alkalinity	mgCaCO3/L	228.33
pH	-	8

ANNEXURE F

EFFLUENT RESULTS	**VARIOUS TEST-** Total dissolves solids, BOD, total alkalinity expressed as carbonate alkalinity and pH	**F**

F.1 EFFLUENT RESULTS

Table for effluent results

1st simulation

Parameters	**Unit**	**Value**
cBOD5	mg/L	130
Ammonia N	mg/L	63
Alkalinity	mgCaCO3/L	67
Total Alkalinity	mgCaCO3/L	67
pH	-	7

2nd simulation

Parameters	**Unit**	**Value**
cBOD5	mg/L	132
Ammonia N	mg/L	58
Alkalinity	mgCaCO3/L	71
Total Alkalinity	mgCaCO3/L	71
pH	-	7.3

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