A report on

Analysis Of Sewage Treatment Plant at Rai

in

Sonipat Region

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

MASTER OF TECHNOLOGY

(Environment Engineering)

By

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CERTIFICATE

This is to certify that Mr. ABHISHEK SAINI, M. Tech. student in the Department of Environmental Engineering has submitted a project report on "ANALYSIS OF SEWAGE TREATMENT PLANT IN SONIPAT REGION" in partial fulfilment of the requirement for award of degree of Master of Technology in Environmental Engineering, during the academic year 2020-2021.

It is a record of the student's research work prepared under my supervision and guidance.

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DECLARATION OF ORIGINALITY

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I declare that this is the true copy of my/our report, including all revisions, as approved by my advisor and supervisor, and that this report has not been submitted for any other degree to any other University or Institution.

Abhishek

(31/07/2021)

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ABSTRACT

Almost 80% of the raw water converted into the wastewater. Sewage treatment is the way toward eliminating pollutants from civil wastewater, containing fundamentally family unit sewage in addition to some industrial wastewater. Physical, Chemical and Biological cycles are utilized to eliminate toxins and produce water in the prescribed standard that are led by CPCB. Fundamentally different wastewater boundaries like pH, Total Dissolved Solids (TDS), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and so forth are inspected at the inlet, outlet and different various destinations of treatment plant.

The point of this investigation is to assess the nature of sewage produced from 7.5 MLD STP situated at Patla town along EP expressway in SONIPAT, HARYANA which is based on Extended Aeration process.

Investigation of sewage nature of this plant is a basic as the vast majority of the treated gushing released into Yamuna waterway staying utilized for water system, watering of parks and greens.

The consequences of these assessments likewise decide if the emanating released into the water body are under cut-off points given by CPCB.

Keywords: Total Dissolved Solids, Biological Oxygen Demand, Chemical Oxygen Demand

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LIST OF ABBREVIATIONS

BOD	-	Biological Oxygen Demand / Biochemical Oxygen Demand
COD	-	Chemical Oxygen Demand
TSS	-	Total Suspended Solids
TDS	-	Total Dissolved Solids
SBR	-	Sequential Batch Reactor
MBBR	-	Moving Bed Bio Reactor
EX. AER	-	Extended Aeration
PST	-	Primary Sedimentation Tank
SST	-	Secondary Sedimentation Tank
BIOFOR	-	Biological Filtration and Oxygenated Reactor
SAFF	-	Submerged Aeration Fixed Film
TKN	-	Total Kjeldahl Nitrogen
WWTP	-	Wastewater Treatment Plant
STP	-	Sewage Treatment Plant
SS	-	Suspended Solids
CPCB	-	Central Pollution Control Board
EPA	-	Environment Protection Act
NRCD	-	National River Conservation Directorate
MLSS	-	Mixed Liquor Suspended Solids
UASB	-	Upflow Anaerobic Sludge Digester
ASP	-	Activated Sludge Process
WSP	-	Waste Stabilization Pond

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CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

In generally treatment of sewage water is just a way to remove the pollutants or the particles that are harmful by the various available treatments present from the household wastewater that mainly consist the organic matter from the kitchen, bathroom and daily purposes etc. Physical, chemical, and biological cycles are utilized to eliminate foreign substances and produce treated wastewater and the process where such treatment takes place is called Sewage Treatment Plant or Wastewater Treatment Plant. Waste water can go towards treatment plants through courses by means of gravity or siphons.

1.2 SEWAGE OVERVIEW

Mixture of water and liquid waste generated due to different activities in the community is termed as sewage.

Sewage is more than 99.9% of water and less than 0.1% of solid such that if 1000kg of sewage sample is considered it consist of 0.45kg of total solids out of which 45% solids are organic in nature and 55% solids are Inorganic in nature.

1.3 ORIGIN OF SEWAGE

If it is generated due to industrial activity it is termed as Industrial Sewage.

If it is generated due to domestic activity it is termed as Domestic Sewage and if it generated after heavy rainstorm it is termed as drainage or runoff.

Kitchen and bathroom waste taken together is termed as Sullage.

Domestic and Industrial Sewage taken together is termed as Sanitary sewage.

Drainage discharge is approximately 25 to 30 times more than sanitary sewage discharge.

1.4 COMPONENTS OF WWTP

A conventional WWTP consist of the following processes: -

I. **Screening Chamber**: - Generally the purpose behind this is to eliminate the gliding and the suspended issue in the wastewater.

   Screen are essentially of two unique sorts FINE SCREEN and COARSE SCREEN

   COARSE SCREEN fundamentally eliminates greater particles having size range between 6mm – 20mm.

   FINE SCREEN fundamentally eliminates more modest size particles going from 0.15mm – 6mm.

II. **Grit Chamber**: - These are given to expulsion of Inorganic suspended particles from wastewater and to additionally advance the natural suspended particles to PST. These are designed for size greater than 0.2mm.

III. **Skimming Tank**: - Skimming tanks are settled for the expulsion of oil and grease particles from the wastewater which if not eliminated hinders the development of Microorganisms needed for organic treatment.

IV. **Primary Sedimentation Tank**: - These are generally provided for the removal of organic suspended particles from the waste water. Generally designed for both average and peak discharges.

   Some chemicals are also used as coagulants such as Alum and Iron salts for the settlement of suspended organic particles.

V. **Secondary treatment**: - Secondary or biological treatment is being carried out for decomposition of dissolved organic matter present in the wastewater by reaction of micro-organisms either in the presence or absence of oxygen.

Generally, it is done by suspending the biomass in the wastewater or either by providing the medium for attachment of biomass and passing water through it.

VI. **Secondary Sedimentation Tank**: - Secondary sedimentation tanks are basically provided for the settlement of dissolved organic matter.

VII. **Tertiary Treatment**: - This treatment is given basically when wastewater is further being utilised for the drinking purposes and for gardening and other purposes so that it meets the required standards set by CPCB and pollution boards.

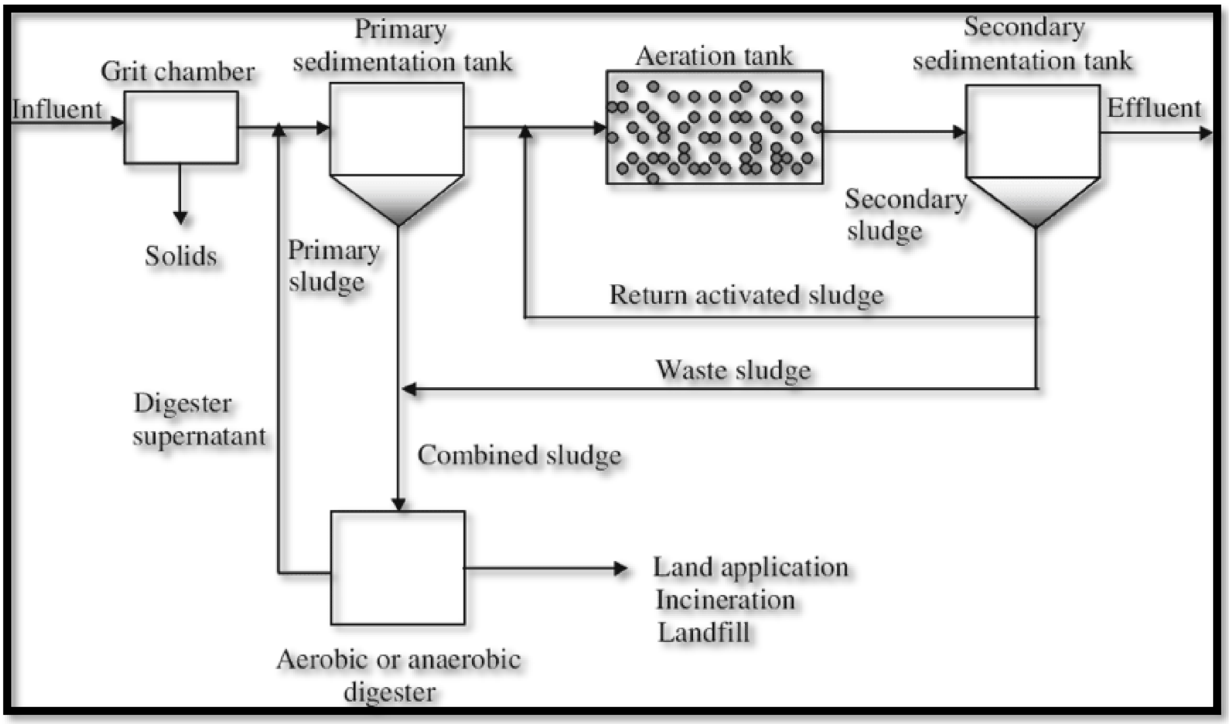

FIG 1.1 SCHEMATIC DIAGRAM OF SEWAGE TREATMENT PLANT

Table 1.1 SALIENT FEATURES OF SEWAGE TREATMENT PLANT

S NO.	Particulars	Size/Capacity	Quantity
1	Inlet Box	3900 X 2000	1
2	Manual coarse screen	1830 W	2
3	Raw Sewage sump	14000 X 7000	1
4	Receiving Chamber	2000 X 2000 X 3000	1
5	Fine Screens	1510	2
6	Detritus Chamber	5700 X 5700 X 700	1
7	Distribution Chamber	3500 X 1200	1
8	Aeration Tanks	32000 X 16000 X 5500	2
10	Secondary clarifiers	31200	1
11	Flash Mixer	2900 X 2900	1
12	Chlorine Diffusion Chamber	7610 X 3800 X 3000	1
13	Biological Sludge Sump	10000ǿ X 3000 SWD	1
14	Secondary sludge lifting pump house	10000ǿ X 5000 HT	1
15	Combined sludge pump	8600ǿ X 3000 SWD	1
16	Thickener	11400ǿ	1
17	Thickened Sludge Sump	4000ǿ X 2000 SWD	1
18	Thickened Sludge Pump House	4000ǿ X 5000 HT	1
19	Sludge Drying Beds	14000 X 28000	10

1.5 Various Sewage Technologies

There are various technologies available in India for treatment of Sewage and Wastewater that includes conventional treatments like Activated Sludge process that is ASP also another one that is Upflow Anaerobic Sludge Digester and Waste stabilisation Ponds generally called WSP etc.

Also, with developing nation with growing population our aim is to keeping land requirement as much less as possible and high efficiency is achieved against various parameters that degrade quality like BOD, COD and TSS and various others, so that treated water can be easily discharged to rivers or can be reused in irrigation and gardening. New technologies that are available are Sequential Batch Reactor known as SBR process a kind of new variant of ASP and other emerging technology is MBBR that is Moving Bed Biofilm Reactor which are being approved under JNNURM projects.

These advancements are momentarily depicted as following: -

1.5.1 Sequencing Batch Reactor (SBR)

SBR is nothing but new kind of variant or can say newly developed technology of Activated Sludge process that contains various phases. It is seen as five phase process that includes filling as first phase, react as second, settle as third, decant and finally idle phase respectively. In this technology aeration or air circulation time varies generally from 60-90 mins according to the capacity of the plant designed. This is new kind of process that are used in various cities in India. It has very good efficiency in removal of both the main parameters such as BOD and COD also very high effectiveness in removing nitrogen and phosphorus along with it. However, the energy consumption is more. Diagram of SBR process is presented in Fig. 1.2.

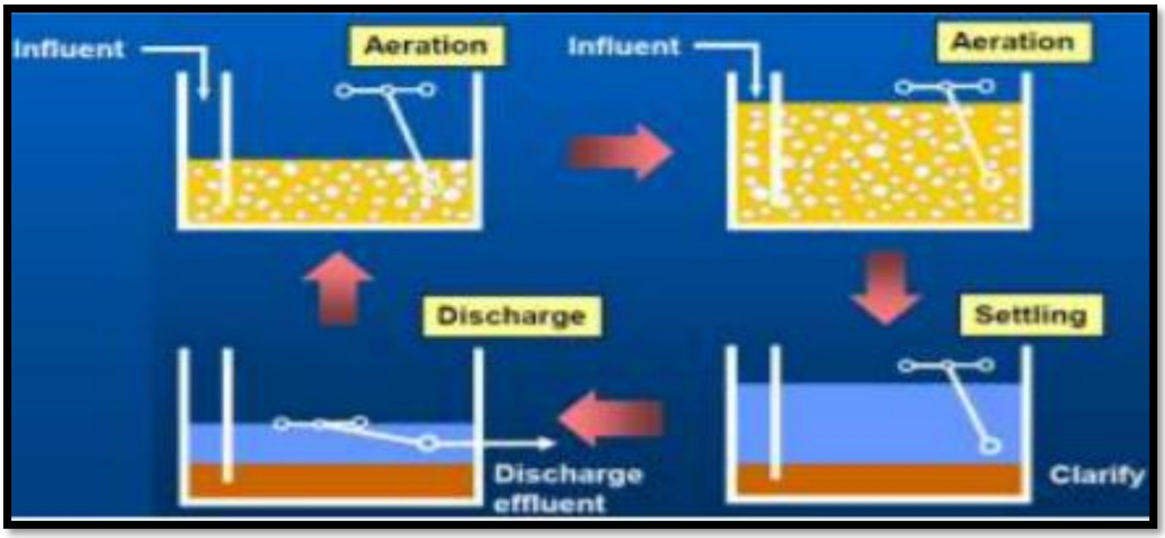

FIG 1.2: SCHEMATIC DIAGRAM OF SEQUENCING BATCH REACTOR (SBR) PROCESS

ADVANTAGES

- Highly effective against BOD as well as N and P removal.
- Observe very less presence of foul smell and corrosive gases
- Aesthetics are also being improved using this process.
- In this there is no requirement of return activated sludge pumping stations and secondary sedimentation tanks.
- Capability to oversee and treat variable stacking conditions, for example, typical, diurnal, weaken storm and stun loads.
- Less manpower required.
- Effluent after treatment is of very good quality that it can be used without filtration.
- Can be extended as a measured framework.
- If required can be used along with primary sedimentation tanks.
- Very good quality or stabilized sludge is generated.

DISADVANTAGES

- Provision is not made for management of sludge.
- No plan of essential treatment to direct contamination load varieties
- Requires initially high energy if cannot be used with bio-methanation.
- Semi-skilled labour is required for operation of plant.
- This technology is patented.

1.5.2 Fluidized Aerobic Bioreactor (FAB)/Moving Bed Bio Reactor (MBBR)

This technology is newly emerging and is also most similar to that of Activated Sludge but certain exceptions are there that includes the media that is present offers microorganisms to grow and helps in maximizing growth of microbes or microorganisms in the aeration tank. Although Diffused aeration is also required in this process. FAB i.e., Fluidized Aerobic Bioreactor technology is related to MBBR technology, the basic or general difference is that in FAB media is kept at stationary position while kept in suspension in MBBR. In India this technology is not common but are in use because of high cost it is preferred wherever the land availability is less and there is no Treatment plant available nearby area. Schematic stream diagram of MBBR technology measure is shown in Fig 1.3.

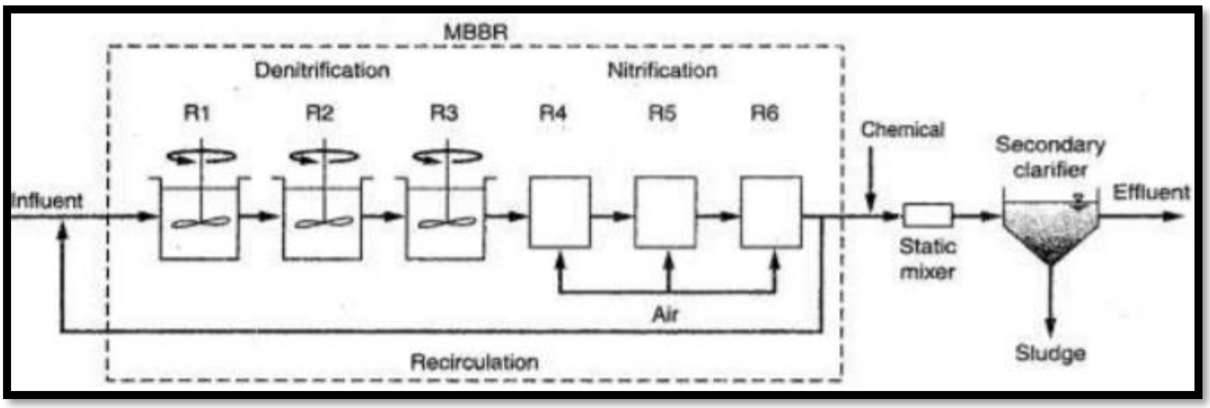

FIG 1.3: SCHEMATIC FLOW DIAGRAM OF MBBR PROCESS

ADVANTAGES

- No constraints till the blowers can be reasonably utilized.
- Circular designs are generally preferred as it will reduce the cost of construction and time.
- This advantage is most important as structure made can be covered for air quality.
- Easy to work and keep up.

DISADVANTAGES

- The media that offered by the various merchants available in market are different in terms of area per unit volume. Also, every merchant advises his own criteria that he had made according the media volume and aeration tank volume which it comes out to be very difficult in selection part because not standardized by govt. Also, quality of this media varies.
- In these technologies media that is provided have to check whether it is moving along whole volume or whether it get stick to the top layer in that case it is required to mixing the media without causing any damage to the biomass layer for that case gentle movers are further needed throughout the tank.
- Also, the media offered by different merchants are patented by them.
- Requires initially high energy if cannot be used with bio-methanation.
- Also, very costly process.
- Requires skilled workers for the operation.

1.5.3 Membrane Bio Reactor (MBR)

This technology is newly designed and also adopted in various parts of our country. In this process both the processes of providing air circulation that is aeration and the secondary sedimentation carried out in the single tank by removing the Mixed liquor suspended solids through the membranes provided instead of settling it down to another tank. It has a very good efficiency of with almost very less values of Biochemical oxygen demand as well as suspended solid. Also, this process has the capability to hold MLSS content almost three to four times the old and conventional technologies such as aeration tanks. In this diffused aeration is also required. Similar to above technologies it also has disadvantage of the membrane size as it is not standardized, so every merchant advises his own shape that is why it is difficult to understand.

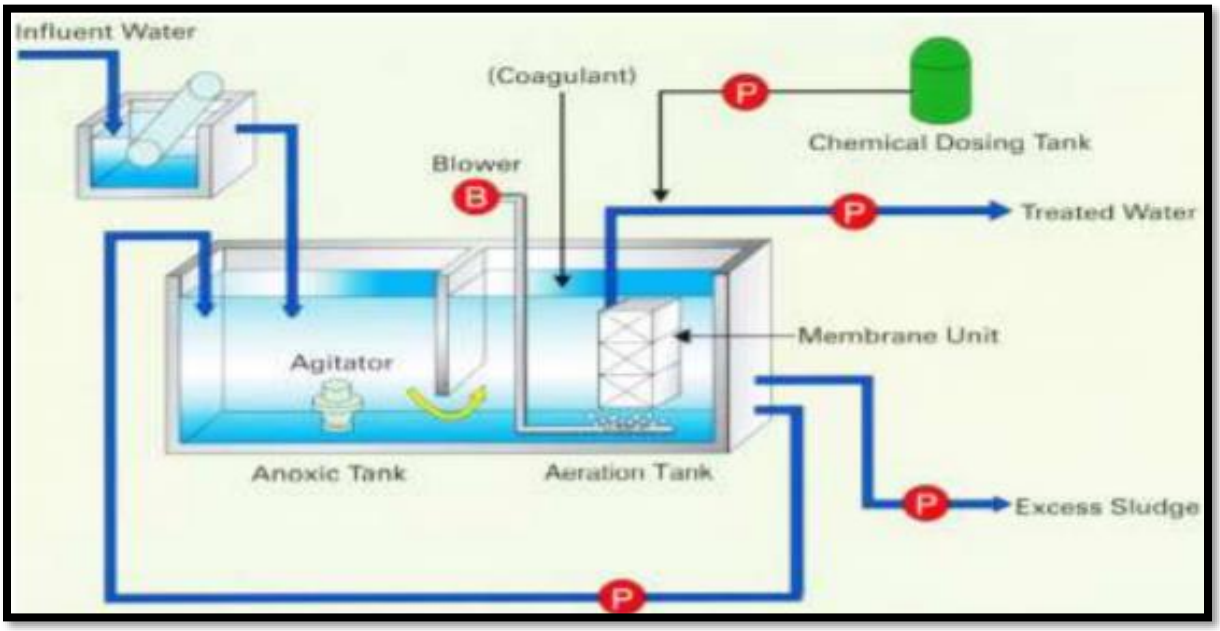

FIG 1.4: SCHEMATIC FLOW DIAGRAM OF SUBMERGED MEMBRANE BIOREACTOR PROCESS

ADVANTAGES

- Highly effective against BOD as well as N and P removal
- Compact framework, lessens plant impression by 20-40% contrasted with an ordinary STP.
- These films are expressed to be tough to guarantee unwavering quality and long layer life, and low layer substitution recurrence.
- The particular framework is expandable
- Very good stability because of high MLSS against the organic shocks which is due to varying discharge.
- The measure works under low pull, the best filtration technique for little to enormous scope film offices, henceforth low force utilization.
- Automated framework makes the cycle tasks simpler to work.

DISADVANTAGES

- Each merchant advocates his own models for the films and their sorts which makes it hard to achieve a typical and approved plan rules
- It is preposterous to expect to tear apart the framework between various makers.
- High dependence on energy contribution to the shortfall of bio methanation
- Patented measure innovation and decanters opposing nearby cannibalization

1.5.4 BIOFOR Technology (Biological Filtration and Oxygenated Reactor)

Key features of the technology

- Primary treatment can be increased by adding the coagulants.
- This process require less space for setup whole process as compared to conventional methods.

- It has another key feature of high-rate filtration along increased aeration.
- This also provides the more contact of wastewater with the air by upside flow of wastewater.
- This process excludes the secondary sedimentation but primary sludge generated can be reused.
- Low land requirement because of the deep reactors.
- A conservative and strong framework

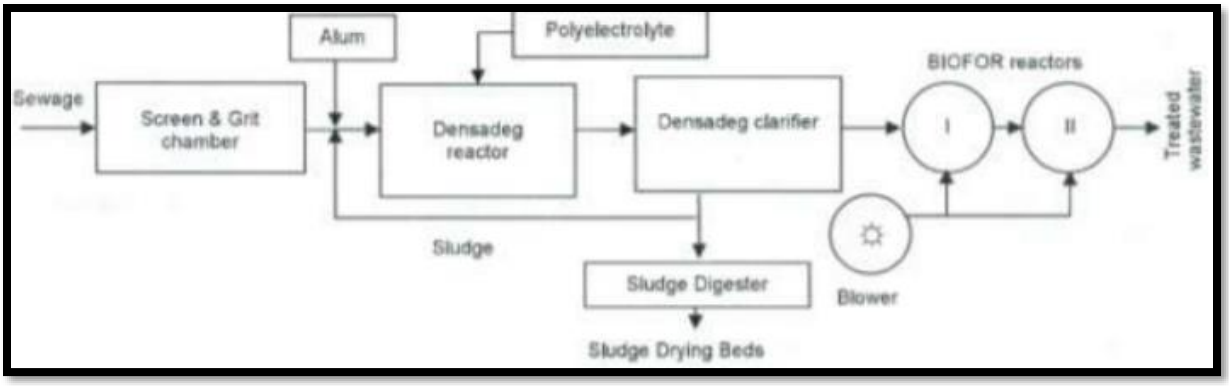

FIG 1.5: PROCESS FLOW DIAGRAM OF BIOFOR TECHNOLOGY

ADVANTAGES

- Treatment comes out to be very compact because of the high-rate processes involved.
- As diffused aeration is also used in this and more time available for wastewater in contact with air due to which high aeration efficiency is observed.
- Space saving as auxiliary sedimentation is apportioned
- Very good against fluctuations in stream rate and organic loads
- Adherent to the strict release norms.
- The effluent after the treatment comes out to be of very good quality that it can be used without providing separate treatment.

- Effluent after treatment comes out can be easily go for UV sterilization without any filtration.
- Very less amount of aerosol and odour observed at the site location.
- Harmful gases are not present in the nearby area.
- Lower activity management empowers lesser labour necessity Impediments

DISADVANTAGES

- In primary sedimentation regular and high amount of chemicals are required.
- Due to the addition of coagulants and flocculants large sludge generation has been observed.
- Post treatment is needed for the sludge generated after primary sedimentation.

1.5.5 High Rate Activated Sludge BIOFOR-F Technology

Key features of the technology

- In general, high level of mechanisation and sophistication
- The flow scheme excludes primary sedimentation tank
- Superior aerated grit chamber and classifier
- Circular aeration tank with tapered air diffusion system
- Second stage aeration and rapid sand filtration through a biologically active filter media
- Dissolved air floatation for sludge thickening
- Digester heating and temperature controlled anaerobic sludge digestion
- Mixing of digester contents through biogas
- Dynamic cogeneration of electrical and thermal energy through gas engines

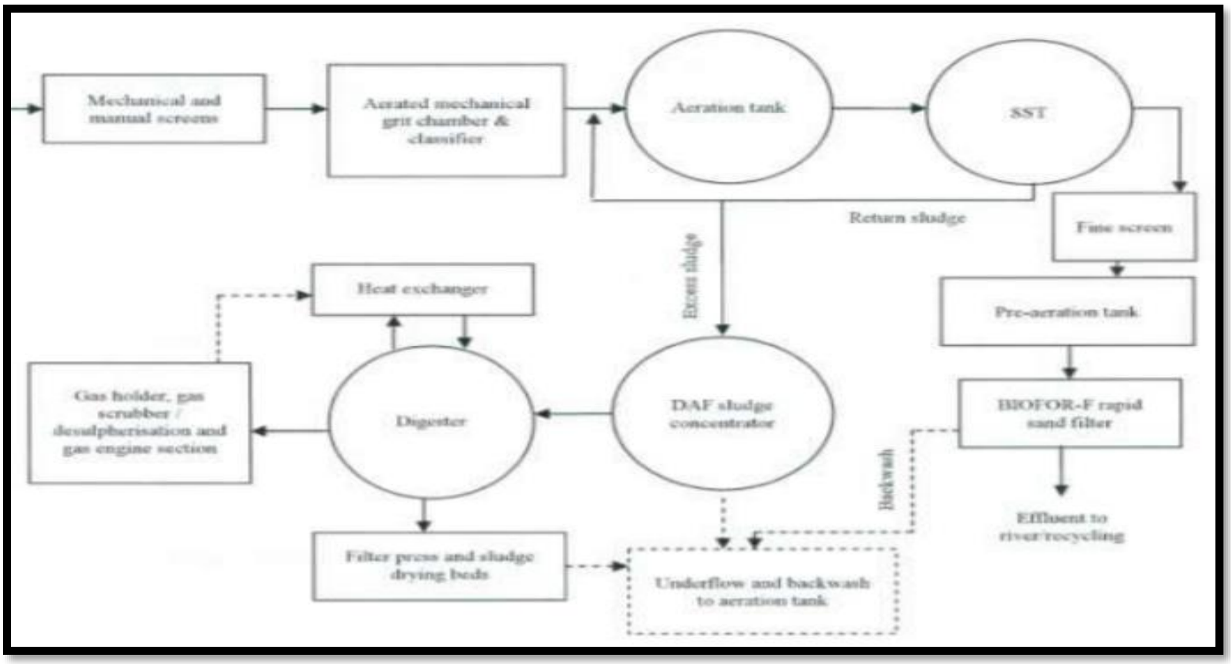

FIG 1.6: PROCESS FLOW DIAGRAM OF HIGH RATE ACTIVATED SLUDGE BIOFOR-F TECHNOLOGY

ADVANTAGES

- Treatment comes out to be very compact because of the high-rate processes involved Treatment comes out to be very compact because of the high-rate processes involved.
- Higher air circulation effectiveness through diffused and tightened air circulation framework
- More land available due to no requirement of primary sedimentation.
- Compliance with stricter release guidelines.
- Stable digester execution and steady gas creation.
- Almost independent in energy necessity because of gas motor-based cogeneration framework
- Very less amount of aerosol and odour observed at the site location.

DISADVANTAGES

- As such there is not any disadvantage or any negative point seen except the cost as cost comes out to be very huge.

1.6 Objectives of the study are:

- To assess and monitor the physio-chemical parameters at inlet and outlet of the Sewage Treatment Plant.
- To check the efficiency of the Sewage Treatment Plant.
- To suggest the measures in effective functioning and treatment of Wastewater.

CHAPTER 2

LITERATURE REVIEW

2.1 WASTEWATER TREATMENT

The focus of the literature review in to understand the previous studies done on the wastewater treatment plant and the problems faced during and after the working and operation of various wastewater treatment plants and their efficiencies. Also, the different kind of technologies that are used and which one is preferred keeping all the constraints in mind like initial cost, operation and maintenance cost and the efficacy. Several studies were done previously in various parts of India to understand the functioning of Wastewater treatment plants. (Derin Orhon, September, 1996)

Wastewater treatment is the way toward eliminating physical, substance and microbiological pollutants from any sort of wastewater, like civil, business or modern wastewater, determined to deliver a last gushing of a quality reasonable for one or the other removal or reuse. To accomplish this, various cycles are applied relying upon the principal motivation behind the treatment. wastewater treatment plant is contained diverse treatment units, which contrast with different treatment levels of the wastewater, as follows (Tchobanologlous G., 2014): (i) Prelim treatment, to wipe out coarse solids, for instance, floatable, coarseness and oil; (ii) primary treatment to eliminate suspended solids and particulate natural matter;; (iii) secondary (or biological) treatment, to eliminate biodegradable organic matter (in solution or suspension) and suspended solids; and finally (iv) tertiary treatment, to remove specific compounds, such as nutrients, microorganisms, etc (Garg, January, 1979)

2.2 HISTORY

The underlying improvement of metropolitan wastewater treatment advancements occurred in the United Kingdom (UK) toward the start of the twentieth century in light of a report delivered by the Commission on Sewage Disposal in 1908, which set up restrictions of biochemical oxygen interest (BOD) and absolute suspended solids (TSS) in wastewater effluents to stay away from issues of anoxic conditions and eutrophication of water bodies. At that point, information on waterborne illnesses was as yet restricted. Thus, the natural wastewater treatment frameworks, including the two most normal frameworks at present utilized around the world, specifically initiated muck (AS) and streaming channel (TF), were created determined to eliminate natural matter and suspended solids. Along these lines, while microbe levels are regularly diminished during treatment measures, their obliteration as well as expulsion is only here and there calculated into framework plan rules and hazard evaluation models.

2.3 TECHNOLOGIES FOR WASTEWATER TREATMENT

Several studies were conducted on various wastewater treatment plants in Indian region. One study of which was conducted by (Mouchel, June 2009) in which In which the various Physiochemical parameter efficiencies were being analyzed along with biological parameter efficiencies of STPs that are present in the Delhi region. There were in each of the seventeen STPs treating homegrown wastewater which were concentrated over a time of a year. These STPs depended on Conventional Activated (ASP), Extended air circulation, physical, chemical and biological treatment (BIOFORE) and oxidation pond treatment measure. Results suggests the Ex. aeration, oxidation lake and BIOFORE were more effective and have more steady outcomes than ASP. Broadened HRT contributes towards high expulsion of FC and FS from the framework. The results also showed that “Vasant Kunj I”, “Delhi Gate”, “Oxidation Pond” and “Mehrauli” perform comparatively well, with actual integrated efficiency (IEa) value greater than 98%. Effluent from these STPs is comparatively safer for agricultural use than from other STPs.

Another study was carried out to monitor the effectiveness of Sewage treatment Plants in Delhi region in 2012 by (Sandeep Kumar Gautam, March 2012) in which they found The average concentration of parameters at inlet sampling site pH, electrical conductivity, total dissolved solids, are 7.16, 2,169 lS/cm, 766.06 mg/l, and major ions bicarbonate, nitrate, sulphate, phosphate, chloride, sodium, potassium, magnesium and calcium values 515.88, 4.28, 82.85, 15.17, 7.01, 23.08, 29.34, 4.14 and 84.31 mg/l. While the average concentration of these parameters, after treatment shows following values 7.47, 2,161.43 (lS/cm), 695.81, 436.52, 1.25, 99.22, 12.69, 6.83, 23.18, 29.07, 4.40 and 82.65 mg/l, respectively. Further, they reasoned that one of the serious issues with these wastewater treatment techniques is that none of the accessible innovations has a direct financial return. The accessible advances are unreasonably expensive because of high capital and upkeep costs. The proficiency of STP isn't acceptable. To improve the efficiencies of the STPs, the treatment frameworks should be appropriately worked and kept up, wellsprings of crude sewage recognized, and existing offices overhauled.

2.4 COLIFORM EFFICIENCY

Another study carried in West Bengal by (Dipu Sukumaran, January, 2015) in which it found out that the expected removal efficiency of oxidation pond and Activated sludge process of waste water treatment plants in three districts of West Bengal is upto the design parameters and in physicochemical parameters However, the coliform content in the approaching wastewater is high to such an extent that even with this elite, it is hard to meet the National or International Standards. Execution of fresher advancements to treat city wastewater is the need of great importance in West Bengal. One of the primary issues in West Bengal is that the waste water is utilized for water system reason and wastewater from these kinds of wastewater treatment plants will adversely affect horticulture and subsequent wellbeing perils. Impact assessments have to be carried out to gauge and link effects on soil, possible groundwater contamination and food quality characteristics. (Naboyuki Sato, December, 2005)

2.5 TSS & BOD_5 REMOVAL FOR VARIOUS TECHNOLOGIES

One study was carried out to check out the various efficiency of removal of various parameters from different technologies by (Abd El-Motaleb M. Ramadan, March, 2016). Various efficiencies of different technologies mentioned below in the tables and they concluded that the aerated lagoons technology is the most efficient in the removal of TSS and BOD5. Wastewater treatment plant operated with oxidation ditch technology is more stable and efficient than that operated with conventional activated sludge technology.

TABLE 2.1 TSS REMOVAL EFFICIENCY

Wastewater treatment technologies	Mean TSS removal efficiency					
	% Range			Mean	±	SD
Conventional activated sludge	17.9	-	94.5	76.7	±	17.6
Oxidation ditch	62.7	-	94.2	87.4	±	6.7
Extended aeration	66.5	-	94.9	87.4	±	5.8
Rotating biological contactors (RBC)	71.6	-	94.2	88.9	±	4.5
Aerated lagoons	86.0	-	93.9	89.8	±	2.2

TABLE 2.2 BOD REMOVAL EFFICIENCY

Wastewater treatment technologies	Mean BOD_5 removal efficiency					
	% Range			Mean	±	SD
Conventional activated sludge	21.9	-	93.3	75.9	±	17.6
Oxidation ditch	53.1	-	94.1	86.4	±	7.1
Extended aeration	67.1	-	92.7	86.5	±	5.3
Rotating biological contactors (RBC)	76.5	-	93.1	88.4	±	3.3
Aerated lagoons	86.6	-	94.7	88.8	±	2.4

TABLE 2.3 COD/BOD_5 RATIO

Wastewater treatment technologies	Mean influent COD/BOD_5 ratio					
	Range			Mean	±	SD
Conventional activated sludge	1.200	-	2.420	1.728	±	0.288
Oxidation ditch	1.110	-	2.770	1.786	±	0.290
Extended aeration	1.270	-	2.470	1.792	±	0.291
Rotating biological contactors (RBC)	1.200	-	2.500	1.724	±	0.288
Aerated lagoons	1.410	-	2.090	1.719	±	0.270

2.6 FUNCTIONING OF WASTWATER TREATMENT PLANT IN INDIA

There are several other studies done by various scholars one of which done by (Prashant P. Bhave, January, 2020) on the Performance evaluation of Wastewater Treatment Plant with average inflow of 6 MLD based on the Rotating Media Bioreactor Technology (RMBR) for 13 weeks and concluded that the COD removal efficiency of overall plant varies from 68.42 to 96.35% during the study period. In the study conducted by (Prashant P. Bhave, January, 2020), it had been observed that the removal efficiency was about 68.42% for the week 5 as the plant was not working and under the process of maintenance. And over the tenure of study, he concluded COD removal efficiency varied from 90.15% to 96.15%. However, he found that overall average Chemical Oxygen Demand was observed 92.65%. The other most significant parameter BOD that varied from 92.37% to 97.33% during the tenure of study conducted. However average removal of BOD was observed 94.97% and similarly TSS i.e., Total Suspended Solids varied generally 89.47% to 97.62% and average was found to be 93.27%. Also, the ratio of BOD to COD i.e., Biodegradability at inlet was observed 0.48. The normal COD expulsion effectiveness of Rotating Media BioReactor (RMBR) up to 3 m and 6 m length from the delta of RMBR is 40% and 75.14% separately. The normal BOD evacuation effectiveness of Rotating Media Bio-Reactor (RMBR) up to 3 m and 6 m length from the bay was found to be 68.06% and 83.69% separately.

Another study was carried out by (Hamed Mohammadi, June, 2011) to compare the performance of extended aeration activated sludge (EAAS) with submerged membrane bioreactor (SMBR) systems in the treatment of high-strength wastewater under the same condition. The Chemical Oxygen Demand (COD) grouping of the influent wastewater for the EAAS and SMBR frameworks was changed between 500–2700 and 500–5000 mg/L, individually. Results showed that the SMBR framework created a vastly improved quality gushing than EAAS framework as far as COD, biochemical oxygen demand (BOD5), total suspended solids (TSS) and ammonium. By expanding the COD focus, the grouping of blended alcohol suspended solids (MLSS) and the evacuation effectiveness of natural matter in the SMBR framework were expanded routinely; in any case, the expulsion productivity of COD in the EAAS framework was unpredictable. The normal BOD5/COD proportion of profluent in the EAAS and SMBR frameworks were 0.708±0.18 and 0.537±0.106, individually. These show that the natural matter in the gushing of the SMBR framework was less degradable, and hence, more organic treatment was accomplished. Nitrification was totally accomplished in the SMBR framework, while the EAAS framework couldn't finish the interaction.

Study carried at Vashi, Navi Mumbai Water dissected for the significant waste-water quality boundaries, like pH, Biological Oxygen Demand (BOD), Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS) and so on The general nature of sewage of 100 MLD Sewage treatment plant will be assessed by gathering tests. The results of these evaluations also determine whether the effluent discharged into the water body are under limits given by MPCB. (Bhakti Kulkarni, 2016)

CHAPTER – 3

MATERIALS & METHODOLGY

3.1 INTRODUCTION

The quality of Yamuna River is being deteriorated due to rapidly increased urbanization and industrialization. There is an essential requirement to analyse the problems occur in this area as well as explore the recommendations for those problems. For that the functioning of Sewage Treatment Plant at Rai in Sonipat region taken into the study and an attempt to find the cause of the degrading quality of the Yamuna River.

3.2 SAMPLING & EXPERIMENTAL METHODS

There are various locations of sampling at the site and samples are collected every week and various experimental methods were applied for the different parameters that were analyzed. The study was carried generally form the month of October, 2020 to the month of January,2021 during which samples were collected and analyzed by the methods as per our IS standards. The samples at inlet, outlet and various locations that are mentioned were collected and examined at the Lab available at STP site located.

3.2.1 SAMPLING METHODS

The examination includes the assortment of tests by utilizing get inspecting in clean plastic holders of 2-l limit by following IS 3025-1 Methods of Sampling and Test (Physical and Chemical) for Water and Wastewater 1999 (Prashant P. Bhave, January, 2020). The example stockpiling is done according to the standards by the Central Pollution Control Board (CPCB) and EPA rules. The examples were breaking down for different contamination boundaries by leading a research facility test which incorporates complete suspended solids, chemical oxygen demand and biochemical oxygen demand according to standard techniques.

3.2.2 Dissolved oxygen Test Procedure

- Take 300 ml of standard sized BOD bottles and fill it up completely.
- After that add 2 ml of Magnesium sulphate to this solution.
- After adding MnSo4, we will add 2 ml of Alkali iodide azide solution to the BOD bottle which lead to the formation of precipitate in the BOD bottle which indicates that amount of oxygen available lead to precipitate. More precipitate formation means more amount of dissolved oxygen available in the sample taken.
- Shaking is done very carefully
- Now adding 2 ml of the concentrated sulphuric acid to the BOD bottle which again dissolve the precipitates formed into the solution.
- Again, shaking is done for dissolving precipitates
- Take 50 ml solution from the BOD bottle using the measuring cylinder or the measuring flask.
- Add Sodium Thiosulphate of 0.025 normality into the Burette, so that titration is done for sample prepared.
- Now, titration of the sample prepared is done with sodium thiosulphate.
- Titration is done till sample turns to pale colour.
- Starch is added as indicator in the sample and sample turns to blue in colour
- Continue gradually titrating until the example turns clear.
- Mark the initial and final readings on the burette and calculation is done.
- The dissolved oxygen calculated as

$$Dissolved\ oxygen = \frac{(A-B) X\ 8\ X\ 1000\ X\ 0.025}{Volume\ of\ sample\ taken\ (ml)} = \text{mg/l}$$

Where A = Initial reading in the burette

B = Final reading of the burette

FIG 3.1 TITRATION IN LAB

FIG 3.2 PREPARING SAMPLE FOR DO

3.2.3 Biological Oxygen Demand Test Procedure

- Fill two BOD bottles with seeded water completely.
- In extra BOD bottles, partially filled with seeded water, carefully measure out the proper volume of sample. Add seeded water till bottles filled completely.
- Plug each container taking consideration to try not to trap air rises inside the bottles as the bottle plugs are embedded.

- Fill the highest point of each bottle neck around the plug with weakening water.
- Determine the initial DO content on one of each set, including the dilution water blank and write the data.
- Place the remaining bottles in the incubator at twenty degree and incubate it for 5 days.
- At the finish of precisely five days (+/3 hours), test the DO substance of bottles.
- Calculate the BOD for each dilution. The most accurate BOD will be obtained from those dilutions that have a depletion of at least 2 mg/L DO and at least 1.0 mg/L DO residual. If there is more than one dilution that meets these criteria, the BOD results should be averaged to obtain a final BOD value.
- The seeded blanks are used only to check the quality of the dilution water. If the quality of water is free from impurities, the depletion of DO should be less than 0.2 mg/L. In any event, do not use the depletion obtained as a blank correction. (3025:PART38, 1993)
- The BOD is calculated as

$$\boldsymbol{BOD = \big(DO\ (initial) - DO\ (final)\big) X\ Dilution\ Factor}$$

3.2.4 Chemical Oxygen Demand Test Procedure

- Take 2 samples in which first is blank, second one is at inlet and other can be taken where COD required to be found out. Take generally of 10 ml each sample.
- Now, in these taken samples 15ml of Sulphuric Acid is added to the distilled water sample i.e., Blank and Silver sulphate is added to the remaining water samples from the different locations where samples are collected.
- Then, Next step is to add the Potassium Dichromate of around 5ml to the samples taken and shake it briskly.
- Further moving to next step add small or a pinch or more accurately 1 gm of Mercuric sulphate crystal is added to

- Place the samples in the COD Digester for the period of 2 hrs at temperature of almost 150 degrees Celsius.
- After taking it out from Digester, keep it allowed to cool for some period of time.
- Now further add 40 ml of the distilled water to the cool down samples.
- Add 3 to 4 drops of Ferroin indicator to the samples
- Titrate it against the Ammonia ferrous sulphate of 0.1 Normality solution.
- The COD is calculated as (PART58, 2006)

$$\boldsymbol{COD = \frac{(A - B)\ X\ Normality\ (Ammonium\ Ferrous\ Sulphate)\ X\ 1000}{Volume\ of\ Sample\ Taken\ (ml)}}$$

Where A = Titrant used for the sample in mL

B = Titrant used for the blank/seeded sample in mL

3.2.5 Total Suspended Solids

- Collect your sample in a HDPE 1 L container.
- Vacuum Pump is connected to the side arm of the taken flask.
- Put a 0.45-micron filter paper on the holder and tight it with the clamps then wet with a reagent water.
- Now pour the water over the filter paper holded between clamps. During the filtration process record the weight of the sample. Record the total sample volume filtered.
- Now, take the filter paper from the holder and keep that in the oven for the duration of one hour at the temperature of 103 degree Celsius.
- Then, take the filter paper from the oven and put it in the desiccator for about 30 mins so it will cool down.
- Now, weigh the filter paper along with the solids that are present on it very accurately as much as possible.
- Repeat steps 5 to 7 at least one more time and as many as are necessary to obtain a reading ±0.0005 g from the previous weight. (Bureau of Indian Standards, January, 2000)
- Calculate your result with the following equation:

$$\boldsymbol{TSS = \frac{\left(Weight(final) - Weight(initial)\right) X\ 1000000}{Sample\ Volume\ (ml)} = mgTSS/L}$$

3.3 General Standards for Discharge of Treated Sewage Water

Sewage is nothing but 99 % of water that carries domestic wastes from the kitchen, bathing, laundry, urine and night soil. It also includes the waterborne pathogenic organisms of already infected persons from their waste (Night Soil). The discharge of treated water should have all the parameters in their permissible limits which are provided by (ORGANISATION, MANUAL ON SEWERAGE AND SEWAGE TREATMENT SYSTEMS, NOVEMBER, 2013)

TABLE – 3.1 DISCHARGE STANDARDS AFTER TREATMENT

NO	CHARACTERISTICS	STANDARDS			
		INLAND SURFACE WATER	PUBLIC SEWERS	LAND FOR IRRIGATION	MARINE COASTAL AREAS
1	Colour and Odour	(B)		(B)	(B)
2	Suspended Solids	100	600	200	(C), (D)
3	Particle size of SS	(E)	-	-	(F), (G)
4	pH Value	5.5 – 9.0			
5	Temperature	(H)	-	-	(H)
6	Oil & Grease	10	20	10	10
7	Biochemical Oxygen Demand	30	350	100	100
8	Chemical Oxygen Demand	250	-	-	250
9	Ammonical Nitrogen (as N)	50	50	-	50
10	Total Residue Chlorine	1.0	-	-	1.0
11	Total Kjeldahl Nitrogen TKN (as N)	100	-	-	100

A. Applicable only if sewer leads to a secondary treatment including biological treatment system; otherwise, the discharge into sewers treated as discharge into inland surface waters. (ORGANISATION, MANUAL ON SEWERAGE AND SEWAGE TREATMENT SYSTEMS, NOVEMBER, 2013)

B. Efforts to done to remove colour & odour as far as possible.

C. For processed 100 mg/l wastewater

D. For cooling water effluent 10% above total suspended matter of influent.

E. Able to pass through 850 micron IS Sieve

F. Max Floatable Solids are 3mm

G. Max. 850 microns settleable Solids

H. Shall not exceed 5°C above the receiving water temperature

I. 90 % survival of fish after 96 hours in 100 % effluent

J. Desired

K. Max Permissible value

This manual recommends the guidelines for treated sewage if discharged into such surface waters used as a source of drinking water as (1) BOD shall not be greater than 10mg/l (2) SS not greater than 10 mg/L, (3) Total Nitrogen not greater than 10 mg/L, (4) Dissolved Phosphorous as P not greater than 2 mg/L and (5) Faecal coliforms not greater than 230 MPN / 100 ml. (ORGANISATION, MANUAL ON SEWAGE AND SEWAGE TREATMENT SYSTEMS (2013), 2013)

CHAPTER – 4

PROJECT AREA

4.1 GENERAL

Sonipat is a city and one of major district of Haryana state in India. It comes under the National Capital Region and is nearly 45 kilometres from Delhi. It is nearly at 214 km southwest of Chandigarh, the capital of the state. The Yamuna River runs along the eastern boundary separates Haryana and Uttar Pradesh. On 22 December 1972, Sonipat was created a full-fledged district. Sonipat Junction railway station is the main railway junction on Delhi-Kalka line. It lies on Delhi Western Peripheral Expressway, Eastern Peripheral Expressway (NE II) and Grand Trunk Road (NH 44) as well as the planned Delhi–Sonipat–Panipat Regional Rapid Transit System. Rai is a village and development block in Sonipat tehsil of Sonipat district in Haryana state of India. It is located just 1 km from Sonipat

4.2 The Project Area: 7.5MLD STP Patla Village, Sonipat district, Haryana

Sonipat is a satellite town adjacent to Delhi & falls in the NCR region. This town is being developed by HUDA on modern town planning principals. The town is located on Delhi-Ambala National Highway & well connected by Delhi Amritsar railway line. The Government of Haryana has decided to set up an education city for imparting quality education. Accordingly, Rajiv Gandhi Education City has been proposed covering more than 2000 acres of land in Phase-I along National Highway Number-I adjacent to sports school Rai & Eastern periphery express way.

The salient features of this education city are: -

- There shall be 40 numbers of education plots having sizes ranging from 2.42 acres to 165.23 acres.

- Apart from plots ear marked for educational institutions there is a provision for Hostels, Staff Housing, Hotels, Shopping Arcades, Medical Centres, Post Offices and Police Stations etc.
- There is also a provision for convention centre, Seminar rooms, Art Gallery, Auditorium and Food Courts & International University Centre.
- A Lake having plan area of 12.5 acres, 6 metres deep has been proposed in this centre connected with Pucca Surface water drains have been proposed.
- Suitable Rain water harvesting system for recharging the ground water shall be provided & this city shall be designed for Zero flood zone.

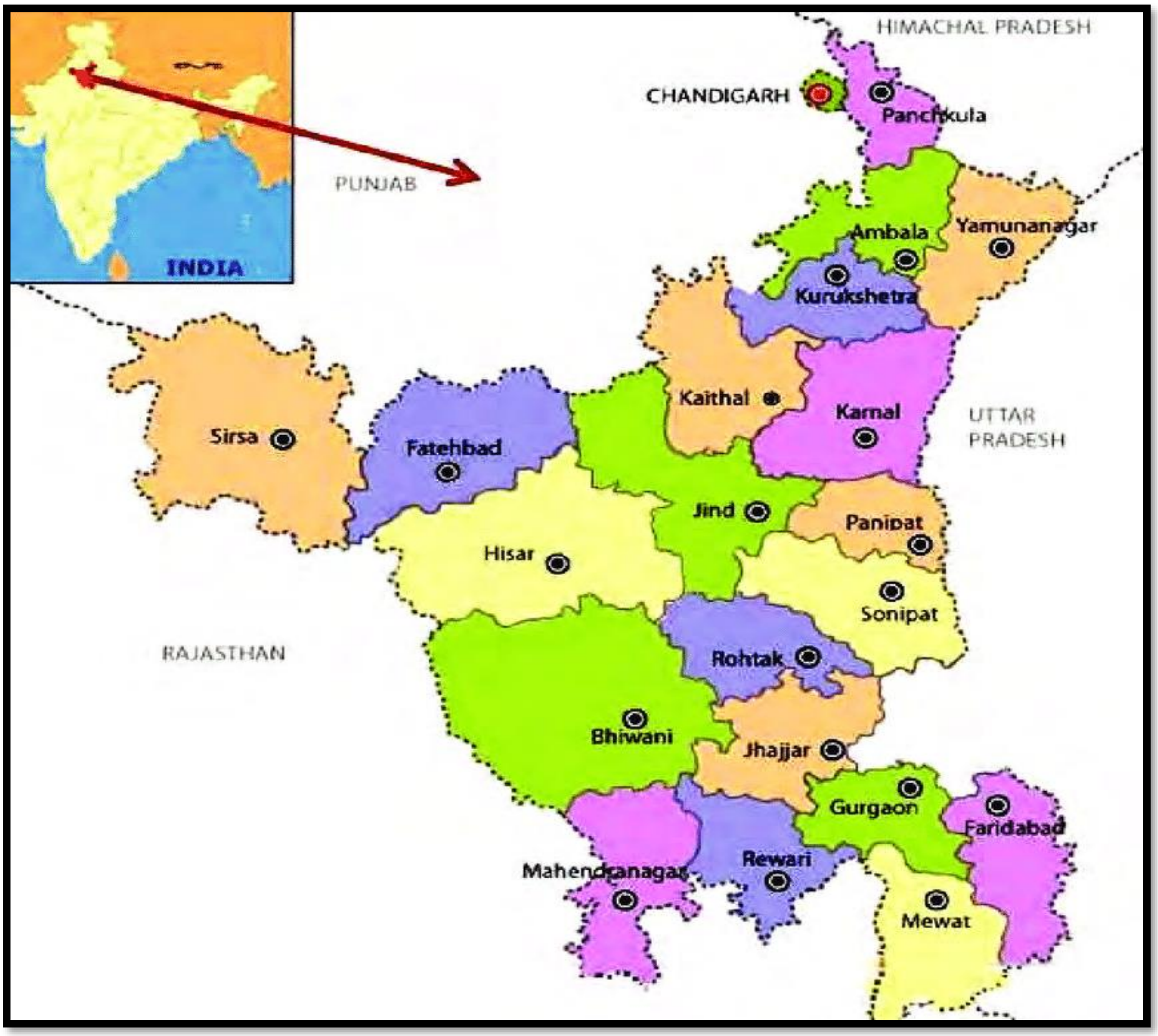

FIG 4.1 MAP OF HARYANA

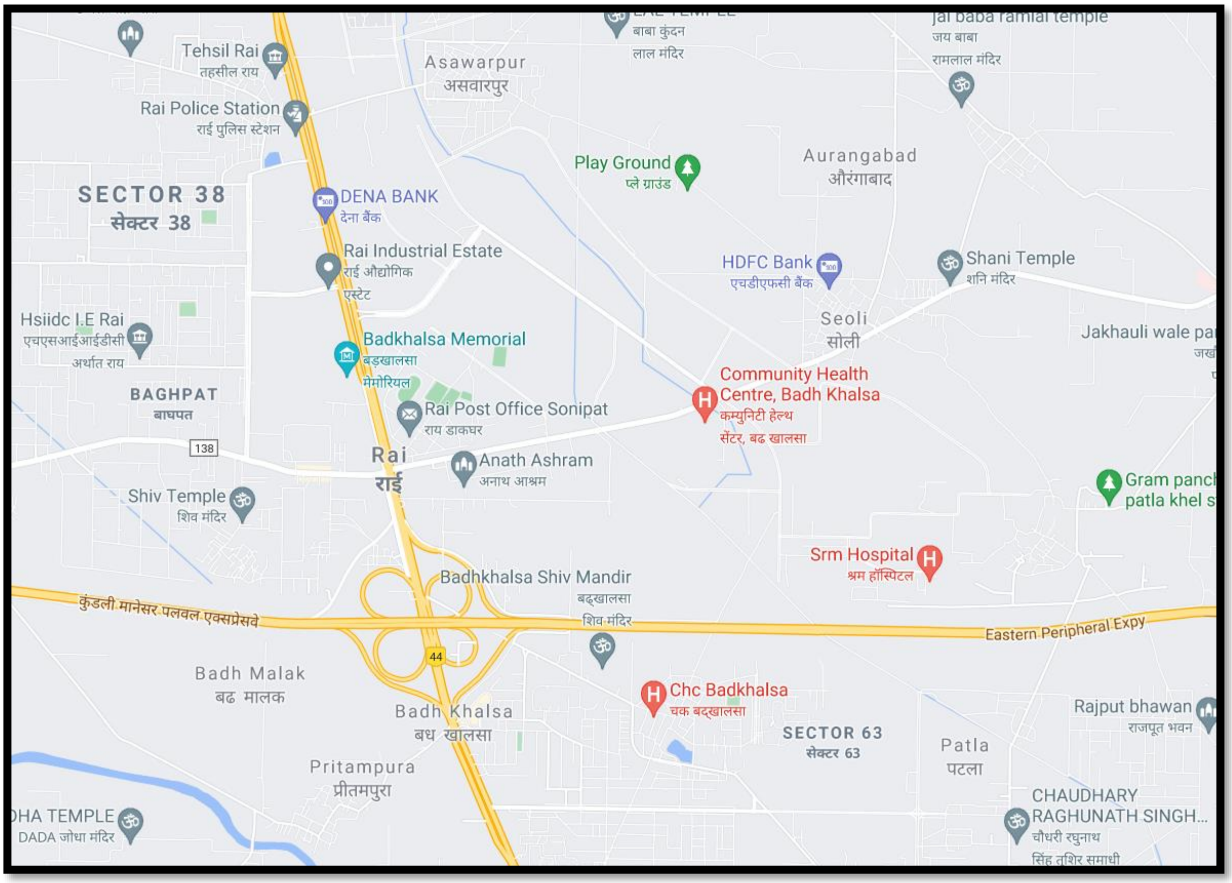

FIG 4.2 MAP SHOWING RAI, SONIPAT

FIG 4.3 SEWAGE TREATMENT PLANT GPS VIEW

The site of STP is located adjoining Patla along EP expressway. The total area marked for STP is 25.49 acres. The site is located at latitude 28º55′ N and longitude 78º08′ E (Fig 4.3) in Sonipat district, Haryana.

CHAPTER – 5

RESULTS & DISCUSSION

5.1 GENERAL

The study highlights the sample at the various location in the Wastewater Treatment Plants. The samples are carried out at various locations to find out the various physio-chemical parameters and to check weather all were in permissible limits or not. The examination includes the assortment of tests by utilizing get inspecting in clean plastic holders of 2-l limit by following IS 3025-1 Methods of Sampling and Test (Physical and Chemical) for Water and Wastewater 1999 (Prashant P. Bhave, January, 2020). The example stockpiling is done according to the standards by the CPCB and EPA rules. The samples were analyzed for the various different parameters such as Total Suspended solids, Biochemical Oxygen Demand, Chemical Oxygen Demand etc. according to the standards given by CPHEEO. Below table showing the various sampling locations.

5.1.1 SAMPLING LOCATIONS

TABLE – 5.1 SAMPLING LOCATIONS

S No	Location Name	Details of sampling
1	S1	The inlet chamber
2	S2	After aeration Tank
3	S3	Outlet (After chlorination)

Wastewater samples were collected and analysed in the laboratory at the Wastewater treatment site for parameters such as Biochemical oxygen demand, Chemical Oxygen Demand, Total Suspended Solids, pH and other parameters etc.

5.2 BIOLOGICAL OXYGEN DEMAND (BOD)

Biochemical oxygen Demand (BOD) addresses the amount of oxygen that are utilised by microbes and different microorganisms while decomposing the natural organic matter under vigorous (oxygen is available) conditions at a predefined temperature. The observations at the various location of Wastewater Treatment Plant are mentioned in the table which shows the variation over 9 weeks as the study being carried out for the period of 9 weeks.

TABLE - 5.2 BOD AT VARIOUS LOCATIONS

Sample Location	Week 1	Week 3	Week 5	Week 7	Week 9
Inlet	180	193	206.6	160	213.3
After aeration	72	73.34	120	53	70.39
Outlet	6.6	6.8	10	7	7.5

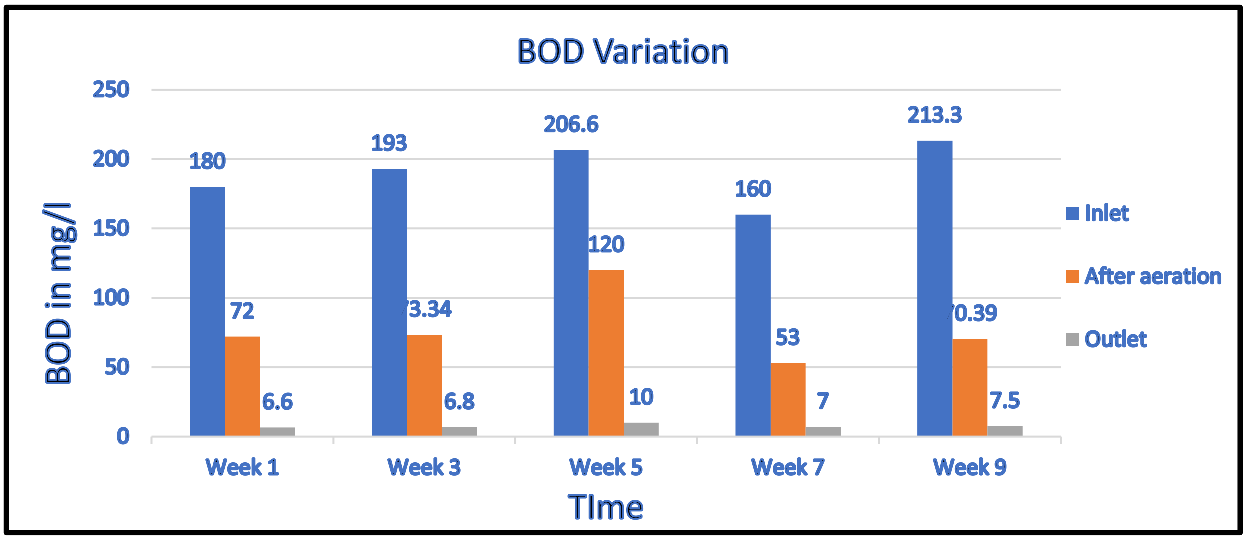

FIG 5.1: BOD VARIATION

5.3 CHEMICAL OXYGEN DEMAND (COD)

The samples at the various location of Wastewater Treatment Plant were collected and below table shows the chemical oxygen demand variation over the period of 9 weeks. Chemical oxygen demand i.e., COD basically includes the how much biodegradable and non-biodegradable organic matter is present in the wastewater. Below table shows the variations

TABLE – 5.3 COD AT VARIOUS LOCATIONS

Sample Location	Week 1	Week 3	Week 5	Week 7	Week 9
Inlet	540	660	620	480	640
After aeration	135	100	250	80	100
Outlet	20	19.5	80	21.5	22.5

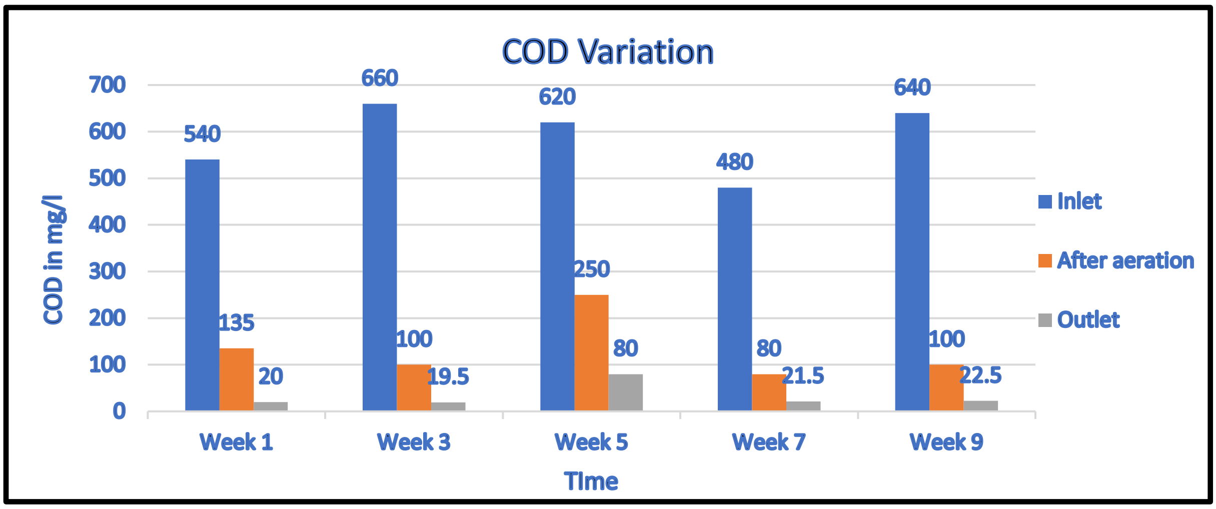

FIG 5.2: COD VARIATION

5.4 TOTAL SUSPENDED SOLIDS

Total suspended solids (TSS) are basically the dry-weight of the particles, that are not broken down or not getting dissolved or mixed in an example of water that remain in suspension can be analysed by filtration process. It is one of the major pollutants listed by the US clean water Act. TSS is nothing but the solids that are not able to pass through the 0.45-micron filter paper. There are several methods available for getting TSS. Below table shows the variation of Total suspended solids i.e., TSS over period of 9 weeks

TABLE – 5.4 TSS AT VARIOUS LOCATIONS

Sample Location	Week 1	Week 3	Week 5	Week 7	Week 9
Inlet	140	186	218	211	192
After aeration	21	37	90	45	20
Outlet	6	7	9	10	7

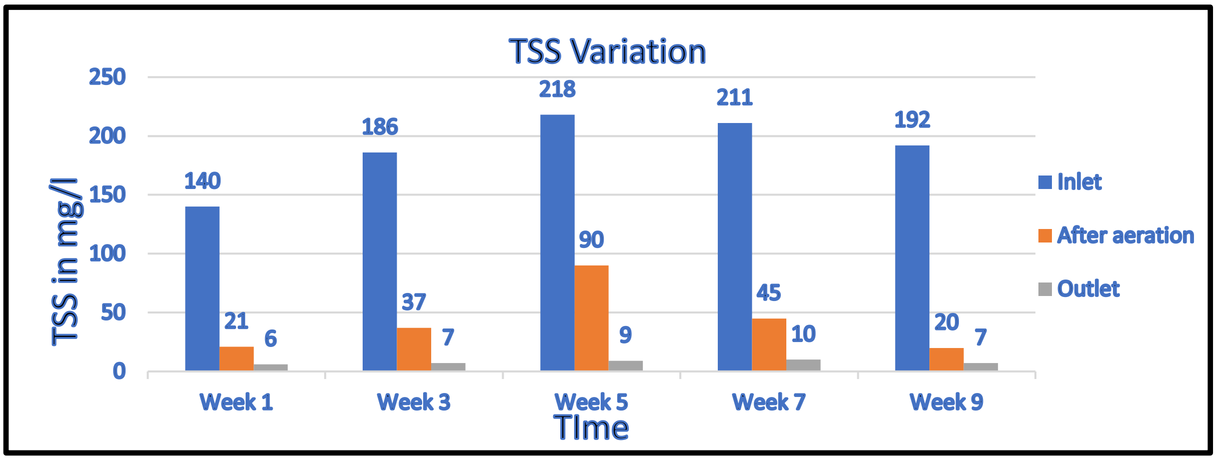

FIG 5.3: TSS VARIATION

5.5 BIODEGRADABILITY

Biodegradable Organic matter present in wastewater is referred as the Biochemical Oxygen Demand (BOD) and both biodegradable and non-biodegradable organic matter referred as Chemical Oxygen Demand (COD). The extent of degradation by microbes can be evaluated by means of biodegradability quotient measured as BOD/COD ratio. This ratio is very useful aspect in indicating the degree of biodegradation of the wastewater. The higher the BOD/COD ratio indicates more amount of biodegradable organic matter and easy to decompose. As wastewater is degraded, the concentrations of all two measures decrease. Below table shows the variation over 9 weeks study

TABLE – 5.5 BIODEGRADABILTY

Sample	BOD	COD	Biodegradability
Week 1	180	540	0.33
Week 3	193	660	0.29
Week 5	206.6	620	0.33
Week 7	160	480	0.33
Week 9	213.3	640	0.33

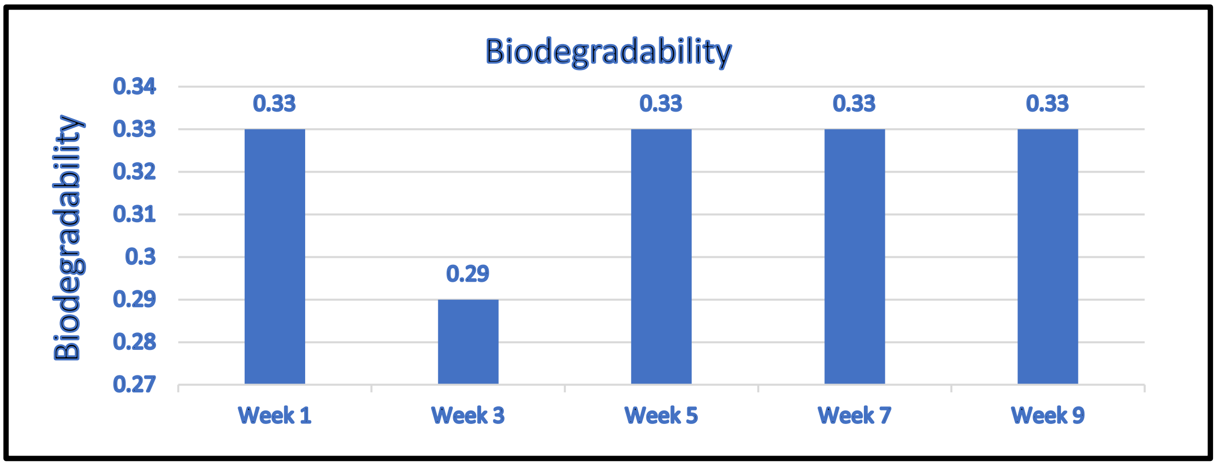

FIG 5.4: BIODEGRADABILITY VARIATION

The wastewater samples were gathered or collected at various locations of the sewage treatment plant and analysed. The pH of the wastewater slightly increased from inlet at 7.3 to 7.8 also it is slightly increasing as wastewater processes to the different units. The Total Suspended values vary from 250 mg/l at inlet to 6 mg/l at the outlet. The maximum effectiveness found out for the removal of COD was 97.04% which was accomplished for the week 3 and the least efficiency was seen at 59.67% for week 5. The COD of wastewater before treatment was ranging from 480 to 660 mg/l and COD of the water after treatment was ranging from 19.5 to 80 mg/l. Biodegradability is generally the proportion or the ratio of BOD to the COD and is generally calculated to know the quality of the raw water so that it can easily predicted whether it is biodegradable or non – biodegradable. This ratio or proportion helps to picking the reasonable treatment measure for the influent raw water. Biodegradability values at the inlet of the wastewater are varied from 0.29 to 0.33. During the analysis period, the average value of BOD/COD or biodegradability was found out at inlet raw wastewater to be 0.322. The maximum effectiveness for the expulsion of BOD was 96.48% which was accomplished for week 9, and the minimum efficiency was seen at 95.16% for week 5. The Biological Oxygen Demand of wastewater before treatment varied from 160 to 213.3 mg/l, and after treatment varied from 6.6 to 10 mg/l. As the week 5 shows efficiencies were less because during that the Sewage treatment plant was under maintenance process.

CHAPTER-6

CONCLUSION

The study has been carried out to assess or to compute or to check the efficiency of the different units of the Wastewater treatment Plant based on Extended Aeration Process. The Chemical Oxygen Demand i.e., COD of the plant has been observed during the tenure of study varying or ranging from 87.10% to 97.04%. General average efficiency of the COD removal has been observed to be 94.49%. It has concluded that average BOD removal efficiency of treatment plant is 95.91% whereas other significant parameters like Total Suspended Solids i.e., TSS removal efficiency observed to be varied from 95.26% to 96.34% during the tenure of study whereas the average TSS efficiency observed to be 93.27%. The Biodegradability or the BOD/COD ratio observed to be 0.322 at the inlet which is main concern that has been observed.

It has been concluded that: -

- The wastewater treatment plant based on the extended aeration process have shown very good efficiency against the various parameters such as BOD, COD and TSS etc. But the drawback is that the land area requirement in huge as compared to the other technologies available whereas the cost consumption comes out to be less in the extended aeration process.
- It has also observed that the parameters such as TSS, BOD was not having very large values at the inlet when compared to the other studies that were conducted by very researchers, this may also be the reason of the efficient working of the Sewage treatment plant.
- Other main reason of very good efficiency was that the networking of pipes was not done because of which water was collected into tankers and dumped at inlet due to

which the observed values of Suspended solids were less as they get settled in the tankers and the area where sewage being dumped.

- This may also be one of the reasons of the low biodegradability as there were chances of mixing of water from various sources. Some of the municipal wastewater got mixed with the wastewater from the industries which increases its toxic content. Proper care shall be required otherwise the treated water used for irrigation and sewage farming may contain heavy metals which lead to the ground contamination.
- Also, the SAR ratio that is Sodium Absorption Ratio can be further calculated but the equipments were not there in lab at the STP as the water further used for gardening purposes, they should have equipments for the calculation of Sodium conc., Magnesium and other ions concentration to check whether the concentration of sodium is in the permissible limits or not.

CHAPTER – 7

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